Marginal Abatement Costs and GHG Emissions Reduction Opportunities for Enterprises under the Hubei ETS

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CCAP
CENTER FOR CLEAN AIR POLICY

OUTLINE

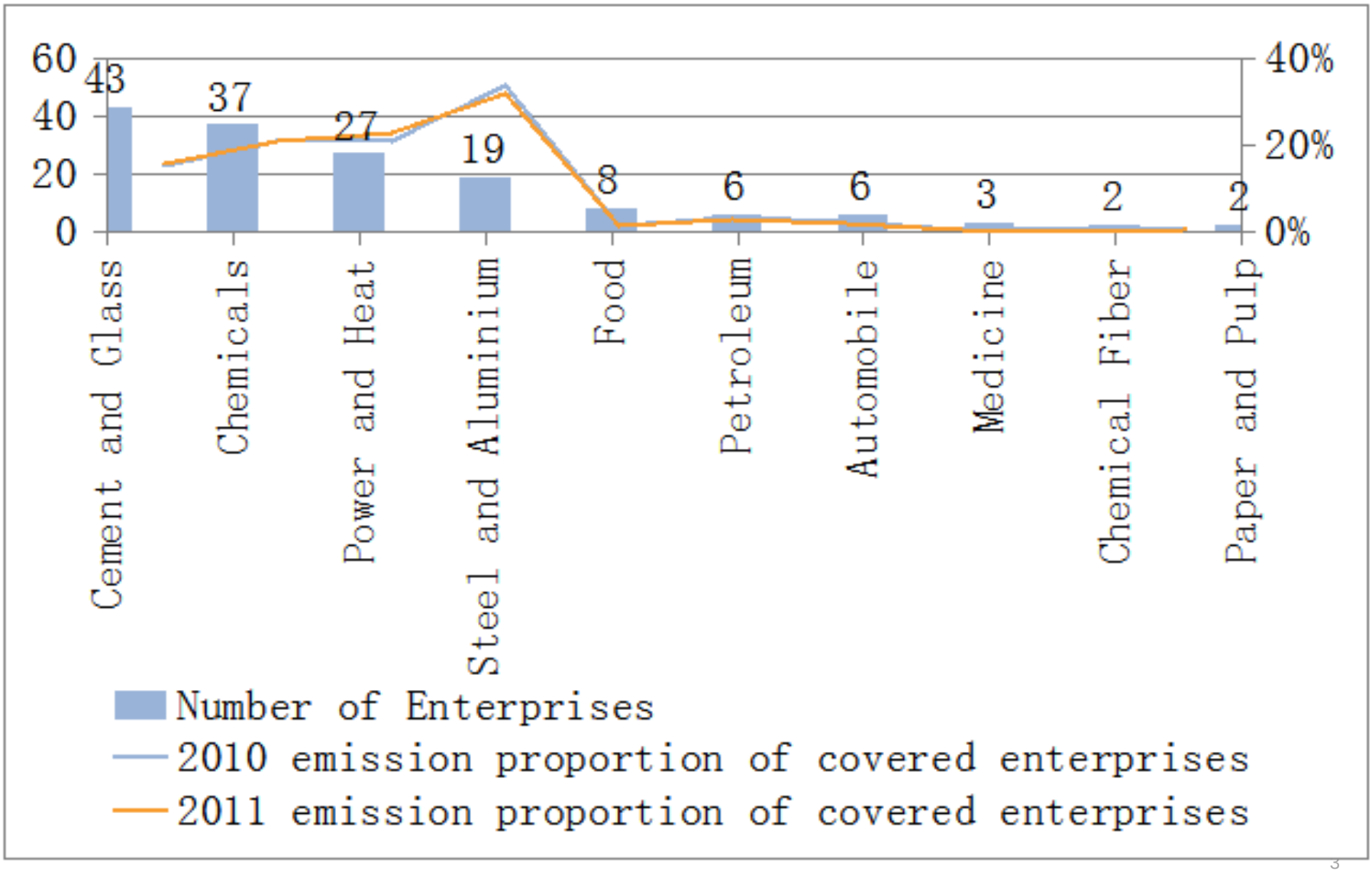
- Introduction to the joint research by Wuhan University and the Center for Clean Air Policy
- Marginal abatement costs for the energy intensive sectors
  - Examples in the power, chemical and cement sectors
- Using the Long-Range Energy Alternatives Planning System (LEAP) Tool to estimate future change in emissions and marginal abatements costs
- Integration of technology advancements
- Calculation of externalities and co-benefits
- Conclusions/Next steps

