Energy solutions for a changing world

Response to European Commission's Consultation Relating to the Review of the EU Carbon Capture and Storage (CCS) Directive 2009/31/EC

The Role of an Emissions Performance Standard in Meeting Europe's Energy Policy Goals and in Enabling CCS as an Option to Meet those Goals[1]

28th July 2014

The European Union's (EU) CCS Directive (2009/31/EC)[2] establishes a legal framework for the environmentally safe geological storage of carbon dioxide (CO_2) to contribute to mitigating climate change. In March 2013, the European Commission launched a consultative Communication on the Future of Carbon Capture and Storage (CCS) in Europe,[3] with the aim of initiating a debate on the options available to ensure the timely development of CCS technology. In its response to this consultation, RAP recommended that a well-designed CO_2 emissions performance standard (EPS) could effectively complement the European Union (EU) Emissions Trading Scheme (ETS). RAP's response to the current consultation, on the review of the EU CCS Directive, reiterates this main recommendation. An EPS would help manage disinvestment in the most carbon intensive plant and provide a strong investment signal for CCS; these are two needed outcomes that the ETS on its own is unlikely to be able to provide no matter how it is reformed. RAP also recommends that public support for CCS commercialisation should be initially focussed on energy-intensive industry rather than the power sector as few options are available to industry whereas a number of lower cost, low-carbon alternatives are available to the power sector.

The European Commission states that the CCS Directive review involves *"*consideration of the broader EU energy and climate change policy context.*"*[4] RAP is a global, non-profit team of experts working directly with regulators around the world to achieve the long-term economic and environmental sustainability of the power sector. Therefore, RAP's consultation response takes a broad view, drawing from global experience, in considering the role of CCS and options to enable it in order to meet EU energy policy goals.

1. Coherent roadmaps and detailed strategies are needed to deliver the EU's energy policy goals.

In order to achieve timely, risk-minimising, and least-cost carbon emission reductions, as informed by climate science, it is advisable for Member States to continue the development and implementation of the Commission's long-term Low Carbon Economy Roadmap.[5] This overarching roadmap needs to be supplemented by detailed and robust decarbonisation strategies that incorporate coherent targets, plans, and roadmaps for particular technologies, including CCS, and sectors expected to deliver the overall strategy. It is also important to ensure

[1] This paper is authored by Sarah Keay-Bright (RAP associate) with review and advisory support by RAP senior advisors Mike Hogan and Meg Gottstein, and RAP associate John Shenot. This paper builds on RAP's response to the European Commission's earlier consultation, "The Future of Carbon Capture and Storage (CCS) in Europe," issued July 2013 (http://www.raponline.org/document/download/id/6646).

[2] The European Commission created a website dedicated to the review of the CCS Directive at http://www.ccs-directive-evaluation.eu/.

[3] The Future of Carbon Capture and Storage in Europe, COM/2013/180 (2014). Available at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC0180.

[4] CCS Directive Evaluation at http://www.ccs-directive-evaluation.eu/.

[5] A Roadmap for Moving to a Competitive Low Carbon Economy in 2050, COM/2011/0112 (2011). Available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0112.

coherence between national and EU plans and strategies. Also of relevance are ENTSO-E's Ten Year Network Development Plan (TYNDP)[6] and resource adequacy assessments. Major infrastructure investments made now will in many cases "lock in" high fossil paths for decades to come, so they must inherently support low carbon performance either immediately or as a definite consequence of binding rules governing their use over time.

2. Intervention is required to manage disinvestment in the power sector.

The ETS cannot guarantee the high and stable prices that would be needed to support CCS investment; besides, high power clearing prices would lead to high consumer prices that are not politically desirable or tenable.

The ETS is an effective tool for capping emissions and a tighter ETS cap is highly desirable. A tighter cap, however, does not necessarily need to accompany, nor would it guarantee a high ETS price ramp. The ETS is by definition a market-based mechanism that operates by constraining supply. It is not and never was a mechanism designed to produce a high price, or any particular price at all, for the simple reason that the demand for allowances cannot be predicted with any certainty. The advent of new technology, less energy-and-carbon intensive economic growth, or different economic growth rates than those assumed are all beyond the scope of the policy and would have unpredictable impacts on the carbon price. A much tighter cap is also possible with low or reasonable price increases if cost-effective measures adversely impacted by well-recognised market failures, for example investment in energy efficiency, are prioritised and ramped up.

