Selling Energy and Saving Energy: Energy Efficiency Obligations in Liberalized Markets

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Work in progress

Art. 7 of the EU Energy Efficiency Directive (2012)

- Each Member States should introduce an energy efficiency obligation scheme (EEOSs).
- Under the EEOS, energy companies must save an annual 1.5 % of their energy sales with additional energy efficiency projects.
- This Article also offers MS the option to introduce alternative policy measures to EEOS, provided that these measures deliver equivalent energy savings.

15 EU Member States

Fawcett, Rosenow and Bertoldi , *Energy Efficiency*, 2019

Table 1 EEOS in EU member states, current status

EEOS status	Member states
Active	Austria, Bulgaria, Croatia, Denmark, France, Greece, Ireland, Italy, Latvia, Luxembourg, Malta, Slovenia, Spain, Poland, the UK
None planned	Belgium, Cyprus, Czech Republic, Estonia*, Finland, Germany, Hungary*, Lithuania*, the Netherlands, Portugal, Romania, Slovakia, Sweden,

*EEOS were planned, but these plans have been withdrawn

How do EE Obligation Schemes work?

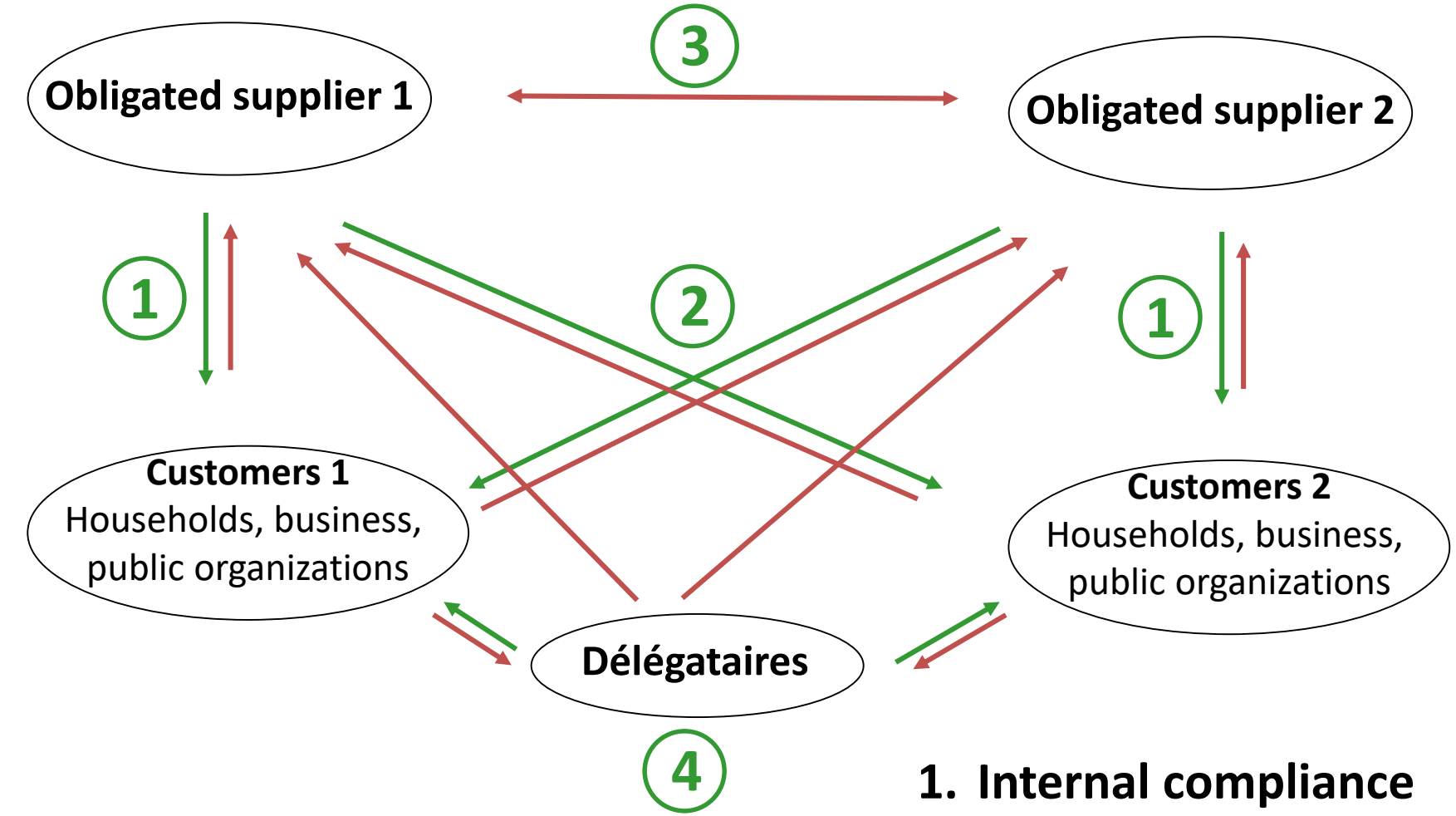
1. A legal obligation on energy companies ("the obligated parties") to achieve a quantified target of energy savings by a certain date
   - Suppliers/ retailers of electricity, gas, heating oil
   - In general proportional to their historical sales
2. Energy suppliers support EE investments from energy users, mostly with grant payments
   - Investments should be additional
3. Energy savings are certified using standardized engineering calculations

- Other names:
  - White Certificates; Demand-Side-Management (in the 1990s); utility EE programmes, Energy efficiency resource standards (US)

Possible flexibility mechanisms

- Obligated firms can achieve energy savings anywhere = External compliance is authorized
  - Not only with their customers
- Trading of energy savings certificates (“white certificates”)
  - France, Italy, Poland
- Certificates may be generated by non-obligated parties
  - Energy service providers

