

Gorecki, Paul K.; Lyons, Sean; Tol, Richard S. J.

**Working Paper**

## EU climate change policy 2013 - 2020: Thoughts on property rights and market choices

ESRI Working Paper, No. 292

**Provided in Cooperation with:**

The Economic and Social Research Institute (ESRI), Dublin

Suggested Citation: Gorecki, Paul K.; Lyons, Sean; Tol, Richard S. J. (2009) : EU climate change policy 2013 - 2020: Thoughts on property rights and market choices, ESRI Working Paper, No. 292, The Economic and Social Research Institute (ESRI), Dublin

This Version is available at:

<http://hdl.handle.net/10419/50139>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

## EU Climate Change Policy 2013-2020: Thoughts on Property Rights and Market Choices

**Paul K. Gorecki, Sean Lyons and Richard S.J. Tol\***

*Abstract:* Under 2013 to 2020 European Union proposals for CO<sub>2</sub> emission reduction, a Member State can transfer to another Member State ‘part’ of their allowed emission allocation in the non-Emission Trading Sector (“ETS”). The paper addresses three questions in relation to these Transfer Emission Units or TEUs. First, what mechanism should be used to facilitate the exchange of TEUs? The preferred mechanism is a uniform price auction, preferably EU-wide. Second, what ‘part’ of the non-ETS emission limit of a Member State should be classed as TEUs – 10%, 20% or no limit? The proportion of the non-ETS emission limit that should be traded should be maximised. Third, who should realise the value of TEUs – the State, existing polluters? The value of TEUs should accrue to the State.

*Key words:* climate change; property rights.

*Corresponding author:* paul.gorecki@esri.ie

---

\* We would like to thank Paul Klemperer who provided comments on an earlier version, while Kelley Ann Kizzier of the Environmental Protection Agency answered queries concerning current and future EU environmental policy. The usual disclaimer applied. All three authors are affiliated with the ESRI, while Richard Tol is also affiliated with the Institute for Environmental Studies and the Department of Spatial Economics, Vrije Universiteit, Amsterdam, The Netherlands. The paper was funded by the Energy Policy Research Centre at the ESRI.

ESRI working papers represent un-refereed work-in-progress by members who are solely responsible for the content and any views expressed therein. Any comments on these papers will be welcome and should be sent to the author(s) by email. Papers may be downloaded for personal use only.

# EU Climate Change Policy 2013-2020: Thoughts on Property Rights and Market Choices

## I. INTRODUCTION

Regulation, whether of taxi cabs in New York or CO<sub>2</sub> emissions in the European Union (“EU”), often creates property rights where none existed before - the right to drive a taxi or to emit one metric tonne of CO<sub>2</sub>. Typically these tradable rights acquire a value reflecting the fact that regulation creates scarcity by limiting the number of taxi licenses or the volume of CO<sub>2</sub> emissions.

Under the EU proposals for CO<sub>2</sub> emission reduction between 2013 and 2020 a new property right is to be created: the right of a Member State to transfer to another Member State ‘part’ of their allowed emission allocation in the non-ETS sector.<sup>1</sup> These rights will be referred to as Transfer Emission Units or TEUs. They are created to reduce the costs of meeting EU emissions targets.

Three important issues surrounding TEUs are, as yet, unresolved.

- First, what mechanism – market or administrative – should be used to facilitate the exchange of TEUs?
- Second, what ‘part’ of the non-ETS emission limit of a Member State should be classed as TEUs – 10%, 20% or no limit?
- Third, who should realise the value of TEUs – the State, existing polluters etc?

The purpose of this paper is to contribute to the debate on resolving these issues.

The paper is divided into seven sections. Section II sets the background in terms of climate change policy. Attention is focussed on 2008-2012, immediately preceding the introduction of the TEUs.<sup>2</sup> These years coincide with the first commitment period under the Kyoto Protocol during which EU and other industrialised countries must meet targets to restrict greenhouse gases. Although the EU has set out emission reduction targets for the period 2013-2020, discussions on a successor to the Kyoto Protocol are due to commence in Copenhagen in December 2009. Depending on what emerges from Copenhagen, the analysis and conclusions in the paper may need to be modified and revised.

Section III presents the rationale and key features of the TEUs, while Section IV details four major characteristics of the market for TEUs, including its size, the major buyers and sellers as well as the market structure indices. Three mechanisms for trading TEUs are evaluated in Section V: bilateral arrangements; market intermediaries acting on an agency basis; and, auctions. In Section VI the issue of

---

<sup>1</sup> The distinction between ETS and non-ETS sectors is explained in Section II below. ETS=Emission Trading System.

<sup>2</sup> The reader who is familiar with the 2008-2012 EU climate change arrangements can skip Section II.

how a Member State should allocate the TEUs is addressed. The final section of the paper returns to answer the three questions posed above. As will be apparent from the analysis in the paper the answers to these questions are not independent of each other, particularly the first two questions.

## **II. EU CO<sub>2</sub> EMISSIONS TARGETS & REGULATION: 2008-2012**

The EU sets a limit or maximum level of CO<sub>2</sub> emissions,<sup>3</sup> referred to as allowances, for each Member State. One EU Allowance Unit (“EUA”) is equivalent to one tonne of CO<sub>2</sub>. The level of allowances is set to restrict emissions below what they otherwise would be. For the EU as a whole the target is to reduce emissions by 8% over the period 2008-2012 compared to the 1990 level. In the case of Ireland its allowances are set at 13% above the 1990 level of CO<sub>2</sub> emissions; in 2005 Ireland’s actual CO<sub>2</sub> emissions were 25% above the 1990 level (EPA, 2008, p. 6). In other words, the target level of emissions is a binding constraint for most participants. Despite the current recession it appears that the target is still binding.<sup>4</sup>

Each Member State has to design a National Action Plan (“NAP”), which demonstrates how it intends to conform to EU Emissions Trading Directive (Directive 2003/87/EC).<sup>5</sup> The current NAP covers 2008-2012. The NAP: divides the overall allowance of a Member State into the EU ETS sector and the non-ETS sector; and, within the EU ETS sector, how the allowances will be distributed. The NAP also considers emission reduction in the non-ETS sector. In Ireland the NAP is designed by the Environmental Protection Agency (“EPA”), within parameters set by government.<sup>6</sup>

The EU ETS sector accounts for about a third of Ireland’s CO<sub>2</sub> emissions as projected over the period 2008-2012 (EPA, 2006, p. 9). Under the 2008-2012 NAP, the EU ETS and non-ETS allowances have to be complied with separately; there can be no transfers of allowances between the two sectors, either directly or indirectly. The allowances are set for the five year period as a whole.

### **A. EU ETS – the Traded Sector**

In Ireland’s NAP the EU ETS sector is divided into: general; cement; and power generation.<sup>7</sup> Allowances are first made to these groups and then, within each group, to individual emission sources, referred to as installations. In general these installations are large readily identified point emissions e.g. a brewery, an aluminium smelter, a power plant, a petroleum refinery or cement works.

The Member State has little discretion in the mechanism selected to allocate the allowances to installations for the period 2008-2012. The relevant EU Directive

---

<sup>3</sup> Non-CO<sub>2</sub> emissions are converted into CO<sub>2</sub> emissions.

<sup>4</sup> See EPA (2009) for details.

<sup>5</sup> For details of Ireland’s see EPA (2006, 2008).

<sup>6</sup> See EPA (2006, 2008) for details.

<sup>7</sup> Other Member States may also include, iron and steel, certain mineral industries and pulp and paper. It appears that power generation is the most important source of CO<sub>2</sub> emissions. In 2005 this sector accounted for 62% of all EU ETS allowances. For details see Matthes & Neuhoff (2007, pp. 23-24).

states that at least 90% of allowances should be distributed free of charge (EPA, 2008, p.3). The allowances are assigned based on historic levels of emission of an installation (EPA, 2008, pp 14-15). In other words, the more you polluted in the past, the bigger the allowance assigned today. There is also an allowance reserve for new entrants into activities covered by the EU ETS.

The remaining 10% of EU ETS allowances can be auctioned or grandfathered or allocated in some other transparent way by the Member State. Ireland chose to distribute 9.5% free to existing and new installations, with 0.5% sold to recover the cost of administering the emission scheme (EPA, 2008, p.5).<sup>8</sup> Ireland retires unused allowances set aside for new entrants and, as such, these allowances contribute towards Ireland meeting its emission targets (EPA, 2008, p. 13). Ireland has thus waived its right to auction EU ETS allowances.<sup>9</sup> Germany (9%), the UK (7%), the Netherlands (3.7%), and Austria (1.3%) have chosen to auction part of their EU ETS allocation.<sup>10</sup> Other Member States may follow.

In Ireland allowances are issued annually by the EPA based on the 2003-2004 emissions of an installation (EPA, 2008, p.5). The installation receives the same annual allocation each year between 2008 and 2012. Thus the installation is provided with certainty concerning the allowance that it will be assigned.<sup>11</sup> Of course, if the installation ceases production then it is no longer assigned an allowance.

The installation must, at the end of the year, hold allowances equal to its emissions that year. The emissions can be greater than, equal to or less than the level of allowances that the EPA assigns the installation at the beginning of the year.<sup>12</sup>

The allowances assigned to an installation can be traded or exchanged by the installation's owners – CRH plc, Diageo Ireland, the Electricity Supply Board, Conoco Philips Whitegate Refinery Limited and so on - within a Member State and across Member States.

An active EU ETS market has developed in these allowances. It grew between 2005 and 2007 from 322 million tons of CO<sub>2</sub> to 2,061 million tons of CO<sub>2</sub> in 2007.<sup>13</sup> These volumes refer to spot, future and options trades. Futures contracts account for the major part of the value and volume of transactions.

The EU ETS market is by far the largest market for CO<sub>2</sub> in the world, accounting for 99% of CO<sub>2</sub> traded by value in 2007. Although the current EU ETS trading period began on 1 January 2008, it nevertheless had the experience of the pilot phase of EU ETS trading between 2005-2007, during which an installation's emissions were capped and trading allowed.

---

<sup>8</sup> The 0.5% will be sold for the EPA by the NTMA. The first tranche of 185,000 EUAs were sold in December 2008.

<sup>9</sup> A change would require the approval of the Dail and the Commission.

<sup>10</sup> For details see: [http://ec.europa.eu/environment/climat/emission/auctioning\\_en.htm](http://ec.europa.eu/environment/climat/emission/auctioning_en.htm)

<sup>11</sup> These are notified to the Commission and published on its website:

<sup>12</sup> [http://ec.europa.eu/environment/climat/emission/pdf/initial\\_nap/ie.xls](http://ec.europa.eu/environment/climat/emission/pdf/initial_nap/ie.xls)

<sup>13</sup> All data in this and the next paragraph is taken from Capoor & Ambrosi (2006, Table 2, p. 13; 2008, Table 2, p. 7).

