

Establishing a Greenhouse Gas Emissions Performance Standard: Observations and Lessons from the California Experience

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What is a GHG Emissions Performance Standard (“EPS”)?

- Performance standard for electric generating facilities with respect to greenhouse gas (GHG) emissions
- Maximum level of GHG emissions per unit of output
- In California, expressed as lbs of CO₂ equivalent per megawatt-hour (MWh)*

*g/kwh or kg/mwh in other countries; lbs/mwh = 453.6/1000 g/kwh

EPS as Appliance Standard

- Similar to an appliance efficiency standard





Purpose of EPS in California

A specific policy tool to address climate change, one that serves to reduce:

- *Financial risk exposure* to the compliance costs associated with future GHG emissions regulations
- *Exposure to future reliability problems* in electricity supplies
- *Potential to “backslide”* during transition to statewide GHG cap (or as GHG emission limits become more stringent)



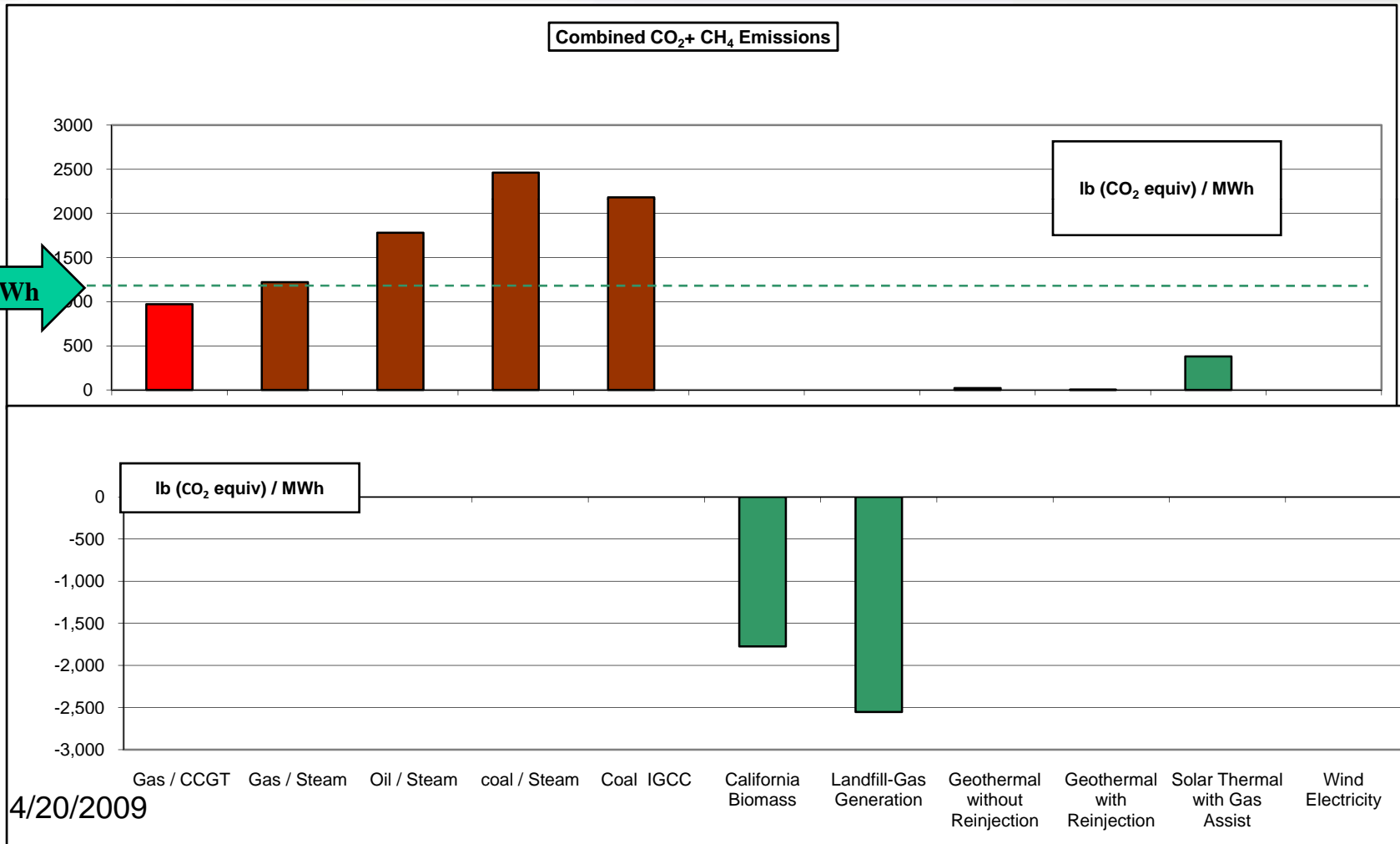
Why Consider Adopting EPS in Conjunction with Cap-and-Trade?

- If **market prices** under cap-and-trade are **unlikely to change the generation dispatch order or to induce new investments/technological advancements in clean generation** at a sufficient rate or magnitude to meet emission reduction goals
- If, in order to meet emission reduction goals through price alone, **market prices would need to increase and remain at an unacceptably high level**
- If current **cap-and-trade design permits unacceptable level of electric sector “carbon leakage”**



EPS Performance Level

Representative GHG Emission Rates





Point of Regulation (Who has to demonstrate compliance?)



What If...

California's higher energy efficiency standards only applied to appliances manufactured within California's borders?