If relying on the ETS carbon price to provide a meaningful incentive for CCS deployment, the price would need to be persistently high — at a level where operation of unabated fossil plant is economically unattractive and where investment in CCS makes economic sense. In wholesale electricity markets, a high carbon price significantly raises the clearing price (due to the non-linear nature of the marginal cost dispatch curve) leading to transfer payments to existing generation of lower marginal cost. This is paid for by increases in electricity users' power bills, which translates to very high decarbonisation costs (€/tonne) — much higher than the price of carbon and higher relative to alternatives.[7] Dramatic increases in the retail price of electricity are politically untenable, particularly in times of economic downturn or stagnation.

The ETS cannot guarantee switching of gas and coal in the merit order no matter how it is restructured.

The uncertainties regarding future wholesale fossil fuel and carbon prices are too great to be confident that lock-in of high-carbon generation or stranded assets will not result. A fixed price or minimum/floor price might increase the likelihood of changing the merit order but provides no certainty and nullifies the core efficient-market rationale for reliance on the ETS in the first place.

[6] The latest plan is available at https://www.entsoe.eu/major-projects/ten-year-network-development-plan/Pages/default.aspx.

[7] For more detailed explanation, see: Cowart, R. (2012). *Prices and Policies: Carbon Caps and Efficiency Programmes for Europe's Low-Carbon Future*. European Council for an Energy Efficient Economy: Summer Study Proceedings No. 2-432, http://www.raponline.org/document/download/id/931; and Cowart, R. (2008). *Carbon Caps and Efficiency Resources: How Climate Legislation Can Mobilize Efficiency and Lower the Cost of Greenhouse Gas Emission Reduction*. Vermont Law Review, Vol. 33 No. 2.

With growth in the share of variable renewable energy sources (RES) there is a situation of overcapacity. But it is the energy resources most useful to the power system and most compatible with EU energy policy goals that are actually leaving the market.

In Europe, renewable energy generation is being, and should continue to be, rolled out at a rate aligned with the EU's decarbonisation trajectory. Supply can therefore exceed demand until the market adjusts and uneconomic generation leaves the market. In most of Europe exactly that situation exists today, with an additional unwelcome dimension. At present, gas plant is leaving the market despite its lower carbon intensity and greater flexibility compared to higher-emission, less-flexible coal plant. **There is therefore an urgent need to manage disinvestment in the power sector to ensure the timely exit of energy resources least compatible with EU energy policy goals.** As discussed above, it is eminently clear that the ETS on its own is not likely to achieve this objective.

The Commission's CCS Communication cites low ETS prices as a key reason why commercial scale demonstration projects in the EU have been delayed. The Commission states that low prices meant funds available through the NER300 programme[8] and the European Energy Programme for Recovery (EEPR)[9] were lower than expected and worsened the CCS business case.

As reforming the ETS to achieve a high and stable price is not politically feasible, it is therefore necessary to complement the ETS with policies that will ensure timely investment in low carbon resources with the right opertional capabilities and disinvestment in high carbon resources.

3. The case for combining price and non-price policies and measures.

Based on analysis and global evidence, the International Energy Agency (IEA) is advising that regions adopt an approach involving both price and non-price measures. In its report, *Summing up the Parts*,[10] the IEA provides a persuasive case that cap-and-trade schemes need to be supported by regulatory interventions in order to cost-efficiently and effectively overcome the well-known barriers to energy efficiency investment and to minimise risks associated with deployment of new low carbon technologies on the supply side. A RAP-commissioned modelling study[11] reinforces these findings. The study demonstrates that energy efficiency programmes can enable the tightening of the ETS cap beyond that which would otherwise be possible, at an affordable cost to households and businesses. The Regional Greenhouse Gas Initiative (RGGI) in the Northeast United States provides an excellent example of this.

