Comparative analysis of the existing and proposed ETS

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Abstract:
Emissions trading schemes (ETS) have been operational to control greenhouse gas emissions in European Union since 2005. Under the EU ETS, the governments of the Member States agree on national emission caps, allocate allowances to industrial operators, track and validate the actual emissions and retire allowances at the end of each year. ETS have been proposed to be introduced in New Zealand, Australia, Japan, US, Canada, Korea, India and two Chinese provinces in the near future. The main idea of the ETS is to create the market for pollution which will provide economic agents with incentives to reduce their emissions (Stavins, et al., 2003). The design of ETS plays an important role in reducing greenhouse gas emissions and promoting environmental and economic sustainability. There are several designs of ETS including cap-and-trade, baseline-and-credit and hybrid, however, cap-and-trade scheme is the most popular among the proposed ETS. The purpose of this paper is to perform a comprehensive review of the existing and the proposed ETS focusing on design issues. Findings of this research will be useful for countries with existing and proposed ETS and for countries intending to adopt ETS in the future.

Keywords: Emission Trading Scheme (ETS), Sustainability, Cap-and-trade, Baseline-and-credit, Hybrid

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1. Introduction

Our climate is changing, largely due to the observed increases in human produced greenhouse gases (Stern, 2007). Greenhouse gases (hereafter GHG) absorb heat from the sun in the atmosphere and reduce the amount of heat escaping into space. This extra heat has been found to be the primary cause of observed changes in the climate system over the 20th century. These changes include increases in global average air and ocean temperature, widespread melting of snow and ice and rising global sea levels (Stern, 2007). The extra heat in the climate system has other impacts, such as affecting atmospheric and ocean circulation, which influences rainfall and wind patterns.

Water vapor is the most abundant GHG. Its concentration is highly variable and human activities have little direct impact on its amount in the atmosphere. The main GHG generated by human activity are carbon dioxide (CO$_2$), methane and nitrous oxide. There are also manufactured gases such as chlorofluorocarbons (CFCs) and halocarbons. Under the 1997 UNFCCC Kyoto Protocol (KP) during the period 2008-2012 38 Annex I nations and the members of the EU accept the commitment to reduce six GHG including CO$_2$, CH$_4$, N$_2$O, PFC, HFC, SF$_6$ to 5.2% below the emissions level of 1990 (Huang, et al., 2008). Under the Article 4.5 of the Protocol, high income Annex II nations are responsible for “helping, promoting and financially assisting affected countries in dealing with the impacts of climate change” (Huang, et al., 2008). In order to achieve targeted reduction in the GHG emissions, the KP has established three market based-mechanisms, emissions trading (known as “the carbon market”), Joint Implementation (JI) and Clean Development Mechanism (CDM). Emissions trading as set in the Article 17 of the KP, allows for “a trade of emissions [AAU] among Annex I Parties or International” (Dagoumas, et al., 2006). Under Article 6 of the KP, JI means that any Annex I nation (i.e. industrialized) can potentially receive credits for the reduction in GHG emissions achieved by investing in projects located in other Annex I nations (Dagoumas, et al., 2006). According to article 12 of KP, which was drafted in 1997 but came into effect in 2005, any Annex I nation can receive credits for the reduction in GHG emissions achieved by investing in projects located in the developing countries. In this paper, we are focusing on only one Kyoto market based-mechanism,
emissions trading schemes (ETS). Overall, KP set legally binding emissions targets for 38 nations. However, KP does not specify the exact mechanism of multi-national or even global emissions trading. This issue has not been clarified at the subsequent international Conferences in Buenos Aires and Bonn (Boom, 2001), Bangkok, Barcelona and Copenhagen.

As compared to KP, where the focus was on the developed nations reducing their emissions, the focus of the 2009 United Nations Climate Change Conference in Copenhagen was on developing nations reducing their GHG emissions. The objective of this Conference was to create a new international post-Kyoto legal architecture for addressing anthropogenic climate change (Macintosh, 2010). The outcome of this Conference, so-called Copenhagen Accord, set a political non-binding agreement without long-term global goal for emissions reduction (Macintosh, 2010). Moreover, no enforcement mechanism in terms of monitoring, reporting or verifying emissions was developed under the Accord. The subsequent meeting in Cancun in 2010 was more successful in achieving international agreements in terms of adaptation and technology transfer, reporting and verification. However, this is also a non-binding treaty which requires rich countries to reduce their GHG emissions (as pledged in Copenhagen Accord) and developing countries to plan their emission reductions to limit global warming to less than 2 degrees above pre-industrial level. This was agreed and adopted by 129 nations participated in the conference (Sweet, 2010).

It seems that in the near future the nations are not likely to create a global emissions trading market which could link national and regional systems into one, although at the single- country or region level, emissions trading has been in place in some form or another for quite some time (Garnaut, 2008; Stern, 2007). For instance, ETS have been operational in European Union, Switzerland, Norway, Australian New South Wales, several Chinese provinces and Japan. There are plans for the ETS launch in Australia, Canada, United States and China. Initially, developed countries were planning to adopt ETS but now developing nations are becoming interested in ETS. Another trend in the ETS development, particularly in the North America, is formation of the emissions trading through regional blocks rather than country-wide coverage. For instance, while the US ETS is still in the preliminary stage,
several states have already joined with Canadian provinces to form three regional blocks, one of which, Regional GHG Initiative, is fully operational and two more will be launched in 2012 (Garnaut, 2011).

The main idea of the ETS is to create the market for pollution which will provide economic agents with incentives to reduce their emissions at the lowest cost to society (R. N. Stavins, et al., 2003). Following Carmona et al. (2009), introduction of the ETS combines two contrasting aspects. Both EU ETS and US Sulphur Dioxide Trading System reduced pollution at minimum cost to society (Carmona, et al., 2009), but at the same time there is an increase in the social cost of reducing pollution because of the transfer of wealth from consumers to producers due to large windfall profits. Therefore, the design of ETS plays an important role not only in promoting environmental and economic sustainability but also is important to the social welfare. There are several designs of ETS including cap-and-trade, baseline-and-credit and hybrid. The majority of the existing and proposed emissions trading schemes were built via cap-and-trade principle.

