# Equity versus cost-effectiveness in the Chinese ETS

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机组的CO_2排放配额计算公式为：
Quota calculation formula

机组供电CO_2配额
Quota for power supply

机组供热CO_2配额
Quota for heat supply

机组CO_2配额总量：
Total quota

$$A = A_e + A_h$$

$$= Q_e \times B_e \times F_l \times F_r + Q_h \times B_h$$

机组供电量
Power supply

供电排放基准
Emission baseline for power supply

机组供热量
Heat supply

供热排放基准
Emission baseline for heat supply

冷却方式修正系数
Correction factor of cooling mode

供热量修正系数
Correction factor of heating quantity

冷却方式修正系数：
Correction factor of cooling mode

　air cooling: 1.05

　water cooing: 1

供热量修正系数：
Correction factor of heating quantity

　1- 0.23× Heating ratio

Three ways to reduce carbon emissions in the power sector

- Reduce tCO2/MWh at individual facilities through improvements in heat rate.
- Shift generation from facilities with high tCO2/MWh to facilities with low tCO2/MWh.
  - Shift generation from older/smaller, less efficient coal plants to newer/larger, more efficient coal plants.
  - Shift generation from coal to gas plants.
  - Shift generation from fossil to renewables / nuclear.
- Reduce electricity consumption.

Carbon tax or cap-and-trade

Dirty coal, highest tax per MWh

Efficient coal, second-highest tax per MWh

Less efficient gas, third-highest tax per MWh

Efficient gas, lowest tax per MWh

Renewable, no tax per MWh

Carbon tax (or cap-and-trade) places the highest burden on the highest emission rate facilities.

It encourages shifting within and among different types of plants, always to lower emissions/MWh, at the lowest cost.

Also, in a competitive pricing market, creates incentives for electricity users to reduce usage based on emissions of the marginal generation facility.

Benchmark approach, with a single rate for <u>all generation</u>

Dirty coal, highest burden per MWh

Efficient coal, second-highest burden per MWh

Less efficient gas, third-highest burden per MWh

Efficient gas, lowest burden per MWh (net subsidy)

Renewable, no burden per MWh (net subsidy)

A single benchmark rate for all generation places the highest burden on the highest emission rate facilities.

It encourages shifting within and among different types of plants, always to lower emissions/MWh, at the lowest cost.

Benchmark approach is equivalent to a tax on emissions plus a subsidy on generation
This subsidy on generation reduces any incentive for end users to conserve electricity

Use of gas (or coal) coming into the plant requires permits, which have a market value and, therefore, act like a tax.

The plant is allocated permits based on the electricity produced by the plant and the benchmark rate. These have a market value and therefore act like a subsidy.

Different benchmarks for different plants.

Dirty coal, burden per MWh?

Efficient coal, burden per MWh?

Less efficient gas, burden per MWh?

Efficient gas, burden per MWh?

Renewable, burden per MWh?

With multiple benchmarks, some sources with higher emission rates can face a lower net burden than sources with lower emission rates

This no longer encourages cost-effective shifting within and among different types of plants in order lower emissions/MWh.

In extreme cases, emissions can even increase.