The French example: Certificats d'Economie d'Energie

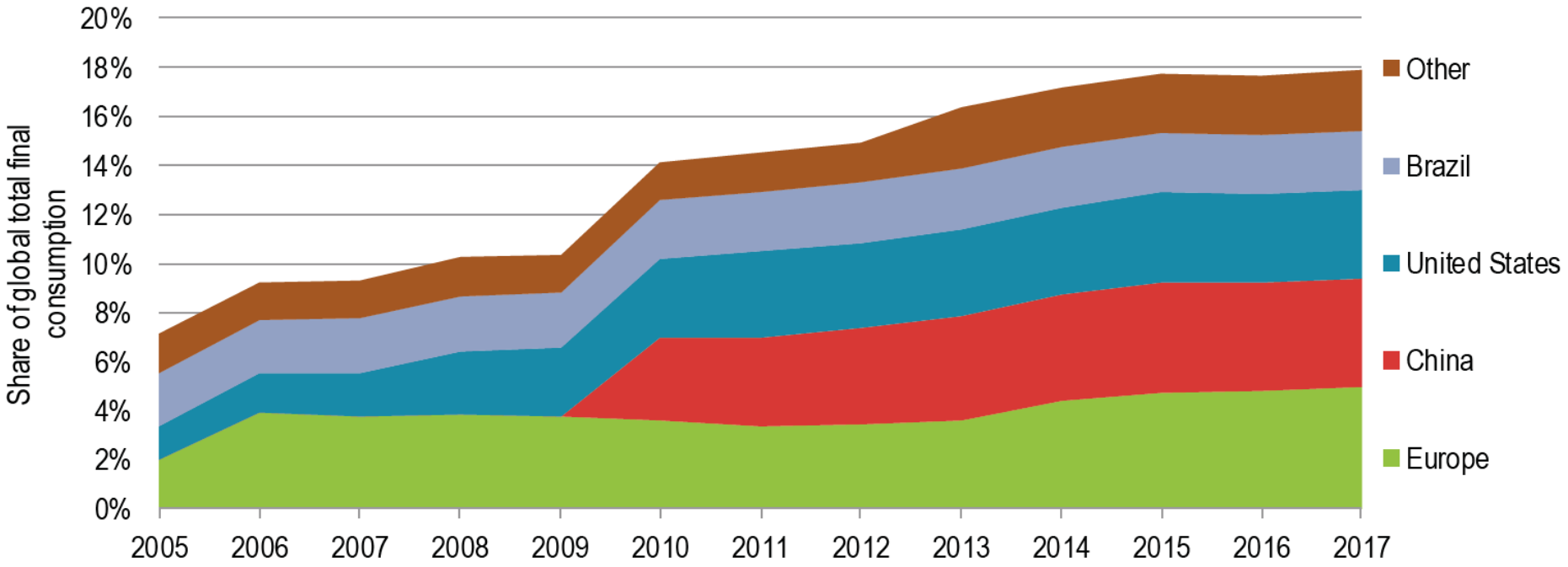


1. **Internal compliance**
2. **External compliance**
3. **Trading**
4. **Delegated compliance**

In the US: Energy efficiency resource standards

- Obligations on regulated monopoly distribution utilities
  - Even in States where energy supply is competitive
- Costs are recovered through regulated wires charges
- Implemented in 26 States

Coverage of EE obligations, by country/region



Source: International Energy Agency, 2019

Why Ask Retailers to Pay for Reducing Sales?

- From energy users' perspective, similar to a combination of EE investment subsidies and an energy tax
- Take advantage of retailers' superior knowledge of end-users
    - Able to find the least-cost options
    - Reduce windfall profits / free riding
- Reduce administrative costs
- Lower political risks (compared to energy taxation)

What We Do

- An IO model describing an EE obligation scheme
  - an imperfectly competitive energy supply market
  - energy suppliers who own private information on their customers
- We compare the incentive, welfare and distributional properties of a variety of energy efficiency obligation designs, keeping the level of the obligation exogenous
- Two design components
  - whether or not suppliers are allowed to promote energy efficiency by their competitor's customers
  - w/o trading of the obligations

Assumptions

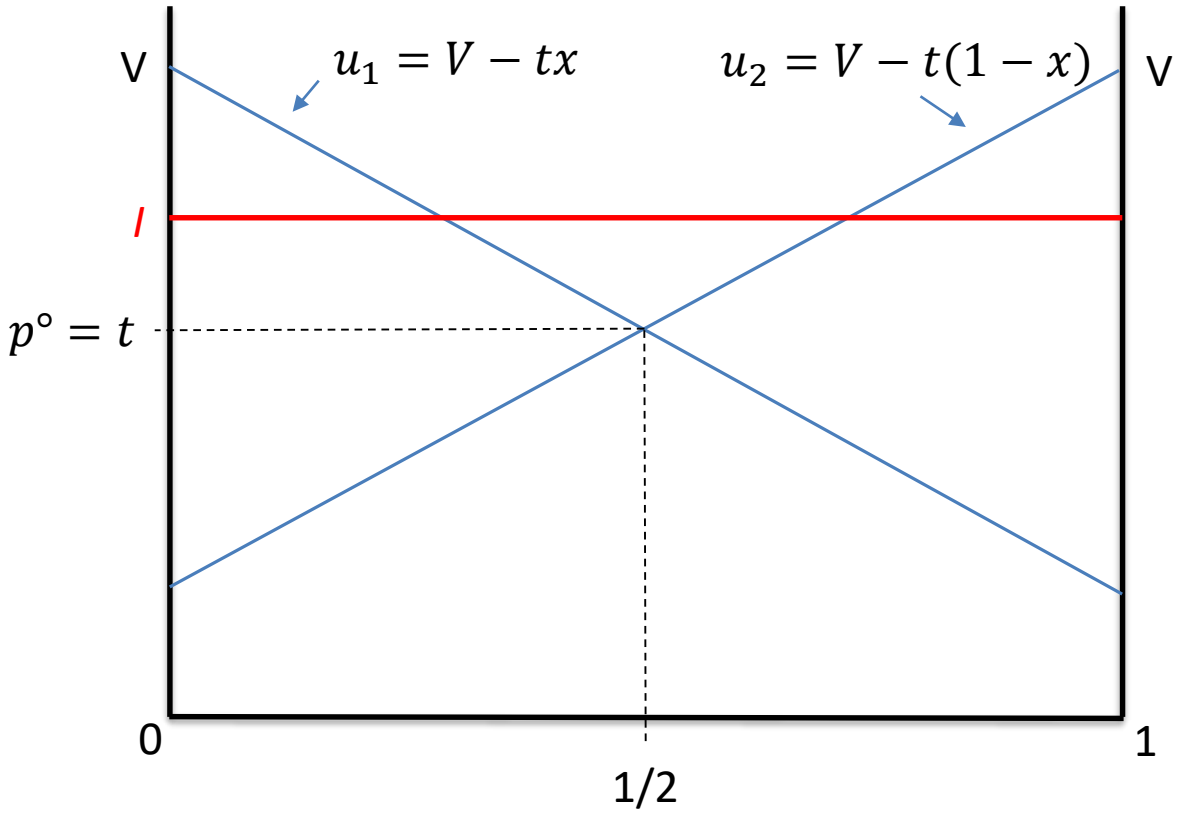
- A continuum of energy users uniformly located on the segment $[0,1]$ which either consumes 0 or 1 unit of energy
- Two energy suppliers located at the two extremities, namely at $x_1 = 0$ and $x_2 = 1$.
- Each energy user located at x and supplied by i has utility:

$$u_i(x) = V - t|x - x_i|$$

where

  - V: the fixed surplus derived from the energy service
  - $t|x - x_i|$: the specific cost of being supplied by i. The "transport" cost parameter t may capture brand loyalty or switching costs.
  - V < 3t/2 : The market is fully covered in the status quo
- Each energy user may invest at **uniform** cost I which leads to zero consumption
  - The uniformity hypothesis relaxed later
- Production cost is zero and I > t
  - No investment in the status quo

The Business-As-Usual scenario



Each firm serves half of the market at uniform price $p° = t$ and no investment.

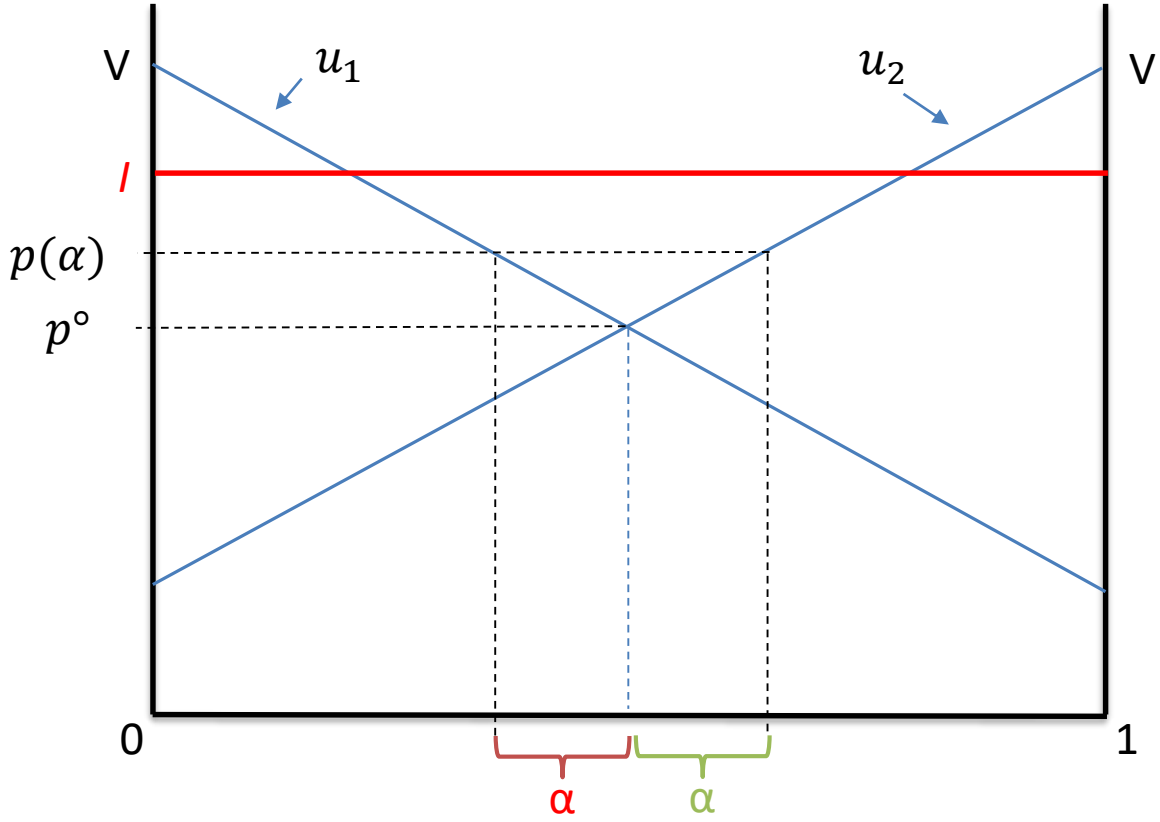
An energy saving obligation

- Each supplier should reduce energy consumption **by subsidizing investments of α energy users**
- Timing
  1. Each firm chooses which customers to encourage
  2. Selected customers receive a subsidy and invest
  3. Each firm sets its price
  4. (Customers who have not invested can invest)

- **Informational assumption:** Each firm privately knows the location of each of its customers.