RGGI is a cap-and-trade scheme covering power sector emissions across nine Northeastern states that has a longer history than California's relatively recent scheme. The RGGI scheme was

[8] NER300 is an EU financing instrument for subsidising installations of innovative renewable energy technology and CCS. The fund is managed jointly by the European Commission, European Investment Bank, and Member States, based on the set aside of 300 million allowances (rights to emit one tonne of carbon dioxide) in the New Entrants' Reserve of the European Emissions Trading Scheme. See http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm and www.ner300.com.

[9] The €4bn EEPR programme was set up in 2009 to co-finance projects (including CCS demonstration) designed to make energy supplies more reliable and help reduce greenhouse emissions, while simultaneously boosting Europe's economic recovery. See http://ec.europa.eu/energy/eepr/index_en.htm.

[10] Hood, C. (2001). *Summing up the Parts: Combining Policy Instruments for Least-Cost Climate Mitigation Strategies*. Paris, France: International Energy Agency. Available at http://www.iea.org/publications/freepublications/publication/Summing_Up.pdf.

[11] Keay-Bright, S. (2014). *Cap and Invest: The Economic Benefits of Investing EU ETS Auction Revenues into Energy Savings*. Brussels, Belgium: Regulatory Assistance Project. Available at www.raponline.org/document/download/id/6969.

designed by its member states to be complemented by directly connected energy efficiency investment programs and other targeted greenhouse gas mitigation measures. Since RGGI's inception – the first three-year compliance period began in 2009 – more than 73 percent of 2012 annual RGGI investments, and approximately 65 percent of cumulative RGGI investments, have funded energy efficiency programs in the region. Over 6 percent of RGGI investment in 2012, and 6 percent to date, funds clean and renewable energy programs, including grants and low-interest loans. The results have been so successful – in terms of emissions abatement, efficiency improvements, and benefits to local businesses and homeowners – the member states recently elected to lower the cap for 2014 emissions by 45 percent.[12]

In its proposed *Clean Power Plan*,[13] the United States Environmental Protection Agency (EPA) encourages states to consider a combination of price and non-price measures to limit carbon emissions from existing installations. The rule sets a cap for each state to cover CO_2 from existing combustion installations based on a combination of four "building blocks" – heat rate improvements for coal units; increased dispatch of combined cycle gas turbines (CCGTs); deployment of nuclear and renewable energy; and end-use energy efficiency. States, however, have considerable flexibility in how they meet the cap. They could choose to implement the measures as used by the EPA to calculate the cap or the state could adopt other measures or approaches – including through cap-and-trade schemes – and also in collaboration with other states.

4. Combining the ETS with an emissions performance standard (EPS) could achieve multiple desired outcomes; it would drive CCS deployment, strengthen investor confidence, and keep rate of decarbonisation on track over all timescales.

An EPS can be formulated in a variety of ways, but its basic purpose is to establish a maximum level or rate of CO_2 emissions emitted in the production of electricity. Somewhat akin to appliance efficiency standards, an EPS establishes a minimum performance level for power plants, whereby some may exceed that performance (in this case, emit CO_2 at a lower rate than the standard) and be valued in the market accordingly, but cannot operate if they do not meet the minimum standard of performance.

The case of California[14] demonstrates that an EPS is clearly effective in preventing the new build of carbon intensive generation such as unabated coal-fired power plant. During its rule-making proceeding that led to the adoption of an EPS in 2007, the California Public Utilities Commission (CPUC) noted that the EPS helped prevent development of some 30 unabated coal-fired power plants that would otherwise have served California's power market.[15] It is worth pointing out that California does not rely on the EPS alone to deliver its decarbonisation strategy. The state has ambitious energy efficiency, demand management, and renewables initiatives, and introduced a carbon cap-and-trade scheme in 2012.

An EPS increases certainty and reduces risk for investment in energy resources, including CCS.

[12] For more information see RGGI, Inc. (2014). *Regional Investment of RGGI CO2 Allowance Proceeds, 2012.* Available at http://www.rggi.org/rggi_benefits.
[13] The EPA proposed regulation is officially called the *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*.
[14] See Table in Annex for summary of how an EPS is applied in California and other jurisdictions around the world.
[15] California Air Resources Board (CARB). 2008. *Climate Change Scoping Plan Appendices: Volume 1 Supporting Documents and Measure Detail*. Available at http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf.

