Business As Usual?
Instituting Markets For Carbon Credits

A thesis submitted to the University of Manchester for the degree of Doctor of Philosophy (PhD) in the Faculty of Humanities

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Contents

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List of Tables

List of Figures

Abstract

Business as Usual? Instituting Markets for Carbon Credits
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Climate change mitigation necessitates substantial alterations to patterns of worldwide economic activity, be that reduction in demand, switches to new technology or 'end-of-pipe' abatement of greenhouse gases. There are profound political, economic and ethical questions surrounding the governance of the means, rate and location of change. Within advanced capitalist economies and internationally through the auspices of the United Nations Framework Convention on Climate Change emissions trading systems have been introduced as part of the broader neoliberal attempts to 'correct market failure' through the definition of new property rights.

This thesis investigates the development, constitution and consequences of institutions for the production, exchange and consumption of credits for emissions reductions. Such credits are financial instruments awarded to organisations for putative reductions in emissions from 'business as usual'. In consumption, credits are equated with a quantity of emissions released elsewhere. The 'Instituted Economic Process' framework (Randles and Harvey, 2002) is used to distinguish the various classes of agent involved in these exchanges and identify the economic and non-economic relationships that constitute these institutions. Inspired by the economic anthropology of Karl Polanyi, this approach asks how economic activity is organised and stabilised within society without presuming that there are universal economic laws of 'the market', that there are essential properties of commodities and agents, or that all economic transfers are conducted within markets.

I argue that crediting is a socially contingent process of commodification of atmospheric pollution which is both ontologically and normatively problematic. Extant institutions are shown to be precarious by appealing to neutral techno-scientific justifications but remaining reliant on subjective judgement. However, they are sufficiently consistent and credible that they persist and expand. These findings are of interest to the academic communities of political economy and environmental and economic geography, climate change policy makers and the environmental movement more broadly.

Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright

Dedication

This thesis is dedicated to my late grandmother, Dorothy Taylor, for all her support and encouragement over the years. I would have felt so proud to hand her a copy for her sideboard.

Acknowledgements

It is a pleasure to thank all the people who have helped me to complete this PhD programme.

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ing a healthy scepticism of the pretentious and purely rhetorical. All have proved essential.

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The Author

John Broderick's background is as a natural scientist, with degrees in Zoology (BA Hons, Cambridge 2001) and Tropical Coastal Management (MSc, Newcastle 2003). Previous research projects have included elucidating the molecular phylogeny of a group of East African termites, synthesising novel fluroalkyl phosphorus compounds and examining the connection between eutrophication and the ecology of *Vibrio cholerae* in Sri Lankan coastal lagoons. Before commencing this PhD he was part of a team developing an innovative MSc programme on Biodiversity, Conservation and Ecotourism collaboratively between Naresuan University, Thailand, and three European partners. He returns to Tyndall Manchester in January 2011 as a climate change Knowledge Transfer Fellow.

Selected Publications

Broderick, J. (2009) Voluntary carbon offsetting for air travel. In: Gössling, S. and Upham, P. (eds) *Climate Change and Aviation: Issues, Challenges and Solutions*. Earthscan Ltd, London.

Gössling, S., Broderick, J., Upham, P., Ceron, J.P., Dubois, G., Peeters, P. & Strasdas, W. (2007) Voluntary carbon offsetting schemes for aviation: efficiency, credibility and sustainable tourism. *Journal of Sustainable Tourism*, 15 (3) pp. 223–248.

Acronyms

AAU	Assigned Amount Unit
ACM	Approved Consolidated Methodology
AM	Approved Methodology
A/R	Afforestation and reforestation
BAU	Business As Usual
CDM	Clean Development Mechanism
CER	Certified Emissions Reduction
CCX	Chicago Climate Exchange
CITL	Community Independent Transaction Log
COP	Conference of the Parties
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board of the CDM
ENR	Economically No Regret
ERPA	Emissions Reductions Purchase Agreement
ERU	Emissions Reductions Unit, credited via JI
EUA	European Union Allowance
EU ETS	European Union Emissions Trading Scheme
GHG	Greenhouse gas
GW	Gigawatt
GWP	Global Warming Potential

HFC	Hydroflurocarbon
IET	International Emissions Trading
IETA	International Emissions Trading Association
JI	Joint Implementation
KP	Kyoto Protocol
LULUCF	Land Use, Land Use Change and Forestry
IPCC	Intergovernmental Panel on Climate Change
ITL	International Transaction Log
MOP	Meeting of the Parties
Mt	Megatonne, 10^6 metric tonnes
NAP	National Allocation Plan
NGO	Non-governmental Organisation
NOx	Any and all oxides of nitrogen
pCER	Primary CER, contracted directly from an emissions reduction project
PDD	Project Design Document
RE	Renewable Energy
RFI	Radiative Forcing Index
RMU	Removal Unit
sCER	Secondary CER, purchased from a third party
SSC	Small Scale CDM
tCO2e	Tonnes of carbon dioxide equivalent
UNEP	United Nations Environment Programme
UNFCCC	United Nations' Framework Convention on Climate Change
VER	Voluntary (or Verified) Emissions Reduction
VVM	Validation and Verification Manual
WBCSD	World Business Council for Sustainable Development

Glossary

AAU Compliance emissions allowance traded and surrendered by states under the Kyoto Protocol

Additionality The requirement that an emissions reduction project would not have occurred without support from credit finance. Definition is difficult in practice and always subjective.

Afforestation Planting of new forests on lands that historically have not contained forests.

Annex 1 Countries Signatories to the UNFCCC who were members of the OECD in 1992 plus those with 'economies in transition' in Central and Eastern Europe.

Annex B Countries Those countries that have binding GHG emissions targets under the 1997 Kyoto Protocol.

Baseline A projected level of emissions against which to define reductions.

CDM Provision within Kyoto Protocol to create a market in emissions reductions made in non-Annex 1 nations.

CER Credit issued by the Clean Development Mechanism equivalent to 1 tonne (metric tonne) of CO_2 emissions, calculated using 100 year Global Warming Potentials.

DOE A third party organisation approved by the Executive Board of the CDM, providing technical and audit services.

DNA Official state body created to review and sanction CDM and JI projects within a party. EUA Emissions allowances traded and surrendered by entities in the EU ETS

Executive Board Senior regulatory authority of the CDM ultimately responsible for overseeing methodologies, DOEs and issuance of CERs.

Global Warming Potential An index used to calculate equivalent warming effect of a unit mass of a given greenhouse gas integrated over a specified time period, usually 100 years, relative to CO_2.

Host country Country in which credit project is located.

Joint Implementation Provision within Kyoto Protocol to create a market in emissions reductions within Annex 1 nations. The traded instruments, Emissions Reductions Units (ERUs), are backed by AAUs when transferred between parties so unlike CDM no new commodity is generate.

Linking Directive Amendment to EU ETS to allow surrender of CERs and ERUs in place of EUAs. LULUCF Catch-all term for changes in terrestrial biological systems, including agriculture and forestry.

Methodology In CDM terminology a quantification and monitoring method, including a baseline, which is used to define credits. Each must be approved by the EB but shared by projects of a similar type.

NAP National Allocation Plan submitted by each state to the EU ETS to assign permits to each emitting installation within its jurisdiction.

PDD Document specifying the technical details, participants, management and organization of an emissions reduction project including baseline and monitoring plan.

CDM Pipeline The sum of all projects within the CDM from validation to registration and issuance of credits.

Radiative forcing Measure of the change in vertical irradiance (in Wm-2) at the tropopause as a result of a change in composition of the atmosphere.

Radiative Forcing Index Ratio of total radiative forcing of a source of warming to that of CO_2 emissions alone over a defined time period.

Reforestation Planting of forests on lands that had previously contained forests but have subsequently been converted to some other use.

Registration Acceptance of a project into to the CDM by the EB.

Registry Electronic database recording provenance of all credits issued by a particular regime and subsequent trades or transfers.

Retirement Cancellation of credits or permits. Permanent removal from circulation.

Sequestration Removal of carbon dioxide from the atmosphere to another reservoir either biological or geological.

Sink A natural or man-made process that sequesters carbon.

Validation In CDM, evaluation of PDD by a DOE prior to registration.

Verification Periodic review of project monitoring data against methodology to quantify reductions achieved.

Part I.

Introduction

1. Introduction

Carbon trading is the exchange of property rights over and financial instruments based on greenhouse gas emissions and seeks to address climate change by altering patterns of economic activity. The problem of climate change can be framed as one of an overflowing pollution dump, access to which is currently poorly governed by social norms or formal regulation (Lohmann, 2005). Broadly, within carbon trading institutions, economic actors exchange financial instruments related to greenhouse gas output or reductions in emissions from 'business as usual'. As such, polluting activities are to some extent governed by price and competition rather than explicitly political processes or norms of restraint, precaution, care or equity. Whilst being widely promoted as an economically efficient means of governing climate change mitigation, carbon markets have received criticism for being unjust and ineffective. This thesis sets out to examine carbon credit institutions, clarify their institutional structure and evaluate their effectiveness in climate change mitigation.

Carbon trading has risen to prominence in international climate policy through the negotiation of the United Nations Framework Convention on Climate Change (UNFCCC). The flexibility mechanisms in the 1997 Kyoto Protocol are intended to reduce the cost of compliance with the emissions limits for industrialised economies and foster sustainable development in developing nations. The first examples of carbon transactions were voluntary undertakings in the early 1990s, between electricity generators, in the USA and the Netherlands, and forestry NGOs operating in South and Central America. Formal regional emissions trading schemes are currently in operation or under development in Europe, the USA, Japan, Australia and New Zealand. In advance of state legislation, voluntary purchases of emissions reductions credits are increasingly popular in wealthy industrialised economies. Internet retailers now enable individuals to calculate personal emissions and consume an equivalent amount of carbon credits in compensation. This exposes new audiences to the problem of climate change, key sources of emissions and to a carbon price of some sort, but arguably entrenches high intensity practices of travel and consump-

tion. Carbon neutrality has become a vogue consumer status conferred to products, business and leisure activities by a variety of private companies operating to autonomous standards. Although the co-benefits of investment to poor communities are often promoted, ultimately carbon offsetting is market exchange, not unbridled philanthropy.

Carbon trading is one example of contemporary efforts to address concerns about the direct biophysical impacts of economic activity and consequential social impacts that can be conceptualised as environmental governance. There are a broad range of social, economic and political structures through which societies negotiate their relationships with and influence on the biophysical world that might be termed environmental governance. Whilst government connotes the authority of the state, and governing refers to the purposeful act of managing, steering or directing society, governance is typically understood as the outcomes of diverse actors attempts at governing and the norms and institutions that emerge (Adger & Jordan, 2009, p10). Empirically, environmental governance captures the role of non-state actors, including private corporations, NGOs of various sorts, academia and industrial associations, in the development of voluntary and compliance regimes oriented towards ostensibly environmental objectives. The degree of formality, spatial coverage and temporal durability of relationships may vary substantially as individuals and organisations coalesce around particular norms or codes. Multi-level governance is used to connote the variety of aligned and competing regimes that a given actor may interact with or may have a bearing on a particular issue area. These definitions are somewhat open, in that they beg the question of how to recognise governance or analyse it. In what way can fashions or trends for particular 'ecological products' such as hybrid cars or organic strawberries be understood in the same framework as the Montreal Protocol?

It is clear that the mainstream economic approaches that treat greenhouse gas emissions as market externalities and propose emissions trading regimes as uniform and unproblematic corrective instruments have substantial theoretical and empirical weaknesses. The deployment of these intellectual arguments and their role in shaping recent economic, social and environmental governance is frequently termed neoliberalism, although outcomes of such developments are diverse and contingent as recent efforts at meta-analysis have demonstrated Castree (2008a,b). It is disputed whether the more useful conceptualisation of neoliberalism is of an historical epoch or that neoliberalisation might be used as a term to capture some particular aspects

of recent change. Castree (2008b) cites privatisation of aspects of society and the environment, marketisation of the same, deregulation and re-regulation in support of the same, the use of market proxies to govern the public sector and the state-led development of civil society as a substitute for state provision of services. To a large extent emissions trading regimes for climate governance represent another instance of these processes (Bailey, 2007; Toke, 2008).

This thesis takes a broadly political economic approach to examining environmental governance through carbon trading. That it also considers the biophysical and spatial effects of emissions trading, it might also be regarded as geographic political economy or economic geography. However, greater attention is paid to the constitution and operation of the exchange institutions. As Bailey & Maresh highlight "The least examined, but pivotal aspect of neoliberal governance is the market; its actors, their motivations, their response to price signals, and how these influence the spatial dynamics and integrity of environmental regimes." (Bailey & Maresh, 2009, p447). Indeed, geographic phenomena, such as the concentration of emissions reduction projects in India and China are shown to be a secondary outcome of the institutional structure and pre-existing economic patterns. The detail of economic institutions is important and this thesis will examine the identities and motivations of agents concerned, the coordinating mechanisms such as prices and standards, the role of the state, and the accountability of agents within carbon credit systems.

Chapter 2 begins by discussing the welfare and environmental economics that theorize climate change as a market failure involving environmental externalities; economic activities can emit greenhouse gases freely without facing the costs of climate change impacts (Stern, 2006). There follows a case for regulation to correct this distortion by assigning liability to polluters and imposing taxes or restraints to realise the socially optimal level of pollution. This approach assumes that the central regulator knows in advance what the most productive use of a resource is, in this case the access to the pollution dump. Emissions trading removes this requirement and gives recognition to reciprocal costs not only borne by the entity suffering harm, but also the polluter who must invest in new infrastructure or curtail their activities. In this body of theory, unrestricted, private bargaining in well defined property rights will lead to the most economically efficient net outcome, regardless of the initial distribution of those rights and with no central intervention except for enforcement (Coase, 1960). However, if transaction costs in asserting rights and negotiating settlements are substantial then this may not be the case. Theoretically, carbon trading draws

on these insights to create institutions which enable flexibility in timing and location of emission abatement and reduce transaction costs between parties. However, there are substantial theoretical and normative failings with this model of market exchange.

A great deal of effort is required to implement a market, defining, formatting and stabilizing the norms, regulations, actors and commodities that will constitute it. This effort is particularly conspicuous in the contemporary neoliberal expansion of market mechanisms to negotiate the relationships between nature and society, from the management of fisheries to the provision of fresh water. Chapter 3 presents the neo-Polanyi Instituted Economic Process approach to analysing market exchange. Whilst Polanyi's work primarily considered macro social tendencies of market institutions IEP has been empirically and theoretically oriented to meso scale analysis of firms, organisations and institutions within particular industries or economic sectors. The actor-network approach to market construction has received substantial attention in theoretical considerations of carbon markets (Lohmann, 2009) therefore chapter 4 presents an overview. Chapter 5 concludes the theoretical part of the thesis by presenting a critique and evaluation of these competing theoretical frameworks. Such diverse literatures cannot be expected to share common scales of analysis nor compatible theories of knowledge and reality. Chapter 5 will therefore also establish my own analysis as meso scale and critical realist. This thesis examines organisations and the institutions they reproduce rather than formally deducing or attempting to empirically approach general macro social phenomena. The critical realist ontology is then distinguished from positivist and constructivist perspectives that have been influential in this topic area and the chapter concludes by setting out the methodological approach for empirical work.

Carbon trading institutions may exist at a variety of scales and regulate diverse entities, from nation states, corporations, power stations, industrial plants and hospitals down to individual consumers. How then is it possible to trade in the absence of greenhouse gas pollution and what are the consequences of doing so? The empirical work to is organised as follows. Three successive chapters 6, 7 and 8 consider the legally regulated emissions exchanges that are part of the UNFCCC international climate regime. Although the focus is on crediting institutions, compliance credit systems do not operate in isolation but are a component of broader market based international climate governance regimes. The demand for credits originates in allowance based systems so their principles will be outlined briefly. The Clean

Development Mechanism has been the most economically important of UNFCCC's trading systems with a global scale that can potentially involve all Parties to the Kyoto Protocol. As of 2009, there are over 4000 projects in the CDM pipeline and it is anticipated they will generate 1.3 billion credits by 2012. Chapter 6 will outline its origin and structure followed by chapters 7 and 8 which will evaluate the ways the CDM institutes the calculation, definition and quality assurance of trading units, the framing of economic activity and agents and the organisation of market and non-market aspects of economic exchange[1]. Strong claims of equivalence are made between allowances, credits and physical GHG emissions so these issues play an important role in determining the efficacy of the institutions. Subsequently chapter 9 will consider the ways similar institutions have arisen for voluntary consumption of privately regulated emissions units, introducing empirical data gathered from interviews with voluntary market participants buying for and selling to UK corporates. The empirical section is concluded by a discussion chapter, drawing together major themes and considering them in relation to the various theoretical positions outlined in Part II. Finally, the thesis concludes with an overview of its contribution to knowledge, personal reflections on the process and points for further research.

[1] Figure 8.2 on page 200 is a diagrammatic representation of the exchange relationships that constitute the UNFCCC Clean Development Mechanism. It is presented sequentially as the culmination of the research in the previous three chapters, however, some readers may find it useful to refer to in advance, as aspects are described.

Part II.

Theoretical Perspectives on Market Based Instruments for Environmental Goods

2. Environmental Economics: Correcting Market Failures

> "Climate change is a result of the greatest market failure the world has seen." Stern, cited in Benjamin (2007)

The Stern Review of the economics of climate change (Stern, 2006) was a landmark in UK climate policy and mainstream discourses of climate change mitigation, estimating the costs of inaction and setting these against the investments necessary to create a climatically benign economy. It emphasizes a central theme in environmental economics: market failure due to externalities.

In his discussion of institutions in a dynamic economy Giovanni Dosi neatly outlines the juxtaposition of mainstream neoclassical economic theory and the 'real world' of economic organisation:

> ...the contemporary economic discipline essentially consists of a process of reduction of institutional and policy issues to exceptions, anomalies and particular cases of a general framework centred around the equilibrium conditions of the economic system postulated by the theory... In a very peculiar overlapping of positive and normative judgements, these "imperfections" of the real world also delimit the domain of institutional intervention, which - it is claimed - should make the world more similar to the theory (Dosi, 2000, p593).

This mode of analysis is well acknowledged within mainstream economic theory (for example see Dasgupta & Heal, 1979, p479) and is central to the environmental economic approach to environmental governance where market failure due to externalities justifies and structures market based instruments (MBIs) for pollution abatement. Bromley goes so far as to call market failure "the defining metaphor in environmental economics" (2007). The argument runs as follows. Liberal proponents argue that price making markets are efficient at allocating resources, maximize

use of information in society, promote innovation, and provide political neutrality on the content of the good life. However, market economies cause environmental damage because there are no prices for environmental goods or the harm caused by pollutants. The damage persists because it is outside of the calculus of market exchange and does not feature on anyone's 'bottom line'.

Transforming polluting practices requires changes in consumption, production and investment from governments, firms, individuals and broadly, environmental economics argues that regulative actions should be weighed and coordinated to the greater extent by introducing corrective prices. Appropriate prices should be determined theoretically in cost benefit calculations, via contingent valuation, replacement cost estimation and hedonic pricing, or through new property rights directly incorporating GHG emissions into the market economy. Theoretical prices are intended to stand in for the utility or welfare associated with the environmental goods or ills, whilst prices arising from the exchange of property rights represent the 'real' demand for environmental protection. In both cases market activity is supposed to deliver optimal levels of pollution or conversely mitigation.

This section will present the vernacular economic framework that prevails in policy, business and academic discussion of carbon markets. It is a positivist and predominantly neo-classical conceptualization of markets, the economy and market failures. This section will not provide comment or critique at this stage but sets out the intellectual background to Market Based Instruments (MBIs) for environmental management and the framework that is 'taken for granted' in policy making and the carbon credit industry.

2.1. Mainstream neoclassical and welfare economics framework

New Environmental Policy Instruments are a feature of environmental regulation in advanced capitalist economies and to a large extent draw upon the conceptual framework and underlying assumptions of mainstream, neo-classical economics. This is not a novel research programme, the foundations having been laid in the welfare economics of Marshall, Pigou, Pareto, Hicks and Kaldor from the late 19th century and then formally codified into environmental economics in the 1960s and 1970s through the work of Coase, Kneese, Arrow, Dasgupta, Baumol and Oates amongst

others (Dasgupta, 1990).

The analysis follows the formal, logic centred conception of economics as the "science that studies human behaviour as a relationship between ends and scarce means which have alternative uses" (Robbins, 1935, p16). It allows, for example, for the analysis crime, marriage and religion within the same framework as industrial productivity and resource distribution (Becker, 1976). This definition depicts economics as a positive, universal social science of choice and stands in contrast to substantive conceptions of the economy as the social activity of subsistence and material want satisfaction (Polanyi, 1957, p253). The ontological and methodological implications of this distinction will be discussed in Chapter 3. There are several concepts of relevance to the discussion of MBIs that will be laid out first; competition, rational action of self interested agents, equilibrium, atomism, exogenous variables, welfare, scarcity and efficiency. Arguments around market failure and the notion of externalities can be discussed from this basis and then related to property rights and new institutional economics approaches to environmental problems.

2.1.1. Competition between atomized, self interested agents leading to equilibrium

Neoclassical economics is methodologically individualist in that the macro scale patterns of behaviour observed in society are explained upwards from the level of individual agents. A series of assumptions and conditions set on agents results in certain conclusions being deduced about market outcomes.

The basic premise of microeconomic analysis is that exchange of goods and services occurs voluntarily between self interested agents to the benefit of both parties. Prices are set by interactions between the crowd of producers seeking transactions with a crowd of would-be consumers. Agents may be individuals, firms or organisations if the latter are considered internally consistent and autonomous[1]. They are taken to be rational, i.e. consistent in their preferences, and maximize their utility or profits by selling at the highest price or buying at the lowest.

It is usually assumed that the crowd of sellers will supply a greater quantity of goods as the price offered rises; there is in effect 'an upward sloping supply curve'. Conversely, the crowd of buyers will demand a lower quantity of goods as the price

[1] Loasby (1976) points out that there is no need for the firm in the general equilibrium model.

rises, "a downward sloping demand curve". Under these assumptions, idealized markets tend towards equilibrium at a price where the quantity of a particular good supplied is matched by the quantity demanded at that price. Market clearing, refers to this equilibrium state or the process of reaching it, with any surplus, shortage, or variation in demand corrected for by a change in the market price or vice versa the quantity supplied.

Competition occurs within each class of agents to find a counterparty in the other class of agents. With sufficiently large numbers of buyers and sellers, each individual agent's actions has no appreciable influence on price; every buyer and seller is a price taker. Freely able to choose between identical transactions of a homogeneous product, each agent faces a notional supply or demand curve of the opposing class of agents in aggregate. The market clears at a unique equilibrium price and quantity where supply and demand intersect. Perfect competition also assumes complete information, that each agent knows the nature of the products for sale and the prices charged or paid across the whole market. Further, the output at which the long run average total cost for an individual supplier reaches a minimum is small relative to the industry's total output so no individual supply curves alter market price. Finally, each agent faces negligible costs in entering or exiting the market. The major implication of a perfectly competitive market is that no one individual has market power. It can then be deduced that suppliers seeking to maximize profit will adjust output quantities so that the short run marginal cost of production equates to the market price. In the long run, profits within an industry will incentivise new entrants, and losses drive out incumbents. An equilibrium price is reached where producers gain no profit greater than the opportunity cost of capital deployed in the production process. This points towards productive efficiency which will be discussed later.

There are of course other neoclassical accounts of market structure where the above conditions are not held. Monopoly, oligopoly or monopsony may exist due to economies of scale, fixed costs, differentiated products, or specific licensing restrictions or other regulations. Although market power is often taken to create dead weight losses to society's aggregate welfare, Schumpeter (1954) argued that the surplus profits that reside with monopoly producers provide both resources for incumbents to engage in research and development and also incentives for external agents to circumvent barriers to entry in such markets. However, there is no need to dwell on the discussions of these particular deviations from idealized conditions as they are not central to discussions of MBIs.

Further qualifications to this model are that the agents and goods are atomized, acting and interacting ahistorically and only through price signals. Markets are impersonal and inclusive so that any given participant may engage in exchange on the same terms as any other. Interests are pre-given and agents are free from social responsibility or moral constraint.. There should also be perfect information, that is to say agents come to know prices and qualities of commodities without costs. In a sense, these conditions make economic action deterministic; a household maximizes its income, a firm its profits, and there should never be disagreements about what a given agent should do (Stiglitz, 1981). The relevant aspects of both qualifications will be elaborated more fully later.

It is not only individual agents that are proposed as atomized units of analysis in neoclassical economics. Land, labour and capital, the factors of production taken as inputs to productive activity, are treated as being able to be individuated and isolated from context, history and connections between each other (Norgaard, 1985; Lipsey & Chrystal, 1999, p118). In this stylized account of mainstream theory, property rights pertaining to these assets are taken as well defined, verifiable, transferable and enforced without cost i.e. legal institutions can provide stable and unambiguous ownership for market participants to engage in free exchange. Theories which address transaction costs, those non-production costs that must be met to participate in economic activity, are again discussed later.

2.1.2. Exogenous variables

Tastes, technology and preferences are defined outside of the general equilibrium formulation of neoclassical economics. They are pre-given, exogenous variables which do not change according to the pattern of the model economy. Not only are the numerical parameters of the exogenous variables defined outside of the model, but also their structural relationships to one another. This level of technological and motivational determinism is an acknowledged but nonetheless profound simplification (Dasgupta & Heal, 1979, p477–479).

2.1.3. Scarcity

In formal analysis scarcity is taken as foundational after Robbins (1935, p16) definition. It is assumed that individual agents have unlimited wants but restricted means

of meeting them at any given point in time. This leads to the general problem of deciding to which of a multiplicity of uses a given set of resources is put. As Stiglitz identifies, this is the single information problem to be solved by neoclassical general equilibrium analysis; all other concerns about incentives, prices and quality of commodities, risk and contingency, likely returns on investment are assumed away in perfect information (Stiglitz, 2001).

2.1.4. Welfare

Welfare, utility and human well being, are interchangeable within modern neoclassical economics and defined technically and specifically as preference satisfaction. A good has worth only in that it satisfies a preference, the intensity of which is measured as individuals' willingness to pay within a market setting. Early welfare economics, that of Marshall and Pigou for example, implicitly used a more objective definition of welfare and appraised economic systems in terms of their outputs in meeting needs for housing, food and the like, with Jevons introducing subjective utility and centering analysis on personal desires (Bromley, 1990). For example, redistributive taxation to provide a basic standard of living for the poor was analytically favoured by the former but not necessarily the later. The neoclassical conception of welfare as represented by exchange values is a very limited, formal, and subjectivist interpretation but one which is used to defend consequential normative positions. If price is held as an indirect measure of subjective welfare then efficient market outcomes should be pursued to maximize market value as an indicator of hedonic preference satisfaction and hence the total welfare of society. The hedonic account of welfare is also central to Adam Smith's 'invisible hand' argument in that it is "the gratification of...vain and insatiable desires" (Smith cited in Bishop, 1995, p178) that acts as the motive force for the material and cultural improvement of society.

Although subjective welfare is promoted as ethically neutral, it does not presuppose what particular bundle of goods is best for each individual, it is hard to sustain when considering society as a whole. In order to make interpersonal comparisons of welfare, for example when assessing public policy, individual consumption must be aggregated and translated via a social welfare function. This describes how different allocations are valued in society and introduces ethical positions with respect to distribution into the analysis. This is especially prominent when long time periods and heterogeneous populations are considered (Stern, 2006, p30). However, that

welfare, what it is to live well, and hedonistic preference satisfaction are collapsed into one another remains and is distinctive to formal economics. This position goes a long way to justifying market institutions via arguments based in neutrality and plurality. With separation from social, political and ethical constraint amoral, disembedded[2] markets enable the good life without public or political definition of the good life itself or appropriate objectives for society as a whole. Substantivist political economy makes objective specifications of the content of the good life, distinct from individual desires and will be discussed at greater length in the following section.

2.1.5. Efficiency: Productive and Allocative

Neoclassical economic theory holds that perfectly competitive markets in equilibrium are both productively and allocatively efficient. Productive efficiency is defined as achieving the maximum output possible from an economy as a whole given a particular input of factors of production, that is land, labour and capital. The economy is said to operate at its productive possibility frontier, representing the different permutations of goods output of the same, maximum output. Inputs are not wasted anywhere in the economy as firms produce and then sell at the lowest possible cost. The marginal cost of production is equalized across all firms in a given market through competition, and they all receive the same market price for their goods without profit, if returns on invested capital, the opportunity cost and risk premium, are not considered profit but rather a cost born by the production process. There are multiple possible equilibria, with different combinations of goods and services, at which the theoretical market economy is productively efficient. This multidimensional frontier is termed the production-possibility curve. It is a tautology, rather than an empirical finding, that theoretical markets should achieve productive efficiency. The conclusion is simply a deduction from stated assumptions.

Allocative efficiency is a theoretical optimum use of resources within an economy. There are a number of definitions, the most usual being Pareto optimality, a proposed condition where a rearrangement of goods cannot make one individual better off without making another worse off. In other words, there is no other economic state specifying who produces what and who consumes that all would choose over the Pareto optimal one. Subject to conditions on voluntary participation, costless transactions, absence of entry and exit barriers and perfect information, rational util-

[2] In Karl Polanyi's sense

ity maximizing individuals and firms will only exchange goods or services when it is to their perceived benefit. Exchanges occur until marginal utility of demand is equal to marginal cost of production. If transactions are voluntary then this is necessarily an equilibrium state. No rational self interested agent would volunteer to trade themselves into a poorer position. Under conditions of perfect competition this equilibrium state also maximizes the total consumer surplus, the difference between the total value placed on consumption of the equilibrium quantity and the aggregate payment made, and total producer surplus, the total revenue minus the total variable cost of production.

A second, less stringent criterion for allocative efficiency considers the possibility of compensation so that aggregate social welfare is taken into considerations. An economic outcome is Kaldor-Hicks efficient if a rearrangement exists whereby welfare gains to the beneficiaries are greater than the welfare loses to others. On this basis winners could in principle, although need not actually, compensate losers and hence both be better off than before.

Both Pareto and Kaldor-Hicks efficiency criteria say nothing about distribution within a given equilibrium state. They are ordinal criteria, in that it is the ranking of welfare that is important, not the cardinal amount of welfare or distribution amongst market participants. Both also are formal definitions and do not describe real economies. However, the idea of efficient outcomes holds powerful sway in arguments for government intervention to make real economies conform to the model of ideal markets.

Finally, note that price is the only specified coordinating mechanism used to reach these optimal states. In an idealized market framework, efficient allocations of resources, capital and labour arise spontaneously through market clearing at equilibrium prices. Any individual agent knows and need know nothing other than its own willingness to meet the market price for various goods, either for the satisfaction of wants or as inputs to production. Consumers require no knowledge of firms production techniques or the costs facing them. Likewise, firms need know nothing of the consumers willingness to pay or technological status of competitors.

2.2. Market failure

The previous section has outlined the key conditions specified in the analysis of ideal markets. From this starting point, it is deduced that social welfare will be maximized

by free exchange of private goods in a society of self interested individuals. This is then taken as a standard against which to assess actual economic activity in modern welfare economics. Aberrations from perfectly functioning idealized markets are interpreted as market failures, with the normative implication that society would be better off if it remedied these failings through legal, political, fiscal or institutional correctives. Typical invocations of market failure include:

- Imperfect competition arising from market power. For example, a monopoly producer can sell at prices higher than marginal costs, extracting pure profits from consumers and imposing dead weight losses on society as a whole.[3]
- Asymmetric information between market participants where one participant has greater knowledge about what is being exchanged than the other such as used cars (Akerlof, 1970). Adverse selection is another example; one party may engage in a contingent transaction in the knowledge that it is more likely than the population as a whole to be able to take advantage of the exchange but this is not detectable by the counterparty. Think for instance of a poorly maintained industrial facility taking out insurance against failure. There are also consequences for incentives and behaviour such as in cases of moral hazard, a situation that may arise when an insured party reduces the care they take and increase the likelihood of the insured contingency occurring.
- Incomplete property rights, causing rational individual agents to exploit a resource greater than the optimum rate a monopoly owner or social planner would. Hardin's misnamed "tragedy of the commons" is a frequently cited example (see also p49). His proposed remedy to over-exploitation of open access resources was privatization or state ownership (Hardin, 1968; Cole, 1999).
- Missing markets in risk and future supply and demand lead to inter-temporal misallocations of resources. It is a necessity for equilibrium that there is a competitive market for each and every good represented in the form of a commod-

[3] Whilst a perfectly competitive firm faces a flat demand curve, it can sell whatever quantity it chooses but only at the market price, a monopoly producer faces the negatively sloped demand curve of the market as a whole. There is no industry supply curve for a monopoly as there is one supplier with a singular production cost curve. Profit is maximized when marginal cost equals marginal revenue and this determines the quantity sold. The price received is determined by the market demand curve and this will lead to pure profit if the average total cost curve is below the demand curve at this quantity. Surplus is lost to society as a whole as the producer could increase output and meet demand at a lower equilibrium price, hence the allocative inefficiency. However, there is also the possibility of the monopoly not being able to gain profits at all, if its average total cost curve is above the demand curve (Lipsey & Chrystal, 1999).

ity and situations concerning the exploitation of natural resources are especially vulnerable to this problem (Dasgupta & Heal, 1979, p39). The absence of markets for the supply of goods in the future also has implications for macroeconomic stability. Most market transactions in real economies are based on spot prices available to participants at that time, in the knowledge of the spot prices for assets held and with expectations rather than certainties regarding future prices. As such, expectations of future market conditions are central to a number of mainstream explanations of economic bubbles and slumps, not only Keynesianism. Market participants can seek to remedy these uncertainties through institutions, such as long term bilateral contracts or vertical integration into a larger firm (Dasgupta & Heal, 1979, p109).

- Public goods whose consumption cannot be restricted in general and are under produced by free markets. Cases such as national defence demonstrate how costs must be borne to produce the good but consumption is collective and free riding possible.

- External effects where third parties are affected either positively or negatively by an economic activity. Allocative efficiency cannot be reached as marginal costs are not represented in market prices.

The common feature of all instances is a theoretical misallocation of resources leading to a loss of social welfare. For example, when imperfect or asymmetric information is given priority over the assumption of perfect information, markets are seen as invariably inefficient and leading to sub-optimal outcomes. Akerlof and Stiglitz's research programme has been to use equilibrium methods to investigate the ways in which actual market institutions accommodate these conditions and examine the incentives for gathering and disclosing information in *inter alia* labour, durable goods, financial and insurance markets (Stiglitz, 2001). In contrast most mainstream economists see environmental issues as a relatively straightforward problem of misallocation of resources due to one or a combination of unmanaged market failures. They opine that if society would only implement the conclusions of welfare economics analysis, persistent environmental problems would be in practice and by definition a thing of the past. The arguments are framed in terms of efficiency, output and free exchange, rather than equity, distribution or the concrete realities shaping economic activity. The final two classifications, public goods and externalities, dominate the literature, especially concerning climate change.

2.2.1. Public Goods

A benign climate can be conceptualized as a public good, or synonymously a collective consumption good, which is non-excludable and non-rival (Stern, 2006, p25). That is to say, it is not possible to prevent anyone enjoying the benefits of a given climatic state, which is experienced by all regardless of their investment in its protection or disregard for its harm, and that any individual's consumption of an amenable climate does not diminish the benefits others gain from it. Comparable examples include national defence or reception of "free to air" TV, in contrast with normal, private goods, that are both rivalrous and excludable. The other typical categories in this bi-axial classification are club goods that are non-rivalrous but excludable, such as a bridge at low utilization, and so called common pool resources[4] which are rivalrous but non-excludable, such as high seas fisheries.

Whilst rivalry is taken to be an inherent property of an object or service, excludability is a feature of the social and technological conditions prevailing. For example, road user charging becomes practically feasible with the advent of number plate recognition or RFID technologies, scientific research becomes excludable with the introduction of patent law within the scope of a given jurisdiction (Lipsey & Chrystal, 1999, p290).

The neoclassical argument runs that market economies under produce non-excludable goods because individuals or firms producing them cannot attract sufficient revenues to meet production costs. The corollary is the traditional rationale for public investment in basic scientific research or public infrastructure. For example, science is stylized as an economic activity producing codified knowledge which is both a good in itself and also an input to other economic activities. It suffers underinvestment because the products are indivisible, inappropriable and uncertain (Arrow, 1962) and it is therefore optimal to use general taxation revenues to support basic research.

In the case of common property non-excludability may provide incentives for individual agents to exploit a resource past the point of optimum marginal return to

[4] Whilst this is common nomenclature in economic textbooks, popularised by the biologist Hardin's landmark paper on "the tragedy of the commons" (1968), it is questionable whether it is entirely appropriate. Common property and access to it may be very well regulated and managed through one political forum or another, in which case they cease to be non-excludable in practice. The situation Hardin describes is better termed free and unregulated access as it contains no enforced or recognised property rights which are typical of commons institutions (Aguilera-Klink, 1994).

society. The gains from an additional agent exploiting the resource are partly additional but partly also at the expense of others. Not only does this lead to inefficient outcomes but it may also compromise the long term sustainability of the renewable resource, as is widely seen in contemporary fisheries (Clark, 1973).

Notably, neoclassical analysis suggests that there will be an optimum quantity of a public good, if it is possible to vary quantity, and ways to arrive at that point through economic policy instruments. Because consumption is collective, the theoretical demand curve for a public good is the vertical sum of each individual consumer's demand curve and the optimum quantity the intersection of this with the marginal cost of supply of the public good. In terms of climate change, the optimum amount of abatement of emissions in a given period is when the marginal abatement cost (MAC) equals the net social benefit of the public good of a benign climate. This formulation implies the calculability of the costs and benefits of the public good, however, as Samuelson points out (1954) no decentralized pricing system can arrive spontaneously at this point for a public good as the prices that would induce agents to produce the optimum combination of goods would necessarily be inefficient in their allocation (Bator, 1958). A centralized computational system will be beset by problems in practical measurement of preference intensities as there is a strategic incentive for individuals to under-report their preference for the public good. For these and other reasons, such estimation techniques and the general approach of Cost Benefit Analysis are academically and normatively contentious issues, aspects of which are discussed in section 2.3.

2.2.2. Externalities

An externality, also known as a spillover or neighborhood effect, is typically defined as an impact felt by a third party due to the economic activity of others. The impacts may be positive, negative or both where multiple third parties are involved. Noise, air pollution and financial regulation to prevent systemic loses are typically given as examples of negative externalities, with investment in research and development or external home improvements typical examples of positive cases. Analytically it is important to note that the effect is incidental or unintended, otherwise it will be considered within the process of market bargaining (Mishan, 1971) [5]. Voluntary

[5] Vatn and Bromley contend that this is not the case as the neoclassical model requires that agents are individually rational and as such their actions cannot be unintended (Vatn & Bromley, 1997).

participation in transactions to mutual benefit is the central relationship of the neoclassical framework. With externalities uncorrected by a supplementary institution, no price is paid for the involuntary impact so the market economy as a whole delivers sub-optimal allocation of resources and reduced net welfare. Simply put, price signals in the market promote too much production of some goods and too little of others.

Negative environmental externalities lead to situations where the marginal social costs of an activity are greater than the marginal social benefits. It is social welfare that is deemed to be reduced, not the individual welfare of any given party which is necessarily increased by the economic activity, otherwise they would not rationally, undertake the activity. As a result market economy will typically produce goods with negative externalities in a quantity greater than the social optimum. A more efficient allocation of resources with greater net social welfare may be possible and as such there are grounds for state intervention or changes in the wider institutions governing the economy. Analytically, public goods are a special case of an externality where the identity of the initiating agent is not connected to the consequences or impacts (Bator, 1958).

In Pigou's original terminology there is a divergence of private net product and social net product (Pigou, 1932) whilst Dasgupta frames externalities as a discrepancy between the accounting price of a natural resource and the market price paid in the actual economy (Dasgupta, 1990)[6]. Both implicitly refer to an ideal Pareto optimal state for identification of market failure[7]. A number of important conclusions follow from this and structure neoclassical "fixes" for market failure; i) public goods

They argue that some courses of action, e.g. costly waste disposal, are not taken because they would violate the assumptions of individual welfare maximization for agents. This is not to say that the production of negative externalities is malicious but rather that they should at least be interpreted as "cost shifting" within the existing regime of rights and liabilities. As such, the effect *is* present within market prices and their argument echoes that around Pareto-irrelevant externalities (see 58). The structural implication is that competitive pressures of a market society will tend to increase the number and scale of externalities and any market correctives will be continually "chasing a moving target" (Vatn & Bromley, 1997).

[6] In this latter framework externalities can be interpreted as subsidies. For example their are implicit wealth transfers from South to North through under priced primary extractive activity if there are social and ecological costs outside of the market, which is one justification for replacing GDP with a Net National Product as a key economic indicator. Gross domestic product by definition ignores the depreciation of capital assets, including the depletion of "natural capital" which is excluded from accounts.

[7] However, this is not the case in all treatments of externalities in the literature, notably transaction cost economics as discussed in section 2.3.2

are outputs of society that are to be provided and measured by economic means, bringing matters of exclusion, voluntary exchange and calculation to the fore and ii) there is the possibility of an optimal provision of public goods and goods generating externalities either positive or negative.

2.3. Fixing environmental market failure

Much economic activity presents society with discordant outcomes. Synthetic fertilizers improve crop yields and farm output but diminish biodiversity and accumulate in food chains to the detriment of predators. Coal fired power stations deliver affordable, reliable electricity but release acidic gases that damage forest and lakes at great distances. Waterfront hotels bring jobs to coastal areas but also rowdy guests who are a nuisance at night. There are many possible ways in which society could recognise and manage these issues, through industrial leadership, compensation, education, or the much maligned 'command and control' regulation, but increasingly the trope of market failure as outlined is becoming dominant; the farm produce enters society's financial accounts whilst the lost invertebrates do not but ought to. Environmental economics has developed policy programmes intended to weigh the harms caused by polluting activities against the benefits they provide, distribute revenues and burdens amongst different parties and realise the greatest economic welfare to society.

In this field there are two main analytical approaches that give rise to related policy interventions; i) marginal benefit, marginal damage cost analysis and the use of taxation or other redistributive price instruments to penalize polluters, compensate those harmed or deliver an optimal quantity of a public good, and ii) the creation of exchangeable property rights between agents to allow those who most value a resource or right to an activity to control access. Both imply the intervention of the state, coordinating resource reallocation or enforcing property rights, to deliver a market ideal but with a minimal intrusion of political positions or processes. Crudely, policies arising from the former are stylized as price instruments and the latter quantity instruments. In the purest mathematical formulations the outcomes of both policy types should be equivalent as both are set with reference to the same optimal equilibrium state (Weitzman, 1974). However, the two programmes are have distinct rationales, assumptions and means of implementation. For the subsequent discussion of carbon trading institutions it is useful to outline both.

2.3.1. Pigouvian Taxes, Shadow Pricing and the Social Cost of Carbon

Historically, the first approach developed to correct externalities or pay for the provision of public goods was Pigou's proposal of taxes at the level of marginal social cost or marginal social benefit respectively (Pigou, 1932). A tax imposed by the state would generate revenues to be used as compensation or remediation. Price instruments influence both supply side and demand side agents to alter the generation of externalities. As well as redistributing resources, the extra costs imposed by such a tax incentivise consumers to reduced demand and hence producers to reduce output. Conversely the extra incentive provided by a subsidy for an under-produced positive externality will promote output or increase the quantity demanded.

Theoretically, all economic agents affected by an externality tax will reduce their production, or consumption, of the externality until the marginal cost of reductions is equal to the tax. The result is that some parties reduce more than others but ultimately all equilibrate to the same reduction cost. Further reductions should cost the same amount regardless of who undertakes them (Baumol & Oates, 1971). This form of price regulation is considered most efficient when applied evenly across the whole of an economy. In analytic terms there should not be discrimination between originators of a given externality as the appropriate uniform tax or subsidy will allocate optimally. In other words, the profit motive incentivises firms within a sector to find the cheapest abatement technologies and across different sectors consumer demand will cause reallocation according to preferences. Those who voluntarily meet the price of the tax are not prevented from consuming goods generating the externality, which would be a loss of welfare, whilst those who choose not to pay goods bearing the tax evidently do not value the good any more than that amount and their welfare loss is less than the damage avoided. Were a regulator to apply different levies across an economy then a market failure, in terms of sub-optimal allocation, would in a sense persist. In not discriminating between means of avoiding, or providing for, an externality, Pigouvian taxes align with many of the libertarian arguments for market processes and market outcomes.

To some extent they reduce the information requirement of the regulator as individual preferences need not be known in advance, nor the most efficient technologies to reduce the externality identified at the outset. However, setting the appropriate level of the tax or subsidy is acknowledged as being problematic, from both analytical and pragmatic perspectives. The optimum theoretical level is not the marginal

net damage at the time of first intervening, but rather the marginal net damage that would be experienced in Pareto equilibrium. Calculating the appropriate level is either a challenging or impossible task according to analyst's position on information in the economy (Baumol & Oates, 1971; Hayek, 2005). Theoretically, such calculations require all the previous assumptions about completeness and competitiveness of markets to be met. Practically, there must be means of introducing proxies for the absent commodities, for example the value of a sparrowhawk or a Pennine vista in the year 2035, in a common value framework[8]. Further, in the case of stock pollutants, like greenhouse gases, calculations are made on the basis of the flow of damages caused by a unit of emissions now, into the far future, discounted and summed (Sinn, 2008). As well as requiring a social welfare function to aggregate and the utility of consumption across different individuals, Pareto equilibrium analysis is essentially static so values across time must be related through a common numeraire, usually the present value of expected utility (Stern, 2006, p304). Efforts to estimate a marginal social cost of greenhouse gases, often known as the social cost of carbon (SCC), place values in a range over orders of magnitude from £0 to £1000+ per tonne of carbon emitted (Stern, 2006, p288). In calculative terms, the SCC will be higher if i) future emissions are taken to be higher, ii) the climate sensitivity parameter used is higher or iii) a lower discount rate is used in the calculation. However, these calculations are entirely speculative given their dependence upon assumptions made about the future flow of greenhouse gases, how to value the future harms that they cause or benefits they realise and how to understand humanity's ability to adapt. Nevertheless, the SCC is suggested as the basis of a "shadow price" for carbon to be incorporated into cost benefit analyses of government interventions or private projects. It can be used, for example, to illustrate the effective subsidy that externality generating industries like primary extraction receive from society as whole, often leading to very regressive outcomes and subsidies from the poor to the rich (Dasgupta, 1990). A shadow price is not typically referred to as a formal economic parameter like SCC, rather it is an administrative tool. This distinction is questionable given the nature of many of the assumptions required to arrive at an SCC and the implicit political economic norms inherent in the neoclassical paradigm.

There is a wealth of literature on the inconsistencies and difficulties of estimates of

[8] Whilst there are substantial disputes as to the efficacy or indeed meaningfulness of using such proxies to arrive at cost estimates, Anderson (1998, p241) emphasizes that even the welfare economics required for CBA is inconsistent in that "there is an implicit tendency to construe costs as essentially homogeneous and cardinal and benefits as heterogeneous and ordinal.".

external costs both for Pigouvian taxation and comparable aspects of cost benefit analysis (CBA) from within mainstream economics and outside of it. In climate policy, the Second Assessment Report of the IPCC was something of a watershed and provoked much discussion and controversy, particularly in its different weightings of the value of individual lives according to the economic output of their country of origin (Pearce et al., 1996). The practice of using price estimates of ecological or human costs is frequently seen as problematic on ethical and broader political economic grounds (Stirling, 1992; Funtowicz & Ravetz, 1993). The outcomes of SCC calculation depend to some extent upon the ethical arguments that preface their structure and rationalize the parameters chosen for the model. For example, aversion to inequality may reduce SCC value by placing intra-generational concerns ahead of inter-generational equality depending upon the relative values of time preference parameters. However the SCC is based upon net social measures of welfare considering utility across different income groups only so far as a net social welfare function is used in aggregation and in practice Pigouvian taxes may have regressive implications as the poor may spend a greater proportion of their income on externality generating goods (Feng et al., 2010). This is to some extent illustrative of the diversity of ethical perspectives on inter-temporal, domestic and international equity within extant societies and the limited ability of reductive aggregative methods like CBA to capture them (Dasgupta, 2008).

The difficulties of such models remain not only in finding the 'correct' parameters but stem from the inappropriate structure of the model in relation to the system examined. For example, environmental problems are necessarily, from the perspective of the modeller, characterized as risk rather than more properly understood in terms of radical uncertainty (Dietz & Fankhauser, 2009)[9]. The Stern review, and subsequent debate it generated, highlighted problems in the creation of present value proxies for future flows of costs and benefits. The analytical difficulties of disentangling risk aversion, inequality aversion, and inter-temporal substitution when 'the answer' is expressed in a single numeraire were prominent (Stern, 2006; Tol & Yohe, 2006; Spash, 2007; Heal, 2009, Chapters 2 and 13). With respect to climate change, some commentators suggest that the environmental economics community is moving away from deterministic measures of climate damage cost and towards probabilistic models (Dietz & Maddison, 2009) which may generate controversial outputs

[9] Pindyck (2007) provides an excellent overview of the distinction between risk and uncertainty and its implications for environmental economics.

and unbounded cost estimates (Weitzman, 2009) although these conclusions are disputed on physical (Costello et al., 2010) and actual social responses to extinction risk (Nordhaus, 2009)[10].

Actual examples of taxes levied via the complete Pigouvian rationale are rare because of the manifold nature of externalities and the prohibitive administrative costs were each to be regulated individually. Pearce vividly illustrates the variation within UK environmental taxation and the discrepancies between these and an optimal SCC (2003). However, there is a case for the less specific 'green tax reform', especially if the revenue raised from ecotaxes can be used to reduce other distortionary taxes such as those levied on labour. This so called 'double dividend' exists where the fiscal benefits of ecotaxation are greater than correction of the environmental externality (Goulder, 1995; Bovenberg, 1999).

In summary, the central mechanism of Pigouvian taxation is redistribution through the introduction of a damage cost tax or welfare loss subsidy. The calculation of these values is pivotal and performed centrally by the regulating authority. Discussions of expected utility estimation, use of discount rates and social welfare functions contribute to these calculations but may also be deployed through other policies or modes of governance such as cost benefit analysis. As with CBA, Pigouvian taxation maintains a theoretical ideal based upon static equilibrium models of individualized, consumption based welfare, and at best provides 'potential Pareto improvement analysis' (Bromley, 1990).

[10] Weitzman presents this as his 'dismal theorem' (Weitzman, 2009); fat tails on the climate sensitivity (CS) probability distribution functions (PDF) combined with a CBA damage function that rises at a faster rate than the CS PDF diminishes imply that the integrated damage cost that tends to infinity. The central point is that uncertainty is the most important issue in climate policy and that CBA needs to be used judiciously. Issues relevant to this argument are i) the underlying climatology, including whether the long tails of CS are actually infinite which hinges on the physical possibility of CS being greater than 20, ii) the ontological status of the CS and the PDF within the CBA i.e. whether the distribution is of one real planetary CS among many real planetary CSs, in which case the PDF is a property of CS, or is the PDF a Bayesian sampling of a singular 'Earth's CS' and the PDF is property of our knowledge of the CS, iii) whether Weitzman's maths actually requires CS to be a doubling rather than any increase, including a thought experiment that suggests wearing the wrong hat might change albedo and cause infinite losses (see `http://julesandjames.blogspot.com/2007/10/weitzmans-dismal-theorem.html`). More widely there are major issues around the appropriateness of this type of economic analysis under conditions of uncertainty and the use of a cash measure of utility and implicitly social welfare.

2.3.2. Coase Theorem, Property Rights and Bargained Solutions

Rather than attempting to correct market failure *ex post* by introducing corrective prices, an alternative literature argues that the extension or revision of property rights is sufficient to allow market transactions to accommodate the externality and realise an optimal outcome. It is this literature that forms the intellectual basis for carbon trading and originates in Coase's landmark article (1960) written as direct critique of Pigouvian welfare economics. *The Problem of Social Cost* made three key contributions to the discussion of externalities; i) it raised the profile of losses to those assigned liability for creating negative externalities, ii) it described a situation where the allocation of rights between generator and receiver of an externality did not ultimately affect net social welfare, and iii) it recognised the importance of transaction costs, at the margin and in total, when considering alternative institutional arrangements. Like neoclassical market failure arguments, the welfare justification is based on maximizing consumption but introduces individual autonomy to reduce information requirements and minimize administration and exclusion costs.

The original cases Pigou cites as justifying remediation, including vehicle taxation for road expansion[11] and agricultural nuisance from rabbit's crossing boundaries (1932, p12), are basic two agent problems where liability is presumed to rest with a recognizable perpetrator and victim. Ronald Coase's landmark 1960 article rejects deontological positions regarding the identification of the perpetrator and victim of an externality. To Coase, liability is not pre-existing and as Yandle puts it "This analysis has nothing to do with polluters' imposing costs on society, but everything to do with competing demands for use of an asset (1998, p121)".

