

Internalisation of External Costs for Electricity Generation

Dr. Alberto Longo
Department of Economics and International Development
University of Bath
a.longo@bath.ac.uk
tel. +44 1225 384508

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dialogue with industry and NGO

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Overview of the presentation

1. Policy instruments available in the electricity market
 - A) Instruments to limit the external costs of the most damaging fuels
 - Command and control Instruments
 - Carbon tax/Energy tax
 - Tradable permits
 - Voluntary agreements
 - B) Instruments to stimulate the growth of renewable electricity
 - Investment Subsidies
 - Fiscal measures
 - Feed-in tariffs
 - Competitive bidding systems
 - Quota obligations / green certificates
 - Voluntary measures
3. Criteria for choosing the optimal policy instrument(s)

Command and Control: Technology-based

- The regulator specifies the methods and equipment that firms must use to meet the target.
- The positive element is that information on the best technology (provided by the regulator) is spread in the economy and all firms have access to it.
- This policy does not stimulate firms to increase research efforts towards new technologies because the latter are provided by the government.

Command and Control: Performance-based

- The regulator sets an overall target for each firm, or plant, and gives firms some discretion in how to meet the standard.
- Technology forcing standards demand a performance (energy consumption level, emission level) that is not feasible with the existing technology.
- The requirements induce firms to invest in developing innovative technologies.

=> little flexibility in meeting environmental standards

=> industries invest to meet the standard and then stop

Carbon Tax / Energy Tax

- Compulsory tax levied on fuels in accordance with their carbon content, with the aim to encourage using less carbon-intensive fuels and to reduce energy consumption.
- The objective of a carbon tax is to internalise the external cost of CO₂-pollution into the price of fossil fuels.
- Double purpose of collecting revenues and try to influence the behaviour of the economic agents.

Carbon Tax cont.

- A pollution tax is not specific, i.e. its revenues are not allocated to any special purpose but go to the general State budget.
- There would be significant variation in timing and size of the carbon taxes among countries and regions, given that the marginal cost of abating CO₂ emissions substantially differs across countries and over time.
- The autonomous (i.e. non-price-induced) energy efficiency improvement, the possibilities for fuel substitution, and the availability of backstop technologies are essential elements in determining the evolution of the tax rate over time.

Carbon Tax cont.

- The tax is part of the electricity price. The consumer, who is supposed to change his or her behaviour, will not be aware of it in a transparent way (Kunsch et al, 2004).
- If a tax is designed to *fully internalize* the external costs of electricity production, taxing the damaging fuels and technologies will result in a **substantial increase of energy prices**.
- Many countries have in fact only partially taxed carbon, and have partially been levied simply on energy.
- The UK, the Netherlands, Germany and Finland have an **energy tax**.
- Denmark, Sweden and Norway's taxes are closest to the theoretically ideal carbon tax.
- The introduction of carbon taxes has not always been successful (Italy).

Carbon/Energy Tax - Electricity

Country	Instrument	Rate €cent per kWh
UK	Climate Change Levy	0.62
Belgium	Cotisation sur l'energie	0.14
Sweden	Energy tax on electricity	2.00
Norway	Tax on consumption of electricity	1.19
The Netherlands	Regulatory Energy Tax	1.00 - 6.00
Germany	Duty on electricity	1.00

Source: Eurostat, IEA

Carbon Tax Rates

Country	Rate €/tonne CO2	Coverage/ exemptions
Denmark	16	Industry pays 50%, Different rates by fuel
Sweden	57.73	Industry pays 50%, other exemptions
Norway	12.80	Oil for transport and coal for industry exempt
Finland	17	50% relief for natural gas

Source: IEA Website:

<http://www.iea.org/textbase/pamsdb/search.aspx?mode=re>

Tradable Emissions permits

- Rights to discharge emissions that can be exchanged through a controlled permit-market
- Each permit represents a fixed quantity of allowed CO₂-emissions, typically 1 metric ton per permit (IEA, 2001). The number of permits in hands represents the total permitted emission quantity; a penalty is applied in case the actual emissions are in excess of this quantity.
- Permits could be allocated to companies on the basis of their historical output of emissions (grandfathering) or they could be auctioned.
- => flexible instrument
- => little experience
- => permits not only for CO₂, but also for NO_x and SO₂!