The purpose of this paper is to perform a comprehensive review of the existing and the proposed voluntary and mandatory ETS focusing on the issues of design. This paper contributes the literature by analysing a wide range of ETS of developed, developing countries and regional blocks. Findings of this research will be useful for countries with existing and proposed ETS and for countries intending to adopt ETS in the future. The paper is structured as follows. Section 2 presents types of ETS design and main issues regarding design. Section 3 provides a discussion of current and proposed ETS. Section 4 addresses practical issues regarding ETS design and implementation and Section 5 concludes the paper.

ETS Design Issues

2.1 ETS designs

ETS is a market-based instrument, tradable permits system adopted for pollution control. ETS can deliver least-cost emission reductions by allowing reductions to occur wherever they are cheapest (Stern, 2007). Following Marcu and Pizer (2003), ETS are delicate to design and implement. If not carefully designed, they can become not simply useless but
even potentially counter-productive (Soleille, 2006). The design of national ETS reflects domestic economic characteristics and environmental policies. Economic situation and natural resource endowments as well as the industrial structure and therefore current emissions structure are important determinants of the ETS design (Tuerk, et al., 2009).

According to Soleille (2006), the following features need to be taken into account when designing an ETS:
- Transaction costs of operation should be kept as low as possible;
- Market for permits should be active so that demand and supply could quickly adjust;
- Reliable measurement and monitoring of emissions need to be established;
- ETS should have the options of banking of permits.

These schemes are of three basic types: cap-and-trade, baseline-and-credit and hybrid (R. N. Stavins, et al., 2003). Cap-and-trade ETS allows the holders of the permits to emit a specified volume of GHG. Government issues tradable permits where the sum of all permits equates to the total GHG that could be emitted to the atmosphere. The initial distribution of permits can be either through auctioning or free allocation to involved parties (Garnaut, 2008; Stern, 2007). Since the permits are traded, this allows the allocation of permits to where it has the greatest economic value. Price of the permit needs to be determined by the market and there will be some volatility in the permit price. Internationally traded cap-and-trade scheme has a greater potential to reduce the cost of abatement by concentrating higher levels of abatement in the countries where abatement can be achieved at lowest cost (Garnaut, 2008).

Baseline-and-credit ETS place the responsibility of creating tradable permits with existing emitters and not on the government (Garnaut, 2008). This scheme involves an algorithm which provides existing emitter with some level of permits (entitlement) to emit. If the existing emitter emits below the entitlement, then the surplus can be converted to tradable permits. This involves calculation of average emission per unit of production based on a given technology, best practice technology and other approaches. However, the choice of
algorithm introduces arbitrariness to the scheme and may encourage rent-seeking behaviour (Garnaut, 2008)

Hybrid models try to address the issues of certainty in both price and quantity. Hybrid scheme will have an establishment of cap-and-trade scheme with an imposed upper limit on the price of permits (Garnaut, 2008; McKibbin & Wilcoxen, 2002; Pizer, 2002). Government will issue tradable permits up to a cap initially but with a commitment to issue permits at a specified ceiling price. This has the certainty about the maximum price while preserving some aspects of ETS (Garnaut, 2008). This approach may cause inefficiencies since it would not allow firms commitment on levels of emissions, and would limit international and inter-temporal flexibility in use of permits.

2.2 Conceptual foundations of the ETS Design
ETS design features include eligible gases, cap, coverage (i.e. sectors) and participation models, permit allocation, penalty for non-compliance, market access, offsets, banking and borrowing, linkage to other schemes, integration to JI and CDM, monitoring, verification and reporting (Butzengeiger, et al., 2001).

2.2.1 Gases
As stated earlier, the KP recognizes six eligible gases including CO₂, CH₄, N₂O, PFC, HFC and SF₆. Of these GHG, CO₂ is the most important, while the contribution of HFCs, PFCs and SF₆ in the global warming is relatively small (Stern, 2007). To foster potential linking with other ETS, GHG can be converted in to the CO₂-equivalents. In terms of environmental integrity, it is advisable to include as many as GHG as possible but it may not be practically feasible since each of the gases requires different monitoring system requirements.

2.2.2 Cap
The methods of determining cap include load-based and source-based cap programmes. A source-based program (e.g. EU ETS) regulates the source of emissions and covers only those polluting sources which are physically located within the respected regulatory jurisdiction (Nelson, 2009). Under a load-based programme (e.g. proposed CO₂ cap in the Oregon power
sector) imported emissions such as emissions related to electricity lost in transmission from
generation sources located in different regulatory jurisdictions also fall under the load-
based cap (Nelson, 2009). The advantage of the load-based approach is that it allows taking
into account potential leakage issues upfront (Nelson, 2009). However, contract shuffling
can raise concerns in such system. Caps can also be absolute or relative.

2.2.3 Permit / allowance allocation
The initial allocation or the total number of allowances issued by the regulator is crucial
since it is used by a regulator “as a knob to control the emissions level” (Carmona, et al.,
2009). Weishaar (2007) distinguishes two types of permit allocation, market-based via
auctioning and administrative allocation mechanisms. The former include financial
administrative allocation mechanisms and free administrative allocation mechanisms (so-
called grandfathering). Alternatively, a regulator can distribute allowances through a
combination of auctioning and free distribution. While Stavins (1997) advocated the
benefits of grandfathering, Cramton and Kerr (1999) suggested that auctions are superior to
free permit allocation because government can use revenues generated through auctions to
reduce distortionary taxes. Following Carmona et al. (2009), grandfathering lead to windfall
profits since companies are pricing their customers at a rate that depends on the emissions
emitted by the marginal production unit. These profits cannot be avoided if the permits are
allocated for free.