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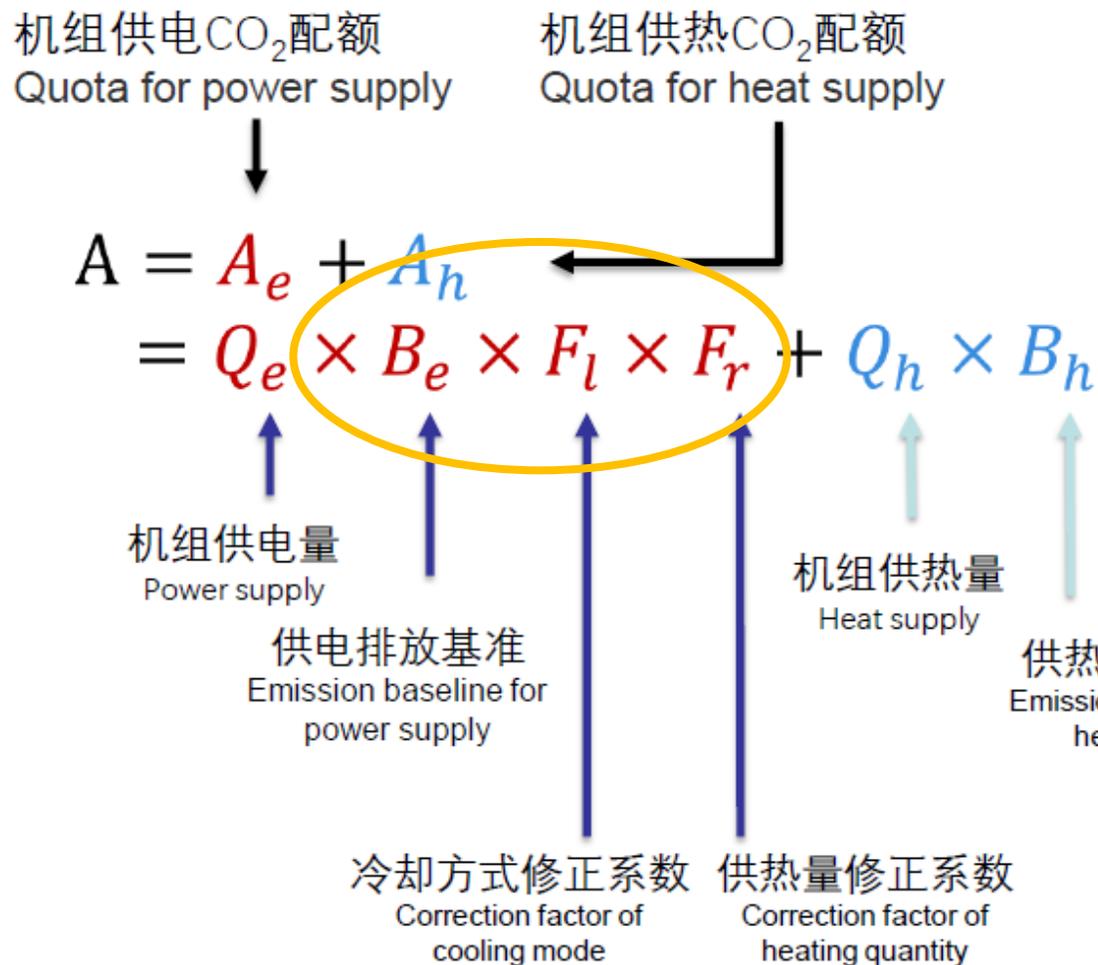
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Question:
With this differentiation, how much equity gain is achieved and how much does abatement cost rise and/or emissions increase?