PART I: EVALUATION OF EMISSIONS

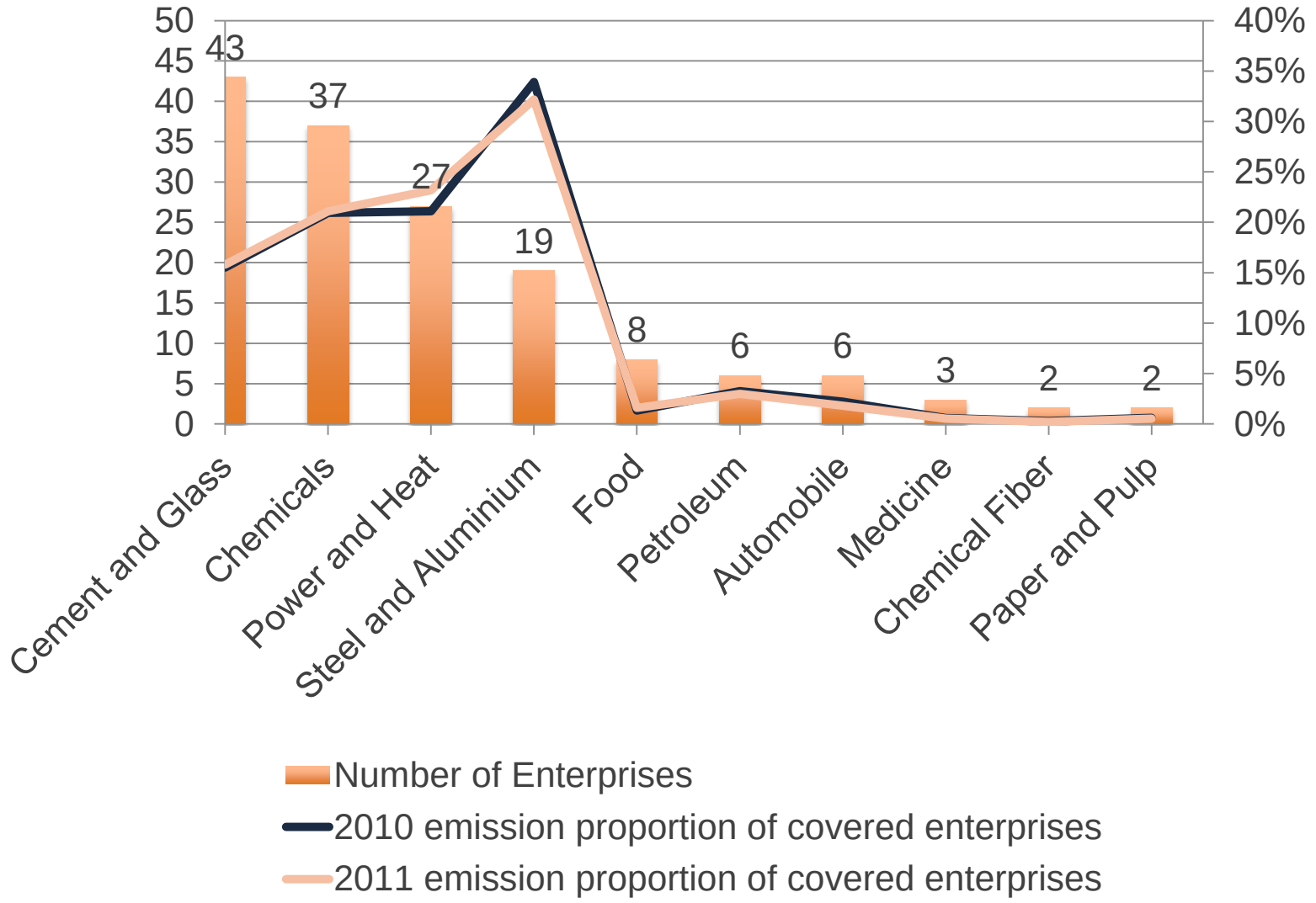
- Methodology
- Application in Hubei Province
- Historical analysis
- Top emitters