The Industrial Emissions Directive (IED) is currently forcing critical investment decisions. Operators of large combustion plants are considering whether or not to retrofit existing plant and invest in emissions cleaning technologies (for SO_2, NO_x, and particulate matter). In the present market conditions, upgrading plant to comply with the IED could make economic sense given the low wholesale price of coal relative to gas and the low ETS price. At the same time it is certain that CO_2 from fossil fuel plant will need to be abated in the medium term if EU decarbonisation targets are to be achieved, as set out in the European Commission's Low Carbon Economy Roadmap.

Low carbon energy resources, including CCS, therefore need to be pulled into the market by forcing existing high-carbon options out of the market and prohibiting high-carbon alternatives from meeting the need for new investment. An emissions performance standard (EPS) could be designed to manage needed disinvestment by ruling out unabated coal from today. It could also be applied with immediate effect to new generation and to unabated gas from 2030 in order to create the need for CCS investment and to ensure that new investment is compatible with medium- and long-term carbon reduction goals.

An EPS trajectory would provide investors with much greater market foresight and investor confidence about when carbon intensive generation will need to shut down, reduce operating hours, or be fitted with CCS technology. This greater certainty would not only reduce the risk of stranded assets but also drive the development of CCS supply chains. It is important therefore that an EPS design be aligned with interim power sector decarbonisation targets reducing over time toward the near total decarbonisation goal for the power sector in 2050, in accordance with the European Commission's Low Carbon Economy[16] and Energy Roadmaps.[17] An EPS trajectory that ratchets down over time in alignment with the sector's decarbonisation strategy can be determined through modelling. A long-term EPS trajectory will give investors more certainty about whether a plant can fully recover fixed costs before CCS is required to be fitted, whether or not it will be economically viable to fit a plant with CCS, or whether it will be more profitable to invest in alternatives.

5. A well-designed EPS can be compatible with the EU ETS, the internal energy market (IEM), and other carbon reduction policies.

If an EPS would be applied at the plant level, as opposed to a portfolio of plant, it would essentially define which energy resources would be eligible to participate in energy markets and remove those that are most carbon intensive.

Applying an EPS across utilities' portfolios would be undesirable as this would be similar to the effect of creating a series of mini-ETS schemes under an umbrella ETS scheme. A portfolio approach might also encourage gaming and would allow continued operation of poor performing energy resources as they could be offset by very low carbon energy resources. If a portfolio approach is adopted then it would be essential to constrain gas-fired generators by some estimated date consistent with the decarbonisation trajectory of EU policy, for example, 2030.

It would be necessary to review and adjust the ETS cap, not the ETS price, in order to manage interactions between the ETS and complementary measures such as an EPS. An EPS would, as

[16] A Roadmap for Moving to a Competitive Low Carbon Economy in 2050, COM/2011/0112 (2011). Available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0112.
[17] Energy Roadmap 2050, COM/2011/885 (2011). Available at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0885.

with other interventions such as RES subsidies, energy efficiency programmes, or CCS commercialisation programs (including a quota/certificates scheme discussed later in this paper), reduce emissions under the EU ETS cap and produce a downward effect on the ETS price. For reasons set out in section 2 above, interventions should not be seen as problematic because they reduce the ETS price. The setting of and review of the ETS cap and its trajectory to full decarbonisation, however, should incorporate the contribution of such market interventions.

An EPS needs to be applied at EU level to ensure compatibility with the internal energy market.

An EPS scheme has already been adopted in the UK and the policy measure is also being discussed in Germany. Where Member States introduce an EPS in isolation from the EU, the risk of leakage could be high, as cross-border trade is expected to increase with full implementation of the 3rd energy package legislation. However, cross-border leakage can be minimized with an EPS design that applies to imported power, as in the case of California's EPS regulation as well as its cap-and-trade program. It is highly desirable to prevent the emergence of different types or designs of EPS schemes across Europe in order to ensure as seamless as possible the functioning of Europe's internal energy market. An EU-wide EPS scheme is therefore desirable. An EPS measure would be a temporary intervention, re-evaluated periodically, and removed once the power sector becomes decarbonised.

6. Public subsidies to commercialise CCS should be focussed on energy-intensive industry rather than the power sector and not in the absence of an EPS.