2.2.4 Coverage
Following Butzengeiger, et.al. (2001) to increase both efficiency and the environmental
effectiveness of the policy, ETS coverage should include as many relevant emitters as
possible. However, this might not be practical because “the direct inclusion of very small
emitters also increases transaction costs” (Butzengeiger, et al., 2001). In fact, to achieve a
liquid market a relatively large number of participants is recommended (Butzengeiger, et al.,
2001). Empirical evidence shows that at the initial stages many ETS are limited to large
emitters such as electricity generation. Participation is closely related to monitoring,
verifying and reporting issues as well as compliance.
2.2.5 Penalty for non-compliance

Following Nelson (2009), the effectiveness of any regulatory regime depends on its ability to create incentives and structure sanctions to ensure compliance. The problem of non-compliance can equally apply to the companies and the regulator itself. For instance, if the country cannot meet its emissions targets regulator must “comply with the target by buying allowances from other countries or generate additional allowances” (Carmona, et al., 2009), either through investments in projects under CDM or JI. With respect to companies, the type of penalty must be linked to the reason of non-compliance such as over-emitting, cheating when calculating or reporting emissions and breaking of contracts (Butzengeiger, et al., 2001).

2.2.6 Integration with JI and CDM

At the same time, ETS as policy must be interacting with the existing policy instruments (Butzengeiger, et al., 2001), either domestic (e.g. national energy efficiency standards, carbon taxes, etc) or international (CDM and JI as defined in the KP). To make sure that ETS is not creating a disproportional burden on the participating organizations, a system of policies need to be developed in relation to the non-participating organizations. These two types of policies need to be closely linked and over time the coverage of the ETS should increase to include non-participating organizations. For example, Australia has very ambitious coverage, while EU ETS has been increasing its scope from phase to phase. Presently CDM and JI integration have a lot of uncertainties.

2.2.7 Market access

The government needs to decide whether access to trading emission allocations needs to be restricted to participating organizations. In this case the market for emissions allocations will be potentially less liquid as compared to the situation when any willing party including financial institutions, non-governmental organizations and private individuals are allowed to participate in trading.
2.2.8 Offsets

Under the KP, ‘offsets’ refer to emissions reductions not covered by the cap in an ETS (Spash, 2009). Following Spash (2009) currently the major source of the KP offsets are the CDM projects which generate so-called certified emissions reduction units (CER). If offset projects fall under the JI, they create emission reduction unit (ERU). Examples of offset projects could be investments in GHG emissions reduction outside of the polluting source and creating sink capacities to absorb GHG pollution (Spash, 2009). Offset projects offer economic development opportunities (Nelson, 2009).

2.2.9 Banking and borrowing

Banking and borrowing of emissions add greater inter-temporal flexibility to the ETS due to lowering the GHG abatement costs, encourages private firms to invest in emissions reductions Based on KP, Z. Zhang (2000) distinguished two types of banking. First, Article 12.10 of the Protocol allows CERs obtained under the CDM during 2000-2008 to be banked for future use by the Annex I nations. Second, Article 3.13 authorises parties to carry forward their unused assignment amounts from one commitment period to the next (Z. Zhang, 2000).

2.2.10 Linkage with other schemes

ETS can be linked either directly or indirectly. Direct links allow trade between different national schemes and can be unilateral, bilateral or multilateral. The examples of unilateral links include the EU Linking Directive which links the EU ETS to the CDM (Tuerk, et al., 2009). In a bilateral system, allowances can be traded freely between two ETS and “each system allowances are equally valid for compliance in both systems” (Tuerk, et al., 2009). Indirect linkage between the ETS is possible through their unilateral links to the third common trading party such as CDM. Following Tuerk at al. (2009), linking allows to create a larger, more liquid carbon market.

Tuerk et al. (2009) analysed the issues of barriers to linking based on the analysis of existing and emerging ETS in USA, Japan, Australia, New Zealand and the EU. They found that due to differences in priorities and objectives in the national ETS, in the short term only very few
direct bilateral links will be possible with indirect unilateral links through the CDM or potential post-KP new crediting mechanisms which are yet to be developed.

2.2.11 Monitoring, verification and reporting
To achieve a reduction in GHG emissions, any ETS should have a strict system of monitoring, verification and reporting. The difficulty in implementation could be the need for different systems for different GHG. There are several international procedures for monitoring such as ISO 14000 series and the European “Eco-Management and Audit Scheme (EMAS).

2.3 Alternatives to ETS
There can be several other policy instruments for reducing GHG emissions. One other market-based approach that is commonly discussed is carbon taxes. Carbon tax can be introduced to reflect full social cost of emissions (damage caused by emissions) (Stern, 2007). Carbon taxes are simple and governments need not to take discretionary decisions about who is allowed to emit (Garnaut, 2008). In addition, taxes are easy to implement with the given intuitional structure and will raise revenue which can be used for investing in low-carbon technologies. High uncertain and volatile carbon prices from ETS may lead to poor decisions and this suggest for a fixed carbon tax over ETS (Pizer, 2002).

However, with a carbon tax, meting of emission reduction targets cannot be guaranteed though it reduces arbitrariness of regulatory interventions (Garnaut, 2008). In addition, carbon tax rate needs variation in order to accommodate increasing emission reductions and this requires constant reassessment of the relationship between the tax rate and the level of emissions.

There are regulatory responses that can be used to reduce GHG levels. Some regulatory options can be to have mandatory restrictions or bans on particular items or mandating, licensing or banning particular technologies or production techniques. However, some of these regulatory measures can be haphazard (Garnaut, 2008).
3. Current and proposed ETS: Country overview

In this section, we provide country overviews of the existing and proposed ETS. Similar analysis has been performed by Milunovich et al. (2007), who compared EU ETS, the NSW GHG Abatement Scheme (GGAS) and the Chicago Climate Exchange (CCX) and discussed the background economic theory underpinning the abatement policy. As compared to previous studies, which performed comparative analysis of the existing ETS, our contribution to the literature is the analysis of a broad range of countries with either existing or proposed ETS. While studies typically focus on the existing ETS, in this paper we compare both existing and proposed schemes. To date the majority of literature has been focusing on the EU ETS (Ellerman & Buchner, 2007; Ellerman, et al., 2010). Typically studies focus either on voluntary or mandatory schemes, but to the best of our knowledge no comparison between the two has been done to date. Very few studies have analysed proposed ETS (Butzengeiger, et al., 2001; Garnaut, 2008).

Most of the literature on EU ETS has established theoretical foundations behind it, while empirical studies on its performance in operational, trading and other aspects as well as the comparison between different phases have only recently been published or forthcoming (Y.-J. Zhang & Wei, 2010) Following Bouttes et al. (2010) one of the major current issues of the EU ETS is that it did not efficiently provide enough incentives for investment in clean technologies.