Eighty per cent of transaction volumes according to Capoor & Ambrosi (2008, p. 8) were conducted in 2007 were over the counter (“OTC”)<sup>14</sup> with the London Energy Brokers Association (“LEBA”) accounting for slightly over 50%. The European Climate Exchange (“ECX”) accounted for more than 84% of exchange-traded transactions. There are at least five other exchanges,<sup>15</sup> with prices posted on the internet.<sup>16</sup>

The traders in the EU ETS market include installations, market intermediaries (e.g. trading houses, aggregators etc) and asset managers (e.g. investors carbon funds, hedge funds). Capoor & Ambrosi (2008, p. 61) observe that banks entered the carbon market massively in 2007.

The EU ETS trading system is underpinned by the Community Independent Transaction Log (“CITL”) that connects Member State registries and maintains an independent record of the issuance, transfer, cancellation, retirement and banking of allowances.<sup>17</sup> It has no role in relation to the financial aspects of a transaction and contains no information in price. The CITL has been in operation since 2005.

It is mandatory for each Member State to have a national registry. These registries will ensure the accurate accounting of all units under the Kyoto Protocol plus the accurate accounting of allowances under the EU scheme for greenhouse gas emission allowance trading. Not only companies but also natural persons may open an account, in any EU registry. This would allow environmentalists to purchase and retire permits so as to make emissions targets stricter. Registration of unregulated firms enables intermediaries and traders to participate in the EU ETS market.

Ireland is a small player in the EU ETS market: it accounts for only 1% of all EU allowances under the EU ETS; and, around 100 of the 10,000 installations covered by the EU ETS scheme across the EU. Thus Ireland, or more accurately installations located in the Republic of Ireland, is a price taker in this market.<sup>18</sup> Furthermore this market, like any other, will be subject to the competition rules of the EU, as EU ETS exchanges effect trade between Member States.

---

<sup>14</sup> In the OTC market, trading occurs via a network of middlemen, called dealers, who carry inventories of securities to facilitate the buy and sell orders of investors, rather than providing the order matchmaking service seen in specialist exchanges such as the NYSE. Definition from: <http://www.answers.com/topic/over-the-counter-finance>. Accessed 19 February 2009.

<sup>15</sup>European Climate Exchange (ECX) based in London and Amsterdam started in April 2005

Nordic Power Exchange (Nord Pool) in Norway began in February 2005

BlueNext in France started in June 2005 (Powernext Carbon became BlueNext on January 2008)

European Energy Exchange (EEX) in Germany began in March 2005

Energy Exchange Austria (EEA) in Austria began in June 2005

SendeCO<sub>2</sub> in Spain started at the end of 2005.

<sup>16</sup> See, for example,

<http://www.eex.com/en/Market%20Data/Trading%20Data/Emission%20Rights/Emission%20Futures%20%7C%20Derivatives/futures-table/2008-09-29#EUA>

<sup>17</sup> For an animated presentation showing the interaction of the CITL and the Member State Registries with respect to several transactions see: [http://ec.europa.eu/environment/climat/emission/citl\\_en.htm](http://ec.europa.eu/environment/climat/emission/citl_en.htm)

<sup>18</sup> The 1% is based on the experimental period 2005-2007. There is no reason to think the share has changed for 2008-2012. For details see Annex to:

<http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/05/84&format=HTML&aged=1&language=EN&guiLanguage=en>

Each installation has to make a decision concerning how much CO<sub>2</sub> to emit annually, subject to the constraint that at the end of the year it has enough allowances to match its emissions. In this respect it has a number of choices:

- First, the installation may engage in *abatement efforts* so that the installation emits less CO<sub>2</sub>. It will be profitable for the installation to do so until the marginal cost of reducing or abating a metric tonne of CO<sub>2</sub> is equal to the price of an EU ETS allowance for one metric tonne (assuming that the marginal cost of trading is zero).
- Second, the installation may *purchase or sell allowances (i.e. EUAs)* on the EU ETS market. If its abatement efforts plus its assigned allowances are less than its volume of emissions it will have to buy EUAs. On the other hand, if its abatement efforts plus its assigned allowances are greater than the volume of its emissions then it can sell the surplus EUAs.
- Third, the installation *could fund and develop a Clean Development Mechanism (“CDM”) project or purchase in the secondary market a Certified Emission Reduction (“CER”) credit generated by a CDM project*, if its abatement efforts and assigned allowances fall short of its verified emissions.<sup>19</sup> CERs can be included in the allowances an installation surrenders, given its verified emissions.

Thus if an installation requires additional allowances it can either purchase EUAs or develop/purchase CDMs/CERs.

It appears that installations in Ireland are overall net purchasers on the EU ETS market. In 2005 installations were allocated 19.237 million tonnes CO<sub>2</sub>, but actually emitted 22.398 m tCO<sub>2</sub>, a difference of 16% of the allowances awarded. However, there was a substantial variation by installation. For example, Scotchtown Cement Works had an allocation of 879,739 tCO<sub>2</sub>, but its emissions were 1,028,010 tCO<sub>2</sub>.<sup>20</sup>

## **B. Non-ETS – the Non-Traded Sector**

The non-ETS sector is the rest of the economy not covered by the EU ETS arrangements. Typically here CO<sub>2</sub> emissions are from small scale sources such as transport (e.g. cars, trucks), buildings (e.g. heating), services, agriculture and waste.

---

<sup>19</sup> The Clean Development Mechanism is a project based method of securing reductions in CO<sub>2</sub> emissions. The CDM is part of the Kyoto Protocol. Each CDM project is given one or more CER units. One CER represents a reduction in greenhouse gases one metric tonne of CO<sub>2</sub>. CERs can be sold and traded internationally between Annex 1 (i.e. developers/funders & purchasers; generally high income per capita) and non-Annex 1 (i.e. suppliers, generally low income) countries. Under the Kyoto Protocol, Annex 1 countries are constrained in their total emissions; non-Annex 1 countries are not constrained. If a non-Annex 1 country reduces its emissions through a CDM project, compared to business as usual, then the CERs can be credited to the meeting of the emissions target of an Annex 1 country. Over 2008-2012 in the non-ETS sector Ireland has committed to purchase CDMs that equate to 8% of its non-ETS emission limit (EPA, 2008, p. 5, 9, 27). For a discussion of CDMs see Ellis et al (2007), Haites (2000); Lee (2004); and Michaelowa & Jotzo (2005).

<sup>20</sup>Data source: [http://ec.europa.eu/environment/climat/emission/pdf/citl\\_2005/citl\\_ireland.pdf](http://ec.europa.eu/environment/climat/emission/pdf/citl_2005/citl_ireland.pdf) (accessed on 26 March 2009).

In order to meet its emission limits in the non-ETS sector, Ireland has introduced a whole range of measures set out in the NAP (EPA, 2006). These measures vary from home efficiency grant schemes to integration of land-use planning and transport development. However, these measures do not include any economic instruments similar to those outlined above for installations in the EU ETS sector.

Individual emission sources are not constrained with respect to their emissions beyond the usual profit and loss calculus with respect to the price of energy. Of course, that would change if Ireland introduced a carbon tax on the non-ETS sector.<sup>21</sup>

One of the mechanisms that the government can use to meet emission targets in the non-ETS sector is to fund and develop CDMs that yield CDM credits or purchase these credits – CERs - in the secondary market. The CERs will count towards meeting the emission limit in the non-ETS sector.

### **C. Conclusion**

Market mechanisms are used extensively in the ETS sector to allocate and price CO<sub>2</sub> allowances - EUAs. Installations trade EUAs OTC and through exchanges, while a small but increasing number of Member States auction off up to 10% of their ETS emission limit. In contrast, in the non-ETS sector very little use is made of market mechanisms or alternative economic instruments such as a carbon tax. That is about to change with the proposals for the non-ETS sector for 2013-2020.

## **III. TEUS: RATIONALE AND KEY FEATURES**

### **A. The Problem**

Under the 2008-2012 system for emissions reduction, each Member State sets a non-ETS sector limit, subject to an overall emissions and an ETS limit. These arrangements, as noted in Section II above, are set out in the Member State's NAP which is approved by the Commission. Under these arrangements Member States cannot sell or exchange or transfer allowances with another Member State between their respective non-ETS sectors.<sup>22</sup> This leads to inefficiencies at the EU level in terms of compliance costs for a given overall EU emissions limit.

Suppose, for example, that Ireland was exceptionally successful in its emission reductions due to low abatement costs. It might be able to efficiently reduce its emissions, at low cost, to below its non-ETS limit. However, Ireland cannot credit this difference to another Member State that is having difficulty reducing its emissions to the non-ETS limit due to high abatement costs. This results in inefficiencies at the EU level. If Ireland could transfer the difference to the Member State with high abatement costs, more emission reduction would take place where abatement costs are lower and less where the costs are higher.

---

<sup>21</sup> See Tol et al (2008) for a discussion of the carbon tax.

<sup>22</sup> Of course they cannot sell those to the ETS sector either.



## B. Towards a Solution: the Swedish Proposal

The Swedish Proposal<sup>23</sup> is designed to increase the efficiency and cost-effectiveness with which the EU meets its non-ETS limits for 2013-2020. Each Member State may transfer part of its non-ETS emission limit to another Member State. These were defined as TEUs in Section I above. Hence while the total EU non-ETS emissions limit remains the same, some Member States can exceed their initial limit, while others emit less than their initial limit through the transfer of TEUs.

The European Parliament's wording of the Swedish Proposal is:<sup>24</sup>

**10) As a means to even out the differences in abatement cost faced by different Member States by allowing for increased geographical flexibility, and at the same time, enhancing the overall cost-efficiency of the total commitment of the Community, Member States should be able to transfer part of their allowed greenhouse gas emissions allocation to other Member States. The transparency of such transfers would be ensured by way of a notification to the Commission and the registration of each transfer in the registries of both Member States involved, and may be effectuated in a manner that is mutually convenient, including via auctioning, use of market intermediaries acting on an agency basis, or by way of a bilateral arrangement.**

Six observations can be made about the proposal:

- It is motivated by a desire to reduce the overall EU-wide costs of meeting the EU non-ETS emissions limit. Given that Member States have different abatement costs at the margin in the non-ETS sector (Tol, 2009, Table A4, p. 1752), there is an obvious opportunity to reduce overall EU compliance costs.
- The “part” of a Member State’s non-ETS emission limit that can be transferred to another Member State is not specified. However, it is an important issue that has implications for the choice of market mechanism for trading TEUs.
- It creates a new property right, the TEU, which can be traded between Member States. The property right is owned, initially at least, by the Member State.

---

<sup>23</sup> A number of different proposals were put forward in framing climate change policy for 2013-2020, including the Irish and the Polish. For details see Tol (2009).