Example: The UK Emissions trading

- First GHG emissions trading system in Europe, with an initial lifespan of 5 years (2002-2006)
- Two main goals:
 - Provide flexibility to firms for complying with GHG abatement obligations
 - Establish the London financial market as the global location for environmental permit trading
- Two groups of potential participants:
- ‘Direct participants’: 32 firms who took part in the initial auction in 2002.
 - Cap-and-trade system.
 - The government subsidy was £215m.
 - Market clearing price was £53.37 per tonne of CO₂-equivalent.
- ‘Agreement participants’: 6000 firms covered by the Climate Change Agreements.
 - Baseline-and-credit system

Voluntary Agreements (VA)

- VA are commitments by the industry to decrease the level of emissions in exchange, for example, of a training programme for energy-efficient purchasing and an audit provided by the authority
- VA are the results of co-operation and negotiation between an authority and an industry and are intended to be followed by some form of contract
- However,
 - => VA do not result in significant effects on the environment
 - => VA may hide a low ambition of the objective itself
 - => VA only contain a pollution program which follows a natural trend, a business as usual trend
 - => VA are often suspected to promote collusive practices between participating firms
 - => VA can never replace legislated regulations or other more conventional policy instruments

Example: Climate Change Agreements in the UK

- 43 industry organisations (representing 6000 companies) have negotiated CCA with the environment department (DEFRA)
- Companies gain an 80% discount from the Climate Change Levy
- 38 agreements are for improvements in energy efficiency
- 4 agreements have specified absolute targets for reduced energy use
- 1 agreement for the aluminium industry sets a target for emissions, relative to output
- The agreements specify obligations for the sector as a whole and translate these obligations into targets for each individual firm
- Failure to meet the targets carries a penalty in the form of the loss of the 80% Climate Change Levy discount

Policies for renewables:

Investment subsidies

- Investment subsidies can help a high initial investment.
- Usually range is 20 – 50% of eligible investment costs, however within the limitations of the Community guidelines on State aid for environmental protection
- The New Opportunities Fund under the National Lottery Act (UK)
 - Targeted technology: Biomass
 - 40% of total investment costs, subject to budget availability
- Aid programme to support Solar Photovoltaic Energy (SPAIN)
 - Targeted technology: Solar PV
 - Maximum subsidy is between 40 – 50% of the total investment costs

Policies for renewables: Fiscal Measures

- Rebates on general energy taxes
- Rebates from special emission taxes
- Proposals for lower VAT rates
- Tax exemption for green funds
- Fiscal attractive depreciation schemes
- Fiscal measures must be in line with the Community guidelines on State aid for environmental protection
- Regulatory Energy Tax (NL)
 - Targeted technology: All renewable technologies
 - Energy levy on electricity and gas consumption by small and medium size customers. Energy from renewables is exempt.
 - The proceeds from the tax can be used by suppliers as a premium tariff for renewable energy producers.

Policies for renewables:

Feed in Tariffs

- Minimum guaranteed price per unit of renewable electricity produced to be paid to the producer
- Premium in addition to market electricity prices
- The level of the tariff is normally set for about 15 years
- Producers of green electricity are encouraged to exploit all available generating sites until the marginal cost of producing green electricity equalises the proposed feed-in tariff price.
- Price instrument

- Erneuerbare Energie Gesetz – EEG (Germany)
 - Targeted technology: Wind, PV, geothermal, small hydro
 - Utilities have the obligation to purchase the electricity produced from RES.
 - The grid operator whose grid is closest to the location of the RES installation has the obligation to pay the tariffs

Policies for renewables:

Competitive bidding processes

- The regulator defines a reserved market for a given amount of renewable energy and organises a competition between renewable producers to allocate this amount.
- Electric utilities are then obliged to purchase the electricity from the selected power producers.
- Competition focuses on the price per kWh proposed during the bidding process.
- Proposals are classified in increasing order of cost until the amount to be contracted is reached.
- Each of the renewable energy generators selected is awarded a long term contract to supply electricity at the pay-as-bid price.
- The implicit subsidies attributed to each generator correspond to the difference between the bid price and the wholesale market price.
- Quantity instrument