Allocation of rights to that asset should be decided on the basis of economic efficiency, itself a feature of transaction costs inherent to the institution[12]. Coase (1960) uses Pigou's own examples to illustrate his point that:

> ...from an economic point of view, a situation in which there is "uncompensated damage done to surrounding woods by sparks from railway engines" is not necessarily undesirable. Whether it is undesirable or not

[11] Although this was the case in the UK in early 20th century, vehicle licensing revenues and fuel duties have not been hypothecated since the abolition of Road Tax in 1937. Transport infrastructure is in the main provided for out of general taxation making it a popular misconception that "cyclists don't pay road tax".

[12] This is a somewhat circular argument as a particular transaction may be related to the initial allocation of rights.

> depends on the particular circumstances...
>
> The question at issue is not whether it is desirable to run an additional train or a faster train or to install smoke preventing devices; the question at issue is whether it is desirable to have a system in which the railway has to compensate those who suffer damage from the fires which it causes or one in which the railway does not have to compensate them (Coase, 1960, p34).

His central conclusion is that optimal allocation does not depend upon the particular distribution of rights but rather the institutional framework and transaction cost structures that result. The most important thing for public policy is to reduce the impediments to bargains being formed between agents so that market allocation can proceed smoothly and to efficient conclusions. Coase showed that with zero transaction costs the final allocation of resources should be the same regardless of which party was deemed to be liable for the externality, the only difference was relative final wealth[13]. As Demsetz succinctly puts it "The output mix that results when the exchange of property is allowed is efficient and the mix is independent of who is assigned ownership" (1967).

This result, known as "Coase's Theorem" (Stigler, 1966), of course has implications for policies and interventions advised to correct market failure. The first relates to liability. If the loss of welfare to the 'liable' party in remediating an externality is introduced into a Pigouvian regulatory analysis then the question is raised as to whether or not the effect on the third party is large enough to be Pareto-relevant (Buchanan & Stubblebine, 1962), indeed whether the market fails in the sense that allocation remains sub-optimal. Coase opens his analysis by asking the question of a polluted river "is the value of the fish lost greater or less than the value of the product which the contamination of the stream makes possible?" (1960, p2). According to this logic, persistent externalities may exist in a Pareto equilibrium state. Were the state to intervene to correct this position the outcome would be allocatively inefficient by neoclassical measures of social welfare. Such Pareto-irrelevant externalities are, unsurprisingly, a contentious position ridiculed by Vatn and Bromley (1994) as "that most wondrous of Panglossian benedictions". In Bromley's words "The hyper-Coasean would advise the victims to remove themselves from the vicin-

[13] Buchanan and Stubblebine constrain this result by specifying that it applies only to firms but the more significant point is that it should hold only where agents' actions are determined by competitive market prices (1962).

ity of the polluter. To force the polluter to stop polluting would diminish the national dividend and thereby be judged socially inferior" (2007, p677).

Rather than have the state intervene and dictate terms, a market with clear enforceable property rights ought to discover through exchange which agent can alter behaviour at least cost. This is intended to both resolve the social welfare loss and also direct agents appropriately towards an optimal outcome:

> It seems to me preferable to use the opportunity cost concept and to approach these problems by comparing the value of the product yielded by factors in alternative uses or by alternative arrangements. The main advantage of a pricing system is that it leads to the employment of factors in places where the value of the product yielded is greatest and does so at less cost than alternative systems (Coase, 1960, p40)

As such, the property rights approach admits the possibility of too little pollution and too much ecological quality. Such is the origin of Larry Summers' infamous World Bank memo arguing that "the economic logic behind dumping a load of toxic waste in the lowest wage country is impeccable and we should face up to that... I've always thought that under-populated countries in Africa are vastly underpolluted" (1992).

The second major implication from Coase Theorem, that efficiency does not depend on patterns of initial allocation, suggests a separation of individual welfare from allocation of resources. The distribution of individual welfare ought to follow from the rights allocation but not interfere with the output mix. In theory, a progressive regime could assign property rights to the least well off and the final outcome would be optimal and unchanged with 'fair', market determined compensation paid to those suffering the externality (Tietenberg, 2003). The formal efficiency of this result is challenged by welfare economists as an appropriate social discount rate is analytically distinct from the discount rates attributed to individual economic agents. When costs or benefits are summed through time, very different values of net social welfare may be realised according to the initial allocation of rights (Dasgupta, 1990).

Further, the Coasian solution to environmental externalities is typically represented as a single polluter single victim bargaining situation. Efficient outcomes are achieved regardless of initial allocation of rights as there is the assumption of perfect information and zero transaction costs. As outlined earlier, this is not a position that Coase endorses primarily on the basis of persistent transaction costs, although it is regu-

larly cited by advocates of free market environmentalism as presenting a strong case for the use of MBIs to tackle environmental pollution. However, it is rarely recognised that the single polluter single victim case is far from a market situation, never mind a *competitive* market. As Hahnel and Sheeran (2009) point out, establishing property rights is only the first step towards creating a market, and assigning liability and damages for an externality is not the same as creating a marketable right. They detail how the bilateral bargaining situations that Coase describes will not produce efficient outcomes unless both parties have 'complete information' i.e. not only of their own damage or abatement cost curve but also their counterparty's, as there are incentives to misrepresent one's own costs.

Coase did however emphasize important ways that the real world did not conform to the blackboard economics of Pigou and other welfare theorists. This aspect of his work is frequently missed in subsequent interpretation (Butler & Garnett, 2003). His first major work on economic organisation describes how the costs associated with market transactions provide incentives to conduct some activities within planned, hierarchical organisations such as the firm rather than through voluntary market exchange (Coase, 1937). He himself laments that:

> The world of zero transaction costs has often been described as a Coasean world. Nothing could be further from the truth. It is the world of modern economic theory, one which I was hoping to persuade economists to leave. (Coase (1988, p174) in Ellickson, 1989)

Highlighting the effects of transaction costs and the institutions that determine them was Coase's foremost intellectual contribution and was developed in time into New Institutional Economics (NIE). Discussing the regulation of public infrastructure and utility companies Williamson (1996, p1020) asserts key aspects of the NIE framework:

> I come down in favor of the propositions that (1) institutions are important, (2) institutions are susceptible to analysis, and (3) public policy analysis should eschew hypothetical ideals in favor of comparative institutional analysis of alternative feasible forms... Attention is thus appropriately focused on (1) the attributes of the assets, (2) the condition of uncertainty and the unavoidable incompleteness of contract, and (3) the importance of embedding contracts in governance structures that mitigate hazards and infuse confidence (with special attention to credible commitments).

For new institutionalists, it is not enough to demonstrate that a market outcome is sub optimal in comparison to an ideal market. In this framework, the externality only *exists* if it is remediable i.e. there is the practical possibility of an alternative, superior arrangement and that this is preferable taking into account administrative costs (Williamson, 2000). NIE substitutes the 'nirvana approach' of welfare economics for a comparative institutional approach (Demsetz, 1969). Asking how the structure of institutions determines the outcomes of economic activity is characteristic of NIE and a distinct position from the assumptions and equilibria idealized in the neoclassical framework. Nonetheless, NIE maintains the methodological individualism of the neoclassical framework for the purposes of its analysis. Agents are relatively free and able to recognise opportunities to increase their individual welfare and take action to realise it, including of course strategic action that may place constraints on their and others' actions (North, 1984). Consequently NIE posits that it is agents acting to maximise self interest that build efficient institutions (Williamson, 1985). This is in distinction to the 'old' institutionalism of Veblen and Commons which placed much greater emphasis on agents' context, relationships, capacity to act politically, and the dynamic processes of the changing structure of the economy (Hodgson, 1994, p70)[14]. Old institutionalism recognises that self-interest and meaningful action must be considered in relation to and as an outcome of institutions not prior to them. For example, public service and the desire to acquire votes are quite different to consuming goods from a marketplace and motivations and means differ as a result. As O'Neill puts it "The old institutionalism differs from the new in that it allows individuals' preferences to be explained by reference to the institutional context in which they operate... The explanatory claims of the old institutionalism enter as unannounced, unnoticed and unwelcome guests into the new institutionalists' assumptions about the 'utility function' of the agent in different contexts" (O'Neill, 2007, p67). Possible modes of action also differ substantially within institutional settings. For example the only way for an individual to express dissatisfaction with the sale of a good in a pure market setting is to not purchase it. There is no way to persuade or argue over the appropriateness of an object for exchange, e.g. a 'womb for hire', nor can an individual make a case based on need or entitlement (Caporaso & Levine, 1992, p223).

[14] Institutional explanations of economic patterns have also been offered in abstract terms and at greater social and historical scales. Marx's account of economic transformation is based on the dialectical tensions between forces of production and relations of production that are institutional in character.

Transactions costs are central to the NIE analysis of externalities. Dahlman (1979) underscores this point by arguing that under the specified conditions for neoclassical analysis (perfect information, zero transaction costs) externalities *cannot* exist as they would be voluntarily bargained away. Given that transactions costs exist in the actual economy, the nature of the externality, the parties affected and the institutional context become relevant in a way that formal neoclassical analysis does not recognise. If the externality exists between two parties and is readily identifiable, common law liability may be all that is required to result in bargains being struck to mutual satisfaction and maximum social welfare, whereas government intervention may be the most efficient institution where transaction costs could mount substantially for example where there are large numbers of affected parties (Coase, 1960). However, in practice the information problems that beset optimal Pigouvian taxation may not be solved. For instance, where it is important to know the value of damages resulting from pollution, for example in a dispute between parties, the judiciary must fill the role of the omniscient bureaucrat and decide upon the marginal cost of pollution that is capitalized in the respective property right (Helm, 2005).

This mode of reasoning also brings to the fore the particular rights that are specified and associated with property rather than treating property only as simple physical entities. An individual or firm holding a property right is permitted to carry out a limited set of actions according to the wider social and regulatory context. This is clear in the case of land where access rights and land use planning regulations may persist, and sub surface mineral resources, ground water or crop planting restrictions apply. Coase then extends this to take "the right to do something" as a factor of production and conversely the exercise of such rights having consequences and costs for others (1960, p44). In the case of environmental externalities, property rights regimes might implicitly allow the release of polluting substances without liability. The explicit creation of new property rights or common law liabilities for these consequences are the basis of market exchange or enable bargains to be made between affected parties.

Cole (1999) argues that all environmental problems are founded in issues of property rights, by conflating property ownership with all forms of control, individual or collective, legal or normative, commercial or public. Although this position is disputable, his analysis offers a useful example of how practical confusion can stem from a misunderstanding of the distinction between "property rights in something and the thing itself" (Cole, 1999, p113). You may own your home but you don't have

the right to burn it down (Dales, 1968). Cole describes the legal status of emissions allowances in American Clean Air Act (1990). Public utility companies can own and trade property rights *in emissions allowances*, however, the emissions allowance isn't a property right itself. The allowance confers the ability to meet a specific government regulation and does not offer *carte blanche* to pollute nor hold any formal sway over the content of the regulation. The regulator is also able to change the scope of regulation and withdraw allowances at will without being bound by the legal necessity of providing compensation to the holders.

J.H. Dales developed the first substantial case for markets in pollution rights in his 1968 essay *Pollution, Property and Prices.* Starting from the premise "to live is to pollute" (Dales, 1968, p13) he argues that waste disposal costs are always a positive amount for society when both the costs of disposal and costs of damage are summed. The best that we can do is to formulate appropriate regulation to minimize this total and key to this is the understanding the particular biophysical fate of wastes in the natural environment and the spatial distribution of sources. In cases where an appropriate geographic constraint encompassing pollution can be identified then emissions trading can be formally shown to provide a least cost means of attaining a given environmental target if not an overall Pareto optimal distribution because of the public good element of the target itself (Montgomery, 1972). Much is made of the putative certainty of achieving the desired environmental objective through a fixed "cap" on permits, as opposed to the uncertain output effects of a Pigouvian tax (Hepburn, 2007).

2.3.3. Public Choice Theory, Austrian Economics and Free Market Environmentalism

Although not directly providing an analysis of environmental economic concerns for ecological public goods and externalities, public choice theory and Austrian economics perspectives respond to the neoclassical and institutional fixes for market failure and provide some of the most vociferous support for market governance of the economy.

Adherents to the Austrian economic theory of Menger, von Mises, Hayek and others, have the primary contention that institutions of private property and the market enable spontaneous but dynamic order as individuals and firms co-ordinate their plans through prices. Price co-ordination is cited as superior to central planning as it

maximizes the use of distributed and tacit knowledge, and superior to participatory planning as it reveals "the *intensity of other people's values* and thus what the specific content of the 'public good' is" (Pennington, 1999, emphasis original). It differs from neoclassical theory in a number of ways, although it shares with neoclassical economics a model of welfare as the satisfaction of wants Austrian economics emphasizes liberty and purposeful behaviour. Notably Austrian economics rejects the notion of ideal markets progressing to equilibrium and allows for the preferences to change as a result of circumstance (Hodgson, 2002, Chapter 11). Disequilibrium is the norm and entrepreneurship a vital characteristic of capitalist economies (Schumpeter, 1954). For example Vernon Smith's analysis of deregulation of the US airline industry in the 1980s describes how the hub and spoke model of delivery had not been anticipated or calculated by any participant but arose spontaneously, developed dynamically and produced new variety in patterns of production and consumption of transport services (Smith, 2002; Donahue, 2002). As a result, efficient allocation and the possibility of market failure are rejected on the grounds that it is actually impossible to know what the optimal case is outside of subjective action. Further, the only way to effectively weigh plural values and preferences is to reduce all social and ecological phenomena to commodities and allow voluntary exchange and price development to direct their fate in society. The role of the state in this model of political economy ought to be limited to the enforcement of contracts and property rights with individuals and firms directly bargaining over supplementary issues, in effect the rest of social life.

Public choice theory, articulated for example by Buchanan and Tullock (Buchanan & Tullock, 1962), concerns the application of economic reasoning, tools and methods to issues of politics and government. This body of theory, being methodologically individualist, takes rational self-interested action as its starting point and makes the distinction between politics and the economy one of institutional context i.e. the market sphere of production and consumption or the government sphere of control of interdependent or public matters (Caporaso & Levine, 1992, p135). The design and implementation of environmental policy is therefore subject to the bureaucrat's propensity to maximize her budget, the politician's to maximize his number of votes and the voter's preference for politicians who will increase their individual wealth. As a result the benign, public welfare optimizing state which is intended to correct market failure is replaced by one of endemic 'government failure' (O'Neill, 2007, p62). Exercises in Pigouvian taxation, cost benefit analysis or shadow pricing (2.3.1)

are seen as vulnerable from the outset so the most effective solution to environmental problems is to directly internalize unintended effects into systems of voluntary economic exchange.

Free market environmentalism is a colloquial title for a loose political economic programme and not a coherent body of economic theory as such. Drawing on Austrian economics and public choice theory, it places emphasis on completely specifying property rights rather than legislating particular environmental standards or levying taxes (Anderson & Leal, 1991). Competitive markets ought to provide incentives for private agents to acquire information and through the sum of their exchanges the institution as a whole reaches a calculate optimum. Putatively objective valuations of ecological phenomena are regarded by free market environmentalists as manifestations of technocrats and bureaucrats own subjective preferences. In contrast, prices generated through market exchange of private property are seen as "transferring subjective values into an objective measure" (Anderson & Leal, 1991, p18) conveying information about interpersonal valuation, social scarcity, and offering a measure of organizational performance on the balance sheet. If a central planner is mistaken in assigning a damage cost or persists in providing an out of date or inappropriate subsidy, the disciplinary mechanisms are much less keen or timely than financial loss or bankruptcy (Pennington, 1999).

This approach focuses on incentives structure afforded by property rights that specify the particular actions that can be taken with particular natural resources. It situates this in a dynamic institutional context of redefinition according to the evolution of social norms in control of land, forestry and fisheries. Proponents argue that systems of private covenants and evolving Coasian bargains have effectively contributed to historical preservation of landscape amenity and agricultural integrity in the United Kingdom and the United States (Anderson & Leal, 1991; Pennington, 1999). This process of redefinition is creative driven by profit opportunities in recovery of the value of social losses from externalities.

> Where environmental entrepreneurs can devise ways of marketing environmental values, market incentives can have dramatic results. It is important to recognize that any case of external benefits or costs provides fertile ground for an entrepreneur who can define and enforce property rights (Anderson & Leal, 1991, p21).

Adopting the ideas of new institutional economics, the free market environmentalism approach sees all socio-political accommodations over natural resources and

pollution problems as being subject to substantial transaction costs but argues that in most cases that market systems economize on these costs and align monitoring and enforcement costs with those who will directly benefit. Only circumstances with insurmountable definition and enforcement costs are ceded to political institutions, and in those cases reluctantly because of the presumed authoritarianism and fiscal irresponsibility that follows (Anderson & Leal, 1991, p23). For example, Anderson and Leal cite cap and trade pollution permit systems as an unfortunate but necessary compromise for cases of atmospheric pollution. The resulting "market socialism" allows for decentralization of abatement but maintains a pivotal and vulnerable role for the regulator in setting environmental objectives and permit allocations.

2.4. Greenhouse gas property rights for climate change mitigation

> If ever there were an environmental problem designed for emissions trading, global warming is it (Ellerman, 2005b).

Through the lens of environmental economics, pollution externalities have come to be seen as substantial and pervasive in industrial society (Pearce, 2002). In liberal democracies, efficiency and cost effectiveness are now primary concerns of environmental policy makers and have shaped the process of policy formulation to provide fix for these so called market failures (Toke, 2008). Indeed, the United States with Executive Order 12291 has gone so far as to mandate regulatory impact assessment, in effect a cost benefit analysis, of all major health, environmental and chemical regulations (Soederbaum, 2007). As outlined in section 2.2 the environmental economics literature proposes a set of theoretical arguments for the use of price mechanisms in regulation to realise least cost, if not economy wide Pareto optimal, levels of abatement through environmental standards with taxation (Baumol & Oates, 1971) or tradeable pollution permits (Montgomery, 1972).

In practice, permit systems have been variously applied to air pollution, water pollution, fisheries and water resource management (Tietenberg, 2003), their most conspicuous use coming with the US sulphur dioxide (SO_2) control programme under the Clean Air Act Amendments in the 1990s (Burtraw et al., 2005). Policy appraisals tend to compare the mitigation costs of MBIs over performance standards or 'command and control' regulations. Rather than review this broad literature, this section

will briefly outline the mainstream position that presents 'climate policy as a natural case for emissions trading' (Hansjurgens, 2005, p223). Many of the aspects discussed here will be developed further in subsequent chapters.

In the highest profile assessment of climate change economics and policy, Stern (2006) identifies four particular features of climate change relevant to their analysis and distinct from other environmental problems typically approached through the framework of externalities. Firstly, climate change is global in its origin and effects given that most significant greenhouse gases (CO_2, CH_4, N_2O) are well mixed in the atmosphere. Secondly, both the biophysical and socio-economic systems associated with climate change develop over time with lags between cause and effect. Thirdly, there are important uncertainties in the timing, size and type of the impacts and costs associated with adaptation. Finally, there is the possibility that large and rapid climate change could cause substantial disruption to the global economy such that marginal economic analysis is not appropriate. They conclude that the first response in mitigation policy should be to introduce a price for the marginal damages caused by greenhouse gas emissions and that the foregoing risk/uncertainty arguments suggest that quantity targets with emissions trading or an iterative tax revised to meet such targets is most appropriate (Stern, 2006, p35). Credibility and predictability of policies are also highlighted because of the necessity to spur long term and large scale investments in infrastructure and technological innovation.

Stern also considers other cases where non-market based instruments may be appropriate. Performance standards and direct regulation are cited as being more effective in correcting market failures if there is asymmetric information or split incentives, such as household heating where neither landlord nor tenant has incentives to invest in insulation if prospective tenants have difficulty in estimating future utility bills. The externalities that are thought to be influential in processes of innovation, for example the low cost of adopting of new knowledge, increasing returns to scale, adoptive externalities and the development of standardized technology and expertise, also suggest that policies that drive widespread learning and diffusion will be more effective than market instruments. Nevertheless, these situations are considered if not exceptional then untypical, and chapters 14 and 15 of the review provide unambiguous support for a uniform carbon price with broad spatial and sectoral coverage on the basis of efficiency, cost effectiveness and the productive gains from economic specialization[15]. Bohringer's (2003) commentary on the Kyoto

[15] The converse is the expectation of corrective tariffs were a small group of nations to take on greater

Protocol similarly concludes that "...the implementation rules of emissions abatement should comply with basic efficiency criteria. Most importantly, the harmonization of marginal abatement costs across space through the use of market based instruments." The specific justification of property rights over emissions taxes are in mainstream economic analysis of climate policy secondary to the broad support for putatively efficient market based instruments *per se*. Broad spatial coverage is justified on the basis of the physical properties of long lived well mixed greenhouse gases; for instance "the geographic source of GHG emissions is irrelevant to their climate change impact. Therefore, GHG emission reductions are a global, rather than local, public good and can be traded in a global market" (Gillenwater et al., 2007).

The simplest form of emissions trading scheme, 'cap and trade', creates property rights for a specified quantity of emissions in a given time period and allocates these to the sources of pollution to be regulated. They are allowed then to trade freely between themselves to the point that at reckoning they each hold as many permits as they have produced pollution. Abatement decisions are directed at the level of the regulated entity, be it state, firm or individual, by the price signal present in the emissions market either directly or as an opportunity cost of not selling permits held. There are many analysts who would subscribed to Ellerman's position and Hansjurgens, in the same volume, summarises the economic, political, and physical rationale for this kind of instrument (Hansjurgens, 2005, p223–226)[16]:

Abatement costs vary substantially among emissions sources so that market oriented instruments, including emissions taxes, present theoretical advantages over uniform standards. This is especially great when the diversity of source activities and the differences between industrialized and developing economies is considered.

Existing regulation is absent in most jurisdictions so that participants in trading schemes have substantial flexibility in the means of achieving abatement.

Damage costs are uncertain and there is reason to believe that the potential response of the climate system has damage thresholds and positive feedbacks.

Introduction of trading is politically feasible because allocation rules can be set to secure the support of vested interests and industry lobby groups. Although

carbon price and attempt to protect domestic industry from competitors in unregulated nations.

[16] I do not attempt here to provide an appraisal of the strength of each argument only a brief presentation.

auctioning is theoretically superior the *real politik* is that incumbent polluters need to be compensated for the imposition of new regulation.

Efficiency in innovation trading provides incentives to stimulate innovation continuously and maintain dynamic efficiency in a way taxes and standards do not.

Relevant pollutants are measurable especially carbon emission through fossil fuel proxy accounting so such schemes are easy to implement. Greenhouse gases can be compared in carbon equivalents although their measurement may be more difficult. The administrative level of implementation should be decided on the basis of transaction costs and enforceability.

Relevant pollutants are uniformly mixed and long lived so that 'hot spots' do not form and the location and time of emission are insignificant. Abatement can therefore be reorganized by market participants to occur at the lowest cost time and place.

As should be apparent from the discussion of economic analysis of climate change in section 2.3, many of these arguments do not apply uniquely to emissions trading or the creation of property rights. Indeed, proponents of a carbon tax or a similar set of Pigouvian instruments would also appeal to the efficiency of the price mechanism, necessity in a regulatory void, and the physical characteristics of the pollutants. Mainstream neoclassical analysis of the pros and cons of these two instruments usually emphasizes their equivalent ability to achieve optimal or least cost emissions reductions under idealized conditions. If uncertainty is admitted, then in theory price (tax) instruments will be more efficient than quantity instruments (trading) if the marginal abatement cost curve is considered to be comparatively flat in relation to the marginal social benefit curve and vice versa if it is steeper (Weitzman, 1974). Hepburn (2006) argues on this basis that unless we are on the threshold of a 'tipping point' then a price instrument, such as an internationally harmonized carbon tax, would be superior to a quantity instrument. If there are extra emissions in the short term then they contribute little to the problem overall and can be remedied by an increase in the tax and consequently abatement in the future.

Richard Sandor, founder of the Chicago Climate Exchange, the world's first greenhouse gas trading exchange (CCX, 2010), places greater emphasis on the incentives for agents in his justification of emissions trading especially those of the entrepreneur to generate profits from the demand for the new commodities (Sandor

et al., 2002). He describes the history of market institution development as being initiated by capital as structural changes cause demand for investment in a new sector. This is followed by the standardization of a commodity and the development of the legal means of assigning ownership. Climate policy, until recent times, was predominantly the domain of nation state regulation and supra-national regime formation (Bulkeley, 2005) but Sandor *et al* illustrate the diversity of organisations and scales of interaction that characterized early greenhouse gas trading (Sandor et al., 2002).

However, in making a historical-political argument around the driving force for the development of market institutions, namely demand for capital, there is not a clear explanation why systems of taxation and subsidy were not similarly able to direct capital. Those who adhere to a 'government failure' model of economic regulation are wary of the opportunities for rent seeking that the allocation of emissions property rights or the collection of tax revenues provide. However, in the absence of an ultra libertarian common law and liability framework, all market based policies involve a central coordinating bureaucracy that may or may not be subject to these concerns which only empirical demonstration will distinguish. Indeed, the opposite may well be the case as revenue raised by environmental market based instruments, including auctions of emissions permits, may provide other benefits as Hepburn (2006) details:

1. Revenue recycling can be used to reduce other distortionary taxes (such as on labour) and increase welfare indirectly. This is a case for revenue generation *per se* and against grandfathering. Pigouvian taxation would also realise this 'double dividend' (Goulder, 1995).
2. More efficient regulation as it avoids incentives to distort emissions baseline e.g. by increasing an output used as an allocation proxy.
3. Starts from basis of the polluter pays principle, allocating rights to a clean environment to the public represented by the state in the first instance.
4. Rents from grandfathered permits would accumulated with shareholders of beneficiary firms who typically represent the richest members of society (Bovenberg et al., 2005).
5. Revenue raising is conspicuous, focusing public and regulated parties' attention on the policy and its broader objectives.

These arguments apply across a number of institutional scales, according to whether the revenue raising is taken to be local, national or international. However, a dis-

tinct feature of property rights systems is that the majority of financial flows from trading activity are not public revenues but are directed by the price mechanism rather than a bureaucracy. This is most often interpreted as providing the benefit of the efficiency and information processing attributes of the market institution. In the context of contemporary climate mitigation, it is also often noted that i) these are flows of private economic resources and ii) they may occur from rich northern economies to the global south as support for investment in mitigation in areas with limited capital. Links to the developing world are cast as both efficient and benevolent (Stern, 2006, Chapter 15). However, given that this is a substantial distributional concern it is apparent that there will be resistance from agents who feel their interests jeopardized, be they states, sectors, firms, civil society groups or individuals, and mainstream economic theory has little to say on the matter. For this reason, amongst others, trading systems that begin with a cap are politically charged at the level of international regimes. Understandably, developing nations consider the introduction of the economic burden of abatement costs on their industrial activity to be a regressive and unjust requirement, especially if it is not matched by meaningful commitment to reductions from rich economies. Chichilnisky and Heal (1998), whilst supporting a greenhouse gas trading system, argue contrary to Coase Theorem that efficiency and distribution are inseparable as a benign climate is a public good, and that marginal utility of consumption decreases with income. Indeed, the European Union opposed the introduction of emissions trading between nations during the development of the UNFCCC Kyoto Protocol on the basis that rich nations ought to demonstrate leadership by initiating domestic reductions rather than buying reductions from overseas (Sorrell & Skea, 1999, p365).

There is also the assumption in much of the economics literature that the specification of appropriate property rights is a straightforward process and that the problem of climate change mitigation is undoubtedly amenable to being framed in terms of commodification. The deleterious effects of greenhouse gas releases are indeed felt across a wide spatial and temporal scale rather than at the point of emissions and so do not cause 'hot spots' of environmental harm. The UNFCCC Kyoto Protocol identifies a basket of six gases as meeting the criterion of being long lived and well mixed; CO_2, CH_4, N_2O, SF_6, PFCs, HFCs. These represent the majority although certainly not all of the agents responsible for radiative forcing (see for instance fig 2 from IPCC AR4 WG1 chapter 2). Of course, the social means and consequences of commodification are a central part of the critique of market governance offered by

Marxian political economists (Bond, 2008).

Within the emissions trading paradigm there are a number of possibilities for organizing the institutions themselves. 'Cap and trade', permit based systems are the most discussed and theorized, as above, but the empirical focus of this thesis are the credit based systems, such as the Clean Development Mechanism (CDM) and various voluntary institutions, that allow for the integration of economic agents based in uncapped economies or sectors. Briefly, in these institutions, property rights are created on the basis of a defined project achieving a specified environmental performance standard. The credits generated for 'over-compliance' can then be traded with other entities failing to meet their particular performance standard.

The CDM was explicitly designed to reduce the costs of compliance with the Kyoto Protocol for the rich nations and direct foreign investment, expertise and technology to developing economies (Grubb et al., 1999). Primarily adopted as a component of corporate social responsibility, voluntary institutions provide a pseudo carbon price to participating organisations and individuals both on supply and demand side of exchange. There are two aspects to the economic justification for credit schemes; i) there are substantially differing energy efficiencies and hence marginal abatement costs between participating entities and ii) market incentives will find lowest cost reductions and minimize bureaucratic losses (Jackson et al., 2001, p38). Whilst there is a substantial environmental economics literature on climate change broadly (see above and Heal, 2009) empirical work on the crediting model of emissions trading is available but limited. Brechet and Lussis (2006) perform a marginal abatement cost partial equilibrium analysis that under their reference assumptions suggests that Belgium could achieve 83% of its abatement overseas through the purchase of CDM and JI instruments at a 2010 marginal carbon price of US$6.9 per tonne. They also trumpet the affordability of such a strategy, concluding that it would reduce total abatement costs by an order of magnitude echoed in other similar work (Chen, 2003; Anger et al., 2007; Blyth et al., 2009). More recently the UK Department of Energy and Climate Change (DECC) has developed an econometric model, GLOCAF, to estimate the price and availability of offset credits under particular circumstances, to aid national planning and to inform UNFCCC negotiations (CCC, 2008, p164).

To summarize, the mainstream economic account of and justification for market based instruments for climate change mitigation is centred on realizing cost effectiveness in abatement. Key points of distinction and disagreement between schools of thought relate to the possibility of achieving a theoretically optimal degree of

abatement and allocation of effort in the global economy. Discussions of the relative benefits of a Pigouvian tax over property rights approaches relate predominantly to the structure of uncertainty in costs and benefit functions and political economic and institutional economic aspects of the systems that are absent from this theoretical framework. Returning to the questions set out in Chapter 1, if we are to learn more about how emissions trading institutions operate and what the consequences are for climate change mitigation, we need a theoretical framework that places the institutions themselves at the forefront of analysis and considers agents' behaviour to be shaped by the institutional context. These systems undoubtedly deserve economic analysis, in the substantive sense that they relate to the material provisioning of society, but there is also the need to consider more fully the social and biophysical processes the commodification process envelopes. Whilst some environmental economists opine that their arguments are insufficiently realised in environmental policies (Pearce, 2002; Helm, 2005), the next chapter details alternative perspectives that are critical of reductive formal analysis and the impacts of policies based on its prescriptions.

3. Neo-Polanyian Perspectives and the Instituted Economic Process Framework

> The instituting of the economic process vests that process with unity and stability; it produces a structure with a definite function in society; it shifts the place of the process in society, thus adding significance to its history; it centres interest on values, motives and policy (Polanyi, 1957, p249–250).

The neoclassical framework at the centre of environmental governance through market based instruments purports to explain the functioning and underlying structure of economic phenomena. Price, the behaviour of agents, the meaning of welfare, the format of a commodity, the nature and transmission of information and a raft of other phenomena are deployed conceptually and either explained internally by deduction or specified in assumptions and preconditions. This section outlines an alternative, and it will be argued superior, framework that maintains economic activity as its central focus but adopts a different conceptual apparatus. The origin is in the economic history and anthropology of Karl Polanyi where the idea of 'the economy as instituted process' is first used to explain the variability within and between actually existing economies (Polanyi, 1957, Chapter 13). In *Trade and Market in the Early Empires* he develops the argument that the substantive economy, the social process of meeting material want satisfaction, is variously instituted in different times and places. Although superficially similar to the varieties of capitalism literature (Hall & Soskice, 2001; Mikler, 2009), neo-Polanyian work emphasises the way economic activity is dynamically instituted in relation to other social, legal and political institutions and the dynamics of variation rather than primarily providing a static taxonomy (Ramlogan & Harvey, 2003). The instituted economic processes

(IEP) framework[1] is oriented towards institutional considerations rather than predominantly firm (agent) centred explanations as the varieties of capitalism literature (Hall & Soskice, 2001, p6)[2] and is much more comprehensive in the types of economic processes that are conceptualised. This wider frame of reference is profoundly different to the axiomatic, isolated, essentialised capitalism of classical and neoclassical economic theory.

Institutionalisation as a process ranges in explicitness from legal codes to social norms, stability from a matter of years to centuries, and scale from a household to a transnational institution, including the possibility of a given agent interacting in multiscalar economic processes. These features of variation exist within different processes and indicate the necessity of careful and specific analysis of, for example, end product markets, labour and employment patterns, price formation, innovation and product standardisation. Accordingly, processes of innovation can be seen not only in terms of knowledge dynamics or intra-firm technical change but also through the reconfiguration of whole supply chains, novel producer-consumer interactions, or the result of particular exchange structures such as multiple monopsony (Coombs et al., 2003). This attention to variety and process has substantial implications for analysis of economic change and growth, richly illustrated in Harvey's work on innovation, competition and distribution in UK food retailing (Harvey, 2000). The following section will detail the IEP perspective and illustrate its utility in examining market processes through the lens of 'the organisation of exchange'. However, it is first it is useful to briefly précis Polanyi's foundational contribution.

Across his academic corpus, Polanyi's intention is to explain the arrangement and integration of economic activity in its own historic and geographic circumstances, rather than formulating universal economic 'laws'. From this rather modest initial theoretical starting point his best known work, *The Great Transformation*, proffers an explanation of the socio-economic breakdown that lead to the rise of fascism and communism culminating in two world wars. He cites four institutions that were at the heart of 19th century Western civilization (Polanyi, 2001, p3):

1. The balance of power system that lead to the Hundred Years' Peace
2. The gold standard, an unprecedented economic institution extending the mar-

[1] The change of emphasis from Polanyi's original 'economy as instituted process' to Harvey and Randles' 'instituted economic process' is considered later.

[2] This is not to say Polanyi provides explanation in terms of structurally determined action but rather that institutions as objective structures generated by intentional agents are the focus of analysis.

ket system internationally

3. The self-regulating market, which was the dominant of the four
4. The liberal state, constructed in support of the self-regulating market

The self-regulating market in Polanyi's framework is a particular mode of economic integration. Integration implies that there is a matrix of interdependent social and economic systems that mutually conform with one another; a more complex and consolidated set of circumstances than a simple multiplicity of exchanges. In Polanyi's terms, recognisably economic processes occur under all social configurations and modes of integration. Drawing on examples from the Trobriand Islands, Dahomey, Hellenic civilisations and English post-medieval history he identifies three distinct patterns of integration that structure economic processes and are echoed by other social institutions rather than remaining as isolated actions (Polanyi, 1957, p251):

Reciprocity between symmetrical economic agents, such as households or kinship groups, not limited to two parties but engaging in reciprocal, non calculative behaviour. Standards of 'equivalence', for want of a better word, are not formally set and maintenance of the pattern is by social disapprobrium rather than strict enforcement of one kind or another.

Redistribution via an 'allocative centre', an authoritative institution of some sort, such as monarchy, church or nation state. Goods are collected, physically or conceptually, and reallocated via custom, law or central authority. For example food sharing after a hunt or through systems of collectivised grain storage.

Exchange agent to agent through price making markets, with supportive institutions of individuated agents and distributed property rights. Price making markets are only regarded as integrative in so far as prices propagate between commodities and have wider indirect effects. Historically Polanyi describes how trade has been diversely instituted, often with restrictions on the types of goods that may be exchanged, the identity and status of participants in exchange and the spatial scales over which circuits of exchange operate.

These forms are not mutually exclusive within a given society. For example, as Polanyi notes "Reciprocity as a form of integration gains greatly in power through its capacity of employing both redistribution and exchange as subordinate measures. Reciprocity may be attained through sharing the burden of labour according to definite rules of redistribution as when 'taking a turn"' (p253). Each form has corre-

sponding modes of social integration, such as the household, monarchy and market society[3] respectively, and Polanyi is emphatic about these broader institutional preconditions that are required for a particular mode to dominate economic activity in the substantive sense. This is central to the main thesis of *The Great Transformation*, which is presented in contingent historical terms but explained by appealing to the ontological reality of institutions. He argues that the self-regulating market required an unprecedented rearrangement of wider aspects of society and culture to create a *system* of price making markets. Market rationality then came to dominate the organisation of human society "...together with the surface of mother earth, which could now be freely marketed, into industrial units under the command of private persons mainly engaged in buying and selling for profit" (Polanyi, 1977, p9, cited in Cangiani, 2003). It is this resulting economic arrangement that Polanyi considers to some extent "disembedded"[4]; the material provisioning of society, no longer organised by social institutions with other non-economic functions and socially defined rationalities, becomes to the greater extent dominated by prices and self interested behaviour. Where economic production may have previously been conducted within a family unit, overlaid with other responsibilities and motivations, in the market society the attitudes of individuals, preferences in mainstream economic terms, became oriented around a self-centred economic rationality. "A whole culture— with all its possibilities and limitations—and the picture of inner man and society induced by life in a market economy necessarily followed from the essential structure of a human community organised through the market"(Polanyi, 1977, p10, cited in Cangiani, 2003). To this end, Polanyi preferred the term "market society" to capitalism with its rather opaque foundation of "value in motion" (Block, 2003).

A transformation to an entirely self-regulated market and creation of an autonomous

[3] Polanyi infrequently uses the term capitalism.

[4] Polanyi also insists that complete separation is an impossibility (2001, p205) and this has been developed further by Block (2003) in the notion of the "always embedded market economy". Krippner and Alvarez (2007) discuss different interpretations of the contradiction between Polanyi's historical description of the late 19th century British disembedded market society and his theoretical presentation of the double movement. Peculiarly, despite his own limited deployment of the term, Polanyi is often associated with the concept of embeddedness (Randles, 2003; Harvey et al., 2007). Typically, he is cited alongside Granovetter's celebrated paper (1985) invoking embeddedness as a supplement to mainstream economics and interpreted as the social connectedness of individual agents. This is to overlook his very different conceptualisation of the economy and economic activity, where (dis)embeddedness is a property of institutions not individuals (Harvey et al., 2007). The development of the factory system during the industrial revolution demonstrates the complexities of "disembedding"; a novel institutional configuration of wage labour, flows of natural resources and exchange of money, whose theorists aspired to self-regulation through the market system but saw how much remained attached to socio-political institutions.

economy with a complete separation of economic activity from social institutions could never be achieved. Polanyi argues that the consequences of freely fluctuating prices having such power over man and nature "implied a stark utopia" (2001, p74) which caused great material suffering for some, reduced social cohesion, increased personal insecurity and diminished solidarity. This stimulated reflexive social protection, through institutions such as the Speenhamland Law, which in turn caused economic incoherence, impairment of market function and further social disruption (Polanyi, 2001, Chapter 7). He termed this tension, between the social and institutional resistance to market outcomes and the internal tendency of market society, its agents and ideas, to further conform itself to market rationality, the double movement. Randles (2003) argues that this concept is inherently 'open' given Polanyi's insistence on contingent institutional situations whilst Harvey, Randles and Ramlogan (2007) link the double movement into his conception of specifically economic processes and their place in society (emphasis in original):

> Embedded does not mean social *as against* economic. Economic processes do not become less economic when they are embedded, or more economic when disembedded. So also, 'disembedded' does not reduce to 'self-regulated'. Even less does 'market-economic' equate to 'asocial economic'. In the light of later works, it is therefore implausible to have an interpretation of the 'double movement' as a to-ing and fro-ing between embeddedness and disembeddedness. The double movement makes more sense, in this retrospective re-fashioning, as a dialectic of regulation and de-regulation within a historical process resulting in differentiated modes of economic governance as a particular domain within contemporary governance structures (Harvey et al., 2007, p11).

As such, there are various possible interpretations of causality and consequence of the double movement in market societies; i) the emergence of market restraint and social protection through state regulation ii) strategic co-construction of regulation, directed by market participants in their own interests, endogenously and iteratively, and iii) regulation led market construction either from the state to achieve a particular objective or by proto-market participants prior to the creation of demand and market activity. These are themes that will be drawn upon substantially in the later empirical chapters.

Polanyi's theory stands against both laissez faire market liberalism and orthodox Marxism (Block, 2001, p xxix); on the one hand he shows how formal economic

ideals are impossible utopias but on the other hand he opens the possibility of market exchange structured by democratic institutions. However, he recognised that the freedom that any given society has to determine its own fate is restricted by the institutional milleu it sits within. In chapters 2 & 3 of *The Great Transformation* Polanyi uses the gold standard to illustrate the limited political options that any national government faced in the protection of its peoples' interests, one consequence of which was the rise of fascism which dissolved both market liberalism and democracy. The gold standard had been instituted to provide security to the financial sector in its investments and dealings overseas, by guaranteeing that participating currencies would have a common basis and hence value could be circulated freely. It institutionalised a transnational interest in peace and stability. However, in operation it also provoked border tariffs to protect currencies and domestic economies from trade deficits, deflation with associated uncertainty for the business community and substantial fluctuations in income for the workforce. These acts fuelled the imperial rivalry of Britain and Germany, as colonial economies became necessary to supply material resources and subordinate trading partners of sufficient scale to pacify domestic class tension.

The concept of the fictitious commodity complements the notion of the double movement in *The Great Transformation's* explanatory framework whilst also representing a normative position. For Polanyi, commodities were characterised as things produced for exchange and it was apparent to him that land, labour and money were qualitatively different entities. Their subordination to markets, in classical theory and 19th century actuality, relied upon a fiction that was inherently inappropriate and unstable. This instability is revealed also in the complementary side of the argument, that real commodities are produced for exchange and instituted as such. Under these arrangements, economic activity is no longer production for use within the household or village but for integration into wider processes of circulation of goods. As a result, wage labourers become dependent upon and hence vulnerable to larger scale socio-economic dynamics than in other modes of economic integration where more local phenomena dictated their fate. With respect to the commodity fiction of labour, Polanyi writes:

> Labor is only another name for human activity which goes with life itself... nor can that activity be detached from the rest of life, be stored or mobilized... Nevertheless it is with the help of this fiction that the actual markets for labor, land and money are organised... To allow the

> market mechanism to be the sole director of the fate of human beings... would result in the demolition of society. For the alleged commodity "labor power", cannot be shoved about, used indiscriminately, or even left unused, without affecting also the human individual who happens to be the bearer of this peculiar commodity (Polanyi, 2001, p74–75).

Land, or nature, similarly does not readily conform to the market model, due to its own autonomous dynamics and its inevitably incomplete incorporation into the market. Empirical consideration of money systems, invariably issued and guaranteed by the state, itself a political institution, reinforces Polanyi's claim of the inseparability of economy and society (Block, 1994; Polanyi, 2001, p205). Exchange money is not a commodity like any other but is a specifically economic institution. Its unique properties create new possibilities and problems. Of the gold standard period, Polanyi writes "In contrast to men and goods, money was free from all hampering measures and continued to develop its capacity to transact business at any distance at any time. The more difficult it became to shift actual objects, the easier it became to transmit claims to them" (Polanyi, 2001, p215). As money was transferred into an autonomous market, such as was the intention of the gold standard regime, it destabilised all other exchanges. This had such an influence over productive activity that the consequences were inevitably socially intolerable. The financial imbalances created between nations could not be solved by the self-regulating market so political, and in these circumstances violent, resolutions were required.

In Polanyi's analysis, the subjugation of labour, land and money to market rationality could only lead to social and ecological breakdown because the systems which produced and regulated them were incompatible with the isolated and calculative dynamics of a self-regulating market system. It is with this framework that he explains the dynamics and history of England through the nineteenth century and accounts for the subsequent world wars. Recently, Polanyian themes have been used in contemporary discussions of neoliberalisation and environmental governance generally (McCarthy & Prudham, 2004; Peck, 2008; Castree, 2008a) and specifically considering labelling and ethical consumption (Guthman, 2007; Hughes et al., 2008), environmental accounting and quantification (Lohmann, 2009), natural resource management (Mansfield, 2004) and water privatization (Bakker, 2005).

3.1. The Instituted Economic Processes approach

The IEP framework is a theoretical approach that draws on Polanyi's insights and has been used variously to examine the structure of UK food retailing (Harvey, 2000), the dynamics of innovation (Coombs et al., 2003), the organisation of call centres and their relations to other economic institutions (Glucksmann, 2007), the organisation of exchange in general (Randles & Harvey, 2002), the genesis of mobile telephony in the EU (Mina, 2003), multiple aspects of food technology, production, distribution and consumption using the tomato as an "empirical probe" (Harvey et al., 2002), mergers and interdependent markets (Randles, 2002) and transformations of economic structure more broadly (Harvey & Metcalfe, 2004). The central objects of these studies are the socio-economic institutions that structure economic activity and how they vary over time. Process and change are key; as organisations and agents interact they alter both their own characteristics and their patterns of interaction, co-constructing institutions. For instance Harvey, Quilley and Beynon (Harvey et al., 2002) go beyond commodity analysis, such as Appadurai's (1986) that focuses on things only because they are exchanged and only through the lens of exchange. They use the tomato as an example of a compound of bio-socio-economic institutions to probe contemporary capitalism and reveal new insights into its variations and dynamics.

Distinct from other economic theories, the approach does not presume markets or market norms to operate within every economic setting, allowing for thoroughgoing analysis of the public sector's economic activities and the levying of taxes in the first instance. Surprisingly, Polanyi has little to say about technological innovation, the internal dynamics of institutional change and competition in market and non-market settings, yet these are areas where his analytical method has been successfully applied. Randles (2003) presents the case for "Polanyian inspired" work, which extends the theoretical tools within a complementary framework, either on the grounds that many contingent situations were not in existence at his time of writing or in order to correct inconsistencies or fill gaps, such as his own misapplication of the fictitious commodities argument to circumstances where market exchange often does not exist, such as the hiring of labour.

It is within the Polanyi inspired literature that this thesis sits, concerning a topic that Polanyi could not have anticipated and which requires a more detailed meso scale analytical framework than he provides. The following section will therefore present

neo-Polanyian IEP perspectives on; i) dynamics and change in society and the economy, ii) the modern nature-society binary, iii) the characterisation of economic processes, iv) 'the organisation of exchange' as a conceptual lens through which to examine market-type institutions.

3.1.1. Dynamics and change

The IEP approach recognises variation in social integration of economic activity (meta level - see 3.1.3), variation in forms of capitalism (macro level), variation in markets exchange within capitalist systems (meso level - see 3.2) and variation in agents' interactions (micro level). The emphasis on processes is necessary to explain order, stability and homogeneity as much as change, variation and transformation. In circumstances of substantial or rapid change, with the emergence of and stabilisation of new norms, it is more fruitful to consider the process of "instituting" rather than the operation of rigid 'institutions' (Mina, 2003). It is a mistake to confuse economic order as equilibrium, indeed were the conditions for equilibrium to be fulfilled a market institution would serve no purpose. Market institutions are inseparable from conditions of change, pervasive uncertainty and novelty. Harvey and Metcalfe (2004) discuss both Schumpeterian and Polanyian perspectives on markets institutions' influences on structural change; the former considering intra-market endogenous growth and change, the latter broader social change and the shifting boundaries of market institutions. In developing a case study of food exchange and distribution in Covent Garden Market they distinguish Polanyi's unique insight into the historical processes of instituting economic activities and also his oversight on the innovative dynamics of market economies that mark Schumpeter's major contribution. Rather than adopt the evolutionary economics trope of the 'selection environment' they clarify that prevailing patterns of exchange and distribution are "not so much an external selection environment for novel innovations, but the framing internal conditions under which innovation is undertaken" (Harvey & Metcalfe, 2004, p23).

3.1.2. IEP and the nature-society binary

This matter of dynamic co-construction applies equally to the commonly held nature-society binary. In IEP terms the two are not considered as separate realms, each providing a neutral, static environment for the other to operate within, to its own

laws. Whilst not going so far as to invoke a wholly relational ontology, as per Latour Callon and Law's actor-network theory, IEP comprehends the two as mutually interacting causal domains. For example, as human activities alter landscapes for agriculture, other patterns of economic activity, settlement, production and consumption, including 'entirely social' relations such as financial contracts, are affected simultaneously with biophysical phenomena like ecosystem species composition, evolutionary selection pressures, eutrophication and sedimentation. In turn each set of conditions and processes continually remakes the other, realising contingent outcomes. Harvey et al (Harvey et al., 2002, p263) illustrate this relationship in the case of BSE and new variant CJD in the UK food industry of the 1990s. Whilst the behaviour of prion proteins has a biological causality, that they were not destroyed by socio-politically defined sterilisation procedures had substantial economic consequences and was profoundly influenced by lay-expert-state relationships in scientific risk assessment. Ontologically, the IEP framework is critical realist, and takes the position that there is no autonomous economic realm; rather contingent, overdetermined outcomes arise from the interrelations with other domains.

The modern separation of nature and society into separate realms has been substantially examined and deconstructed elsewhere in contemporary geographic literature (Castree, 1995; Harvey, 1996). Ginn and Demeritt (2009) neatly illustrate the epistemic difficulties of the binary through the oxymoron 'natural food'. In practice, all food production and consumption occurs within economic institutions and is imbued with inter-subjective meaning; that some modes of production are deemed sufficiently archaic or traditional to warrant labelling as 'natural' serves only to bring out further social controversies. Harvey, Quilley and Beynon's work on the tomato (2002) extend the the IEP framework into the realm of 'nature' by describing how domesticated plant and animal breeds, Burmese cats or Jersey potatoes for instance, are best understood as bio-socio-economic institutions. Their evolutionary path is shaped both by their material circumstances and artificial selection subject to the varying commercial agricultural practices, household economies, fashions and social norms of what constitutes the right characteristic for an individual organism as a representative of the breed. Horticulture, national cuisines, GM technologies and supermarket retailing can be similarly comprehended.

Although the IEP approach considers institutional variety it does not treat each empirical case as unique or peculiar, subscribing to a wholesale relativism. As detailed in the next section, number of core and specifically economic processes organise the

analysis and provide a framework for comparative studies.

3.1.3. Specifically economic processes

Polanyi's work that forms the basis of the IEP approach considers pre-capitalist, socialist and capitalist forms of economic organisation within the same conceptual framework by defining specifically economic processes and situating them within a wider set of social institutions (1957). Firstly it bears repeating that his definition of the economy is substantivist (see p111) and specifically concerned with the material reproduction of humanity. Secondly, whilst the emphasis is placed on "the economy *as an instituted* process" alternating emphasis with the neo-Polanyian *instituted economic* process framework, this distinction is primarily a matter of scales of interest, macro social patterns of integration versus meso scale processes of institutions, rather than a divergent reinterpretation.

Polanyi argues that historical circumstances present specifically economic processes, that may be more or less differentiated from other social, political and cultural processes. His analysis is primarily concerned with locational movements of physical goods, writing that appropriation and distribution, the processes of goods changing hands and changing place respectively, are the pre-eminent and distinctively economic processes which "Between them, these two kinds of movement may be said to exhaust the possibilities comprised in the economic process" (Polanyi, 1957, p248). This neglect of processes of production and consumption and the immaterial aspects of economic activity is addressed in contemporary analysis (Harvey et al., 2002; Randles & Harvey, 2002). Polanyi distinguishes between different means of appropriation, via physical transaction, or via disposition, i.e. by legal or authoritative decree. As described earlier (p77) the preconditions for economic integration in a given mode include non-economic institutions, in religion and government for instance, which have persistent and widespread effects. Aspects of a mode may be instituted quite differently and with different social consequences. For example, three types of exchange are possible, only one of which is associated with market society; *operational exchange* which is the change in location of goods through trade, *decisional exchange* at an independently set rate and *integrative exchange* at a bargained rate in antagonistic market encounters. Empirically, this latter form achieves economic and social significance as land and food become "mobilized through exchange, and labour [is] turned into a commodity free to be purchased in the market." (Polanyi,

1957, p255). This is not to imply that there is an inevitable temporal sequence, in the manner of Marx's historical materialism; the different modes of integration, reciprocity, redistribution and exchange do not represent stages of economic development and indeed may operate simultaneously.

This anthropological stance disputes the universalist proposition that all trade is market based, and that all money is exchange money. It distinguishes historical instances of trade incentivised by personal gain from trade associated with other social functions, for example as a symbolic act to gain public status or a duty associated with social status (Polanyi 1957 p259). Similarly, different types of money can be identified according to social situation of their use and its economic function. Polanyi specifies three types; *payment money* to meet diverse but non-market obligations, such as a dowry, *standard money* for the equating of different goods in accounts or taxation systems, and *exchange money* for use in indirect market exchange of goods (p265). Each type may be diversely instituted with other norms, for example standard money may operate in both administrated set-price markets and competitive integrative markets. These distinctions are drawn out in the IEP approach by examining the four core economic processes, production, consumption, exchange and distribution, and their institutional context.