Point of Regulation

- Could not be focused on in-state generators
 - Did not have jurisdiction over out-of-state generators
 - Leakage risk substantial
- Load serving entities (LSEs) were required to demonstrate compliance with the EPS



California and Washington focused on LSE actions that:

- Represented **new long-term financial commitments** to electric generation [**“go, no-go” gateway screen**]
 - LSE investments in new plant construction
 - LSE acquisition of new ownership share in power plants owned by others
 - LSE alternations to “retained generation”—existing, LSE-owned power plants that extend life significantly (five years or more) or increase rated capacity
 - New or renewal “long-term” contracts (5 years or more) between LSE with in-state or out-of-state generators—**and all sources of power had to be specified under those contracts**
 - Some exemptions permitted for existing CCGTs



Carbon Capture and Storage (CCS)



Addressing CCS in the EPS Rule

- Unabated coal-fired plants are effectively precluded under any EPS that is lower than approximately 900g to 1150 g of CO₂/kWh
- How can an EPS be designed that both:
 - Precludes long-term commitments to plants that will have high emissions over their lifetime, but
 - Does not preclude viable plans for CCS that can meet the standard over time?
 - **Delaying the EPS was not a viable option in California**



Treatment of CCS in California's Washington's (and Oregon's Pending) EPS

- **(1) Make the EPS effective immediately for new long-term commitments and (2) give coal with CCS an opportunity to “pass the EPS screening” via a rigorous pre-approval process with stakeholder involvement**
 - Advantage: If the pre-approval requirements are meaningful enough to reduce uncertainty/risks of EPS non-compliance, this approach can “raise the bar” for emissions performance without “shutting the door” on CCS
 - Disadvantage: Requires extensive project-by-project review and approval of CCS plans before the CCS project is actually operational, and there is some risk that the plant will be non-compliant on a life-cycle basis “in actual operation”



The California Rules and CCS

Project Applicant Must Demonstrate that:

- (1) CO₂ injection project **complies with applicable laws and regulations**;
- (2) CO₂ capture, transportation and storage project has a **“reasonable and economically and technically feasible plan”** that will result in a **“permanent sequestration”** of CO₂ once the...project is operational”
- (3) **Emission levels will meet the EPS over the life of the plant** (with CCS accounted for over that life)



The California Rules and CCS (cont.)

In practice this means:

- Project comes before the Commission for approval
- Stakeholders have a public forum to review assumptions and raise concerns
- Project plan is feasible with enough CCS to meet the EPS
- Approval may be granted even if the CCS project may become operational after the power plant comes on line or the LSE enters into (or renews) the contract
- Commission approval may be subject to conditions (e.g., required start date of CCS)




Washington State Rules and CCS

CCS Plan Must Also:

- **Provide for a start date within 5 years of plant operation** for geological sequestration or other approved CO₂ storage method
- Include **penalty provisions** for failure to achieve implementation of the plan on schedule

Impact of the EPS—Has it Made a Difference?

- 
- We can never know for sure what “would have happened” if not for the California EPS
 - Washington, Montana and Oregon (pending) also adopted an EPS
 - Industry/Environmental coalition proposing EPS as part of a CCS policy component for national legislation on climate policy
 - Over 90 new unabated coal-fired power plants have been cancelled in the US over the last couple of years
 - Some of them were on the drawing board to serve California’s power needs
 - EPS sent financial community a clear signal that CO₂ emission rates are relevant to the financial risk profile of power plants
 - EPS elevated the issue of CO₂ emission rates in the permitting process across many states
 - EPS improved “transparency” of carbon risks by requiring that all new long-term commitments be with specified power sources



About The Regulatory Assistance Project

RAP is a non-profit organization providing technical and educational assistance to government officials on energy and environmental issues. RAP is funded by US Department of Energy, several foundations, and international agencies. We have worked in 40+ states and 16 nations.

Meg Gottstein served as Administrative Law Judge at the California Public Utilities Commission for over 20 years, and was a key architect of California's energy efficiency and climate change policies for the power sector. Before joining the Commission, Meg consulted for the US National Governor's Association and other clients on renewable energy, energy efficiency and other energy topics. In addition, she served from 1979 to 1981 in the Carter administration as the Department of Energy's Regional IX Director for the Appropriate Technology Grants program. Meg Gottstein received a Bachelor of Arts in German and Economics from Tufts University and a Masters of Public Policy from the Kennedy School of Government at Harvard.

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Additional Slides

- Why Consider EPS with Cap and Trade?
- Flow Chart of California's EPS Rules
- Examples of "Upgrades" language from Washington State and California
- Extra slides on Biomass-Fueled plants and EPS
- EPS Language for the EU:
 - Adopted CCS-ready language (Dec. 2008)
 - Proposed Bill language (not adopted)
- Prelim Observations Specific to EU

Lessons Learned: “The Devil is in the Details”

- Effective EPS design involves a range of considerations when:
 - Selecting the EPS performance level and implementation date(s)
 - Identifying the best “point of regulation” given the specific circumstances (jurisdiction and risk of leakage)
 - Deciding whether the EPS should include existing plants (and the range of possible coverage options)
- ***Major Lesson Learned from California’s Experience: If you have the option (not available to California), minimize leakage from the start through your decision about geographic coverage—DO SO!***
- With careful design, an EPS can
 - Account for the efficiency of combined heat and power
 - Support development of carbon capture and storage