Example of possible analysis: Do differentiated performance standards help coal? CO2 policy in the U.S. electricity sector
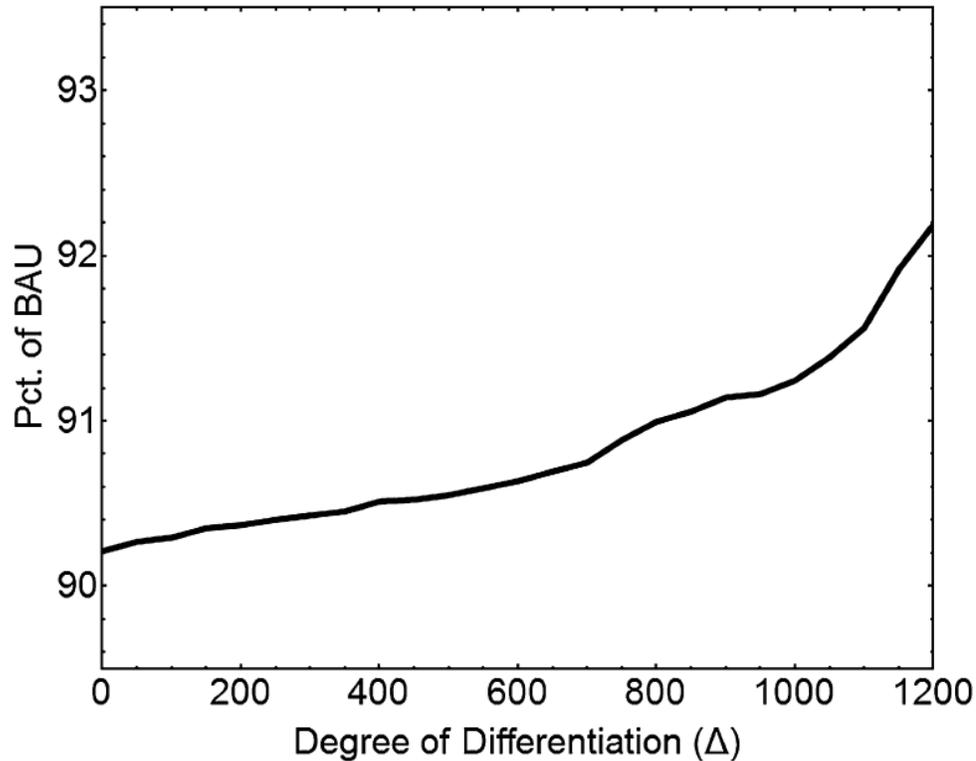
Fig. 2. Coal generation and usage with differentiation.
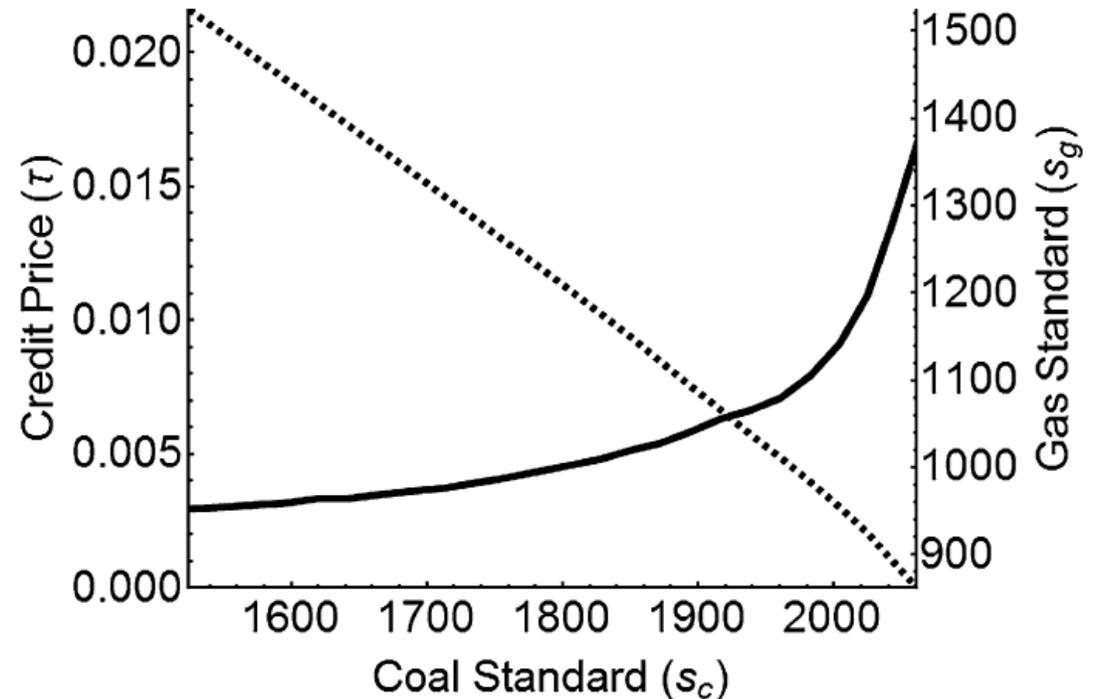
Fig. 6. Credit prices and gas standards as a function of the coal standard.

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