<sup>24</sup> European Parliament legislative resolution of 17 December 2008 on the proposal for a decision of the European Parliament and of the Council on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (COM(2008)0017 – C6-0041/2008 – 2008/0014(COD)). This may be accessed at: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008-0611+0+DOC+XML+V0//EN&language=EN#BKMD-18> The Swedish proposal developed subsequently to the original proposals by the Commission (CEC, 2008a).

- The TEU is likely to have value, given that there are differences, at the margin, between Member States in their abatement costs in the non-ETS sector.
- The transfer of TEUs between Member States should operate in a transparent manner, ensured via national registries. As noted in Section II.A above the national registry per se provides no information as to price or other contractual conditions. Its purpose is solely to validate the transfer of TEUs.
- The mechanism for affecting the transfer of TEUs between Member States is for the buyer and seller to determine. Several mechanisms are suggested in the proposal but none is recommended. This raises the possibility that different mechanisms being used for transferring TEUs between Member States.

An illustrative example might assist the exposition (see Table 1).<sup>25</sup> Suppose that the marginal cost of abatement per tCO<sub>2</sub> in Member State A was €50 in the non-ETS sector and for Member State B was €30. If the price of a TEU was €40, where one TEU was equivalent to a tCO<sub>2</sub>, then Member State A could purchase a TEU from Member State B. As a result Member State B would emit one tCO<sub>2</sub> below their initial non-ETS limit (i.e. 4999 tCO<sub>2</sub> in Table 1) and so have a credit of 1 TEU which can be traded. The abatement cost is €30 of resources. In contrast, Member State A emits one more tCO<sub>2</sub> that their initial non-ETS limit (i.e. 1301 tCO<sub>2</sub> in Table 1), and purchases 1 TEU from Member State B. This saves €50 of resources. Overall there would be a saving €20 of resources. Compliance costs would be reduced.

**Table 1**  
**Trading in TEUs: An Illustrative Example**

Member State	Allowance (tCO <sub>2</sub> )	Marginal cost of abatement	Actual Emissions (tCO <sub>2</sub> )	Trades	Final Allocation (tCO <sub>2</sub> )
A	1300	€50	1300+1	Buys 1 TEU	1300
B	5000	€30	5000-1	Sells 1 TEU	5000
Total	6300	-	6300		6300

Source: See text.

#### IV. TEUS: FOUR MARKET CHARACTERISTICS

Designing market mechanisms cannot be done in a vacuum. In this section four important market characteristics are considered. Estimates are provided of the identity and size of buyers and sellers, market concentration and market size. However, first the distinction is made between primary and secondary participants

<sup>25</sup> This example assumes that the non-ETS emission limit is binding. In other words that the non-ETS emissions limit for a Member State is greater than its projected actual emissions over the period 2013-2020 with no policy intervention. If, in fact, as appears to be the case for several Member States the non-ETS emission limit is not binding (Tol, 2009, 1, p. 1747), then these Member States may sell the difference between the emission limit and its actual level of emissions.

since these estimates are confined to the primary rather than secondary market participants.

## **A. Market Participants: Primary and Secondary Markets<sup>26</sup>**

In many existing carbon markets there is both a primary and a secondary market. In the case of Clean Development Mechanisms (“CDMs”) the primary market consists of funding and developing the CDM projects which yield the carbon credits, CERs. These CERs can then be sold in the secondary market by the developer to, for example, a power plant which can use the CER towards meeting its emission limit. Equally, as noted in Section II.A above, in EU ETS market a Member State can sell up to 10% of its emission limit in the secondary market.

The difference between the two markets, for the purposes of TEUs, is that the primary market will consist of only the 27 Member States, which are the original owners of the TEUs. The secondary market consists of intermediaries such as dealers, brokers, exchanges, and private sector financial firms which are already players in the broader carbon market.<sup>27</sup> They buy from the original TEU owners and then trade both with other secondary market participants and Member States.

Secondary market participants perform valuable roles in terms of facilitating the trading of carbon products such as CDMs and EUAs. These participants also develop financial instruments such as derivatives and carbon linked bond transactions. In addition, of course, there are investors in carbon credits that speculate on the future price of carbon. The large size and growth of the carbon market - €47 billion in 2007 compared to €9 billion in 2005 - has encouraged the development of these instruments and investment in the market.

## **B. Who's Buying? Who's Selling?**

Who are likely to be the major players in the primary TEU market? Which Member States will be the major buyers? Which the major sellers? Tol (2009, Table 4, p. 1748) has modelled the impact of the Swedish proposal under five calibrations. Irrespective of the calibration Ireland will be small buyer, accounting for, on average across the five calibrations, 3.9% of all purchases.

Overall there are likely to be 14 sellers and 13 buyers.<sup>28</sup> The largest purchasers, in order of importance are: Italy (24.1%); Spain (15.5%), France (12.8%); the UK (11.3%); Germany (8.8%); and, the Netherlands (6.9%). If the buyers were all of equal size then each would account for 7.7%. The five leading buyers have a market share of 72%, the six leading 79%.

The big sellers are, in order of importance: Poland (36.9%); Romania (20.0%); the Czech Republic (10.3%); Bulgaria (8.0%); Hungary (7.6%); and, Slovakia (4.6%). If

---

<sup>26</sup> The discussion of the carbon market in these paragraphs draws heavily on Capoor & Ambrosi (2008, pp. 59- 66)

<sup>27</sup> Of course, a Member State may participate in both the primary and secondary market.

<sup>28</sup> All the percentages refer to the average across all the five calibrations. In general the results demonstrate considerable stability across the five calibrations, but there are some exceptions, such as the UK and Germany which while buyers under four of the calibrations become a seller under the other calibration. See Tol (2009, Table 4, p. 1748) for details.

all the sellers were of equal size each would account for 7.1% of the market. The four leading buyers account for 75% of the market.

However, a number Member States account for only a small market share as either a buyer or a seller. Six countries have a market share of between +/- 2%, eight +/- 3%.<sup>29</sup> This suggests that some Member States may be buyers or sellers, depending on the price of TEUs and the success of their own domestic abatement efforts.<sup>30</sup>

It should be noted that Tol's results assume that there is no limit on the proportion of a Member State's non-ETS emissions that can be traded to another Member State. However, as noted above, legislation may impose a restriction on the proportion of the non-ETS emission limit that can be traded. This is unlikely to change the identity of the major buyers and sellers of TEUs - given the differences in marginal abatement costs<sup>31</sup> - but is likely to change the size of the TEU market.

### C. Market Structure

A common measure of market structure is the Herfindahl-Hirshmann Index of concentration. It is defined as the sum of the squares of the market shares of the buyers or sellers. It will vary between 10000, a monopoly (i.e.  $100^2$ ), to  $(1/N) \times 10000$ , where N is the number of firms in the market and they are all of equal size. In the primary TEU market on the seller side the minimum value of the HHI is 714, for buyers, 769.

Competition authorities have used the HHI index to categorise markets in terms of the degree of competition.<sup>32</sup> However, these are a very rough and ready classification as many other factors affect the degree of competition. Nevertheless, these classifications are used for purposes such as screening for mergers that might result in anticompetitive effects.

Using the data from Tol (2009), it is possible to estimate the HHI for both buyers and sellers, as shown in Table 2.

**Table 2**  
**Concentration of Buyers and Sellers in the Primary TEU Market, 2013-2020**

	<b>HHI</b>	<b>Classification</b>
Buyer	1345	classified as 'moderately concentrated' since $> 1000$ & $< 1800$
Seller	2063	classified as 'highly concentrated', since $> 1800$

Source: Estimates based on Tol (2009, Table 4, p. 1748).

<sup>29</sup> The six countries are: Cyprus, Estonia, Finland, Latvia, Luxembourg, Malta and Slovenia. The eight also include Belgium and Lithuania.

<sup>30</sup> This conclusion needs to be viewed with some caution, since most of these Member States are quite small. Hence in relation to their emission limit their participation in the TEU market may be large, suggesting that they are unlikely to switch between being a buyer and seller.

<sup>31</sup> See Tol (2009, Table 1, p. 1747).

<sup>32</sup> See, for example, Competition Authority (2002).

The results suggest two oligopolies, with sellers more concentrated than buyers. However, no single participant would appear to have a market share considered to be dominant.<sup>33</sup> Thus the market might be workably competitive.

#### D. How Big Will the TEU Market Be?

The size of the TEU market is important, as discussed below, in selecting which is the best mechanism for allocating these property rights. The working assumption is that 10% of the non-ETS emission limit can be traded as TEUs. Using Tol (2009) to identify which Member States are likely to be buyers and which are likely to be sellers; Table 3 indicates the likely magnitude of trades in TEUs assuming that the 10% is traded.

**Table 3**  
**Leading Buyers and Sellers of TEUs, Member States, Annually 2013-2020, Assuming TEUs Fixed at 10% of Non-ETS Emission Limits**

Buyer	m tCO <sub>2</sub>	Seller	m tCO <sub>2</sub>
Italy	30.5	Poland	21.7
Spain	21.9	Romania	9.8
France	35.4	Czech Republic	6.9
UK	31.0	Bulgaria	3.5
Germany	43.9	Hungary	5.8
Ireland	3.8	Slovakia	2.3

Note: CEC (2008a) presents the non-ETS emission limit for Member States for 2020 in tCO<sub>2</sub>; Tol (2009) the identity of the buyers and sellers in the TEU market by order of importance.

Source: CEC (2008a, Annex, p. 15) and Tol (2009, Table 4, p. 1748).

This naturally raises the issue of whether this volume of trading is large or small. It is an issue to which we return to below. However, two caveats should be noted.

First, Tol's model, which as noted above, imposes no restrictions on the proportion of a Member State's non-ETS emission limit that can be traded as TEUs, finds that 109.2 m tCO<sub>2</sub> will be traded annually over the period 2013-2020. This is 4% of the non-ETS emission limit in 2020. This suggests that the 10% limit may not be binding. However, this is misleading since the 10% limit applies at the Member State level. Based on Tol (2009) it appears that indicates for some Member States the level of selling (e.g. Poland and Romania) is excess of 10%.<sup>34</sup> Hence the 10% limit is likely to be binding for at least some Member States.

Second, the volume of trades in both Tol (2009) and in Table 3 is the physical volume of TEUs that would be delivered between buyer and seller. However, the evidence on commodity markets, such as crude oil and gas as well as carbon allowances, is that the financial volume of trades exceeds the physical volume deliveries by a substantial

<sup>33</sup> Under EU competition guidance on enforcement priorities, single firm dominance is unlikely for a firm with a market share of 40% and less. The closest is Poland on the seller side with a market share of 36.5%. For details of enforcement priorities see CEC (2009). Of course, Member States are not firms and so may not be subject to competition law in terms of buying and selling TEUs. This issue is discussed further below.