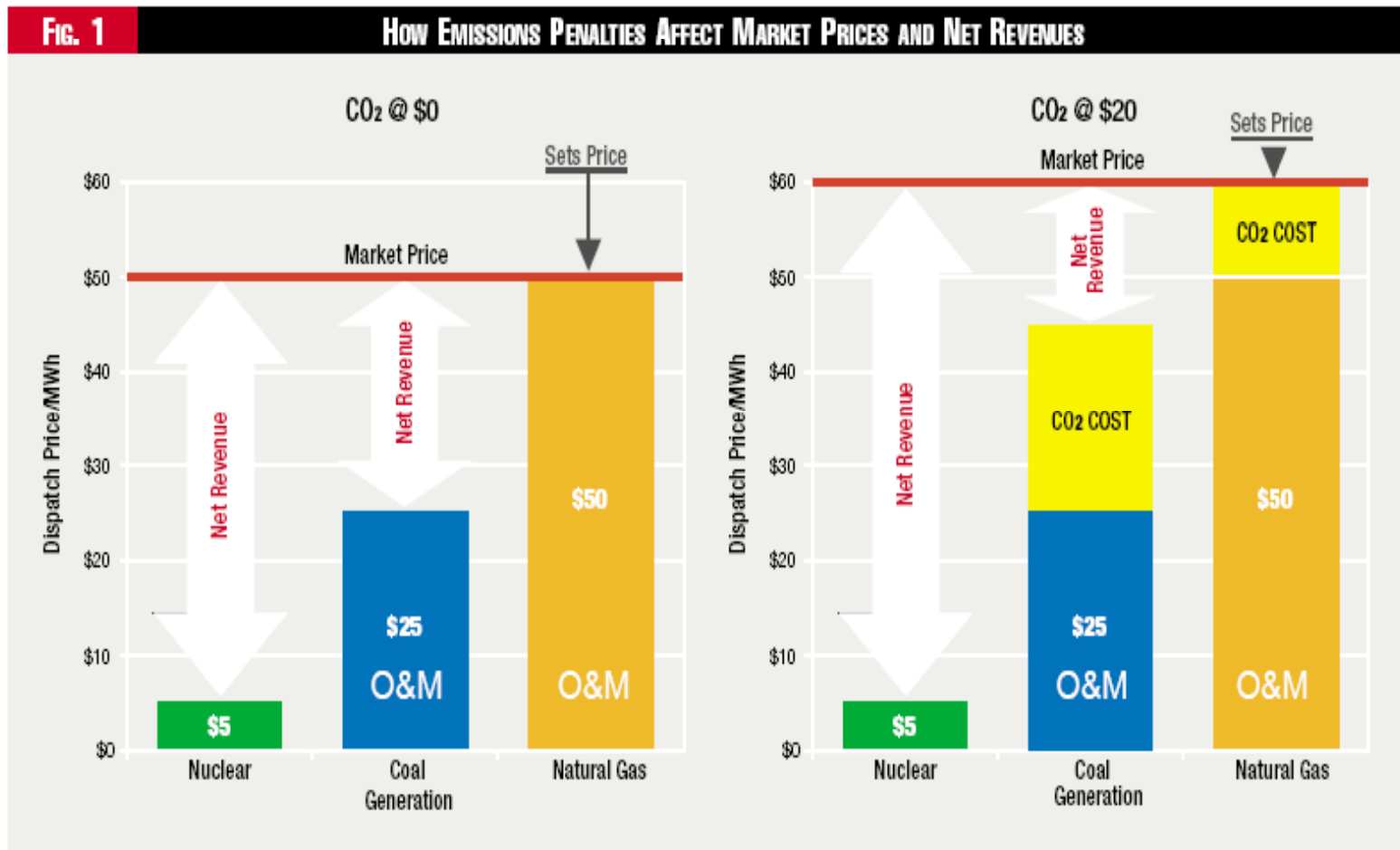
Why Consider EPS with Cap-and-Trade?



Emission Charges and Market Prices Under Cap-and-Trade

- In the power sector, emissions can be reduced by:
 - 1. Changing the generation dispatch order** (higher emitting resources are dispatched “last” and for fewer hours)
 - 2. Changing new investment decisions** (cleaner generation is built)
 - 3. Reducing end-use demand for power** (less supply-side resources required)
- What do recent evaluations say about how much (and at what cost) market prices under cap-and-trade are able to change (1) and (2)?

How Emission Charges Can Raise Prices Without Changing Dispatch or Emissions



Source: "The Change in Profit Climate" -- Public Utilities Fortnightly May 2007 --Victor Niemeyer, EPRI



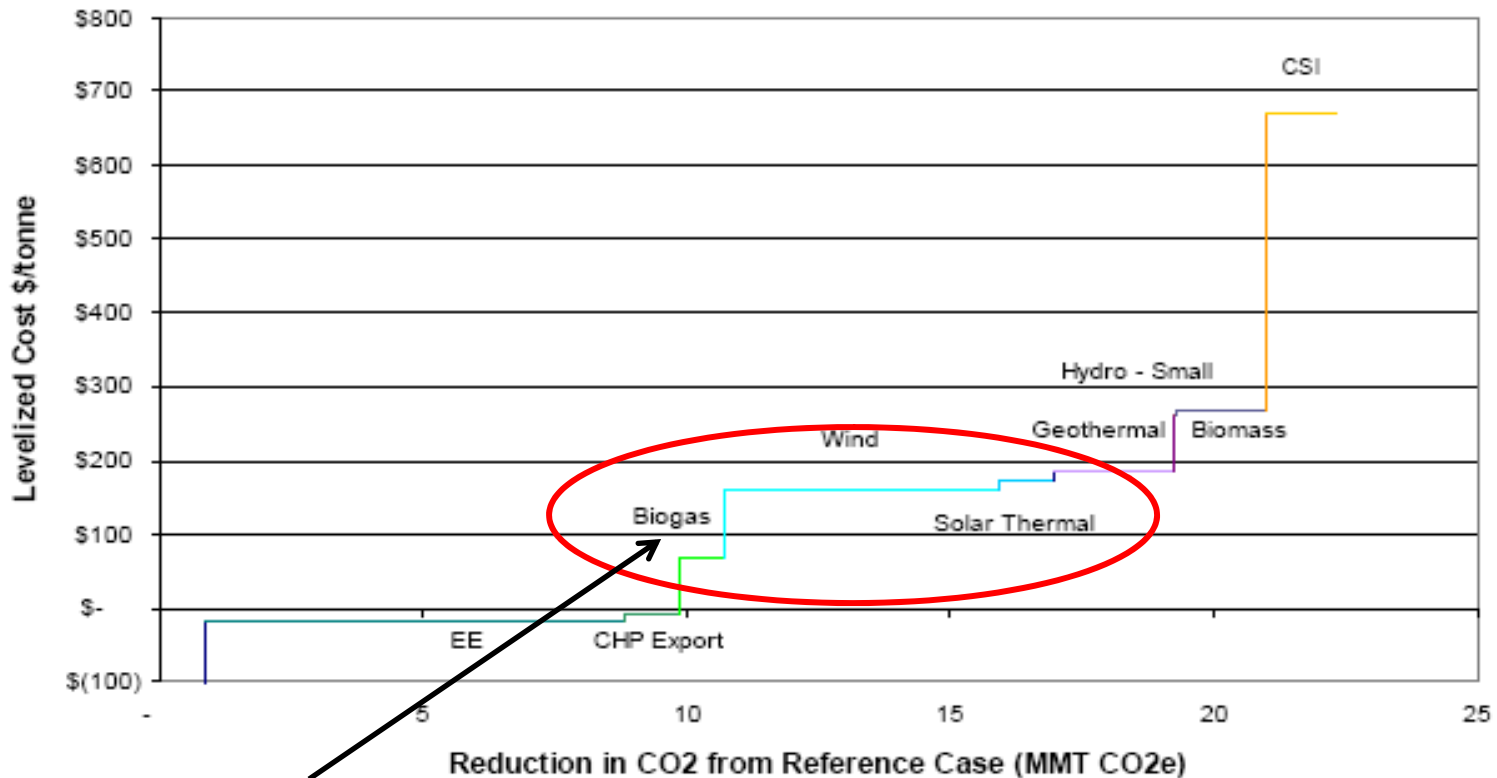
Generation-Side Emission Charges Can Increase Wholesale Power Prices With Little Effect on Dispatch & Emissions