Design 1: External compliance is prohibited

(Each retailer can only induce investments on their own customer base)



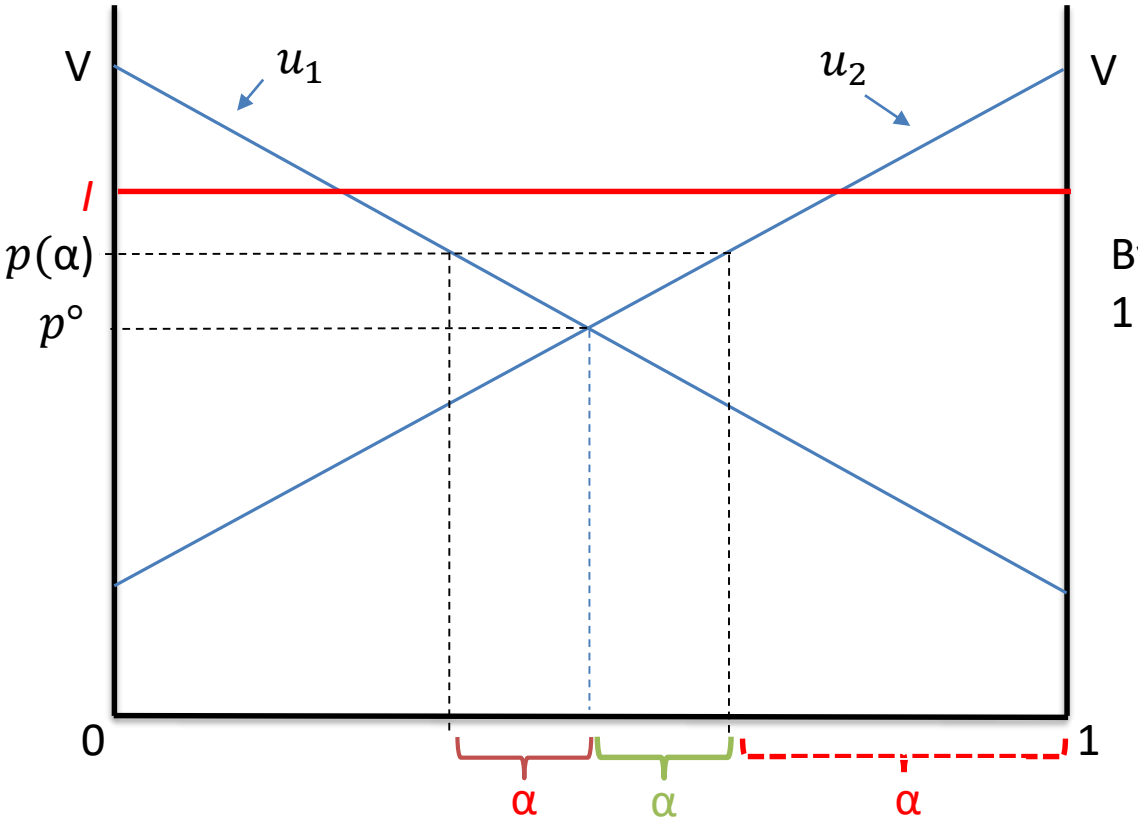
Subsidy = $I - p°$

Results. (i) Each firm targets its less "loyal" customers

(ii) The energy price increases

Design 2 : External compliance is authorized

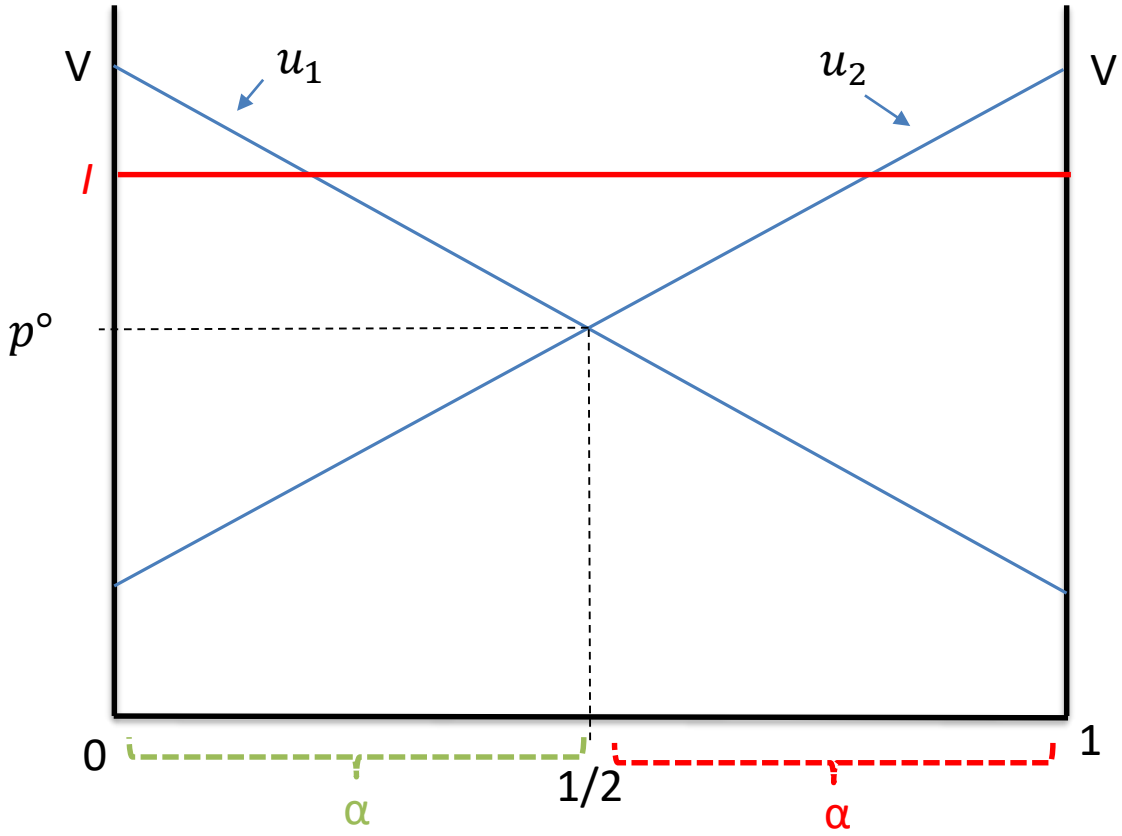
(Each retailer can induce investments anywhere)



By unilaterally deviating, firm 1 increases its profit

Internal compliance is not a Nash equilibrium.