Following Morotomi (2006), who analysed the outcomes of the Japanese voluntary ETS, in general introduction of a voluntary or trial ETS prior to introduction of mandatory ETS has several advantages for both businesses and the regulators. First, regulators have the first hand experience of managing collection of the emissions data, maintenance of the electronic registry, legal treatment of the emissions allowances, development of detailed rules for the emissions trade. Second, businesses receive informational advantages from participating in the scheme. In Japan businesses can also obtain a subsidy from the government to cover one third of their capital investment. Although, voluntary system does bring reduction in emissions, it is not cost-effective because of partial coverage (Duval, 2008) and the fact that marginal costs of abatement will differ between emitters (R. Jones &
Yoo, 2009). In addition, voluntary system is not likely to provide adequate incentives to motivate emitters to innovate and find abatement options beyond their voluntary agreements (R. Jones & Yoo, 2009). According to Duval (2008), voluntary ETS cannot cope well with risk and uncertainty since such systems do not provide certainty either about GHG emissions or abatement costs and cannot accommodate changes as fast as the price instruments. Therefore, voluntary ETS should be used as a trial before introduction of a mandatory system. Alternatively, they can be used as domestic complements to national or international policy frameworks including more cost-effective policies (Duval, 2008).

In relation to the country experience, it should be noted that although in Japan, Australia and Switzerland voluntary agreements (VAs) varied in terms of stringency, monitoring and enforcement, covered small amount of industries, were limited to only few eligible gases and enjoyed small trading volumes, they did achieve a reduction in emissions. In addition, due to limited demand and small participation, voluntary emissions allowances tended to be cheaper than permits sold in the mandatory schemes (REFERENCE).

In this study we classify ETS depending on whether the ETS is mandatory (e.g. EU ETS) or voluntary (e.g. Japan and Switzerland). In contrast to mandatory scheme, where organizations have to abide by the rules set by the regulator, under a voluntary scheme, organizations may voluntarily choose to participate in ETS. In this case, participants will be liable for their emissions and the targets will represent legally binding agreements that companies have to comply to. It is customary for countries to start with the voluntary ETS in the pilot stage of its implementation and then transfer to mandatory regime after the trial period is over.

ETS can be further classified as outside or under the Kyoto. Schemes outside the Kyoto tend to be regional rather than national and include New South Wales GGAS, Regional Greenhouse Gas Initiative and Western Climate Initiative. All national schemes are organized under the Kyoto.
3.1 Existing (Mandatory) ETS

3.1.1 EU ETS

First multi-nation multi-sector ETS in the world was adopted in the European Union in 2005 (Stern, 2007). It has been organized in three phases. At the start of Phase I (the 1st EU ETS period) the certificates (EU Allowance) for companies to trade were distributed for free by each of the twenty five Member States through the National Allocation Plans (NAP). Phase I covered power industry (power plants, oil refineries, coke ovens), heavy industry (production and processing of ferrous metals, cement installations, etc), glass and pulp and paper sectors. Since there were more certificates distributed than needed, the price of carbon has been steadily declining until the end of this phase (Alberola and Chevallier, 2009). Overall, approximately 40% of the CO₂ emissions in EU were covered by the ETS. Banking and borrowing of allowances were allowed only within the Phase I, and no transfer of allowances into future phases was allowed. Non-compliance penalty for each metric tonne of the CO₂-equivalent emitted over the allowance was 40 euro.

Phase II of the EU ETS (the Kyoto Commitment Period, January 2008 -December 2012) includes now 27 members of the EU and three non-member nations (Iceland, Liechtenstein and Norway). During this phase GHG emissions were capped at 8 percent below 1990 levels. In addition to industries covered in Phase I, Phase II extended coverage to include aviation (from 2012). Similar to Phase I EU Allowances were distributed via NAPs. Non-compliance penalty has been increased to 100 euro per each tonne of CO₂-equivalent for emitting above the target. Linkage of EU ETS with other schemes is possible though bilateral agreements. Banking of allowance in the second phase is unlimited, while borrowing is restricted to the current, not future period.

Phase III, starting from January 2013 will last until December 2020. During this phase allocation of permits will be centralized and up to 60% of certificates will be auctioned. As compared to previous phases, only 5% and 10% of allowances were allowed to be auctioned by each Member State. From 2013 petrochemicals, aluminum, maritime transport and forestry will be included in the scheme.
Prior to the inclusion of Norway into the EU ETS, it already had the CO$_2$ tax in 1991, which covered mineral oil refineries and petroleum exploration and production in the North Sea. When ETS started in Norway in 2005, the scheme covered only 10% of emissions predominantly from the industrial use including cement and lime production, petrochemicals, ceramics, pulp and paper as well as the energy sector including mineral oil refineries and offshore oil and gas production. In 2008 after completion Phase 1, Norwegian ETS was linked to the EU ETS. Following the Norwegian National Allocation Plan (NAP, 2008), Phase II covers 35–40% of the GHG emissions (15 Mt per year). Out of this 50% of the allowances are sold at the prevailing market conditions, while the rest are either distributed for free (approximately 39%) or put in the reserve for the new power plants built under the carbon capture and storage technology. After 2012 all allowances will be auctioned.

Similar to Norway, UK joined EU ETS after establishing its own scheme in 2002, which was voluntary in nature. The thirty-two so-called “Direct Participants” and approximately 1,500 other trading parties participated in the Scheme. The participants differed in size, industry (i.e. energy-intensive and service industries), sector (both private and public sector) and included such organizations as Shell, British Airways, UK Coal and others. The annual emission reduction targets for each Direct Participant were developed based on its “baseline’ emissions between 1998 and 2000” (DEFRA, 2006). Although every year the target was increasing, over the life of the scheme each direct participant committed to a 13% reduction in emissions (DEFRA, 2006). Smaller trading parties mostly participated in the trading. In April 2002 when the ETS commenced, 96% of the allowances were awarded to the Direct Participants and the remainder to smaller parties. Over the life of the scheme, a reduction in GHG emissions equal to 7.2 million tonnes of CO$_2$ equivalent has been achieved (DEFRA, 2006). In 2006 UK ETS was terminated and UK joined the EU ETS.