- Study of upper Midwest, coal-heavy region concluded that a carbon charge of \$25/ton would raise wholesale power prices \$21/MWH.
 - “Even a CO₂ value of \$50/ton would produce only a 4% reduction in regional emissions given the current generation mix.”
- Study of gas-heavy Texas found that “when gas is selling for around \$8MMbtu, even a CO₂ value of \$40/ton produces little emissions reduction” from the existing mix.
- **In the longer term, a price on CO₂ can encourage new investments in new non-emitting generation—but at what cost?**

Source: “The Change in Profit Climate: How will carbon-emissions policies affect the generation fleet?”
Victor Niemeyer, (EPRI) -- *Public Utilities Fortnightly* May 2007. Describing modeling results from ECAR-MAIN and ERCOT

Implied carbon price for new low-carbon capital investment

CO2 Supply Curve of Selected Low-Carbon Resources



CO2 price must be in the \$150/tonne range to induce investment in renewable energy beyond the RPS



Other Indications that Carbon Prices Alone May Be Insufficient.....

A recent International Energy Agency study concludes that even if strict caps push the carbon price above \$200 per ton in the “wealthy” countries (Europe, US included) by 2050, annual global carbon output by that time would be triple the level required to hold warming below two degrees Celsius....



Potential for Carbon “Leakage” Under Cap-and-Trade Design

- When rules-of-the-game of cap-and-trade are different among interconnected regions covered by the cap
 - Example: If Utah and other states with unabated coal plants received free allowances (for existing or new coal plants) and other states did not.
- When the geographic reach of the cap still permits leakage to regions not covered by the cap
 - Example: Emissions cap limited geographically to California
- The result can be long-term commitments to high emitting plants in the “less constrained” or “unconstrained” regions by those regions subject to stricter rules.



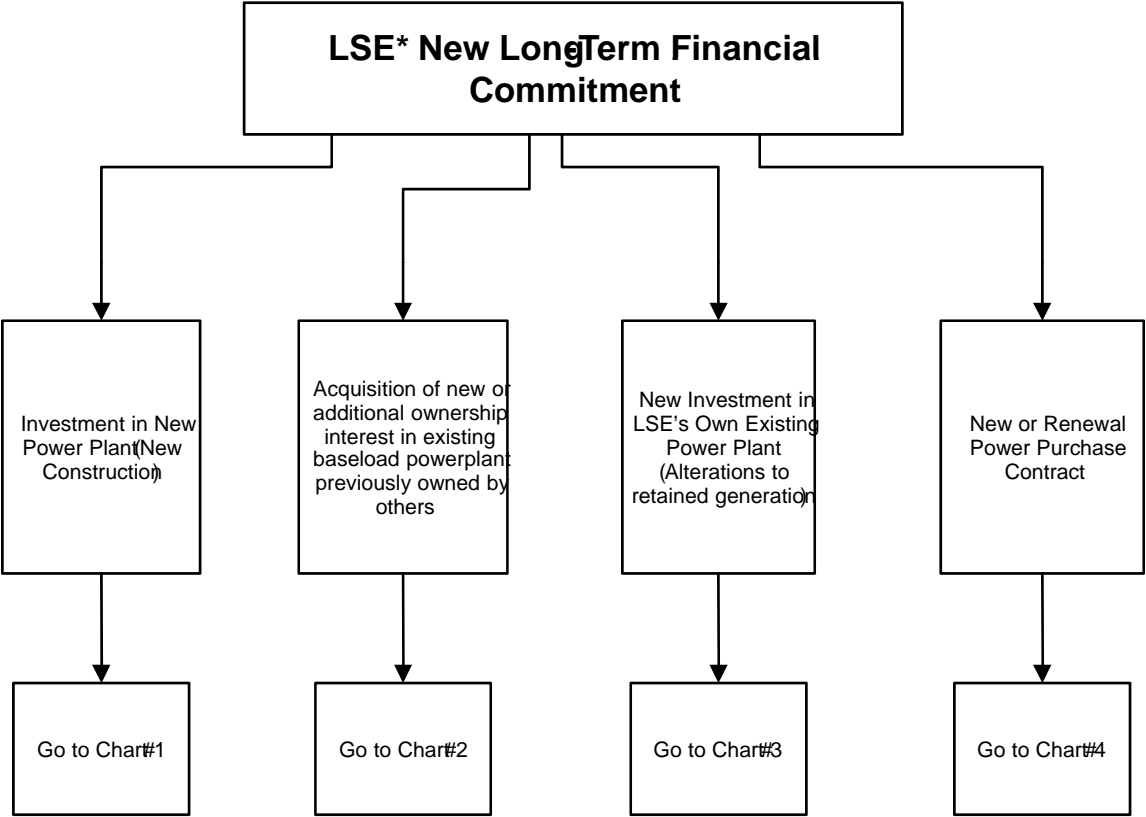
Recommendations

- Realistically evaluate what level of emissions (and at what cost per ton of CO₂ reduction) you are likely to achieve through cap-and-trade alone.
- Is leakage under the current cap-and-trade regime a potential problem?
- **If you are still likely to be short of your goals (or the market prices needed to achieve them would be unacceptably high)—or if carbon leakage is a problem--add more policy tools to the “toolbox”**
- An EPS can be an effective tool—if designed properly!