Harvey (2007) provides greater clarification. Production is the transformation of the qualitative characteristics of objects and activities by the use of labour and technology. Consumption similarly concerns qualitative transformation but occurs where resources, including immaterial services, are used up so that they can no longer be exchanged. Appropriation and the process of exchange is the matter of ownership, the instituting and transfer of property rights between individual, collective or social entities. Finally, distribution is the movement across space and time of objects and people for economic ends. Whilst being distinct from one another, these core processes are mutually dependent which gives rise to their definition as economic. This forms the basis of a claim to a relational ontology; it is the relations between these processes that constitutes their economic specificity and reality. For example, a cultural or personal leisure activity such as walking a dog, becomes recognisably economic when performed for money and associated with contracts for employment or services. 'Process' also emphasises the concatenation of economic activity over time, in that no single market is self sustaining nor are exchanges unique and timeless. An empirical case such as the simple can of tomato soup might show, for instance, how consumption end markets relate to both social institutions such as domestic labour,

how mass standardisation favoured particular modes of exchange and retail arenas, how the dynamics of innovation depend upon bio-socio-economic production systems and how patterns of spatial and temporal availability themselves dependent upon distribution networks and storage technologies (Harvey et al., 2002, p268). Whilst IEP does not provide a the basis for universal causal accounts, the analytical tools applied *post facto* are able to illuminate economic activity in a unique way.

3.2. IEP and the organisation of exchange

Although founded in economic sociology, the IEP approach has the potential to contribute to analysis of market based instruments for environmental governance, previously considered predominantly by political scientists and human geographers if at all outside of environmental economics. The distinctly economic aspects of these governance structures warrant an economic theorisation. IEP offers a means to better understand processes of commodification in this circumstance, admitting a subtlety and diversity to the possible dynamics of 'the market'. As has previously been noted (p77), exchange processes can be empirically observed to be instituted in a variety of ways. Taking an anthropological approach to Adam Smith's proposal that there is a propensity in human nature to "truck, barter, and exchange one thing for another" (Smith, 1993, p21) Polanyi describes how reciprocal gift exchange is historically the first mode of economic allocation and distribution outside of the village unit. It is on this basis that Dolfsma and Spithooven (2008) refute the NIE claims that "silent trade", and that primitive and universal propensity to "truck and barter", can exist between parties that have not previously been in contact, do not share language and have a very minimal common frame of reference. This substantial disagreement hinges on the importance of oft overlooked non-economic institutions for the conduct of economic activities, in this case language and learning in relation to market exchange.

Randles & Harvey (2002) develop an analytical framework to systematise this diversity and to incorporate non-market exchanges of labour, goods and services in the same terms. Whilst the IEP framework identifies four core economic processes, which cannot be entirely ontologically detached and thus ought not to be methodologically, exchange bears a more substantial theoretical consideration than production, consumption and distribution. Mainstream accounts of market relations typically conform to Weber's basic model of two symmetrical buy and sell crowds,

interacting in isolated, one time, irreversible, unequivocal exchange events Swedberg (1994). However, it is clear that exchange processes cannot be instituted in the same way for all types of market and thus be amenable to the same formal analysis; labour, capital and end-product markets have substantially different characteristics. Randles & Harvey (2002) propose a three step analysis to identify the general organisation of a set of exchanges:

1. *Identify differentiated and separate classes of economic agent between which exchanges occur, and detail the nature of entities exchanged.* Class in this useage means an discernible group of agents with a distinct economic function in common with each other. Mutual dependencies and asymmetries in (diverse) power relations exist at the level of class to class not agent to agent. It is perfectly possible for a given entity to be a member of multiple classes; for example I am currently both a consumer of university tuition and a consumer of electronic goods. These goods are exchanged in quite different markets, arising from quite different instituted processes of separation of the parties to exchange.
2. *Specify interdependence with other classes of agent and of non-market exchanges, e.g. public infrastructures funded by taxation.* The purpose here is to identify the interactions and reliance between instituted exchanges. For instance, sellers in a given market need to purchase inputs to their production activities. Buyers often need to buy a number of goods in combination with one another. These inter-dependencies also concern non-market exchanges such as the education provided by the state and the household reproduction of the workforce Thus it is possible to see how changes to these supportive economic activities may have multiple downstream ramifications.
3. *Describe non-market relationships across an exchange that are economically significant for that institutional circumstance e.g. producer-user interactions, open book accounting and collective bargaining.* This aspect is especially significant in cases where the entity to be exchanged is co-produced or specified by interactions between agents on either side of the exchange. It is this aspect that is closest to the frequent (mis)use of Polanyian "embeddedness" (Harvey et al., 2007).

In addition to characterising the *organisation* of the exchange institutions, Randles & Harvey (2002) propose that the nature of the agents, entities and modalities of exchange can have important economic consequences. Broad distinctions can be drawn between labour markets of labour—capital/employer exchange, intermediate markets of firm—firm exchange, end product markets of firm—consumer ex-

change and financial markets between holders and users of capital. The nature of entities concerned clearly has implications for the organisation and consequences of their exchange; the sale of factory with its workforce and machinery is quite different to the sale of a watch from a market stall. In this way, the IEP approach does not take Polanyi's category of the "fictitious commodity" as essential or universal, instead detailing the ways in which economic fates of land, labour and money are institutionalised.

Further, economic phenomena such as competition are not universal and pre-given. Harvey and Randles offer the example of differentiated models of retailing in contemporary Western economies, from specialist retailers to department stores, shopping malls and novel varieties of distribution through internet sales, call centres and home delivery. Competition in this instance is highly structured on both supply and demand sides so that whole models of retailing compete with one another as much as particular products within a given retail environment. Similarly, examining high pay in the labour market David Bolchover argues that there is a "talent myth" driving corporate remuneration, based upon social norms and structural conditions of work and employment, not idealised market processes (Bolchover, 2010).

Finally, the distribution function of markets which is "an inherent part of the value formation of the commodity" (Randles & Harvey, 2002) is interwoven with the previous two considerations and a key component of structural differences. The processes of exchange and distribution may be very tightly bound in the case of livestock markets or separated into other distinct institutions in, for example, distance selling. Harvey et al (Harvey et al., 2002) detail the transformation of the instituted complex of the Guernsey tomato industry, from small holder producers coordinated by a state marketing board distributing through regional wholesale markets to grocer retailers, to large producers directly integrated into supermarket supply chains. The creation and the allocation of products, varieties of tomato in this case, and of value is shown to be closely related the instituting of production, distribution and exchange.

The variety observed in the organisation of exchange is not a matter of 'market imperfections', as neoclassical theory would recognise them. Rather, it is better seen as an outcome of contingent social and economic processes. This naturally begs the question of what remains of the causal mechanisms identified in both mainstream economic theory and Polanyi's original thesis in *The Great Transformation*? Harvey and Randles are mute on this point, simply denying that labour, land and money

have intrinsic, universal or essential properties that lead to regularities. This is not to say that the approach does not reveal worthwhile insights but that, like actor-network theory, the neo-Polanyian approach is reluctant to generalise between circumstances. It is in no sense a predictive science, adhering to Polanyi's central thesis that the economy occupies a shifting place in society with causality originating in the different processes of institution (Harvey, 2007, p165). The explanatory power of the IEP approach, discussed at greater length in Chapter 4, nonetheless rests in the proposition of real causative mechanisms and the analytical units which constitute them and are affected by them. For instance, with respect to labour markets Randles & Harvey (2002) make insightful comments to the effect that it is the embodiment of labour power that provides the opportunity for workforce unionisation and bargaining, accounts for the non transferability of 'value' arising from education, and places non-market processes at the centre of analysis of labour markets (household reproduction, education and health care funded by taxation). It is through these analytical developments that we can begin to account for the modern welfare state that is absent from Polanyi's work (Harvey et al., 2007).

Whilst not using the "organisation of exchange" methodology explicitly, Mina (2003) identifies neo-Polanyian resonances in studying the formation and standardisation of the European market for mobile phones:

1. Co-existence and co-evolution of market and non-market ('out of-' or 'before-the-market') transactions in the emergence of new economic activities
2. Interactions between public and private agents in determining the form of new markets and commodities
3. Tension between central planning and self organisation in the creation of new social spaces for economic activity
4. Competition is an instituted process itself, rather than a universal feature of all economic activity. Mina argues that one must ask "...especially in times of technological and institutional uncertainty who is competing with whom, for what, by what means and in what way" (2003).

Cases such as this demonstrate clearly how 'economic laws' of supply and demand are a result of particular historical circumstance. Likewise, in examining 'carbon markets', which are without doubt synthetic and conjunctural, the IEP approach invites reflection and explanation of the creation of supply and demand crowds, the definition of the medium of exchange, interdepencies with other economic activities

and the role of different agents in regulation and instituting of the 'self regulating' market.

4. Actor-network Analysis of Market Construction

The sociology of market construction (Callon, 1998c) founded on actor-network theory and New Economic Sociology (NES) (Swedberg, 1997), provides a sophisticated alternative perspective which has already been used to examine carbon trading (Callon, 2009; Lohmann, 2009; MacKenzie, 2009). In this section the ANT sociology of market construction is discussed in relation to neo-Polanyian IEP.

NES and IEP are not alone in acknowledging the failings of neoclassical axioms. Detailed consideration of the market as an institution and of market actors is found in a range of academic literatures. Behavioural economics allows the rationality, preferences and cognitive capabilities of agents to vary (Brekke & Johansson-Stenman, 2008). Similarly, social psychology examines the influence of social context on the behaviour of agents, for example in the formation and expression of self interest, and has been applied in economic contexts (Lewis et al., 1995). However, they say little about systemic, institutional and historical dynamics, maintain the assumption of the individuated agent, and do not contribute to the understanding of the integration of socioeconomic and biophysical systems, a key matter in terms of climate change. Whilst environmental economics attempts to analyse this integration, it does so by maintaining the neoclassical model of *the* market (p52). New Institutional Economics takes mainstream economics away from costless transactions, equilibrium outcomes and the assumptions of complete markets, but maintains the core idea of atomised, pre-given agents with static, known preferences and technological progress that accumulates in the same way as capital. North, Olson, Posner, Williamson, Elinor and Victor Ostrom and related authors provide adjunct theories to the neoclassical paradigm and with the public choice school extend its reach into new areas of social action. Nonetheless, the individual and their actions remain central features of an ultimately reductionist framework. This matter also persists in NES but is addressed by Polanyian IEP approach and the constructivist perspectives

of Callon and related authors. This section concludes by appraising their respective suitability for the research task at hand, namely understanding the construction and consequences of novel carbon trading systems.

4.1. The sociology of market construction

A research programme into market construction has recently been built around actor-network theory (ANT) and the notion of performativity. The theory in ANT is something of a misnomer as it is espousedly atheoretical in its description of concrete social situations, instead providing an ontological framework and methodological direction to approach research problems. In this framework, social structure is not presumed to exist *a priori*; rather particular 'large scale' phenomena are merely micro networks of relations being continuously made, unmade, and extended, identifiable only in retrospect (Barry & Slater, 2002). Performativity is a concept used to describe this continuous contingent process and, in terms of market construction, economics is identified as a performative *technology* that formats market participants relations and actions. "Economics does not describe an existing external 'economy', but brings that economy into being: economics performs the economy, creating the phenomenon it describes" (MacKenzie & Millo, 2003, p108). It is not vulnerable to the criticism of NES that it does not provide causative mechanisms because it denies their presence in the first instance. Like the IEP approach it does not seek to detail an essential capitalism, as Donald MacKenzie outlines:

> The social studies of finance builds upon an argument put forward by (amongst others) the French economic sociologist Michel Callon: that a politics that is simply 'pro-market' or 'anti-market' is wholly inadequate. Markets are plural, and their nature and effects have a great deal to do with their 'nuts and bolts': the details of their design and functioning (Mackenzie, 2007, Clarendon Lectures).

This section will outline the ANT basis for Callon and others' work and then outline the approach and key insights into market construction.

4.1.1. An outline of actor-network theory

ANT is best understood as an ontological position and methodological programme rather than a specific 'theory'. It was developed initially by John Law, Michel Cal-

lon and Bruno Latour in the field of science and technology studies but has since significantly influenced work in organisation and management studies, geography and sociology. This section predominantly uses Castree (2002) as an entry point and *Reassembling the Social: An Introduction to Actor-Network-Theory* (Latour, 2005) for further development.

Latour provocatively dismisses widely held systems of understanding by redefining what society *is*. Rather than being an adjective describing a type of stuff, as for instance in social context, social factors or social science, he argues that *social* should be used to designate a trail of associations between other entities. Whilst accepting that IBM, France, and Maori culture maybe have utility as concepts, he argues that in novel circumstances or where groupings are contested, traditional sociologies are no longer able to simply document actors' accounts of well known types "to impose some order, limit the range of acceptable entities, to teach actors what they are, or to add some reflexivity to their blind practice" (Latour, 2005, p12). The ANT programme, however, proposes that the work of a sociologist is to examine the patterns of associations, the connections between things, which give rise to the world we observe. In this schema, 'social' designates a type of connection (Latour, 2005, p5) and the purpose of a social science is to 'reassemble' society.

The ambiguity in Latour's use of 'social' is deliberate and serves to highlight the heterogeneity of what might be gathered together in a society, rather than presuming to know this from the outset. Groups are best understood as actor-networks of both human and non-human entities that are continuously performed and hence, not static entities at all. Active group formation leaves traces that can be identified as actors seek to enroll others, distinguish themselves from others, perform actions and re-create their identities. With a composite, dynamic identity, entities can only be defined in relation to other entities, rather than *a priori* belonging to natural or social realms.

Action is therefore not interpreted as a consequence of an intentional subject able to act alone, but rather it is a contingent property of a network of relations, hence the hyphen in 'actor-network theory'. As the social and natural are hybridised, priority in explanation and causality must be set aside. Without the transcendental mechanisms of a structure, of society behind the actors, social scientists must pay very careful attention to the circumstances and relations which contribute to a particular situation. Power is an outcome, a relational achievement that must be produced, and locally accounted for. Methodologically exhaustive documentation of the actor-

network continues until explanation is present in the convincing description of the actor-network itself, requiring no underlying, transcendental forces to replace the actors as causative mechanisms.

Latour argues that accounts need to remain 'flat' with a complete sequence connecting from a particular local event to global scales as defined by the particular actor-network. Keenly felt by geographers, a relational account of space is interpreted by Castree (2002) as the replacement of topographical thinking with a topological vocabulary. Form, and consequently formalism, are described as a type of translation allowing transport of agency between sites, information literally being the packaging of an entity into an alternative vehicle for displacement[1]. Latour identifies this formatting as a key feature of "the sociology of the social" in performing a society. This is a strong ontological position; entities or groups do not exist as such and in isolation, it is only though connection that they come into being. As a result, the activity of the social sciences in drawing boundaries ought to be recognised as an agency in an actor-network which can both rarefy and multiply entities (Latour, 2005, p227). This notion of actor-network construction is extended to the philosophy of science and treats 'facts' not as entities in themselves but rather as an extended and complex actor-network. The creation of standards and the discipline of metrology are foregrounded in ANT and are of particular relevance to quantification for emissions exchange (Latour & Woolgar, 1986).

> Metrology puts new objects into circulation. It multiplies realities by creating objects that can be regarded neither as representations of reality nor as the expressions of the social subjects who created them. Reality is not a blank screen onto which social categories can be projected. Metrology creates new objects that make a difference in the world (Barry, 2002, p277).

If the local and the global are understood as a continuous circulation then formatting activities are central. For example the hybrid material, institutional, convention of the reference kilogram masses at the International Bureau of Weights & Measures at Sèvres illustrates "metrology as the paramount example of what it is to expand *locally everywhere*, all the while bypassing the local *as well* as the universal" (Latour, 2005, p229). This activity extends to quasi-standards through much less regimented but no less significant actor-networks typically characterized by "social

[1] Displacement describes the occlusion of the real relations between entities by the presence of apparent static and unitary commodities (Castree, 2003).

explanations". For instance, without reading newspapers or magazines I would not be able to identify myself as an "ecotourist", interpreting my choice of holiday destination as ethical or indulgent, and it is from such traceable documents that ANT descriptions can be built.

4.1.2. The 'Laws of the Markets'

Callon (1998a) makes two substantial contributions to the understanding of market construction that deserve attention in this thesis and discussion in relation to the IEP framework; i) that market economies are constituted by calculative agencies that are not singular actors, and ii) efforts to calculate inevitably and continuously fail to completely enclose all relevant features of the world, in effect externalities are irreducible. He initiates his discussion of markets with Guesnerie's definition that "a market opposes buyers and sellers, and the prices which resolve this conflict are the input, but also in a sense, the outcome of the agents' economic calculation" (1996). This highlights that a) agents pursue their own interests by calculating in order to optimise/maximise, b) agents have divergent interests, so they engage in c) transactions in order to resolve the conflict by defining a price. Callon places calculation, or more precisely *calculativeness*, at centre of his analysis and elides the distinction between mainstream frameworks that assume the ability of agents to calculate and sociological frameworks that place calculation into the realm of institution, habit or cultural history. Both can be discussed in common in the ANT framework by looking at how, what and why particular modes of calculation exist and change through time. Calculativeness is the ability to i) establish possible states of the world, ii) rank them to preference, iii) identify and describe actions to achieve these states. Callon argues that this cannot solely be a property of a human individual, or of a mind in isolation, but requires figures, inscriptions, writing mediums and other tools so in keeping with the symmetrical relational ontology of ANT he introduces the idea of *calculative agencies*, once again disrupting the neoclassical notion of a given utility function. It is therefore not an entirely socially or culturally constructed competence which determines either selfish/calculative behaviours or generous/disinterested behaviours.

This leaves the substantial problem of conditions of uncertainty or worse ignorance, in the sense described by Knight (1921). Callon asks "How can agents calculate when no stable information or shared prediction of the future exists?" (1998a, p6).

The solutions to these coordination problems lie in relations between agents, over and above exchange. For example, contingent contracts through which agents become entangled over time and are no longer able to be strangers engaged in discrete events. Common knowledge, shared points of reference, shared cultures, rules, procedures, routines, and conventions are used to guarantee co-ordination. In the ANT ontology it is not that a network is constructed from pre-existing agents with fixed identities, but rather "everything which might stabilize their description and their being, are variable outcomes which fluctuate with the form and dynamics of relations between these agents." (1998a, p8). Agency derives its logic from the connections and disconnections of its network.

Gift giving is the contrary economic position to calculativeness, an agent engages in economic activity freely and disinterestedly, and Callon uses this to illustrate a key process in economic action. It is a persistent anthropological problem to distinguish between repeated reciprocal acts that if intentionally engaged in would not constitute gift giving, and genuine disinterestedness. Callon adopts Bourdieu's position that it is the time lag between gift and counter-gift that presents a "socially structured amnesia" that distinguishes the two. It is the way that the relationship is framed to enable a return gift to be accounted for or not that places the agent in a calculative or non calculative disposition. The importance of framing extends to other dimensions of economic activity and is prefigured in the mainstream notion of the externality (see section 2.2). Framing includes identifying and defining distinct objects and actors; "In short, a clear and precise boundary must be drawn between the relations which the agents will take into account and which will serve in their calculations and those which will be thrown out of the calculation as such" (Callon, 1998a, p16). Understood this way, a pure gift represents total externalization as there is no calculation performed and nothing taken into account prior to action. Callon introduces the term overflowing to represent the opposite case, or rather the impossibility in attempting to sever all connections and completely frame an exchange. For example, the sale of a car includes the incorporated 'know how' in the object so that reverse engineering is technically possible, the subsequent economic consequences of which are altered by other intellectual property right regimes. Further, efforts to disentangle entities to enable exchange can in fact multiply and make conspicuous connections. Boundary objects (Star & Griesemer, 1989) stabilize these contentious relationships as their plural interpretations connect different actor-networks, but inevitably create overflows. For instance, registers of human body parts for donation

list a great variety of information on life history, sexuality, drug use and other matters deemed salient. Economics itself, with all its internal disputes and methodological variety, serves as a set of boundary objects. Callon et al. (2002) and Slater (2002) advance the discussion of disentanglement/entanglement describing it as both a semiotic-material process and also a legal-contractual process. Whilst there are clear resonances to other Marxian descriptions of commodification, especially through the idea of alienation, Callon situates this as a dynamic process on an analytical continuum as opposed to specifying an essential aspect of capitalism. Examples of these processes are performances of the economy and economic techniques and technologies (Parry, 2008).

From these two positions on the origin of calculative agencies and the persistence of overflows, Callon argues that economics is a performative activity that formats the world that it purports to measure and helps agents to conform to its precepts. Performativity here operates in two senses; the first being the ontological recognition of the continuous repetition of economic and social activity that 'makes' the economy, the second, that which Mackenzie describes as the Austinian sense (2004), describes an utterance that makes itself true. Callon cites the construction of a 'perfect market' for strawberries driven by a young counselor university trained in neoclassical economics as an archetypal example (Garcia, 1986). One might also interpret the development of neoliberalism through a transnational 'thought collective' of academic institutions, think tanks, media, politicians and government officials in a similar way (c.f. Mirowski & Plewhe, 2009). "The economy is embedded not in society but in economics, provided one incorporates within economics all the knowledge and practices, so often denigrated, that make up for example accounting or marketing" (Callon, 1998a, p30). In this way, he treats economics in the same way Foucault treats government, not as a series of knowledge claims but rather a set of discourses and institutional techniques (Slater, 2002). Historically this not a static process; without making any grand historical claims, Callon draws on others' empirical work (Meyer, 1994, Miller, 1998) to argue that the growth of the discipline in academic and practical settings constantly refines its understandings and at the same time enables the society to act more 'rationally' by extending the realm of calculativeness.

The normative conclusions he raises, with a nod to Foucault, are limited; what matters is what counts and hence how society counts, matters. As these processes are not final and irreversible one gets the impression that he is optimistic of the possibility of refinement to suit societies' best interests but with a note of caution that this

requires oversight on the disciplines of metrology, accounting and economics. As the consequences of markets cannot be predicted in advance, their concrete configurations can only be described *'in vivo'* Callon urges caution in their implementation and that they should be constantly monitored and evaluated as ongoing experiments (2009). He takes a similar position with regards to the state. Like the IEP perspective on the necessity of state participation in the setting of standards, rules governing the relationships between employers and employees, currencies, central banks and the like, Callon is concerned with recognising the diversity of configurations that exchange relationships and market societies can take rather than presenting an *a priori* classification and normative prescription. On Fligstein's proposal (1996) that economic globalisation is none other than a hegemony of the market structures of the USA, Callon identifies this with arrangements that specify accountability of the firm to shareholders as the priority relationship, and that it is opposed diversely is a direct result of the constitutive role of the state in the economy and the historical paths that each takes. On Schumpeter, Galbraith and Chamberlin's discussions of monopoly and anti-competitive market structures, Callon responds that these conditions should not be seen as market imperfections but that economic agents make deliberate efforts to avoid simple market framings and attempt to entangle consumers, suppliers and the state in their own interests. Competition in this framework is not a starting point for economic analysis but an historical end point when calculative procedures are established and identities confirmed to the extent that agents struggle to entangle others. Lock-in as an institutional feature, interweaving governance structures, material commitments, commercial relationships and public discourses, is therefore not a degenerate one. Rather, it is a "compulsory companion" of markets and represents a situation of "manageable flexibility" which necessitates closed or lost options but enables calculative activity. Setting the rules of the economic system, including the methods of calculation, is of the utmost significance to agents and allows them to achieve dominant positions by anticipating other agents' actions.

The empirical work that has been inspired by this framework has predominantly been conducted on financial markets. It has been used to address both the implications of a relational ontology and material sociology in trading floors, derivatives pricing, arbitrage and the like (MacKenzie, 2003; Beunza & Stark, 2004; Knorr-Cetina, 2005; Callon & Muniesa, 2005; Beunza et al., 2006; Hardie & MacKenzie, 2007) and, when highlighting the performative role of economics, its has become a sociology of economics as much as economic sociology (MacKenzie & Millo, 2003;

MacKenzie, 2004). The ambiguous role metrology plays in connecting political and economic activities through the "technology of government" has been examined by Barry (2002), particularly the way measurement focuses scrutiny in certain directions, anti-politically, but also reveals awkward "brute facts" that necessitate political attention. Callon's subsequent work on the "economy of qualities" further develops the network ontology with respect to the notion of formatting for exchange (2002). As well as variously situated supply chain literatures that name check the economy of qualities (for example Wilkinson, 2006; Raynolds, 2009), the approach has been substantially operationalised to consider diverse topics. The commodification of human organs of various sorts has been shown to depend upon the unstable connections of various professionals, lawyers, doctors, biochemists, accountants, their trades and technologies such as surgeries, immunosuppressants and transport networks, and dynamic socio-cultural norms (Parry, 2008). Within the field of environmental governance, it has been used to examine an ecological certification scheme for timber products (Eden, 2009), the creation of green consumers of forest products and associated supply chains (Kortelainen, 2008) and the development of tradable property rights for fisheries (Holm & Nielsen, 2007). The market segmentation of sub-prime lending in the USA, whose instability contributed to the present financial crisis, have also been attributed to the calculative agencies, credit scoring systems, associated with the government backed lenders Freddie Mac and Fannie Mae (Poon, 2009).

The performativity approach to market analysis has received robust criticism on a number of levels. Taking the empirical example of the use of game theory in the design of FCC broadcast licence auctions a number of authors dispute the Callonian interpretation of events whose unpredicted outcomes deny the efficacy of economics as a performative technique (Nik-Khah, 2008; Santos & Rodrigues, 2009). Miller (2002) contends that Callon's disentangling required to perform *Homo economicus* is an impossibility, echoing Polanyi's claim that the disembedded economy is an utopian ideal. Fine (2003) argues that the framework lacks causative mechanisms for economic theory to effect material outcomes, without which Callon's position is somewhat tautologous. He highlights the point that economic notions such as capital, class or the necessity of profit are absent from Callon's framework and that these weaknesses are not just analytical issues but hold normative significance for the ability of social science to challenge the hegemony of rational choice models.

4.1.3. The construction of carbon markets

Much of the academic literature examining carbon trading has been policy specific with little formal theorisation (e.g. Haites & Yamin, 2000; Jotzo & Michaelowa, 2002; Asuka & Takeuchi, 2004) or come from either mainstream economics (e.g. Ekins & Barker, 2001; Newell et al., 2005; Georgopoulou et al., 2006; Grubb & Neuhoff, 2006) or political science studies of the international environmental regimes they contribute to (e.g. Barrett, 1998; Kim, 2001; Repetto, 2001; Boehmer-Christiansen, 2002). Economic sociology, of any description, has paid little attention to these new markets, save for a few notable ANT papers. Lohmann was first to operationalise Callon's ANT treatment of externalities to analyse the creation of novel carbon markets (2005). MacKenzie (2007; 2009), Callon (2009) and further work by Lohmann (2009) have extended analysis of the Kyoto flexibility mechanisms and EU ETS within this framework. The central themes are the means of commodification as simultaneously material and social, for instance the apparatus of hydrofluorocarbon (HFC) combustion and the mathematical expressions of global warming potentials that contribute to the construction of CDM credits, and the instabilities in the framing processes in the "hot" situations that are pervasive in nascent market institutions. As Lohmann (2009) remarks, this emphasis on framing "Instead of focussing on imagined pre-existing or intrinsic properties of environmental objects and agents, it focuses on what produces and sustains the objects and agents." Similarly, Powells (2009) identifies "emergent marginalisation" in UK as new measurement and financing regimes are created with the stated policy goal of reducing emissions and alleviating fuel poverty. Examining the UK's Energy Efficiency Commitment (EEC) he presents an example, echoed in other work on the 'new carbon economy', of the disentanglement/entanglement of particular events so that they can be transacted in novel commodity forms.

4.2. Comparison of theoretical frameworks

The central task of this thesis is to examine a particular type of market based instrument for climate change mitigation. As outlined in the introductory chapter, there are profound political, economic and ethical dimensions to the governance of the means, rate and location of changes to emitting activities. Markets for 'carbon commodities', like voluntary offset credits or CDM Certified Emissions Reductions

(CERs), are denominated in tonnes of carbon dioxide equivalent (tCO2e) but they are not markets in physical entities, i.e. natural preexisting 'things' that are external to society. Actual volumes of greenhouse gas emissions are related in some way to the instruments being traded, but the commodity form is itself a convenience, a way of comprehending, organizing and distributing responsibility for pollution (permits) or abatement efforts (credits). Broadly defined, carbon offsetting is a redistribution of emissions reduction efforts via an economic transaction; GHG reductions made by one actor, be that a nation, industry, corporation or individual, are sold to an unrelated actor to defray their expectation or commitment to emissions reduction. The nascent carbon markets enable these transactions by providing a set of institutions, represented by credits and allowances, to structure this exchange.

The analytical framework outlined in chapter 2 is the intellectual genesis of these institutions, so one might assume that it would be an appropriate starting point for the detailed empirical work in this thesis. However, mainstream approaches also concern themselves primarily with idealized activity *inside* the market institutions but have little to say about the inevitable and critical social and political milieu that *they are the result of*. As Cangiani succinctly puts it "economists worry about the quantitative rates, the relative prices of commodities, but do not perceive the price system as a system of social relations, as a social structure" (2003). The mainstream rationale also assumes a great deal of homogeneity and determinism in both social action and natural systems. There are substantial critiques of these modes of analysis regarding other economic phenomena, so a skeptical approach seems appropriate given the novelty of the institutions and diversity of systems within which they interact.

The political economy presented in chapter 3 and the ANT in this chapter, are both critical of the neoclassical assumptions that pervade the environmental economics and NIE paradigms that inform carbon market development. Both provide reasons to doubt the efficacy of the neoclassical approaches in addressing ecological concerns but present their critiques in different ways. Institutionalist and substantivist perspectives object to the reductionism and empirically false assumptions required for such analysis. In contrast, the ANT approach seeks to answer the question of how the rational economic behaviour proposed by theory may actually be achieved in practice (Slater, 2002). For Callon "*homo economicus* really does exist" (1998a, p51) but he must be accounted for. Despite Swedberg and Granovetter's exhortations for NES to return to Durkheim's traditions and examine central features and processes of the economy (1992), in its elaboration it has tended to be supplemental to the

neoclassical rational actor model and implicitly adopt much of its framework and analytical units. It has been content to elaborate extra-economic, contextual issues of networks and culture even as networks were cited as "proto-institutions" their full critical force was not realised (Peck, 2005). The substantial problem with both NES and ANT descriptions of market construction is that whilst they purport to describe and explain economic phenomena, neither presents a convincing body of distinctively economic theory. From an opposing starting point, the anti-essentialism of the ANT project can lead one to ask just what is 'the economy' in Callon's framework. The implicit answer is that it is whatever economics measures and defines as the economy, the clearest illustration of this being Mitchell's insistence that 'the economy' did not exist until the 1930s (2008). The result is a very open definition:

> The economy is better seen as a project, or a series of competing projects, of rival attempts to establish metrological regimes, based upon new technologies of organization, measurement, calculation, and representation (Mitchell, 2008, p1120).

Whilst acknowledging efforts that market participants make to entangle other actors to enable calculation, Slater argues that it is alienability, one result of successful framing, that is the distinctive feature of market exchange (2002). It is perfectly possible for all manner of attachments to the entity exchanged to persist, indeed externalities illustrate the failings of framing, the distinctive feature of markets is that buyers and sellers 'are quits' at the point of exchange. Slater goes on to emphasise the instrumental rationality that buyer and seller in a market setting pursue because they are made into strangers by the legal and institutional framing mechanisms. However, this argument does not adequately deal with social network accounts of the empirical persistence of familiar relationships existing in tandem with exchange and Callon's own notion of overflowing that is presented dialectically with framing. If framings and boundaries are taken as permanently unstable, ambiguous and the site of political struggle, how is complete alienability achieved and if not how do we recognise market from non-market, economic from non-economic? In short, Callon's approach tends to dissolve 'the economy' into society and replaces it with calculability[2].

This raises further uncertainties. Does calculability mean only recognising and considering, or does it require full commensuration or indeed fungibility? Take the

[2] Callon's selection of commercial externalities and market relationships for further theoretical elaborations seems quite arbitrary (1998, p246).

example of a car which causes pollution that is not recognised by its driver until it is 'calculated' by local government pollution monitoring (Barry, 2002). What does it matter from the ANT perspective that a fine may be issued, the vehicle seized, the driver 'named and shamed', banned from driving, or imprisoned? Arguably all could have financial costs attributed through another calculative process but it is not clear that they are in any sense 'economic' activities or that we should interpret driver behaviour economically. As a result this approach steers worryingly close the the totalizing economics of Robbins (1935) and Becker (1976) that seeks to define the domain by its rationality.

A second concern is that the constructivist ontology of ANT that underpins Callon's account of economic activity disavows persistent social structure and so does not attempt to provide an historical explanation of economic development and social change outside of specific contingent configurations. Whilst this approach might be revealing of particular issues and moments in the deployment of carbon markets, it is not clear how aggregate behaviours might be understood and these are central concerns given the global scale of climate change and fervent ambition of carbon market promoters. Although ANT offers a thoughtful critique of theories appealing to stable object-identities, 'classes of agent', underlying tendencies and transcendent mechanisms to explain social action (Latour, 2005), it is not entirely convincing. O'Neill defends essentialist discussions of the market and market economies from contemporary accounts of contingency, specificity and variability in the institutions, networks and agents that constitute them (1998, p7–15). He argues that both critics and supporters of markets, Marx, Hayek, Neurath and Mises for instance, have appealed to some consistent features within a realist ontology based on empirical observations. Essential properties are seen as those that an object must possess in order to be recognised as a particular kind of object, whilst there are accidental properties that it may also possess but do not detract from it being a particular kind but neither are they necessary. Objects may have prerequisite conditions, supporting institutions in the case of markets, that are necessary for their realization but that does not undermine the possibility of essential features. Nor do markets necessarily exhibit universal outcomes if one recognises the possibility of dispositional properties, that an object possesses but are not realised in all circumstances. O'Neill argues that institutional variety does not mean that markets do not share any common features at all and that the analytical category is not useful. Moreover, essentialism should not be regarded as synonymous with uniformity (1998, p12). If some theorists make

universal claims that turn out to be false that is a failing of the claims themselves, not the possibility of essential underlying properties. He concludes that it is on this empirical basis that essentialist explanations ought to be examined, but not dismissed *tout court*. It may well be that there are differences between actual markets but that comparison is possible and it is scientifically productive to distinguish superficial difference from systematic similarity.

There are certain similarities between the IEP and ANT approaches to economic analysis. Indeed, Lohmann's work on carbon markets has drawn on Callon and Polanyi in turn (2005; 2009). Randles' and Harvey's (2002) attention to variation and specificity in the institutionalisation of economic activity is at first glance congruent with Callon's regard for calculation and the continuous framing and overflowing that enable market exchange. The diverse and dynamic, asymmetries, dependencies and relationships highlighted in the first, map onto the performative (generic sense) framework of the second. In both cases they require the researcher to recognise what is stable, what is dynamic and what is significant about the identities, rationalities and relationships within a given case rather than making *a priori* assumptions. For example, the concept of fictitious commodities is incompletely developed and not entirely convincing because of the universal explanation and binary categorization of real and fictitious commodities that Polanyi presents. However, the arguments for an entirely relational ontology seem weak whilst there are critical realist approaches, aware of the issues raised by actor-network theory and sensitive to the contingencies of actually existing capitalist relations that maintain real transcendent mechanisms in explanation (Castree, 2002). The concepts proposed by the IEP framework, including classes of economic agent, exchange relationships, and the specifically economic processes of appropriation, production, distribution and consumption, provide a useful analytical structure, upon which specific details of an empirical case can be supported whilst being anatomized. They also allow general insights to be drawn from comparison of historically and geographically distinct cases.

For the purposes of this study, IEP is preferred to both ANT examinations of 'the market' and Marxian work on the neoliberalisation of environmental governance or the commodification of nature. IEP is oriented towards examining the meso scale organization and institutional arrangement of economic processes in carbon credit exchange. Chapter 3 has illustrated IEP as a contemporary analytical framework that provides unique and powerful insights into the organisation of the economy. Notably, its anthropological origins ensure that diverse 'market imperfections', such

as taxation or producer-consumer interactions, are not seen as aberrations but consistent institutional features of actual economies. It does this whilst maintaining a keen sense for what is distinctly economic and does not reduce all activity to an undifferentiated social kind (Granovetter, 1985; Hodgson, 1994), unspecified actor-networks (Callon, 1998b) or generic political action (Fligstein, 2001). Similarly, attention to detail in relationships and processes that constitute the economy is absent from most Marxian and Polanyian inspired studies of environmental governance where the emphasis is most often placed on commodification, political actions and socio-ecological consequences (see for instance Prudham (2004) and Mansfield (2004))[3]. This project will be neither a macro scale political economy of meta-

[3] This is not to say that Marxian analysis does not detail economic processes but that it predominantly emphasises an essential capitalism. Castree (2003) outlines the six following features of capitalist commodification identified as regularities within the geographical 'commodification of nature' literature.

Privatization means attributable ownership or legal title, which in Marxist literature is a precondition of capitalist exchange between parties. However, this is not a feature unique to capitalist economies in that there are many existing and historical systems of *de juro* or *de facto* control that effectively privatise entities even if they are not subsequently brought into money mediated exchange.

Alienability is the ability of commodities "to be physically and morally separated from their sellers", distinct from "alienation" in the sense of estrangement of a sentient human worker. Although an entity may be in some sense privatized it does not automatically follow that it is alienable. Castree gives the example of indigenous ethnobotanical knowledge, which for moral (or inherent, tacit knowledge) reasons, could not necessarily be seen as alienable and is to some extent isolated from market exchange. The difficulties but possibilities of realising a market in human organs provides a more visceral illustration.

Individuation is the ontological activity of defining boundaries and limits both in terms of legal or social definition and materiality. This applies as much to the agents, be they individuals, groups or institutions (firms, the state), which are to participate in exchange as to the commodity itself. Both aspects are socially determined and this process is fundamental yet subtle; "it involves a discursive and practical 'cut' into the seamless complexity of the world in order to name discrete 'noun-chunks' of reality that are deemed to be socially useful" (Castree, 2003 p280).

Abstraction is in Castree's sense the opposite of synecdoche. It is the process by which a specific instance or thing is associated with broader category or classification and as such loses its unique and specific detail. As such it is similar but different to individuation, in that it emphasises the process of semiotic homogenisation, i.e. reduction to a generic set of properties, subsequent to an exercise in the "naming of parts". He highlights Robertson's work on wetland banking (2000, p473) in the USA whereby similarities between actually distinct entities are detailed in order that they can be rendered equivalent and hence unproblematically spatially exchangeable. The standardization and consistency necessary for commodity exchange is realized through technical means and the authority of expertise; in the case of wetlands banking it is the Rapid Assessment Methodologies that "function as instruments of translation between science, policy and economics" (Robertson, 2006, p373).

Valuation has two aspects according to Castree, neither requiring a rigidly Marxist labour theory of value. The first is that in capitalist economies there is the tendency for money to become the dominant representation of value, overwhelming distinctions made for use-value, existence-value,

narratives and structural determinism nor an exhaustive, micro social account of power acting through collective agency.

functional-value, practical, ethical or aesthetic reasons. The second is the role the commodity takes as a vehicle for the circulation of capital as money in an economy generating residual wealth. He refers to Neil Smith's emphasis on commodities as merely a part of an ongoing process of accumulation, whereby profit is the chief motive force for production, exchange and consumption.

Displacement describes the occlusion of the real relations between entities by the presence of apparent static and unitary commodities. A central feature of capitalist economies is the spatio-temporal separation of production and consumption such that exploitations of labourers or ecological impacts are systematically concealed and would remain so without specific intervention.

5. Research Approach

This chapter describes the ontological and epistemological commitments of the IEP framework and details the methodological approaches used in Part III.

5.1. Ontological and epistemological commitments

Critical realism provides a naturalist anti-positivist framework for knowledge production in both the natural and social sciences, frequently deployed in geographic and institutional political economy. It is a combination of Bhaskar's transcendental realism (1975), a philosophical position based on a realist ontology, and critical naturalism (1979), an application and qualified extension of this position to the social sciences. Naturalism, the idea that natural and social phenomena can be analysed within the same ontological framework, is justified by regarding scientific progress as the generation of understanding rather than the creation of constant conjunctions. Critical realist explanations also avoid the epistemic fallacy of confusing epistemology with ontology. Statements about knowledge are not statements about being for a number of reasons. Positivist positions in the social sciences fare even less well than in natural sciences as social systems are characteristically open, difficult to measure and frequently irreversible (Outhwaite, 1998) whilst social objects are heavily concept dependent and reliant on the non-universal meanings ascribed to them (Sayer, 1998).

The implied ontology of empirical stances leads to the fallacy of actualism, a consequence of understanding causality as the "constant conjunctures of events" in experimentally closed systems (Hume cited in Hollis, 1994). Empirical realists hold that universal causality is inferred from repeated experimentation and such generalisations of invariance are to be deemed "scientific laws". However, such closed systems are the exception in nature and constant conjunctions are *produced* rather than found. In real, open systems, structures, mechanisms, powers and *tendencies* of nature may

or may not be actualised and thus generate phenomena available to experience. It is the business of science to discern theses tendencies from a particular perspective and not to claim universality. Bhaskar is clear that causal laws are ontologically distinct from patterns of events (1975). Reality can be considered in three domains; the domain of the *real*, or possible, which is greater than the domain of the *actual,* and the domain of the *empirical* which is again a subset of the actual and forms the basis of all knowledge. Whilst reality must be ordered and structured in order to be intelligible to science, it is a fallacy to say that events must be invariant. This distinction, termed transfactuality, indicates that laws operate independently of their actuality or empirical identification.

Historically, environmental degradation has been identified by researchers from within a non-critical positivistic natural science approaches, but these disciplines were subsequently found lacking in explanatory power or insight into the complex, human-nature relations at work. Indeed, they naively reproduced assumptions and common sense narratives of deforestation, soil erosion and over-exploitation of common pool resources by 'ignorant' indigenous peoples lacking effective property rights or knowledge to 'manage' nature (Forsyth, 2001). However, critical realist political ecology has offered more robust explanations by adopting ecological representations from the natural sciences and maintaining a realist ontology, whilst engaging with social constructions of nature and introducing theoretical insights from critical social theory. In a similar way, I adopt a critical realist approach to the study of climate change mitigation, maintaining that GHG emissions are real physical phenomena but critically investigating the social systems that monitor and exchange property rights over their presence or absence.

The objects of analysis proposed by the IEP approach are the agents, materials and institutions that constitute economic activity. They are situated within real, open systems of causative relations. Indeed, it is the intention of agents contributing to the instituting of new MBIs to have real consequences over the dispositions and behaviour of other agents and the material flows of GHGs. However, these very same agents and flows are part of other overlapping systems and hence unequivocally identifying causative relationships at the level of the real will inevitably be imperfect.

Although briefly outlined in section 2.1 it is worth returning to consider the methodological and analytical implications of distinguishing substantivist and formal approaches to economics. Neither term is associated with unique and entirely coherent

literatures but broad contours can be drawn that go further than the most basic definitions. The formal approach reduces value and welfare to subjective preferences and allocation of resources to the spontaneous calculative outcomes of price making markets using logical reasoning. The substantivist approach concerns itself with the embodied and concrete processes of material provisioning, industrial organisation and comparative interests of concrete social groups. The distinction results in an implicit epistemological position in explaining economic reality; either the economy exists as an isolated sphere governed by its own logic or it is enmeshed in broader social relations and institutions and must be studied as such. This changes not just the mode but also the subject matter of the discipline.

The formal approach emphasises the calculative aspects of economics and as a result makes the allocation of resources to maximise the satisfaction of unspecified, exogenous wants the central goal of the economy. From a formalist perspective the production and distribution of goods are considered as economic activity because they can examined from the perspective of choice and efficiency, not because there is anything inherently "economic" about them. Conversely, empirically stable economies can be seen to persist neither with unlimited wants nor persistent scarcity. Skills and knowledge for instance, increase with application and trust which is essential to economic activity is not consumed (Hodgson, 2001, p277).

The substantive approach focuses on "the empirical economy... an instituted process of interaction between man and his environment, which results in a continuous supply of want satisfying material means" (Polanyi, 1957 p248). The emphasis is not on the mode of calculation but on the systemic processes. With this definition, Polanyi avoids reducing economics to catallactics and recognises the variety of institutions that economic activity takes place through. It also removes choice and scarcity from their foundational role. Choice may exist for economic agents and conditions of scarcity may prevail but they should not been seen as applying to each and every economic circumstance. Scarcity particularly, is an instituted phenomenon, arising from the assumption that economic action is always self interested and profit seeking; "...what was deemed to be general and natural is instead historical and social, in one word institutional" (Cangiani, 2003).

By re-conceiving the "economy as an instituted process" and looking to the "place occupied by the economy in society" (Polanyi, 1957) substantive analysis extends the relevant social phenomena that have a bearing on the economy, and hence should be of interest to economics, but does not presuppose a single analytical method

and conceptual framework unlike the totalizing approach of Robbins and others (e.g. Becker, 1976). In Polanyi's framework, the relationship of society to the biophysical environment is an expression of the social relationships that format society and structure the actions of those agents engaging in economic activity. Given the empirical variety of these relationships then there are epistemological implications of this framework. Abstract general theorizing of 'economic laws' is of little use when particular, contingent and dynamic social contexts to some extent structure economic action. For instance, within Polanyi's conception of the economy, money is recognised as a politico-economic institution in its own right and not an unproblematic medium of exchange (Harvey et al., 2007, p2). Polanyi terms the practice of using reductive formal approaches universally to analyse concrete economies the 'economistic fallacy', echoing Marx's thinking that "all the learning of modern economists" concerns "the representation of the bourgeois relations as immutable laws of the society *in abstracto*" rather than in its historical circumstance (Marx, 1976, p. 9 cited in Cangiani 2003). Section 3 explores these issues further.

Methodological individualism, related but distinct from formal economics, has a significant effect on the form of explanatory theory presented by formal economics. Assuming maximising agents with stable preferences making isolated choices enables logical reasoning in a way that acknowledging variability, context and society would not. However, macroeconomic theories built on these patently false microeconomic assumptions are readily questioned (Hodgson & Screpanti, 1991, p13). As a trivial example, if consumer behaviour is explained without any reference to fashion or social norms there is little room for the advertising industry.

All abstract explanatory frameworks will isolate and reduce real phenomena but some do to a much greater extent than others, with real social and cultural effects of their own. Normative considerations are not part of formal economic science as in making choices economic agents exhibit only instrumental rationality; other people or material things encountered are treated only as means to an end and not of worth in themselves or subject to other social norms or cultural considerations (Caporaso and Levine 1992, p23). The intellectual dynamics of an issue can sometimes be revealing of broader social relations of authority, for example, reduction of ecological complexity to a single numeraire of value is widely articulated in criticisms of cost benefit analysis (O'Neill 2007) but persists in many Western liberal democracies as a legitimate means of decision making. New institutionalist and property rights approaches go some way to acknowledging the social context of economic activity, but

only so far as different institutions offer alternative incentives to agents. There is little or no problematization of the institutions themselves, their origin or relationship with broader social processes. That *process*, change over time and hysteresis, is significant to economic activity and institutional structure is an important aspect of the substantive framework.

5.2. Empirical methods and data analysis

Exchanges of emissions reductions credits are conducted for compliance with environmental legislation at the national and international scale and also voluntarily for a variety of reasons. The compliance market is a well monitored, ordered and complex institution that has enabled transactions worth billions of dollars, with a certain degree of transparency afforded by online data sources. The voluntary market is much more diverse, diffuse and opaque with very little organised or open information. Substantially different research methods and data sources were therefore employed.

The UNFCCC keeps a full set of documentary references, including rules and regulations, records of meetings and decisions and a suite of project documents for those activities submitted for crediting, on its website website www.unfccc.int. This is supplemented by the CDM Rulebook http://www.cdmrulebook.org/ a database of CDM rules prepared by law firm Baker & McKenzie, with funding from eight public bodies, and updated after each CDM Executive Board meeting. There is also a variety of publically funded, openly available datasets including the IGES publication CDM in Charts (v11.1, 2010 was used for this work) and the CDM Pipeline database prepared by the UNEP Risø centre (data cited here was drawn from the May 2010 edition). These sources, academic and relevant epistemic community literature provided the material for analysis of the economic activity and institutional constitution. Grey literature documents were held electronically on an indexed hard drive where possible and searched for keyword terms iteratively as knowledge of the trading system was developed. The CDM Pipeline database was manipulated in Excel and numerical data exported to SPSS for the production of descriptive graphical figures.

I also attended a number of emissions trading events including "Effort Sharing under the Climate Package. Assessing the role of the Clean Development Mechanism"

at the European Parliament (4th June 2008) the launch of the Project Developers Forum (17th November 2008), an Environmental Audit Committee evidence session (31st March 2009), Climate Camp protest and workshops outside the European Climate Exchange (1st April 2009) and CarbonExpo 2009, the largest international industry trade fair of its kind (Barcelona, 27th–29th May 2009). As well as taking notes at presentations, gathering reports and promotional literature, I informally talked to a wide variety of market participants.

In order to discuss the voluntary market chapter 9 builds on the previous outline of the operation of the CDM. Without central authorities like the UNFCCC and the CDM Executive Board, no one set of procedures has come to dominate and the market is fragmented. In this emerging arena there is limited documentary material that either frames transactions or reviews the market[1]. Quantitative data are also scarce and unreliable as most transactions are undertaken confidentially and not aggregated in any way. This chapter therefore examines the ways that carbon market participants talk about the institutions that they are a part of, and teases out a number of themes that are echoed by representatives of different classes of economic agent.

The primary empirical focus is UK based corporate consumers and the intermediaries and developers that supply them. Although subject to much media discussion and critique, general retail offset provision is a small market by volume of credits retired. This is noted in Hamilton (2007) and confirmed in interviews with retailers. Corporates were therefore taken as the major end market and interviews conducted with organisations that had investigated the market for carbon credits, most having concluded purchases, and those organisations that interacted with them, including project developers and retailers.

An initial telephone and website survey was undertaken, in collaboration with Dr Stefan Gössling at Lund University, to provide a familiarity with the market and provide a basis for subsequent interviews. This data has been reported in Gössling et al 2007. I attended a series of workshops related to the UK government's interventions in the market (see section 9.3.5) which provided a useful initial overview of the issues at stake and contact with relevant individuals and organisations. These were the SDC/DEFRA/UKERC workshop "Carbon Neutrality" (Oxford, 18th–19th December 2006), DEFRA Consultation Workshop " Carbon Offset Code of Best Prac-

[1] The bulk of data collection for this chapter was conducted from late 2006 to mid 2008. A number of the industrial standards that are described have subsequently issued much more detailed guidance.

tice" (London, 19th March 2007) and SDC Scotland "Carbon Neutrality and Carbon Offsetting " (Edinburgh, 20th April 2007).

Interviews were conducted with 23 individuals, primarily active in voluntary carbon markets, in person and over the telephone between July 2008 and June 2009. These are detailed in Table 5.1. Questions were presented in a semi-structured format, based around the neo-Polanyian themes identified in chapter 3. Whilst there were common themes raised with all participants, for instance "Who does your organisation conduct business with?", specific questions were to a large extent tailored to the type of organisation and its activities in the market. In some cases questions specifically invoked the IEP analytical framing, "What do you supply to your customers, what services are provided?", whilst others dealt with issues couched in vernacular terms of the industry, "What additionality criteria do you use?".

Interview schedules were updated as my understanding of the market increased. Because of the semi-structured format I was able to follow particular lines of enquiry that individual respondents were knowledgeable of.

Interviewees were identified by web searches, from direct contact at events and by referral from other participants. All participants were asked if it was possible to record the interviews for fidelity and assurances were made that any specific quotes would be anonymized and attributed only to the individual's position and the type of their organisation. None objected entirely although two requested that I stop the recorder at certain parts of the interview and a third interview was conducted over the telephone, with note taking, as I did not have an adapter available at the time. Substantial notes were made for all interviews with full transcription was conducted for approximately half of the total running time across the sample for the purposes of direct citation.

In basing chapter 9 around these interviews, the intention is not to present an interpretivist view of the subjective perspectives of participants, nor was a formal content analysis performed to produce a numerical representation of discourses (Hajer, 1995). The rationale for selecting interview participants and the structuring of questions was intended to yield broad coverage of the institutions, drawing on the particular expertise of participants. It was not intended to gather a statistically representative sample to make inferences about the market as a whole. There is considerably more empirical material than presented here. Issues selected for discussion were identified to illustrate comparative aspects with the compliance market and indicative themes from the theoretical framework.

Semi-structured formal interviews were not conducted with CDM participants because of time constraints in gathering and analysing data. As outlined above, there is a great deal of information on the CDM is available in documentary and database format. Indeed, there was sufficient information to describe the institution adequately without additional qualitative information. It is of course possible that I have missed quirks, exceptions, particularities and details that arise in interview situations, however, I did make first hand contact with compliance market participants in a number of arenas. Furthermore, I believe, although I cannot unequivocally establish the fact, that the institution is sufficiently codified and formalised that limited further information could be gleaned from participants. The use of interviews in the voluntary market case is not a means of gathering subject positions, it is an attempt to find the patterns of action associated with organisations within larger economic networks. Were interviews to have been conducted with compliance market participants they would have had a similar purpose but one which would have to some extent been duplicated by documentary records. The approach taken was adequate to meet the research objectives and knowledge claims are carefully made on the basis of the evidence presented.