Overall, EU ETS is generally portrayed in the literature as an example of successful design. In particular ETS has very high standard of monitoring and reporting as well as compliance measures. All necessary modern infrastructure for the success full operation of the system has been established in the first phase. However, there are several design flaws which have reduced the effectiveness of the EU ETS. Following Jones et al. (2007) if in the initial stage
the total allocation has turned out to exceed actual emissions, in the second phase market scarcity is expected “reflecting informational difficulties.” Second problem relates to the over-provision of free allocations, which has been solved in the second phase.

### 3.1.2 New South Wales (Australia)

The GGAS, one of the first regional mandatory ETS in the world, is the first Australian mandatory emissions trading scheme, which covers GHG emissions from production and the use of electricity and two states (the New South Wales (operational since 2003) and the Australian Capital Territory (operational since 2005)). The Scheme strives to achieve a 5% reduction below the KP baseline of 1990 (GGAS, 2008). It is designed as baseline-and-credit and it will be in place either until 2021 or until the nation-wide ETC becomes operational. GGAS establishes annual GHG benchmark and requires individual participants (those who buy or sell electricity in the NSW) to meet their allocation by surrendering abatement certificates created from project-based emission reduction activities (GGAS, 2008). These certificates are produced by the Abatement Certificate Providers (ACP). Each certificate is equal to a tonne of emissions and can further be traded between the market participants. In the event of non-compliance with the mandatory benchmark, participants are liable for AU$ 15 penalty per tonne of CO₂-equivalent, which will be adjusted on the annually based on the CPI. The scheme covers all GHG which are associated with the production and use of electricity. Main regulator of the Scheme is Independent Pricing and Regulatory Tribunal of New South Wales (IPART), which acts as the Scheme Administrator and the Compliance Operator.

### 3.2 Proposed (Mandatory) ETS

#### 3.2.1 New Zealand

New Zealand is aiming at 10 to 20 percent reduction relative to 1990, conditional on a comprehensive global agreement to limit the temperature increase to less than 2 degrees (Garnaut, 2011). New Zealand ETS is the system that enables the trading of New Zealand Units (NZU). NZU gives the right to emit one tonne of carbon dioxide or equivalent. ETS in New Zealand will be reviewed and assessed in 2011 to identify about the other trading partners action on climate change. The key areas for the review would be how to change
the scheme’s design to match any possible new global deal to fight climate change, whether
to ramp up the scheme and to include new sectors. New Zealand government is considering
including all sectors of the economy and all GHG by 2015 (New Zealand Government, 2011).
The scheme covers about half the country’s GHG emissions during its first phase and runs
until the start of 2013. A transition period between 1 July 2010 and 31 December 2012 will
be introduced and during this period participants will be able to buy emission units from
government for a fixed price of $25. In addition, participants in the energy, industrial and
liquid fossil fuel sectors will have to surrender only one emission unit for every two tonnes
of emissions they produce. After the transition period one emission unit will be equal to one
tonne of emissions.

New Zealand ETS will cover forestry, transport fuels, electricity production, industrial
processes, synthetic gasses, agriculture and waste. Sectors will introduce to the ETS
gradually over a period of seven years. Transport, electricity, industrial processes and waste
sectors may start reporting their emission levels voluntarily two years before their
mandatory obligation. Agriculture sector has four years of voluntary reporting before the
mandatory reporting. Agriculture, which is responsible for half the country's GHG emissions,
mainly methane from livestock, is excluded until 2015. New Zealand ETS can be
internationally linked and will reflect international climate change rules. This ETS will use
self-assessment for monitoring, reporting and verifying emissions produced by participants.
In addition, an electronic register will record on who holds emission units and called the

Government will provide financial assistance for some sectors in the form of free emission
units. New Zealand's scheme allocates up to 90 percent of pollution permits for free to
energy-intensive firms that export their goods to nations without carbon caps. Each permit
represents a tonne of carbon emissions. Power generators and transport firms receive no
free permits. New Zealand will provide opportunity for its ETS to be linked with the
international schemes. With international linking, the activities of large New Zealand
participants will have little or no impact on world prices. If the scheme were limited to New
Zealand units, one large player buying or selling their units would have a material impact on prices.

New Zealand ETS has penalty schemes in place if participants fail to collect emissions data or other required information, calculate their emissions and/or removals, keep records, register as a participant when you are supposed to, submit an emissions return when required, or notify the administering agency or provide information when they are required to do so. In addition, participants will be fined if they knowingly alter, falsify or provide incomplete or misleading information about any of their obligations under the emissions trading scheme (New Zealand Government, 2011).

3.2.2 Japan

Japan’s voluntary ETS was designed as baseline-and-credit system, in which participating companies were eligible for government subsidies as assistance in reducing GHG emissions. These subsidies had to be returned to the government if companies failed to achieve emissions reduction. Overall the scheme achieved a modest reduction in emissions.

Japan is maintaining strong commitment to action on climate change following Copenhagen accord and Cancun. They have set their reduction targets of 25 percent below 1990 levels by 2020 (Garnaut, 2011). But this commitment is premised on fair and effective international framework in which all economies participate and agree on ambitious targets. Japan also has a longer-term target to cut carbon dioxide from fossil fuels by 30 percent from 1990 levels by 2030. This proposes a mandatory ETS (cap-and-trade), a global warming tax together with a range of measures to promote renewable energy and additional measures to promote energy efficiency. The proposal broadly outlines a scheme which would see emissions caps implemented on large emitters in two phases, from 2013 and 2016.

The Japanese scheme would initially cover only carbon dioxide, which currently accounts for about 95 percent of Japan’s GHG emissions. Japan’s emissions reduction target would be virtually impossible to meet without deeper emission cuts by manufacturers, power generators and offices and commercial operations. It confirms that companies forced to
comply with carbon caps under the new rules and will be able to buy carbon offsets from abroad to help them meet their target. It also signals that some concessions will be made to carbon-intensive industries that face stiff international competition and to low-carbon sectors, such as solar panel manufacturing, that help to curb greenhouse gas emissions.