CCS is a high-cost, pre-commercial technology, and its commercialisation should be supported. The NER300 programme and the European Energy Programme for Recovery could continue to be used to incentivise early adoption of CCS and achievement of the EU's Strategic Energy Technology Plan objectives.[18] The latter could be strengthened by including targets for CCS demonstration and conditions that should be met, including siting of suitable CO_2 storage near sources. Recycling ETS revenues into both CCS demonstration projects and energy efficiency programmes ensures a decarbonisation pathway that supports competitiveness in EU heavy industry and affordability of electricity bills.

To further support CCS commercialisation, the Commission's consultation invites views on the use of a quota/certificates scheme for CCS. This approach essentially mandates a certain level/quantity of technology procurement (the "quota" or "obligation"), which can be met through the acquisition of CCS certificates. A quota/certificates scheme has similarly been applied to renewable energy generation technologies in various jurisdictions, commonly known as a renewable portfolio Standard or renewables obligation. In its Communication issued last year the Commission briefly explained how such a scheme might work (see Box A below).

[18] See http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm.

Box A: Commission's Outline of a CCS Quota/Certificates Scheme

Extract from the European Commission's Communication on the Future of CCS in Europe[19]

A mandatory CCS certificate system could require carbon emitters (above a certain size) or suppliers of fossil fuels to buy CCS certificates equivalent to a certain amount of their emissions or embedded emissions (in case the commitment is placed on the fossil fuel suppliers). Certificates could be given to the oil and gas industry, ensuring that the knowledge already contained in these sectors regarding geology and field expertise is contributing to identifying the best-suited storage sites, including the possibility for enhanced oil and gas recovery, in so far as this ensures permanent CO_2 storage.

Box 1: CCS obligation currently in operation

Starting in 2015, electric power utilities in the state of Illinois in the USA are required to source 5% of their electricity from a clean coal power source, with a target of 25% by 2025. Plants operating before 2016 qualify as clean coal as long as at least 50% of CO_2 emissions are captured and sequestered. This requirement rises to 70% for coal power plants expected to commence operating in 2016 or 2017, and to 90% thereafter.

Such a system could work with the ETS, provided the volume of CCS certificates that would be required would have its equivalent in ETS allowances, which would have to be permanently withdrawn from the market (the quantity of carbon reductions through CCS certificates is known, so that a swift integration with the ETS system would be possible by reducing the amounts of ETS allowances with the same number). Such a system could define how much CCS needs to be developed and delivered. If targeted in scope, the impact on the functioning of the ETS could be limited whilst still allowing the flexibility to business to meet the cap.

From the perspective of EU competiveness, it would be logical to focus subsidies for the commercialisation of CCS in heavy industry applications as the heavy industry sector has limited options for decarbonisation strategies compared with the power sector. A quota/certificates scheme would be more appropriate for CCS compared with a fixed price scheme (also known as Feed-in-Tariffs (FiTs)). While the latter have successfully delivered investment in renewable energy technologies in Europe such as wind, solar, and biomass, they are unlikely to be appropriate for CCS investments, which are large and infrequent. For example, the use of degression – a key feature of a well-designed FiT that ratchets down the supporting fixed price as costs reduce over time – has been very effective in promoting a large number of small installations built by a wide range of promoters using a wide range of strategies. This approach would not be so effective with CCS. There simply will not be sufficient volume or variety of projects to deliver cost reductions associated with continuous product improvement, technology selection, mass production of parts, and streamlining or standardisation of processes.

[19] The Future of Carbon Capture and Storage in Europe, COM/2013/180 (2014), page 330. Available at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC0180.

A CCS quota/certificates system is more appropriate for large, infrequent investments but it needs to be emphasized that **such a scheme should not be introduced without an EPS**. In the absence of an EPS, a CCS quota/certificates scheme has severe limitations because it:

- Only promotes the development of a small number of CCS plants;
- Does not prevent the construction of other carbon intensive (non-CCS) plants;
- Does not prevent incremental investments in life-extension of existing high-carbon plants; and
- Does not address existing high-carbon plants.