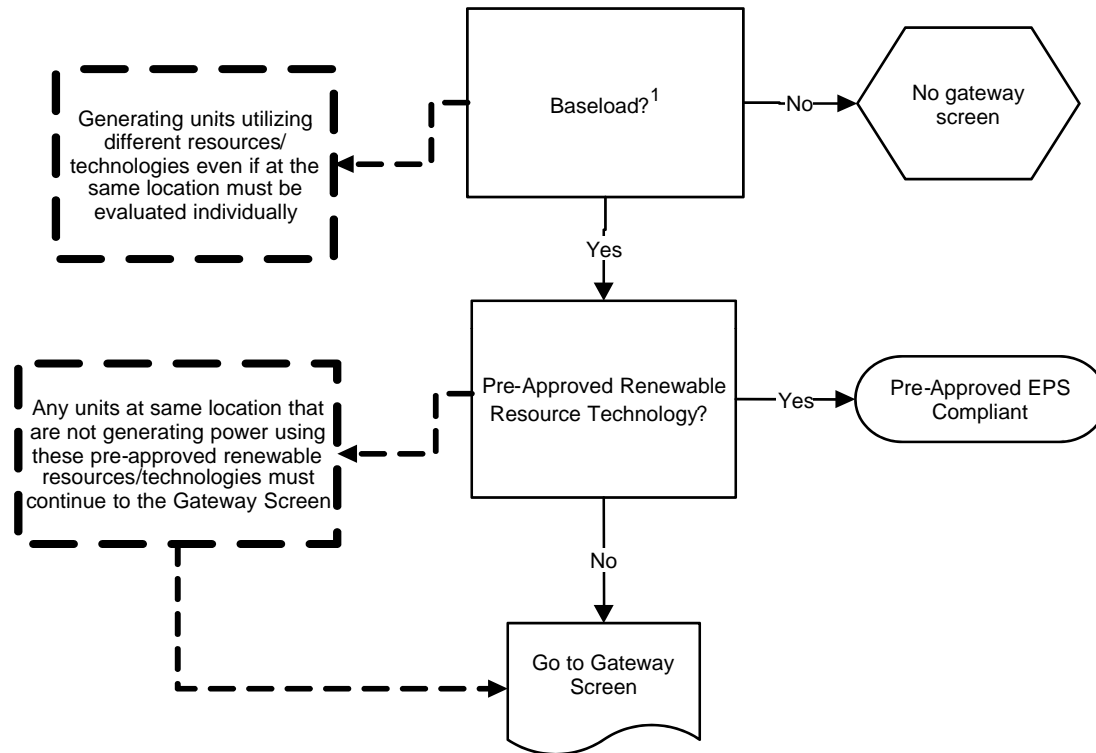
California's EPS—Flow Chart Illustrations

Flow Chart of California GHG Emissions Performance Standard



“LSE” = load-serving entity

Chart #1 LSE Investment in New Power Plant (New Construction)



¹ Is the investment being made to a generating facility designed and intended to provide electricity at an annualized capacity factor of 60% or greater?

Chart #2
LSE Acquisition of New or Additional
Ownership Interest in Existing Baseload
Powerplant Previously Owned by Others

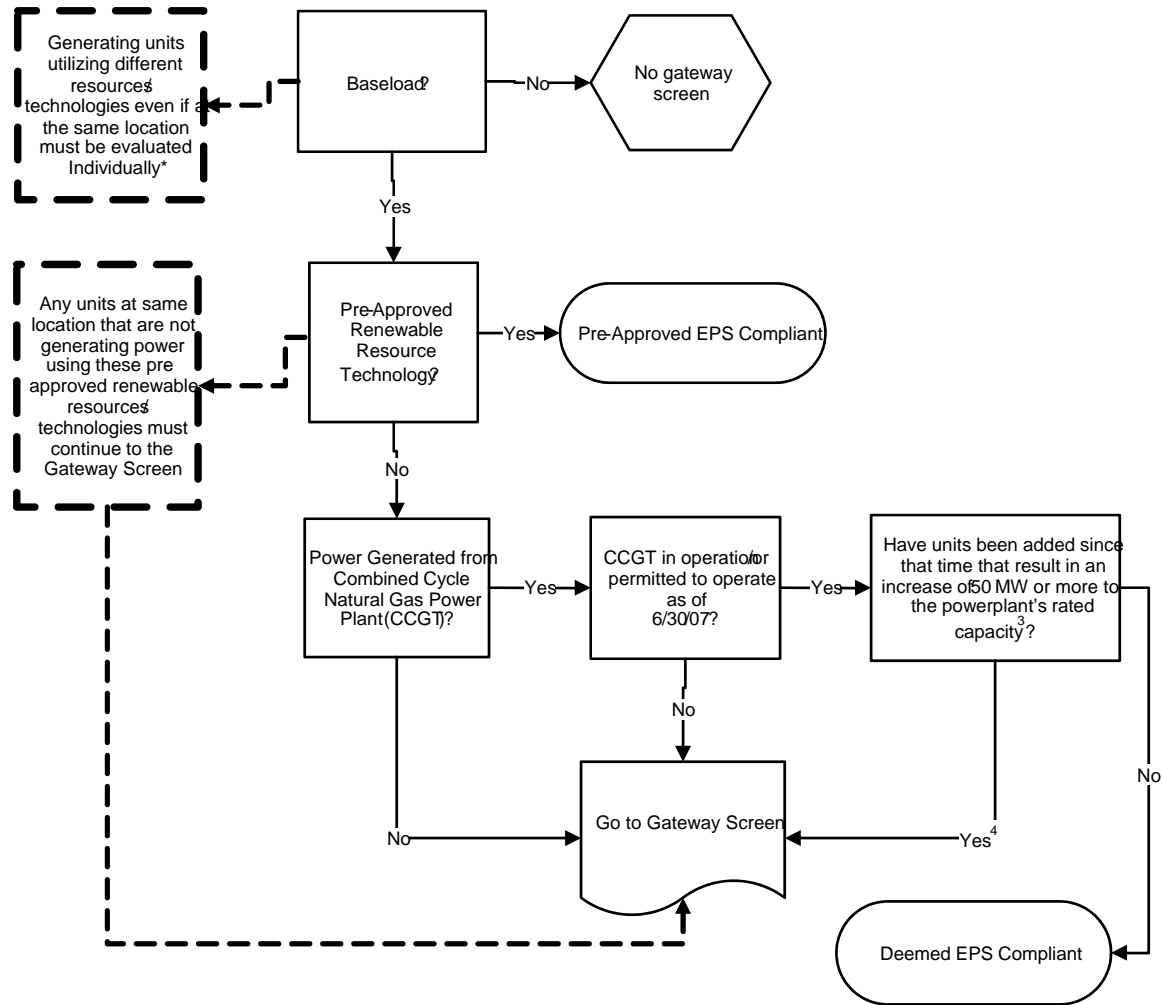


Chart #3
LSE New Investment in its Own
Existing Powerplant
(Alterations to Retained Generation)