<sup>34</sup> Ten per cent of the non-ETS allocation for Poland and Romania is 21.7 and 9.8 mtCO<sub>2</sub> (Table 3 above) while Tol (2009, Table 4, p. 1748) predicts that these two Member States will sell 40.3 and 21.9 mtCO<sub>2</sub>, respectively, if there is no upper limit on the volume of TEUs that can be exchanged.

margin. Matthes & Neuhoff (2007, p. 44) put the multiple at five fold for carbon markets and 12 and 13 for crude oil and natural gas, respectively. Much of the difference will be accounted for by trade in the secondary market.

## **V. EVALUATING THREE ALTERNATIVE MARKET MECHANISMS**

Four criteria are used to evaluate three market mechanisms. These criteria - market players; availability of price information; transaction costs; and potential for gaming – are set first set out. Next the mechanisms that have been suggested by the Commission for TEU trading are defined: bilateral trading; market intermediaries acting on an agency basis; and, auctions. These criteria are then applied to the mechanisms which are then ranked from most to least preferred.

### **A. Four Criteria for Distinguishing Between Mechanisms**

#### *1. Market Players*

In general the more market players the more competitive is the market. This is not of course a universal rule, but nevertheless mechanisms that expand the number of players beyond the 27 Member States will score more highly. Allowing more players could also encourage a liquid secondary market to develop.

#### *3. Price Transparency*

An essential purpose of any market is the price information that it yields. Price is an important signal for resource allocation. High TEU prices signal to a Member State that it may be better to invest in domestic abatement and sell TEUs, while if prices are low the Member State may decide that it is a better to buy TEUs than invest in domestic abatement. Hence a mechanism that is more price transparent will score more highly.

#### *3. Transaction Costs*

Transaction costs are those involved in the exchange of TEUs. There are initial fixed costs in creating the market mechanism itself, such as establishing the rules for bilateral exchange or the structure of an auction. There may be search costs to determine the price (e.g. bid and ask) and quantities willing to be traded and by whom. There may be bargaining costs in order to reach an agreement. If an intermediary, such as a broker or dealer, is used to carry out a trade then there is likely to be a commission charge, often a percentage of the value of the transaction. Finally, there may be costs ensuring that the transaction is actually completed. Hence contracts and enforcement mechanisms may need to be put in place. Transaction costs drive a wedge – similar to a tax – between what the buyer pays and the seller receives. Hence a mechanism that yields lower transaction costs will score more highly.

#### *4. Anti-competitive Behaviour & Gaming*

Markets are capable of being rigged, by either buyers or sellers. Sellers may coordinate their behaviour to obtain a supra-competitive price by withholding TEUs from the market, forcing buyers to pay more. Hence a mechanism that is less conducive to anticompetitive behaviour will score more highly.

Clearly if one mechanism scores more highly in all of the criteria it is the appropriate choice, but if that is not the case then some judgement will be needed to select the best mechanism.

### **B. Three Market Mechanisms**

The three mechanisms that were suggested by the Commission for TEU trading were not fleshed out in any detail. Nevertheless, the broad characteristics of each mechanism can be sketched out. In some instances a certain amount of detail is provided based on the experience of other carbon markets, such as those for CDMs and the EU ETS market. However, one has to be mindful of the differences in relying on such comparators.

There is, of course, the difficulty that the characterisation of the mechanism may not be independent of the criteria. In other words, there may be a danger that the description of the market mechanisms is set out in such a way that (say) auctions is the most preferred option. In the discussion below every attempt has been made to guard against such bias by being as explicit as possible about the description and the application of the criteria. Furthermore in the case of market intermediaries and auctions the experience of existing carbon markets is drawn on extensively, rather than designing them from scratch.

#### *1. Bilateral Arrangements*

Bilateral arrangements would involve exchanges of TEUs between one Member State and another Member State. If a Member State is a buyer such as Italy, Spain or Ireland they will engage with likely sellers such as Poland, Romania, and the Czech Republic and so on. Negotiations may be held by one Member State with several Member States separately or simultaneously. In some instances, the buyer might enter into a long term contract for allowances over 2013-2020, while in others the transaction might be in the form of spot market transaction. Contractual terms would have been settled, which might be complex for a longer term contract.

The actual trading on behalf of a Member State might be delegated to specialist state body with expertise in trading in carbon, commodity and/or financial markets. In the case of Ireland, for example, the National Treasury Management Agency (“NTMA”) already participates in the CDM market on behalf of the State.<sup>35</sup> This body would be

---

<sup>35</sup> The government created a Carbon Fund under the *Carbon Fund Act 2007* which is administered by the NTMA. According to the *2007 Annual Report of the Carbon Fund*, investments have been made in three funds: European Bank for Reconstruction and Development Multilateral Carbon Credit Fund; the World Bank Carbon Fund for Europe; and the World Bank BioCarbon Fund (NTMA, 2008, p. 14). In terms of expenditure the National Development Plan 2007-2013 approved €270 million for purchase of carbon credits. There was a prior

given instructions to buy or sell a certain volume of TEUs by the Member State as part of its plan to meet its non-ETS limit. In the case of Ireland the instructions would be from the Environmental Protection Agency and the Department of the Environment, Heritage and Local Government.

## *2. Market Intermediaries Acting on an Agency Basis*

Under this option the Member State uses the services of one or more experienced intermediaries that already act as brokers in the various carbon markets that exist including those for CERs and EU ETS. The broker would execute the trades in the OTC market. Examples of intermediaries include Evolution Markets Limited and Tradition Financial Services Limited, both of which are members of the London Energy Brokers Association (“LEBA”). If the market volumes were sufficient then the TEUs might be quoted on some of the carbon exchanges which have developed such as the European Climate Exchange and/or the Green Exchange (Capoor & Ambrosi, 2008, pp. 65-66).

As with bilateral arrangements, the Member State might delegate the actual trading, together with instructions, to an expert state or quasi state body.

## *3. Auctions*

Auctions are broadly speaking arrangements under which TEUs would be sold to the highest bidder. There are a large variety of different auction types, while auctions have been used to sell everything from rare pictures to radio spectrum. Furthermore, there is a large literature both on auctions in general (e.g. Klemperer, 2004), and carbon markets, in particular (e.g. Matthes & Neuhoff, 2007; Defra, 2007).

In order to give a sense of the characteristics of an auction for TEUs might look we draw on the proposals for auctions for 2013-2020 in the EU ETS sector where Matthes & Neuhoff (2007, p. 3) recommend the following features of an auction for carbon rights in this case EUA:

- All entities with registry accounts would be eligible to take part in the auction.
- The auction should be organised as a single round, sealed bid auction.
- The price formation should rely on a uniform market clearing price.
- A relatively high frequency of auctions should be aimed at (at least monthly).
- Governments should credibly announce distribution of allowances over time.
- A reserve price based on prices in secondary markets on the previous day should be announced.

---

commitment of €20 million by the Minister for the Environment, Heritage and Local Government in these funds (NTMA, 2008, p. 29).



- Credit posting for a fraction of maximum bid value (e.g. 10%) ensures integrity of auction.
- Set-up, running costs and implementation delays are likely to be lower if an institution with similar operations is commissioned to carry out the auction on behalf of one or multiple governments.<sup>36</sup>
- A restriction of bids to certain maximum limits should not be introduced for the phase-in of auctioning.
- A market monitoring mechanism should be set up as is the case for most commodity and financial markets.

Thus there will be a single market price which all successful bidders pay. Bids are organised in descending order of the bid price. Where the demand curve intercepts the volume of CO<sub>2</sub> that is the market price all bidders pay.<sup>37</sup>

It could, of course, be argued that some of these features would be modified for a TEU auction. Four, in particular, stand out.

- First, it could be argued that frequent auctions would be costly particularly for Member States that are likely to be smaller sellers. However, as discussed below, based on the record of existing carbon market auctions by German, UK and Austria such a frequency is feasible for the TEU volumes that might be traded, while for Member States with smaller volumes they could hold joint auctions.
- Second, there may not be – initially at least - a secondary market with which to set the reserve price. However, there other carbon prices that could be used for such a purpose, including the price in the EU ETS market or the CDM market.
- Third, since the participants in the primary market are Member States then the necessity for credit posting is redundant. However, one consideration, discussed below, in order to increase the number of participants, is to allow non Member States to participate in which case such a requirement would be appropriate.
- Fourth, since the auction is held by a Member State there is a question of who will provide a market monitoring mechanism. However, this appears to pose no problem for the carbon auctions under the EU ETS by Member States. For example, in the UK an independent person is appointed to monitor the auction, who prepares a report which is subsequently published (Steeds, 2008).

---

<sup>36</sup> The UK EUA auction, which is organised by a government agency, the UK Debt Management Office – a body similar to the NTMA, Austria appointed the Climex Trading Platform to conduct the auction. For thirteen years the auction was conducted free of charge by the Chicago Board of Trade and is currently conducted by the US EPA. The German EUA auctions are conducted by a banking group KfW on behalf of the government.

<sup>37</sup> Some difficulties may arise if more than one bidder submits the same price which coincides with the market price. These issues are discussed in Matthes and Neuhoff (2007, pp. 32-35).-

In designing and implementing an auction, there is considerable experience that can be drawn upon. As noted above four Member States current auction EU ETS carbon allowances, while there also a number of US greenhouse gas markets that can be relied upon.

### **C. Testing the Mechanisms: Which Scores the Best on Each Criteria?**

The European Parliament states that the choice of mechanism “may be effectuated in a manner that is mutually convenient ...”<sup>38</sup> This suggests a series of bilateral arrangements between Member States. However, this is too limiting a set of possibilities. In some instances, for example, smaller Member States that are buyers or sellers might form joint selling or buying agencies to increase their bargaining power and/or reduce transaction costs. If a Member State chooses to auction their TEUs or engage a market intermediary then this necessarily constrains the choice of the buyer. Furthermore there may be situations in which it is optimal for a particular mechanism to be employed at the EU level. This suggests a variety of mechanisms may emerge, some bilateral, others ‘one to many’.

The size of the TEU market may be an important issue in considering the most appropriate market mechanism. If, for example, there is high fixed transaction costs associated with a particular mechanism, then this mechanism will be more appropriate if the market is large rather than small. In some cases, of course, the mechanism can be designed so that volume makes little difference. There may, for example, be auctions that work well for small market sizes and different designs that are more appropriate for larger market sizes.

In the discussion below two scenarios are considered: a low volume of trading; and a high volume of trading. As noted above the precise proportion of a Member State’s non-ETS allowance limit that can be converted into TEUs has as yet to be decided.

#### *1. Number of Market Participants*

The number of primary participants under all three mechanisms is 27, but under both the auctions and the intermediary agent mechanisms there may be an opportunity for the participation of secondary market players. In other words, initially the sellers would be the Member States, but some of the buyers would be secondary purchasers.