Full external compliance is the Nash equilibrium



Results. (i) The price does not increase compared to the BAU scenario

(ii) profit is less than under internal compliance

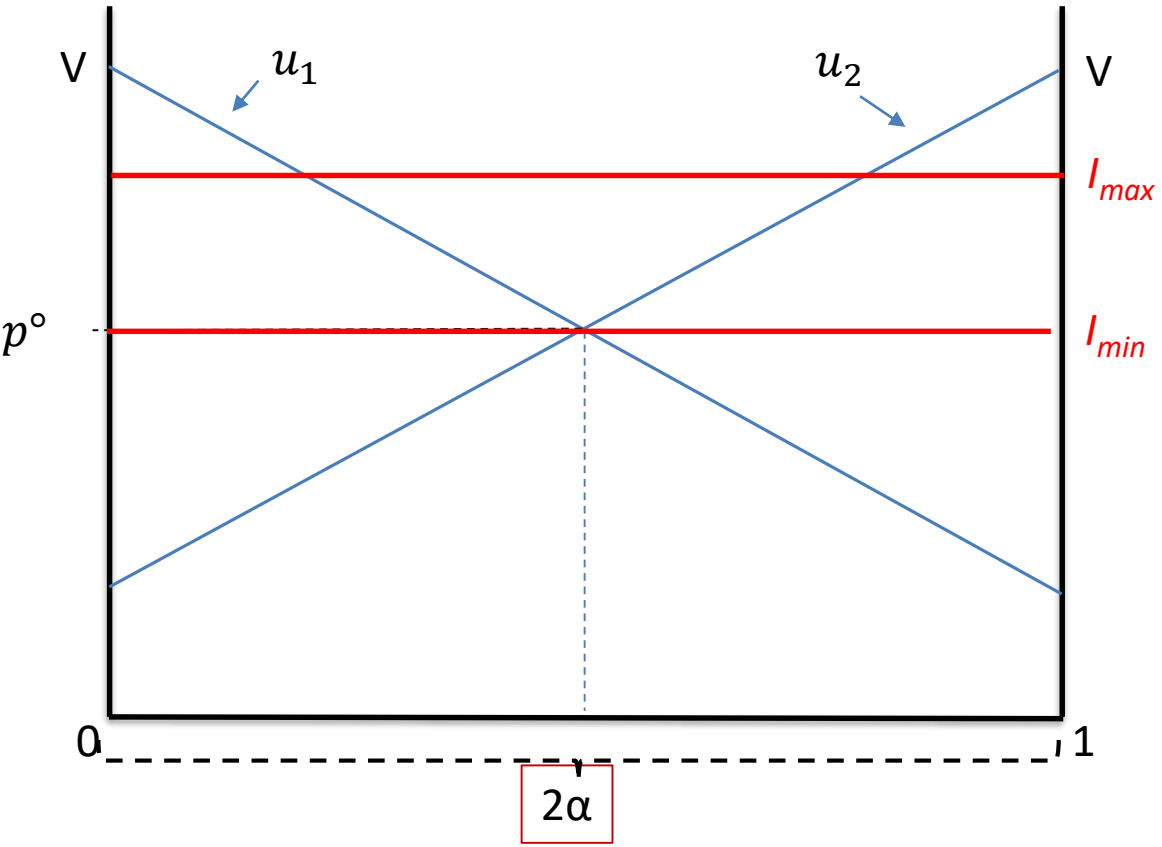
Interim conclusion

- Allowing external compliance leads to full external compliance
- Hence the firms do not exploit their informational advantage on demand
- The energy price does not increase
- Firms will be better off if they could commit to target their own customer base
- So far, this is welfare neutral because the investment cost is uniform and perfectly known by both firms

What happens if we introduce imperfect information on investment opportunities ?

Private information on heterogenous investment costs

- Assumptions
  - Half of the customers invest at cost I_{min} , the others at cost I_{max}, with $I_{min} < I_{max}$
  - Both types of customers are uniformly distributed over [0, 1]
  - **Each firm privately knows its customers' investment cost**