Therefore, a CCS quota/certificate procurement scheme should only be introduced to complement an EPS, not as an alternative to it, thereby providing greater assurance that some CCS will be built to enable its commercialisation. Further, if such a scheme were to be introduced, the following should be considered:

- An alternative compliance payment (ACP) option should be applied. An ACP cap on the certificates system, set at a high "circuit breaker" level, ensures against CCS developer mismanagement. It permits compliance through payments if the cost to comply by purchasing power from a CCS facility rises above a certain threshold; and
- A quota/certificates scheme could be supported by ETS revenues.

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ANNEX: Comparison of EPS Regulation in US States and Canada

See also: www.raponline.org/docs/RAP_ResearchBrief_Simpson_EPS_Updated_2010_08_12(2).pdf

	Year Adopted & Review	Level	Scope	Existing Plants	Design	CCS Provision
California	2007	1100 lbs CO_2/MWh (approx. 500 gCO_2/kWh): performance level to be no higher than emissions rate of a CCGT.	Any and all long-term financial commitments with baseload facilities designed/intended to operate at capacity factor >60 percent	Some are exempt (grandfathered): existing baseload facilities owned by investor-owned or public utilities unless they becomes subject to new long-term commitments; existing CCGT pre-June 2007. The following will trigger EPS in existing plants: ○ If generation capacity of pre-2007 CCGTs are increased 50MW or more ○ Extension of life of power plant by 5 years or more ○ Intention to convert non-baseload power plant to baseload power plant.	○ No offsets. ○ No averaging over plant portfolio. ○ Flexibility for regulator to give exemption for reasons of reliability or unforeseen circumstances (catastrophe). ○ Renewables are compliant, including biomass. ○ Methodology adopted to calculate emissions rate for cogeneration.	○ CCS ensures EPS compliance. ○ Need for reasonable, economically and technically feasible plan for permanent sequestration of CO2.
Washington	2007 Review every 5 years	Standard is lower of: a) 1100 lbs of greenhouse gases per MWh (approx. 500 gCO_2/kWh); or b) the average available GHG emissions output as determined and updated by the Washington Department of Community, Trade & Economic Development which is obliged to carry out a survey every five years of new combined	Any and all long-term financial commitments with baseload facilities designed/intended to operate at capacity factor >60 percent	Pre-June 2008 baseload generation are exempt (grandfathered), until subject to new long-term financial commitments ○ EPS compliance required if existing unmodified station generating capability is 350MWh or greater ○ Increase to the facility is greater of the following measures: a) increase in station-generating capability of more than 25 MWh; or b) increase in CO_2 emissions output by 15 percent or more.	○ Renewables are compliant, including biomass. ○ Pre-June 2008 cogeneration (natural gas or waste gas) until subject to new ownership interest or upgraded ○ Flexibility for regulator to give exemption for reasons of reliability or unforeseen circumstances (catastrophe).	○ CCS ensures EPS compliance. ○ Need for financially, economically, and technically feasible plan for permanent sequestration of CO_2. ○ Requirement that carbon sequestration begins within 5 years of plant operation with penalty if failure to achieve implementation on schedule.

	Year Adopted & Review	Level	Scope	Existing Plants	Design	CCS Provision
		cycle gas turbines available and offered for sale in the US.				
Oregon	2009 Review every 3 years; can modify EPS by rule and greenhouse gases included under EPS.	1100 lbs CO_2/MWh (approx. 500 gCO_2/kWh)	New, long-term financial commitments (5 years +) to baseload facilities entered into by the utility.	Improvements or life extensions will trigger the EPS for existing plants except for: ○ Maintenance and repair; ○ Installation of emissions control equipment; ○ Improving heat rate of facility or greenhouse gases/MWh; ○ Modification to maintain reliability; or ○ Acquisition of an additional interest.	○ Renewables exempt. ○ Excluded are any generating source that uses natural gas or petroleum distillates as a fuel source and is primarily used to serve either peak demand or to integrate renewable energy. ○ Pre-July 2010 cogeneration is exempt unless subject to new long-term financial commitment. ○ Flexibility for regulator to give exemption for reasons of reliability or unforeseen circumstances (catastrophe). ○ CHP emissions determined using an output based methodology. ○ Certificate/license of electricity service provider can be revoked if it provides electricity in the state using baseload generation of non-compliant facility.	○ EPS does not apply where plan in place to become a low carbon emissions resource, if sufficient documentation (CCS not explicitly mentioned but clause intended to allow for CCS). ○ Implementation date, 7 years.