Image: Coal-fired power plants in Hubei

湖北ETS：行业和排放情况



HUBEI ETS: SECTORS AND EMISSIONS PORTFOLIO



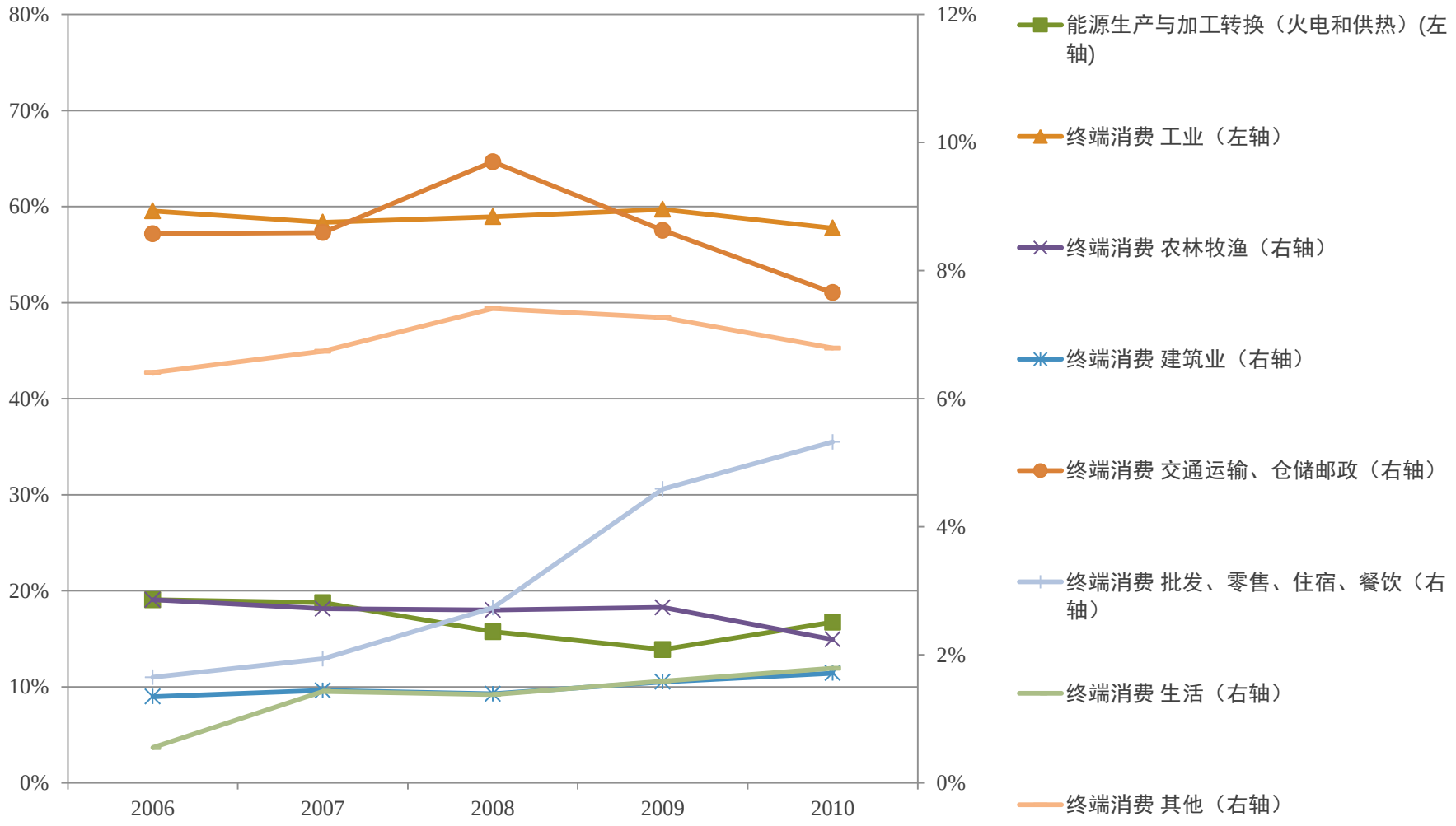
HUBEI PROVINCE CARBON EMISSIONS TRAJECTORY: 2006-2010

SOURCES OF ENERGY AND EMISSIONS

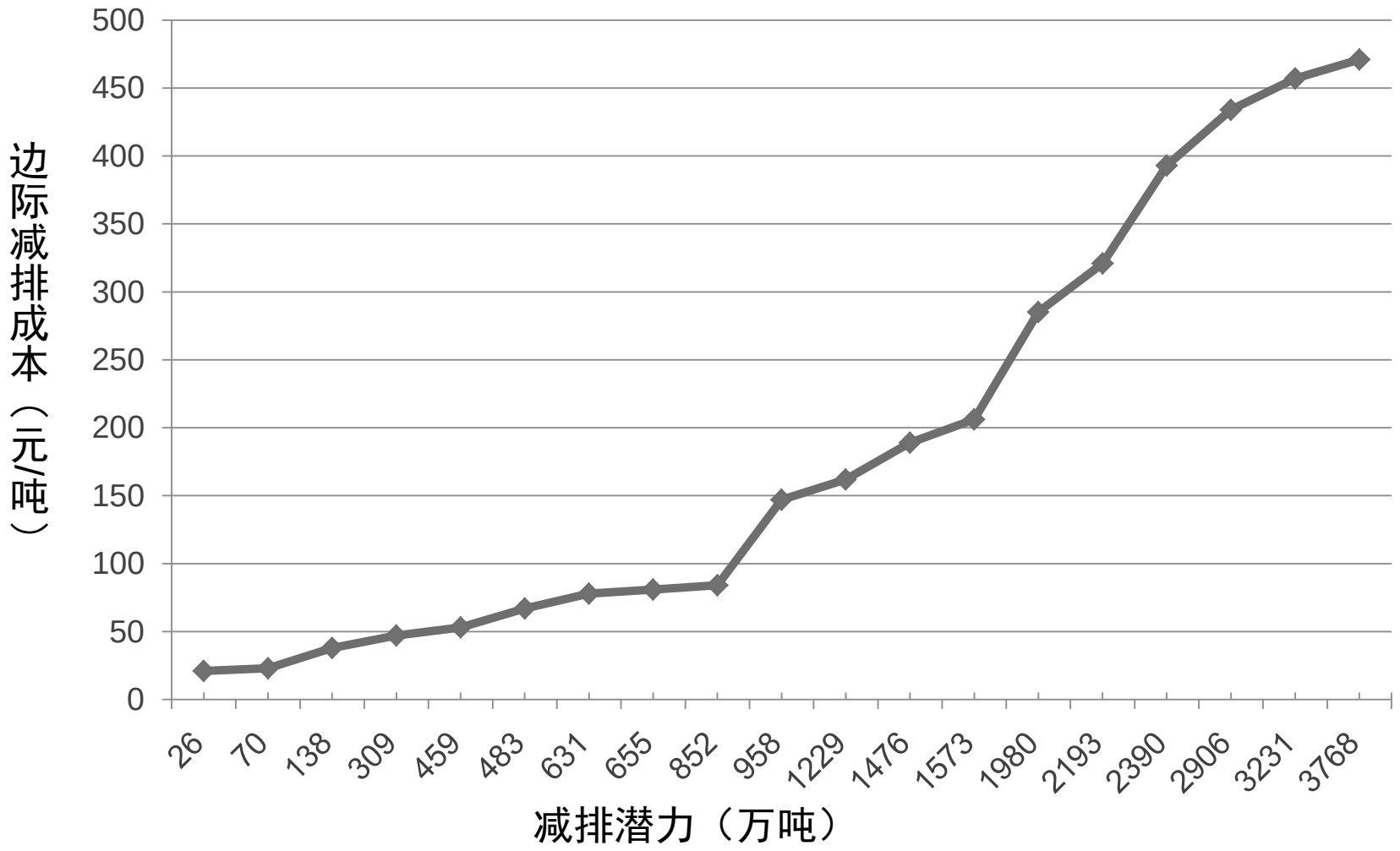
Primary sources of energy – energy from raw fuels extracted from natural environment that have not been subject to transformation, e.g. fossil fuels.

Secondary sources of energy – energy derived from the transformation/conversion of primary sources, e.g. heat, electricity, and petrol.