Table 5.1.: Formal interviews undertaken

Respondent	Class of Economic Agent	Interview Date	Person or Telephone
C1	Consumer	20081028	In person
C3	Consumer	20090429	Tel
C4	Consumer	20090514	Tel
C5	Consumer	20090521	Tel
C6	Consumer	20090602	In person
C7	Consumer?	20090604	Tel
I1	Intermediary/Consultant	20080716	Tel
I2	Intermediary/Regulator	20081106	Tel
I3	Intermediary/Journalist	20081119	In person
I4	Intermediary/Lawyer	20090305	In person
I5	Intermediary/NGO	20090418	In person
I6	Intermediary/Regulator	20090420	In person
R1	Retailer/Developer	20080713	Tel
R10	Consumer	20090205	Tel
R11	Retailer/Developer	20070716	Tel
R2	Retailer/Developer	20080716	Tel
R3	Retailer	20080731	In person
R4	Retailer/Developer	20080801	In person
R5	Retailer/Developer	20080930	Tel
R6	Retailer	20081029	Tel
R7	Retailer/Developer	20090127	Tel
R8	Retailer/Developer	20090127	Tel
R9	Retailer/NGO	20090305	In person

Part III.

Extant Carbon Markets

6. Enabling the Exchange of Emissions (Reductions)

Most discussions of carbon trading explicitly or implicitly assume the clear and unproblematic definition of private property rights or exchange of a simple commodity that may be entered into mathematical models as a factor of production or transferred around national or international emissions accounts. 'Externalities' are brought under market exchange as pollution property rights, implicitly understood as simple commodities free of their own externalities and connections. Chapter 3 has argued that markets should not be seen as pre-existent, fixed, external phenomena nor can they be adequately represented as simple set of logical arguments. Rather they are better and variously described as historically contingent configurations of agents and technologies engaged in continuous and dynamic exchange relations. This is most apparent when the property rights or contracts subject to exchange are novel and separate from a physical entity, and even more so at the genesis of such markets. Of course, such situations are not unique to the creation of market based instruments for environmental regulation. Markets for vehicle insurance or indeed money itself are familiar cases of instituted economic relations where physical entities are incidental to the economic and social consequences of relations they create. Concerns about intellectual property rights and the circulation of digital music through systems of exchange and free distribution offer another contemporary example. In this case, the election of the Pirate Party to the European Parliament has made the political act of instituting the boundaries of property and market especially conspicuous (Edwards, 2009).

This section uses the Polanyi inspired instituted economic processes approach to frame the most fundamental features of carbon markets; the accounting units and quasi-property rights that are subject to market exchange, and the differentiation of classes of economic agents engaged in trade. This overview will then be built upon in later accounts of patterns of exchange and the composition of governance

Table 6.1.: Basic Classification of Greenhouse Gas Emissions Trading

		Motivation for Consumption of Units	
		Required by law, exchange governed by state	Voluntary actions, private governance
Production of Units	Units issued by regulator, total quantity fixed	Compliance allowance market e.g. EU ETS	Voluntary allowance retirement e.g. Sandbag, CCX
	Entities can earn new units by initiating projects, quantity potentially unlimited	Compliance credit market e.g. CDM	Voluntary credit production and retirement e.g. carbon neutrality

institutions in compliance and voluntary markets. It is worth briefly considering terminology that has been used loosely in informal discussions of market based climate policy instruments and presenting a basic classification of the exchange institutions presently in operation.

Emissions trading systems can be classified into two basic types; 'cap and trade' and 'baseline and credit'. The primary distinction is the origin and quantity of the traded units, *allowances* in the former and *credits* in the latter. Briefly, allowances are fixed in number whilst credits are 'manufactured' and potentially unlimited. *Carbon offsetting* is a frequently encountered term that usually refers to the use of carbon credits to balance emissions arising from a specified activity, for example an airline flight. However, a broader definition is warranted to include all indirect emissions reductions achieved through the cancellation, usually referred to as retirement, of a GHG instrument, including those based on allowances. Carbon markets enable these transactions by providing participants with a set of institutions and instruments, denominated in tonnes of carbon dioxide equivalent (tCO2e), to structure exchange. In abstract terms, GHG reductions are attributed to one agent, be that a nation, industry, corporation or individual, and sold to a second, unrelated agent whilst being held as equivalent to emissions reductions achieve by the buyer's own actions[1]. When employed as a noun, 'a carbon offset' typically refers to a project derived emissions credit. However the purchase of credits is only one possible form

[1] The recently introduced British Standards Institute PAS2060 provides a similar and more widely used definition.

of transaction and not exclusively the case; I therefore use 'offsetting', infrequently and as a general term. The term *carbon neutral* is used to connote the status of an item, action, or organisation that has had its quantified emissions liabilities offset.

6.0.1. Allowance based systems

Allowance based systems are not the focus of this work but provide an important entry point and background. They are also the most important systems, in economic and politic terms, at the European scale and arguably at the global scale. The basic environmental economic formulation of emissions trading proposes that a regulating authority decide upon a particular quantity of allowable emissions, the entities to be subject to this restriction and the time periods within which they are to be bound (Tietenberg, 1990). Allowances are allocated to entities who are allowed to buy or sell them freely, provided that at various reckoning points they have sufficient to meet their obligations in relation to real emissions output. An unproblematic, direct correspondence is assumed between the allowances allocated, which are social institutions, and the emissions from the scheme participants, which are material entities. The basic components of a "cap and trade" scheme are therefore:

- A group of polluters to be regulated by and participate in the scheme
- A defined quantity of permissible emissions, the "cap", inscribed in allowances to be exchanged between participants
- An accounting system to record ownership of allowances and their subsequent transfer
- A regulator to allocate and receive allowances and issue sanctions for non-compliance
- A monitoring and reporting regime to record physical emissions
- A group of intermediaries that facilitate transactions between producers and consumers

The European Union Emissions Trading Scheme, EU ETS, globally the most active carbon trading institution (Capoor & Ambroisi, 2008), serves as an example illustrating these features. The scheme is divided into phases to allow for alteration of the terms and coverage at pre-determined intervals, Phase 1 being some what experimental and operating from 2005-2007, Phase 2 from 2008-2012 matching the Kyoto

commitment period and Phase 3 from 2013-2012 intended to initiate decarbonisation of the European electricity supply. Approximately 11,500 installations which are responsible for nearly half of EU carbon dioxide emissions are required to participate. The EU ETS Directive[2] defines an installation as "a stationary technical unit where one or more activities listed in Annex I are carried out and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution". In practice this means a factory, power station or heating system that is a substantial point source of emissions. Examples local to Manchester include the Castleton cement works, Manchester Airport terminal CHP plant and University of Manchester Stopford Building boilers. The majority of allowances, EUAs, are allocated for free by the 30 member state governments[3] under National Allocation Plans (NAPs) which must be approved by the European Commission. The restricted quantity of allowances is issued annually and installations must surrender to their national regulator a quantity equivalent to their monitored and independently verified carbon dioxide emissions for a given calendar year by April 30th of the following year. If an installation fails to do so it must pay a fine, €100 per excess tonne of emissions , and make good the shortfall in the subsequent year. The Community Independent Transaction Log (CITL) is a publically available electronic database that tracks the movement of allowances among each of the national registries that log the allowances held by installations and market participants. The European Climate Exchange (ECX) and a number of other commodity exchanges provide standardised contracts and clearing house functions for spot, future and options trades in EUAs. In conjunction with banks and investment funds, that have no use for the allowances but participate in trading them for speculative gains, an increasingly the liquid market has developed over time with 3,093 million EUAs being transacted in 2008 in relation to an annual cap of 2,083 million EUAs (Kossoy & Ambrosi, 2010).

The EU ETS allows credits from the CDM to be used as equivalent to EUAs subject to certain criteria. The first is that only a limited proportion of reduction effort should be met by the import of CERs. This principle is described in the Kyoto Protocol as 'supplementarity' but no numeric interpretation is given in it or the EU ETS Directive. In practice the quantity of offset credits allowed into the EU ETS Phase II is specified by each NAP and limited for each installation in a given phase. Cur-

[2] Directive 2003/87/EC, as amended by Directive 2004/101/EC.

[3] EU 27 plus Norway, Iceland and Lichtenstein.

rently this allows an EU-wide proportion of 13% of the volume of EUAs to be supplemented by CERs; however in practice the CITL recorded that 82 million CERs, representing 4% of the total volume of EUAs, were surrendered in 2008 (Elsworth & Worthington, 2010). The Linking Directive (EC 2004)[4] also specifies that credits generated from nuclear power projects or biological sinks cannot be used in the EU ETS and that large hydroelectricity projects (20MW) must comply with international guidance "including those contained in the World Commission on Dams year 2000 Final Report". EU buyers are the largest source of demand for credits from the CDM, driven by both the direct compliance requirements of the EU ETS and the prospect of speculative gains made on the stricter caps of Phase 3.

6.0.2. Outline of credit systems

Credit based systems reward participants for environmental performance that is quantifiable and in someway an improvement on the *status quo*. Unlike cap and trade, there is no maximum quantity of emissions set for the system as a whole. Participation by an economic agent that wishes to earn credits is voluntary. The regime authority awards credits, which may then be sold to other entities that are subject to regulatory obligations, based on a particular set of criteria. In this way, a financial incentive is created for environmental improvement. For example, an iron foundry may install a new, efficient furnace and be awarded credits equivalent to the difference in emissions from 'business as usual', had it continued to operate the old furnace. Once issued, credits may entitle the holder to increase emissions from a regulated activity, or installation, by a quantity equivalent to the credited reductions. The aforementioned foundry may sell its surplus to another installation that has not invested in improvements. In the case of stock pollutants such as greenhouse gases there is also the possibility of credits being awarded for the removal of pollution from the atmosphere, for example through afforestation projects producing a biological carbon 'sink'. The market mechanism as a whole is therefore intended to reduce abatement costs and provide flexibility by instituting a new incentive for participants with low marginal abatement costs to *voluntarily* change their plans and make measurable reductions with the expectation that those with higher marginal abatement costs simply purchase the traded instrument and continue to pollute.

[4] Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms.

6. Enabling the Exchange of Emissions (Reductions)

From the simplest schematic perspective, I propose that two classes of economic agent and three core economic processes may be identified in emissions reductions credit exchange. The selling class is comprised of economic agents who hold emissions reductions credits but have no use for them themselves, whilst the buying class have a consumption incentive and will make a monetary payment to the sellers for the property rights to the credits. The three processes are separate but interconnected and may be mapped to a neo-Polanyian classification:

PRODUCTION: The creation of credits for emissions reductions

EXCHANGE: The transfer of credits for money

CONSUMPTION: The redemption of credits against an emissions reduction commitment

Production is the creation and assignment of new GHG instruments, exchange is their voluntary sale and purchase accompanied by financial transfers, and end consumption is the ultimate surrender of credits in lieu of some other emissions reduction requirement[5]. It is immediately apparent that distribution is not identified as a core process in these markets. Why is this the case when it is foregrounded in both Polanyi's own economics and the neo-Polanyian work that follows? Simply put, the exchange of carbon credits is not material. There are no physical flows directly implicated in the exchange, indeed even the financial transfers occur almost exclusively electronically and not as cash money. This is not to say that there are no material consequences of these acts of exchange. Far from it. The infrastructures associated with both production and consumption of the credits are often substantial but rights to them are not directly transferred and no material changes location. The process of exchange, property 'changing hands', accounts simultaneously for distribution, property 'changing place'.

Each of the processes can be broken down further. Crediting necessarily occurs prior to exchange; it is the origin of the instruments to be exchanged. It is the process by which an activity is identified as deserving of credit; generically this is the award

[5] The simplest case does not even include exchange; if the receiver of the credit retains and uses the credit directly then consumption effectively occurs without exchange. For example, this may occur when the receiver is a large organisation with multiple regulated sites. If we consider two entities, a producer and a consumer, then a single contract may define the project and the emissions reductions that are to be paid for, but without the creation of a transferable instrument. Neither of these circumstances can be considered an emissions trading institution because they do not generate transferable, marketable units.

of a property right of some sort but specifically in the case of carbon credits it is for the reductions of GHG emissions. Firstly, an activity must be delimited spatially, temporally, and legally to the extent that ownership or rights can be assigned to an economically active entity. This is usually regarded as a project and the basic unit of analysis. Secondly, as emissions reductions credits are earned quantitatively, an estimate must be made of the amount of emission reductions that the activity has produced or an amount assigned arbitrarily. Thirdly, an external agent or broader institutional structure must create transferable instruments that can circulate independently of producer-consumer relations. This requires some system of accounts with which to record the ownership of the credits prior and subsequent to their changing hands. These tradeable instruments are often referred to as "property rights", but as the putative rights conveyed do not pertain to a material entity and are not recognised in law in the same way, this is somewhat misleading. Typically the third party is a state agency which creates a regulatory right with legal circumstances under which the credit has utility and may be redeemed (Wemaere et al., 2009, p39). However, this conception needs to be expanded to consider voluntary emissions exchanges. The regulating third party may in principle be any organisation that is duly recognised by a broader social institution within which the credit can be "redeemed". An example in this case may be the staff of a corporation who recognise their organisation as being environmentally responsible as a result of engaging in such transactions. Crediting is thus tied to the systems of exchange and consumption through recognition of the validity and comparability of credits.

The possible and actual use of credits, their consumption, is often taken for granted but is also empirically open. There may in fact be a multiplicity of specific uses for the credits available. As much as production, it is this that determines the economic and biophysical consequences of the institution. In a system of voluntary exchange, there is no incentive or justification for the production of credits without a complementary demand side. The quantity and type of projects that are incentivised are specified by both the demand side agents and also the institutions that recognise the validity of the credits arising. It is possible to imagine a supply crowd of production institutions with variable organisational forms, be they firms, independent standards organisations, government bodies or whole supply chains, generating credits and competing for business from members of an equally diverse demand crowd.

The exchange institutions outlined in this way suggest that the mainstream economic assumption, that emissions reductions credits are a homogeneous commod-

ity competed for only on price and entering the macroeconomy as a simple factor of production, substantially underestimates the institutional requirements of such a concept nor the possible range of concrete institutional forms that may attempt to approximate it. The carbon trading systems that have developed in the last decade illustrate the processes of instituting economic activity and institutional variety within those processes.

6.1. An overview of the Kyoto Protocol flexible mechanisms

The Kyoto Protocol commits the developed countries named in Annex 1, OECD plus the former communist states of Eastern Europe, to modest reductions of GHG emissions, on average 5.2% from 1990 levels. Emissions caps are placed on a 'basket of 6' greenhouse gases - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). The quantitative basis of these caps are base year emissions of 1990 with targets to be met cumulatively over the commitment period of 2008-2012. Article 4(2)(a) of the UNFCCC, the broader climate governance framework under which the Kyoto Protocol sits, provides the precedent for "flexibility mechanisms" in stating that "...Parties may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention" and Article 4(2)(b) "...with the aim of returning individually or jointly to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases". Within the Kyoto Protocol, the "EU Bubble" is a special provision of Article 4 that allows for a group of nations to be able to meet their emissions commitments in aggregate if a formal agreement is reached and submitted to the UNFCCC. Of course joint responsibility and the notion of coordinated policies and activities do not imply or require market exchange of those responsibilities. These ideas were introduced in supplemental legislation within the Kyoto framework. Article 17 of the Kyoto Protocol introduces and Decision 11 of CMP1 (2005) specifies the conditions under which states can transfer the units of their Annex B commitments amongst themselves. These provisions are collectively termed "Emissions Trading" and establish the Assigned Amount Units (AAUs) that entitle states to increase or decrease their permitted national emissions output through exchange. In order to participate they must fulfill certain reporting requirements, demonstrate administrative capability

and at all times hold a "commitment period reserve" of 90% of their original AAU allocation or most recent reported emissions inventory (FCCC/CP/2001/13/Add.2, Annex paragraph 6).

The Emissions Trading articles focus exclusively on the transfer of allowances between parties and have little connection to particular policies or activities that lead to changes in emissions output. Following the initiation of the UNFCCC in 1992 a number of nations engaged a pilot programme of Activities Implemented Jointly (AIJ) that consisted of overseas infrastructure projects funded by developed countries which could not be counted for credit on their future commitments but were intended to act as capacity building and exploratory activities. The Joint Implementation (JI, Article 6) and the Clean Development Mechanism (CDM, Article 12) are the formal project based, crediting systems that were subsequently included in the Kyoto Protocol.

Article 6 provides for the transfer of Emissions Reduction Units (ERUs), new GHG instruments, which are attributed to project activities in Annex 1 countries, both parties to such trades having quantitative emissions limits. In practice this has meant the post-socialist 'economies in transition' of Eastern Europe hosting projects, with the ERUs to be sold to richer economies to meet their commitments under Annex B. Article 6 allows for any Party to authorise any other legal entity, including private actors or international bodies such as the World Bank, to fund and develop such projects under the authorising Party. ERUs can be created under the simplified procedures of Track I, if the host nation meets a series of criteria relating to its national inventory and monitoring system, or a project by project Track II crediting process similar to the CDM with a central governing body, the Joint Implementation Supervisory Committee (JISC).

Supplementing Article 12, the Marrakesh Accords, formulated at the 2001 Conference of the Parties (COP), explicitly outline the structure and procedures of the CDM. They detail the procedures and rules for the creation of Certified Emissions Reductions (CERs) that are attributed to projects based in countries without quantified emissions limits and which can be sold to countries with limits. This possibility, considered the "Kyoto surprise", arose as a compromise position between the United States' insistence on greater flexibility for large polluters and the Brazilian Green Development Fund proposal that would disburse the proceeds of punitive fines on countries failing to meet their targets (Lovbrond et al., 2009). Article 12(2) outlines the twin objectives "to assist Parties not included in Annex I in achieving sustain-

able development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3". The primary motivations for its inclusion were to decrease the costs of meeting quantified targets by integrating a pool of low mitigation cost activities in developing economies and to direct new investment in clean technology to countries with limited finance and trends of rising emissions (Grubb et al., 1999, p103).

The GHG instruments created under JI and CDM are attributed to project activities rather than being allocated by decree to national accounts. A project is a geographically restricted activity that is specified in a series of documents and may involve a number of organisations, for example a production facility, a bank and an engineering consultancy. The instruments created through JI and CDM can be held, exchanged and used by organisations and individuals not only nation states. Unlike other aspects of the international climate regime the JI and CDM directly and explicitly engage private and non-state actors (NSAs) in the deployment of low carbon infrastructure and the production emissions reduction instruments. They are multilateral in structure but are not grant making funds with their own resource base for investment. By operating in countries without quantified commitments, the CDM also increases the pool of instruments with which to meet the overall commitments of the Parties.

The Kyoto Protocol therefore institutes 3 different units of exchange outlined in table 6.2. There are 3 further units associated with Agriculture, Forestry and Land Use (AFOLU); Removal Units (RMU) that may be claimed by Annex 1 units according to the GHG inventory guidelines[6] and the expiring credits awarded to afforestation/reforestation projects under the CDM, Temporary CERs (tCER) and Long-term CERs (lCERs)[7]. These units are both accounting units to record the GHG output of the parties and also tradeable instruments, based on a correspondence to a quantity of material GHG, which carry the entitlement to emit GHG under certain conditions (Wemaere et al., 2009, p37).

The creation of CDM credits, Certified Emissions Reductions (CERs), is regulated by a centralized secretariat, paid for by Parties to the KP and by fees levied for the registration of projects. At the top level the CDM is "subject to the authority and

[6] For a/r see CMP/2005/8/Ad3, p5 paragraph 1(a)-(d) and other sinks CMP/2005/8/Ad3, p5 paragraph 1(e)-(h).

[7] As detailed in CMP/2005/8/Ad1, p62 paragraph 1(g)-(h).

Table 6.2.: Flexibility Mechanisms under the Kyoto Protocol

	Emissions Trading (ET)	Clean Development Mechanism (CDM)	Joint Implementation (JI)
Transferable Unit	AAU	CER, tCER, lCER	ERU
Mechanism type	Cap and Trade	Baseline and Credit	Hybrid
Initial Holders of Units	Nation states	Project participants, may be Parties or entities authorised by a Party (i.e. NSAs)	Nation states
Unit Allocating Authority	UNFCCC COP/MOP	CDM Executive Board	Track I: Annex 1 Party / Track II: JI Supervisory Committee
Market Participants	Annex 1 Parties to the Kyoto Protocol i.e. nation states	Parties to KP or entities authorised by a Party, including private sector organisations	Annex 1 Parties to KP or entities authorised by a Party, including private sector organisations
Location of Projects	N/A	Non-Annex I States	Annex I States
Accounting System	National Registries and International Transaction Log (ITL)	CDM Registry, National Registries and ITL	National Registries and International Transaction Log (ITL)
Determination of quantities	Negotiated, specified in Annex B	Reductions attributed to projects on basis of calculation and monitoring	Conversion of AAUs, calculated reductions attributed to project
Final Use of Units	Annex 1 Party commitments	Annex 1 Party commitments and private sector voluntary and mandatory purposes	Annex 1 Party commitments and private sector voluntary and mandatory purposes

guidance" of the COP/MOP (KP Article 12, Point 4) and supervised by an Executive Board (EB). The COP/MOP, the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP), is intended to streamline the activities of the UNFCCC, the "COP", and the Kyoto Protocol, the "MOP", by combining the two decision making bodies' annual meetings. The EB consists of 10 individuals elected by the COP/MOP, including one member from each of the five UN regional groups (Africa, Asia, Western Europe and others, Eastern Europe, Latin America and Caribbean), two other members from Annex I Parties, two other members from non-Annex I Parties and one member from the small island developing states (CMP/2005/8/Ad1, paragraph 7). Members must have appropriate technical or policy expertise and may serve up to two consecutive two-year terms. The EB meets at least three times a year and fulfills a number of roles:

- Approve baseline and monitoring methodologies
- Be responsible for the accreditation of auditors
- Maintain a public database of rules, procedures and methodologies and projects, project documentation and monitoring reports
- Commission and publish technical reports as required to fulfill its duties
- Maintain the CDM Registry of issued credits
- Make recommendations to the COP/MOP on the overall structure and operation, known formally as the modalities and procedures, of the CDM.

Project audit itself is undertaken by certified external agencies known as Designated Operation Entities (DOEs). These independent organisations are typically accountancy firms, engineering or environmental consultancies in the private sector that fulfill the inspection and verification roles of the CDM. They are accredited to perform these function for specific industrial sectors and must meet a range of criteria including relevant technical competence and staff, financial stability, internal quality assurance procedures and demonstrate no conflict of interest exists between its functions and its business interests (CMP/2005/8/Ad1, Appendix A, paragraph 1). The performance of each DOE is monitored, periodically reviewed and subject to spot checks by the CDM Assessment Team.

Creation of carbon credits is described by the CDM project cycle. It begins with a formal proposal, known as a Project Design Document (PDD), identifying the project participants and detailing location, relevant national authorities, the period for credits to be claimed, and a justification case that the project is additional and requires

support from the carbon market to proceed. A quantification methodology, selected from a list approved by the EB, is outlined. This illustrates a counterfactual alternative future emissions profile under 'business as usual' conditions, the savings to be claimed by the project and the monitoring and auditing procedures to be used. The project participants must also secure a Letter of Approval (LoA) from the host party government, stating that the project can proceed. There may also be a period of public consultation where comments are invited on the project documents. The proposal is then checked, in CDM terminology "validated", by a certified third party referred to as a Designated Operational Entity (DOE) for completeness and compliance with the CDM procedures and methodologies.

Once approved, the project is submitted to the EB for registration by the DOE and a fee is paid. The EB has 28 days to make a request for review or clarification. As the project enters operation, the monitoring programme begins and further verification audits, conducted by a different DOE to the validating DOE, check that monitoring data is reliable and as specified in the registered PDD. The DOE is then able to submit a request for issuance to the EB for the quantity of CERs that the project has earned. There is again a period where the EB can request further review of the project before reaching the final stage where credits are issued to the designated project participant's account within the CDM registry. The registry is an independent database of uniquely numbered credits and accounts. Ownership is transferred from non-Annex 1 entities that earn credits to accounts in Annex-1 national registries via the International Transaction Log (ITL), itself a publically accessible electronic database. An administration fee is deducted by the CDM at issuance and 2 per cent of issued CERs are assigned to a fund for climate change adaptation in vulnerable countries. The registry system is the ultimate arbiter of ownership and reduces the likelihood that buyers may be defrauded by the 'double selling' of emissions reductions from a given project. It also provides the means for regulated entities under the EU ETS and the Kyoto Protocol to demonstrate compliance with their mandated emissions targets.

Parallel to these documentary procedures the project may commence construction according to the project participant's access to up-front capital. By definition, this ought to be related to their confidence in securing CDM registration and subsequent carbon credit revenue. The CDM project cycle has little control over the material aspects of the project and project planning, save for requiring compliance with the details presented in the PDD. If the project itself or the monitoring plan are to be

revised, the DOE must submit a request for deviation to the EB and according to the decision reached may render the project ineligible for credits.

The outline presented here describes the institutions and processes that are arranged to enable the exchange of emissions reductions between a variety of parties. There are a number of aspects that deserve attention as they are key to the outcomes of the market; i) defining a project and its eligibility to receive credits, ii) establishing its additionality, i.e. that the project's outcomes are the result of the incentives provided by emission trading, iii) quantifying emissions reductions attributable against a counterfactual case, iv) quality control systems that are intended to ensure compliance and v) assigning ownership and legal title to the credit instruments. It is these procedures that mediate between the economic activity of the material projects and the economic institutions that organise and incentivise them. Their development, through variation and stabilisation, is ongoing. The Marrakesh Accord sets out the broad principles, the "Modalities and Procedures", but many of the details are arrived at in a stepwise fashion as rulings are made and precedents set by the EB[8]. The information presented below provides a snapshot as of 2009-2010 as work was undertaken was on this project.

6.2. Earning credits: defining a project and its eligibility

One of the most distinctive features the CDM is notion of a project. The orderly and regular exchange of emissions instruments requires a procedure through which particular entities are assigned the rights to CERs. In cap and trade systems, liabilities and allocations are oriented around agents at a specified scale, a country, a company or an installation for instance. In the CDM participation is voluntary so no liability is defined, rather credits are earned for a defined activity: the project.

[8] The CDM also contains a less exacting set of procedures for small scale (SSC) projects with the objective of increasing supply by reducing registration and quality assurance costs which would otherwise be prohibitive and relaxing some of the criteria for determining a project's eligibility to receive credits (CMP/2005/8/Ad1, Annex II). The advantages include, the ability to "bundle" multiple sites with similar activities into a single package for quality assurance, a simplified PDD, standardised baselines for particular types of activity, reduced stringency in determination of additionality and permission to contract the same DOE for validation and verification. Because of these incentives, the definition of scale has been a controversial topic with amendments to the Marrakesh Accords made at COP8 and COP11 (Michaelowa 2007). The current terms are that estimated emissions reductions are less than 60kt p.a. or the power of the equipment to be installed, if a renewable energy project, is less than 15MW or produces less than 60GWh p.a..The May 2010 CDM Pipeline lists 943 SSC projects with an anticipated yield of 134,911 kCERs by 2012. This represents 43% of the total number of projects but just 8% of the expected total 2012 yield.

Physical quantities of greenhouse gases are not directly exchanged in emissions trades. However, the instruments that are exchanged are associated with economic activity that releases or sequesters these gases, for example, electricity generation, landfill waste disposal or home cooking. The buying and selling of credits is intended to reduce overall compliance costs by allowing consumers to take advantage of low cost mitigation opportunities outside of their own sphere of operations. Therefore to create instruments for exchange, a clear link needs to be made between particular, specified mitigation activities and the actions of the economic agents who will be given ownership of the instruments. For instance, the distribution of compact fluorescent lightbulbs involves not only the manufacturers, marketers, financiers, distributors and users of the bulbs but also the grid and electricity generating systems which is actually burning fossil fuel, each of whom may wish to make a claim to the emissions reductions (Broekhoff, 2007). Similarly when biofuels were considered by the CDM a decision had to be made as to whether the manufacturer or consumer of the fuel is able to claim reductions (EB 26, Annex 12).

In the case of the CDM, mitigation activities are outlined in Project Design Documents (PDD) a standardised template that includes the information upon which the audit and governance bodies, Designated Operational Entities (DOEs), Designated National Authorities (DNAs) and the CDM Executive Board (EB), will make decisions to validate the project award credits (section 7.3 details these quality control procedures). It is also the main source of publically available information on a project for local stakeholders and wider scrutiny[9].

The current version of the CDM standard PDD[10] requires the following information:

- Identity of project participants i.e. the Parties (countries) involved and the public or private organisations from each that are participating in project and who will received the CERs awarded.
- Technical description of the project activity including relevant operating permits and approvals.
- Location of the project activity, including Host Party(ies), and details of precise physical location.

[9] A project developer may circulate a Project Information Note / Project Idea Note (PIN) to raise finance and discuss technical aspects of a project with potential collaborators. However, these are private documents and not standardised to the same extent as a PDD.

[10] Version 03, Approved at EB 25, 28 July 2006, http://cdm.unfccc.int/Reference/PDDs_Forms/PDDs/index.html

- Category(ies) of the project activity under the CDM scope and classification scheme[11].
- Technology to be employed by the project activity, including construction sequencing, operational plans and arrangements for training.
- Estimated amount of emission reductions over the chosen crediting period.
- Details of any public funding of the project activity, and where relevant a statement and justification that this is not a diversion of ODA.
- Identification and justification of a baseline and monitoring methodology, the sources and gases included in the project boundary and a description of how the baseline scenario is arrived at and how the project activity is additional.
- Identification and justification of data and measurements for baseline study and ex-post estimation of reductions.
- Identification and justification of monitoring methods, calculations and procedures to be applied for ex-ante calculation of emission reductions.
- Specification of the start date, duration of the project activity and the period for which credits will be claimed.
- Estimation of the environmental impacts of the project and if considered significant an environmental impact assessment as required by the host Party.
- Brief description how comments by local stakeholders have been invited, compiled and accounted for and a summary of comments received.

These documents are essential to the functioning of the credit market. They provide the basis for creation of the credits and a central means of communicating and coordinating between stakeholders. Producing PDDs is a technical task that the organisations that host projects typically have no existing personnel capacity for or experience in. A class of consultants has arisen that provide technical services in both designing the project activity and writing documentation. These consultants may in some cases also actively take a stake in the project and act as a project developer.

PDDs are made publically available on the UNFCCC website after submission to the CDM. The data that they contain is collated and circulated in the 'CDM Pipeline' a database prepared by the UNEP Risø centre, a publically funded research institution. These data illustrate the types and locations of projects that are currently

[11] http://cdm.unfccc.int/DOE/ scopes.html

receiving credits under the CDM (see figures 6.1 and 6.2). Examples include; 'end of pipe' projects such as hydrofluorocarbon (HFC) incinerators which reduce GHG emissions from industrial plants, fuel switching projects where biomass waste such as bagasse from the sugar industry is used to fire boilers, methane capture projects which cap landfills and coal mines and may burn the gas to produce electricity, and grid connected renewable electricity projects such as wind turbines and hydroelectric generators.

Subject to meeting its twin top-level objectives, of meeting the emissions targets of the Kyoto parties and achieving sustainable development (see p129), the CDM is ostensibly open to a wide variety of projects with very few outright exclusions. The Marrakesh Accords prevent Annex 1 countries surrendering CERs generated by nuclear facilities and specify that land use change credits can only be claimed for afforestation and reforestation (CP/2001/13/Ad2). The first COP/MOP, Montreal 2005, specified that broad local, regional or national policies or standards cannot be considered as individual CDM projects but rather as part of a Programme of Activities (PoA) which may be eligible under different rules. Subsequent Executive Board decisions have emphasised location specific, infrastructure focused projects that can act as a focal point for measurement and calculation. The following broad approaches have been precluded:

- Projects exclusively based on training or capacity building for technology transfer (EB23 Report, para 80)
- Projects intended to reduce the consumption of aviation and shipping fuels, specifically citing shortened shipping routes as an example (EB25 Report, para 58)
- Projects relating to capacity building to enforce or police a standard or law (EB 33 Report, para 30)
- Projects whose products are intended to reduce emissions outside of a monitored project boundary (EB35 Report, para 22). This is in accordance with an earlier ruling specifically on the substitution of biofuels for fossil fuels; consumers of biofuel are eligible for CERs but producers are eligible only if consumption is within the reported boundary (EB 26, Annex 12, para 1)

Outside of these exclusions, project eligibility is broad but dependent upon the use of Approved Methodologies (AM). Methodologies are documents describing the baseline against which emissions reductions are to be calculated and how monitoring

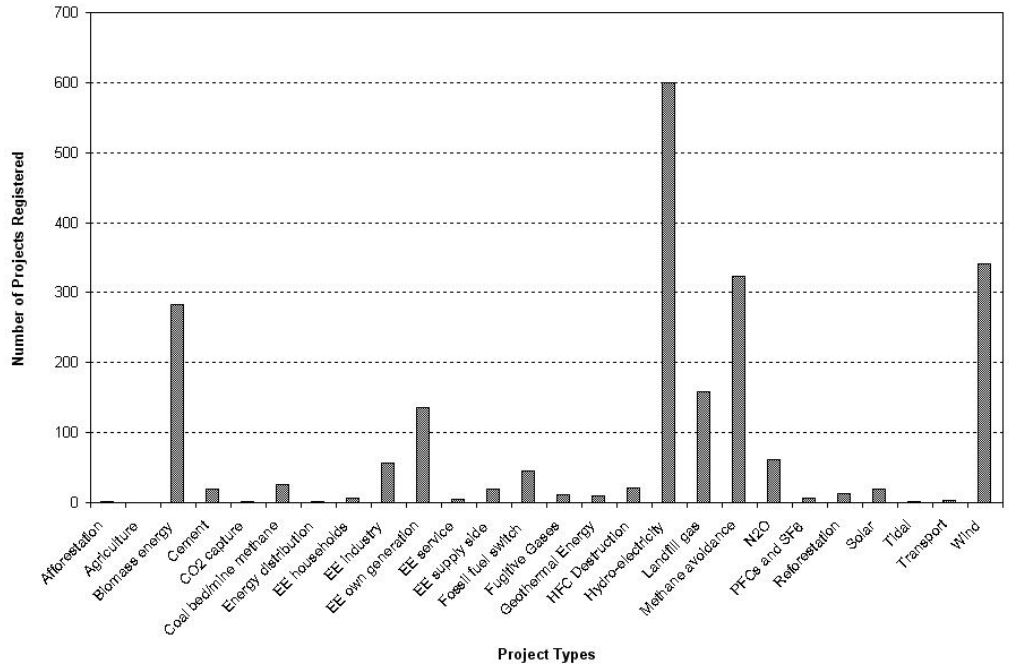


Figure 6.1.: Distribution of registered CDM project types, May 2010 CDM Pipeline

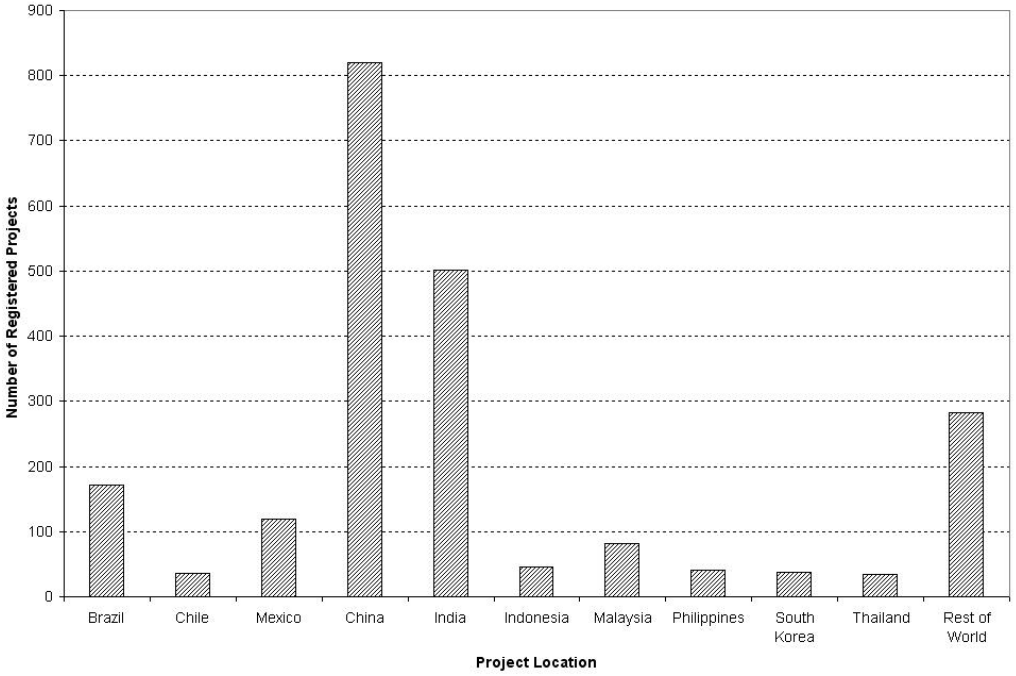


Figure 6.2.: Distribution of registered CDM project locations, May 2010 CDM Pipeline

and data collection are to be carried out. There are many technologies, policies and interventions that a project participant could claim would reduce emissions but in order to be eligible to receive CERs a project must demonstrate its implementation is in accordance with the CDM rules. New projects and new methodologies enter the CDM from the bottom up, via private entities and NGOs with direct project interests but also NGOs and networks with wider geographic or sectoral concerns such as HEDON or SouthSouthNorth. Public finance from bodies such as The World Bank, state owned corporations like MASDAR, and overseas development agencies such as DFID, has also initiated and funded pilot projects and methodology development.

The CDM publishes all approved methodologies and project participants must adopt one of these or submit a new methodology (NM) to the EB's Meth Panel (MP) alongside the PDD. The Meth Panel is a group of 16 technical experts selected by the EB and tasked to provide recommendations on the appropriateness of new protocols, provide tools to assist project participants to choose appropriate methodologies and identify sectoral experts to contribute to the approval process. The procedure for approval is substantial, involving the CDM's secretariat completing a desk review, a period of public consultation, production of a report by two members of the MP, consideration by the whole MP which then issues a recommendation to approve, or not, or seek further clarification from the project participants, that ultimately the EB considers and acts upon (http://www.cdmrulebook.org/521 20101116).

Projects and methodologies are classified according to a numbered "sectoral scope", based on the sources of emissions listed in Annex A of the Kyoto Protocol. Illustrative project types from the UNFCCC Methodology Booklet (2010) and CDM Pipeline are provided:

1. Energy industries (renewable / non-renewable sources) – Displacement of a more emissions intensive energy source with renewable energy, biomass or a less intensive fossil fuel. More efficient power plants producing electricity and district heat.
2. Energy distribution – Reduction in losses in transmission of electricity or district heat.
3. Energy demand – Energy efficiency improvements in industrial facilities, domestic houses, industry, public & private sector buildings.
4. Manufacturing industries – Waste heat or waste gas used for electricity production in industry.

5. Chemical industries – Recovered CO_2 from waste gas substituting for fossil fuels in chemical processes, reduction of N_2O from production of nitric acid, adipic acid, caprolactam.
6. Construction – None as yet.
7. Transport – Construction of new bus rapid transit systems efficient transport, shift of cargo transport from road to rail.
8. Mining/mineral production – Methane collected and destroyed from coal mines or coal beds.
9. Metal production – Upgrading industrial plant to greater efficiency or less emissions intensive processes.
10. Fugitive emissions from fuels (solid, oil and gas) – Recovery in place of flaring of methane from oil wells, gas pipeline leaks.
11. Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride – HFC-23 and SF6 destruction at industrial facilities .
12. Solvent use – None as yet.
13. Waste handling and disposal – Biogas from manure, waste water, industrial solid waste, palm oil solid waste, by composting or aerobic treatment. Collection of landfill gas, composting of municipal solid waste, or incineration of the waste instead of landfill.
14. Afforestation and reforestation – Restoration of degraded land with trees or shrubs with or without silvipastoral activities.
15. Agriculture – Irrigation, alternative low N_2O fertilizers, rice crop methane reduction.

The development of methodologies is a time consuming and expensive activity with no guarantee of success. As of May 2010, 131 methodologies had been approved, 172 rejected with 32 new methodologies pending. There are substantial variations in the distribution of projects amongst sectors, see figure 6.1 on page 138. This unevenness is also seen in the numbers of methodologies developed for each sector, there being none in construction, mining or solvent use but thirty three within energy industries. There is also substantial variation in the use of methodologies by projects; for example 1606 of the 5955 projects submitted to the CDM (including those rejected and withdrawn) have used ACM0002 'Grid-connected electricity generation

for renewable sources (no biomass)'. A fee of US$1000 is required at the time of submitting a new methodology but this can be regarded as a prepayment if the project is subsequently registered. This cost is small in comparison to the time, expertise and resources required to initially develop a methodology which may be a substantial burden for projects yielding low volumes of credits. There is therefore an incentive for project developers to seek repeated, similar projects rather than a diversity of types (Chadwick, 2006).

If the core components of a new methodology are similar to an existing approved methodology, for example in terms of technology used, calculation of emissions, they may be combined to form an Approved Consolidated Methodology (ACM). The EB instituted this procedure in order to have a more concise set of documents and avoid inconsistencies of treatment between projects (EB 27 Report, Annex 10, para 8). As an illustration, ACM0002 is applicable to a wide variety of renewable energy projects including new installations and capacity increases, retrofit and replacement of existing facilities. The technology involved can be hydroelectric (run-of-the-river or reservoir), wind, geothermal, solar, wave or tidal provided that it is grid connected as emissions reductions are calculated in relation to the electricity system that the project connects to. ACM0002 (version 12.0.0, 2010) combines and supersedes 8 previous methodologies submitted with projects including a wind farm in Jamaica, a hydroelectric scheme in Panama and a geothermal plant in Indonesia. It is not applicable to projects where the energy produced from the new equipment displaces fossil fuel use on the site of the project, or includes the use of biomass for power generation, or hydroelectric projects with an energy:reservoir area ratio of less than $4 W/m^2$; these circumstances have separate methodologies.

There are also requirements for a Party to be eligible to host CDM projects. It must have signed and ratified the UNFCCC and Kyoto Protocol, established a Designated National Authority (DNA) with the capability of examining and approving CDM projects, and develop a set of project approval criteria that implement the sustainable development requirement of the CDM. DNAs may have different organisational arrangements either; i) within existing government departments; such as in Malaysia where the Ministry of Natural Resources and Environment has been appointed as its DNA, ii) constituted as an inter-ministerial committee; for example China's DNA, the National Development and Reform Commission (NDRC), which approves Chinese CDM projects in consultation with the Ministry of Science and Technology (MOST) and the Ministry of Foreign Affairs (MOFA), based on the as-

sessment results of the National CDM Project Examination Board, or iii) or existing as an independent body; such as Indonesia's DNA, the National Commission for Clean Development Mechanism (NC-CDM) (Curnow & Hodes, 2009, p20).

DNAs also act as the main point of contact for investors looking to participate in CDM projects within the Party and may contribute to identifying, promoting and attracting finance and work within national government to foster supportive legal and administrative conditions. Their capacities may be a significant influence on the geographical distribution of CDM projects. As of May 2010, just 58 of the 5955 projects submitted to the CDM (including those rejected and withdrawn) are located in the Least Developed Countries (LDCs)[12]. 32 of the LDCs host no CDM projects at all, with 16 of those having no DNA in place. De Lopez et al. (2009) suggest that the costs of operating an effective DNA are higher than fees levied on such low numbers of projects and in reality LDCs frequently operate 'paper DNAs'. This is by no means the only barrier to LDC participation in CDM projects although it is a procedural necessity.

Finally, it should be noted that the CER yield of different projects varies over eight orders of magnitude ranging from an LED lighting scheme in a single building that is projected to generate just 2,260 CERs in its ten year crediting period (Project 4759, Bucheon Fawoo, Korea) to a HFC-23 project that is expected to produce an incredible 219,182,229 CERs over a 21 year period (Project 0472, HFC-23 Decomposition Changshu 3F, China). For context, the 10 million CERs awarded annually to the Changshu 3F are claimed to represent reductions equivalent to the annual GHG emissions of Kenya or Luxembourg, ranked 94th and 95th of 213 nation states with data available (UNSTATS 2010). Issuance up to 2010 has been dominated by very large early entry industrial gas projects with 76% of credits issued being based on reductions of HFCs and N_2O. As more projects have entered the pipeline and they begin earning then this balance will change but it is expected that reductions in CO_2 emissions will only account for 54% of total CERs earned before 2012 (derived from CDM Pipeline May 2010). Whilst burning fossil fuels for energy is the most economically ubiquitous and pervasive source of GHG emissions, more than half of CDM credits will come from projects that reduce methane N_2O and HFCs.

In summary, there is a hierarchy of institutions that determines the eligibility of ac-

[12] There are presently 49 nations recognised by the United Nations as LDCs representing "the poorest and weakest segment of the international community". The classification is based on population, gross national income and two composite indicators of economic vulnerability and human assets.

tivities presented as mitigation projects to receive credits. The possibility of emissions trading and crediting was initiated in the Kyoto Protocol, the general principles of the CDM were broadly set by the Marrakesh Accords with further guidance issued by COP/MOPs, methodology approval is given by the EB and MP setting the framework for acceptable types of projects, whilst DOEs make the recommendations on individual cases. Methodologies and hence project eligibility have evolved through a "case law" procedure[13], as project participants make submissions and the Methodology Panel and Executive Board assess them setting precedents with consequences for other similar projects.

6.3. Owning credits: issuance, registries and legal title

As credits are intangible entities a system for recording their existence and ownership is necessary. When they are issued, the instruments come into being in a single database known as the CDM Registry. Title a credit is assigned uniquely and enables regulators to check that multiple entities are not claiming the same emissions reductions, an issue know as double selling or double counting. As a condition of participating in the Flexibility Mechanisms, Annex 1 nations must have their own compatible national registries to record their holdings of different Kyoto units and receive CERs. Each CER carries a unique serial number, documenting the Party of origin, project identity and commitment period, and can be recorded in only one registry account at any one time (FCCC/KP/CMP/2005/8/Add.1, Appendix D). The self standing CDM registry allows Parties that have not yet developed their own registries, i.e. some non-Annex 1 Parties, to hold an account and take possession of credits. Once credits have been received they can be transferred to a buyer's account in the national registry of another Party. The transfer is conducted via the International Transaction Log, a computerised system that records the movement and cancellation of instruments and verifies that transactions are compliant with the

[13] It should be noted that the legal accountability of various participants in the CDM is not clear, especially the Executive Board itself and individual members of the EB who act in personal capacity and not as representatives of their Party. The EB has received threats of legal action from project developers unhappy with its rulings, however it has not yet been tested in the courts despite the substantial financial interests at stake (Streck and Lin 2008 Making Markets Work). There is no appeals process so the possibility of apparently arbitrary and final decisions is of concern to private investors and a repeated source of requests for reform either through rules on due process, opportunities to request review of decisions or the creation of an independent ombudsman.

terms of the Kyoto Protocol (Barreca, 2010)[14].

A key feature of the CDM is the participation of non-state actors in the exchange of instruments. The Letter of Authorisation, required for registration of the project initially, transfers the right to the CERs subsequently issued to a project from the national government to the project participants. Individual accounts can be held in national registries by legal entities if approved by their respective DNA. It is in this way possible for CERs to be issued to any public or private organisation named on the PDD which can then transfer title and use rights to the CERs to another organisation or surrender them for national regulatory compliance.

The CDM Registry, national registries and ITL allow secure assignment of ownership and confidence in the accounting of the CER instruments once they have been created. The registries contribute to framing property rights in the CERs, not in the emissions or emissions reductions themselves. Use rights, the effect that possession of the unit achieves, are subsequently developed in national jurisdictions (Wemaere et al., 2009, p42). As a result of a stable ownership structure, exchanges between agents can be conducted without fear of dispute, loss or theft. Contracts between independent entities can then be drawn up for the delivery of CERs, at a particular point in time and at a certain price with confidence. This is the basis of market exchange and can occur entirely separately from the processes of production and consumption of the instruments.

[14] Records of issuance to projects are publically available through the UNFCCC website http://cdm.unfccc.int/Issuance/cers_iss.html.

7. Calculating and Qualifying the Units of Exchange

7.1. Establishing additionality

CDM credits are awarded on the basis of putative reductions from a baseline rather than on measured GHG emissions to the atmosphere. Logically, for such instruments to stand for emissions reductions in exchange, it must be shown that the difference between the baseline situation (discussed further in section 7.2) and the actual measured circumstances, defined in the PDD as *the project*, would not have happened under "business as usual" conditions. If the project would have been initiated regardless of the award of credits then any claimed reduction is materially meaningless; all that remains is a monitoring and accounting process[1].

There are two problematic aspects to awarding credits in this way; firstly whether or not the project activity occurs as a result of the crediting, the issue of additionality, and secondly what quantity of credits should be awarded to a particular project, the issue of quantification. It is impossible to directly measure the alternative case without the credits as it does not occur. A subjective decision is always required in deciding whether an activity is additional or not. This has been recognised by regulators and researchers since the start of the CDM. Investigating what was, prior to the Marrakesh Accords, referred to generically as "joint implementation", Jackson et al (2001, p4) note that "JI labours under an almost intractable epistemological problem, namely; the irreducible uncertainty arising from the counterfactual baseline against which emissions reductions and costs are measured.". Or, as Dan Welch memorably phrased it "Offsets are an imaginary commodity created by deducting what you hope happens from what you guess would have happened." (Welch, 2007).

[1] The biophysical and economic consequences of this 'false positive' also depend upon how the credit is consumed. If it is simply recorded in an account and plays no role in social or individual decision making then there is little problem.

A case for additionality may be presented in different ways but ultimately a judgement must be made by a consumer, auditor or management board to accept that the emissions reductions claimed are meaningful. Within the CDM, claims to additionality are determined in the first instance by the DOE checking the PDD prior to submission for registration (see section 7.3). The canonical definition is that "A CDM project activity is additional if GHG emissions are reduced below those that would have occurred in the absence of the registered CDM project activity" (CMP/2005/8/Ad1, p16 paragraph 43). That is to say, emissions reductions claimed by a project should only be rewarded with credits if the savings claimed are the result of the award of credits and are not 'business as usual' (BAU). Whilst the Marrakesh Accords offered general guidance on the approach to be taken, the detailed interpretation of additionality was left to the CDM EB. In 2004, the EB introduced a standardised tool kit[2] that can be specified in project methodologies and which presents a series of questions that must be addressed by project participants. A synopsis of the additionality toolkit flow chart, adapted from CDM in Charts v11.1 (Mizuno et al., 2010) is presented in Box 7.1.

7.1 CDM Additionality Tool

Participants must identify alternatives from which to choose a single business as usual case against which to define emissions reductions

(a) Describe realistic and credible alternatives investments that project participants or similar developers might make to achieve the "outputs or services comparable with the proposed CDM project activity" (EB39, Annex 10, page 4). For example different electricity generating infrastructure, alternative manufacturing processes or equipment for a given product, often including, and justifying, no change to present circumstances.

(b) Establish regulatory additionality; if a project is implemented to meet existing legal obligations then it is not additional. This is not sufficient alone to demonstrate additionality. Illegal activity can be consider as an alternative if the project participants "show that those applicable legal or regulatory requirements

[2] Tool for the Demonstration and Assessment of Additionality v1 (EB 16, Annex 1). If the additionality tool is specified in a methodology then it is mandatory when using that methodology so there are multiple incentives to use it rather than make individual justifications and submit a bespoke methodology.

are systematically not enforced and that noncompliance with those requirements is widespread in the country" (EB39, Annex 10, page 5).

Investment analysis to determine whether the project is a financially attractive option without the revenue from CER sales or is likely to be financially attractive in comparison to alternatives in the same market. If the project is shown to be financially attractive then the barriers test is required. This section is further augmented by "Guidance on the Assessment of Investment Analysis v2" (EB41, Annex45).

(a) Determine appropriate method; where the project generates no financial gain, such as the installation of "end of pipe" abatement technology in existing plant, then use Option I, otherwise II or III.

(b) Apply analysis, gather data for:

Option I: Simple cost assessment, document the costs associated with the project and the alternatives outlined. If the project is more costly than at least one alternative then step 3 is not required.

Option II: Investment analysis where project generates revenue outside of sales of credits, such as from the sale of electricity. "Identify the financial indicator, such as IRR , NPV, cost benefit ratio, or unit cost of service most suitable for the project type and decision-making context" (EB39, Annex 10, page 6).

Option III: Benchmark analysis, identify an appropriate indicator as per Option III but make comparison against "the market" and not a specific developer's decision making rationale or profitability.

(c) Calculate financial indicators and make comparison between alternatives documenting and justifying relevant parameters in the PDD. This section is further augmented by "Guidance on the Assessment of Investment Analysis v2" (EB41, Annex45).

(d) Apply sensitivity analysis to test robustness of conclusions to variations in key assumptions such as credit rate, discount rate on future revenue or project costs.

Barriers test to determine if there are barriers that prevent the project specified from going ahead but not one of the alternatives. The CDM must be shown to

alleviate one of the following barriers to the project progressing. This should be supported by with independent data or expert reports.

(a) Investment barriers, other than simple profitability as detailed in 2, for example equivalent projects using the same technology in the same region have only been commissioned on non-commercial terms or that private capital is witheld due to perception of host country risk demonstrated in credit rating or credible reports.