	Year Adopted & Review	Level	Scope	Existing Plants	Design	CCS Provision
Canada	August 1, 2012 (adopted) July 1, 2015 (enters into effect)	420 tonnes CO_2 /GWh (equal to 420 g/kWh) – the emissions intensity level of a natural gas combined cycle, high-efficiency generator	New coal-fired plants that start producing electricity commercially on or after July 1, 2015, and coal-fired units that have reached the end of their "useful life." The Canadian Government plans to introduce EPSs for each industry on a sector-by-sector basis, starting with the EPS for coal-fired power plants.	Units that have reached the end of their "useful life" must comply with the standard. The end of a unit's useful life is reached: ○ If commissioned before 1975, after 50 years of operation or at the end of 2019, whichever comes earlier. ○ If commissioned between 1975 and 1986, after 50 years of operation or at the end of 2029, whichever comes earlier.	○ Temporary exemption possible for a unit due to an extraordinary, unforeseen, ad irresistible event that causes a disruption to the electricity supply in the province where the unit is located. ○ For each calendar year, units must submit an annual report of their emissions ○ The quantity of CO_2 emissions is determined by the use of a continuous emission monitoring system or by using a fuel-based method	○ Emissions from CCS do not qualify as emissions under the EPS

	Year Adopted & Review	Level	Scope	Existing Plants	Design	CCS Provision
US – Proposed National Regulations	September 2013 (new)[20] June 2014 (modified & reconstructed) [21] June 2014 (existing)	<u>New</u>: Between 1,000 and 1,100 lbs CO_2/MWh (1,100 lbs/MWh = approx. 500 g CO_2/kWh). Differs for natural gas and coal. <u>Existing</u>: Emissions rate set state-by-state. Proposed emissions rates for 2020-2029 range between 244 lbs CO_2/MWh for to 1882 lbs CO_2/MWh. The proposed final (2030) goals range from 215 lbs CO_2/MWh to 783 lbs CO_2/MWh	Proposed regulations cover fossil-fuelled electric generating units. Those covering modified, reconstructed, and existing sources differentiate the standard based on fuel (natural gas and coal) and size.	Proposed rule is based on Section 111(d) of the Clean Air Act. ○ Emission reduction targets and compliance deadlines are set by state in a "guideline document" ○ Covers all existing power plants, including those undertaking modification or reconstruction	○ EPA proposed state-by-state average rate-based targets (i.e. lbs CO_2/MWh). ○ State targets are not applied to each unit – they represent an average rate of CO_2 emissions across the power sector. ○ States may meet their CO_2 goals through a number of measures, including: heat rate improvements, energy efficiency, plant retirements, and renewable energy. Notably, this means that non-electric generating units may be obligated to perform under a state plan. ○ States may convert their rate-based target into an annual tonnage emissions budget. ○ States may enter into multi-state cap-and-trade programs. ○ States submit plans to EPA to meet performance standards for approval; in the case of a multi-state program, they could submit a single multi-state plan in lieu of individual state plans.	○ Standards for new sources are based on CCS technology – that is, coal fired power plants will be unable to meet the CO_2 emissions standards for new sources without capturing some portion of CO_2 emissions. ○ In setting state targets for existing sources, the EPA determined the "best system of emission reduction" for each state and its utilities. One of the factors considered in making this determination was improvements to the efficiency (heat rate) of coal-fired units. CCS was not considered in the calculation. ○ Under the proposed rule for existing sources, emission reductions achieved through CCS could be used to help meet the emissions performance level required under a state plan.

[20] It is also important to note that existing power plants must also comply with New Source Performance Standards in order to receive a CO_2 emissions permit (http://www.gpo.gov/fdsys/pkg/FR-2010-06-03/pdf/2010-11974.pdf#page=1).

[21] The emissions rates for modified and reconstructed power plants are not described in this table. They are available at https://www.federalregister.gov/articles/2014/06/18/2014-13725/carbon-pollution-standards-for-modified-and-reconstructed-stationary-sources-electric-utility. It is important to note that modified and reconstructed natural gas and coal-fired power plants must also comply with the emission rates for existing plants.