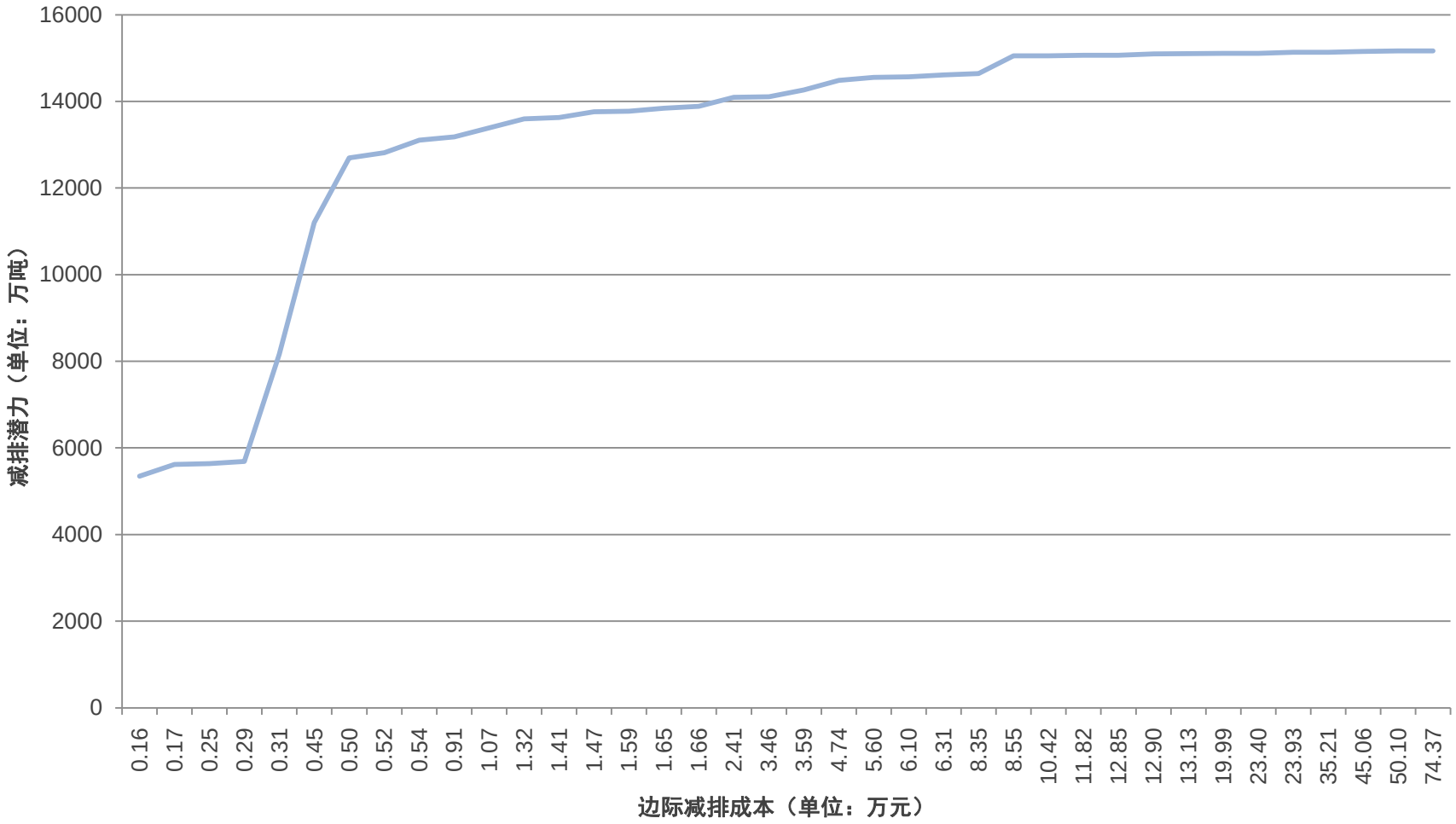
EMISSIONS COMPARISONS BY SECTOR



POWER INDUSTRY MARGINAL ABATEMENT COST CURVE



MARGINAL ABATEMENT COST CURVE: INDUSTRIAL SECTORS



PART II: LEAP MODEL & MEASURING COST OF EMISSIONS

- Introduction to the LEAP tool
- Technology Factor
- Calculating externalities
- Co-benefits from avoided emissions

LONG-RANGE ENERGY ALTERNATIVES PLANNING SYSTEM (LEAP)

- LEAP is a tool for energy policy analysis that is used to track energy consumption, production and resource use in all sectors of an economy.
- In this study we propose how LEAP can be used to forecast future marginal abatement costs in the industrial and power sectors in Hubei.

→ LEAP will forecast future energy consumption, production growth and change in emissions output based on the change in technology and the inclusion of a price on air pollutants.

LINKING THE DISTANCE FUNCTION MODEL AND LEAP TOOL

LEAP Tool

- LEAP tool is used to estimate data points (energy, economic, and environmental) under various scenarios (e.g. baseline, abatement, and time series scenarios)

Policy

- LEAP can be used to measure the costs of meeting a specific policy goal. In this case we evaluate the implementation of the Hubei ETS.