Competitive bidding system: Greece

- AER (since 1994)
- Targeted technology: Biomass (including CHP), hydropower, onshore and offshore wind
- Characteristics of AER VI, February 2003:
 - Size of the tender is 578 MW subdivided in technology bands:
 - Price caps in each category are:
 - Large scale wind (400MW): 5.216 ct/kWh
 - Small scale wind (85MW): 5.742 ct/kWh
 - Offshore wind (50MW): 8.4 ct/kWh (indicative price cap)
 - Hydro (5MW): 7.018 ct/kWh
 - Biomass (8MW): 6.412 ct/kWh
 - Biomass Anaerobic digestion (2MW): 7 ct/kWh
 - Biomass CHP (28MW): 7 ct/kWh

Policies for renewables:

green renewable certificates (quota obligations)

- The regulator imposes a quota as a percentage of the total electricity production, which has to come from renewable sources.
- Wholesalers, distributors or retailers of electricity are liable to respect the quota.
- To give them more flexibility and compensate for missing green kWh, they can purchase green certificates from the green electricity producers.
- The price of green certificates will be close to the difference in price between renewable electricity and classical electricity. The additional revenues for the producers will compensate them for this difference in price.
- Distributors, which do not achieve the quota imposed by the regulator, will have to pay penalties.

Green renewable certificates: Italy – Law 79/99

- Targeted technology: all RES
- All electricity producers or importers should feed the grid with at least 2% of electricity from renewable resources
- This obligation refers to those who produced or imported an amount of electricity from non-renewable sources exceeding 100 GWh/y, net of co-generation, power station self-consumption and exports.
- In order to meet this annual threshold, interested operators are required to file green certificates with the Transmission System Operator.

Voluntary Measures: green electricity purchasers

- The diffusion of renewable energies cannot be assured spontaneously by the market, unless it is cost effective.
- But there is now some evidence that certain groups may buy some goods that are more expensive, because they have some public good benefits.
- The arrangements under a liberalised electricity market which enables consumers who want to pay for this environmental good to purchase green electricity directly from a supplier, is one response to this demand. This solution can provide insight into the preferences of consumers and their willingness to pay for renewables.

Experience with green electricity purchasers

- The problem of free-riding remains a very real one.
- The proportion of green electricity purchasers is low, around 2–3%, except with incentives in the form of tax exemptions for electricity consumers.
- In the Netherlands in 2001, 8% of consumers opted to buy green electricity, but with a tax incentive of 0.06 euros/kWh.
- This percentage may be increased by information campaigns, education, formation and training can help to increase the acceptance of renewable energies.

Generation disclosure rules

- “Disclosure” = the requirement that utilities provide their customers with additional information about the energy they are supplying (fuel mix percentages and emissions statistics.)
- “Certification” = the assessment of green power offerings to assure that they are indeed utilizing the type and amount of renewable energy as advertised.
- Both disclosure and certification are designed to help consumers make informed decisions about the energy and supplier they choose. Indeed, disclosure is often thought of as a good policy to help **educate customers** about electricity and thereby to prepare markets in advance of retail competition.

Criteria for choosing the policy instruments

- Efficiency
- Cost minimization
- Equity
- Technological innovation
- Energy security
- Feasibility
- Impact on the job market
- Uncertainty
- Site location

Efficiency

- Economic instruments, such as subsidies (tradable green certificates, feed-in tariffs, competitive bidding designs), taxes, emission permits should guarantee the best outcome in terms of efficiency and flexibility.
- Among subsidies, tradable green certificates seem to be the most appropriate (Menanteau et al., 2003)
- The efficiency of voluntary agreements is questionable: it depends on the agreement

Cost minimization

- Command and control instruments impose costs of monitoring and enforcing
- Subsidies have a fiscal and welfare cost of their own
- Tradable green certificates and emission permits require a minimum of state involvement for the setup of the market
- Voluntary agreements are time consuming

Equity

- Polluter pays principle, but who is the polluter?
- Increase in electricity prices that consumers pay (not income related)?