(b) Technology barriers, in terms of skills or additional infrastructure that are unavailable or present a risk to the project's success and justify greater investment returns.

(c) Prevailing practice, the project is the first of its kind and cannot secure support.

(d) Other barriers as detailed and justified by project participants.

Common practice test to show the project to be disimilar to other activities in its locality or industrial sector as a 'credibility check'. All projects should describe analysis of other similar activities, outside of those involved with the CDM, and if they exist provide a justification why there are financial or other barriers specific to this project.

As Chomitz notes "Additionality is an inherently unobservable characteristic of projects. Conceptually, a perfectly accurate additionality test implies a perfectly accurate behavioural model which specifies the conditions under which the project would be undertaken" (Chomitz, 2002, p36). The CDM's procedures attempt to collate sufficient information on which to characterise these conditions and a behavioural model. Whilst being framed as 'tests' and accompanied by more specific guidance in documents such as 'Guidelines for Objective Demonstration and Assessment of Barriers' (EB50, Annex 13) or the Validation and Verification Manual (EB44, Annex 3), there are rarely unequivocal answers to the questions posed even when the content of the tests is prescribed (Michaelowa, 2005). This is the case for each component of the additionality tool. Even compliance with national legislation, which would appear to be relatively straight forward to determine is vulnerable where such legislation is not finalised or effectively enforced.

For instance, Africa's largest CDM project, the Pan Ocean Gas Utilisation Project in

the Niger delta (Project 2029), is anticipated to earn over 2.6 million CERs annually on the basis that it destroys methane released from oil wells that would be otherwise combusted in open flares. The "business as usual" case presented in the PDD is that the flares continue as they have done for the previous thirty years despite the well documented impacts on human health, local agriculture and ecosystems (Jike, 2004). Although there are national regulations were enacted in 1979 to prevent such pollution (Eweje, 2006) the PDD itself notes "...that gas flaring in Nigeria is an issue of concern to the Nigerian Government and numerous proposals have been discussed for many years as to how to limit such flaring. Options that have been discussed include a legal ban on flaring and substantially increasing the fines for flaring. Despite these discussions, it is clear from the volumes of gas flared that this continues to be the common practice in Nigeria and will continue so for the foreseeable future" whilst "...the payment of the fine is economically advantageous to investing in any other option" (Project 2029 PDD 2008 v05 p13). The PDD goes on to indicate that the CDM "incentive" to prevent flaring would supplant legislative processes towards a ban (Project 2029 PDD 2008 v05 p15). In registering this project the CDM endorses the legitimacy of the claim to additionality; that flaring would not be controlled despite the World Bank identifying Nigerian gas flares as the continent's largest source of emissions, Shell, the region's largest producers, announcing in 2004 that it would voluntarily stop all flaring by 2008[3] and the Nigerian national government having made repeated declarations that it would enforce an end this harmful practice.

Financial data are difficult to verify and the final justification for investment is known only to the individuals responsible for taking the decision. This is especially the case for projects which generate direct or indirect revenue streams in addition to sales of CERs for example through electricity production, reduced costs of meeting other pollution regulation, increased efficiency and reduced fuel costs (Chomitz, 2002). The test is vulnerable to manipulation because of information asymmetry between proponent and regulator as the "hurdle rate" for initiation of the project is set by the investors and the financial data for comparing cases supplied by consultants in the pay of investors (Fischer, 2005; Haya, 2007). These microeconomic considerations are subjective and especially problematic where credit revenue is a small component of total project funding and may only make a small difference to the internal rate of return. These two points can be illustrated by examining the UNEP

[3] A target that it has subsequently failed to achieve, see Shell (2008) The Elusive Goal to Stop Flares http://www.shell.com/home/content/environment_society/shell_world_stories/2008/flaring/ accessed 23/11/2010.

Risø pipeline for projects which provide financial data in their PDDs.

To May 2010, the total investment in projects registered with the CDM, is recorded as approximately US$64 billion (table 7.1). It is argued that this has been levered by the total anticipated yield of 1.8 billion CERs. The proportion of funding for projects received as credit revenue can be calculated using basic price assumptions, in this case the indicative range given by the World Bank State of the Carbon Market Report 2008. The contracts for the purchase of CERs are typically made before their issuance so price information is not typically available in the public domain[4]. Although evidence of the prices paid for CERs ought to be subject to CDM scrutiny via the validation checks made by DOEs, Schneider (2007) found that 30% of PDDs sampled presented "black box" financial additionality cases with very little information disclosed. Nevertheless, by working through estimations in an appropriate range, the variation between projects in the proportion of money from CER revenue can be seen to be substantial. Solar projects, are indicated to receive just 1% of total project investment from CER sales, which may go some way to explaining why there are just 20 projects registered. In the categories with the greatest number of projects, wind and hydro, CDM revenues make up about 10% of project investment, i.e. the bulk of the economic resources to develop the project do not come from the exchange of credits. However, in the categories generating the greatest proportion of credits, industrial gas destruction and coal mine methane, CER revenues pay for project investment costs many thousands of times over.

These figures suggest two things. Firstly, it is frequently difficult to ascertain whether the financial influence of CDM was decisive in many cases. Profitable projects may be 'sweetened' by CDM revenue but it is often too small a proportion and comes with too much of 'cost' given the time required to transit the CDM process and the risk of not being registered or not earning the quantity of credits as estimated, to be unequivocally financially additional. For example, Hultman et al (2010) present evidence from South America and India that project managers place greater emphasis on the price and trends in electricity and fuel than CER revenues. Secondly, there are those cases where financial additionality is clear but where CERs command market prices that are very much higher than the projects' marginal abatement costs. Industrial gas projects involving N_2O, SF_6 and HFCs are likely realising substantial gains, of the order of hundreds of millions of dollars, through scarcity rent, an economically inefficient situation (Wara, 2006).

[4] See chapter 8 for discussion or market structure and types of transaction.

Table 7.1.: CDM Investment in Registered Projects

Project Type	Number of Projects	Total Project Investment /Million US$	CERs Anticipated by 2012 /1000	% of Investment as Carbon Revenue at US$10/CER	% of Investment as Carbon Revenue US$15/CER
Agriculture	0	0	0	0	0
Biomass energy	283	3422	97576	29	43
Cement	19	278	21502	77	116
CO_2 capture	2	60	139	2	3
Coal bed/mine methane	26	524	62626	119	179
Energy distribution	2	12	739	62	93
EE households	7	107	967	9	14
EE industry	57	734	9582	13	20
EE own generation	136	3537	108848	31	46
EE service	5	81	330	4	6
EE supply side	19	2393	9951	4	6
Forests	14	61	110288	1818	2726
Fossil fuel switch	45	8970	44332	5	7
Fugitive	12	828	10101	12	18
Geothermal	9	543	476448	877	1316
HFCs	21	73	220143	2996	4494
Hydro	599	18486	154577	8	13
Landfill gas	159	1305	65537	50	75
Methane avoidance	323	622	246897	397	596
N_2O	62	468	3754	8	12
PFCs and SF_6	6	371	2312	6	9
Solar	20	1325	1228	1	1
Tidal	1	0	1104	3	4
Transport	3	457	1978	4	6
Wind	341	19081	143938	8	11
Total	**2171**	**63,739**	**1,794,941**	N/A	N/A

For many projects, marginal revenue from the sale of credits is argued to be decisive in gaining investment in the project. Figure 7.1 displays the spread of the internal rate of return (IRR)[5] of 2678 projects and the difference claimed by the incorporation of the revenue from the sale of CERs. Whilst this is an incomplete sample, not all projects present such detailed information within their PDDs[6], as a whole the data may be regarded as illustrative of those projects claiming financial additionality. The majority of such projects are quite profitable without CER revenue, the inter quartile range for IRRs is 6.0% to 9.0% with a median value of 7.0%, and as Shrestha and Timilsina term them they are "economically no regret" projects that may be free-riding (2002). There are four far negative outliers, with an IRR of -25% or less, but only seventy eight projects that are not profitable before the addition of CER revenue. The most profitable project, a heat recovery scheme at a chemical plant (CDM4521) has an IRR of 61.8%. When CER revenues are included the IQR increases and broadens from 9.7% to 14.7% with a median value of 11.6%. Only five projects are still not profitable, two solar, two wind and one landfill gas. However, there are 211 projects with rates of return greater than 20%, the highest being an SF_6 destruction project at a magnesium casting plant with an extraordinary IRR of 195% (Project Ref 2486). It seems to be fair to fair to say that, certainly for renewable energy projects that make up the majority of CDM activities, already profitable projects become more so and non profitable projects do not proceed far enough to be considered for CDM. This phenomenon is know is adverse selection, a feature of incentive institutions with information asymmetries and where participation, in this case submission to the CDM, is voluntary for participants (Tietenberg, 2003).

Independent sensitivity analysis of CDM projects has shown that carbon market parameters (the price of CERs and baseline emissions factors) are much less significant to the financial viability of renewable energy projects than major features of the project (load factor, electricity tariff, investment costs) (Diakoulaki et al., 2007). This may not be the case for projects whose type has produced much more variable issuance, for instance coal mine methane or landfill gas where projects have

[5] The IRR is a common metric for assessing the profitability of capital projects. It is the discount rate that makes the net present value of a project (NPV) zero and as such is an indicator of the rate of profit on a project, rather than the magnitude.

[6] By citing no source of non-CER revenue in Investment Analysis test 2a projects do not need to demonstrate financial additionality. For example, none of the 23 HFC destruction or 69 N_2O projects provides this data. It must also be noted that the figures presented here are subject to the veracity and completeness of the financial case even where data is presented. Section 7.3 illustrates the processes for examining project documentation and some of the difficulties faced by DOEs.

received just 45% and 35% of anticipated CER yield (CDM Pipeline May 2010). Financial analysis shows how incorporating such variance with price dynamics raises the sensitivity of the project case (Patel, 2008). The profitability of projects may also be highly dependent upon local corporate and income tax structures and other incentives offered to promote renewable energy such as guaranteed electricity prices and whilst PDDs are required to present sensitivity analysis there are question marks over the efficacy of DOE's assurances and whether these analyses are sufficiently rigorous (Schneider, 2007). These conclusions relate to an intractable problem known as Grubb's paradox (Sugiyama & Michaelowa, 2001) whereby "the most 'cost-effective' projects may be the least 'additional' and strict project additionality would give perverse policy incentives... any project that would only require a small incremental benefit (such as a CER at low cost) to make it proceed would also only require a small shift in market conditions to make it viable without crediting" (Grubb et al., 1999, p xxxix). This raises serious doubts over the espoused efficiency gains of the CDM over non-market policies.

The obvious response to the aforementioned problems is to suggest that the CDM strictly enforces a financial additionality criterion with a high threshold to reduce the likelihood of non-additional projects. This policy option would be an impediment to credit revenues being able to leverage other economic resources. It would also result in the exclusion of many projects that would not have gone ahead for quite different reasons than profitability. Such a situation is not tolerable to those who emphasise the CDM's role in delivering investment for activities that increase well being and access to energy in the poorer communities of developing countries (Shrestha & Timilsina, 2002). It is for this reason that the other components of the additionality tool, the barriers test and common practice test, are present but they face similar difficulties of knowledge of the counterfactual case and asymmetric information.

For example, improved cooking stoves (ICS) and biogas digester community development projects have been shown to have *negative* incremental costs as they save fuel wood which has a recognised market value (Begg et al., 2000). The projects are financially justifiable at the outset but would not be expected to occur given the lack of financial capital, distribution of materials, dissemination of designs and techniques. The authors judge that "For projects at the household level or medium scale supply projects, relying on financial assessment to judge additionality in areas where access to money is low, is not useful in determining whether a project is additional"

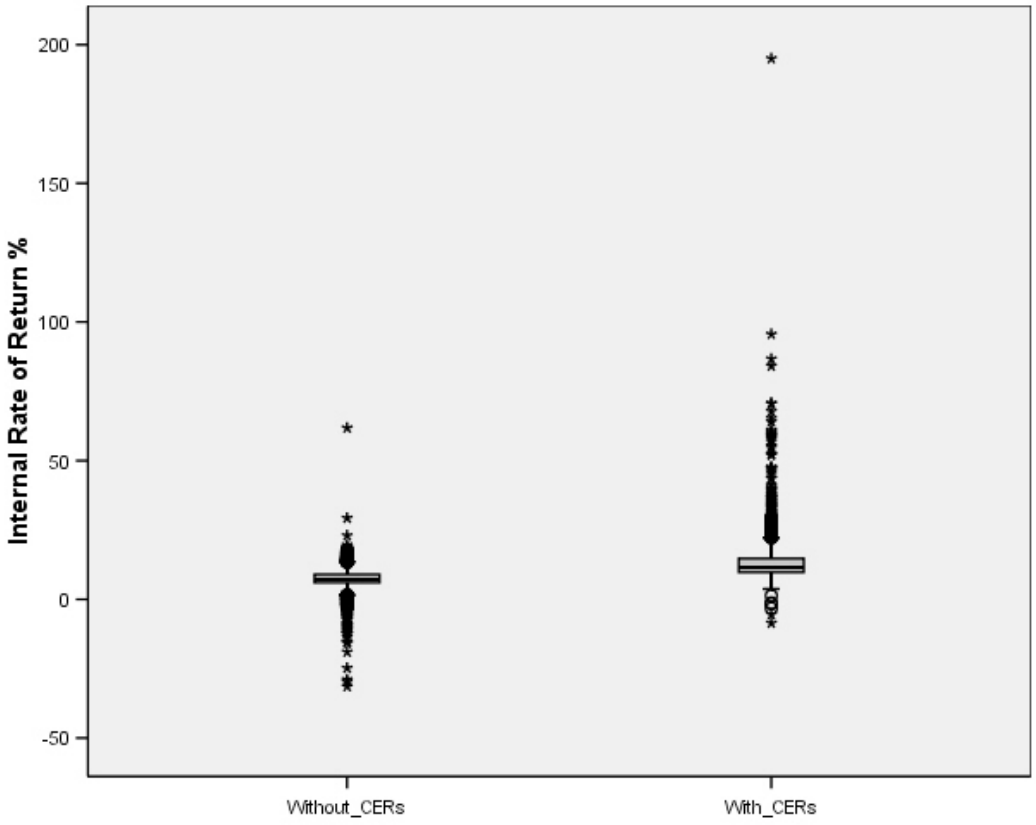


Figure 7.1.: IRR for CDM projects with and without CER revenue.
Boxes indicate the interquartile range (IQR), the horizontal lines within boxes indicate the median value, circles represent outliers (>1.5 x IQR) and asterisks extreme outliers (>3 x IQR). Data from UNEP Risø CDM Pipeline May 2010 "CDM_Projects" table, n=2678

(Begg et al., 2000, p22). However, in these cases this wood was not traded so savings were realised in time for the users of the stoves. Access to high grade energy can contribute substantially to quality of life and economic productivity for the communities involved but there is little sense of what project participants do with liberated time and what the emissions consequences of this are (see section 7.2.2 on leakage).

A sample of CDM PDDs found that the barrier test was the most frequently used means of claiming additionality, being cited in 74% of proposals (Schneider et al., 2009). However, all construction projects must to some extent overcome barriers of skills, siting, risks with equipment reliability and so on, or as Michaelowa recognises "Otherwise everybody would start projects everyday" (2005). To ascribe one to be the decisive factor will inevitably remain subjective especially in situations where government provides multiple supporting frameworks such as planning concessions, favourable taxation or proportional requirements in electricity supply (Schneider, 2009). For instance, an in depth review of hydro-electricity projects registered under the CDM in China raised concerns over multiple aspects of additionality. New projects registered with the CDM represent 5.1GW of capacity, a substantial proportion of total installation of 9GW in 2007, which should be considered against previous annual installations of around 7.7GW without CDM support (Haya, 2007). In this case, political and economic conditions are manifestly supportive, and the technology difficult to deny being "common practice", raising significant questions of any specific claims of additionality[7]. CDM documents do not clearly defined what proportion of existing similar projects constitutes common practice nor even the scale, "relevant region", appropriate for comparison (VVM EB39 Annex 2 p27). Lewis (2010) concurs that many RE projects in China are not additional but that the CDM EB is beginning to reject projects, including ten simultaneously at EB51 (November 2009), on the grounds that government subsidies had been lowered to increase the financial case for additionality. In response, the Chinese DNA and EB members pressed for greater clarity and transparency in the decision making process. While the CDM remains without numerical thresholds then there will inevitably be case by case variation. Ultimately, while introducing thresholds may increase the uniformity of judgements it would merely move the matter of subjectivity to a different location in the governance framework, from DOEs or individual EB meetings to the arena that makes the initial threshold ruling. The intractable

[7] That many such projects pass DOE approval seems largely explicable by the presence of the "E- rule" i.e. they are assessed against a counterfactual policy framework of legislation prior to the Marrakesh Accords (see page 248).

difficulties of asserting and determining additionality mean that it is the most frequent reason for the rejection of projects by the EB, a recent survey concluding that it was the cited in 67% of those projects reviewed and 82% of those ultimately rejected (Green, 2008).

7.2. Quantifying units of account and exchange

Traded GHG instruments are almost universally defined as representing a tonne of carbon dioxide equivalent and exchanged and surrendered at single, uniform rates. However, as noted earlier the instruments exchanged are not material commodities, not property rights over material commodities. The calculative procedures of the CDM examines economic activities, such as the operation of a wind turbine, and assign quantities of instruments to them. These quantities of instruments can then be subject to market valuation and exchange. There are a number of aspects to this calculative process; i) describing a baseline, ii) fixing project boundaries, iii) estimating leakage, and iv) verifying reductions.

7.2.1. Baselines & Calculations

As part of the process of establishing additionality, a range of alternative development scenarios must be outlined for each project and a credible business as usual case chosen. An emissions profile over time, the baseline, for the project is determined by making assumptions about the actions of the project participants and the "anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity" (CMP/2005/8/Ad1 paragraph 44). For example, in the case of a landfill site methane capture project, all methane spontaneously generated by the decomposition of waste is assumed to be released to the atmosphere, or for a renewable electricity project a fossil fuel plant is assumed to supply the same quantity of electricity to the grid. Figure 7.2 illustrates the baseline assumption (blue line), emissions monitoring (red line) and calculation of credits (blue area). The baseline may be defined as a constant output of emissions, or an extrapolation of current trends, or dynamically refer to economic conditions over time.

In the case of grid connected renewable electricity for instance, it is common for the baseline to be defined as the 'combined margin' a composite metric which assumes

an increase in capacity and combines the emissions factor of the existing grid, the 'operating margin', and the most recently constructed infrastructure, the 'build margin' (Michaelowa, 2005). But no such phenomenon exists in material terms. That a new plant is built and enters operation is undeniable but how the grid responds, in terms of the day to day supply of electricity and the decisions to built new facilities, according to *inter alia* marginal production costs in a competitive dispatch market, long run contracts, political commitments and physical constraints on the ability to respond to demand, depends upon strong knowledge claims from what amounts to a predictive social science. To enable crediting, these responses are modelled to generate a counterfactual case. This provides a basis for quantification but the data requirements for the best econometric dispatch models are high and may not be available in some countries, their epistemological foundations also being questionable, so ultimately baseline cases become a matter of expert judgement. This matters a great deal as i) such a high proportion of the pipeline uses grid displacement methodologies, 3592 of 6785 proposed projects, and ii) it can have substantial implications for the quantity of credits each project is eligible to receive and hence subsequently the financial case, the price of credits and the strength of an additionality claim.

Baselines calculation procedures for each project are outlined in the PDD and must adhere to an approved methodologies that have been examined by the Meth Panel. Baselines are defined in such a way that reductions due to simple cut backs in general activity at the project site are not credited. This procedure is best illustrated through an example. Taking AM0001 Incineration of HFC Waste Streams, the business as usual case is that the operators of a plant producing the refridgerant HFC-22 release HFC-23, an unwanted GHG byproduct, to the atmosphere because they are under no regulatory or normative obligation to contain this harmful pollutant. The project is to install an incinerator which combusts the HFC-23 waste stream. Reductions are calculated by monitoring the quantities of HFC-23 produced and destroyed and the quantity continuing to be released, the quantity of HFC-22 produced, and the quantity of other GHGs released due to energy consumption in the incinerator. The amount of credits that can be claimed are restricted to a fixed proportion of the total output of HFC-22 to prevent gaming of the system and increasing the proportion of the byproduct in the waste stream. This would no doubt be profitable as such projects earn enormous revenues; each tonne of HFC-23 measured as being destroyed is credited with 11,700 CERs as it is defined to have a global warming potential (GWP) of 11,700 times carbon dioxide over a 100 year period. That is to say,

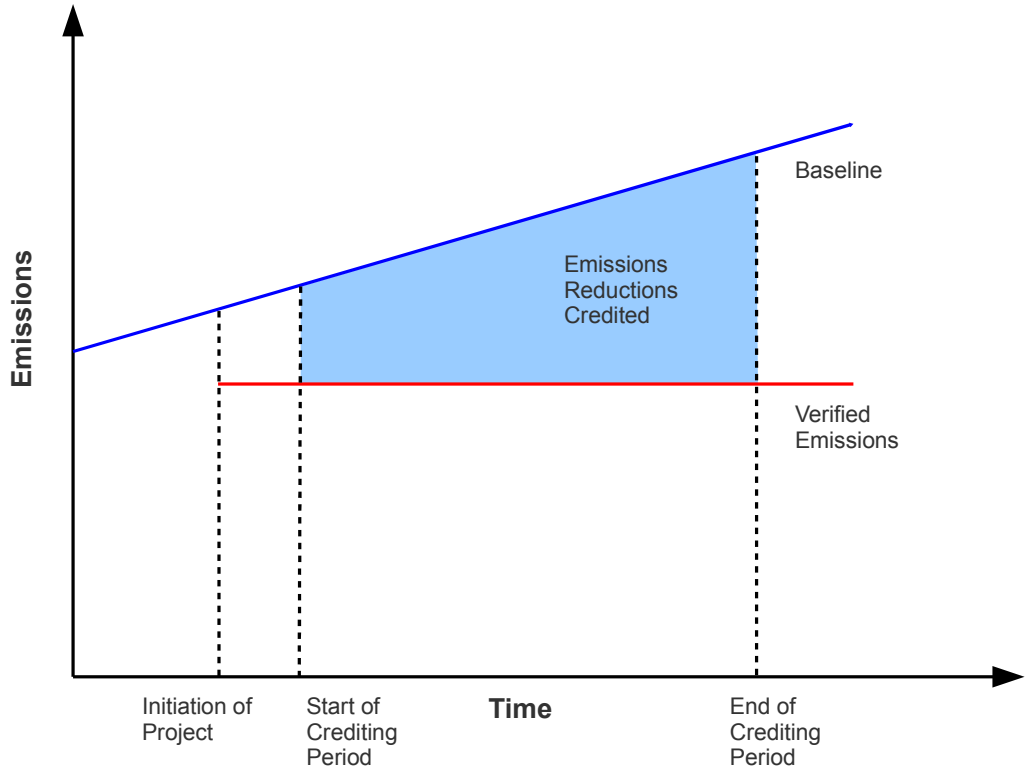


Figure 7.2.: Quantification of emissions reductions against a counterfactual baseline

one tonne of HFC-23 is said to trap the same amount of energy in the atmosphere over 100 years as 11,700 tonnes of carbon dioxide under assumptions of particular atmospheric conditions. This process of commensuration, i.e. homogenising different greenhouse gases despite their different chemical fates and scientific uncertainty over their impacts, and by implication the making equivalent reductions in the release of these gases from whatever the source, has been highlighted by MacKenzie (2008) and Lohmann (2006, 2008) although with contrasting normative conclusions. For MacKenzie "making things the same" is a political process that displays the variation within contemporary capitalism and the importance it places on stabilising scientific outputs by confining them to a 'black box'. For Lohmann, the processes of calculation are unstable and illusory, with carbon markets very unlikely to deliver the changes required to avoid dangerous climate change. That calculation is sustained, so that a market functions, reveals pre-existing inequalities in power over knowledge and economic resources.

Because they are associated with additionality, baselines are similarly problematic. Methodologies are required to be transparent and conservative, i.e. that assumptions are clearly stated and justified and where there is uncertainty over parameters a value that produces a lower baseline should be employed (EB 41 Report, Annex 12, Part III, para 4). However, as Jackson argues (2001 p4) "[the baseline] refers neither to what is happening, nor to what has happened, nor even to what might happen in future. Instead, the baseline is an estimate of what would have happened if the intervention had not taken place - an assertion which is impossible, in principle, either to verify or falsify. What makes it worse is that the indeterminacy of the baseline provides significant incentives for gaming by those involved in he buying and selling of emissions reduction credits." Lacking empirical knowledge of the non-existent scenarios, the regulator is subject to presiding over conditions of moral hazard whereby the project participants have an incentive to inflate the baseline in order to be able to claim more credits. For instance, in the case of HFC-23 destruction, the revenues earned by CER sales are so substantial that there were concerns that they would create an incentive to construct new HFC-22 plants or reinstate closed plants simply to destroy waste byproducts. AM0001 therefore specifies that the plant must have been in operation from 2005 until the start of the project and also for three years between 2000 and 2004. However, this still leaves the possibility that the cross subsidy on HFC-22 production could decrease prices and hence increase quantities produced. At the time of approval of the methodology this was not considered to be the case (MacKenzie, 2008). However, subsequent monitoring data has revealed patterns in HFC-22 production that would suggest it is being manipulated simply to yield CERs (Filzmoser, 2009) and that historically the baseline has been inflated in some cases so that a greater quantity of reductions can be claimed (Wara, 2006).

7.2.2. Leakage

Boundaries for the impact and influence of projects must be set to enable calculation of reductions, both in time and space. The emissions to be included within a project boundary are defined by the CDM as those "under the control of the project participants that are significant and reasonably attributable to the project" (CMP/2005/8/Ad1, paragraph 52). The approved methodologies detail the sources of emissions to account for within a given type of project and may vary considerably in complexity and scope. They may or may not include adjustments for direct connections with uncertain boundaries, such as GHG emissions from the production

and transport of fossil fuels to the project site or the release of methane from anaerobic decomposition of flooded vegetable matter in hydroelectric reservoirs (Kartha et al., 2004).

Projects do not operate entirely independently of wider product and energy markets and political networks so there is also the possibility of a given project having an indirect influence on emissions outside of its defined and monitored boundary. For example, projects which protect or reforest large areas of land are recognised to displace people and deforestation to other areas so that the net change in forest cover is lower than that measured within the project boundary (Schlamadinger et al., 2007). These counterproductive effects are termed leakage and are not unique to offset projects. They have been discussed predominantly in relation to emissions reductions from LULUCF (Schwarze, 2002; Ebeling & Yasue, 2008) and the incentives for heavy industry to leave regions governed by stringent emissions standards or policies (Grubb & Neuhoff, 2006; van Asselt & Brewer, 2010).

Within the CDM the matter has received comparatively little attention. Millard-Ball and Ortolano (2010) attribute this result to the disciplinary heritage and analytical predispositions of the sectoral specialists involved in the Meth Panel; engineers had dominated the early stages of the CDM as project proposals centred on industrial plants and energy technologies and they were unfamiliar with the economic tools used to recognise and account for rebound effects. Rebound effects are a general economic phenomenon whereby increasing efficiency of a process, e.g. insulating to reduce the costs of heating a home to a given temperature, leads to increasing demand so that the reductions in consumption are less than anticipated[8]. These phenomena are well recognised in transport planning, where for example, increasing road capacity may reduce congestion but also induce greater volumes of traffic, and so have been a thorny issue in the development and approval of proposed CDM transport project methodologies.

As an example of what is included within boundaries and what is not, AM0021 for the Decomposition of N_2O from Existing Adipic Acid[9] Plants, takes a baseline sce-

[8] The rebound effect was first recognised by William Stanley Jevons in 1865 and has more recently been characterised in the Khazzoom-Brookes (K-B) postulate which formally statement that "with fixed real energy prices, energy efficiency gains will increase energy consumption above what it would be without these gains". Sorrell (2007) provides a comprehensive review of the issue, including a taxonomy of direct, substitution and income effects, and indirect, due to embodied emissions in efficient technologies and secondary rebound effects.

[9] Adipic acid, 1,6-hexanedioic acid, is a simple chemical intermediary used in the production of nylon.

nario of ongoing production with unregulated release to the atmosphere of N_2O waste. Boundaries are set at the scale of the plant and the year of monitoring. Projects using this methodology earn credits for removing N_2O from the adipic acid waste stream in a number of ways; catalytic destruction, thermal decomposition and by separation for use in another industrial process. In general then, eligible emissions reductions for a plant in year y are calculated as:

$$ER_y = BE_y - PE_y - L_y \tag{7.1}$$

Where BE_y is the baseline, PE_y the emissions from the project implementation and L_y emissions increases due to leakage. These variables are expanded and defined against a host of measured process parameters and defined constants over 6 pages and 18 equations. Briefly, baseline emissions in year y are calculated with formula:

$$BE_y = Q_{N2O,y} \times GWP_{N2O} + Q\_steam_{p,y} \times EF_{CO2,Steam,y} \tag{7.2}$$

Where $Q_{N2O,y}$ is the measured quantity N_2O destroyed by the facility in year y, GWP_{N2O} is a constant, the 100 year GWP of N_2O, $Q\_steam_{p,y}$ is the measured quantity of steam generated by the project in year y that would otherwise have been produced using fossil fuels, and $EF_{CO2,Steam,y}$ is a constant, the emissions factor of steam production in the absence of the project. There are then two way of quantifying the N_2O that is destroyed in the plant, $Q_{N2O,y}$, indirectly by the measurement of nitric acid consumed by the plant, or directly by measuring the N_2O stream at the inlet of the catalytic reactor. The direct measurement method includes an arbitrary correction of -5% for the uncertainty inherent in the measurement and a weighting to prevent artificial increases in adipic acid during the period the project earns credits:

$$Q_{N2O,y} = Q_{N2O,m,y} \times 0.95 \times \frac{P_{AdOH,y}}{P_{AdOH,Pr,y}} \tag{7.3}$$

where $P_{AdOH,y}$, the maximum eligible quantity of adipic acid production, is the lowest of either production in year y, $P_{AdOH,Pr,y}$ or the maximum annual production in the three years prior to the start of the project.

Project emissions are calculated from the measured parameters of remaining N_2O emissions[10], fossil fuel consumption on site (with reference to the "Tool to calculate

[10] Where the process is not 100% effective at removing N_2O from the waste gas stream and the equip-

project or leakage CO_2 emissions from fossil fuel combustion"), grid electricity consumption, ammonia emission from the decomposition process and direct emissions of hydrocarbons from the plant:

$$PE_y = PE_{N2O,y} + PE_{FC,j,y} + PE_{EC,y} + PE_{NH3,y} + PE_{HCE,y} \tag{7.4}$$

The remaining variable in the emissions reductions equation 7.1, L_y, accounts for leakage and is very straight forward requiring only the measurement of the steam consumption of the plant, $Q_{St,c,y}$, and an estimation of the CO_2 emissions factor for the production of steam $EF_{St,c,y}$ if steam is produced outside of the project boundary:

$$L_y = Q_{St,c,y} \times EF_{St,c,y} \tag{7.5}$$

Despite going to these great lengths to capture, measure and calculate the various chemical flows at the project plant and its connection to grid electricity, there is no requirement for any of the four projects that implement this methodology to consider any market economic consequences of the CDM on their industry. However, these are pertinent as the industry is highly concentrated; there are just twenty three adipic acid plants in operation world wide and all bar one of those that are eligible to participate in the CDM have done so. There is evidence that during the 2008-2009 recession production of adipic acid shifted from plants that had fitted N_2O abatement equipment prior to the CDM to those that had done so afterwards and were earning credits (Schneider et al., 2010). At a carbon price around US$15 per tonne, CDM eligible plants can earn an order of magnitude more profit from the production of CERs than from the production of adipic acid. CDM eligible plants are therefore at a strong competitive advantage and during the recession did not reduce output whilst the rest of the industry fell by 26% (Schneider et al., 2010). This is significant as these four projects, of more than two thousand registered, account for 3.6% of the total CERs issued to date, and represents a clear case where the economic resources transferred through crediting serve to increase net emissions when wider interactions of a project and its economic context are taken into account. Schneider et al. (2010) conclude that the creation these credits is inflated by approximately 20% meaning the net effect on emissions when consumed will be an increase of 13.5 MtCO2e.

ment is not necessarily operational all of the time, for example when it is subject to maintenance work.

Nevertheless, such indirect leakage effects have historically been overlooked in the development of methodologies on account of the difficulties in calculation *ex ante* (Boyd et al., 2007). The extent and transmission of such effects will always remain a contingent and variable phenomenon, dependent upon the concrete features of the economic systems concerned such as the scale of distribution and exchange itself related to technology, history and physical properties of the commodities concerned. Millard-Ball and Ortolano (2010) suggest a variety of possible mechanisms including energy equipment price effects where production capacity is limited, the realisation of "suppressed demand" in energy systems that suffer brownouts and intermittency, and production price effects due to reduced raw material demand at project sites.

Quantification is reliant first upon the identification of changes in rates of emissions but then also upon attribution of causative mechanisms. It is clear to see why these effects are overlooked; by definition leakage occurs outside of the physical project site and so it is not trivial to identify or explain. Information asymmetries are also significant in the relationship between regulator and project proponent; without the recent recession the distortions in the adipic acid market may have been present but remained unnoticed. Vohringer et al (2006) argue that indirect leakage through economic effects is small for any given CDM project and estimates should be made and implemented at the sectoral scale. However, in relation to rebound specifically, Sorrell's review of over 500 studies (2007) noted that although variable it is wrong to assume that the effects are small enough to be negligible; in some cases they have been founded to be over 50% and when considered over the long term efficiency improvements are recognised as one of the major drivers of capitalist economic expansion (Prudham, 2009).

As noted previously leakage is not a problem restricted to crediting regimes. Any sort of emissions reduction intervention or policy can have secondary effects outside of its defined arena. However, most other interventions do not make strong quantified claims about their effects. A CER is intended to represent a physical tonne of GHG which is materialised when the credit is consumed in place of reductions in another time or place. Carbon taxes or performance standards are not measured for performance so directly. Although there may be times when estimates of their effectiveness are made in terms of physical quantities of emissions, they do not make claims to accurate correspondence.

7.2.3. Temporality

Emissions reductions instruments institute the possibility of exchanging emissions reductions not only between locations, agents and activities but also through time. The purchase of credits, the construction of a project, the award of credits and the consumption of credits are not simultaneous acts and need not occur in a strict linear fashion or in immediate succession. For instance, in 2008 primary contracts to produce new CERs outweighed their consumption CERs 4:1 because of the anticipation of future demand[11] Temporality is also relevant to additionality, quantification, leakage and the arrangement of contracts and finance.

Temporality can be illustrated with an example project timeline. Box 7.2.3 details one of the first projects to enter the CDM pipeline and one which is being considered for renewal into its second 7 year period[12]. It shows a relatively simple case of project design through to renewal of the crediting period but one which also illustrates that the sequential, production line nature of crediting is out of step with the physical processes of GHG mitigation. The project starts collecting the waste GHGs over three years before any credits are assigned to the project participants and over six years before they are consumed in Europe. It is worth considering that this need not be the case; the temporal conditions are a feature of the crediting institution, there are variations where forestry projects are concerned and indeed the voluntary market is 'innovating' to provide upfront capital with forward sales of credits to a range of project types (see section 9.3.2 on the disputes arising).

[11] State and trends (2009) records 389 million CERs were contracted in 2008 and that 87% of combined primary CDM & JI contracts were signed by European buyers, both states and private sector. Assuming proportionality in JI and CDM contracts this implies that 338 million CERs were contracted for, more than four times the 82 million listed as surrendered in the CITL.

[12] The project timeline has been assembled from the public documents on the CDM website http://cdm.unfccc.int/Projects/DB/JQA1094478108.13/view.

7.2.3 HFC Decomposition Project in Ulsan, South Korea (Project 0003)

26/09/2002	First contracts drawn up between project participants.
01/01/2003	Plant begins storing HFC23 from operations. PDD records this as start of crediting period as HFC23 is no longer being released to the atmosphere.
03/07/2003	Project announced in local newspapers.
21/10/2003	Project participants hold local stakeholder meeting.
12/12/2003	Documentation submitted to CDM to open period of public comment.
	Construction of waste treatment facility
23/04/2004	Thermal destruction of HFC23 begins, with monitoring as per PDD.
02/06/2004	Letter of Approval from South Korean DNA for commencement of CDM activity.
	Validation of documentation
24/03/2005	Formal registration as CDM project.
	Verification of monitoring reports
16/01/2006	First request for issuance of credits to CDM EB for period 01/01/2003 to 31/03/2005.
03/02/2006	937,238 CERs issued to project participants.
	Further cycles of verification and issuance follow with sale to companies regulated under the EU ETS.
30/04/2009	CERs are surrendered by power stations and industrial facilities in Europe to meet EU ETS requirements for 2008.
	Request for renewal of crediting period submitted
31/12/2009	Expiration of first crediting period.
22/05/2010	Request for review of renewal submitted by CDM Watch to EB
17/09/2010	EB states that it will examine the possibility of baseline inflation (EB 56 Report Annex 46)

In the CDM, the time period over which a project should measure emissions and claim credits is defined in its methodologies and documented in its PDD. The archety-

pal sequence for crediting would be as per the project cycle outlined on page 132. Participants plan and agree the activity they will undertake, raise capital to finance the implementation, have their documents validated by a DOE, make a request for registration to the CDM, construct, operate and monitor the activity, have a DOE verify the monitoring data, receive credits for the period of operation and then sell these credits to another entity to meet a compliance requirement. In actuality, there can be some considerable variation in the sequence of these actions but because the CDM awards credits for emissions reductions *ex ante*, i.e. after a project has been in operation and after it has been inspected for compliance (see 7.3), there is a fundamental production sequence. While forward contracts for credits, typically in the form of an Emissions Reduction Purchase Agreement (ERPA see chapter 8), enable the financing of the project prior to the award of credits, and a certain lee-way in the CDM regulations gives project participants confidence to commence construction and operation, the sequence of verification prior to issuance prior to consumption is rigid in the CDM to EU ETS production-consumption route.

Temporality is important in the cause and effect relationship implicit in the distinction between business as usual baseline and the additional project activity. By definition, for a project to be additional, the award of CERs must be central to the initiation of the project. Solely the presence of, relatively, low emissions infrastructure is insufficient to earn credits under the CDM; there are no savings if the infrastructure was built for business as usual motivations. However, it has been possible under the CDM to retrospectively apply for registration of an operational project if it can be argued that CDM support was 'seriously considered in the decision to proceed with the project activity' (CDM: Guidelines for Completing the PDD Version 6.2, p. 11), a window that was closed on 31 March 2007[13].

The idealised model of additionality is that a project is implemented or not implemented through a binary decision and that this presence/absence position is maintained indefinitely. However, some projects which have low or negative marginal abatement costs will likely be undertaken at some point in time. Upgrading industrial equipment to achieve higher energy efficiencies may be in the long term economic interests of a project owner but often there is neither the impetus or access to finance to effect these changes. Likewise national electricity infrastructure and such

[13] The date had previously been set as 31st December 2005; the substantial time taken to submit, revise and approve methodologies meant that many projects were only able to make formal requests for registration after the executive board moved the cut off deadline back on a number of occasions (DEFRA Perspectives Guide 2007 p11).

cases often use the barrier test to justify additionality. It is these projects that might also be expected to apply for credits retrospectively, as a 'bonus' income stream but not one that was essential to the initiation of the project. With rising energy prices and increasing awareness of climate change, credit revenues may only serve to bring such projects forward by 10 or 15 years (Begg et al., 2000 p39). As infrastructure like a hydroelectric dam may be in operation for many decades this raises the question of how long a baseline is valid for. Is it reasonable to use present day emissions as the basis for calculating reductions earned in 2020? It is possible to calculate the expected variation in project output as a result of shorter periods of validity in order to assess its importance in setting baselines (Begg & Van der Horst, 2004), however, these conditions must be arbitrarily assumed. There can be no *ad hoc* or *post hoc* means of determining when a project stops being additional.

This matter is addressed to some extent in the CDM by restricting projects to a choice of either a single crediting period of 10 years or a shorter 7 year crediting period with the possibility of renewal twice more (CMP/2005/8/Ad1, p17 paragraph 49). At renewal a DOE must inspect the project documentation and confirm to the EB that they believe the assumptions within the PDD's additionality case and baseline to still be valid (EB 43 Annex 13). If, for instance, legislation has been introduced requirement the control of a particular source of emissions then a project may no longer hold regulatory additionality. The converse of this is that there is a disincentive for non-Annex 1 countries to introduce such legislation as their project participants would lose their CER revenue streams. The 'E+/E- rules'[14] are intended to mitigate this moral hazard somewhat by allowing contemporary regulations that incentivise the project to be overlooked in the assessment of additionality and conversely offer no advantage to the introduction of rules that promote emissions intensive fuels to enhance the additionality claims of others by default (EB22 Annex 3). Were crediting periods to be short and re-evaluation of additionality to be frequent then the anticipated returns to a project would become more uncertain. This could then have an effect on the investment case, potentially deterring project participants due to low rates of return or high risk of losses and driving them towards safer projects less dependent upon carbon finance which are arguably less additional for other reasons (see section 7.1 p7.1).

[14] E+ refers to policies that give relative economic advantage to more emissions intensive technologies and fuels that would tend to increase emissions in the baseline case. E- policies, such as subsidies which promote less intensive technologies or fuels, would tend to weaken an additionality case.

A project may in some cases only earn CERs for a short proportion of its lifespan. This clearly has a bearing on the financial calculations that contribute to securing funding but also the additionality case. Aside from eligibility to receive credits, project participants and investors must consider whether there will be any value in credits produced decades hence. Their worth, either as a use value in meeting regulatory commitments or as exchange value on a market is dependent upon future political economic circumstances. Substantial uncertainties remain in negotiations of the post-Kyoto UNFCCC or successor agreements (2012+) and Phase III of the EU ETS (2013–2020) over the quantities, sources and vintages of CERs that will be eligible for compliance (Capoor & Ambrosi, 2009). As a result, prices for CERs to be delivered or issued post-2012 are heavily discounted on markets if not in PDDs. For example, one of the most recent entries into the CDM pipeline, the 140MW Shiyazhi hydroelectric plant in Guizhou Province, China, CDM6316 submitted April 2010, has an anticipated lifetime of 35 years from the date construction started, August 2007. The investment analysis is presented in the PDD on the basis of three seven-year crediting periods with a CER price of €8.20 and a discount rate of just 4%. From the documents presented on the CDM database it is not possible know if the contract to buy the CERs it produces, signed September 2009, is guaranteed at this price for the whole period, however it seems very unlikely given the regulatory uncertainties.

There is also a broader question of the appropriate time scale over which to attribute the consequences of a project. This is most obviously considered in the discussion of permanence of carbon sequestered in biological stores. If a project's methodology was to plant trees, that would not have been planted as business as usual, and give credit for additional carbon sequestered in above and below ground stores, then there is there is a reasonable possibility that the trees may die at some point and, through decomposition or combustion, release the carbon stored back to the atmosphere. However, the emissions released by the agent consuming the credit remain in the atmosphere continuing to contribute to radiative forcing. The Kyoto Protocol addresses this by issuing temporary CERs (tCERs) and long Term CERs (lCERs) to afforestation and reforestation (A/R) projects. tCERs are accounted for on the basis of carbon stored since the start of the project and lCERs on the basis of carbon stored within the present crediting period. When surrendered as part of an Annex 1 target both must be replaced or re-validated at the end of a commitment period, unlike regular CERs which permanently defray liability for emissions. In effect, liability for the impermanence of storage is passed to the buyer with this mode of credit eligi-

bility. The information problems and asymmetries that beset crediting are displaced and potentially compounded by moving responsibility to the buyer who may know very little about the structure and terms of the regime, nor the details of a particular project, nor have the ability to effect the progress or outcome of the project (Danish, 2009). As a result the CDM A/R mechanism has received very little uptake, with just one project registered in the CDM pipeline and eight at validation (as of May 2010). Alternative proposals include rental of credits, creation of buffer zones, seller liability and various forms of insurance policy some of which are under discussion in the related topic of avoided deforestation (Marland et al., 2001; Schlamadinger et al., 2007; Ebeling & Yasue, 2008). However, it is questionable whether these institutional arrangements would be able to handle synchronous bio-regional scale losses as anticipated in some climate models towards the latter half of the 21st century (Scholze & Prentice, 2006; Betts et al., 2008).

In the voluntary market where *ex post* crediting is not rigidly enforced, there is the further weakness that it may be many decades before the sequestration claimed by *ex ante* credit sales is biologically realised. Credits are presently being sold from the time of tree planting on the expectation that over the trees' lifetimes the carbon value of the credit will be sequestered (Gössling et al., 2007). Forward crediting is not unique to sequestration projects; it is perfectly possible to sell credits to raise capital to implement an energy efficiency or RE project, although it is not accepted in any extant compliance regimes (see section 9.3.2).

Presently within the CDM, biomass is more frequently encountered as an energy source, rather than as a carbon store. Indeed, ACM0006 Consolidated Methodology for Electricity and Heat Generation from Biomass Residues is one the most popular, with 287 registered projects (CDM Pipeline May 2010). A number of such biomass projects have received substantial criticism for their impact on local communities and loses of biodiversity, where tropical forest, or marginal land described as secondary or degraded, has been cleared for mono-cultural plantations of palms for oil in Borneo or eucalyptus for charcoal in Amazonia (Lohmann, 2006; Friberg, 2009). The CDM is accused of supporting such projects in the name of emissions reductions but leading to a variety of other unaccounted for consequences. A quirk of these projects is that because of concerns about permanence, projects of these kinds have not generally earned credits from sequestration in the plantation itself, nor even from the use of biomass as a substitute for fossil fuels. The controversial Plantar project in Minas Gerais, Brazil, uses a methodology that calculates emissions

reductions from improvements in the charcoal manufacturing facility which reduce methane emissions (AM0041), making an explicit claim that it has no effect on the type and source of fuel to the facility. The disputed plantation and the pig iron mill it supplies are claimed to be business as usual and not isolated from the emissions reducing activities (PDD Project 1051).

Palm oil related projects in the CDM claim credits from their waste stream, empty fruit bunches (EFB), palm kernel shell (PKS) and mesocarp fibre, both for the substitution of fossil fuels in heat and electricity production but also for avoiding methane releases from rotting vegetable matter. ACM0006 specifies that only waste material may be used and that the project should not lead to changes in the primary agricultural product market e.g. for the sugar, palm oil or rice that the waste is derived from. This avoids a vulnerability that other carbon accounting systems have regularly fallen in to, the assumption that biomass is renewable and as such results in net zero carbon emissions through a continuous cycle of regrowth. This cannot be sustained when the timescales of regrowth, dependent upon the original land use prior to use for biomass and the type and productivity of biomass grown, are significant in comparison to the time period of GHG radiative forcing (Zanchi et al., 2010). In the long term the assumption may well be justified but on decadal scales accounting for the sequence of flows has been instituted inappropriately by ignoring "the up front carbon debt of bioenergy" (Zanchi et al., 2010). It remains to be seen if the CDM addresses these and other inconsistencies in its land use change rules (Blujdea et al., 2010) particularly under increased political pressure to promote afforestation and reforestation projects.

The temporal implications of rebound effects and market leakages from energy and fugitive emissions projects are often not considered so carefully as for sequestration projects. In direct comparisons of biomass and energy projects, researchers typically assert that "...if emissions reductions are clearly permanent (e.g. fossil fuel is not burned), then emissions credits might be bought and sold. If emissions reductions are not clearly permanent (e.g. carbon is sequestered in a forest), then emissions credits might be rented instead." (Marland et al., 2001, p260), see also Chomitz, 2002). This is to overlook the fact that energy infrastructure and energy efficiency investments necessarily have temporal elements, the operation of a project in the present day having effects in future economic patterns and consumption. Of specific concern are rebound effects from investments that increase productivity and economic activity in economic activities associated with credited projects. From the

basis of the time period of radiative forcing from long lived GHGs Kevin Anderson argues that "Carbon dioxide and its warming effect remain in the atmosphere for 100 years. Because it is there for 100 years we need a high degree of confidence that the offsetting investments do not increase emissions over that 100 year period. Which offset broker can do a 100 year prediction? Offsets investments have absolutely no confidence limits that can be applied to them over 100 years" (Minns, 2007). Whilst there are well documented micro and macro rebound effects, see previous section 7.2.2, there is a dearth of empirical evidence on the inter-temporal consequences of CDM projects.

Arguably it may be more appropriate to judge the indirect effects of the institution as a whole which will again take care to identify and for consistency with the market approach, quantify. Proponents of the CDM contend that it has stimulated the Chinese renewables industry, acting as an incentive to innovation and increases in capacity, with an uncalculated positive leakage effect (Lewis, 2010). Conversely, there are those who argue that the likelihood of specific and economy wide rebound effects from CDM and other low carbon projects is an insurmountable challenge to quantification and that it is a poor basis for a system of exchange (Lohmann, 2010).

Finally, the inter-temporal exchange of credits has implications for overall reductions achieved by a trading institution because of the incentives it provides for leakage of a different kind. This issue was discussed in the pilot phase of the flexibility mechanisms, Activities Implemented Jointly running from 1995 to 2001, as it had the potential to reduce the stringency of Annex 1 targets. If emissions reductions credits from the interim period, 2000 to 2008, were allowed to count as equal to emissions from Annex 1 parties in the commitment period, 2008 to 2012, then there was less incentive for domestic action in Annex 1 parties in the pre-compliance period. By increasing the supply of credits available for the commitment period the exchange relaxes the annual emissions output necessary to achieve compliance. Annex 1 party emissions may therefore have been permitted to continue unabated or on a rising trajectory in the years preceding compliance than otherwise would have been the case. Parkinson et al (1999) made quantitative estimates that suggested that Annex 1 "lost action" in the interim period would likely be 30% to 60% of the quantity of credits carried over into the commitment period. The implication was that a country like the Netherlands with target of a 6% reduction from 1990 levels would actually realise the cumulative equivalent of a 2.2% to 8.3% increase (Jackson et al 2001, p220) if one considers the whole period 2000 to 2012. There is a certain "production line"

sequence and economising logic that projects must be initiated early if CERs are to be credited in advance of the opportunity for consumption i.e. the Kyoto commitment period. CERs accrued over eight years from a smaller number of projects will be cheaper than the same quantity produced over five years from a greater number of projects. However, the "early start rules" (Kyoto Protocol Article 12.10) have persisted and allowed projects to claim credits for their operation from January 2000, with the likelihood that this has further weakened the Kyoto targets[15].

7.3. Quality assurance procedures

Alongside the framework of rules that outlines CER production, specifying what activities are to count and how calculations should be performed, there are quality assurance procedures to ensure compliance with the CDM's rules. Appropriate documents are also made available for transparency and accountability of participants and the regime. These activities are primarily to ensure the effective functioning of the regime but to some extent they serve the interests of market participants. Were confidence in the instruments and accounting systems of production to fail, then substantial investments may prove worthless as they could not be relied upon for consumption purposes. As one guide to the CDM puts it, with the ultimate power and responsibility in awarding CERs, the EB "acts like a guardian of the 'currency' that the CERs embody (Michaelowa et al., 2007, p6)".

The CDM has a limited secretariat based with the UNFCCC in Bonn providing a range of administrative and clerical functions that contribute. This has grown from just six staff at the outset to approximately sixty, both clerical and technical, in 2008 (Purdy, 2009). Substantial backlogs in registration of projects and issuance of credits led to a recruiting drive through 2009–2010, but it has proved difficult to recruit staff with sufficient expertise whilst respecting policies on geographic and gender balance, meaning for example that 36% of posts in some programmes remain unfilled (CDM Executive CDM Executive Board, 2009).

The EB acts the central coordinating body that sets the CDM's rules and has the final say on most matters. However, it delegates a number of technical and review tasks to subsidiary panels. Whilst the secretariat supports the EB's activities the

[15] Emissions data for the period up to 2008 will soon become available which will allow this analysis to be repeated empirically, rather than on the basis of projections.

bulk of project level monitoring and assurance is conducted by privately contracted DOEs. These are independent auditors, predominantly profit making multinational firms, some with historic involvement in accountancy, legal and financial services, Ernst & Young Shin Nihon for instance, and others that have previously focussed on environmental management, consultancy and compliance, like ERM Certification and Verification Services. Others are business specifically set up to provide services in this market, JACO CDM for instance, and a few, such as Asociación Española de Normalización y Certificación (AENOR) and Japan Quality Assurance Organisation (JQA) are non profit making associations dedicated to industrial standardisation and quality. There are 51 organisations presently accredited as DOEs, however, the bulk of validations and verifications are carried out by just three; Det Norske Veritas (DNV), TÜV Süddeutschland (TÜV SÜD), and Société Générale de Surveillance (SGS) had performed 61.3% of validations and 74.9% of verifications. Each DOE must be accredited by the EB on the recommendation of the Accreditation Panel, which also advises on suspension, withdrawal and reinstatement of accredited status (EB 3, Annex 1, paragraph 4)[16]. Like the EB, the AP members are volunteer experts, appointed by the superior body, in response to advertised positions. Over time, the AP has been given the powers and funds to recruit *ad hoc* Assessment Teams with particular technical or geographic expertise to examine the performance of DOEs through desk reviews, observation and spot-checks (EB 9, Annex 1). The requirements for accreditation include retention of suitable personnel with demonstrable expertise in the sectors (as outlined on p139) and geographic areas in which they wish to work, suitable legal and administrative composition, appropriate insurance coverage, and internal frameworks for QA and maintaining impartiality.