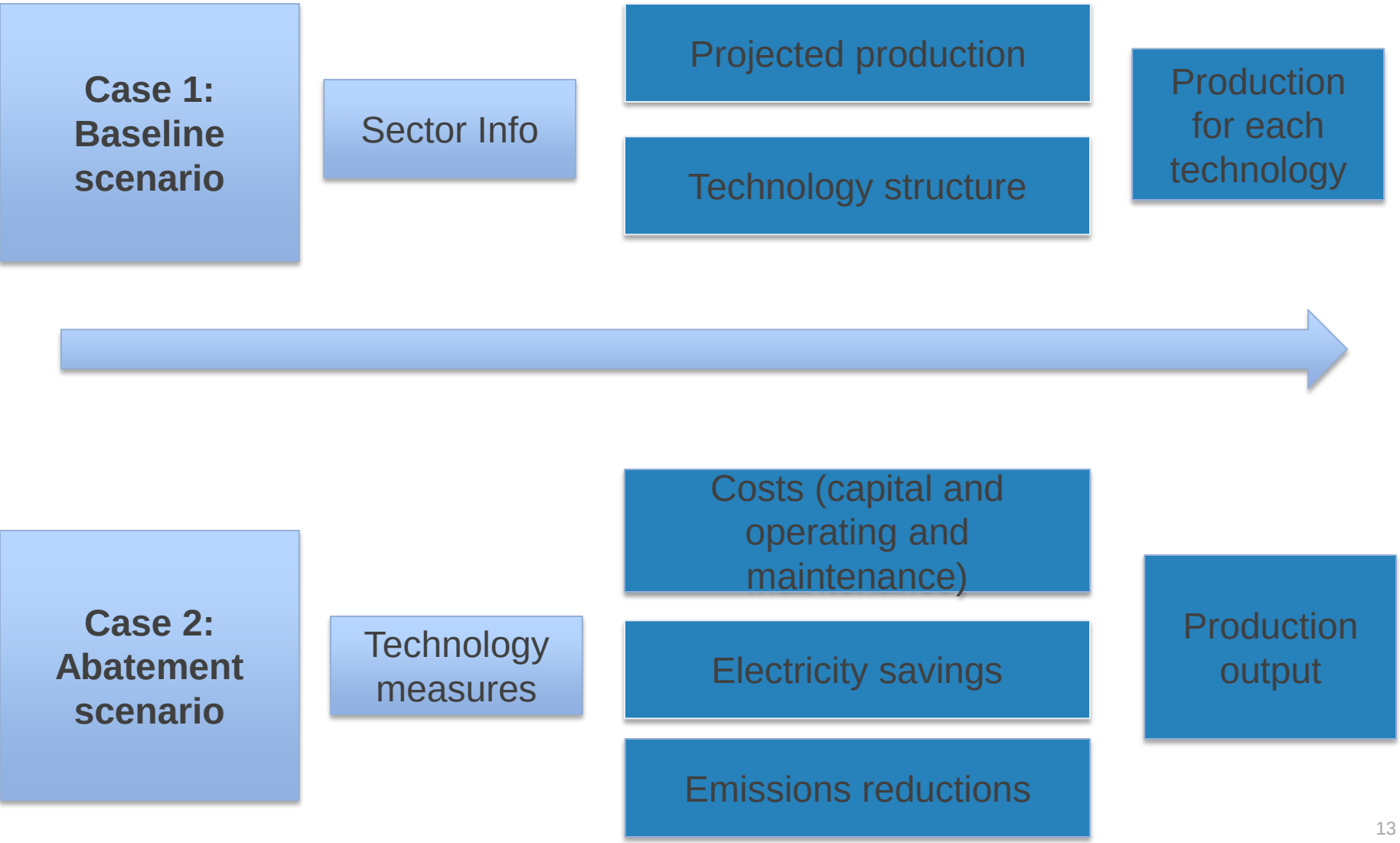
Technology Factor

- Based on technology factor and using capital cost (and operating/maintenance, and fuel costs) associated with technologies we import these numbers into LEAP

Distance Function Model

- The data points will be imported in the distance function model to estimate abatement and future scenarios in MACCs as applied to the power, chemicals and cement sectors

LEAP TOOL: BASELINE VS. ABATEMENT SCENARIO



TECHNOLOGY MITIGATION MEASURES

- The study will incorporate investment costs for a variety of mitigation options and technology advancements in sectors covered by the Hubei ETS

Sector Analysis Options:

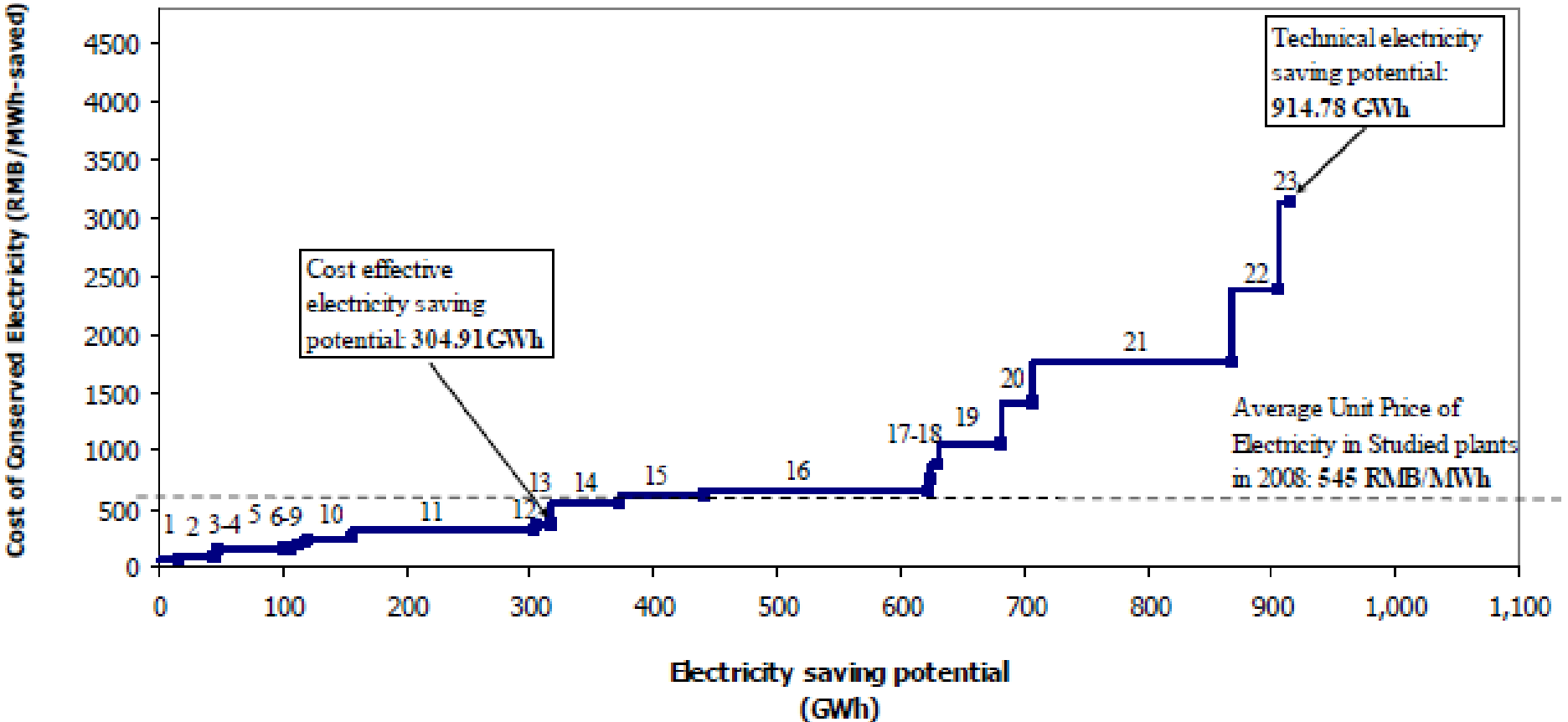
- **Power sector**: Circulating fluidized bed combustion (CFBC), Integrated Gasification Combined-Cycle (IGCC), combined heat and power (CHP), etc.
- **Cement sector**: process management and control, high-efficiency motors and drives, high-efficiency roller mills, high-efficiency powder classifiers, combustion system improvement, etc.