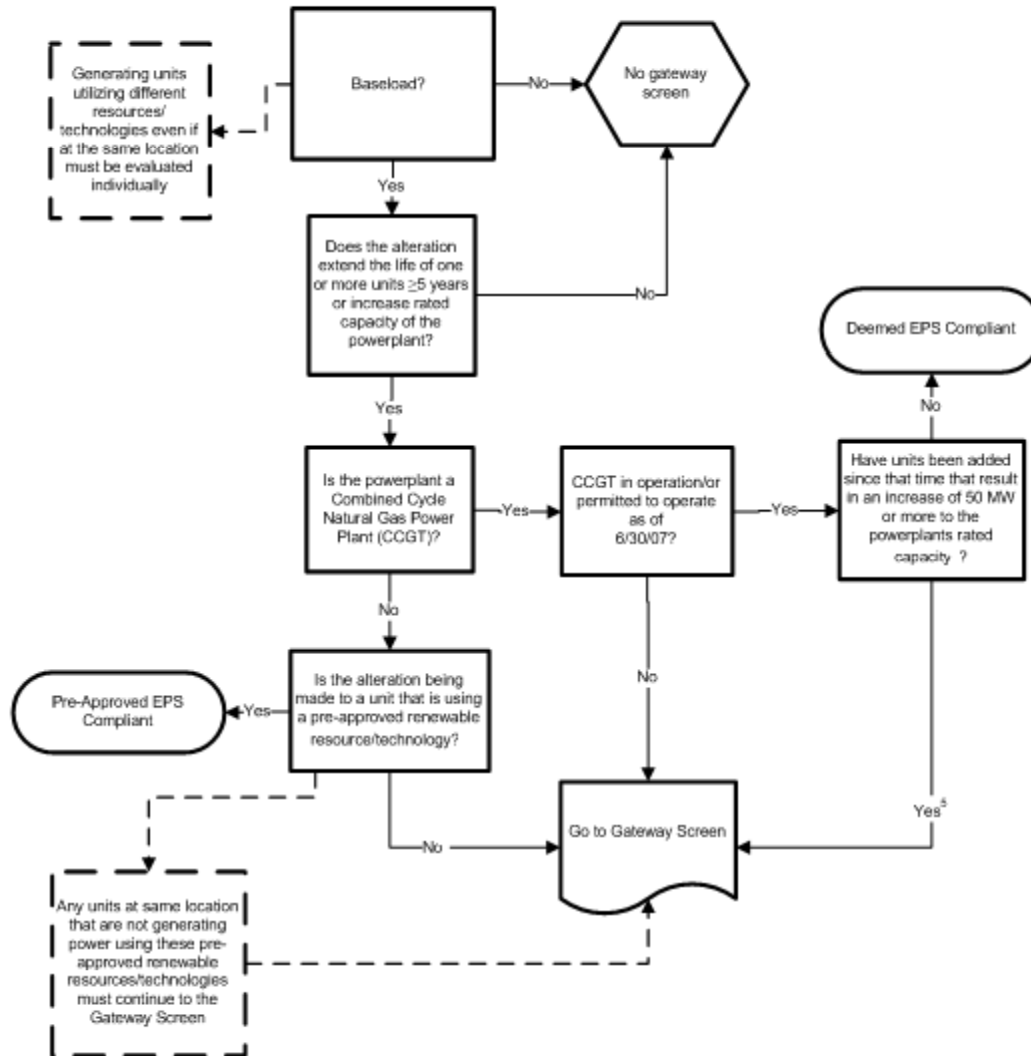
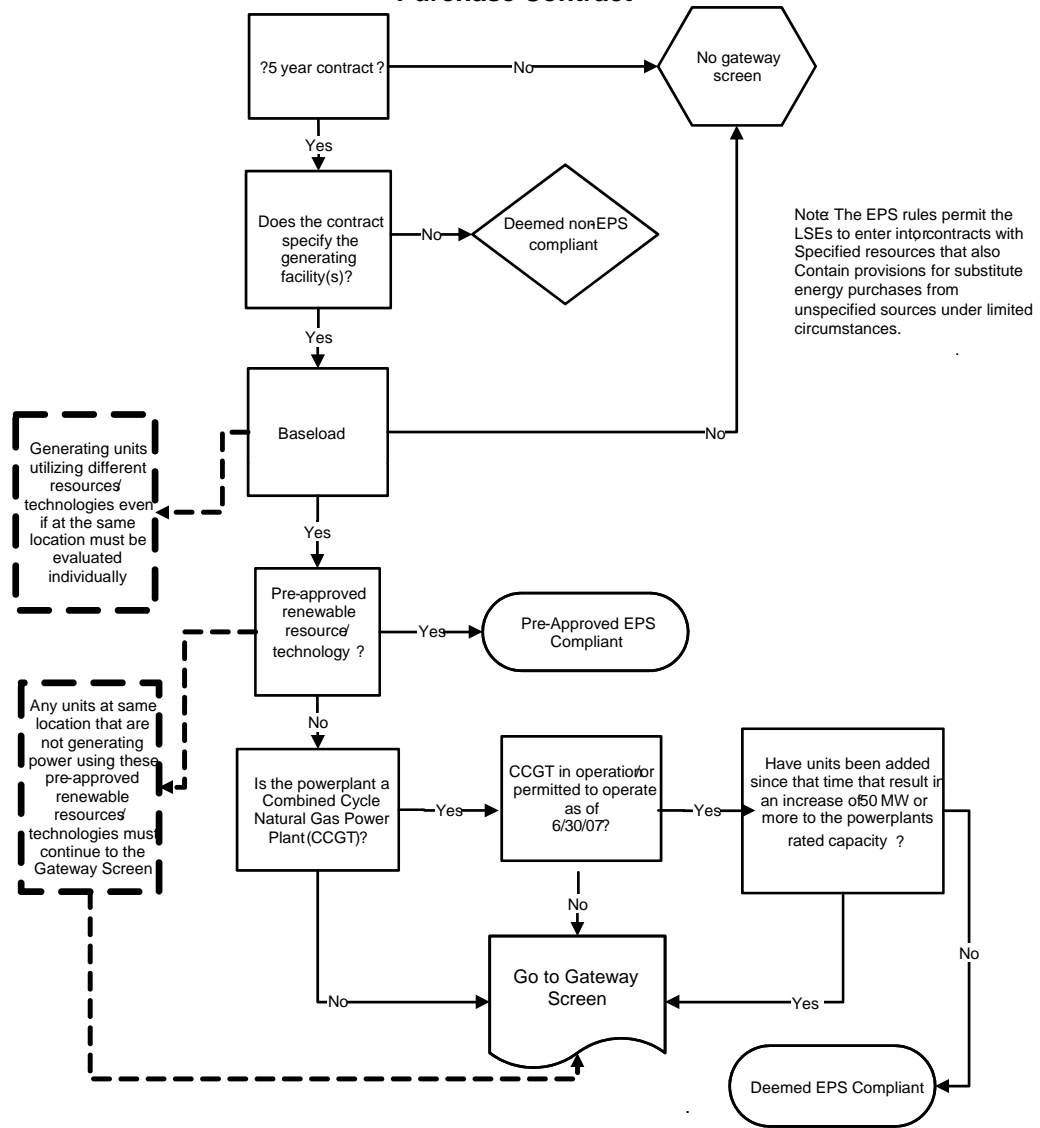
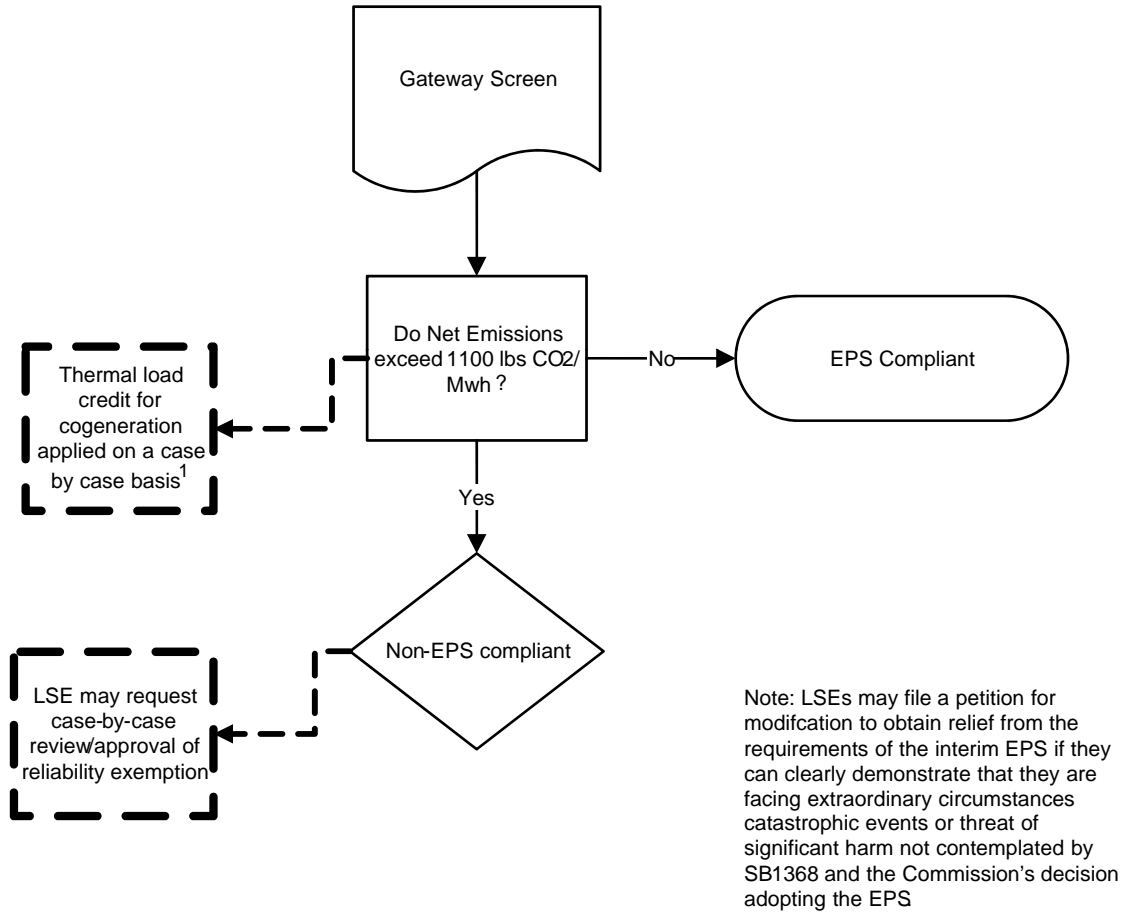