The question arises as to why secondary purchasers would be interested in purchasing TEUs. There are several reasons:

- Greenpeace and other environmental groups may wish to purchase and cancel TEUs as a way of making emissions targets stricter;
- Brokers, dealers, and others involved in carbon markets may take different views from Member States as to future demand and supply for TEUs and hence may be willing to purchase TEUs on this basis (i.e. speculate);

---

<sup>38</sup> For citation see Section III.B above.

- The schedule for reduction in the non-ETS market for 2013 to 2020 is to be achieved in a series of well defined annual emission reductions. There is likely to be some under/overshooting of annual targets and thus a spot demand for TEUs which secondary market players may be able to supply. Alternatively the secondary market players may develop products that mean Member States can hedge against shortages, so that in effect an insurance policy is sold.<sup>39</sup>

A larger TEU market is more likely to signal a demand for the services of secondary players, while a small thinly traded market suggests little demand and hence the secondary market players have little incentive to enter and develop expertise.

Irrespective of market size the number of participants is confined to 27 for bilateral arrangements and but will be greater than 27 for the other two mechanisms with high volume trading due to the presence of secondary market participants.<sup>40</sup>

## *2. Transparency*

On transparency, attention needs to be paid to prices and quantities. Under the terms of the Swedish proposal, set out above, information on quantities traded will be public through the national registries, although there is likely to be a delay on publication of data from the registry. ETS data for 2008 is, for example, being published, in aggregate form, in April 2009.<sup>41</sup> This process will occur irrespective of the market mechanism. However, the same cannot be said for prices.

Bilateral arrangements are the least transparent. There is no obligation for either party to divulge the price. Indeed, there may be reasons why the seller or buyer may not want the price to become public. The seller may be trying, for example, to price discriminate. This lack of transparency occurs whether or not a high or low volume of TEUs are traded.

In contrast auctions – at least judged by the option set out above and the practice of the EU ETS CO<sub>2</sub> auctions conducted by several Member States and the US EPA SO<sub>2</sub> auction<sup>42</sup> – tend to be very transparent with not only the price being published but the quantity to be sold is set out credibly in advance for a number of months. Furthermore an independent observer provides an account of the auction process, further increasing transparency.

The intermediate option is somewhere in between these two. A number of brokers and exchanges that operate in carbon markets publish prices relating to CDMs, CERS and EUAs. There is no reason that such information would not be provided for TEUs. However, at low volumes the market for TEUs is likely to be thin and may not merit

---

<sup>39</sup> On the various sorts of financial products that have been developed in carbon markets see Capoor & Ambrosi (2008, pp. 59-66).

<sup>40</sup> Mattheus & Neuhoff (2007, p. 44) argue that an auction compared to a free allocation will increase trading volume in secondary markets.

<sup>41</sup> For each installation, its allocated, verified and surrendered level of emissions is released on the Commissions website. For details see: <http://ec.europa.eu/environment/ets/> (accessed on 20 April 2009).

<sup>42</sup> These are all discussed further below.

the collection and publication of price data. However, the reverse would obtain with high volume TEU trading.

### *3. Transaction Costs*

At low TEU volumes it is likely that transaction costs will be lowest with bilateral arrangements and intermediary agent mechanisms and highest with an auction. Public servants in a state body involved in bilateral agreements are on fixed salaries while brokers typically charge a percentage of the value of the transaction. At low volumes it may thus make little difference whether a bilateral arrangement or intermediary agent mechanism is used. In contrast, at low volumes the fixed costs of establishing an auction through, for example, extensive consultation, the costs of testing the auction design, the costs of running the auction itself, including the independent observer, may mean that these costs may not be covered.<sup>43</sup>

However, things are likely to change at high market volumes. Auctions are clearly superior as the fixed costs noted above are spread over much higher volumes of sales. Since an intermediary agent such as a broker or dealer is likely to charge on a commission basis, transaction costs are likely to be lower with an auction. Bilateral arrangements transaction costs are also likely to increase as the volume of sales increases and contractual negotiations may be more complex. More staff will have to be hired.

Finally, in terms of search costs, auctions are likely to be lower than bilateral arrangements, with the intermediary option in between. This reflects the fact that the auction pre announces the quantities to be sold and links the price to that in the secondary TEU (or other carbon) market, all of which are easily accessible. In contrast, bilateral arrangements are just that; while the intermediary option is likely to generate – at least at high volumes – good data on price.

### *4. Collusion*

There is an obvious concern that there may be collusion on the part of sellers and, to a lesser extent, buyers. The sellers could, for example, restrict the supply of TEUs in order to raise price. Such a strategy may be feasible because a small number of sellers account for a large percentage of the market. According to Tol (2009, Table 4, p. 1748) the leading four sellers will account for 75% of the TEU market.

However, while there is an obvious incentive for sellers to collude, there are certain structural and market characteristics that are considered to be more conducive to collusion and anticompetitive behaviour. In other words, while sellers have an incentive to act anti-competitively, they may not be able to successfully implement such a strategy. The elements for successful collusion are: agreement on a price or some other focal point; it is costly for participants to deviate from the agreed price or other focal point; and weak competitive constraints.<sup>44</sup> In some cases the market

---

<sup>43</sup> Based on reading the development and implementation of the UK ETS auction design. For details see: <http://www.defra.gov.uk/environment/climatechange/trading/eu/operators/auctioning.htm>.

<sup>44</sup> This discussion is based on Competition Authority (2002), CEC (2004) and ICN (2006).

mechanism can affect or mitigate the impact of the characteristic, while in others the mechanism has no impact. It is to these issues that attention now turns.

In this discussion it is assumed that a Member States and its agencies are the subject of EU competition law and hence any collusion – either overt or covert – would be a breach of Article 81 of the Treaty. In trading TEUs the Member State is not conducting any regulatory or public good function, but conducting an economic activity and hence can be considered an undertaking and thus subject to EU competition law.<sup>45</sup>

For the sellers to collude they need to agree on some important dimension of competition such as price, quantity, product or geographic space which will serve as a focal point. TEUs are undifferentiated homogenous products. A TEU from Poland is no better or no worse than one from Romania. There are no substitutes for the buyer, apart from domestic abatement efforts. The quantity of TEUs is constrained by an upper bound yet to be set of a Member State's non-ETS emission limit. There are few sellers, as pointed out above, making co-ordination easier.

The cost structures of the Member States that are the major sellers are similar in that their non-ETS allowances limits are not binding and so have TEUs to sell (i.e. Poland, Bulgaria, and the Czech Republic) or their marginal abatement cost is low relative to that of the buyers of TEUs (i.e. Romania).<sup>46</sup> Similar cost structures are important in facilitating co-ordination since the firms' interests are more likely to be aligned.

The sellers will be aware of the estimates of the marginal abatement costs of the major buyers of TEUs and thus be in a position to price TEUs slightly below these abatement costs so as to maximize profits.<sup>47</sup> In addition the sellers will also be aware of the extent to which a Member State is a buyer of TEUs, since this information will be in the public domain. Such information would form part of any programme as to how a Member State would meet the non-ETS emission limits for 2013-2020. Since these limits have to be met progressively on a linear path over that period, the ability to switch between years is limited. Sellers are placed in a stronger position compared to a situation where buyers had more discretion over the timing of the CO<sub>2</sub> reduction in the non-ETS sector.

In sum, the focal point of any agreement might be a price of TEUs somewhat below the marginal cost of abatement of the buyers of TEUs. It is not clear that there would be anything to gain from limiting the quantity offered by the sellers to less than the (assumed) 10% limit on the non-ETS emission limit for TEUs.

The next issue is the ease with which deviations from the agreement can be monitored and detected. In a collusive agreement there is usually an incentive for members to cheat since if they charge slightly below the agreed price then they can sell more of their product. However, in the present case it is not clear that the incentive to cheat is

---

<sup>45</sup> For further discussion of the concept of an undertaking under EU competition law see Whish (2009, pp. 82-91). It is also difficult to see how any collusion would be permissible under Article 81(3), which allows otherwise collusive agreements if they have certain positive effects. For further discussion see Whish (2009, pp. 148-161).

<sup>46</sup> For details see Tol (2009, Table 1, p. 1747).

<sup>47</sup> Tol (2009, Table 1, p. 1747) provides data on marginal emission reduction costs for the non-ETS sector for 25 Member States for several calibrations.

as strong as in other markets, since there is an upper bound on the proportion of a Member State's non-ETS limit that can be sold as TEUs. The tighter the upper bound, the less the incentive to cheat.

Nevertheless, be that as it may, there will still be some uncertainty as to demand at a given price, since buyers could be much more successful at abatement efforts than anticipated and/or there may be a slowdown in economic activity. Thus demand for TEUs may fall short of expectations. Lowering the price thus increases the probability of selling all the TEUs that a seller is entitled to sell.

Shaving the price should result in a drop in the TEU price and the cheater selling all of their TEUs early in the year. The more transparent the market mechanism the easier it is to monitor and detect deviations. The issue of transparency was discussed above. Auctions are the most transparent market mechanism followed by market intermediary and bilateral agreement being the most opaque.

The next consideration is the creation of deterrent mechanisms for punishing deviations. There has to be a credible threat that deters the cheating. Furthermore the punishment should occur as soon as possible after the detection of the cheating. If the benefits from cheating are immediate and large and punishment takes time to implement then punishment may not be effective in preventing deviation from the agreed strategy. Studies of cartel behaviour suggest a number of punishment mechanisms such as posting a bond which is forfeited to the other cartel members or price wars or increasing output. However, the latter two have the disadvantage that they also punish all members of the cartel and hence may lack credibility. The high frequency combined with the transparency of auctions outlined above, suggests auctions are likely to be conducive to quick detection and punishment, followed by the market intermediary and bilateral agreements.

One obvious way around these problems would be for the sellers to form a joint venture or selling agency, designed to maximize profits of the Member State participants. However, as noted above, Member States participating in these TEU markets would be considered undertakings and hence subject to EU competition law. A joint selling arrangement by the leading sellers would normally be considered a breach of EU competition law. This would not prevent, of course, some of the smaller Member States holding, for example, joint auctions.

The final consideration is the reaction of outsiders, which in this instance mainly refers to the buyers. These reactions can be divided into two categories. First, the buyers may try and design strategies to disrupt the cartel, by for example signing long term contracts with some of the leading sellers. Second, even if it could be argued that Member States were not undertakings for the purpose of competition law, there can be little doubt that the buyers – including Ireland – would argue strongly against such arrangements on the grounds that they clearly be contrary to the aim of achieving low cost emission reduction. The buyers include leading Member States such as Italy, Spain, France, the UK Germany and the Netherlands in order of importance.