EXAMPLE IN THE CEMENT SECTOR: DATA COLLECTION NEEDS

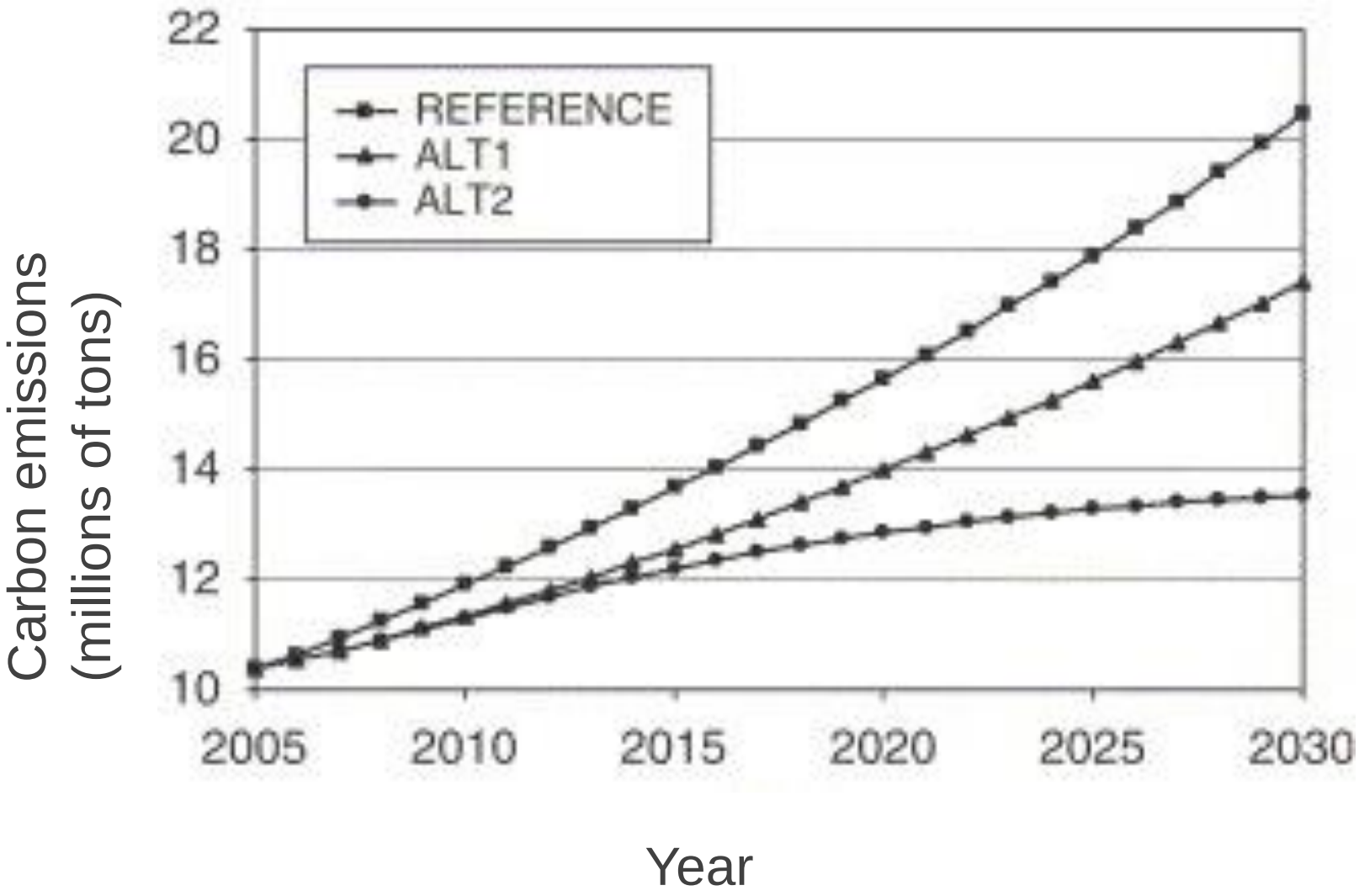
- Type of technology measure
- Production capacity per year
- Fuel savings (GJ/ton of clinker)
- Electricity savings (KWh/t-cl)
- Primary energy savings (GJ/t-cl)
- Capital Cost (RMB/t-cl)
- Change in annual operating & maintenance cost (RMB/t-cl)
- CO2 Emission Reductions(kg CO2/t-cl)