7.3.1. DOE Tasks

DOEs are involved throughout the CER production process and perform a number of specific activities:

Feasibility Prior to contracting for emissions reductions and submitting for registration, a project developer may employ a DOE to examine the proposal and PDD.

Methodology Validation When submitting a new methodology, which must be in combination with a PDD, then a DOE must review the submission against the

[16] The current accredited list of DOEs is available at http://cdm.unfccc.int/DOE/list/index.html

guidelines for new methodologies and perform a completeness check on all documentation and forms prior to submission to the Meth Panel (EB 52, Annex 9).

Project Validation A DOE examines a project's documentation PDD and LoA, makes site visit(s), interviews project participant staff and local stakeholders, and assesses the additionality case and monitoring plans presented in PDD for consistency and conformity with CDM rules. If found to be satisfactory, the DOE can request registration from the EB, in which case the project will automatically enter the CDM with little further scrutiny unless 3 EB members make a "request for review". If the DOE finds the project proposals to be wanting it can specify a) clarification (CL) that more information be provided to make a judgement, b) corrective action request (CAR) where the project does not meet CDM regulations and project and/or documentation must be amended, or c) forward action request (FAR) for an matter that is not a problem at present but should be reviewed at the first verification.

Stakeholder Consultation The DOE should make the PDD publically available and both via the CDM website and more locally and invite comments during a statutory 30 day period. It must then include and account for these comments in its registration report but is not required to enter into a dialogue with any concerned parties.

Project Verification After implementation a DOE, independent of the DOE that registered the project, must review the project documentation and any CLs, CARs or FARs and verify on site that the project participants have adhered to the plans set out. The monitoring equipment, procedures, data and documentation are checked for accuracy and quality. The outcome is that the DOE rejects verification or produces a verification report.

Requests for Deviation If circumstances have changed to a small degree, such that the methodology still holds but a detail of monitoring cannot be performed as specified in the PDD, the verifying DOE can request permission from the EB for deviation. Such requests are only valid for the period of monitoring verified unless a request is made to revise the whole monitoring plan

Request for Issuance Once satisfied with all documentation, data and calculations, the verifying DOE can produce a certification report that "during a specified time period, a proposed CDM project activity achieved/resulted in the

> reductions in anthropogenic emissions by sources of GHGs as verified" (VVM 01 para 214). This constitutes a request for issuance from the CDM and CERs will be forthcoming provided that three or more EB members do not initiate a request for review of issuance within 15 days. They can do so only on the grounds of "fraud, malfeasance and incompetence" of the verifying DOE (CMP/2005/8/Ad1, paragraph 65).

Within the process, DOEs act as intermediaries between the EB and the project participants, handling all formal communications relating to clarifications, reviews, requests for issuance and other interactions. This may be an administrative convenience to reduce the risk of a cacophony of requests frustrating the EB's operation. However, it begins to reveal the importance of the DOE organisations to the functioning of this exchange system.

As the CDM Secretariat has grown in number and capability, and decisions have been made by the EB and various panels, the basic procedures have been embellished somewhat. The CDM Validation and Verification Manual was introduced in draft form in 2008 at EB39 and adopted formally at EB44, setting out the standard procedure for assessing projects. It had been developed jointly and spontaneously by three of the largest DOEs, DNV, TÜV SÜD and KPMG. Prior to its introduction there had been concerns about the consistency of different DOEs' interpretations of the CDM rules and concerns about competitive pressures and DOE liability. The Registration and Issuance Team was created and has a formal role between the DOE's request for issuance and the delivery of CERs. It has increasingly asked for corrections, outside of the full EB review procedure, to the frustration of project developers (Michaelowa & Purohit, 2007). The PDD template itself has been 'beefed up' to include greater detail on monitoring methods and plans at the outset, with the intention of forcing project participants to consider these issues thoroughly in advance to avoid delays and requests for deviation at a later stage (Michaelowa & Purohit, 2007).

DOEs are commissioned by project participants but are effectively regulators, acting as an extension of the EB. Their purpose is to ensure compliance and maintain the environmental and economic integrity of the system. As a result the EB has the power to immediately suspend or withdraw the status of a DOE. To further underline this responsibility, DOEs are liable to replace within 30 days any unwarranted CERs issued on their recommendation if an EB initiated review finds significant deficiencies in a project and the DOE's assessment (CMP/2005/8/Ad1, paragraph 22). This is

could have substantial financial implications with one issuance request potentially for CERs with a spot market value of millions of euros. The liability will of course vary with the scarcity and value of the instruments, the penalty being denominated in the same (emissions) accounting unit as the failing, not a currency fine. The most serious sanction is the withdrawl of accreditation, however, neither of these two measures have been enacted in practice. Whilst there have been 150 cases of projects rejected by the EB following successful validation reports (CDM Pipeline May 2010) the EB has been remarkably lenient on DOEs. It has initiated just 11 spot checks and as a result has issued temporary suspensions for four DOEs, including the largest three DNV, SGS and TÜV SÜD (Schneider & Mohr, 2010). A variety of reasons were cited including poor internal review, inadequate staff experience and expertise, and most significantly an absence of independent technical review (in essence the DOE had taken the proponents claims at face value). There has been ongoing criticism from NGOs and civil society groups that there is little will from the EB to operate a more robust assurance system to the extent that WWF has commissioned its own metric and ongoing audit scheme for DOE performance (Gilbertson & Reyes, 2009; Schneider & Mohr, 2010).

7.3.2. Economic Implications of Audit

The costs of employing DOEs for these sequential steps must be met by the project and may be a substantial economic consideration for small projects (Michaelowa & Jotzo, 2005). DOE fees for validation are in the region of US$8,000–30,000 for a large scale project and US$6,500–10,000 for a small scale project with its reduced complexity and depth (CD4CDM, 2007). Verification fees are approximately US$5,000–25,000 with a supplement for the first verification as the DOE employed must check the work of the other DOE that previously validated the project. Whilst there is also a DOE charge to validate and submit a new methodology, this is dwarfed by technical development costs which can be more than other quality assurance and consultancy costs combined (Chadwick, 2006). While there are simplified regulations and procedures for approval of small-scale projects (those generating less than 60,000 CERs per annum), employing auditors for validation and verification is still costly. A recent Delphi study of experts in the field estimated average total transaction costs of a small-scale project is in the order of $US45,000, which by extension represents a US$0.70 per tCO2e generated, in comparison to $US0.05 for large scale, and a minimum viable size of between 20,000 and 50,000tCO2e p.a. (Cames et al., 2007). This

incentive towards large projects has led to criticism from commentators as one reason for the low sustainable development benefits of projects implemented thus far (Cosbey et al., 2006; Olsen, 2007).

There is a tension between the economic status of DOEs as predominantly profit making businesses and the regulatory role they play in the exchange system. This is presents a certain conflict of interest as their fees are paid by the organisations they validate, a situation intensified in a market that is so concentrated (Lund, 2010). As one close study of DOE performance notes "...though the CDM was designed in a way to maximize the Executive Board's control over the Designated Operational Entities, in practice, we cannot be assured that these private agents are not pursuing their own goals, at the cost of those delegated to them." (Green, 2008, p22). The UNFCCC AWG KP, which is negotiating the successor to the Kyoto Protocol, has discussed the possibility of the EB selecting and paying DOEs itself rather than allowing project developers discretion (Stehr, 2008, p68). This approach would remove restructure the institutional incentives, however other more drastic reform would have the EB vastly increase its secretariat and perform all audit directly, removing market exchange entirely.

DOEs are active economic participants in the production and exchange of credits in other ways than as procedural auditors. Whilst they must maintain independence and guarantee no commercial or financial conflict of interest in their audit and other consultancy roles their accumulated knowledge of i) the technical details of the field they specialise in, ii) the administrative procedures of the CDM and iii) the success and failures of previous projects submitted to the CDM, places them in an ideal position to assist in "carbon asset development". With so many ways a project can fail to earn credits profitably, risk management is a key part of the production process. As a result DOEs market their services strongly, TÜV SÜD for example use the strap-line "Choose certainty. Add value". Whilst there may be no formal violation if DOEs consult on projects that they are not engaged with, these activities raise question marks about their broader regulatory disinterest.

The measurable and economically valuable output of the CDM is not material emissions reductions but credible financial instruments. Whilst the particular audit procedures of the CDM are intended to describe the material effects of a project, consistency and conformity with administrative guidelines themselves are the priorities. It is seemingly in neither the DOE's, nor the participants interests to actively pursue anything more. Rather than questions remaining as to a simple financial conflict of

interest, it would appear from my experiences talking to DOEs and project developers at trade events and workshops, that there are more subtle incentives for all parties to align themselves to the performance of regularised and repeatable audit procedures even if those procedures struggle to fulfill their promises. Even the EB, constituted by individuals representative of nation states that seek to gain politically and economically from the success and persistence of the CDM is not invulnerable. Flues et al (2008) note that the location of approved projects can be correlated to the national composition of the EB.

7.3.3. Role of National Government

A notable feature of the quality assurance procedures of the CDM is that it includes an element of national government involvement and discretion. There is a multi-step process between submission of project proposals and the issuance of CERs, to ensure that projects meet the CDM's criteria and a project must first seek Letters of Approval (LoA) from the governments' of the entities involved in the contracting of the project[17]. At this stage the Designated National Authority (DNA) of the host party must be satisfied that the project meets the sustainable development requirement of the CDM. This is one of the few aspects of the CDM where sovereignty and national priorities are ostensibly protected in the interpretation of the rules. National governments have taken different approaches to the methods and criteria for discriminating projects, for instance Brazil and Mexico use simple checklist assessments against submitted PDDs whilst China has drawn up national priorities and set preferential and discriminatory rates of taxation (Olsen & Fenhann, 2008). However, the practical consequences of this governance structure have been to reduce the broader benefits of CDM projects to host parties to a minimum through a combination of limited DNA capacity and expertise, relative to project developers, and a competitive "race to the bottom" to produce the cheapest CERs. Whilst the broad concept of sustainable development is contested, multiple surveys of PDDs and project operations have found that the CDM is failing simply to deliver against a range of non-carbon benefits to host communities (Cosbey et al., 2006; Sutter & Parreno, 2007; Schneider, 2007).

[17] Unilateral CDM projects are also permitted where the host party and project participants proceed without a buyer for the CERs (see chapter 8), however an LoA must still be submitted at some later date when an entity wishes to receive CERs in an Annex 1 national registry account (EB 18, paragraph 57).

As noted previously (p6.0.2) the utility of a CER is determined by its consumption route which has so far been dominated by the regulatory requirements of the EU ETS. The terms of the Linking Directive which allow CERs to be used to meet emissions liabilities place very little restriction on CER origin and no requirement for local benefits over and above putative emissions reductions. The result is that under these competitive pressures, the host DNA is the sole arbiter of a project's contribution to sustainable development. Whilst protected sovereignty allows some degree of national differentiation in favoured project types and terms (Michaelowa, 2003) it allows the demand side to determine the degree of supplementary benefits supplied by projects (Pearson, 2007). The Chinese state has the ability to set an approximate floor price for all primary ERPAs in the region of €10, requires that the project owner be a Chinese controlled company, and approves projects that accord with national development priorities (Ganapati & Liu, 2009). However, there is little interest in using the mechanism to forward objectives other than industrial investment. Its influential position in the market exerts downward pressure on prices for other nations that may wish to have more stringent operational criteria. The status of the DNA also privileges the national government over local communities when the implementation of projects is very rarely of national strategic importance. In contrast, the concept of subsidiarity in promoting accountability, transparency and effective environmental governance has been espoused by the European Commission in its approach to climate finance (Communication from the European Commission to the European Parliament et al., 2009) and recommended in response to the calls for reform of the UNFCCC financial mechanisms post-Copenhagen (Muller, 2009).

Over time, the CDM EB has increased the scrutiny on additionality claims, for instance rejecting Indian wind turbine projects where the project owners have publically lauded their profitability regardless of CDM (Michaelowa & Purohit, 2007). Figure 7.3 illustrates the fate of projects entering the CDM pipeline proportionately. Over this time the absolute numbers requesting registration rose from 143 in 2004-2005 combined to 717 in 2008, falling slightly to 650 in 2009. Many fewer projects were accepted unconditionally although the underlying data suggest patterns in the types of projects that were submitted being dominant rather than simply increasing scrutiny. For example, of 34 projects submitted under the Cement sectoral scope by May 2010, fourteen were rejected by DOEs, and nine by the EB under review, a remarkably high failure rate.

Whilst emphasised as essential for the environmental integrity of the system, the

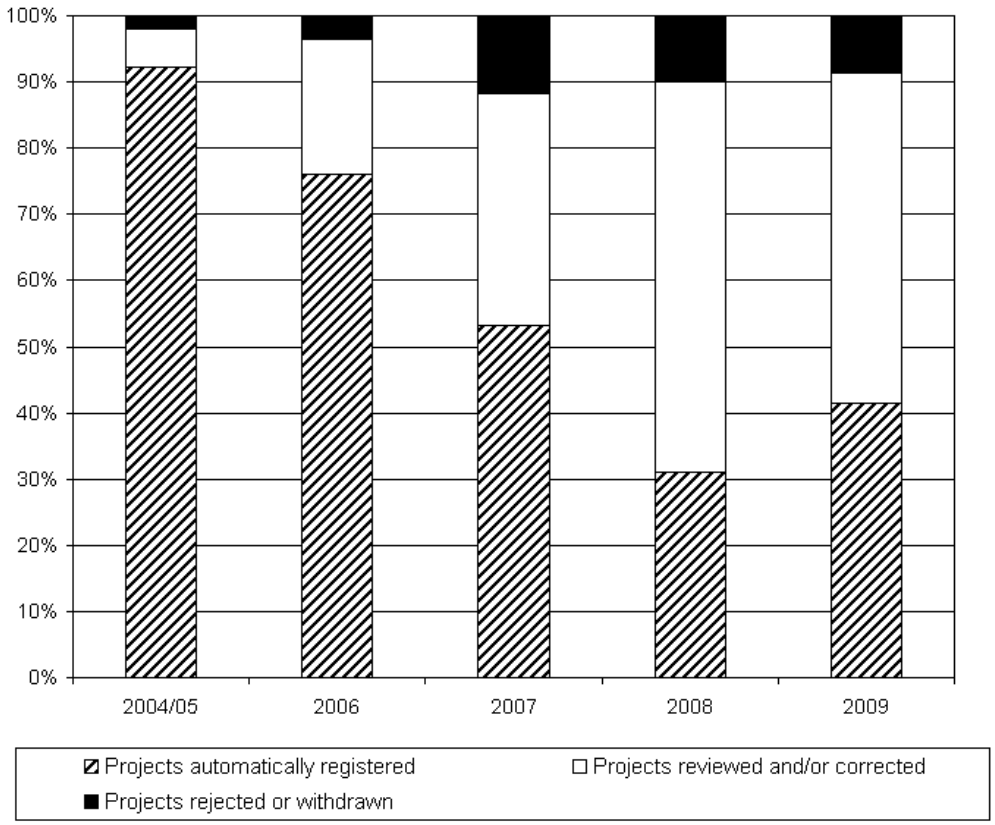


Figure 7.3.: Fate of CDM projects entering the pipeline

quality assurance procedures of the CDM are regarded by some in the industry as burdensome and bureaucratic (see Krey (2005) and the interview data presented in Chapter 9), preventing many low carbon technology projects from going ahead either by directly discriminating against them or by placing too high a transaction cost barrier, particularly in the case of small and distributed projects which are economically advantageous to the beneficiaries (Michaelowa et al., 2009). Both these perceived failings cannot be dismissed as particular to specific projects, project types or auditors, nor do they invalidate the CDM as a whole but they do point to inevitable, systemic weaknesses in crediting systems that are necessarily reliant on some form of additionality claim.

One further outcome of the assurance procedures and the requirements for public documentation is that the pipeline has been open to independent scrutiny outside of DOEs. The tension between transparency and commercial gain means that exclusions can be made in the publication of sensitive proprietary information in DOE reports, although this should not exclude necessary evidence for an additionality case or data for an emissions baseline (CMP/2005/8/Ad1, paragraph 27). The technical and bureaucratic complexity is clearly a barrier to much public engagement, but a few academic groups and large environmental NGOs with the resources to hire staff or external consultants have produced a number of critiques of the process from these sources (Haya, 2007; Schneider, 2007; Wara & Victor, 2008; Wara, 2008). The EB has acted or begun to act on a number of issues thus raised, and whilst it is superficially appealing to account for this as a result of the external scrutiny it is very difficult to tell what the UNFCCC and CDM's own quality assurance procedures would have realised independently.

7.4. Summary

This chapter has described how the CDM defines the boundaries of a project, its eligibility for credits and the volume of credits that it may earn. It has also identified difficulties in establishing i) the presence or absence of a project's additionality, ii) the counterfactual baseline from which credits are to be calculated, iii) leakage, the increases in emissions that are not accounted for in the project documentation, iv) the temporality of crediting on the project scale and the whole Kyoto Protocol scale, and v) quality assurance and the role of government. These empirical phenomena may be interpreted within the IEP framework to posit connections to broader underlying

tendencies and make comparisons with other examples of the process of instituting markets.

In looking at the first four of these issues, that together might be considered as matters of commodification, we see a fundamental difficulty with the mainstream economics ideal of pricing externalities in this way. Crediting creates property rights for claims to emissions reductions based on subjective assessments of additionality. The entities that are exchanged are themselves contingent social institutions and not property rights over physical commodities as is implied in environmental economics theory. The exchange of these credits has physical consequences but this is not through the movement of material quantities of gases around the world, nor the exchange of property rights over quantities of gas. Definitions of additionality, baselines, leakage and temporal boundaries are determined against dynamic social activities, intentions and incentives, not by looking for static, regular natural scientific laws. It is clear from the evidence presented in this chapter that the 'right quantity of credits' cannot be calculated solely by an engineer. The substantivist, institutional approach of IEP allows us to think about the social activity of instituting new ways of regulating economic activity. It problematises the issues of defining the commodity and moves beyond the emphasis that ANT economic sociology places on calculability and towards an understanding of the constellation of economic agents that participate in economic and non-economic relationships.

Each of these four commodification issues are matters of interest to carbon market participants and regulators, receiving attention in specialist news media, such as Point Carbon, ThomsonReuters, and First Climate Market Report. However, the problems are typically framed here as technical issues that may be resolved by investigation and the authority of the CDM Executive Board. The basic model of crediting as a political and subjective process is not articulated; the mantra of 'real, additional and verifiable' reductions is repeated by all agents with a common interest in the persistence of the institution. The IEP framing shows how issues such as the validity of profitable and 'economically no regret' projects for crediting (p150) and the emissions consequences of the Kyoto commitment period on the policies of governments before it (p171), hinge on the connections between the economic activity of projects or nations and the exchange of credits. This is clearest in the case of leakage from adipic acid project methodologies that do not fully consider the incentives affecting the project participants or the wider economics of the industry (p159). The IEP and the organisation of exchange approach (section 3.2) foregrounds these mul-

tiple economic relations. Indeed, the problems of quality assurance and the role of DOEs in the CDM becomes more explicable when one considers how an ostensibly regulatory institution has become an economic activity in itself. The following chapter goes on to deploy this framework fully, examining the various relationships between classes of agent.

Finally, it is worth noting the importance of national governments in exchange institutions, a theme emphasised by Polanyi. States and markets are often juxtaposed in discussions of the organisation of economic activity but the CDM demonstrates the role of states in instituting systems of exchange and then also in directing aspects of their operation. The EB and the expert panels commissioned by it are both state sanctioned and directed through the UNFCCC COP/MOPs and also populated by state civil servants. DNAs regulate the approval of projects within their borders and also have some discretion over the economic aspects of project operation. Section 7.1 illustrates the other ways states have influence over the regimes of subsidies, taxation and utility pricing that are so important to project additionality. This theme will be picked up again in the following chapter.

8. Patterns of Exchange

With the foregoing outline of the institutional arrangements I will turn to consider the exchanges that occur within existing carbon markets and begin to build up a general conceptual model of the economic agents engaged in exchange and their various institutional relations. Exchanges are typically classified by market participants as occurring within the primary market and the secondary market, the distinction being made on the presence or absence of the CER at the time of exchange. The possibility of exchange occurring without the entities on one side of the exchange being absent may seem peculiar but there are a great deal of commodity and security markets that trade in forward contracts, futures and options. In emissions trading, a great many contracts are of this kind because of the nature of the consumption process. This is related to the more significant question of the motivations for the different agents to participate in emissions trading at all.

The Kyoto Protocol places no requirement to hold or surrender CERs on private entities, only the Parties to it. Why then, should private entities wish to acquire CERs? During the compliance period 2008-2012, states with emissions over their Annex B targets will need to purchase tradeable units from other Parties either as CERs, ERUs or AAUs. There is substantial oversupply in AAUs, 'hot air', from the former Soviet Union and associated economies which collapsed in the early 1990s. However, purchase of such units would be regarded as illegitimate in the international arena, failing to meet the normative agenda of the Kyoto Protocol even whilst technically remaining in compliance. Green Investment Schemes, programmes of associating AAU purchases with low carbon policies and investment in central and eastern Europe, have attracted interest. The Japanese government has made recorded purchases and as the majority of OECD countries are emitting more than their own AAU allocations it seems likely that there will be further interest despite concerns about the environmental efficacy (Grubb et al., 2010). Purchasing ERUs via Joint Implementation would be considered a more legitimate means of securing AAUs. The JI has a similar regulatory framework to the CDM although this reduces its

economic attractiveness by placing a greater technical and administrative burden on the seller. CERs are likely to be a substantial part of Annex 1 Party compliance and the CDM pipeline lists 512 projects with a public sector investor and 28 further projects initiated by the World Bank administered carbon funds out of a total of 4534. The bulk of CERs are contracted to investment banks, industrial chemical and cement manufacturers, utility companies, oil companies, engineering firms, investment funds and specific carbon developers. Whilst some of these buyers will sell to Annex 1 Parties, demand for CERs from states represented just 10-14% of CER purchases in the period of peak activity 2006-2008 (Capoor & Ambroisi, 2008; Capoor & Ambrosi, 2009). The remaining demand originates in the EU ETS from installations that will exceed their EUA allocations and cannot use AAUs for compliance with a tiny amount from companies and individuals participating in voluntary offsetting. As a result, the bulk of exchanges are between private entities and the majority of consumers are also private entities.

8.1. Primary market

The primary market represents the first set of exchanges which initiates the production of CERs. Primary trades, that are conducted before the issuance of the credits, exist between the cited project participants i.e. developers who wish to purchase CERs, and hosts who control a facility or company which can implement the project. The most basic reciprocal obligations are therefore the supply of CERs in exchange for a defined price. The purchasing party may desire the CERs for their own compliance purposes, as in the case of Annex 1 countries or large utility companies, or they may be investing with the intention to sell on the credits at a later date, such as an investment bank commodity desk or a special purpose vehicle created solely to bear CER risks. These first contracts may then facilitate a project host and developer in securing the often substantial remaining finance to initiate the project. The importance of CER revenue in securing external investment is often cited in additionality cases and it is the ERPA that is practically used by project developers and prospective investors as the basis of other financial arrangements. It must be remembered that in cases where carbon revenue is a very low proportion of total project finance such claims should be regarded sceptically or in conjunction with other “barriers” that award of credits surmounts (see p154)

Whilst there is no one standard contract for the exchange of reductions credits there

are a number of templates that are frequently employed by market participants. The Emissions Reduction Purchase Agreement (ERPA) was first used by the World Bank and then subsequently developed by the International Emissions Trading Association (IETA) and is frequently used as a template. As the ERPA was developed primarily by an institution seeking to buy CERs for its early Prototype Carbon Fund (PCF) and IETA's interests are more closely aligned with Annex 1 entities, an alternative document, the CERSPA, with clauses and considerations more favourable to sellers was funded by the Korean and Swiss governments (O'Sullivan, 2007). The CERSPA also includes detailed supporting documentation to guide sellers who are typically much less familiar with the procedures and requirements of the CDM than developers involved in multiple projects.

By definition all primary contracts for credits are forward contracts for future delivery and rely upon an uncertain institutional process for issuance of credits, typically crossing national and hence juridicial borders. As a result there are substantial risks to project participants on both sides of the exchange so contracts contain clauses on timing, consequences of late, non or partial delivery and participants obligations to managing the project construction, monitoring and progression through the CDM process. Delivery may be a fixed volume, a minimum volume with option to purchase any surplus, or a proportion of total project yield. Prices may be fixed in advance, indexed to another market price such as the current EUA spot price or mean price over a specified period on a named exchange, or an index with a floor and a ceiling. Compliance buyers that intend to surrender the resulting CERs for their own purposes are typically happy to pay a fixed price and adopt the risk of variation as they can assess the exchange in relation to their own, known, abatement costs (Michaelowa, 2007). Speculative buyers and those looking to profit on the secondary market may be more inclined to set a floating price thus securing a rate of profit. Prices are typically denominated in dollars or euros to mitigate the risk of currency fluctuations especially where local currency is known to be volatile. Payments from the buyer may not directly go to the project host but may be scheduled to be split, with a proportion paid directly the project's financiers so as to mitigate the risk of default and reduce the cost of credit (CD4CDM & EcoSecurities, 2007). Contracts will also detail responsibility towards the settlement of taxes and fees, respective liabilities and indemnities for example in relation to staff or local laws, the legal system under which the contract is to apply, and provisions for the settlement of disputes.

To participants already involved in international commodity trades the terms and potential difficulties are often little different to their other activities save for the various risks in commodity yield that depend greatly upon social and political processes in the institution (Knox-Hayes, 2009). As a result ERPAs typically contain 'conditions precedent' to the buy and sell obligations to mitigate these specific risks; whilst advance payments may be made at the time of the contract being signed, future obligations may be conditional upon the project being validated and registered with the CDM, or that the CERs are eligible for use in the EU ETS at the time of delivery. ERPAs may also be structured to manage delivery risks by guaranteeing the sale of the first CERs up to a threshold and then providing an option to purchase on any further CERs issued.

To clarify, an ERPA defines the terms of exchange between agents rather than being a fundamental part of the genesis of the instrument[1]. This evident in that the ERPA template specifically contracts not just for CERs but also "Emissions Reductions" and "GHG Reductions". The distinction is made that CERs are the *units* issued by the CDM, whilst "GHG Reduction means are the removal, limitation, reduction, avoidance, sequestration or mitigation of GHG emissions", i.e. the physical change due to the project (IETA ERPA v2.0, 2004). Between these are the "Emissions Reductions" which are "any right, interest, credit, entitlement, benefit or allowance to emit (present or future) arising from or in connection with any GHG Reduction by the Project and includes any right that may be created under any regulatory or legal regime as a result of the GHG Reductions whatsoever". Whilst the assertion that GHG Reductions exist outside of a regulatory regime is unsupportable despite the claims of market participants, see previous sections 7.1 and 7.2, there are two important implications; i) that terms of the contract clearly situate the entity purchased as a right within a social institution[2], and ii) more prosaically imply that

[1] In their otherwise excellent account of carbon credit markets Bumpus and Liverman (2008) make the mistake of attributing the privatisation and abstraction of GHG emissions to the ERPA rather than the PDD.

[2] Whilst this is not a universally held view, in the course of interviews a number of participants of differing classes emphasised the physical nature of the emissions reductions that they were exchanging, confusing the activity of a project with a tangible quantity of gas. For instance one reported "These reductions, they're physical. So for example if you have a straw burning project, a biomass project, the fact that the project is operational, you burn the straw, there will be some CO_2 or whatever gas, saved. You're right you can't trade anything on the back of that until these are verified but there are a number of reasons why you wouldn't be able to get these verified e.g. wasn't operated in compliance with monitoring plan or conducted as best practice, or whatever reason, you may take the project to a DOE and the DOE may say no, I'm not going to verify that. And so practically speaking, something has happened, so what can you do with these then?" (I4).

such contracts sustain 'regime shopping'. Contracts drawn up in this way facilitate exchanges despite uncertainties in the project undertaken and the status of the entity to be exchanged in a developing framework, in this case before and after the period governed by the Kyoto Protocol (Carr & Rosembuj, 2007). If project participants fail to get registration and issuance under the CDM then the ERPA can remain in place for participants to submit the project under an alternative standard and complete the exchange.

There are also variations on the contract structure according to the participants' preferences for different sorts of risk in price, volume, instrument ultimately delivered or involvement in the project activity itself (Nordseth et al., 2007). Upfront payments for CERs prior to delivery are reported to be rare but may be provided by some development banks, ADB is noted for this model (Bakker et al., 2007), and incur a substantial discount on the CER price. Simple 'ERPA off-take' contracts guarantee the future terms of sale of CERs for participants, however, the degree of financial commitment and involvement in delivery of a project and its progress through CDM registration is variable. 'ERPA developer' structures require the buyer to provide technical input and guide the project in the CDM process, preparing documents, commissioning DOEs and the like in return for a reduced unit price of CERs. This structure is typically associated with small projects and the new specialist carbon market companies like EcoSecurities, AgCert and CAMCO that are, for a price, able to manage and deliver projects with hosts that would otherwise lack the technical and financial capacity (Meyrick, 2007).

Joint ventures, a more complex type of primary exchange where the CER buyer also takes an equity stake in the project as a whole, are becoming increasingly important with buyers potentially also sharing risk and reward from non-carbon revenue streams (Castree, 2009, p33). Joint ventures may be arranged through the creation of a new company with the sole purpose of delivering the project with equity investment from the project host and CER buyer. Equity positions are more likely where the CER buyer already operates facilities similar to the project host, has identified the potential for technology transfer or can secure finance on good terms (Barreca, 2010). For buyers, such arrangements mitigate both counterparty risk, that the seller does not fulfill their financial obligations, and project risk, that the project is not delivered effectively for one reason or another and fails to realise the anticipated CER yield due to mismanagement. For sellers, they can provide upfront capital, reduce risks and assist in securing investment from other investors or lenders. Increasing

the proportion of debt financing in a joint venture can also increase the return to equity investors provided that the IRR is higher than the interest rate, especially if interest payments on debt are tax deductable (CD4CDM, 2007). The degree of equity that is taken may be restricted by national legislation, China for instance through its DNA mandates that all CDM projects must be 51% owned by a Chinese entity. Elsewhere it may be possible for foreign project developers to buy out whole facilities and manage them for CER production. Project developers reported to me that they had purchased or were in negotiations to purchase whole landfill sites in the USA, Mexico and Brazil in an effort to increase CER yield in a historically under performing sector[3].

CDM modalities and procedures do not mandate the involvement of an Annex 1 Party prior to the issuance of credits. Non-Annex 1 project developers are therefore able to initiate project with their own capital, or loans secured on the anticipated CER revenue stream, and name a buyer Party at a later date in what is know as 'unilateral CDM' (EB 18, paragraph 57). The project developer may expect a higher price for CERs generated this way as they will be sold directly to the secondary spot market without any delivery or regulatory risk (see following section 191). There are those who regard unilateral CDM favourably as it permits developing country agents a greater autonomy in emissions trades and enables a greater proportion of revenue to remain in country (Del Rio, 2007). However, there are concerns that such projects do not promote foreign investment and technology transfer and Malaysia has enacted rules through its DNA that exclude unilateral projects by requiring a non-Annex 1 entity to be named on the PDD before an LoA will be provided (Curnow & Hodes, 2009). Unilateral projects are also likely to dispersed unevenly, because of the high benchmark for technical expertise and financial capital, being situated predominantly in China, India, Brazil and South Korea which already host the majority of CDM projects (Michaelowa, 2006b).

As noted earlier, states and public investors represent a small proportion, just 12%, of primary buyers. The CDM pipeline classifies 2066 of 4534 buyers as 'Carbon Market' which is assumed to mean that their economic activity is predominantly

[3] Without more detailed research it is impossible to say if the under performance of landfill gas projects in terms of CER delivery has any general emissions implications. It seems likely that methane evolution rates have been overestimated in the baseline in which case there is no ecological detriment. However, it is plausible that landfill sites could be biophysically "managed" to increase rates of methane evolution over "business as usual" and hence inflate CER output.

or exclusively based in emissions trading[4]. The largest 25 are listed in table 8.1. If banks, financial institutions and investment funds are included, it can be seen that the majority of primary contracts are signed by organisations that will not use the credits for their own compliance purposes but for sale on to others in the secondary market. However, it is not always clear where boundaries lie between compliance and financial motivations for some participants. There are a few companies, like EDF Trading, operating as subsidiaries of larger compliance purchasers buffering their exposure to price volatility. The Prototype Carbon Fund, the first primary market buyer was initiated in 1999 by the World Bank, is also a hybrid, pooling finance from Annex 1 Parties and the private sector. And a recent survey identified €10.8 billion invested in 96 "carbon funds", expected to deliver about a sixth of the total CDM yield, 300 million CERs by 2012, with an emphasis on securing CERs for compliance objectives rather than direct profit, 61% intended for the former and 38% the latter (Alberola & Stephan, 2010).

Within the primary market there also exists a class of agents frequently referred to as 'aggregators' that buy ERPAs, or forward contracts for CERs on the basis of ERPAs, and then sell other forwards contracts, futures and options, to consumers with a compliance requirement for CERs. These agents create derivatives, assets whose value is based on another entity that is not exchanged, but do not primarily operate as financial speculators trading in uniform contracts on exchanges. Rather they act as a bridge between primary and secondary market making trades for commercial gain. Whilst this activity may have no direct material consequence and hence no climatic implications it may increase the flow of primary CERs, by allowing developers to realise profits in the short term, and alter the temporal flows of resources around the system.

8.2. Secondary market

The other group of exchanges, the secondary market, relates to CERs that have already been issued into registry accounts and can be delivered immediately (sCERs). The delays in implementing the ITL meant that the first exchange with delivery did not take place until November 2007 although a few exchanges had been made contractually beforehand (Capoor & Ambroisi, 2008). As can be seen in fig 8.1 there has

[4] Unfortunately, the methodological notes that accompany the pipeline do not detail their classification method.

Table 8.1.: Top 25 entities listed on PDD as buyer by number of projects

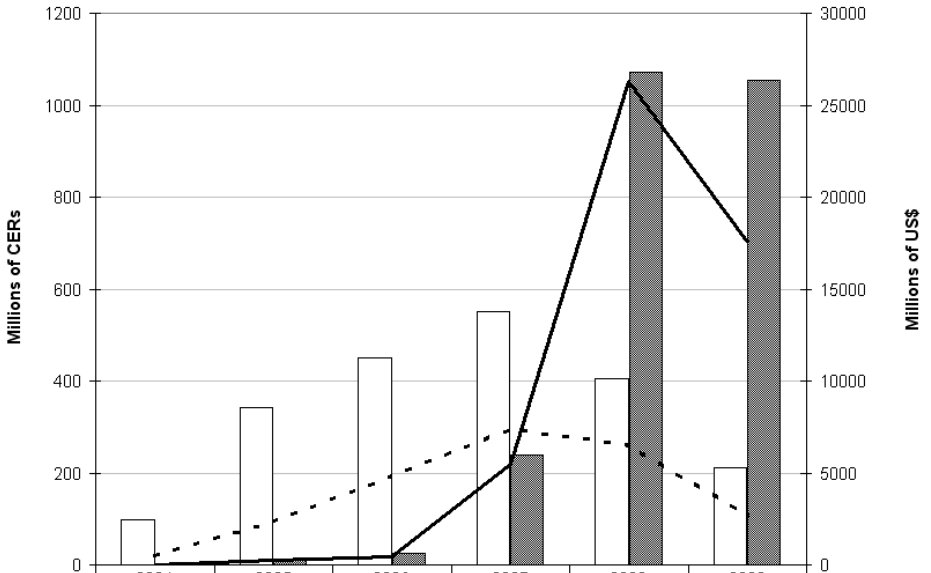
Entity	Country	Type	Number of Projects
EcoSecurities	UK	Carbon market	291
Tricorona Carbon Asset Management	Sweden	Carbon market	169
EDF Trading	UK	Carbon market	110
Mitsubishi	Switzerland	Technology	105
Vitol	Japan	Oil	105
RWE	Ireland	Utility	96
AgCert	Germany	Carbon market	96
Carbon Resource Management	UK	Carbon market	86
CAMCO	UK	Carbon market	71
Trading Emissions	UK	Carbon market	67
MGM Carbon Portfolio	Luxembourg	Carbon market	64
Danish Ministry of Climate & Energy	Denmark	Public	62
ENEL	Italy	Utility	62
Cargill International	Switzerland	Agriculture	62
Kommunalkredit	Austria	Public	60
Marubeni	Japan	Carbon market	59
KfW	Germany	Public	58
Agrinergy	UK	Carbon market	55
Essent Energy Trading	Netherlands	Carbon market	50
Noble Carbon	Ireland	Carbon market	49
Climate Change Capital	UK	Carbon market	48
Endesa	Spain	Utility	47
IBRD	World Bank	Bank	47
Deutsche Bank	Germany	Public	45
Energy Systems International	Netherlands	Carbon market	45

been a distinct peak period of primary contracting followed by subsequent rapid increase in the secondary market. Uncertainty surrounding the nature of a post-Kyoto agreement, which may or may not have quantitative targets that can be met by tradeable instruments or may include programmatic and sectoral crediting that could drive down the price of credits, combined with uncertainty around the criteria for the use of CERs in the EU ETS Phase 3 (2013–2020) has reduced the incentive for new projects to be developed. CERs that have already been issued or will be issued before the end of 2012 therefore make up the bulk of recent transactions.

Prices in the EU ETS varied widely in Phase 1 due to overallocation and substantial uncertainties in emissions data between regulators and installations and also between market participants (Ellerman & Buchner, 2008). Phase 1 was recognised to be 'learning by doing' so the overallocation problem was contained from the outset by preventing EUAs from being banked into Phase 2. Phase 2 prices fell from a record high of €28.73 in July 2008 to a low of €7.96 in February 2009, recovering to maintain approximately €13–15 to April 2010 (Kossoy & Ambrosi, 2010). Prices of sCER have been closely linked to EUAs with a spread in the region of €9–11 before July 2008, that created a strong incentive for even ETS participants that held sufficient EUAs to match their emissions to purchase CERs up to the proportion allowed in their NAP. Profits were made by selling the equivalent quantity of EUAs to another installation with short of allowances in what is known as a 'strip and swap' trade (Bailey & Maresh, 2009). These trades increased the proportion of CERs surrendered in the EU ETS towards the total limit set under the NAPs rather than limiting CER consumption to installations with short positions. For Phase 2, this was 13% of the total quantity of EAUs allocated but if the EU moves to a 30% reduction target, from 1990 levels by 2020, as it has tabled in the Bali twin track negotiations to a Kyoto successor, it will rise to represent 50% of the reduction effort (Bows et al., 2009)[5]. Phase 2 of the EU ETS is thought to be oversupplied due to the present economic downturn (Morris & Worthington, 2010) so excess EUAs will suppress the secondary market for CERs. However, the ability to bank EUAs out to 2020 means that there is incentive to continue to purchase and surrender CERs, even with a two to three euro spread, because of the added certainty the EUAs provide.

Secondary market transactions for immediate delivery can occur via a trading platform such as the European Climate Exchange (ECX), known as "spot trades", or bi-

[5] As the allocations for Phase 3, 2013-2020 were not available at the time of this work, this intention cannot be expressed as a proportion of total EUAs, however, it will be a minimum of 11%.



	2004	2005	2006	2007	2008	2009
Primary volume	97	341	450	552	404	211
Secondary volume	0	10	25	240	1072	1055
Primary value	485	2417	4813	7433	6511	2678
Secondary value	0	221	444	5451	26277	17543

Figure 8.1.: CDM Primary and secondary market dynamics. Data collated from World Bank State of the Carbon Market annual reports.

laterally between market participants on unique terms, know as "over-the-counter" trades (OTC) do not. Whilst these market and volume data indicate the dynamics of trade, only the primary market should be regarded as having any direct emissions reduction effect. CERs may change hands a number of times in the secondary market as a result of speculation by financial institutions or hedging by compliance consumers but they do not have any emissions implications. They do, however, generate public price information which had previously been only available to those directly engaging in trades. The secondary market also redistributes financial risks around market participants. Whilst it is cheaper for end consumers of large volumes of CERs, national governments and large EU ETS installations with anticipated shortfalls, to contract their own primary CERs (pCERs) there is always the risk of the project failing to achieve CDM registration or under performing in operation. Insurance providers have begun to provide specific policies against low yield or non-delivery for a variety of political, regulatory or breach of contract risks (Capoor & Ambrosi, 2007) as although ERPAs may situate the bulk of this risk with the seller, the buyer will have faced expenditure on due diligence, search costs, technical staff costs and opportunity costs in the deployment of its staff and capital. Financial institutions and investors supplying the secondary market take on this risk and price volatility but charge a mark up to end consumers. Increasingly, sophisticated structured trades are being undertaken to reduce risks to financial institutions by selling from a portfolio of CERs with guaranteed delivery for senior tranches, a middle tranche with a guaranteed percentage of delivery and a lower tranche that would take any remainder (Capoor & Ambrosi, 2009, p45).

Contracts for future delivery of CERs may be sold 'back to back' from a portfolio ERPAs, freeing up capital for further primary market transactions. The involvement of speculators in such trades have been criticised for increasing systemic risk through market bubbles and securities based on projected cash flows from a collection of ERPAs have been developed in a model akin to that which obscured the risks of sub-prime mortgage lending (Chan, 2009). Whilst these secondary and speculative transactions do not make any claim to affect final emissions budgets they undoubtedly alter the political and regulatory environment by generating powerful coalitions for the expansion of market activity *per se.* The financial value of both credits and their consumption regime are determined to a large part by political and social processes making the regime especially vulnerable to lobbying. The novelty and technical complexities provide further opportunities for regulatory capture and

'revolving door' movement of officials and experts between regulators, public institutions and private participants (Lang, 2009). Indeed, there are those who cite the creation of a class of economic agents holding carbon units whose interests are positioned against the fossil fuel lobby as a primary motivation for the creation of the EU ETS (interview respondent R9). Whether this claim is valid or not, business models that are founded on the circulation of credits and profits generated from brokerage activity, create incentives for the maintenance of lax environmental criteria on the production of credits in order to increase volume. In addition to the economic outcomes of another finance driven recession, the complexities that abound in such markets also lead to difficulties in effective regulation and greater opportunities for fraud and manipulation with climatic consequences (Lohmann, 2010).

Primary CER price data is hard to come by because contracts are signed bilaterally and confidentially so secondary sources such as the World Bank market survey are the only guide. The price of pCERs had been volatile prior to 2006 when the Chinese DNA began to provide LoAs only to projects that secured a price around €8–9 per CER (Capoor & Ambrosi, 2007). Whilst this is an informal policy, China provides such a large part of the available supply that other sellers have also been able to hold their ERPA prices at this level given the gap between CER and EUA prices. The largest economic "losses" from the exchange of credits occur as scarcity rent in the gap between primary and secondary CERs. Primary market prices have historically remained within a band of €7–12 stabilising at €9 per CER since mid 2009 (Kossoy & Ambrosi, 2010) with a consistent spread of approximately €4 to the sCER price. The primary to secondary CER spread represents about a third of the purchase price for those consumers not contracting pCERs and has been highlighted in the voluntary market as being responsible for the largest cost to consumers, greater than the money spent on project construction and operation. A recent value chain survey revealed that typically just 27% of the final retail price of a CER is spent on project implementation, the remainder being accounted for in retailer mark up and interest and dividend payments to project investors (Carbon Retirement, 2009). However, the project implementation cost elements of a pCER should not be seen as rigid or representing an objective marginal abatement cost given the complexities and subjectivity in defining additionality (see section 7.1).

8.3. Relationships between classes of economic agents involved in the CDM

Exchanges of CERs and complimentary economic flows are be represented diagrammatically in figure 8.2. The economic activity, that in its simplest form was a bilateral exchange, can now be seen as just part of a complex economic arrangement involving state, private and civil society actors in the definition, production, transfer and consumption of credits. Distinctive classes of economic agents can be identified:

Project Entities Organisations, variously privately owned companies, state owned companies, NGOs, government agencies, communities or municipalities that engage in polluting activities and can host a project i.e. an intervention or alteration that changes their GHG emissions. The entity is responsible for the construction and operation of the project.

Regulated Consumers Organisations bound by emissions trading regulations who are permitted to surrender CERs as equivalent to other traded units for their pollution liabilities. In the case of the CDM this is presently just EU ETS installations.

Annex 1 Parties Industrialised nation states with commitments under the Kyoto Protocol to hold a quantity of tradeable GHG units equivalent to their emissions caps from 2008–2012.

Non-Annex 1 Parties Developing nation states participating in the Kyoto Protocol but with no emissions caps. Designate National Authorities are mandatory government agencies that oversee CDM activity in a Party. May receive fees or taxes from project entities for carbon market or broader economic activities. May have influence over state owned companies that host or interact with project entities, for example electricity generators and distributors.

Project Developers & Carbon Funds Companies or NGOs that act as intermediaries between project entities and CER consumers. Developers may pro-actively seek project entities, prepare CDM documentation, manage submissions process and arrange project finance. They contract to buy the credits earned by the project. Carbon funds contract for CERs on behalf of consumers and speculative investors who do not have expertise or volume requirements to enter primary market directly or who wish to spread risks.

Brokers & Aggregators Private companies that buy and sell CERs both issued credits (sCERs) and futures contracts (ERPAs). These participants have no direct use for the CERs they hold.

Carbon Market Investors Private or public financial institutions that provide loans and equity to carbon market participants in return for interest payments or a share of revenues.

Product Markets Not strictly a class of agents but the wider system of economic exchange that the project entity and regulated consumers sell their outputs to, for example electricity or industrial products. For project entities these economic connections typically provide the bulk of earnings. For regulated consumers, the consumption of CERs enables them to supply to product markets at lower cost than otherwise.

Suppliers Companies that provide goods and services to project entities and regulated consumers that may be related to emissions reductions activities or the broader economic activity of the project entity.

Consultants Specialist organisations that provide technical, legal or financial advice to project entities and project developers for a fee. For graphical simplicity, law firms are omitted from the diagram as they are potentially involved anywhere that a contract is drawn up between participants.

CDM EB Body that governs the rules and procedures of the CDM. Receives payments from project entities for administrative functions and contribution to an Adaptation Fund for Non-Annex 1 Parties.

DOE Audit firms contracted by project entities to demonstrate compliance with CDM rules to the EB. May also act as consultants on risk management and project documentation.

UNFCCC COP/MOP Top level institution constituted by Parties to the UNFCCC. Issues guidance to EB, sets emissions limits and trading terms for Parties.

Civil Society Groups Diverse companies, trade associations, charities and not for profit organisations that represent particular groups' interests to Parties and the EB. May have general environmental or development agenda or more specifically address carbon markets. In terms of the latter the International Emissions Trading Association (IETA) is the largest and most active (Lovell, 2007), other examples include the Project Developers Forum (PDF), the Carbon Market Investors Association (CMIA) and Carbontradewatch.

Voluntary Consumers Businesses and individuals, predominantly operating in Annex 1 countries that offset their emissions by purchasing and retiring CERs.

Figure 8.2 is a gross simplification of actual economic activity but broadly illustrates the relationships between key agents involved in the production, exchange and consumption of CERs. Whilst offering little additional insight, it provides an overview and summation of a number of the issues outlined in the preceding chapters. It clearly illustrates the multiplicity of interconnections between participants and the possibility for novel externalities arising from these exchanges. They may be positive or negative but it would be naive to assume that system succeeds in completely internalising the effects of GHG emissions that are backed by tradeable accounting units.

Economic connections of market participants on both the buy and sell sides of the primary market may have emissions implications not accounted for in the calculative processes. On the sell side, leakage resulting from the project activity can occur temporally or spatially as described in section 7.2.2, with emissions increases from stimulated activity or decreases from enhanced technology penetration. Research suggests that the CDM is responsible for vibrant hydroelectric and wind turbine manufacturing and installation industries in China and India, with impact outside of CER trades and similarly high efficiency bagasse co-generation has been normalised across Brazilian sugar mills (Carbon Trust and Climate Strategies, 2009). One would expect such material and social developments to have emissions reductions consequences but that is very difficult to prove or quantify.

On the buy side, the economic consequences of credit exchange needs to be seen in combination with cap and trade systems, like the EU ETS. At the crudest level it is reasonable to assume that the lower cost of CERs in comparison to EUAs is reducing the burden for high emissions technology and activities. As a result there is less of an incentive for innovation and transformation in the socio-technical energy system which remains 'locked in' to fossil fuels (Unruh, 2000, 2002). This is especially likely to be the case when a large proportion of promised emission reductions effort is to be met by imported credits (Bows et al., 2009). Buyer side economic conditions also feed back through the primary and secondary CER markets in the opposite direction in times of recession. For instance, the ArcellorMittal Carbon Fund that was intended to secure 100 million CERs closed when the downturn in the European steel industry meant fewer tradeable units were required by the parent company and the wider recession provided surplus EUAs (Alberola & Stephan, 2010).

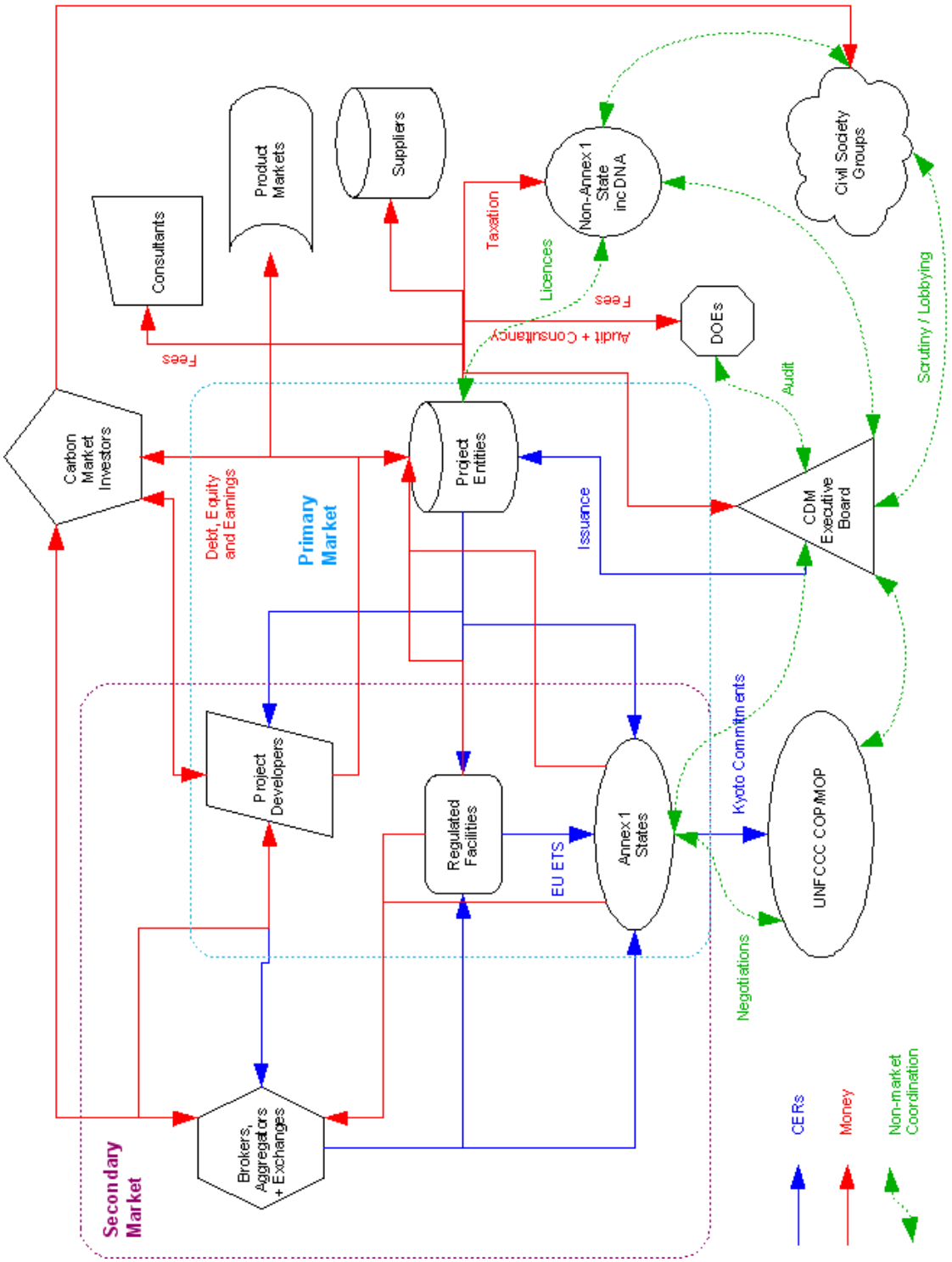


Figure 8.2.: Relationships of exchange of CERs

8.4. Non-market economic flows

In addition to the variety of market transactions that surround credit exchange there are a number of non-market flows that sustain the operation of the various crediting organisations. A fee of US$0.10/CER for the first 15,000 CERs per year and US$0.20/CER for any CERs above 15,000 CERs anticipated per year is required in advance at registration of a project (EB 23, Annex 35). This is capped at a maximum of US$350,000 but at the time of issuance it is recalculated and deducted without a maximum restriction. These charges are to cover the running costs of the secretariat, although partly as a result of its recruitment difficulties the CDM is presently running a healthy surplus of $11m p.a. with a reserve of $45m (FCCC/KP/CMP/2009/16). Also at issuance 2% of CERs issued are retained as a Share of Proceeds for an adaptation fund for non-Annex 1 parties administered by the COP/MOP (SOP-Adaptation). These credits are subsequently sold on the secondary market by the World Bank predominantly as OTC trades.