Japan has been holding bilateral talks with developing nations to transfer clean-energy technologies and receive emissions offsets to meet its 2020 goal. Japan signed a bilateral agreement with China over the weekend that will see the two neighbors work closer together on climate change and energy-efficiency projects. However, questions of emissions permit allocation, international linkages to international schemes and how to cover power sector emissions are left open at this stage.

However, there is significant uncertainty surrounding the establishment of a mandatory ETS due to political uncertainty. Japan is increasingly facing challenges with their national emissions trading scheme, since powerful business groups have warned of job losses as they compete against overseas rivals facing fewer emissions regulations. Japanese officials and politicians no longer believe that forcing companies to accept allocated emission caps, as in Europe, would work in Japan. Japan is now trying to reconsider of having an ETS than a Carbon tax.

3.2.3 South Korea
South Korea, the world's fifth-largest importer of oil and one of the world's fastest-growing carbon polluters, has been trying to shift away from its reliance on fossil fuels, sharply increasing investment in green resources. South Korea’s emissions doubled between 1990 and 2007 and the nation is heavily reliant on fossil fuel imports to power its economy. The Ministry of Environment said in a statement the Korea Exchange (KRX) will serve as a platform for carbon emissions trading, also known as cap-and-trade. Under the program, participating organizations will be issued emission permits, a right to emit a certain amount that should not exceed the limit set by the government, and can trade remaining allowances or buy them from those who emit less. South Korea plans to reduce emissions to 30 percent below business-as-usual levels by 2020 (Garnaut, 2011). The government plans to allocate
more than 90 percent of carbon trade rights with no charge during the first phase between 2013 and 2015. Trading is likely to start from 2013 and is part of a two-step plan by the government to mandate emissions cuts by big polluters. The South Korean government recently introduced a scheme which requires 374 local companies to set GHG reduction targets by September 2011.

About 470 firms or operations emitting more than 25,000 tonnes of carbon dioxide per year will have to participate. In total, these represent 60 percent of South Korea's total GHG emissions of just over 600 million tonnes a year. All sectors, from ship-building to refiners, electronics to power firms, will be covered, even buildings such as universities, waste disposal sites and big amusement parks. Trading begins in 2013 and from 2016 the two subsequent phases run for five years each. The government will impose regulations to force major emitters to comply as part of the nation's efforts against climate change. The biggest emitters, which produced more than 125,000 tonnes of CO₂ in the past three years, will be given a grace period before they are subject to mandatory cuts. No detailed incentives or penalties for the cuts have been decided.

The actual trading plan will be managed by Korea Power Exchange, Korea Exchange or a new commodities exchange to trade emissions. The committee is also thinking of trading certified emission reductions. These are tradeable offsets or credits that are created to promote and reward investors of clean-energy projects. Linking the trading scheme with bigger markets such as China in future is also being considered.

3.2.4 Russia

Russia has ratified KP in 2005 and during 2008-2012 pledged not to allow an increase in the GHG above 1990 levels. Even without additional measures, the compliance is not likely to be a problem because at present the average level of emissions is 30% below 1990. Russia has pledged to above conditional on appropriate accounting of the potential of Russia’s forestry and legally binding obligations by all emitters (Garnaut, 2011). In fact, before Kyoto expiry in 2012, Russia has more than 5 billion sovereign emissions rights (AAUs) to sell (Sergeyev &
Szabo, 2010), meaning that at present it is one of the largest producers of the AAU in Europe.

Over the period 2006-2009 Russia introduced several legislations including a plan of social and economic development 2020, legislative measures targeting energy efficiency improvements, proposals for a national Climate Change doctrine and a Decree 884-r, which stipulates the creation of the ETS in Russia under Article 17 of the KP. In this Decree government commissioned largest state-owned credit institution in Russia, Sberbank, to participate in pilot projects which involve emissions trading of all six GHG under Kyoto. In 2010 Sberbank hosted 2 carbon-credit tenders for projects that plan to cut greenhouse gases under the United Nations’ Joint Implementation program with bids as much as 30 million tones of CO₂ equivalent (Ustinova, 2010).

3.2.5 China
Following Chang and Wang (2010), Chinese government at different levels expressed interest in reducing emissions in late 1990s. In 2001, the State Environmental Protection Agency (SEPA) launched so-called 4+3+1 program which initiated pilot emissions trading in four provinces (Shandong, Jiangsu, Shanxi, and Henan), three cities (Shanghai, Tianjin, and Liuzhou), and one company (China Huaneng Group) in the power sector (B. Zhang, et al., 2010). The system mostly targeted SO₂ emissions and was designed as cap-and-trade. China has pledged to cut its carbon emissions per unit of economic growth by 40 to 45 percent by 2020 from 2005 levels.

Although, limited trading still occurs in these pilot areas, overall these pilot ETS have failed due to conflicts in different environmental policies and strong administrative interference (B. Zhang, et al., 2010). Recently, the Chinese government announced that all-China pilot emissions trading system will be implemented in the 12th Five-Year Plan (2011-2015). Although this program is still under development, legal system for reduction emissions in power industry is already in place as well as the emissions trading platforms. At present in China there are eight environmental exchanges. The first, Tianjin Climate Exchange, was established in Tianjin Binhai Area in 2008 and is designed as domestic cap-and-trade trading
platform system. The second, China Beijing Environmental Exchange (CBEEX), was designed as domestic and international platform. The most recent exchange was opened in June 2010 in Dalian, Liaoning province.

3.2.6 India
The Government of India has made a commitment not to allow country’s per capita GHG emissions to rise above per capita emissions of Advanced countries (Joshi & Patel, 2009). India will soon start a market-based emission trading system to check industrial pollution that will allow auctioning of pollution permits to industries under an ETS for air pollution. The proposed system involves regulator setting a pollution cap, aggregate as also for individual units, and let industries trade permits by ensuring low pollution self-regulation. To begin with, the system will be implemented in Gujarat and Tamil Nadu as these states contain critically polluted areas with many large industries. It will be implemented under a cap on air pollutants set by the respective state pollution control boards as a pilot for the rest of the country for six months. Auctioning of the permits will also yield revenue for implementing regulations, besides ensuring that firms responsible for emissions bear the full cost of their emissions. Introduction of emissions trading would position India as a clear leader in environmental regulation among emerging economies (Christopher, 2010).