Technological innovation

- The optimal instrument(s) should remove imperfections in the systems of innovations
- Economic instruments should generate a dynamically efficient pattern of incentives on corporate and consumer behaviour
- The effect on prices and quantities are different according to the type of instrument => implications for energy security
- Some researchers consider command and control instruments in a rather positive way: if the regulator is able to identify a best-practice environmentally friendly technology

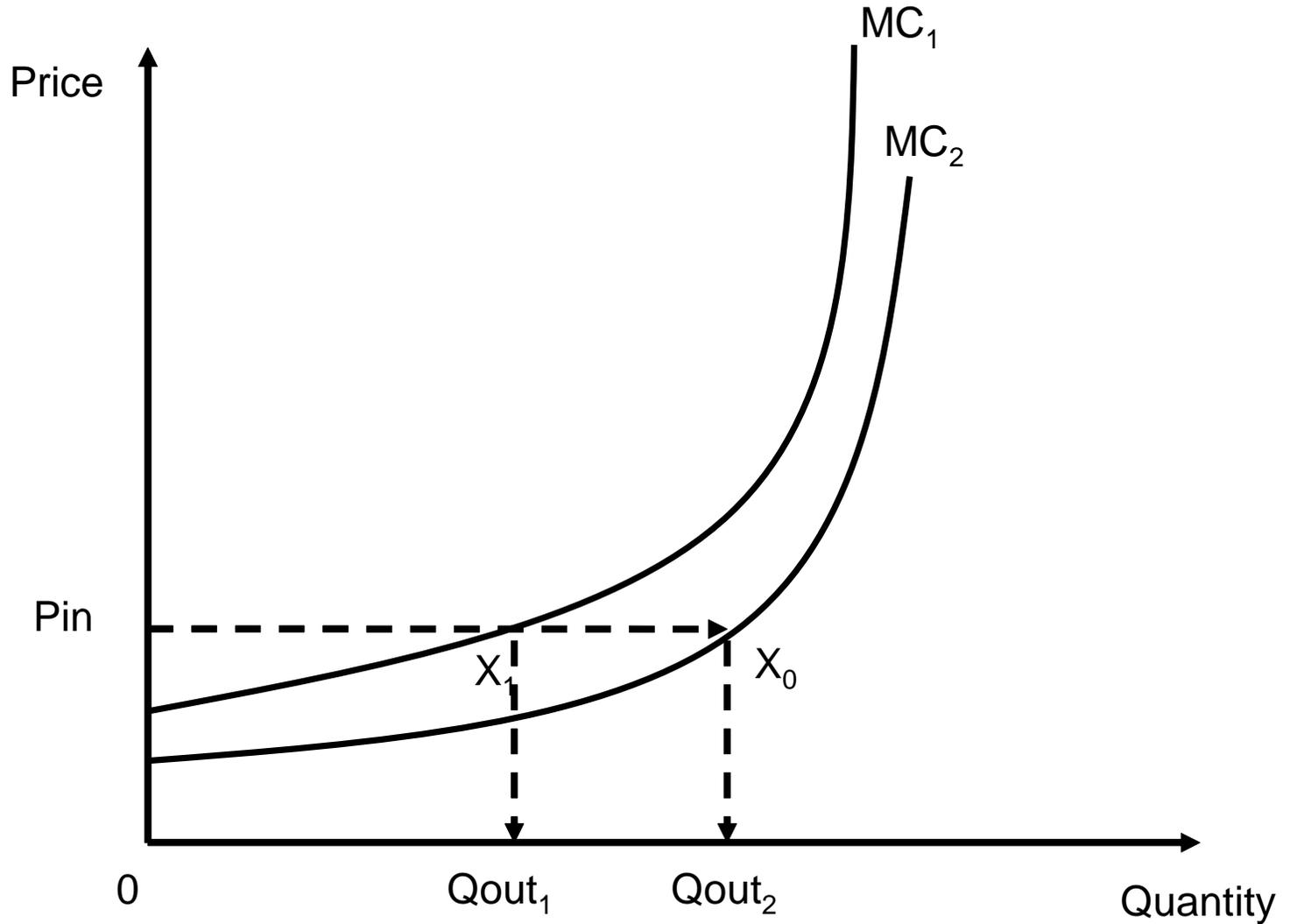
Energy security

- Policy makers should also consider how instruments affect the security of energy supply and how the liberalization of markets will influence the applicability of each instrument.
- These concerns should especially take into consideration the rising level of the demand for energy.
- This means that it might be important to focus more on instruments that can stimulate the increase in the production of green electricity, rather than instruments that affect the price of green electricity.
- In terms of overall dependence on foreign supplies of fossil fuels, the move to renewable sources has a positive impact (i.e. it reduced dependence). In terms of overall reliability of supply of the electricity system, however, the position may be more complex and more work is needed on that.