The operation of the exchange system incurs other administrative costs that may be recouped from participants. National registries typically charge fees to create and maintain accounts in addition to the brokerage and legal fees to conduct trades (CD4CDM 2007). DNAs may also levy a fee or national governments directly tax CER earnings. These may be revenue raising or serve to incentivise project types that are seen as national priorities. For example, the Chinese state taxes CER revenues from HFC projects at 65%, N_2O projects at 30% and renewable energy, energy efficiency and methane destruction projects at 2% (Schroeder, 2009a). India in comparison makes no charge, funding its DNA from general taxation. Such taxes may be levied by withholding a proportion of CERs in the host national registry or as a financial tax on the revenues generated by their sale.

The organisations that host the projects are of course also liable to various corporate taxes and depending upon the treatment of CERs as goods or securities general sales taxes may be payable. Conversely and as has already been mentioned in section 7.1, state regulated economic incentives through preferential taxation, loan guarantees and feed-in tariffs may promote particular sectors and reduce the cost of credits from certain project types. South Africa, for example, is currently amending its tax laws so that earnings from the sale of primary CERs are exempt of income tax and VAT which are expected to increase project earnings substantially, and in Vietnam, CDM projects enjoy a four year income tax exemption with a 50% discount for the

following five years (Curnow and Hodes, 2009). In some respects, this may be regarded as the broader tax base of developing economies subsidising the creation of credits for sale to rich economies.

DNA fees, CDM fees and the SOP-Adaptation, as well as the payments to DOEs at various stages, are typically borne by the seller and included in the larger package of project financing (Degouve, 2007). To the parties to the CER exchange they are production costs like any other but they represent another financial hurdle to smaller projects. As their levels and purposes are not determined by another set of market exchanges it opens the possibility for restructuring to favour particular types, locations and sizes of projects through negotiated political means. Indeed, projects in LDCs are exempt from CDM fees as an incentive to spur projects in these Parties (EB37 Annex 20, paragraph 5). The existence of these non-market flows also provides an incentive for reduced scrutiny of the environmental integrity of the production of credits. As noted in section 7.3.3, Annex 1 Parties have demonstrated little will to enforce sustainable development criteria when approving projects, instead tending to favour high yielding industrial projects.

8.5. Summary

The CDM market is comprised of multiple sets of exchanges; between entities that can earn credits and those that choose to use them to meet compliance obligations, between Annex 1 and Non-Annex 1 states, between private entities and states, between sub-national government and private entities. Credit exchanges are described by participants as belonging to primary or secondary markets on the basis of whether or not the credits are already in existence or are being contracted for production. In this chapter, the IEP framework has been used to outline the organisation of these different exchanges, identify classes of agent and depict economic relationships diagrammatically.

Within the primary market, section 8.1 shows the variety of the ways of contracting and setting prices that are predominantly not conducted through oppositional market exchange. It is only the primary market that makes any claim to emissions reductions, the secondary market facilitating the circulation of credits between compliance users and operating as an arena for commodity speculation and increasingly sophisticated financial strategies. Very little of the money exchanged for credits in

the secondary markets is seen to be invested in emissions reductions projects. By combining these outcomes with the observations made in chapter 7 we can see how credit institutions organise flows of carbon finance. The majority of economic resources invested in renewable energy projects originates from the projects' existing economic activity rather than credit sales. In these circumstances then, the financial resources flowing from end credit consumers are predominantly dissipated by financial intermediaries and the multiplicity of economic agents associated with project design, operation, permitting and audit. In effect, a regulating institution has become an economic activity in itself with incentives to increase the volume of credits produced and exchanged regardless of environmental efficacy.

The IEP framework also directs us to the non-economic aspects of relationships between exchange participants and the returns to a theme identified in chapter 7, the role of the state in governing economic activity. On the first point, the provision of technical expertise by primary market buyers, both public and private, in delivering projects and ultimately credits is the strongest indicator that exchange does not occur between atomised agents. In the most obvious case of the second point the China is known to have set informal price criteria for CERs being sold (p178). Project approval hinges on this matter, over and above any project quality oversight the DNA is mandated to perform. Because of the proportion of production originating in China there is effectively a pCER floor price not set by market equilibrium. Paradoxically, this elevated price may in fact have increased the volume of credit production and exchange by reducing price volatility and guaranteeing returns in the nascent market.

Finally, it is worth noting the substantial non-market economic flows associated with credit exchange. The anthropological approach advocated by Polanyi sees such flows as unexceptional in empirical economies. They are important both for the maintenance of the institution, for instance DNA fees and CDM fees, but also, returning to the themes of the previous chapter, to a large extent influence claims of additionality that are so central to crediting.

9. Regularising Without Regulating: Voluntary Carbon Market Exchange

In recent years concerned air travellers, well meaning celebrities and environmentally sensitive brands have engaged in carbon offsetting to mitigate the climate impact of their actions. The premise is that for a small payment, the atmospheric consequences of a holiday, home delivery or business trip can be 'neutralised' through dealings in the carbon markets. Retailers of carbon credits have sweetened the transaction by adding the prospect of non-climate benefits to those locally involved with the offset project; an Indian community may gain access to a regular mango crop through carbon forestry or UK pensioners enjoy warmer housing as the result of an insulation programme. Enthusiasts for voluntary offsetting argue that it engages polluters outside of existing regulation in issues of environmental sustainability, physically reduces emissions and provides a new source of investment in a range of worthy causes, biodiversity conservation, low carbon technology and international development for example. However, accusations of fraud and allusions to 'indulgences for climate sins' (Smith, 2007), have been echoed in words of caution from government, academia and campaign groups as they witnessed very rapid growth and innovation in the retail voluntary offset market during 2006 and 2007 (Adam, 2006; DEFRA, 2007; Gössling et al., 2007; Economist, 2007).

This chapter focuses on voluntary carbon offsetting. In its simplest terms this is an economic exchange between two participants: a transaction with money moving in one direction and a commitment to reduce emissions, often manifested in financial instruments quantified in tonnes of CO_2 equivalent (tCO2e), in the other. The voluntary aspect of these exchanges are that neither the producer nor consumer of credits is compelled to curtail their polluting activities by legal mandate. Voluntary exchange has grown rapidly and spontaneously, with an estimated US$258 million worth of transactions in 2007, up from US$58.5 million in 2006 (Hamilton et al., 2008), demand for the service coming from individuals, corporations and govern-

ment agencies. These are global developments with new emissions trading schemes developing in the US, Australia and New Zealand and international transactions in credits linking polluters in rich nations to project developers in Asia and Latin America.

An example exchange might be an airline passenger flying New York–Amsterdam paying a contribution towards the installation of a new hydroelectric dam in China that displaces coal generated electricity from the local grid. Carbon credits are typically regarded as regulatory rights; they provide a means of meeting a mandated target and avoiding sanction. However, voluntary credits confer no such right in law. This then raises a number of questions:

1. What entities are traded or services provided in voluntary markets? Why are consumers making payments if they receive no property or other right in return? Is the idea of a uniform carbon commodity borne out in practice?
2. What other activities are associated with buying emissions instruments? How do participants calculate the appropriate quantity to consume? Does this process increase or decrease their direct emissions output?
3. How do participants decide what transactions to engage in and what emissions instruments to buy and sell? What is consistent and what is variable in these instituted economic processes?
4. In what ways are these institutions similar or different to the regulated systems of exchange such as the CDM and EU ETS?

These questions will be addressed in turn, and general conclusions about these novel economic institutions and the biophysical and social implications of such free market environmentalism drawn out.

9.1. Distinguishing compliance and voluntary markets

Like the previous chapters I have adopted a Polanyi inspired institutional framework to approach the voluntary market. A simple use of the framework is to consider the differentiation of compliance and voluntary markets. As in table 6.1 on page 122, the distinction is often drawn at the role of the state or international environmental regime in setting the terms of production, exchange and consumption. For instance, the Kyoto Protocol places obligations on states to reduce emissions

and institutes an internationally regulated market of standardised units with sanctions for those who fail to meet its terms. In contrast, an individual person may voluntarily log on to the website of a carbon credit retailer of their choosing, make an arbitrary payment and receive nothing of any legal standing or utility in return. However, they may still have participated and in doing so produced a carbon trading institution.

However, by paying more attention to the different processes of consumption, exchange and production, the distinction between voluntary and compliance breaks down somewhat. For example, in the UK airline passengers are voluntarily buying and cancelling credits produced by private companies to the terms set by UNFCCC CDM. There is also often an assumption that voluntary transactions only entail credit instruments, however, one of the largest voluntary systems, the Chicago Climate Exchange (CCX), primarily exchanges allowances. It is clear that production and exchange aspects of compliance and voluntary markets overlap, however, a meaningful distinction can be made with regard to the motivation for and terms of consumption. Compliance market instruments, by definition must be recognised by national and international emissions legislation and in all present cases means that they are accepted into cap and trade systems. Buyers and sellers exchange voluntarily in order to meet legislated emissions targets, therefore the terms are set and enforced by the states which ultimately accept the instruments as meeting the targets[1]. In contrast, the governance of voluntary markets is much more diffuse as the choice of credit institution, exchange partner, quantity and terms always rests with the buyer. How this is vested with some stability is discussed in the next chapter.

9.2. The 'why' and 'how' of offsetting

It is briefly worth considering the motivations for businesses to purchase credits voluntarily. Predominantly it seems that corporate reputation and being seen to be an environmentally benign organisation were substantial. It was not clear from interviews if consumers genuinely considered offset credits to be materially equivalent to the reductions that they delivered in their own operations. The mainstream economic rationale for offsetting argues that it is more efficient to reduce emissions

[1] It should be noted that buyers are not mandated to purchase credits specifically; they may be awarded a free allocation of allowances, be able to purchase allowances from other participants, or may simply reduce their polluting activities to minimise their liabilities.

through the activity with the lowest marginal abatement cost. From a consumer's perspective this would necessitate estimating the MACs of the various options available to them and weighing this up against the cost of purchasing credits for some or all of their intended degree of emissions reductions. However, some retailers reported the lack of basic environmental data available to their clients and the number that to their surprise wished to contract them for consultancy services but did not go on to purchase credits. More than one retailer made comments similar to the below:

> Things changed quite a lot. Initially, when we went out just to sell carbon offsets, there were a few that bit and it was all very exciting, but as time went on we realised that the majority of businesses wanted advice on carbon footprints and carbon reduction so the carbon offset bit came later. Because many NE businesses hadn't even done their footprint, it was like cart before the horse to try to sell them offset, so that's what we concentrated on offering. By the end of the five years we had teamed up with [energy consultancy] so we formed a partnership with them offering carbon footprint and energy audits and reduction advice to businesses. We moved away from just selling offsets to charging for
> R2 carbon footprints and energy audits as well.

This aspect of market relations highlights a prior step in voluntary offsetting that has been cited as a central benefit. Voluntary offset retailers argue that 'carbon literacy' and individual consumer understandings of climate change are increased by voluntary credit purchases because in most cases there is an accompanying calculation of the emissions output of the activity to be offset (Evidence given by Climate Care and The Carbon Neutral Company to House of Commons (2007)). One retailer argued that they play a direct educational role:

> It is very much around reduce, replace, neutralise framework because we're not in the market of flogging offsets, we're in the market educating and demonstrating to consumers ways that they can reduce and replace their emissions and ultimately offset the rest if you like. We don't necessarily consider our success based on the amount of offsets that we sell. We think it's equally important to get hits on the website and people actually calculating their emissions created from driving and awareness
> R10 raising in that regard.

Another focused on the measurement services, audit and reductions targets that they also provided alongside credit retirement:

> We carry out carbon audits. We'll go into an organisation and we'll produce a carbon footprint document for the organisation itself or for a product up to PAS 2050 standard and use the GHG Protocol for organisational foot-printing. We'll do the foot-printing part first, then provide full carbon management strategies for organisations and then offsetting as well.
>
> R8

The implication is that as well as funding mitigation projects elsewhere, those purchasing credits better understand their own climate change impact and hence reduce it. Evidence for this is tenuous, both in terms of the depth of literacy fostered and its secondary consequences. A recent postal and online survey followed up with sophisticated statistical analysis found that individuals that purchased offsets were more likely to undertake multiple flights in a year than those who did not (Whitmarsh, 2008) and were also more likely to have a self identity that favoured offsetting (Whitmarsh & O'Neill, 2010). This might suggest that voluntary credit purchases were secondary behaviour following on from other preferences or pre-existing "guilt" and that calculation had little dispositional impact.

It would appear that a similar trend is developing, of business consumers that have no legal liability for their GHG emissions voluntarily measuring and monitoring their output as a necessary precondition for offsetting. Interviews with business consumers suggest a variety of justifications, not all of which would necessarily encourage direct reductions. One was quite bold in arguing that offsetting provided a political risk management strategy that would enable things to carry on as before:

> If you listen to the policy debate and you listen to the public debate and you look at the scientific debate you have to of course take this issue really seriously. Taking care of this or really being proactive about this ensures the growth, the continuing activity of your business. You can think of other industries in the past that had challenges and they didn't look at their challenges seriously enough and their business model collapsed. Look at the tobacco or the fur industry. Other really bad industries that didn't take care of their issues... And thereby ensuring, there's never a guarantee but at least try to ensure that our customers can continue flying the way that they have in the past, thereby keeping them able to do what they used to do. In that way it also makes sense for our customers. If you were honest and you are serious about this and you can convince the general public or environmental NGOs that you're serious about this

> then you will avoid people sitting on your planes at Heathrow Airport or so on.
>
> C3

Provided that it is credible to the expert and public audiences then cancelling credits is a simple and immediate activity in comparison to running an aggressive internal mitigation programme that may take years to realise. Some UK based businesses, The Co-op Group, Marks & Spencers and BSkyB for instance, are clearly pursuing both strategies voluntarily, with public statements of environmental performance targets and audited progress reports. However, claims to carbon neutrality may be regarded sceptically and the public relations effect is acknowledged as ambiguous, as one interviewee described clearly:

> We do communicate on carbon neutral but we're aware that for some people it works as a phrase but for some people it just gets their hackles up. So, I think its good from a communications perspective because once people get it its quite simple. They balance things out. But for an awful lot of people it's tarnished with some of the negative connotations that its a cop out its a licence to pollute and we're very careful in our communications that this isn't the first action we're taking, the main thing that we do is reduce our overall emissions and once we've done what we can there, recognise that we offset the rest. But, it's also a way of allowing us to do something right now that makes a difference, whereas some of the initiatives to reduce emissions are going to take months if not years to put in place. We do use the term carbon neutral but it's not our headline and we try and avoid it being taken as a headline but there is a risk that that overshadows all the rest of the stuff that we're doing which is actually more important.
>
> C6

9.3. The standardisation in the voluntary market

In contrast to the considerable and rigid bureaucracy of the CDM and EU ETS it is remarkably easy to engage voluntarily in carbon transactions. From a retailer's perspective, all that is needed is a shop or website to promote a carbon saving concept, frequently a tree or a stove, some means of advertising to potential consumers and a way of receiving payments. Indeed both of these features are provided by the e-Bay online auction site and so it is no surprise that one enterprising organisation has

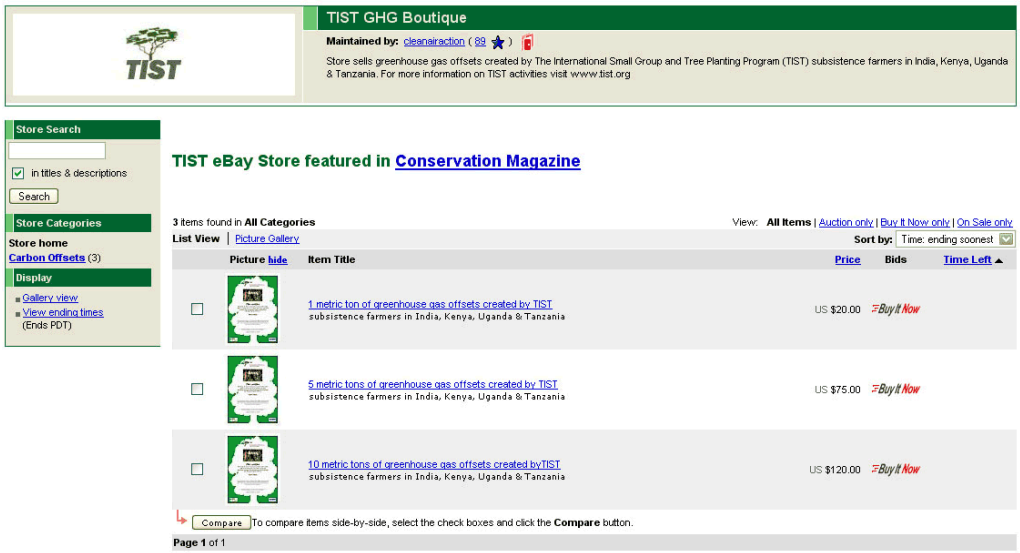


Figure 9.1.: Screen-grab of The International Small Group and Tree Planting Programme (TIST) eBay "GHG Boutique" (18/12/2007)

done just that (Figure 9.1). A 'carbon calculator' to assist your customers in quantifying their emissions is helpful, although by no means essential. A glossy certificate as a memento of their transaction may generate more repeat business but has little legal standing. Your customer may then feel free to pollute without concern because, in the words of Robert Aisi, the Papua New Guinea ambassador to the UN, "A tonne is a tonne is a tonne" whether it is stored in trees or released in burning fossil fuels (Aisi, 2005).

Although a caricature, the above example highlights both the tenuous and immaterial nature of carbon credit transactions but also the contrasting effort to format the exchange in terms of a quantified material entity. Although denominated in metric tons it is not clear what is being bought and sold, nor what the contractual responsibilities of the various parties are. In voluntary markets, the buyer does not receive a delivery of goods or experience the use of a service directly, rather money is paid and an action is performed elsewhere. This feature of transactions has been of particular concern to government regulators and NGOs wishing to implement and maintain trading systems. One interviewee was quite animated when discussing the voluntary market:

> When you're selling something that doesn't actually exist physically how much scope is there for you to not do what you said you'd do. Just com-

> pletely lacking in regulation and passionately believing that every action that someone takes that they think makes a difference has to be geared to be making a difference.
>
> R9

Without a regulatory requirement specifying the terms of exchange there is the potential for greater diversity in voluntary transactions than in the CDM. Without formal regulation, the claims that are made by retailers need only match the expectation of consumers such that they continue to purchase the product. Early transactions in the period 2000 to 2006 were primarily conducted between retailers and consumers on terms set by individual retailers. The Carbon Neutral Protocol is one example that set out how The Carbon Neutral Company would go about commissioning projects and auditing emissions reductions. However, without customers having any way of monitoring or confirming effective implementation of the project the potential for unintentional failure or deliberate fraud was great. Some respondents found that proprietary standards could gain credibility by association and the organisations that buy from them. As one interviewee recounted:

> I suppose it's implicit because [proprietary] offsets have been bought by the UN for one of its COP projects. They've been bought by international businesses who have been through tender processes. It hadn't been endorsed directly by DEFRA but [proprietary standard developer] sat on the committee to discuss the voluntary code. So it was as near as damn it, as good as there was out there at the time. It was a recognised brand, and that was important to the selling. That gave us a good kick start in terms of selling the projects and the process.
>
> R2

Credibility can also be located within the retailer's organisation if they are seen to be legitimate or reliable. In response to my question about offsetting received broad criticism in the press one interviewee argued that:

> Inevitably they came up but the strength of having a [city] council behind it, was that as much as people grumble about councils, there's the believe that it was bona fide with the council behind it. If it had been a little charity or something without the council's support it might have been different.
>
> R2

There remains the question of why multiple proprietary standards did not persist in the market? It appears that there has been little attempt to resist wider independent standardisation. One interviewee describes the situation as follows and this seems

to be borne out in later market surveys (Hamilton et al., 2008):

> They [owners of those proprietary standards] were broadly supportive, many of them said "we are only doing this because there isn't something in the market". We would prefer to have an internationally recognised base standard which we can then add our own specific attributes on. For example, there was one company that had its own standards, now uses the VCS as its base standards then adds on a couple of geographical and sustainability requirements and that's very much what we hoped for it to do. I2

They went on to describe the additional credibility that comes with recognition by multiple, external organisations and the scrutiny that comes with both comparison and audit:

> What it was was that they were all finding it a long winded process setting their own standards. It was beneficial to them to have an independent standard that was supported by a range of NGOs and businesses and other organisations so that they had something external to test their project against...There had been a lot of questions in the press about whether offsetting was a bunch of snake oil and stuff like that. They wanted to have something that brought them together to say that they were clearly doing something that was demonstrably good and demonstrably credible to separate themselves from those who weren't, and to have a public code of conduct that they would be audited against, and they can say look we are doing what we say we're doing. I2

As the CDM predates the 2005–2006 boom in voluntary retailers setting up (Gössling, 2007), it would also have been possible for organisations to retail credits generated by the CDM without the development of any extra standards. However, sCERs trade at a much higher price than primary ERPAs or similar contracts, there is a clear opportunity to increase profit margins by employing less exacting standards that meet the need for assurance but at a lower cost:

> Why would you pay a premium? Why would you bother with a compliance market when the voluntary market exists? We want to make it affordable and accessible to consumers. Its this whole idea of being assured of the value chain around these credits. R10

There is also the possibility that transactions would be conducted on some basis

other than market exchange, a simple donation or contribution to a fund for instance. Surveying the market in 2006 it was found that of the organisations identified as offering offset services online to individuals, almost all conducted transactions in credits (Gössling, 2007). Further, all the major voluntary standards use institutional analogues of the CER, the unit of exchange that is so central to the CDM, with similar controversy surrounding the definition and veracity of credits.

Credits generated outside of the CDM but validated and verified to an external set of criteria are typically referred to as Verified or Voluntary Emissions Reductions, abbreviated as VERs in both cases. Without the organising role of the UNFCCC a variety of market actors have developed autonomous quality assurance standards, formalizing different parts of the credit creation process and with varying degrees of rigour. Standards in the voluntary market typically comprise of i) rules for the validity and additionality of projects, ii) rules for the quantification of credits including methodologies, iii) quality assurance procedures, including monitoring, audit and the specifications for registries and iv) procedures for the governance of the standard itself. The most prominent complete offset standards, that include all these elements, are:

Voluntary Carbon Standard (VCS) http://www.v-c-s.org/ The VCS was initially developed as a collaboration between business NGOs The Climate Group, International Emissions Trading Association (IETA), the World Economic Forum Greenhouse Register, and the World Business Council for Sustainable Development (WBCSD). The VCS has complete carbon accounting procedures similar to CDM but relies more heavily on auditors and consultants to perform quality assurance and adopts ISO standards (14064-1:2006, 14064-2:2006, 14064-3:2006) as the basis of emissions calculation, validation, monitoring and verification. The standard has no specific requirement for supplementary social or environmental beneficial outcomes from projects and accepts large hydro, nuclear, forestry and industrial gas destruction. There is the possibility of alignment of interests between auditor and developer given that the same company can validate and verify a single project without any further scrutiny or independent approval (Kollmuss et al., 2008). Unlike the CDM, issuance is not managed by a single body and multiple registries are accredited.

VER+ https://www.netinform.de/KE/Beratung/Service_Ver.aspx This standard and registry are offered by a prominent audit company and DOE, TÜV SÜD. VER+ credits are generated using calculation methods and audit procedures from the

CDM but with more relaxed crediting periods and wider geographic scope. Like the VCS specifies no additional social or environmental benefits arising from project implementation than the emissions reduction credits, although industrial gas destruction, nuclear and hydroelectricity (>80MW) are not eligible.

Chicago Climate Exchange (CCX) http://www.chicagoclimatex.com/ The CCX was a hybrid system in two senses: firstly, most companies involved participated on a 'cap and trade' basis but it had rules for credit generating projects and secondly, membership was voluntary but commitments were legally binding. There were over a hundred full members representing a wide variety of organizations including electricity generators, primary and secondary industry, municipalities, states and educational institutions. Other organizations could qualify for offset credits for a variety of project types including forestry and agricultural practices. Additionality was assessed on a group basis rather than project by project and there were question marks raised over projects rejected by the CDM subsequently entering the CCX (Carbon Finance, 2008). However CCX was bought out and its various components broken up in late 2010 and it is not clear what aspects will remain functional (Stumhofer, 2010).

Gold Standard (GS) http://www.cdmgoldstandard.org/ The Gold Standard is a 'not for profit' organization initiated by the WWF, initially intended to supplement the CDM and promote local benefits from the emissions reduction projects, increase the stringency of additionality requirements and stimulate innovation in clean technology rather than simply provide least cost emissions abatement. To achieve supplementary GS certification, CDM projects must be based on renewable energy or energy efficiency methods, and undergo more detailed Environmental Impact Assessment and local stakeholder consultation. Other accounting and registration procedures are as for the CDM. There is also a GS VER standard with an independent registry, external audit procedures similar to but less onerous than the CDM, simplified procedures for 'micro scale' projects generating less than 5000 tonnes of reductions per annum, less stringent requirements for host country approval and a wider variety of approved project implementation and monitoring methods.

An indicative voluntary market survey, conducted by market intermediary New Carbon Finance, found that 96% of reported voluntary transactions in 2008 were validated against one of the independent standards, with the VCS by far the most

used, accounting for 48% of transactions surveyed, four times the next most frequent standard, the GS (Hamilton et al., 2009)[2].

The VCS, VER+ and GS draw upon various aspects of the CDM as a source of technical expertise through the use of existing methodologies, professional capacity by specifying only accredited DOEs, credibility by association of these, and most significantly the supply chain of projects and project finance. With less stringent validation procedures, the VCS can register projects more quickly than the CDM. This has led to credits being generated in the time between a project starting operation and its documentation being completed by the CDM. Such pre-registration VERs have dubious claims to financial additionality, the extra income for the short period prior to earning CER credits arguably having little consequence to the initiation of already operational projects. However a number of market participants articulated this association positively, as conferring the approval of the CDM board to these voluntary credits:

> A lot of the VCUs being traded now are coming from pre-registration portion of CDM projects. You've got a credit the same effectively, the day before and the day after registration, and the price is probably a third.
>
> R3 VCUs prior to reg, CERs post reg, you're buying CERs in all but name.

> Of the 3 projects that we have they're pre-registered VERs so as you probably know they're all voluntary credits that are bound to become CERs under the CDM. So we feel we get the quality of the CDM process because they're in line to become CERs but we still get them at a premium price because they're not CERs yet. So we can tell our customers you get all the auditing and all the vetting of the CDM process but we're charging you a fee that is acceptable for you and thereby we feel that we can
>
> C3 make it mandatory.

[2] Data quality is poor in the voluntary market and not comparable with the CDM Pipeline or World Bank data sets for the compliance market. Without all transactions passing through a monitored registry or regulated exchanges it is very difficult for market analysts to produce reliable data. The New Carbon Finance survey (Hamilton et al., 2007, 2008, 2009) is the largest of its kind but interviews with market participants suggested that there was a very varied regard for the accuracy of its outputs. Most retailers interviewed, however, reported that they made data submissions to it. The NCF survey could not distinguish primary and secondary transactions so there is the risk of double counting the movement within a supply chain of individual credits from one year to the next, and also the same transaction reported by buyer and seller. Retirement data may be more reliable in the first regard but not the second. Standardisation is a precondition of secondary market sales so one would expect a heavy bias upwards.

This phenomenon has a regional and technological pattern, with most such projects being grid connected hydroelectricity and wind turbines in India and China (Hamilton et al., 2009). This may be a result of consumer preference for projects that promote decarbonization of energy systems or developers claiming voluntary compliant credits from projects prior to their acceptance by the CDM. Whether this is a positive outcome, the voluntary markets assisting worthwhile projects to reach the compliance market, or alternatively of questionable merit is not clear. If the revenue stream from the CDM is the primary motivation for project development, are the pre-compliance credits really additional? Without doubt, however, many voluntary market participants' claims to innovation and coverage of the "gaps" that the CDM leaves in climate mitigation finance are clearly questionable. The voluntary market does not appear to be supporting LDCs or addressing geographic imbalances in the CDM, indeed the latest surveys suggest trends in the opposite direction with reductions in the numbers of projects funded in Africa and Latin America and increases in Asia and North America (Hamilton et al., 2009). The alignment of compliance and voluntary market supply chains is discussed further in section 9.4, but is an area that deserves much greater scrutiny in future.

9.3.1. Function of standards

I asked market participants what role these crediting standards fulfill. The most frequent response was that they should provide the basic definitions shared between buyers and sellers for the unit of exchange. As one respondent discussing the initiation of a new standard put it:

> ...one of the things that we found was that while the Gold Standard had been successful and rightly so in terms of increasing its projects, it still wasn't something available that covered the whole of the voluntary carbon market in terms of giving a basic standard that says a tonne is a tonne is a tonne that says your emission reduction is real, verified, additional, permanent etcetera without making any claims or requirements about sustainability attributes which other standards do. I2

Other interviewees discussing the basic definition of credits, provided by a standard, also used a tangible commodity conception of the units of exchange rather than describing them as financial instruments. A standard's role was to ensure that the units exchanged were or corresponded directly to quantities of emissions, and quantities

of credits were invariably referred to as tonnes of CO_2. Consistency in calculations appeared to be an important source of credibility for retailers, the implication being that the audience for the calculations anticipate a single accurate figure, without acknowledgment of the subjectivity involved in calculation[3]. For instance:

> What ICROA's[4] partly to do is standardisation. We will retain our own competitive edges in different areas but what we will do is make sure that the calculations of carbon, particularly when they're done online are done along standard lines. One of the criticisms is that on 10 different websites you'd get 10 different answers about how much carbon is released from flying from London to Sydney and what we're all trying to do is at least get that standardised or at least explain where the differ-
> R8 ences lie.

For retailers and those organisations that profit by acting between producers and end consumers, standards also provide fungibility of units, to the extent that price competition becomes possible. This retailer's comments were typical of a number of others in a similar position:

> If you're talking to a client that wants a specific thing we don't have then we go out to the market, you accept a certain quality standard and see what the best price you can get it at is. There's a whole range of secondary market suppliers including banks, commodity traders who see carbon as just another commodity to be traded, a whole range of potential suppliers. You bump into them at trade fairs, you use personal
> R8 contacts, people who you've worked with in the past, just a web search.

With multiple proprietary standards, much of production and retail would be conducted "in house" with a single organisation supply chain and no requirement for a functional aggregator class of agents. It is therefore in the interests of many intermediate organisations to support independent standards that increase the possibility of high volume exchange on secondary markets. It also seems likely that widely recognised standards with uniform units of exchange offer benefits to buyers and sellers by reducing search and transaction costs. By adhering to a recognised standard both

[3] Indeed this positivist assumption runs through the critique presented in Gössling et al. (2007) as it reviews the calculation standards that voluntary retailers employ.

[4] ICROA is the International Carbon Reduction and Offset Alliance, a trade association rather than an exchange standard. It was founded in 2008 by retailers to the voluntary market with support from the NGO The Climate Group.

classes of agent minimise the time spent negotiating contracts. One retailer commented that:

> Carbon is increasingly standardised, it actually makes our life easier because you either meet a standard or you don't and you can write into the contract that you are buying a particular commodity, VCUs, CERs, GS CERS, whatever they happen to be and if the seller cannot produce that product for whatever reason, because the project doesn't come up to scratch then the consequences are written into the contract, which we'll follow and that's very easy in lots of ways. R3

Similar sentiments were expressed about intermediary organisations by credit consumers who wished to engage in a credible activity but without individual investment in expertise and knowledge:

> In the early days of [NGO] we were asked by our members and partners to help them with their efforts to be carbon neutral, one aspect of that was helping decide what kind of voluntary carbon units or VERs to use and we felt rather than go through the same process every time as there were a number of organisations looking at this we thought that a standard would be useful. I2

The authority of standards also serves to deflect criticism from specific retailers or consumers onto the certifying body. There are a number of calculative practices that are not valid within the CDM and are of questionable worth but which have found favour with voluntary retailers and consumers, for instance forward, *ex-ante*, crediting which is discussed in section 9.3.2. Similarly when discussing the sale of pre-registration credits, one retailer referred to standards as defining acceptability:

> Well, they'd have to be VCS, that's in the code. There's a year's period of grace as we run into it. All credits sold by ICROA members have to be either VCS, GS, CER or EUA. If its pre-reg and doesn't have any of those other, we can't sell it. R8

Likewise in discussions of funding projects that are "economically no regret", one consumer deferred to the expertise that is implicit in the judgments and positions taken to accept or reject projects and methodologies:

> If a project is viable without co-financing then it should not receive co-financing at all. But I'm not the policy maker so I don't know the details

of every single project going through the CDM mechanism. It seems to
C3 be the best thing out there now that we piggy back on.

Note that in both cases above, the arguments for or against both general policy or specific cases are reduced to the single matter of acceptance under the terms of a standard. This might entail multiple steps, for instance approval of a methodology, submission of registration documents and verification of a project's implementation by an auditor, but they are all encompassed and communicated via the institution of a standard.

There is clearly a tension here when market participants hold a conception of credits as material things but implicitly recognise that those things are socially defined by the procedures set out in the credit standards. Standards are dominant arbiters of a blurred boundary between "quality" and "reality". In this grey area, the CDM is usually seen as a procedural benchmark. The Advertising Standards Agency has made judgments on a number of corporate carbon neutral and carbon offset claims on the basis of comparison between voluntary standards and the CDM (ASA 2008, ASA 2009). Its clearest statement is from a case involving Eurostar where the adjudication stated "We acknowledged that Eurostar had followed best practice methodology for carbon neutrality and that credits were to be either certified (CERs), or from projects that complied with one of the Standards within the voluntary market that were evaluated and validated to a sufficiently high level (ASA, 2008)."

In the absence of formal regulation between buyers and sellers bodies like the ASA[5] are important in stabilising institutions like emissions trading. Its rulings on the validity of claims made on the basis of carbon credit exchanges have reinforced the importance of 'independent' standards. In this case the ASA endorsed the VCS as a valid standard for crediting that would be acceptable to substantiate carbon offset and carbon neutral claims, although it has been criticised within the industry as providing a weak basis for demonstrating reductions and, as described in section 9.3.5, is not regarded favourably by the UK government.

However, the content of standards is heavily influenced by retailers and consumers who have much to gain from a "light touch", from overtly industry lead bodies like ICROA to the VCS board which is comprised almost entirely of representatives of organisations directly involved in emissions trading. The voluntary market is often

[5] The ASA is an independent body overseeing advertisers' output and responding to complaints from the public. ASA rulings are recognised both by advertisers and the related UK government departments such as the Office of Fair Trading and the Office of Communications.

discussed positively for its acceptance of "innovative" modes of crediting. This invariably means sources of credits, audit or calculation methodologies that, for better or worse, are not eligible under the CDM:

> People wanted to have something that was seen to be as rigorous as the CDM so that the voluntary market didn't seem like a poor relation and in fact tonnes through the voluntary market were not a poor relation and were not seen to be less rigorous. However, there were issues that people had, is there a way that we can do this without the level of bureaucracy and delay that the CDM involves? Other ways that we can expand on what the CDM allows so that we can try new approaches using the CDM's levels of rigour as a benchmark. So we want to be as rigorous but do other things such as performance standards or other types of additionality test, and so forth. A broader set of countries and project types included. That's the way we wanted to deviate from the CDM and have wider set of methodologies but aiming to achieve the same level of rigour and acceptance as the CDM. I2

Considering voluntary transactions in the UK, by volume occurring predominantly between large corporates and secondary retailers, VER standards have becomes the main source of credibility and coordination. Like the EB in the CDM, in determining the acceptability of calculation methodologies, setting the terms of audit and requiring registries and some degree of transparency in documentation, they have become the central governance institutions.

9.3.2. Forward crediting and forward selling

A significant issue that is unique to voluntary markets is the possibility of forward selling of credits that do not yet exist or *ex-ante* creation of credits for reductions that have not yet happened. Both are accounting conventions, with a different validation and verification regime to that used for *ex-post* compliance credits (see also section 7.2.3). In *ex-post* accounting the credits are created as accounting units after the project has been in operation and monitoring data is available. The initial capital to construct the project may come in part from forward sales of the rights to credits, as is typically the case with ERPAs. With *ex-ante* crediting, reductions are claimed and sold as credits on the basis of the project's plans. There may also be a monitoring regime with reconciliation. In the UNFCCC and EU ETS compliance markets,

the credits must be available for surrender at the time the consumer must produce credits for their liability. However, in the voluntary market, some consumers are happy for their payment to be used to initiate a project that will yield reductions in future, or are unaware that this is the terms of the contract that the retailer is selling. As one retailer critical of the practice argued:

> A lot of donors are not in a position to even have that conversation. If you go onto our website and donate to us, we will offset your emissions. There's no possible way that we can engage people in a conversation that tells them "thanks for the money, you are aware there's a risk we're not
R6 going to be able to offset your emissions". You just can't do that.

For this reason, the UK Government Offset Quality Assurance Scheme, discussed further in section 9.3.5 also specifies how credits are to be managed by a retailer and cancelled within a specific timescale, effectively excluding *ex ante* systems. Forward crediting is different to a consumer who intentionally forward contracts for credits but makes a carbon neutral claim only on the basis of those credits that have been delivered at the time of the claim. Forward crediting transfers the consequences of an unsuccessful project from the seller of the credit to the buyer and atmosphere. As can be seen from the CDM, there are substantial possibilities for projects to yield many fewer CERs at verification than anticipated. One survey found that all project types with the exception of N_2O destruction delivered fewer CERs than calculated in the PDD and that methane based animal waste and landfill gas projects delivered 72% and 67% less than projected respectively (Castro and Michaelowa 2008). This phenomenon has been attributed to inaccurate or over optimistic estimation models, delays and failures in the practical execution of the project activity and procedural losses due to divergences between monitoring plans and monitoring activity. A few very large industrial projects have substantially over performed such that overall CDM issuance was 96.8% of projections up to May 2010 (UNEP Risø Pipeline 2010). However some of these values must be regarded with a degree of scepticism given the matter of inflated baselines and market leakage (see section 7.2). The voluntary market has not favoured industrial gas projects but does show substantial use of methane abatement projects which have been some of the poorest performers in the CDM.

Forward selling may encourage a greater proportion of capital investment from credit sales and reduce costs by reducing debt interest payments and default risk premia. It may also provide a greater likelihood of additionality although this is

not a logical necessity. One retailer was keen to differentiate their credits developed using this model:

> Because a lot of our credits are based on a forward accounting process to help build in that additionality argument, what happens is a client will come to us and say "I like the low energy stoves. There's £100,000 to buy X tonnes of carbon in that project". They give us that money then we send it to our office in Nairobi and they go and build the stoves. It's very clear that without their money it wouldn't have happened. Now there's an increased delivery risk there as compared with selling issued credits. Most of our clients are prepared to take that small risk in exchange for the much tougher financial additionality test that that provides. R8

The same projects could be delivered through an *ex-post* credit system. There is nothing substantially different in carbon accounting terms or the physical implementation. However, the financial flows and risks are quite different This rearrangement of delivery risk and capital requirement is not permitted by the VCS, although forward sales are allowed on the basis of a successful validation.

9.3.3. Audit Requirements

Against the transaction enabling function of standards there is the burden of the audit requirements for project developers. A VER standard only practically functions if it is adopted by market participants *and* if its specifications are fulfilled. Independent audit, as provided by DOEs, is the primary means of ensuring that credits that are claimed against a standard meet with its requirements, offering some measure of consistency and credibility of the credits and, by association, of the standard as a whole.

The quality assurance mechanisms in the CDM, outlined in section 7.3, were described by voluntary market consumers as bureaucratic and burdensome, denying carbon finance to projects that were described in strong normatively positive terms, for instance in providing health benefits or reducing local deforestation, holding uCO2-eqp others, and driving developers to larger projects:

> To be eligible for CDM we need to reach a certain volume and that might not necessarily be in the best interest of the villagers. One of the problems with the CDM is that you have to have projects of a certain size so

> smaller, no less beneficial projects, are prohibited against... It just seems that the smaller projects are being pushed to one side because everyone's searching for the big bucks.
>
> R2

> We always struggle with that CO2e because of the community scale of our projects. We're never going to withstand the costs of CDM or certainly not in the near future and some of the costs with large scale GS are quite prohibitive. The GS has a micro GS threshold so that the costs associated with that are much lower than with normal GS. It's mainly down to verification which is sampling based rather than exhaustive.
>
> R8

Stricter standards with more substantial audit procedures raise transaction costs for project developers and these are passed on into a price competitive market. In setting minimum requirements for monitoring and verification, standards are crucial in maintaining stability and credibility of exchange against pressures to reduce costs on both sides of secondary transactions.

Like calculation, there is no absolutely "correct" method for verifying and validating that will produce an entirely accurate credit supply chain. Ultimately, it seems that the credibility of the standard endorsing the credits is the most important aspect and that this is a matter of prevailing consensus in media and policy arenas. Credits generated in ambiguous ways illustrate this point, firstly those using proprietary standards and secondly those claimed for avoided deforestation.

Increased audit increases direct costs on the production of credits and may be a burden for small scale projects. In these cases retailers may be prepared to generate and sell credits to end consumers that are asserted as meeting a proprietary standard, with less rigorous sampling methods or no third party involvement. One interviewee described a long standing project they wished to continue to sell credits from:

> There are some projects, like that energy efficient lightbulb project that we've been working with since 2002. We've always contracted the credits as plain VERs not VCUs, partly because when we first started working with it there wasn't a VCS but that project because its so small it would find it quite hard to bear the transaction costs of the VCS, to get a DOE in to do the validation, certification and so on.
>
> R3

In such cases the retailer's reputation and brand may be cited as the source of credibility rather than an independent set of audit criteria or audit performance. However, recent market surveys suggest that the use of proprietary standards is declin-

ing with time (Hamilton et al., 2008). This has been corroborated in interviews with consumers and provides the second example. In Europe there is limited expert and formal recognition of afforestation credits and standards that endorse credits from avoided deforestation primarily because of concerns about permanence. One consumer interviewed was wary of using their trusted retailer for these transactions in advance of widespread recognition of a standard, instead describing tentative approaches and efforts to directly partner with NGOs:

> My strategy for us is that if we do anything with forestry we would only do it first with our internal emissions, not with our customer emissions so we would put our toe into the water, look at the temperature, test it. And then if we feel confident going forward after a year or maybe two years the we say "OK, now we feel confident, this is a good project, this mechanism works" and now we roll that out to our customers...
>
> [Our usual supplier] has offered me different projects. But I feel that is an area where we haven't made a decision yet. Maybe at the end of the day we'll say it's safe and the mechanism works to buy from an offset provider like [Project Developer X] or [Project Developer Y] even forestry, and that's fine, but at the moment I feel that a lot of those NGOs on the ground are struggling with the offset providers to get the projects off the ground and so we can jump over those hurdles directly and go into the field and help them off the ground. And by the way if we do that, the benefit is that we know that our money will go further. C3

There is a tension between even the limited audit requirements of the major voluntary standards and consumers' price sensitivity. With increasing transaction costs involved in registering, validating, operating and verifying a project it is not surprising that 49 per cent of credits traded in the voluntary markets in 2007 originated from projects over 100,000 tCO2e per annum (Hamilton et al., 2008).

9.3.4. Consumer Reliance Upon Standards

UK corporations have since 2005 increasingly consumed credits and engaging credit retailers in order to made carbon neutral claims and retail their own products packaged with an offset claim. Amongst others, HSBC has used credits to offset business travel and direct energy consumption, Eurostar has offered a carbon neutral

rail service and Avis carbon neutral car hire. As outlined in section 9.3.1, standardisation has facilitated these transactions by reducing the requirement for research into counterparties and the various contracts for carbon reductions that they could provide. One retailer stated that they had noticed suppressed market demand in the early stages of their operations due to persistent uncertainty in the credibility of standards:

> What we've quickly found is that with the Code of Best Practice and all the issues around CERs and VERs, until you provide a bulletproof statement of standards there's no way, companies were very reluctant to just climb on board something. They wanted to retain a lot more control over their own sourcing and that kind of stuff. They were very reluctant to go out to their customers. You don't want to go out to your customers and then the standards change. I think there's a lot of nervousness around
> R6 that.

Whilst over time consumers may have become more accepting a common basic definition of emissions reductions, market participants distinguish between standards on the extra criteria that they screen for, GS providing a greater insistence on local benefits of the projects earning credits for instance:

> Smaller customers are less savvy, bigger ones more exacting. Sometimes people request GS but often just to see what's out there. They sometimes see price premium and say if that's the case I'm happy to just have VCS. Very few, maybe an NGO, will say we're just going to take GS, most now
> R3 if they're going to specify a voluntary standard they'd put VCS in.

Whilst VER standards tend to promote this basic commodity conception of credit contracts, that they ensure "a tonne is a tonne", interviews with representatives of consuming organisations revealed that they appraised carbon markets in two other ways. Firstly, almost all organisations look beyond standards to the projects that generated them, placing extra criteria on them over and above emissions reduction. This interplay between the notional emissions reductions worth of credits and the projects that they are associated with is picked up in section 9.4. Secondly, a number of consumers described due diligence and scrutiny procedures in addition to those mandated by the standard the credits were validated against. One consumer described the following:

> Our original intention had been to choose two different providers and

> use both of them but at the end of the day we thought [retailer] was the only one who could live with our pickiness. Whilst we have some standards that we insist a project has, we don't accept those standards as sufficient verification that we are happy with it so we go through the PDD documents and probe for more detail, particularly on additionality, but potentially on other things. C6

One retailer, described on their website and in interview how they sought to differentiate their credits as being more robust than the standards they were certified to, and certainly more than competitors' credits, even on the most fundamental criteria:

> Clearly the GS has considerable traction but even GS, there's one project that I've seen that, its first project I think, that's hopeless. I think it fails on just about every test that I'd put a carbon offset project through. So again I think these things are minimum standards.... we'd encourage our clients to look into various issues in more detail, and additionality is the key. R8

The Co-operative Group has similarly made efforts to inspect and assess projects that it has purchased credits from and been vociferous in its support for the voluntary offset market (House of Commons, 2007). It has gone to great lengths, in some cases directly visiting projects to inspect their progress and outcomes (Shearlock, 2008). However, this raises the issue of consumers' expertise in key issues of carbon accounting and social survey that would be relevant to effective appraisal of project consequences. A number of interviewees, with less hubris, explicitly recognised difficulties in assessing for instance the additionality claims of projects that they had purchased credits from:

> In some cases, such as jute mill, we went back and really pushed them on whether this wouldn't have happened anyway... We tend to err on the side of caution but also recognise you can never be 100% sure of this without thoroughly thoroughly going through the books which no project is going to allow you to do. C6

> I've thought about flying out there but that would mean I would have to fly to Philippines, China, Chile and I was looking at one in India in quite rural areas. We had one person in the company fly out to China and look at two projects in the Philippines yes so somebody from our company went out there and looked at the project and made the choice. It wasn't

> a technical expert though. He had no way of assessing in detail how the money streams were flowing there and how the carbon was being calculated and so on, other than trusting what the offset provider and the project developer were telling him, the reports they were showing him and so on.

C3

The major implication is that the whole supply chain is highly reliant upon the standards set and the audit procedures required. One retailer commented:

> We've had plenty of dealings with the GS people and I've got the conviction that if they've signed off on something there's no need for further... they're very thorough in their approach. I don't think there's any additional value in anyone else having another look at it. Certainly for CDM GS, anyone who tries to institute any other proceedings above that, I mean what is the point? When does the checking stop, as Wittgenstein would have said?

R6

Another interviewee neatly summarised their primary motivation to follow up a project as being quite separate to the emissions reductions:

> All the due diligence occurs prior to and then we have a monitoring basis, keeping an eye on the projects to make sure that nothing untoward happens that gains huge media attention. It really is just a reputation monitoring part of it.

R10

Despite some consumers claims to engage in detailed assessment of the supply chain of credits it appears that this aspect of governance presents no greater prospect of robust environmental integrity than that which standards enshrine. There are limitations in expertise, market incentives to reduce costs and organisational priorities oriented around reputation rather than ecological outcomes which militate against high stringency consumer lead institutions.

9.3.5. Government Intervention in the Voluntary Market

In the UK, Government responded to the growth of voluntary offsetting by issuing a Code of Best Practice which after consultation was implemented as a Quality Assurance Scheme which retailers could apply to particular products. Its most controversial aspect was the exclusive endorsement of the compliance regimes (Clean Development Mechanism, Joint Implementation and EU Emissions Trading Scheme) for

the supply of emissions reductions units. It appears that the bureaucrats' intentions were to remove "rogues" from the market, companies with lax emissions reduction contracting, to maintain the integrity and effectiveness of the system and consumer confidence.

> Offset Code of Best Practice and QAS consultation trundled on at its own pace... looked like it was going to be just CDM and EUAs which was the position we were all pushing for internally and there was kick back... We needed to clear out the cowboys. People who sell the same credit twice, who don't do what they said they were going to do. R9

> [senior regulator] wanted the VER industry to coalesce itself around a single standard that it could put forward, but that clearly wasn't going to happen, the market isn't at this point in time moving towards a single standard, so we thought we would go ahead and launch the scheme I6

However, the scheme was not to go so far as to formally regulated the market and enforce the use of compliance units. In test cases of corporate claims the government was happy to allow the ASA to make judgments and didn't move to regulate against VERs and implicitly the standards that generate them. This was articulated to me in terms of variable *quality* of emissions reduction units and the scale of potential harms:

> ...the Quality Assurance Scheme is saying that there are these things available and you don't have to be protected against them but there are different standards of quality, if they were dangerous or really problematic we would have to step in and regulate and remove them...Traditionally policy making is done by looking at the cost and benefits in terms of to the government department and also to society in general of putting through legislation and some system to regulate that, in terms of C's and B's, and that depends on the size of the market and how many people are buying offsets and how much harm is potentially being done by those purchases. I6

The implication is that the UK government had little confidence in the governance procedures of VER standards but acknowledged that the scale of transactions was too small to be of major consequence. The reputational risk to emissions trading as a whole, by association with fraudulent activity, could be mitigated by acting to distinguish the quality of credits. The system can be made sound by having cred-

ible institutions that exclude isolated transgressors. Where there were failings, the governance structure of the CDM allows problems to be revealed and resolved:

> We knew there were problems with the CDM but at least there was a framework for correction and there was more transparency. There were things that were wrong with it but at least they were visible.
>
> R9

> If you're worried about all these things that are wrong with CDM get involved in changing the CDM don't just set up your own crap thing that no-one can regulate, it's bound to let cowboys in. Try to make the regulated system better.
>
> R9

The proposals appear also to have been taken seriously by a number of UK airlines, with EasyJet, British Airways, Flybe and Virgin Atlantic programmes complying. One retailer speculated that this was associated with formal regulatory pressure:

> Airlines seem to be the only sector that's gone for CERs for voluntary programmes and I think they are the ones that felt most under pressure around inclusion or not of aviation within EU ETS therefore the best way to avoid regulation is to use a regulated instrument to show that they were almost quasi regulated.
>
> R3

Some retailers have drawn on the invitation to discriminate on quality and have used the QAS as part of their sales package despite higher cost and competitive tendering processes:

> [The CoBP was] recognised as the highest quality and if you want to be able to sleep at night as well as say that you're carbon neutral. If you want to go to bed at night and say you're carbon neutral and not worry about whether you're going to get caught out because you bought pre-CDM VERs then you may be prepared to pay that price.
>
> R6

However, discriminating along the lines of an ambiguous notion of "quality" has drawn substantial criticism from buyers and sellers in the voluntary market. The problematic aspects of the CDM outlined in chapter 7 are widely recognised if rarely articulated in public. One buyer discriminated against both the projects that were incentivised by the CDM[6] and the process for earning credits:

> My feeling is if they've [DEFRA] got absolute confidence in the CDM then they probably haven't looked at it thoroughly enough. The very fact

[6] Section 9.4 addresses this matter in greater detail.