EXAMPLE IN THE CEMENT SECTOR: MEASURING THE IMPACT OF TECHNOLOGY

- An **energy savings supply curve** captures the technical and economic perspectives of energy conservation (for both fuel and electricity savings)
- 23 energy efficiency measures in the cement sector, including electricity savings and costs. EE measures are compared with the average unit price of electricity (545 RMB/MWh).



LEAP SCENARIOS (BASE CASE AND ALTERNATIVES)



VALUING EXTERNALITIES

- Negative externalities such as CO_2 are typically not valued → impacts the supply of emissions and distorts true costs of pollution

- Pricing emissions can positively influence the cost-effectiveness of energy savings potentials, such as the investment in energy efficiency and renewable energy technologies

- Government policies (such as an ETS) can encourage reduction in carbon emissions, and investments in energy efficient technologies

APPLICATION OF EXTERNALITIES IN THE LEAP TOOL

- In the LEAP we factor in the evaluation of negative externalities, by attaching a suggested price to emissions: CO_2, SO_2, NO_x and particulate matter.

- By internalizing the cost of polluting, LEAP can determine how this will impact the emissions trajectory with an emissions cap and technology advancements.

- Externalities and co-benefits can be measured through two approaches:
  - Cost-benefit analysis
  - Environmental impact analysis

COST BENEFIT ANALYSIS

- A cost-benefit model applies a comparison of a base case (business-as-usual) versus an abatement case.
- The abatement case is a comparison case ***with*** the ETS policy which places a market value on ton of CO_2 and includes the integration of technology.

Costs	**Benefits (measured incrementally)**
• Costs of technology (inclusion of discount rate) • Costs of operating and maintenance of technology	• increased energy efficiency = less investment in new generating plants • reduced electricity costs (evaluated by amount reduced and price of electricity) • less fossil fuels to be produced or imported • reduced emissions (due to less fuel combustion)

ENVIRONMENTAL IMPACT ANALYSIS

Methodology to Calculate Avoided Emissions

Step 1) Estimate reductions in energy consumption

Step 2) Estimate fuel and emissions factors. Air emissions factors will be associated with each fuel source and catalogued in Table 1

Step 3) Total emissions and reductions

Step 4) Quantify the value of avoided emissions based on market value associated to each air pollutant (e.g. market value of CO2 or SO2)

Step 5) The quantified value of avoided emissions will be impact the marginal abatement costs

Table 1: Air emissions factors measured by fuel or electricity intensity

Fuel or Electricity	CO2	NOX	SOX	PM

IMPORTANCE OF EVALUATING CO-BENEFITS

- By only measuring the impact of reduced CO_2 emissions this approach does not cover all externalities (including SO_2, NO_X, PM)
- A co-benefits analysis will quantify all potential co-benefits from reductions in energy use and assign a dollar value to the reduced (avoided emissions), which allows you to compare a policy or technology development's costs and benefits
- Makes technology advancements and mitigation options more economically attractive

谢谢！

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