Given that the leading sellers can agree albeit tacitly, without an overt collusive agreement, on a price for TEUs which market mechanism would appear, in view of the discussion above, to the best in terms of securing adherence to that agreement. Auctions would appear to score highly, where the reserve price would be the focal

price – or (say) discounted 10% - agreed by the cartel members. Auctions are – at least as set out above – extremely transparent in terms of price and quantity. Detection from the agreement is quick and any deterrent mechanism can be imposed rapidly, denying the cheater the benefit of their gains.<sup>48</sup> At the other extreme is a bilateral agreement. Here prices and to a lesser extent quantity is much more opaque. There will be longer time lags in detecting and punishing cheaters, thus increasing the chances deviation from the agreed price. Buyers will be in a better position to employ strategies to counteract the cartel. The market intermediary falls between the bilateral agreement and auctions.

The rankings between the three mechanisms remain unchanged if the market volumes are high as compared to low. However, in all cases the cartel becomes less stable. At higher volumes there is more incentive to cheat as the payoff is potentially larger; there will be more players in the market and hence the secondary market will develop at least under some market mechanisms. The costs of monitoring deviations to determine who is cheating are likely to increase as the volume of TEUs for sale increases. Auctions will be more frequent as will other forms of transactions.

#### D. Adding-Up: Which mechanism?

The results of the application of the four criteria to the three market mechanisms is summarised in Table 4. No mechanism dominates. Bilateral arrangement ranks 1<sup>st</sup> with respect to anti-competitive behaviour, but 3<sup>rd</sup> in terms of number of market players. Equally, auctions ranks 1<sup>st</sup> terms of transparency, but 3<sup>rd</sup> terms of anticompetitive behaviour. Hence there is a need to aggregate across the four criteria.

**Table 4**  
**Choosing Between Three Market Mechanisms for Allocating TEU**

Criteria	Market Intermediaries	Bilateral Arrangements	Auctions
Number of Market Player (a) Low TEU vol (b) High TEU vol	27 Member States + (a) few and (b) more secondary market players	27 Member States & No Secondary Market Players Under either (a) or (b)	27 Member States + (a) few and (b) more secondary market players
Price Transparency (a) Low TEU vol (b) High TEU vol	(a) Low/Medium (b) High	(a) Low (b) Low	(a) High (b) High
Transaction Costs (a) Low TEU vol (b) High TEU vol	(a) Low (b) Medium/High	(a) Low (b) Medium	(a) High (b) Low
Anti-competitive behaviour/gaming (a) Low TEU vol (b) High TEU vol	(a) Medium (b) <=Medium	(a) Less Likely (b) <=Less Likely	(a) More Likely (b) <=More Likely

Source: See text

<sup>48</sup> As noted below holding auctions at the EU level under the auspices of the Commission is likely to resolve some of these competition concerns.

The following procedure is employed:

- All four criteria carry an equal weight.
- For each criterion the market mechanisms are ranked 1, 2, and 3 where a higher rank indicates that the mechanism is preferred to a lower scoring mechanism.
- The ranks are added for each mechanism to get an overall score.
- The exercise is conducted separately for high and low TEU volume.

The results are presented in Table 5.

**Table 5**  
**Ranking Market Mechanisms for TEUs, by Volume of TEUs Traded**

Volume of TEUs	1 <sup>st</sup> Best	2 <sup>nd</sup>	2 <sup>nd</sup>
Low	Market Intermediaries	Auction	Bilateral Agreement
High	Auction	Bilateral Agreement	Market Intermediaries

Source: See text

The preferred market mechanism depends critically on whether there is a high or low volume of TEUs. However, irrespective of whether the TEU volume is low or high bilateral agreement is never a preferred mechanism. The discussion above suggests that in general it is better to have a high than a low volume of TEUs, suggesting that the preferred mechanism is an auction.

The issue of whether or not the TEU market will be high or low revolves around the proportion of the non-ETS emission limit that can be traded and whether or not this volume is likely to be sufficient to sustain the auction arrangements set out above. On the assumption that TEUs can constitute 10% of the non-ETS emission limit Table 3 above estimated the likely magnitudes of demand and supply by Member State. Is that sufficient for auctioning? To answer this question reference is made to the experience of the UK where auctions of EUAs has been a regular occurrence.

Table 6 presents, on the left hand side, the proposed annual schedule of UK EUA auctions over the period 2008-2012,<sup>49</sup> while the right hand side presents the likely volume of TEUs sales by the leading Member State as presented in Table 3 above. The table suggests, using an average of 17 m tCO<sub>2</sub> or a lower bound of 8 m tCO<sub>2</sub>, that Poland and Romania could easily run auctions and perhaps the Czech Republic and Hungary. These countries are the leading sellers of TEUs and hence it appears that the high volume scenario is an appropriate characterisation of a major portion of sales of TEUs. Clearly if the limit were raised from the assumed maximum of 10% to 15% or 20% then more sellers would be able to use auctions. There is nothing to prevent,

<sup>49</sup> Reference is made below to the volumes auctioned by Austria in its EUA auction. Details of the volume and frequency of the Netherlands auctions is not as yet clear although it does intend to auction 3.2 m tCO<sub>2</sub> per annum. Germany auctions 40 m tCO<sub>2</sub> per annum on an at least monthly basis. For details see: [http://ec.europa.eu/environment/climat/emission/auctioning\\_en.htm](http://ec.europa.eu/environment/climat/emission/auctioning_en.htm) (accessed 20 March 2009).



of course, some of the small sellers holding joint auctions if the transaction costs prove too high.

Evidence from other carbon auctions indicates that TEU auctions may be cost-effective at lower volumes than indicated for the UK in Table 6. For example, Austria's EUA auction as part of its EU ETS allocation is 0.5 m tCO<sub>2</sub> per annum 2009 to 2012 in two auctions per year.<sup>50</sup> In the US, although for SO<sub>2</sub> rather than CO<sub>2</sub>, the US Environmental Protection Agency conducts an annual auction 125,000 spot and 125,000 advance (not saleable for seven years).<sup>51</sup> However, lower volumes are associated with less frequent auctions.

**Table 6**  
**Proposed Schedule of UK EUA Auction, 2008-2013, and Leading Sellers of TEUs, Member States, 2020, Assuming TEUs Fixed at 10% of Non-ETS Emission Limit**

Proposed Schedule of UK EUA Auctions		Leading Sellers of TEUs, Assuming TEUs 10% non-ETS emission limit, 2020	
Year	m tCO <sub>2</sub>	Seller	M tCO <sub>2</sub>
2008	23	Poland	21.7
2009	23	Romania	9.8
2010	23	Czech Republic	6.9
2011	8	Bulgaria	3.5
2012	8	Hungary	5.8
Average	17	-	-

Source: Table 3 above and Department for Environment, Food and Rural Affairs (2007, paragraph 16).

Although auctions rank first for three criteria, they nevertheless rank third when it comes to anti-competitive behaviour/gaming. This therefore means that great care is needed in auction design to minimise the opportunity for such behaviour. Klemperer (2004, p. 122) in his review of what really matters in auction design states:

In conclusion, the most important features of an auction are its robustness against collusion and its attractiveness to potential bidders. Failure to attend to these issues can lead to disaster.

A small group of Member States have both the incentive and the capability to collude to act in an anti-competitive fashion in the TEU market. It appears unlikely that these Member States could also be exempt from EU competition law in such conduct. Member States that are buyers of TEUs will not accept such market rigging. Such conduct is inconsistent with the overall tenor of climate change policy. It may discourage secondary market players from entering the market. This suggests that

<sup>50</sup> For details see: <http://www.climex.com/austrian-auctions.aspx?lang=EN>. (Accessed on 20 March 2009).

<sup>51</sup> It should be noted that the US Environmental Protection Agency conducts an annual auction 125,000 spot and 125,000 advance (not saleable for seven years) allowances each year. For thirteen years the auction was conducted free of charge by the Chicago Board of Trade and is currently conducted by the US EPA. These are auctions for SO<sub>2</sub>, rather than CO<sub>2</sub>. This experience suggests that the transaction costs associated with an auction might not be prohibitive even for low volumes of allowances. For further details see: <http://www.epa.gov/airmarket/trading/auction.html>.

there needs to be some agreement between Member States on the market mechanism used for the trading of TEUs, beyond a listing of the possible mechanisms as set out in the European Parliament proposal quoted in Section III.B above.

One option would be for an EU wide auction conducted by an independent agency with experience in carbon markets and/or auctioning. The auction mechanism would remain, as set above, but there would be only one auctioneer. In terms of the volume of TEUs to be auctioned, each Member State could independently submit a schedule of TEUs to be sold over the period 2013-2020, with the proceeds redistributed on a pro rata basis. Such long term commitment would make it harder to effectively punish any cheaters from an agreement.<sup>52</sup> Both potential buyers and sellers could submit TEUs. It is not clear whether or not each Member State would be required to reveal how many TEUs they had submitted, in the interests of making it more difficult for Member States to collude. There would be agreed mechanism for setting a reserve price such as the TEU price in the secondary market or if one does not develop the price of EUAs or CDMs/CERs

An alternative approach would be to more tightly constrain the actions of Member States in their auction – or other mechanism – design.<sup>53</sup> Such an approach might also increase participation since it would reduce the costs of participation. It could, for example, be agreed that Member States would not collude in setting a reserve price close to the abatement costs of the leading buyers and/or the quantities to be auctioned. However, there some aspects of auction design such as dates of auctions and reservation prices that it might be appropriate to agree upon. There may be a role here for the Office of the Chief Economist of DG Comp to provide advice to Member States both on the auction design as well as providing reports to Member States on a regular basis as the auctions proceed.

## **VI. TEU RIGHTS: WHO SHOULD BENEFIT?**

TEUs are likely to be a valuable property right, which raises the issue of who should realise their value. In the 2008-2012 phase of EU climate change policy similar rights in the EU ETS sector were given away free to existing polluters either in part (minimum 90%) or in whole. In the case of Ireland 99.5% were given away free.<sup>54</sup> In the case of Austria, Germany, the Netherlands and the UK auctions were created to partially realise the value of these rights for society as a whole. The sums can be substantial. Germany realised close to a billion euro in 2008 (BMU, 2009,). The UK in its auction on 19 November 2008 realised €4.6 million (Steeds, 2008). If Ireland, for example, had auctioned off 10% of its EU ETS allowance it would have realised €36 m in 2008.<sup>55</sup>

---

<sup>52</sup> It may not be necessary for the full seven year allocation to be preannounced, but the period has to be long enough to provide some sought of market certainty and transparency as well as not reducing the incentive to cheat by a cartel member.

<sup>53</sup> Some of these issues are discussed in Mattheus & Neuhoff (2007, pp. 53-57).

<sup>54</sup> Unused allowances in Ireland were not sold but retired.