> is that the mechanism for getting CDM verification, from an outsiders perspective, looks like its pretty slow. If you have more and more projects going through it its only going to be slower and slower, unless they beef it up. It seems a shame to hold up good projects on that basis. C6

> I'm encouraged by the fact that they are looking for some sort of a voluntary standard that could be more standardised but am just waiting to see what happens with that... Whilst there might not be a single standard across the voluntary market, its often allowing projects to take place that might be too small to be worth going through the CDM process but are actually as or more valuable. I think the risk with what they've done is cut out things that are actually very positive. C6

> We've bought CERs. Its not that we've got something against the CDM. What we've got is an issue with saying that that's the only valid projects there are...We have a number of areas where we have a different view from DEFRA. Our stance tends to be that if we believe we are doing the right thing then we do it, we communicate about it absolutely transparently and if we don't agree with their advice we ignore it. C6

The CDM is not exclusively seen as benchmark by voluntary retailers nor is government "approval" or guidance seen as necessary when it places a greater price premium because of its transaction costs, delays and connection to the EU ETS secondary market. A typical response by one retailer was:

> A few people in early days around consultation of CoBP I met people who said "we think we understand this market well ourselves we don't need to be told what to do by DEFRA. If DEFRA chooses to go down the CDM route then we'll ignore it"... There was one client who said "we really want to comply with the QAS" and I said you realise you'd have to use CERs then and the price of your programme will double or more and I didn't get any response to that so price is an important determinant. R3

Finally, the spatial scale of governance can interfere or align with efforts towards standardisation and this can be seen in the case of the QAS. International businesses that I spoke to highlighted how national guidance can be problematic and that they preferred to operate to international standards:

> Our position on the DEFRA code is its not realistic, it's not suited to purpose, and we have an international business, [our offset programme] is

> in the UK, the Netherlands, Germany, Austria, Switzerland, and France, so having a UK kitemark for an international business, we are not that interested if they're not going to respond to the repeated requests that have been made by the industry around this, through various consultation processes.
>
> I think on some of the other, not offsetting, reporting guidelines DEFRA has one set of advice, ADEM who is the French equivalent has a totally different set of advice... [some of our clients] are based world wide and the minute you go down the route of doing different reporting, particularly as you've got passengers who travel and are exposed to information about us in both markets, they hear one figure here and one figure there and then they're thinking "What on Earth's going on? They don't know what they're doing."

R10

C6

These comments suggest that recognition and consistency are the most valuable functions of standards to market participants. However the first also suggests a certain opportunism, the respondent may have been more amenable to citing UK government recognition overseas if it had been supportive of their programme's own agenda.

9.4. Conspicuous production

In discussions with market participants it is very clear that the projects that are cited as the origin of credits are as significant to exchange relationships as the accounting units themselves. Whereas CERs have near universal fungibility and acceptability to the regulatory bodies that recognise them as equivalent to AAUs and EUAs, consumers in the voluntary market are much more particular about the provenance of the VERs they purchase. Section 9.3.4 suggested that consumers discriminate between standards but it is also the case that they discriminate amongst credits validated to a given standard. This section will discuss how non-uniformity in commodity consumption manifests itself and why it may exist at all.

9.4.1. Projects, commodities and stories

In abstract terms, emissions reduction credits are awarded quantitatively to incentivise activities that ought to contribute to climate change mitigation. They do not

have any inherent materiality but the projects that they are awarded to do. This is naturally the most obvious and conspicuous aspect of emission trading for individuals and organisations that are not expert or regular market participants. Where there is a normative motivation to contribute to social and economic development this must be represented in the projects themselves as standardisation, save for the Gold Standard, has tended to focus on GHG quantification. For instance, one retailer who performs no project development described the following criteria for selection:

> We only accept VCS and GS. For example, the fact that we don't advertise, but for the purposes of your anonymous research we don't take any projects that are too industrial, we don't take forestry, we have a preference for renewables. Projects need to be able to demonstrate some additional social, environmental, economic benefits locally at project sites so we're interested in local sustainability aspects of the projects. R10

The GHG element is assumed to be assured by the presence of VCS or GS certification, then the retailer selects projects according to other criteria. The majority of UK corporate offsetting is publicised and conveys to a broad audience, that may include direct customers, regulators and employees, the organisation's engagement and commitment to climate mitigation and corporate social responsibility. In discussions with both retailers and consumers the "story" conveyed by the projects that supply credits came up again and again. Although similar, it is worth citing the variety and multiplicity of ways I was told of the importance of "story":

> Generally renewable projects are priced at a premium to industrial energy efficiency projects of the same standard... The way the voluntary market differs from the regulatory market is that clients want some of the story around what it is they're supporting rather than just the commodity credit. I think the market is shifting towards a greater acceptance of commodity stuff, people just want to say that they've offset so many tonnes but generally people want some story to help communicate what it is that they're doing. Quite often there is a disconnect between those projects that have a story associated with them and those stories that have the most carbon associated with them. R3

> What is it easiest to sell? Is it easiest to sell, in the notion to the consumer, in terms of the sustainability piece some kind of charismatic carbon like wind in India where you can talk about you know, job creation, renewable energy, all this kind of thing, or just some random fungible CER

> that's come from some HFC project in China or some industrial gases project. What's sexier? The sexier ones are the ones that you can talk about and get into the details of.

R10

> If you look at the kinds of credits that we sell, the vast majority is stuff that we've generated ourselves through our Nairobi office and there's a very good story that goes along with that. Its more than just about saving carbon its about health benefits, its about social benefits, its saving people money, its putting people's living standards up. We can tick a lot of boxes for clients with those sorts of boxes in a way you're never going to do with a typical CER project, industrial gas destruction, power station energy efficiency. Who cares, I can't sell that.

R8

> As a buyer I want to get the best deal and I want to get a guarantee and I want to get a photogenic project that I can easily explain to my customers. Which is also why for example we're also looking at forestry. Its something I can explain easily to my customers. Buying credits from methane pig farms in the Philippines is something you really have to explain to somebody, and then even if you do, they can say why should I support pig manure in the Philippines?

C3

> That's what it's all about. Its about wanting to tell a story, to say, we understand climate change is a real issue. We've done all the reductions, and reductions are kind of hard to communicate, but if we finish it off by going carbon neutral we can talk about some projects we've done and some projects we buy in from elsewhere. There's something more communicable about it, I don't know why that is. There's something very tangible about it.

R6

Market participants variously described favoured projects as "charismatic", "sexy", "photogenic", "tangible" and those that can be "explained easily". Conversely, one retailer had tried to operate as a commodity exchange, providing uniform, reliable credits at the lowest cost to voluntary consumers. However this model did not succeed:

> We built it as a high volume, low margin model like an exchange. But voluntary offsetting, the way that it's different to compliance, that's not an appropriate business model for offsetting because the buyers are not looking for compliance so they are interested in where the project comes

> from so you have to spend a lot more time sourcing the projects. And the companies that you work with they want a lot of hand holding. The exchange model that we started with is not the right model. R6

The emphasis placed on communicating storylines may also be one reason why very few EUAs have been cancelled voluntarily. Arguably, removing allowances from a strict emissions cap is one of the most reliable means of making a quantified emissions reductions claim, however, very few offset retailers offer this option and uptake has been low. Only one consumer interviewed had considered EUA retirement and they immediately mentioned the lack of "emotional" attachment possible:

> We looked at it [retiring EUAs] at the time we were going through all the possibilities what we were looking for were projects that were relevant to us and that we could have some sort of emotional attachment to and EU ETS we were just never going to become that emotionally involved in(!) I think we're looking for more out of it than the simple offset. C6

In a fascinating effort to provide this connection, one retailer described buying EUAs from hospitals and universities and legally contracting assurances from them that the revenues raised would be invested in emissions reductions. This model is functionally equivalent to Kyoto Joint Implementation and has an additional twist in that projects may be non-additional and yet still generate tangible savings. Even though the purchase and cancellation of EUAs have the same 'accounting level' effects regardless of whose EUAs they are, the retailer I spoke to had tried to create projects and write additionality into their retirement of EUAs. In this case the retirement corresponds to an energy saving action, not simply the sale of over allocated hot air that might otherwise have been used by an over-polluting installation. This case emphasises the way that the story is attached to a physical project not an immaterial commodity or instrument. If one assumes a deterministic outcome for the EU ETS, i.e. that all allowances will be consumed by an installation releasing an equivalent amount of pollution, then the above developer's actions are a waste of time and money. However, it is notable that consumers talk about their offsetting strategy in terms of the projects that they supported rather than the credits that they bought, for instance:

> We have some wind farms, both in India, a couple of small scale hydro power, possibly in China. We've got one which is a jute mill where they converted one of their plants to use the left over jute for energy production. C6

As well as the low cost, forestry projects' appeal rests in the obvious form of materiality; the tonnes of carbon dioxide sequestered in the standing biomass of the trees:

> We will be able to have a more photogenic project because we can then communicate to our customers in a more direct way. To put it simply we could say, "look, this forest, these 100,000 hectares, this is the [our company] forest" and you can look at it on Google Earth and you can go and visit it if you like. These are concrete things that I discuss with these NGOs as a possibility going forward. So it's something they can really touch, see, grasp and it's our project, we've adopted this forest this community around or inside the forest and so on.

C3

The converse of the importance of publicity in offset programmes is that there are potentially negative consequences of being attached to a "bad news" story. Critical press reports of failing projects have directly linked consumers to projects, one story in The Telegraph even going so far as to name a project consumer in the headline "How Coldplay's Green Hopes Died in the Arid Soil of India" (Dhillon 2006). Elements over and above the reliability of quantification procedures therefore enter consumers considerations of offset counterparties. One interviewee even considered the secondary relationships of the project host:

> We have looked at things, with the jute mills, trying to check as far as we could what the jute was used for, what the energy was used for, to make sure that the energy wasn't going to some clothing factory that used child labour. That was our slight nagging doubt and we check all that to the extent we can.

C6

Acknowledging the reputational risk both in purchasing CERs and VERs, one might wonder why publicise a "story" or why offset at all? Indeed, a public offset strategy is not the norm for UK businesses even if it is by no means unusual. Some of these issues have already been discussed in section 9.2.

9.4.2. Credit portfolios that spread a story

Exchanges of credits can be classified according to the classes of agent participating, with a general distinction made between primary, secondary and retail markets (section 8). The purchasing requirements of end consumers vary in each market

from the hundreds of thousands of units that large coal powerstation and industrial facilities are using for EU ETS compliance, to fractions of tonnes by individuals looking to offset flights or events. Similarly projects earning credits vary in productivity from HFC destruction of the order of millions of units per annum to energy efficient lightbulb schemes that may only earn hundreds. One consequence of divisible, transferable and 'non-perishable' accounting forms of emissions reduction units is that these diverse and mismatched scales can be accommodated; there is no requirement for a 'double coincidence of wants'.

This aspect has significant implications in the voluntary market where the scales of consumers and producers are often substantially mismatched and occur via an intermediary. An individual consumer or small business will typically purchase less than 10 tonnes of carbon dioxide equivalent units from a retailer, who in turn will purchase from multiple projects selling to both primary and secondary markets, spreading costs and risks. They may be offered the option to buy a unit from a specific project but this is not always the case. Some of the largest retailers, including in the UK Climate Care, sell only from their 'portfolio' or projects. This implicitly treats the units as a uniform commodity. The trend towards 'selling stories' is by no means universal. There was and is still demand for 'any old carbon' from some consumers, a point made dismissively by one retailer:

> What they [the clients] wanted first and foremost was the carbon neutral brand. This was at the point where discussions were going on about local projects but they didn't care whether they were overseas or local. R2

Another retailer recounted an experience from around 2004, early in the development of the UK voluntary market:

> If you told me 5 years ago that we'd be able to sell carbon from an industrial energy efficiency project to a small business or coal mine methane flaring to a small business I'd have said the voluntary market will never take that. I remember in our old office so 4-5 years ago, someone offering me a million tonnes of landfill gas flaring or energy generation in Egypt and I just laughed at him and said clearly you've got no understanding of how the voluntary market works. We could have picked up that project at a dollar a tonne, or less, he'd have taken whatever we would have given him and now we could sell that, it would go. R3

The ability to sell credits against a standard might be considered the sign of a mature

market that has developed over time. The same retailer also recognised the usefulness of portfolios as a temporary way of selling credits from unpopular but low cost projects by packaging them with more expensive and more positively received projects.

> This provides us a way of selling stuff which is difficult to sell on its own. I think that [selling charismatic carbon] it is a temporary thing. As the market gets more sophisticated and more commoditised, the need for story element decreases... We'll put together mix 20% renewables, 20% methane capture, 60% industrial efficiency and charge a combined price. Then the price will come down. When they want to communicate about the offset projects that they're using they can shine the light on the renewables project and still get the advantage of having a relatively cost effective portfolio because they've got a big chunk of industrial, more commodity carbon, in there. It's a way of trying to optimise price and perceived quality. The carbon quality is the same for all of them because it's on the same standard but it's a communications value around the
> project as well.
>
> R3

Similarly, a business consumer described how their aspirations to purchase credits from projects with community benefits could be managed alongside the cost implications by using a portfolio.

> The fourth project I'm looking into now is a pre-reg VER but also a GS project because we want to up the game gradually and get better and better. GS has co-benefits but of course they're more expensive as well. Now, currently the GS costs me pretty exactly twice as much as the pre-reg VERs but we build it into an average price, we have a package that
> we charge our customer and we feel that makes a lot of sense.
>
> C3

Further, a retailer of credits described how they were able to accommodate the wishes of their customer base, even if that was through questionable biological sequestration, by providing a mix of projects to fulfill different aspects:

> The reason that we still offer UK forestation is because it is a popular form of offsets. People like it because they can go see it, it's tangible, a tree is iconic for people it's something that still is quite popular. What we tend to do is if clients are keen on forestation we recommend that it's a small part of a balanced portfolio so that the overall vintage period isn't

> dangerously long. The danger with forestation is that it's 50 or 100 years away when we're being advised to stabilise over the next 4 or 5 years so we tend to recommend it's part of a portfolio including much shorter vintage projects or perhaps 6 years. R8

Buyers and sellers may also have more prosaic reasons for using portfolios. Higher volume business consumers reported holding an inventory portfolio that helps to manage volume requirements, cash flow and liability on the buyers' side. In such situations credits are purchased periodically and deducted from stock as they are cancelled to meet emissions output.

Portfolios therefore perform a diverse array of functions, offering the ability to communicate multiple storylines to increase perception of quality, reduce the costs of production, balance temporality, hedge price and reputation risks, and excuse questionable projects. The common feature, however, is the ability to dislocate perception and from quantitative commitments. A business may 'shine the light' on projects with high social and health benefits to increase positive public perceptions but substantiate the emissions reductions claim with credits from industrial projects. What is it about the institutional arrangements that allows this situation to persist? One consumer remarked how little scrutiny their programme had been put under:

> We've been asked very little about them. So for the effort we've put in, it's a little disappointing. It's one of the areas, where... the message of carbon neutrality isn't one we've got out there enough. From a purely commercial perspective you could argue that we could have been a lot more laissez faire about it and just hoped for the best and we'd probably have been fine. Saved us a hell of a lot of time and effort, but it wouldn't have felt like the right thing to do and I think now that we've got this process to step back from it would feel very wrong. Also, we're getting better at it... I think they just don't know about it. Last survey something like less than 10% knew we were offsetting. More people understand the broader picture that we're "good at this". C6

This was reiterated by a retailer whose perception of their clients customer base was that there was a very limited understanding of what constituted carbon neutral claims:

> I think that many of the companies will look at it as a compliance model, there's no doubt about that, but my experience with consumer facing

> organisations, when they go to their consumers the consumers don't understand the compliance market at all.

R6

However, some were at pains to distinguish between the supplementary qualities of standardised VERs and the core emissions reductions claims that being made:

> One of our existing clients that we're talking to has gone for a portfolio that only comes 10% from us and 90% from really cheap rubbish shit in the US and we've said at some point you guys are going to get really shafted. They're not claiming that it's carbon neutral, our brand is not visible there at all. People are going to realise that most of the carbon you're selling them is crap and so we are looking to source robust carbon that is as cheap as we can get it, so VCUs.

R3

Given the opacity of many publicly made carbon neutral claims and the sophistication and expertise required to discriminate between them, even where details are available, there is clearly the opportunity for a certain degree of misdirection. Nevertheless, the voluntary market receives some degree of expert scrutiny from journalists, NGOs and trade associations. The ASA, for instance, scrutinised adverts from an insurance company, ibuyeco, that had purchased a portfolio of credits, a large proportion of which were deemed to be unsatisfactory and unable to support the claims of 'carbon neutral driving' (ASA, 2009). Claims relating to the supplementary benefits of particular projects and the presentation of portfolios have not been similarly tested and are likely to be even more subjective in their rulings. Business consumers are conscious of this but also that many of their key audiences are not naive. Where other corporates are important clients, their internal expertise and price sensitivity may put divergent pressures on the type of offset portfolio that they present, for instance:

> It also depends how you look at our customers because when you survey its individuals but a reasonable proportion of our customer base is large corporate customers, and whilst the individuals travelling within that corporate might not know it, if the travel manager that's making that purchase decision knows and you've actually captured quite a lot of people. And they tend to be a more educated group on this and an easier group to work at that level of detail with. Some of them were the ones that actually prompted us to look at this in the first place.

C6

> Then if I talk to the majority, them being large corporations I don't talk to

> the CEO and say this offsetting is a good thing to do, I talk to the travel department and these guys compare us and look at the market, and these guys will challenge me and I really have to build a strong business case of why I'm charging them for this. At the end of the day it's all voluntary because the client could decide to [travel] with someone else who's cheaper. C3

These dynamics towards and away from uniform commodity carbon, expressed in the contradictory growth of offset portfolios and creation of 'charismatic carbon', are suggestive of a Polanyian double movement. This will be discussed at length in the following chapter.

9.5. Summary

Individuals and organisations could coordinate their climate mitigation activities in many conceivable ways. Even just considering market exchanges there could be substantial diversity in contractual terms and the parties involved. Bilateral commitments are the simplest relationships but there are many physical and institutional obstacles to their flourishing. This chapter has described how in a novel arena, uniform contracts for accounting units representing material quantified emissions have come to predominate and stabilised by a number of non-market, co-ordinating institutions.

As in Chapter 6, carbon crediting is best seen as an empirically variable institution with a range of possible configurations. There is potential variability in the types of commitments made between agents, the agents themselves and the timing of the commitments. The CDM is but one set of procedures that does not absolutely and unequivocally define emissions reductions. Whilst it is possible for retailers to voluntary consumers to offer different arrangements it seems that the majority favour standardisation close to the CDM model of 'real, additional, verifiable' credits that are rhetorically positioned as material commodities.

One distinct feature of this commodity model is the act of fixing emissions fluxes to specific agents at specific locations over specific time periods to define both liabilities and credits, as outlined in chapters 6 and 7. As a result, the act of calculating emissions liabilities is a necessity for those engaging in voluntary transactions. Indeed this has become a substantial economic activity in its own right, a point repeatedly

made by interviewees on both buy and sell sides and outlined in section 9.2. However, whilst heralded as contributing to 'carbon literacy' there is little evidence that these calculations either promote direct emissions reductions or conversely legitimise high emissions lifestyles and business models by encouraging all sources of emissions to be seen as equivalent.

There is no single instrument of exchange with a common property registry as in the CDM, so from an IEP perspective one must ask what is the basis of the economic exchange or if not, are these institutions of a different economic kind. It is observed that some standards require credits to be logged in a registry which provides accounting units over which to hold property rights but without regulated cancellation or surrender, consumption claims remain direct relations between buyer and retailer, retailer and project host. These registries do not offer complete coverage and are not always coherent with state emissions accounting regimes, leading to the possibility of double counting. As the performance of voluntary market retailers and their contracts remain untested in the courts, consumers may be vulnerable to a fraud whose consequences they do not feel. This asks an interesting question of Polanyi's economic anthropology; can the voluntary market be regarded as an exchange institution if property is not defined or enforced? The economic resources supplied by voluntary credit consumers are not made in exchange for a material entity and may not confer them any formal rights. In this respect, the offsetting might be better understood as a redistributive process (p77) with the combined complex of the retailer, offset standard and project developer acting a redistributive centre. The offset consumer is not seen to be an agent in the allocation of the economic resource as they have little ability to control the final destination. However, the provision of resources to the centre is not mandatory, nor integrative, nor governed by a powerful social norm. It is therefore more appropriate to consider the particularities of an institution that is broadly exchange based through the IEP framework, noting the particular aspects and their economic implications.

Increasingly voluntary standards that provide a degree of regularity and equivalence. They allow individual projects and credits to be tested against wider standards, and are themselves open to scrutiny. In the UK, the government has chosen to exclude the most widely used standard, the VCS, from its Quality Assurance Scheme although it is accepted as the basis of marketing claims and appears to be becoming the *de facto* basic standard in the UK and USA (Hamilton, 2009).

Much of the motivation for consumption is associated with normative agenda of 'do-

ing your bit' to fight climate change or contribute to international development. Corporate purchases of offset credits are also often accompanied by public claims. Without a regulatory body to receive credits or specify eligible projects, there is greater potential variation in projects in the voluntary market. It might also be expected that preferences for projects with non GHG co-benefits to their host communities would be incentivised as they would make for more positive and appealing publicity. However, it appears that many consumers purchase from a portfolio including much less appealing industrial and agricultural projects. Despite the promise of delivering a raft of high quality schemes and the aspirations and claims of many consumers to support such projects, fewer as a proportion of total credits, are being delivered over time. Many worthwhile projects, with more robust additionality claims and more stringent screens for community benefit could be delivered were consumers prepared to pay for them. Although the Gold Standard which provides the best indicator of this commitment is used more in the voluntary market than in the CDM[7], it appears that the success of standards in producing credible credits with consistent, if not stringent, quantification protocols is that price competition is driving voluntary credit production to look very much like the CDM, minus HFC and N_2O projects (Corbera et al., 2009).

The IEP theorisation suggests that beyond the day to day matters of climate policy there are dynamics common to other instances of market genesis. As in the case of second generation mobile telephony described by Mina (2003), the mainstream economic concepts of competition, atomised participants and utility maximisation are clearly not responsible for the development and operation of voluntary carbon market exchange institutions. However, unlike in the telephony case the state is not proving strongly influential in the creation of the market and the setting of standards. In summary, this chapter has described the contradictory processes of standardisation and product differentiation, audit and economic efficiency.

[7] High quality volume data for the voluntary market are not available but the 2009 NCF survey recorded 12% of transactions in the voluntary market in 2008 to be GS validated. The Feb 2009 CDM Pipeline reports just 3,028,000 GS CERs are anticipated by 2012 out of a total of 2,910,925,000 (0.10%). Although the two figures are different measures of market activity, it seems reasonable to conclude that the GS has less prominence in the compliance market by volume.

10. Discussion

This chapter attempts to synthesise the information and arguments presented in the preceding chapters that outlined and evaluated the institutions enabling a trade in emissions reductions credits. There is considerable detail presented in these chapters, which is important not only to provide the reader with guidance through a complicated topic but has also been necessary for the author to elucidate the tendencies within the institutions.

Chapter 3 outlined a neo-Polanyian analytical framework that assists in comprehending carbon credit exchange and introduced concepts that are absent from both mainstream economic theory and the ANT economic sociology that have been prominent in this field. These concepts and areas of analytical emphasis include i) substantive economics and the specificity of economic processes, ii) institutional context of exchange relations, iii) the organisation of exchange and dynamic processes that create the conditions for economic exchange, iv) non-market economic flows and v) the Polanyian concepts of fictitious commodities and the double movement. The analytical value of these concepts in relation to carbon credit institutions is discussed in turn and the utility of the IEP framework as a whole is appraised.

10.1. Substantive economics and the identification of specifically economic processes

The substantive approach to economics focuses on the empirical economy, a society's processes of material provisioning, rather than reducing economic analysis to a logical calculation. The series of conclusions drawn in this chapter each in their way arise from taking a substantive approach. For instance, scarcity is a foundational concept in neoclassical economics but I discuss in sections 10.2 and 10.3 how this is contingent and institutionally determined. However, I will focus firstly on the flawed assumption of the efficiency of carbon credit exchanges.

The primary rationale for market based instruments in environmental policy is that they promote this calculative process, however, the evidence presented in chapter 7 shows that there are significant problems with this approach. Were one to consider the CDM purely through the lens of mainstream economics then marginal abatement cost (MAC) harmonisation would be the primary rationale to support the exchange of credits, with the ultimate objective of correcting a market failure at least cost. It is not trivial to empirically demonstrate that a given project supported by a crediting transaction is either contributing to allocative efficiency or is one of the most cost effective projects that could be undertaken. In order to demonstrate optimal allocation one would need to show that in turn, each project supported is the next most cost effective possibility in both the host and donor economy. This also requires a metric against which to make that assessment, for example incremental cost which is the cost of making an investment in an activity with lower emissions than the baseline case (Jackson et al., 2001, p39).

The argument that the market type mechanism automatically performs the ideal calculus, at a lower cost than alternative interventions, is substantially related to the type of economic theory one adopts. Even within the neoclassical framework there is recognition of the presence of manifold visible and hidden subsidies, distortions, market structure imperfections and information problems that agents in the actual economy are faced with and thus make the determination of efficiency a fraught and subjective task. Sections 7.1 and 8.1 clearly demonstrated that each CDM project may involve a myriad of financial backers and economic influences. The research in chapter 8 also shows that there is not just one market for credits but that they move through a series of different types of exchanges between different kinds of economic agent.

Finally, it is also worth noting that the substantivist approach recognises the specificity of economic activity. That is to say, while the empirical economy is variously associated with social and political activity, the core processes of production, consumption, exchange and distribution can be discerned. For example, carbon credit institutions might be interpreted as social practices of ethical consumerism or the political actions of government to regulate industry, however, the substantivist framework identifies their specifically economic aspects. This has formed the basis of the organisation of the empirical material. Chapters 6, 7 and 8 discuss the three of the core economic processes Polanyi identifies; distribution was set aside because it occurs simultaneously with exchange for immaterial entities like carbon credits.

10.2. Institutional context of economic relations

Having recognised carbon credit exchange as economic, methodologically this thesis has set aside idealised formal analysis. The empirical work has shown that the institutedness of credit relations in international governance regimes, consisting of both state and non-state classes of agent, shapes the economic activity of credit exchange. Conversely, credit exchange is one aspect of these novel institutions that shape other economic activities.

Firstly, constructing and operating the projects that earn credits requires financial resources substantially beyond those generated through CER sales. In raising these funds project developers turn to IRR calculations and therefore pit mitigation projects against other investment options and weigh up the risks and potential returns or in China's exceptional case, consider the benchmark for rate of return set by the state (Schroeder, 2009b). Research that focuses solely on technical, engineering or socio-political aspects of mitigation potential and costs misses a very substantial part of the incentives and actual governance of mitigation by the CDM. 'Cheap carbon' is not only a feature of the technology involved, although industrial gas projects illustrate how that can be relevant, but also of national economic circumstance. Similarly, those countries and regions with rapid industrial expansion, stable governments and high rates of economic growth will find it easy to attract CDM investment whether warranted or not. China, India, Brazil, Mexico and South Korea have delivered 92.1% of CERs and host 76% of projects (CDM Pipeline May 2010). They each have stable, growing economies with feed in tariffs, preferential taxation, public investment and renewable energy subsidies applicable to many project types. It is clear that LDCs and countries without well developed capital markets and public investment in the economy will struggle to compete for CER funds. Much of the geographically uneven outcome of the CDM is due to prevailing national economic conditions, a point clearly identified by taking the IEP approach to exchange (3.2 on page 87).

Secondly, despite being predominantly determined by market exchange, the pCER price floor set by Chinese DNA prevents a competitive equilibrium price developing and increases scarcity rent. Without this intervention it is possible that lower prices may, counter to mainstream theory, have reduced total volume due to uncertainty associated with volatility at the outset of a market. Aside from this intervention, it appears that many other project host parties and companies are unwilling to trade

at less than €6 per CER as the investment in a DNA for the host government, and search, legal and other transaction costs for the selling company are not viable at lower prices (Degouve, 2007).

Thirdly, additionality requirements create an important interaction between the CDM and national environmental regulation. There were early concerns that the CDM would provide a disincentive for Non-Annex I governments to pass environmentally progressive regulation. Were low emissions technologies to be mandated or financially supported then additionality demonstration becomes more difficult. In 2005 the EB issued guidance intended to reduce these concerns stating that only regulations that favour low emissions development passed before the adoption of the Marrakesh Accords should be considered in the business as usual baseline. Any subsequent legislative requirements ought to be disregarded by DOEs validating projects (EB22 Annex 3). Although intended to remove a perverse incentive, this judgement creates the peculiar situation of projects entering the CDM not being judged against their host country's operational environmental standards.

10.3. The organisation of exchange and dynamic processes of commodification

Randles & Harvey (2002) provide the framework used in this thesis to approach the organisation of exchange and processes of commodification. Chapter 7 shows how the entities that are exchanged, property rights over GHG emissions or reductions, have no *a priori* form, and only exist as an instituted set of calculative procedures and relationships between classes of agents within the compliance and voluntary markets. It is revealing of the commodity form of credits, the variety of organisations that participate in the production and audit of credits, and the importance of state agents in setting the terms of trade and the type of activities that are eligible to earn credits.

The market exchange between economic agents acts in subtle, immaterial ways, but nonetheless with material consequences. Talk of commodification, may to some extent over emphasise the materiality by associating the instruments of exchange with physical quantities of GHGs. The grey literature and policy literature are replete with references to 'carbon commodities' and 'tonnes of carbon'. As Castree (2003) clearly summarises, all commodification processes are multifaceted and all

commodities exist as a bundle of social relations, but the in the case of carbon trading institutions there are no physical entities directly changing place or changing hands at all. The new institutions created are closer to monetary systems that enable economic exchange. They also contribute to new motivations and social dynamics, as Marx articulated in his presentation of the M-C-M' circuit of accumulation.

As credits are produced by fiat rather than manufacture, the authority to issue credits is central to the institution. In this sense it is worth noting that credit-based systems align more closely to traditional 'command and control' policies than allowance systems (Ellerman, 2005a). Credibility is the major determinate of value within credit exchange institutions and its origin differs substantially between compliance and voluntary regimes. The IEP framework captures these dynamics and relates them directly to the economic process in a way that other frameworks do not.

Further, project level abatement decisions, i.e. what to build, when and where, are primarily governed by broader economic circumstances and by the terms and conditions of the regime authority rather than the price of the credits within the market (section 7.1). In fact, no measurement of emissions need occur in a credit regime, the regulator may choose to grant credits on the basis of standalone policy or the presence of investment so long as confidence is maintained in the regime (Ellerman, 2005). This feature is at the heart of debates about the effectiveness and environmental integrity of project-based credits. What is at stake is the correspondence between the social institutions of the trading regime, the quotas and property rights, and the material flows of pollutants over time. The same criticisms also hold in respect of cap and trade schemes and is often overlooked. The level of the cap determines the physical implications of each traded instrument and there is not necessarily a one to one correlation with material units of greenhouse gas emissions.

Credit generating projects are always situated within wider economic systems, see figure 8.2 on page 200, and this means that commodity form will remain problematic. Problems of spatial and temporal leakage, as raised in the case of N_2O and HFC projects or rebound from energy savings, section 7.2.2, cannot be entirely eliminated as complex social systems are indeterminate in the long term. Credits are just one economic institution that influences project host economic activity and greenhouse gas output. As such claims that credits are exactly equivalent to material tonnes of emissions are logically insupportable.

Grubb's paradox, raised in section 7.1 on page 153, goes to the heart of the dif-

ficulties of using this kind of market mechanism to deliver quantified emissions reductions and why assumptions of unequivocal commodities are inappropriate. By all accounts there are a great many low emissions actions and policies that are 'economically-no-regret' (ENR) but which are not being done for one reason or another. They therefore offer the possibility of very cheap 'reductions' in any institution that attempts to stimulate low carbon development through crediting. If perfect market assumptions held then none of the many possible projects at negative marginal abatement costs, i.e. projects whose implementation generates net economic benefits for their operators, would exist. However, given that they do, price competition would suggest that they will be identified, credited and consumed first, but with a very substantial risk of some being business as usual activities. There is no way to determine unequivocally associate the initiation of a particular project with the sale of particular credits. Alternatively if they are screened out of crediting through the use of stringent financial additionality criteria so that only 'economic regret' projects remain then the costs of credits will be raised and the rationale for instituting a market substantially weakened. Confident determination of the ENR–ER boundary will likely only get harder as time goes by as national and international policies and norms change and the price of fossil fuels increases (Carbon Trust and Climate Strategies, 2009, p58).

Energy efficiency interventions in buildings and transport are thought to present substantial low or negative cost mitigation possibilities that are persistently overlooked in economies around the world (Enkvist et al., 2007). However, there are very few credit financed projects that address these areas (see 7.1 on page 151) because of the institutional structure of CDM and for many of the same reasons that these changes are not being conducted under 'business as usual'. The site specific notion of 'the project' does not adequately correlate with the pattern and types of change that are required in these sectors, upfront capital requirements may be very high, infrastructure and planning considerations substantial, and the widely distributed nature of inefficient homes and vehicles make calculation difficult and monitoring very expensive. The ENR aspects of these interventions also means that market leakage may be expected to be substantial, increasing emissions in diverse, distributed and difficult to measure ways.

However, this additionality paradox is clearly less significant in the case of industrial and fugitive gas projects which present their hosts with no financial return aside from that earned through credits. Yet, here there are other political institutions at

work or national political norms of pollution regulation. For instance, HFCs could be regulated by the Montreal Protocol on Substances That Deplete the Ozone Layer (1987), a political regime that has contributed substantially more to climate change mitigation than the Kyoto Protocol (Molina et al., 2009). The IEP framework takes the social and political embeddedness of economic institutions as a starting point rather than working from an assumption of atomised individual action that would be blind to such considerations. Additionality can therefore be seen as a weak concept overall, and not just a problem of determination.

It is also clear that crediting systems do not meet with the new institutional economics ideals of simplistic property rights and institutions that realise low transaction costs. The most striking feature of emissions reduction crediting is the complexity and ambiguity in the definition and allocation of the commodities. However, their operation is eminently possible and sufficiently stable to allow considerable resource flows. Section 7.3 illustrated the substantial transaction and audit costs related to the production of credible, fungible instrument that are borne by the compliance market but these are not sufficient to impede high volumes and are in any case dwarfed by the rents and speculative gains that are realised by project developers (see page 152) and in secondary transactions (section 8.2).

Finally, by looking to the organisation of exchange a notable geographic element of the CDM's transaction costs can be demonstrated. Financial intermediaries, consultants and DOEs are almost exclusively based in Annex 1 countries and so economic revenues from their activity remain in richer nations. This is an empirical rather than theoretical criticism but a rather substantial one. Whilst there is a case for support by way of grants for CDM host countries to develop unilateral projects and capacity in auditing and project development to reduce and retain transaction costs (Michaelowa, 2006a) it is arguable that ODA would be better spent directly implementing development projects rather than supporting lower mitigation costs for rich nations.

10.4. Market and non-market economic flows

Despite the issues outlined above, the CDM's rules for production of CERs have been sufficiently stable to enable economic flows governed by market exchange and motivated by private gain. The primary CDM market, section 8.1, fits Aristotle's

conception of chrematistic activity with credits only ever produced for exchange between parties; those who produce them have no direct use for them, by definition under the UNFCCC. This exchange indicates a flow of financial resources from a class of organisations or states who wish to increase their output of emissions to class of existing polluters who can demonstrate reductions. As there are a host of institutional risks and variables, gain motivated developers seek out the most productive projects with a high rate of return on investment. These are the projects hosted by the most intense polluters, the HFC and N_2O manufacturing facilities and landfill sites. More broadly it should be no surprise that some CDM projects have encountered local resistance. This has been initiated by fenceline communities and environmental justice groups that object to the continuation of economic activity that is detrimental to local environmental conditions and injurious to health (Lohmann, 2006). Because credits are awarded for changes to existing patterns of pollution, revenues should be anticipated to flow to a highly polluting class of agents and it cannot be assumed that climate mitigation will also reduce the other 'externalities' that such agents impose in their locality.

Primary CDM market flows also generate a secondary, material effect. CER production is to a large extent associated with industrial gases, however, they are consumed in the EU ETS, which principally influences emissions of CO_2[1]. There is therefore an exchange in the qualitative type of gases entering the atmosphere, not only the location and timing of their source. CO_2 emissions will increase in Europe as the CDM reduces methane, N_2O and HFCs in Asia and South America.

IEP also helps to identify some surprising yet influential non market economic flows. Section 8.4 details the carbon credit specific flows, namely CDM fees, the SOP-Adaptation levy, registry fees and DNA fees and the general national taxation regimes that apply to credits generating projects as a matter of course. In financial terms, the Chinese taxes on industrial gas CERs have generated the greatest funds. Flows such as these may to some extent explain the lack of will for DNAs to set strict sustainability criteria when screening projects.

However, the most significant influence of non-market economic flows is exerted by state taxation and energy pricing. Projects are necessarily set in wider economic circumstances and the state may be a key influence on the incentives that result. For

[1] Article 24 of the EU ETS Directive (2003/87/EC) allows nations to voluntarily opt in N_2O from point source industrial installations to Phase 2. As of October 2010 Austria, The Netherlands and Norway had done so (DECC 2010).

instance the tax laws and renewable electricity price guarantees of a state are seen to have more influence on a CDM project's additionality than the presence of absence of carbon finance (p152). In this way, non-market economics relates to each of the previous conceptual points outlined in this chapter; the importance of institutional context of economic activity, the contingency of commodification and the significance of overlapping economic relations.

10.5. The Polanyian concepts of fictitious commodities and the double movement

The concepts of fictitious commodities and the double movement are two of Polanyi's most referenced contributions to political economic scholarship. As discussed in chapter 3 they offer both analytical and normative perspectives on the relationship between integrative market exchange, society and nature. Voluntary and compliance carbon markets illustrate and ambiguities of both concepts in their original form and provide empirical detail to support an IEP interpretation.

Briefly to recap, Polanyi describes land, labour and money as fictitious commodities as, in market societies, they enter economic processes through market exchange, even though they are not originally 'produced for sale'. Nonetheless, Polanyi documents a tendency within market societies to expand the scope and depth of market relations. He argues that the consequences of this are social and ecological instabilities that invoke a societal response to reform or remove the market institution. It is this that is referred to as the double movement.

It is possible to see early indications that Polanyi's concerns around the creation of fictitious commodities may come to pass in carbon trading institutions. GHG emissions can be quantified and recorded as units of account in national emissions inventories, organisational environmental management strategies or personal carbon footprints without becoming units of exchange. It is quite a different institutional matter to enable exchange of such units, or create new units not founded on emissions output but on supposed reductions. Whilst credits *are* 'produced for sale' they are property rights over units of account, and not the underlying entity, a stable and favourable climate. Like money, the units exchanged in emissions trading regimes are politico-economic institutions, not material objects. As such they are vulnerable to the decisions made by bureaucracies, a point that is acutely felt by compliance

market participants. Millions of dollars hinge on the acceptability to the European Commission of industrial gas CERs for use in the EU ETS, and similarly on the additionality arguments accepted or rejected by the CDM EB (section 7.1). There is no evidence so far of social instability but it is not beyond the realms of reason to suggest that sustained high electricity prices, sparked by a tight EU ETS cap over a predominantly fossil fuel grid linked to a rapidly growing aviation industry, could precipitate unrest. In such circumstances it seems most likely that the cap would be relaxed rather than allow people to go cold or substantially redistribute economic resources through taxation. The political economic impact of emissions trading under a series of caps sufficiently stringent to decarbonise OECD energy use by 2030 (Bows et al., 2009) needs to be considered fully before the majority of mitigation policy is surrendered to market exchange.

Polanyi's description of the double movement does not go so far as to detail local or immediate causative mechanisms. Harvey et al. (2007) interpret the double movement as a dialectic of regulation and deregulation of economic activity in their IEP framework. It is the institutionalisation of economic activity that is in question, so the tendency to market deregulation is not a matter of separation or 'disembedding' of the economy from society. In the opposite direction, IEP extends the double movement by presenting three possibilities for the causation of regulation; social protection by the state, strategic construction of the conditions for market activity by market participants and state led market construction towards a particular goal.

This framework suggests a number of ways that different aspects of carbon credit institutions can be interpreted. Firstly, climate change could be seen as an economic externality and that compliance credit institutions are an attempt by a coalition of nation states to reform the market economic system to address this danger. However, the active role of nation states and non-state actors in the design and operation of the exchange institutions (section 6.2) suggests that it is an expansion of market relations in the interests of multiple classes of economic agents that are driving this agenda. Where there have been criticisms of the efficacy of CDM, reform has been to minor procedural details, such as incentives for the participation of LDCs, rather than to the structure of the institution.

Secondly, a double movement of social protection may be seen within the supplementary certification schemes, such as the Gold Standard, that recognise failings in the CDM and voluntary market. Despite clear and thorough institutional arrange-

ment there has been limited material penetration of such schemes. It is proposed that their failure to be adopted by compliance regimes, has left them as little more than an ethical smokescreen for other less benign projects. Indeed, the empirical evidence from the voluntary market, presented in section 9.4.2, suggests that combined portfolios of supplemented and basic credits are used to increase credibility and prestige at minimum cost.

Thirdly, section 9.3.1 describes efforts to increase the credibility of both the production and consumption of carbon credits by various classes of agent in the voluntary market. The VCS for instance, promotes itself as being a basic standard that identifies carbon reductions that can be exchanged and consumed as equivalent to emissions. It does not claim to provide any local, community or ecological benefits like other standards, but has become the most widely used voluntary standard and has good recognition with the corporate consumers that represent the bulk of the demand for voluntary credits. However, whilst promoters of standards appeal to the possibility of certification providing unambiguous carbon commodities, it is clear that there are differences in stringency of crediting criteria and quality assurance procedures between the standards available. Interviews with producers and consumers show how both parties make efforts to identify specific projects, and the 'stories' that they can communicate, looking beyond the simple quantity of credits. This 'conspicuous production', detailed in section 9.4, is a pronounced feature of the voluntary market in contrast to the consumption of uniform commodities in compliance regimes. There is simultaneously a tendency to standardise the units of exchange to increase volumes, reduce costs and maximise economic gain for participants but also a corresponding response from market participants to know the origin and some aspects of the conditions of production of the credits they purchase.

Again, it may appear that a double movement of some sort is occurring, however, the details are not captured in a simple explanation of expansion and consequent retreat of market institutions. It is here that the IEP approach, recognising the particularities of the exchange institutions offers a more subtle explanation. This example appears to reveal a tension in the process of instituting immaterial commodities where the qualities of the commodity are not familiar or readily verifiable to the consumer. In order to promote exchange activity, the retail class of agents enriches commodities by over-writing their uniformity and enlisting the credibility of third parties such as environmental NGOs.

Considering both fictitious commodities and the double movement, it is clear that

the original Polanyian concepts are useful starting points for analysis but leave persistent ambiguities in this case. Although, the IEP approach retreats from macro scale grand historical causation it provides additional insights and analytical guidance.

10.6. Appraisal of IEP framework

The above sections have shown how the IEP framework has revealed insights into the process of instituting markets for carbon credits. It has drawn attention to a number of difficulties in the definition of emissions reduction credits and then related these to the economic systems within which the classes of agents that participate in the institution are situated. However, whilst the IEP framework is methodologically useful in identifying the structure and operation of economic systems, it offers few specific causative mechanisms or hypotheses to test against empirical findings. Further, unlike Marxian analyses of commodification it provides little sense of repeated and historic regularities in formatting for exchange.

At the macro social scale, Marx and Polanyi presented explanations for large scale trends in *Capital* and *The Great Transformation*, although recent scholarship is reluctant to follow them (Castree, 2008a and 2008b). Nonetheless, Castree (2003) outlines six features of capitalist commodification identified as regularities within the 'commodification of nature' literature; privatization, alienability, individuation, abstraction, valuation and displacement each of which might be identified in the foregoing carbon credits case. Applying this approach might provide further insights into carbon markets and also contribute to discerning the general tendencies of capitalist processes by comparison with cases from, for example, forestry (Prudham, 2004), fisheries (Mansfield, 2004) and mining (Bridge, 2002). However, Marxian commodification fails to capture broader and diverse institutional features such as multiple markets, non market economic flows, and peculiar dynamics and incentives such as found in HFC baseline manipulation and N_2O market effects. These features may have been overlooked without the IEP framework.

Finally, Polanyi's original concepts of the double movement and fictitious commodities, have proved ambiguous in this case. Neither directs the analysts attention to the supporting non-economic relationships between economic agents that are either necessary for exchange to take place or arise as a response to the instabilities of 'pure'

market exchange. It is here that the IEP framework provides a useful extension, for instance in comprehending the additional standards and 'stories' that overlay CDM and voluntary market credits.

Part IV.

Conclusion

11. Conclusion

The Clean Development Mechanism has exceeded the expectations of many business and policy elites who at the signing of the Kyoto Protocol had little idea of the scale it would reach in the decade following. Billions of dollars have been invested in the credits that are exchanged and the projects which generate them. Despite substantial criticism from civil society groups, academics and some quarters of the business community, it has persisted and grown in scope and size even if at a lower rate since the 2008 financial crisis and the uncertain outcome of the COP15 at Copenhagen in 2009. The CDM bureaucracy itself continues to grow and with negotiations for new crediting mechanisms post 2012 appears to be an established and important part of the international climate regime. It is difficult to quantitatively estimate voluntary sales of emissions reductions credits, for the reasons outlined in chapter 9, but surveys suggest it has slowed dramatically in 2009 from exponential rises in volume in preceding years. The main third party standards bodies have continued to register new projects and new methodologies and lobbied for accreditation with regulated bodies in new trading regimes in the USA, Australia and New Zealand. Carbon markets appear to be a persistent policy innovation.

The theoretical analysis presented in Part II provided substantial principled reasons to be sceptical of the prospects for mainstream economic theory to provide policy proposals that were both analytically consistent and contributed to concrete human well being. Critics of the approach contend that it is not the absence or failure of markets that causes environmental problems but rather the inappropriate extension of market norms (O'Neill, 2007). Price mechanisms may be unjust and regressive, limiting access to goods or influence for poorer members of society in what ought to be political matters (Lohmann 2006). The Coasean body of theory removes the proper moral stigma attached to acts of pollution, and individuated, economic transactions lack a sense of collective endeavour or sacrifice necessary for social transformation (Sandel, 1997). The socio-technical systems that drive greenhouse gas emissions are typically associated with long lived infrastructures and habits and there are accusa-

tions that the marginal logic of carbon trading may not incentivise innovation, long term planning or radical change and, indeed, it may enable further lock-in to highly polluting infrastructure (Unruh, 2000; Driesen, 2008).

The mainstream economics framework has limited analytical purchase on the matter of emissions credit instruments because so many of the formal assumptions on the structure of markets and action of agents are violated. For example, nation states are key agents in the process of defining, enforcing and participating in the institutions, theoretically and empirically. For a host of reasons, their actions cannot be described in instrumentalist atomized terms. Alternative economic frameworks that have contributed to the development of credit institutions highlight this. Public choice theory pays attention to possible welfare losses from government failure. In considering firms' interactions between themselves and with households and the state, new institutional economics suggests that the efficacy of actual alternative institutional arrangements may differ because of transaction costs absent from neoclassical theory. The Austrian perspective rejects market optimality and symmetrically market failure, so justifications cannot be made by reference to an ideal allocation but invokes benefits of autonomy and the putative calculative and information aggregating properties of market coordination. Because of the scale and inseparability of normative issues from climate change policy and analysis, positivist economics is analytically problematic and ideologically naive.

For all the libertarian rhetoric of neoliberal reforms, the role of the state and government is still central to governance and whilst Robbins accents scarcity and choice in markets, the implicit goal is the maximisation of the circulation of goods and services as commodities (Bromley, 1990, p91). The extent to which the underlying dynamics of capitalist economies are substantially altered by new modes of governance is questionable. Within the realm of environmental governance, the majority of efforts at 'sustainable development' adhere to the reformist notion of economic growth with ecological modernisation. Patterson (2009) argues that this is not to say it is, just, a smokescreen; indeed it may be closer to a raw growth tendency where improvements in human welfare can only be conceived of in terms of expanding the economy. Ecological degradation is genuinely considered, but as a problem to be managed so that maximised growth might address poverty alleviation, problems of malnutrition, lack of access to clean water and all manner of insults to human dignity, within a broadly capitalist social order. This is especially conspicuous in the development of market based instruments (MBIs) to achieve particular social or

environmental goals.

Nevertheless, the empirical material in Part III has shown that the exchange of emissions reductions has been effectively instituted and shows a number of objective stable features. Quantification and assurance procedures are in place and widely accepted by market participants. Model contracts are available and market participants have become arranged into a constellation of economic agents that produce, exchange and consume emissions reductions credits. The 407 million CERs that had been issued by the CDM by May 2010 are anticipated to be joined by another 600 million before the close of the Kyoto compliance period in 2012, generated by over 2100 registered projects. Each CER can be redeemed for an increase in allowable emissions by the nation states, public and private sector organisations that purchase them, predominantly large industrial plants and power stations in the European Union. The demonstrable economic consequences of the mechanism are to transfer finances from EU electricity purchasers and industrial manufacturers to consulting organisations that provide CDM project development services and the financiers that back them. A proportion remains with the owners of polluting infrastructure in NAI states and host governments, almost entirely China, India, Brazil, Mexico and South Korea. Emissions undoubtedly increase in the consuming nation, but as illustrated in chapter 7, the quantification and quality assurance mechanisms that are meant to ensure correspondence between the units of exchange and material quantities of greenhouse gases are fundamentally flawed. Because of the ambiguities in the crediting process and the definition against a counterfactual model, it is simply not credible to claim that credits could have a 100% guarantee of being "real, additional, verified" reductions. That is not to say that the all transactions are fraudulent or false, but rather that it is a logical impossibility to accurately measure the absence of pollution from a business as usual baseline. Those projects that were genuinely incentivised by finance from CER sales may indeed contribute to climate stabilisation but it is not possible to quantify this with any certainty when they are embedded in other economic flows (see 7.2.2 on page 159). Further, determining additionality is a matter of subjective judgement not a statement of fact. It is too much to give the the economic agents nominated on the PDDs complete agency so looking at the institutional incentives surrounding investment in CDM projects it is clear that the most "cost effective" i.e. most attractive projects are those that we are least able to distinguish. Greater robustness could be provided by seeking out projects that are economically isolated or providing a larger proportion of funding

to the project from CER sales, however, both of these remedies work against the gain motives of individual agents and the cost minimising logic of market type institutions. Furthermore, credit exchanges require substantial expert investment and in voluntary markets where oversight is not mandated to the same degree then it is likely that there will be questionable approvals. However, in voluntary markets, the consequences on the consumption side of the exchange are not so clearly defined. It is not so clear that emissions will necessarily go up as credits are consumed, in the same way one would see in compliance markets.

I can only speculate as to why the institution persists and continues but would suggest that it serves the short term political economic ends of the majority of regime participants. Host states and organisations receive modest revenues, consumer states and organisations reduce their regime compliance costs and producers, financiers and intermediaries are afforded the opportunity to accrue rents and increase economic activity. The detrimental consequences of the GHG pollution are translocated spatially and temporally by the climate system so that provided contracts are sufficiently robust and quantification sufficiently credible then exchanges between parties can continue.

The complexity and opacity of the procedures and methods surely contributes to this process. I have found research for this project both bewildering, enthralling and time consuming. As a result the final contribution to knowledge may appear trivial in relation to the detail provided, or tedious for those steeped in the markets. However, to get to this stage has taken some considerable investment. I feel this has been necessary in order to provide a robust critique of some aspects. The depth of sophistication of the institutional procedures that contribute to the production of some CERs is staggering and I have only been able to present a very limited set of illustrations in the empirical chapters. Developments in the voluntary market are even more difficult to appraise for the reason that there are multiple different standards organisations with their own myriad structures and procedures. This complexity surely prevents both consumers and regulators from apprehending the full implications of particular practices and lends a skein of expert respectability through a vocabulary and conceptual framework that excludes casual scrutiny. Further, this variety reinforces the notion that exchanges are contingently and variably instituted and need not conform to a rigid model or pre-existing commodities.

At present extant emissions trading institutions do not appear to offer a high degree of likelihood of delivering net emissions reductions when the whole supply chain

from the production of credits to their consumption by a polluter is taken into account. They would certainly not meet many of the key ecological economic tenets of strong sustainability, acknowledgement of thermodynamic and material flow limits, recognition of discontinuous and non linear ecological damage functions or the rejection of a hedonistic account of welfare (Pearce, 2002).

With this thesis I hope I have accomplished a number of tasks. I have provided an overview of the theoretical rationale for carbon trading and a synthesis of the critiques of much of its basis. By introducing the neo-Polanyian IEP framework I hoped to bring some analytical clarity to the complex relations and processes present in the carbon markets I examined. Further, in operationalising the IEP framework in a novel setting I hope to contribute to the advancement of this body of theory. However, it was lacking in some respects, notably the ability to move away from ideographic descriptions of particular exchange processes. Related to this point it also lacked other comparator studies. In retrospect, a Marxian commodity analysis may have better suited some aspects of the study and further time spent integrating the two may prove fruitful.

Considering climate policy and empirical matters, the study suggests a number of subsequent avenues that could prove fruitful or be significant with regards to improving the environmental integrity of the institutions. With the advent of registries for voluntary credits it may be possible to perform comparative analysis of data disclosed in PDDs. For example, the proportion of funds contributed to a project by credit revenue, could be grouped by methodology, standard, and year of origination, and hence may be revealing of additionality claims. Using similar information sources, rejected projects could be tracked through sequential submissions to CDM, GS, VCS and VER+, revealing the boundaries between acceptability and exposing questionable claims of environmental integrity. Finally, the class of DOEs plays such a crucial and contested role in the production of credits and credibility that their activities and performance deserve much greater scrutiny, and studies could theoretically contribute to the critical accounting literature.

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