Chart #4
LSE New or Renewal Power
Purchase Contract



EPS Gateway Screen



¹ Credit will be calculated using Commission adopted methodology.



Examples of EPS Language on “Upgrades



Examples of EPS Language: “Upgrades” to Existing Plant

Washington State:

“Upgrade” means any modification made for the primary purpose of increasing the electric generation capacity of a[n] ... electric generating facility. “Upgrade” does not include routine or necessary maintenance, installation of emission control equipment, installation replacement, or modification of equipment that improves the heat rate of the facility, or installation, replacement, or modification of equipment for the primary purpose of maintaining reliable generation output capability that does not increase the heat input or fuel usage as specified in existing generation air quality permits as of the effective date of this section, but may result in incidental increases in generation capacity.”



Examples of EPS Language: “Upgrades” to Existing Plant

California:

- For “grand-fathered” existing CCGTs, the EPS has to be met for any units added to [baseload] powerplants that “result in an increase of 50 MWs or more to the powerplant’s rated capacity;
- For new investments in the LSE’s own existing (non-CCGT) baseload powerplants that:
 - 1) are designed and intended to extend the life of one or more units by five years or more;
 - 2) result in a net increase in the rated capacity of the powerplant, or
 - 3) are designed and intended to convert a non-baseload powerplant to a baseload powerplant



Considering Biomass-Fueled Plants in an EPS Rule

Biomass-Fueled Power Plants



- Net impact on GHG emissions varies greatly depending upon how generating plant is “fueled”
 - With waste biomass
 - With biomass grown for plant fuel
- Generating plant that utilizes waste biomass fuel *actually leads to a net reduction in GHG emissions by trading off methane gas for CO₂ emissions*
- EPS size threshold will matter for biomass-fueled plants. Few will be built >300 MW

Biomass-Fueled Power Plants (cont.)



- CA's EPS takes into account net emissions for the full "life cycle" (including growing and processing of biomass fuels)
- In EU:
 - Biomass is currently exempt from trading scheme and falls under renewable directive and feed-in tariffs adopted in member states
 - Will future requirements/standards be developed regarding sustainability of fuel?