Conclusions

- Several instruments are available
- Politically difficult to have a EU-wide carbon tax
- Subsidies seem an appropriate set of instruments, however
 - Equity issues
 - Energy security
 - ...
- Further work is needed in the identification of optimal instrument(s)

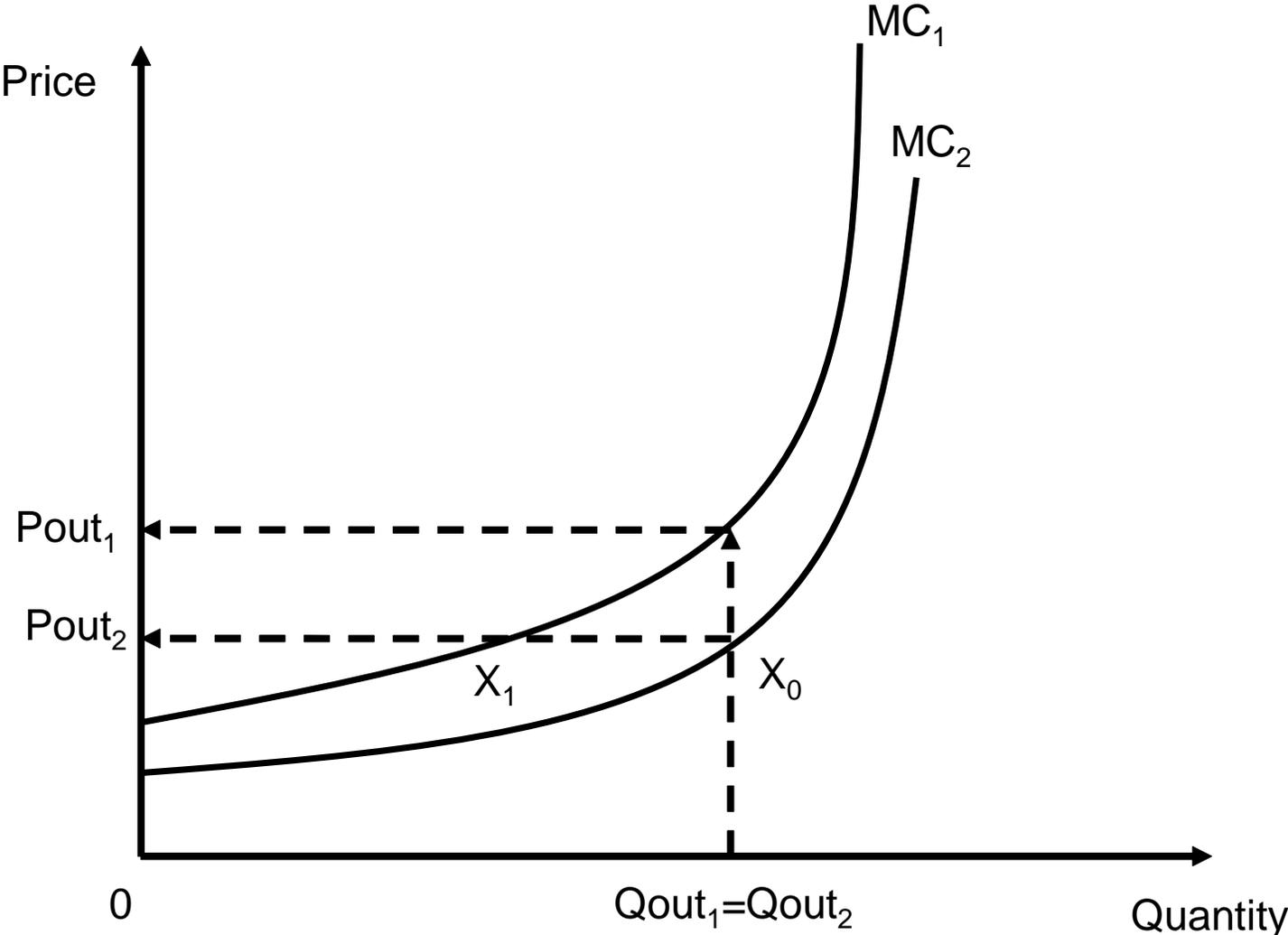
Feed-in tariffs



MC_1 = Marginal Costs for Utility 1.

MC_2 = Marginal Costs for Utility 2.

Competitive bidding system



MC_1 = Marginal Costs for Utility 1.

MC_2 = Marginal Costs for Utility 2.

The effect of a technological change on quantity and price of green electricity production