<sup>55</sup> Total annual average allocation for the EU ETS sector in Ireland over 2008-2012 is 22.281 m EUAs (EPA, 2008, Table 2.1, p.15). The EUA price is €6.15 based on the UK November 2008 EU ETS auction (Steeds, 2008).

It is difficult to think of any arguments as to why the new property right, the TEU, created in the non-ETS sector should be given away free. Furthermore, there is compelling evidence that grandfathering allowances on a free-of-charge basis, as has been the practice in Ireland at the present time in the EU ETS sector, has led to inefficiencies and distortions from which auctions do not suffer (Mattheus & Neuhoff, 2007, pp. 9-22). Thus the value of the new property rights should be enjoyed by the Member State, not private interests.<sup>56</sup>

There is another reason why TEU should not be given away, but rather auctioned with the proceeds going to the State. To achieve the emission reductions in the non-ETS sector set for 2013 to 2020 requires that these property rights are priced appropriately by the Member State to ensure that compliance costs are minimised. These rights should not therefore be treated as though they were a free good with a zero price. The prices of these property rights are important signals for Member States in deciding the level of domestic abatement compared to trading in TEUs. Thus if they are auctioned an explicit price will be attached to them and there is a greater chance emissions will be reduced in a cost effective manner, one of the key objectives of the EU climate change agenda.

## VII. CONCLUSION: ANSWERING THE THREE QUESTIONS

The creation of the TEU property rights for the 2013-2020 phase of EU climate change policy is a welcome development. It offers the opportunity to meet the EU emissions target in the non-ETS sector more efficiently and effectively than under the current 2008-2012 phase of EU climate change policy.

The property rights are likely to acquire value given they are limited and can be traded between Member States. Since Member States have different marginal abatement costs there are likely to be gains from trading these property rights. Compliance costs will be reduced.

Three questions were asked at the start of the paper. The questions, together with the answers plus some policy suggestions are as follows:

*First, what mechanism – market or administrative – should be used to facilitate the exchange of TEUs?*

The preferred mechanism is a uniform price auction because compared to other mechanisms:

- The number of market participants is maximised.
- Transactions costs are minimised.
- Prices and quantities are transparent.

---

<sup>56</sup> The comparison between the ETS and non-ETS is not exact when considering the granting of TEUs to private interests. While in the former case there were clearly identified installations responsible for matching their emissions with their allowances, no such parallel exists in the non-ETS sector and so another method would have to be used to allocate TEUs to private interests.

- It can be calibrated to take into account the potential for anti-competitive behaviour and gaming, preferably by holding EU-wide auctions under the auspices of the Commission.

*Second, what 'part' of the non-ETS emission limit of a Member State should be classed as TEUs – 10%, 20% or no limit?*

The proportion of the non-ETS emission limit that should be traded should be maximised because:

- This will facilitate the achievement of the non-ETS emission limits at least cost in an efficient way.
- The market for TEUs will work better the higher the volume as more players will become involved, financial instruments will be developed and reliable price data will be generated.
- The more participants that become involved the more competitive the market is likely to be, especially in view of the small number of important sellers in the primary TEU market.

There is a need for Member States to agree on the form of mechanism since:

- Leading Member States that are likely to be sellers of TEUs will have an incentive to collude, particularly if their behaviour is considered to be outside the ambit of competition law.
- One solution might be to ask the Chief Economists Office of DG Comp to comment on the mechanisms proposed or, preferably, if there is one EU wide auction arrangement conducted under the auspices of, but not necessarily by, the Commission.

*Third, who should realise the value of TEUs – the State, existing polluters etc?*

The value of TEUs should accrue to the State. There is no reason for these valuable rights to be given away 'free' to some third party. In the case of the EU ETS the distribution of allowances on a free of charge basis has led to inefficiencies and distortions.

23 April 2009

## References

- BMU (2008) *Release of EU Allowances in Germany. Annual Report 2008*. Berlin: BMU. This may be accessed at: [http://www.bmu.de/files/pdfs/allgemein/application/pdf/jahresbericht\\_kwf\\_08\\_en.pdf](http://www.bmu.de/files/pdfs/allgemein/application/pdf/jahresbericht_kwf_08_en.pdf)
- Capoor, K. & Ambrosi, P. (2007) *State and Trends of the Carbon Market 2007*. Washington: World Bank.
- Capoor, K. & Ambrosi, P. (2008) *State and Trends of the Carbon Market 2008*. Washington: World Bank.
- CEC (2004) "Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings." OJ C 31/5 February.
- CEC (2007) *Limiting Global Climate Change to 2 Degrees Celsius. The Way Ahead for 2020 and Beyond*. COM (2007) 2 Final. Brussels: CEC.
- CEC (2008a) *Proposals for a Decision of the European Parliament and of the Council on the Effort of member States to Reduce Their Greenhouse Gas Emission to Meet the Community's Greenhouse Gas Emission Reduction Commitments up to 2020*. COM (2008) 17 Final. Brussels: CEC.
- CEC (2008b) "Emissions Trading: Commission to connect EU with UN carbon credit registry before December." Press Release IP/08/1246. 6 August.
- CEC (2008c) "Questions and Answers on the Decision on effort sharing." Memo/08/797. 17 December 2008.
- CEC (2009) *Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings*. C (2009) 864 Final. Brussels: CEC.
- Competition Authority (2002) *Notice in Respect of Guidelines for Merger Analysis*. Dublin: the Authority. This may be accessed at: [www.tca.ie](http://www.tca.ie).
- Department for Environment, Food and Rural Affairs (2007) *EU Emissions Trading Scheme. Consultation on Proposed UK auction design for use in the EU Emissions Trading Scheme Phase II*. London: the Department.
- Ellis, J, H. Winkler, J. Corfee-Morlot & F. Gagnon-Lebrun (2007) " CDM: Taking stock and looking forward." *Energy Policy*. Vol. 35, pp. 15-28.
- EPA (2006) *Ireland's National Allocation Plan*. Dublin: EPA.

- EPA (2008) *Ireland's National Allocation Plan for Emission Trading 2008-2012*. Dublin: EPA.
- EPA (2009) "Ireland's GHG Projections 2008-2012". Press Release. 12 March.
- Haites, E, & F. Yamin (2000) "The clean development mechanism: proposals for its operation and governance." *Global Environmental Change*, Vol. 10, pp. 27-45.
- Hepburn, C., M. Grubb, K. Neuhoff, F. Matthes, & M. Tse (2006) "Auctioning of EU ETS phase II allowances: How and why?" *Climate Policy*. Vol 6, pp. 137-160.
- Howard, A. (2005) "International transaction log and CDM registry." Presentation to UNFCCC Slide Event at COP/MOP 1, Montreal, 1 December. Available at: <http://www.ieta.org/ieta/www/pages/getfile.php?docID=1284>
- International Competition Network (2006) *ICN Merger Guidelines Workbook*. Prepared for the 5<sup>th</sup> Annual ICN Conference in Cape Town.
- Klemperer, P. (2004) *Auctions: Theory and Practice*. Princeton: Princeton University Press. All pages references refer to the online version, which may be accessed at: <http://www.gqq10.dial.pipex.com/>
- Lecocq & Ambrosi (2007) "The Clean Air Development Mechanism: History, Status & Prospects". *Review of Environmental Economics and Policy*, Vol1, No 1, pp. 134-151.
- Lee, M-K et al (2004) *CDM Information and Guidebook*. 2<sup>nd</sup> Edition. Roskilde, Denmark; Unep Riso Centre.
- Matthes, F., & K. Neuhoff (2007) *Auctioning in the European Union Emissions Trading Scheme*. Final Report Commissioned by WWF. Berlin/Cambridge Oko-Institut e.V/University of Cambridge.
- Michaelowa, A, & F. Jotzo (2005) "Transaction costs, institutional rigidities and the size of the clean development mechanism." *Energy Policy*. Vol. 33, pp. 511-523.
- National Treasury Management Agency (2008) *Carbon Fund Annual Report 2007*. Dublin: NTMA
- Steeds, D. (2008) "Independent Observer's Report on the conduct of the EU ETS Carbon Emissions Allowances Auction on 19 November 2008". London: Evolve Business Consultancy.
- Tol R. et al (2008) *A Carbon Tax for Ireland*. Working Paper 246. Dublin: ESRI.

Tol, R. (2009) "Intra-Union Flexibility of Non-ETS Emission Reduction Obligations in the European Union." *Energy Policy*. Vol. 37. pp. 1745-1752.

Whish, R. (2009) *Competition Law*. 6<sup>th</sup> Edition. Oxford: Oxford University Press.

<b>Year</b>	<b>Number</b>	<b>Title/Author(s) ESRI Authors/Co-authors <i>Italicised</i></b>
<b>2009</b>		
	291	Measuring House Price Change <i>David Duffy</i>
	290	Intra-and Extra-Union Flexibility in Meeting the European Union's Emission Reduction Targets <i>Richard S.J. Tol</i>
	289	The Determinants and Effects of Training at Work: Bringing the Workplace Back In <i>Philip J. O'Connell and Delma Byrne</i>
	288	Climate Feedbacks on the Terrestrial Biosphere and the Economics of Climate Policy: An Application of <i>FUND</i> <i>Richard S.J. Tol</i>
	287	The Behaviour of the Irish Economy: Insights from the HERMES macro-economic model <i>Adele Bergin, Thomas Conefrey, John FitzGerald and Ide Kearney</i>
	286	Mapping Patterns of Multiple Deprivation Using Self-Organising Maps: An Application to EU-SILC Data for Ireland Maurizio Pisati, <i>Christopher T. Whelan</i> , Mario Lucchini and <i>Bertrand Maitre</i>
	285	The Feasibility of Low Concentration Targets: An Application of <i>FUND</i> <i>Richard S.J. Tol</i>
	284	Policy Options to Reduce Ireland's GHG Emissions Instrument choice: the pros and cons of alternative policy instruments Thomas Legge and <i>Sue Scott</i>
	283	Accounting for Taste: An Examination of Socioeconomic Gradients in Attendance at Arts Events <i>Pete Lunn and Elish Kelly</i>
	282	The Economic Impact of Ocean Acidification on Coral Reefs Luke M. Brander, Katrin Rehdanz, <i>Richard S.J. Tol</i> , and Pieter J.H. van Beukering
	281	Assessing the impact of biodiversity on tourism flows:



- A model for tourist behaviour and its policy implications  
Giulia Macagno, Maria Loureiro, Paulo A.L.D. Nunes and  
*Richard S.J. Tol*
- 280 Advertising to boost energy efficiency: the Power of One  
campaign and natural gas consumption  
*Seán Diffney, Seán Lyons and Laura Malaguzzi Valeri*
- 279 International Transmission of Business Cycles Between  
Ireland and its Trading Partners  
*Jean Goggin and Iulia Siedschlag*
- 278 Optimal Global Dynamic Carbon Taxation  
*David Anthoff*
- 277 Energy Use and Appliance Ownership in Ireland  
*Eimear Leahy and Seán Lyons*
- 276 Discounting for Climate Change  
*David Anthoff, Richard S.J. Tol and Gary W. Yohe*
- 275 Projecting the Future Numbers of Migrant Workers in  
the Health and Social Care Sectors in Ireland  
*Alan Barrett and Anna Rust*
- 274 Economic Costs of Extratropical Storms under Climate  
Change: An application of FUND  
*Daiju Narita, Richard S.J. Tol, David Anthoff*
- 273 The Macro-Economic Impact of Changing the Rate of  
Corporation Tax  
*Thomas Conefrey and John D. Fitz Gerald*
- 272 The Games We Used to Play  
An Application of Survival Analysis to the Sporting Life-  
course  
*Pete Lunn*
- 2008**
- 271 Exploring the Economic Geography of Ireland  
*Edgar Morgenroth*
- 270 Benchmarking, Social Partnership and Higher  
Remuneration: Wage Settling Institutions and the  
Public-Private Sector Wage Gap in Ireland  
*Elish Kelly, Seamus McGuinness, Philip O'Connell*
- 269 A Dynamic Analysis of Household Car Ownership in  
Ireland  
*Anne Nolan*

- 268 The Determinants of Mode of Transport to Work in the Greater Dublin Area  
*Nicola Commins and Anne Nolan*
- 267 Resonances from *Economic Development* for Current Economic Policymaking  
*Frances Ruane*
- 266 The Impact of Wage Bargaining Regime on Firm-Level Competitiveness and Wage Inequality: The Case of Ireland  
*Seamus McGuinness, Elish Kelly and Philip O'Connell*
- 265 Poverty in Ireland in Comparative European Perspective  
*Christopher T. Whelan and Bertrand Maitre*
- 264 A Hedonic Analysis of the Value of Rail Transport in the Greater Dublin Area  
*Karen Mayor, Seán Lyons, David Duffy and Richard S.J. Tol*
- 263 Comparing Poverty Indicators in an Enlarged EU  
*Christopher T. Whelan and Bertrand Maitre*
- 262 Fuel Poverty in Ireland: Extent, Affected Groups and Policy Issues  
*Sue Scott, Seán Lyons, Claire Keane, Donal McCarthy and Richard S.J. Tol*
- 261 The Misperception of Inflation by Irish Consumers  
*David Duffy and Pete Lunn*
- 260 The Direct Impact of Climate Change on Regional Labour Productivity  
Tord Kjellstrom, R Sari Kovats, Simon J. Lloyd, Tom Holt, *Richard S.J. Tol*
- 259 Damage Costs of Climate Change through Intensification of Tropical Cyclone Activities: An Application of FUND  
Daiju Narita, *Richard S. J. Tol* and *David Anthoff*
- 258 Are Over-educated People Insiders or Outsiders? A Case of Job Search Methods and Over-education in UK  
Aleksander Kucel, *Delma Byrne*
- 257 Metrics for Aggregating the Climate Effect of Different Emissions: A Unifying Framework  
*Richard S.J. Tol*, Terje K. Berntsen, Brian C. O'Neill, Jan S. Fuglestedt, Keith P. Shine, Yves Balkanski and Laszlo Makra

- 256 Intra-Union Flexibility of Non-ETS Emission Reduction Obligations in the European Union  
*Richard S.J. Tol*
- 255 The Economic Impact of Climate Change  
*Richard S.J. Tol*
- 254 Measuring International Inequity Aversion  
*Richard S.J. Tol*
- 253 Using a Census to Assess the Reliability of a National Household Survey for Migration Research: The Case of Ireland  
*Alan Barrett and Elish Kelly*
- 252 Risk Aversion, Time Preference, and the Social Cost of Carbon  
*David Anthoff, Richard S.J. Tol and Gary W. Yohe*
- 251 The Impact of a Carbon Tax on Economic Growth and Carbon Dioxide Emissions in Ireland  
*Thomas Conefrey, John D. Fitz Gerald, Laura Malaguzzi Valeri and Richard S.J. Tol*
- 250 The Distributional Implications of a Carbon Tax in Ireland  
*Tim Callan, Sean Lyons, Susan Scott, Richard S.J. Tol and Stefano Verde*
- 249 Measuring Material Deprivation in the Enlarged EU  
*Christopher T. Whelan, Brian Nolan and Bertrand Maitre*
- 248 Marginal Abatement Costs on Carbon-Dioxide Emissions: A Meta-Analysis  
*Onno Kuik, Luke Brander and Richard S.J. Tol*
- 247 Incorporating GHG Emission Costs in the Economic Appraisal of Projects Supported by State Development Agencies  
*Richard S.J. Tol and Seán Lyons*
- 246 A Carbon Tax for Ireland  
*Richard S.J. Tol, Tim Callan, Thomas Conefrey, John D. Fitz Gerald, Seán Lyons, Laura Malaguzzi Valeri and Susan Scott*
- 245 Non-cash Benefits and the Distribution of Economic Welfare  
*Tim Callan and Claire Keane*
- 244 Scenarios of Carbon Dioxide Emissions from Aviation  
*Karen Mayor and Richard S.J. Tol*

- 243 The Effect of the Euro on Export Patterns: Empirical Evidence from Industry Data  
*Gavin Murphy and Iulia Siedschlag*
- 242 The Economic Returns to Field of Study and Competencies Among Higher Education Graduates in Ireland  
*Elish Kelly, Philip O'Connell and Emer Smyth*
- 241 European Climate Policy and Aviation Emissions  
*Karen Mayor and Richard S.J. Tol*
- 240 Aviation and the Environment in the Context of the EU-US Open Skies Agreement  
*Karen Mayor and Richard S.J. Tol*
- 239 Yuppie Kvetch? Work-life Conflict and Social Class in Western Europe  
*Frances McGinnity and Emma Calvert*
- 238 Immigrants and Welfare Programmes: Exploring the Interactions between Immigrant Characteristics, Immigrant Welfare Dependence and Welfare Policy  
*Alan Barrett and Yvonne McCarthy*
- 237 How Local is Hospital Treatment? An Exploratory Analysis of Public/Private Variation in Location of Treatment in Irish Acute Public Hospitals  
*Jacqueline O'Reilly and Miriam M. Wiley*
- 236 The Immigrant Earnings Disadvantage Across the Earnings and Skills Distributions: The Case of Immigrants from the EU's New Member States in Ireland  
*Alan Barrett, Seamus McGuinness and Martin O'Brien*
- 235 Europeanisation of Inequality and European Reference Groups  
*Christopher T. Whelan and Bertrand Maitre*
- 234 Managing Capital Flows: Experiences from Central and Eastern Europe  
*Jürgen von Hagen and Iulia Siedschlag*
- 233 ICT Diffusion, Innovation Systems, Globalisation and Regional Economic Dynamics: Theory and Empirical Evidence  
*Charlie Karlsson, Gunther Maier, Michaela Trippl, Iulia Siedschlag, Robert Owen and Gavin Murphy*
- 232 Welfare and Competition Effects of Electricity Interconnection between Great Britain and Ireland  
*Laura Malaguzzi Valeri*

- 231 Is FDI into China Crowding Out the FDI into the European Union?  
Laura Resmini and *Iulia Siedschlag*
- 230 Estimating the Economic Cost of Disability in Ireland  
John Cullinan, Brenda Gannon and *Seán Lyons*
- 229 Controlling the Cost of Controlling the Climate: The Irish Government's Climate Change Strategy  
Colm McCarthy, *Sue Scott*
- 228 The Impact of Climate Change on the Balanced-Growth-Equivalent: An Application of *FUND*  
*David Anthoff, Richard S.J. Tol*
- 227 Changing Returns to Education During a Boom? The Case of Ireland  
*Seamus McGuinness, Frances McGinnity, Philip O'Connell*
- 226 'New' and 'Old' Social Risks: Life Cycle and Social Class Perspectives on Social Exclusion in Ireland  
*Christopher T. Whelan and Bertrand Maitre*
- 225 The Climate Preferences of Irish Tourists by Purpose of Travel  
*Seán Lyons, Karen Mayor and Richard S.J. Tol*
- 224 A Hirsch Measure for the Quality of Research Supervision, and an Illustration with Trade Economists  
*Frances P. Ruane and Richard S.J. Tol*
- 223 Environmental Accounts for the Republic of Ireland: 1990-2005  
*Seán Lyons, Karen Mayor and Richard S.J. Tol*
- 2007** 222 Assessing Vulnerability of Selected Sectors under Environmental Tax Reform: The issue of pricing power  
*J. Fitz Gerald, M. Keeney and S. Scott*
- 221 Climate Policy Versus Development Aid  
*Richard S.J. Tol*
- 220 Exports and Productivity – Comparable Evidence for 14 Countries  
*The International Study Group on Exports and Productivity*
- 219 Energy-Using Appliances and Energy-Saving Features: Determinants of Ownership in Ireland  
Joe O'Doherty, *Seán Lyons* and *Richard S.J. Tol*

- 218 The Public/Private Mix in Irish Acute Public Hospitals:  
Trends and Implications  
*Jacqueline O'Reilly and Miriam M. Wiley*
- 217 Regret About the Timing of First Sexual Intercourse:  
The Role of Age and Context  
*Richard Layte, Hannah McGee*
- 216 Determinants of Water Connection Type and Ownership  
of Water-Using Appliances in Ireland  
*Joe O'Doherty, Seán Lyons and Richard S.J. Tol*
- 215 Unemployment – Stage or Stigma?  
Being Unemployed During an Economic Boom  
*Emer Smyth*
- 214 The Value of Lost Load  
*Richard S.J. Tol*
- 213 Adolescents' Educational Attainment and School  
Experiences in Contemporary Ireland  
*Merike Darmody, Selina McCoy, Emer Smyth*
- 212 Acting Up or Opting Out? Truancy in Irish Secondary  
Schools  
*Merike Darmody, Emer Smyth and Selina McCoy*
- 211 Where do MNEs Expand Production: Location Choices of  
the Pharmaceutical Industry in Europe after 1992  
*Frances P. Ruane, Xiaoheng Zhang*
- 210 Holiday Destinations: Understanding the Travel Choices  
of Irish Tourists  
*Seán Lyons, Karen Mayor and Richard S.J. Tol*
- 209 The Effectiveness of Competition Policy and the Price-  
Cost Margin: Evidence from Panel Data  
*Patrick McCloughan, Seán Lyons and William Batt*
- 208 Tax Structure and Female Labour Market Participation:  
Evidence from Ireland  
*Tim Callan, A. Van Soest, J.R. Walsh*
- 207 Distributional Effects of Public Education Transfers in  
Seven European Countries  
*Tim Callan, Tim Smeeding and Panos Tsakloglou*