Existing and Proposed EPS Language for the European Union



EPS Language For The EU— What's Currently in Place

“CCS-ready” provisions adopted December 2008 by
European Parliament (Article 34 Amendment of Directive 2001/80/EC):

1. Member States shall ensure that operators of **all combustion plants with a rated electrical output of 300 megawatts or more** for which the original construction license or, in the absence of such a procedure, the original operating license is granted **after the entry into force of Directive XX/XX/EC of the European Parliament and of the Council**, have assessed whether the following conditions are met:
 - suitable storage sites are available;**
 - transportation facilities are technically and economically feasible;**
 - it is technically and economically feasible to retrofit for CO₂ capture.**
2. If the conditions in paragraph 1 are met, the competent authority **shall ensure that suitable space on the installation site for the equipment necessary to capture and compress CO₂ is set aside**. The competent authority shall determine whether the conditions are met on the basis of the assessment referred to in paragraph 1 and other available information, particularly concerning the protection for the environment and human health.



Proposed EPS Language For The EU

Version #1 (Environment Committee-Oct 7, 2008):

Member states shall ensure that **from 1 January 2015** the **operating permit for all electricity-generating large combustion installations with capacity greater than 300 MW** granted a construction permit or, in the absence of such a procedure, granted an original operating permit after 1 January 2015 include conditions requiring **compliance with an emission performance standard of 500 g CO₂/kWh**.

By 31 December 2014, the Commission shall conduct a review of the provisions of this Article. The review shall consider in particular the **emission performance standard** referred to in paragraph 1, the **possibility of widening the scope** to include existing installations and installations other than those generating electricity, and the **possibility of introducing derogations to address the concerns of Member States that may be unable to comply** with the requirement referred to in paragraph 1. The review shall **include participation of all relevant stakeholders** and, on its conclusions, the Commission shall bring forward appropriate proposals.”



Proposed EPS Language For The EU (continued)

Version # 2: Amendment to Proposed Industrial Emissions Directive (December 2008)

1. **From 1 January 2010**, all permits for **electricity-generating large combustion installations with a capacity of more than 300 megawatts** that are **granted a construction permit, or in the absence of such a procedure granted the original operating permit**, on or after 1 January 2010 shall include conditions requiring compliance with an **emission limit value to air of 450 grams of carbon dioxide per kilowatt hour of electrical output**.
2. **By 1 January 2025** all permits for **electricity-generating large combustion installations with a capacity of more than 300 megawatts other than those installations covered by paragraph 1** shall include conditions requiring compliance with an **emission limit value to air of 450 grams of carbon dioxide per kilowatt hour of electrical output**.



Proposed EPS Language for the EU (continued)

Amendment to Proposed Industrial Emissions Directive (continued):

3. The emission limit value referred to in paragraphs 1 & 2 shall be **verified on an annual basis by the competent national authority.**

4. **By 30 June 2014, the Commission shall review the provisions of this Article** taking into account overall progress in reducing greenhouse gas emissions and the potential contribution of appropriate abatement techniques. The review shall **consider in particular lowering the emission limit value** referred to in paragraphs 1 and 2, **bringing forward the date referred to in paragraph 2 or introducing a phased approach**, and **widening the scope of application to include large combustion installations other than those in the electricity sector.** On conclusion of the review, the Commission shall where appropriate bring forward proposals.”

Preliminary Observations Specific to European Union



Under an EU-Wide Mandatory EPS

Degree of leakage risk appears relatively limited (but is there potential leakage anyway?)

- EU grid is not integrated with Russia
- Norway is not inclined to build coal-fired plants
- Switzerland is land-locked without indigenous coal supplies
- Although Spain is linked to Morocco (which has coal plants)
 - Grid infrastructure is limited
 - Unlikely to permit substantial sales into Europe



Under a Voluntary or Geographically Limited EPS in EU

Degree of leakage risk could be high:

- Depending on level of imported power needed to meet in-region demand for power
 - Note: UK is an “isolated” region (imports of electric power ~2%), unlike other regions of the EU
- Where imports can come from and emissions profile of that power
- **Cost of leakage under EU’s cap and trade program depends on:**
 - Absolute level of cap (21% reductions for ETS sectors by 2020 relative to 2005)
 - Resulting market prices for carbon allowances and offsets

Type of Facilities Subject to an EU EPS?

This issue may still be on the table:

- New facilities only

- October 2008 Amendment proposed by the EU's Environmental Committee

- Also Existing Facilities

- December 2008 Amendment proposed for EU Directive on Industrial Emissions

Results of ECF Study Scenarios for EU



- GHG reductions remain below 7% in the timeframe between 2005 and 2030 if only new installations are covered by the EPS
- Under scenario with EPS between 350 and 500 gCO₂/MWh, requiring compliance of existing facilities by 2020 increased emission reductions by up to 17% over the base case (new installations required to meet the standard by 2010)

Does a Facility Threshold Make Sense for the EU?



- Capacity Factor Threshold does NOT appear applicable
 - Most member states dispatch coal plants to follow load and as peaking plants (depending on fuel mix and price of coal versus gas)

Is a 300 MW Size Threshold Reasonable?



➤ Appeared in:

- October 2008 Amendment proposed by the EU's Environmental Committee
- December 2008 Amendment proposed for the EU Directive on Industrial Emissions



Quantitative Analysis for EU

ECF Study for the EU finds that:

- 70% of reduction potential lies with installations >300 MW capacity
- For scenario that includes new and existing facilities with EPS of 350 gCO₂/kWh:
 - Reducing size threshold from 300 MW to 100 MW improves emission reductions from 25.4% to 34.3% over the whole period (2005-2030)



Implications of Alternative EPS levels

- 500 gCO₂/kWh (1100 lbsCO₂/mwh)
 - Easily achieved by newly built natural gas plants (combined cycle gas turbines “CCGTs”)
 - Not likely to be met by older, less efficient existing gas-fired plants
 - Minimum of 30% co-firing of biomass or CCS necessary with oil, hard-coal, or lignite

Implications of Alternative EPS Levels (cont)



➤ 350 gCO₂/kWh

- Can be achieved by new, efficient plants using natural gas
 - (possible exceptions for cooling technologies, smaller-sized facilities, certain geographical locations)
- Minimum of 50% co-firing of biomass or CCS necessary with oil, hard-coal, or lignite

➤ 150 gCO₂/kWh

- Can only be achieved by using biomass or by combining fossil fuel use with CCS