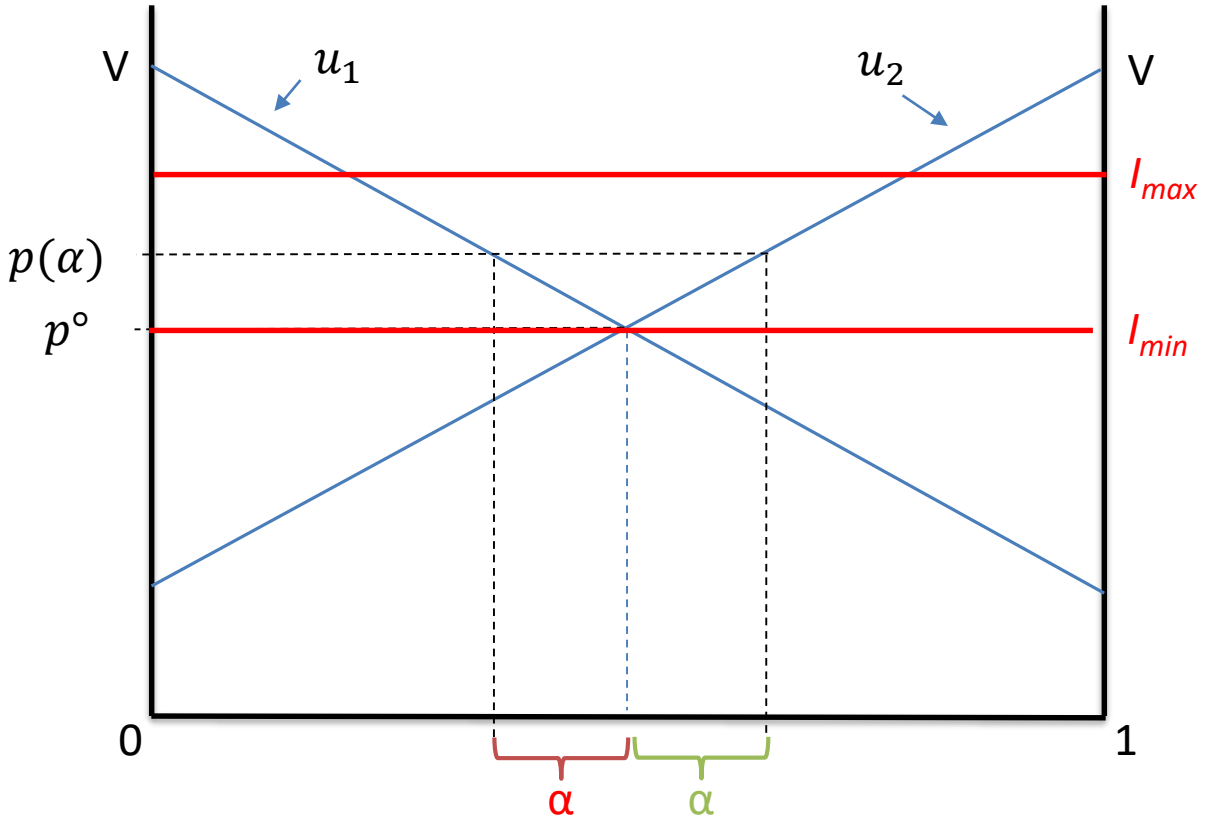


Minimizing the cost for achieving the obligations requires inducing investments by customers with cost = Imin

This is only feasible with internal compliance

Design 1: External compliance is prohibited

Strategy a. Targeting its less loyal customers (cost inefficient)

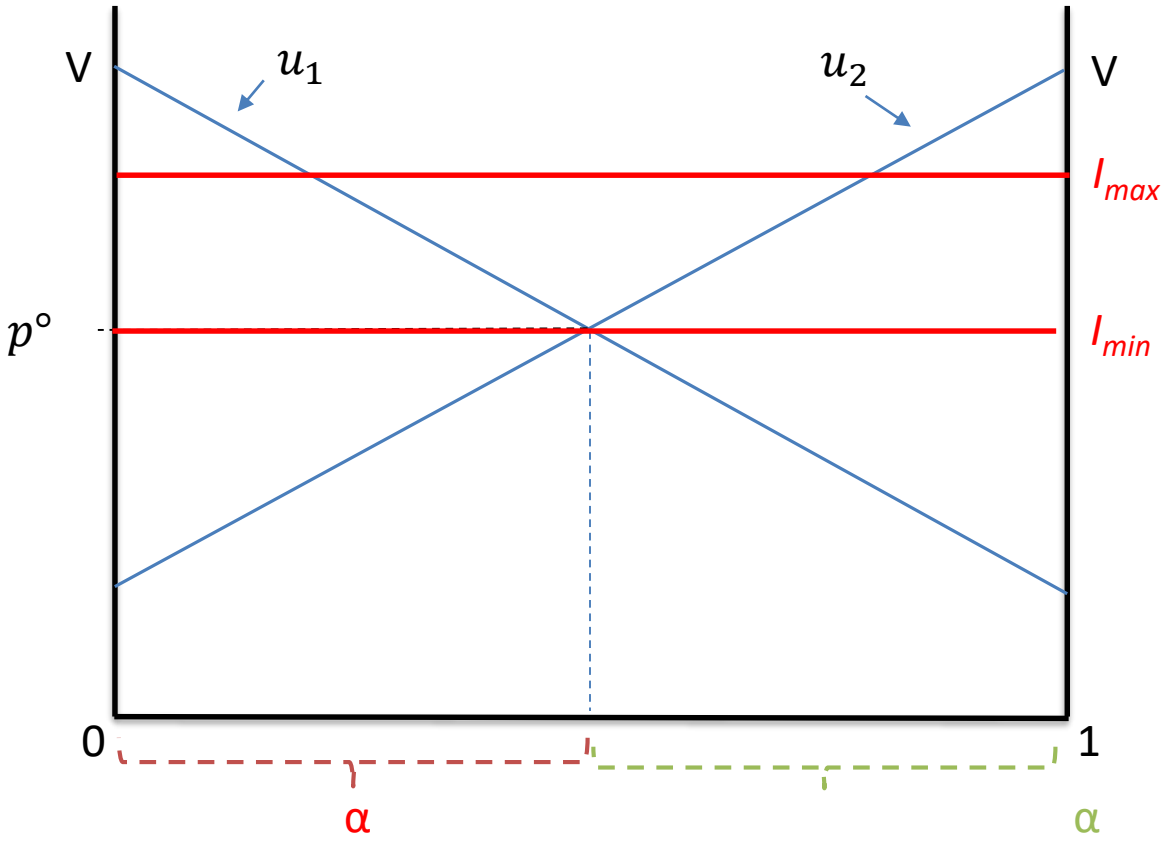


Total subsidy cost = α(I_{max} –t) / 2

Market profit = $p(\alpha)$(1/2- α)

Design 1: External compliance is prohibited

Strategy b. Targeting its low-cost customers (cost efficient)



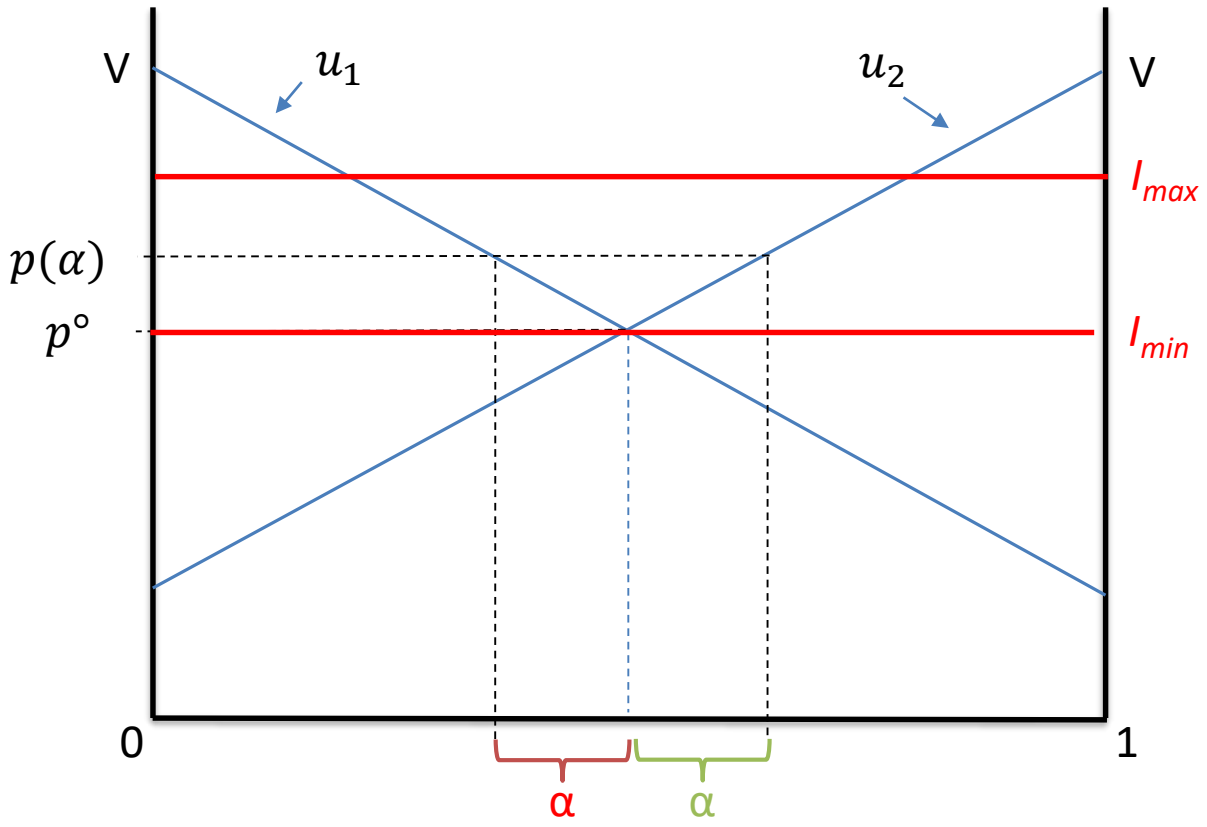
Total subsidy cost = 0

Market profit = $p°$ (1/2- α)

Strategy b is chosen if $(p(\alpha) - p°)\left(\frac{1}{2} - \alpha\right) < \frac{\alpha}{2}(I_{max} - I_{max})$

That is, when the gap between I_{min} and I_{max} is wide

Design 2: External compliance is authorized



Targeting its less loyal customers (strategy a) is not a Nash equilibrium

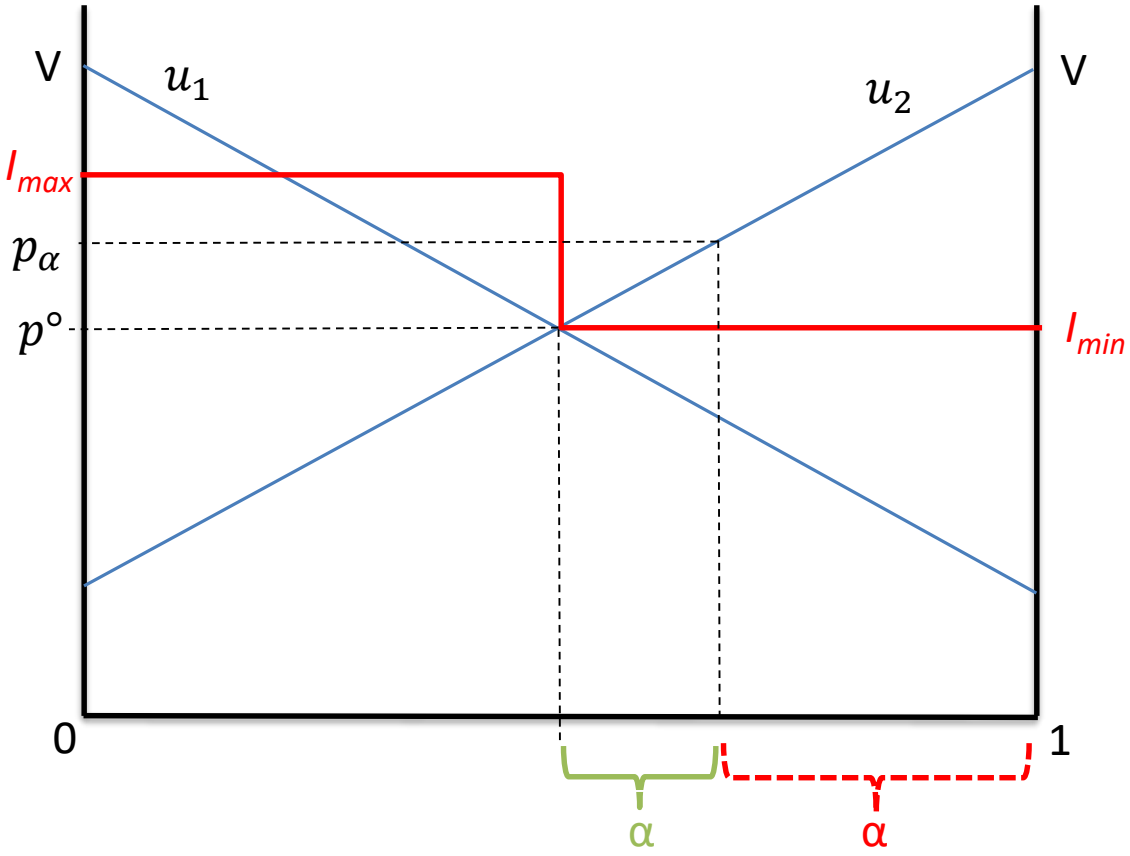
Cost efficiency of the two designs

	Low S $S < (p(\alpha) - t)(\frac{1}{2} - \alpha)$	Medium S $(p(\alpha) - t)\left(\frac{1}{2} - \alpha\right) < S < \alpha t$	High S $S > \alpha t$
External compliance is not authorized	Cost inefficient	Cost efficient	Cost efficient
External compliance is authorized	Cost inefficient	Cost inefficient	Cost efficient

where $S = \alpha\left(\frac{I_{max} - I_{min}}{2}\right)$

Allowing external compliance increases the total investment cost **when firms are symmetric**

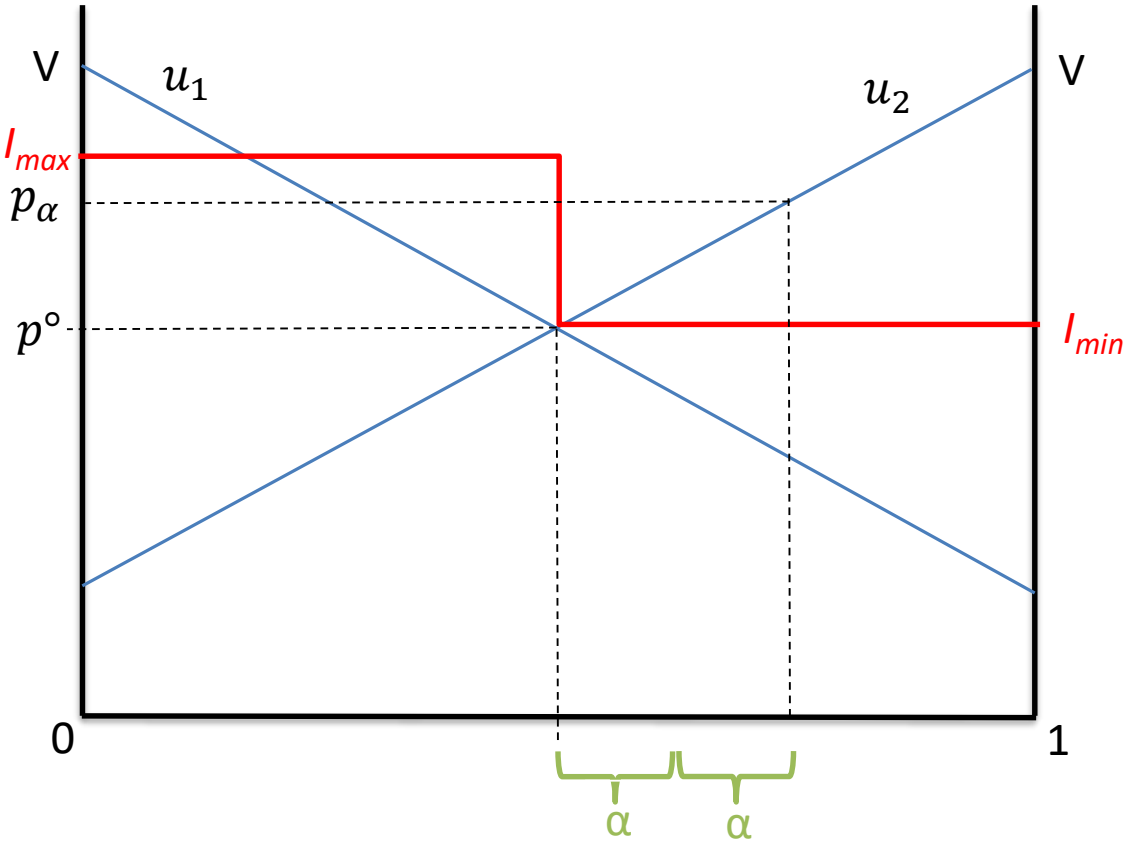
Asymmetric firms



- **Both firms target the low-cost customers if the gap between I_{max} and I_{min} is sufficiently wide.**

- Otherwise, the firms target their competitor's customers and the overall investment cost is not minimized

Trading with perfect competition on the certificate market



The EEOS with trading certificates is cost efficient:

Firm 2 generates all the investments and sells α white certificates to firm 1. As a result, firm 2's price is higher..

Takeaways

- Providing flexibility by authorizing external compliance reduces social welfare if firms are symmetric
  - A prisoner's dilemma may lead firms to target their competitors' customers, thereby not exploiting their informational advantage
- Imperfect competition on energy markets clearly disturbs the functioning of EE obligations schemes
- Trading solves the problem if the certificate market is competitive
  - If not, we don't know (yet)
- Is it a more socially-efficient solution than direct public intervention? Depends on governmental failures
  - Public investment subsidies + energy taxation versus EEOS