3.2.7 Australia
Australia has proposed to have an ETS called Carbon Pollution Reduction Schemes (CPRS) and will use a cap-and-trade mechanism. However, the extreme weather related catastrophic conditions have given rise to the discussions on Carbon taxes and to delay the introduction of the CPRS. Australia may commence its Carbon taxes in July 2012 which may be followed by the CPRS in 3 to 5 years time.

The initially proposed CPRS will cover 75 percent of Australia’s total emissions directly affecting about 1000 entities. CPRS will have a commitment to reduce carbon pollution by 25 percent of 2000 levels by 2020 if Australia is a party to an international agreement capable of stabilizing GHG at 450 parts per million Carbon dioxide equivalence (Garnaut, 2011). Emissions from the stationary energy, transport sector, fugitive energy, waste water
and waste incineration and synthetic GHG are included in the CPRS. CPRS will not include emissions from waste landfill and combustion of biofuels and biomass energy and deforestation. Landfill facilities with emissions of 25,000 tonnes of carbon dioxide equivalence or more in a financial year will be covered by the CPRS. Australian government has excluded agriculture energy from the CPRS which accounts to about 16 percent of the national emissions (Australian Government, 2011).

The price for Australian emissions units will depend on a number of factors, including the scheme cap, scheme coverage, international linking, and the costs of emission reduction opportunities. The CPRS has been designed to be able to link with international carbon markets. Unlimited banking and limited borrowing of permits will help lower overall CPRS costs (by providing flexibility over when abatement can occur) and will help promote a smoother carbon price path. The entities will report under the National Greenhouse and Energy reporting System (NGERS), which provides a national framework for reporting greenhouse and energy data. The report will need to include direct emissions for which an entity is liable, the details of those emissions and certain data used to measure emissions. If a liable entity does not surrender sufficient units, then it will have an administrative penalty. The administrative penalty is calculated by multiplying the unit shortfall with the penalty per unit, which will be 110% of the average auction price or a lower amount if prescribed in regulations (Australian Government, 2011).

3.3 Regional blocks: US and Canada
23 states of the USA and Canadian provinces have established three regional ETS, all of which are designed as the cap-and-trade systems. Canada has pledged have a 17 percent reduction relative to 2005 and they are expecting the targets to be aligned with final economy-wide emission targets of the US (Garnaut, 2011). The Regional GHG Initiative (RGGI) is the first mandatory program to reduce GHG emissions in North America. This scheme introduced a regional cap on the CO₂ emissions that fossil – fuelled power stations can emit. During the first period of operation (2009-2014), the cap is set at 188 million short tons of CO₂ per year and applies only to electricity generating facilities of producing 25 megawatts and above. In the second phase of operation from 2015, the cap will be
decreased by 2.5 percent every year with the goal to achieve 10 percent reduction in CO₂ emissions by 2018. At present the scheme covers 209 fossil fuel-fired power plants. Planned review of the RGGI is expected in 2012. As compared to the EU ETS design features, under RGGI there are no restrictions on banking, which reduces volatility on the market. If in the EU ETS compliance period is one year, RGGI design allows multi-year compliance period (three years). Similar to EU ETS, RGGI is a source-based program.

In contrast to RGGI, the Western Climate Initiative (WCI) covers approximately 90 percent of economy-wide emissions in the Partner jurisdictions. WCI is set to achieve reduction of the regional GHG to 15% below the 2005 levels by the year 2020 based on the individual member’s emission reduction goals. Only forestry and agriculture are not covered by program.

Similar to WCI, Midwestern GHG Reduction Accord (MGGRA) is multi-sector cap-and-trade mechanism. The MGGRA will cover energy (electricity generation and imports, Transportation fuels and fuels serving residential, commercial and industrial buildings) sector and also extend to industrial combustion and process sources (MGGRA, 2009) as long as the sector has annual emissions equal to or greater than 20,000 metric tonnes of CO₂-equivalent. The goal of MGGRA is achieving a 20% reduction in the emissions as compared to 2005 level by 2020 and 80% reduction below 2005 levels by 2050. As compared to the EU ETS, where Phase 1 started without emissions reporting prior to the launch, MGGRA requires participating organizations to report their emissions of six GHG two years before the introduction of the scheme in order to set the accurate amount of allocations to distribute. This allows avoiding over-allocation of permits, which happened in the EU once it was launched.

3.3 Voluntary ETS

3.3.1 Japan

At present Japan is the world's fifth-biggest emitter of GHG. Japan launched its Voluntary domestic emission trading scheme (JVETS) in May 2005. The government of Japan provides the economic incentives for corporations that try to achieve emission reduction targets.
determined by them and implements a voluntary participation in domestic emission trading utilizing trade of emission quotas (cap-and-trade). One third of cost of GHG reductions activities will be subsidized by the government, however, if industries fail to reach the targets, subsidy should be returned to the government. In this scheme the participants are allowed to transfer the excess emission allowances to the next term. Japanese government expected JVETS could be good basis for a future cap-and-trade scheme. In the first round they had around 31 firms and the second phase around 61. The first phase (2005-2007) of the JVETS ended in the summer 2007 and the second phase is from 2006 to 2008. First phase achieved 29% reduction of the base year emissions (base year is the emission average from 2002 to 2004) and second phase achieved 25% reduction of the base year emissions.

One of the big contributions of JVETS is that has established basic infrastructure (the emission monitoring, reporting and verification guidelines, registry system, and emissions management system etc.) which is required for smooth operation. JVETS has third party emission verifiers to conduct emission verification to ensure the credibility. Monitoring and reporting guidelines are similar to EU ETS guidelines and these ensure appropriate reporting and monitoring by the participants. JVETS are aiming to improve target setting and verification method, expand the number of participants and improve the transaction systems for smoother operations.

3.3.2 Switzerland

In January 2008 the Swedish government introduced the voluntary Swiss ETS and the mandatory CO₂ tax. To be exempt from the tax, companies need to enter voluntary agreements to reduce CO₂. Based on these targets for 2008-2012, emission allowances were distributed to participating companies free of charge. In the event of excess emissions, allowances had to be purchased either domestically or on the international market. Industries covered by the ETS include energy intensive industries such as cement, ceramics, paper and pulp, and glass production. In the event of non-compliance with the ETS, violating company will have to pay penalty. In future, the government is planning to link the scheme with EU ETS.
4. Discussion

This section compares the existing and proposed ETS focusing on design features. EU ETS can consider as a successful ETS design since EU is learning from their past mistakes in Phase I and II. The current analysis shows that not all proposed ETS include all 6 Kyoto gases, but focus on CO\textsubscript{2} reductions, meaning that majority of anthropogenic emissions is covered, but not all. EU ETS Phase I, RGGI, Switzerland ETS cover only CO\textsubscript{2}. Most observed caps are either based on 1990 (Kyoto baseline) or 2000 emission levels. Australia New South Wales, EU, New Zealand, Japan and South Korea chose caps based on 1990 emission levels whereas Australian CPRS is based on 2000. US and Canada regional blocks have designed their caps based on 2005 emission levels. Nations seems to be in agreement with choosing one tonne of CO\textsubscript{2}-equivalent as a face value of a permit.

If in the past ETS chose allocating permits for free, current evidence shows that majority of proposed ETS will allocate permits initially through a combination of grandfathering and auctioning. Grandfathering is typically thought as assistance to the affected industries. In the initial stages, banking and borrowing are limited to the compliance period. For example, EU ETS did not allow transfer of permits from phase I to future phases. It is typical for all mandatory ETS to place a penalty for non-compliance, such as over-emitting, cheating, under or non-reporting and breach of contracts. The non-compliance penalty is calculated based on the tonnes of CO\textsubscript{2}-equivalent and is typically adjusted for inflation.

Monitoring costs are very high, typically governments tend to outsource monitoring and verification to the private sector. Every scheme provides assistance measures to carbon intensive industries which may be exposed to international trade. Such measures include subsidies (Japan) and free permits (Australia, New Zealand). It is customary for the ETS to have free market access meaning that all interested parties can participate in carbon trading (spot market and the derivatives). The market for Carbon derivatives is growing very fast and at present there are many environmental exchanges such as, Chicago Climate Exchange, Nordic Nord Pool and Tianjin Climate Exchange.
Schemes do vary in terms of the industries covered, but almost every country targets to include carbon-intensive industries such as energy, in particular electricity generation from fossil fuels, and heavy industries. It is also common for nations to exclude agriculture at least in the first few years of the ETS operation. It is customary for ETS to have provisions for offsets which can be either under KP or not. For example, the offsets under New South Wales (Australia) ETS are not under the KP. However, most countries have not explicitly stated about the provisions for offsets.

Final goal of every country’s ETS is to link with the global carbon market. Therefore, every scheme has some provisions for linking its ETS with other regional or global schemes. For example, Swiss ETS is linked with the EU ETS. However, these provisions may have not specifically addressed the problems that will be faced in practice. It is ideal for countries to link their ETS with JI and CDM. But in practice only EU ETS has such integrations. Even though some of the other ETS has provisions to link ETS with JI and CDM, the amount of such integrations are very small.

5. Policy Implications and Conclusion

In this paper we have compared existing and proposed mandatory and voluntary ETS. We have found that in order to achieve a reduction in the GHG emissions, an ETS must give sufficient incentives to economic agents to reduce their emissions. ETS must give sufficient incentives to economic agents to reduce their emissions. At the initial stages the ETS need not to be over ambitious in terms of the amount of sectors covered and the desire reduction levels. It is recommended to have a trial voluntary ETS prior to the introduction of mandatory schemes. First, this will provide necessary experience for both the regulators and market participants. Second, it will assist in formulation of the mandatory cap. Third, it will provide sufficient time to have necessary infrastructure and institutional readiness for an efficient mandatory scheme.

Allocation of permits should be based on collecting emissions data from all eligible GHG for at least several years prior to the implementation of the ETS. This data will be used as a baseline reference case based on which the cap and amount of allowances to be issued will
be determined. Otherwise, national ETS will have the problem of either under or over-allocation the allowances similar to what happened in EU. Problem of the EU ETS in the first phase was over-allocation of permits. All EU members gave up allowances for free apart from Denmark, which auctioned 5% of the allowances. Ellerman and Buchner (2007) report that in 2005, allowances exceeded emissions by approximately 80 million tons of CO$_2$-equivalent or 4% of the EU’s maximum level. This over-allocation of permits lead to decrease not only in the price of permits, but also in prices of goods and services in the economy.

Weishaar (2007) examined differences of free and auction allowance allocation mechanisms with regard to allocative efficiency. He found that in the open dynamic economy, both initial allocation allowances give similar outcome but auctions and financial administrative allocation mechanisms perform worse than the free allocation. However, a mixture of free allocation and auctioning would be the preferred method of initial allocation. For example, free allocation of permits can be used as form of assistance to the affected industries. The revenue from auctioning could be used to invest in low-carbon technologies and also used in CDM and JI. However, the proportion of free allocation and auctioning will vary due to different factors and decision should be left at the country’s discretion.

Following Tuerk et al. (2009) to implement bilateral or multilateral linking good coordination between the nations is required which can be achieved through binding agreements. Such agreements contribute to the stability of the carbon market overall since withdrawal and termination conditions are clearly specified (Mehling & Haites, 2009). To date, no binding bilateral or multilateral agreements are present.

For an ETS to be successful, monitoring, verification and reporting have to be of a very high standard which assigns higher costs. Different gases, industries require varying standards, however, with time technological advancement and learning by doing will bring a substantial reduction in these costs. Penalties for non-compliance should be of progressive structure so that it will provide the incentives to become more efficient and effective. The appropriate enforcement structure for penalties should be in place.
References


Christopher (2010). India to launch emission trading to check industrial pollution. Trade Carbon Offsets absolutely free


i CO₂ – Carbon dioxide, CH₄ – Methane, N₂O – Nitrous oxide, PFC – Perfluoro carbons, HFC – Hydroflouro carbons, SF₆ – Sulphur hexafluoride

ii One EU Allowance represents the right to emit one tonne of CO₂.

iii Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, the United Kingdom.

iv Including Beijing, Shanghai, Tianjin, Hebei, Yunnan, Shanxi, Hubei and Dalian.

v RGGI includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont