



Evaluating Economic Policy Instruments for Sustainable Water Management in Europe



The research leading to these results has received funding from the *European Community's Seventh Framework Programme (FP7/2007-2013) / grant agreement n° 265213* – project EPI-WATER "Evaluating Economic Policy Instrument for Sustainable Water Management in Europe".

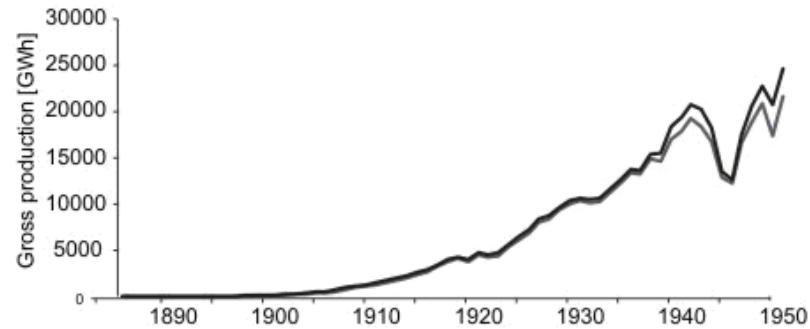
Hydropower development in Italy: tradable certificates for renewable energy

Lorenzo Carrera and Fabio Farinosi, FEEM

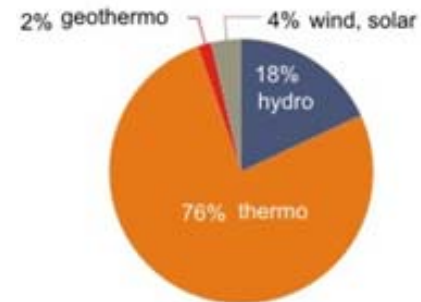
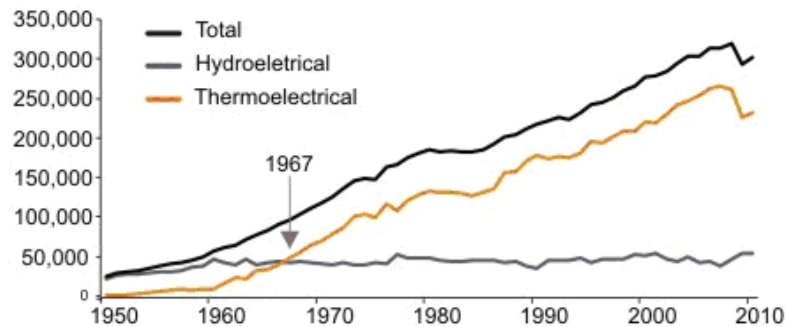
Fondazione Eni Enrico Mattei
Venice, 24th November 2011

1. Hydropower development in Italy

- From 1880s to early industrialisation

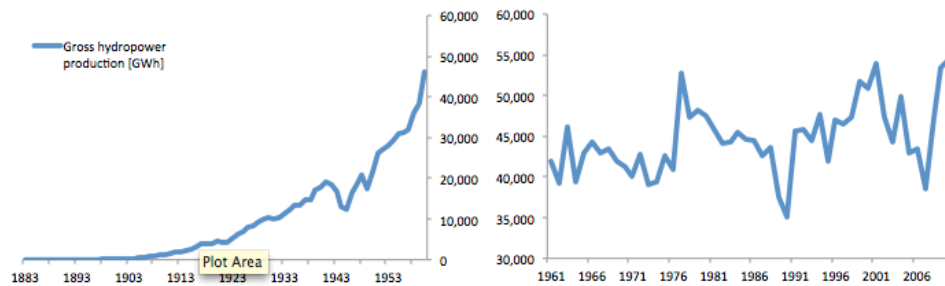


- From 1950s

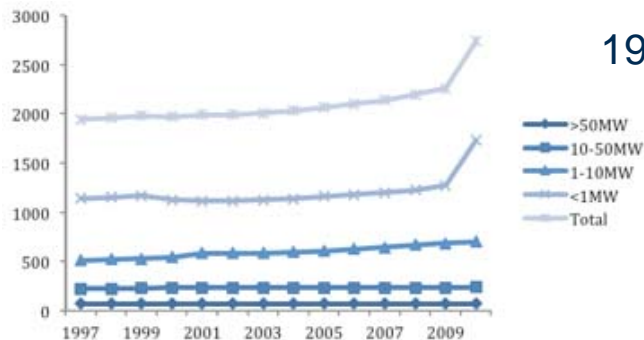
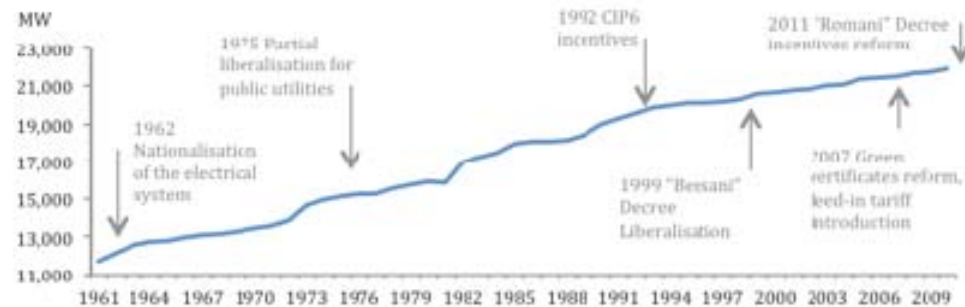


2. Hydropower development (Cont)

From 1946 to 1960
hydropower production (GWh)
increased steeply, afterwards
a constant but greatly lower pace.
Production affected by variability.



After 1960 the installed capacity
(MW) increased constantly.
Several **reforms** of the sector:
1962-1975-1992-1999-2011

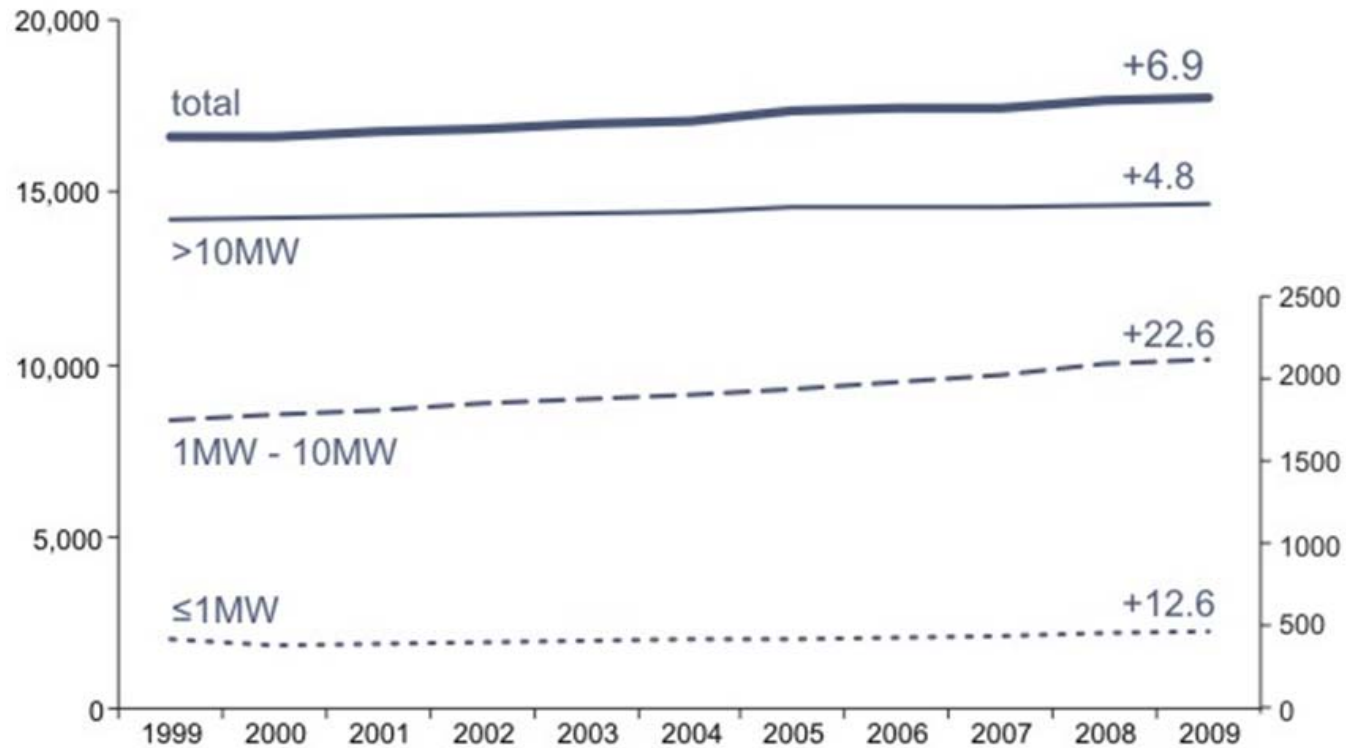


1999-2009: nr. HPPs grew at an annual average
rate of 1.3% but the installed capacity increased
only by 0.7% per year. **Small and medium size
HPPs** (<1 MW and 1-10 MW) have higher rate
of expansion, while the number of larger HPP
remains constant.



3. Installed capacity trends for different categories of plant size

Development of the installed hydropower capacity per categories of plant size (own elaboration based on GSE 2010).

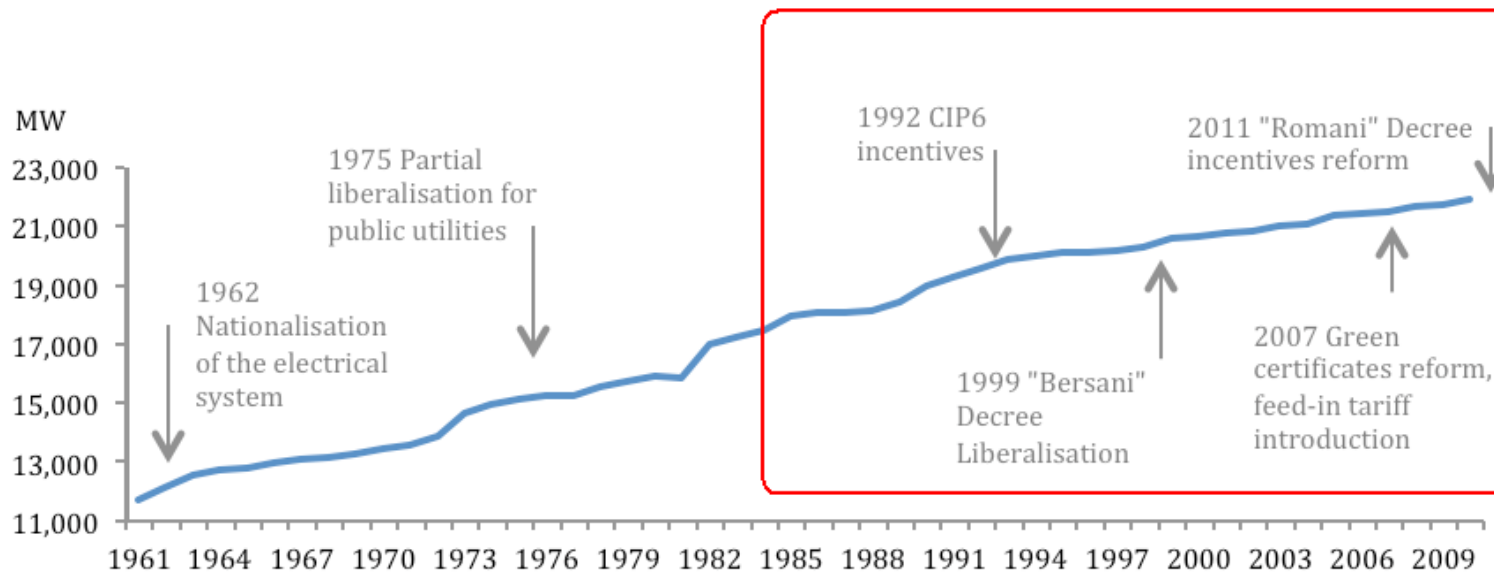


Left y-axis refers to the total installed capacity and the HPP with capacity exceeding 10MW. Right y-axis refers to the other two classes of installed capacity.

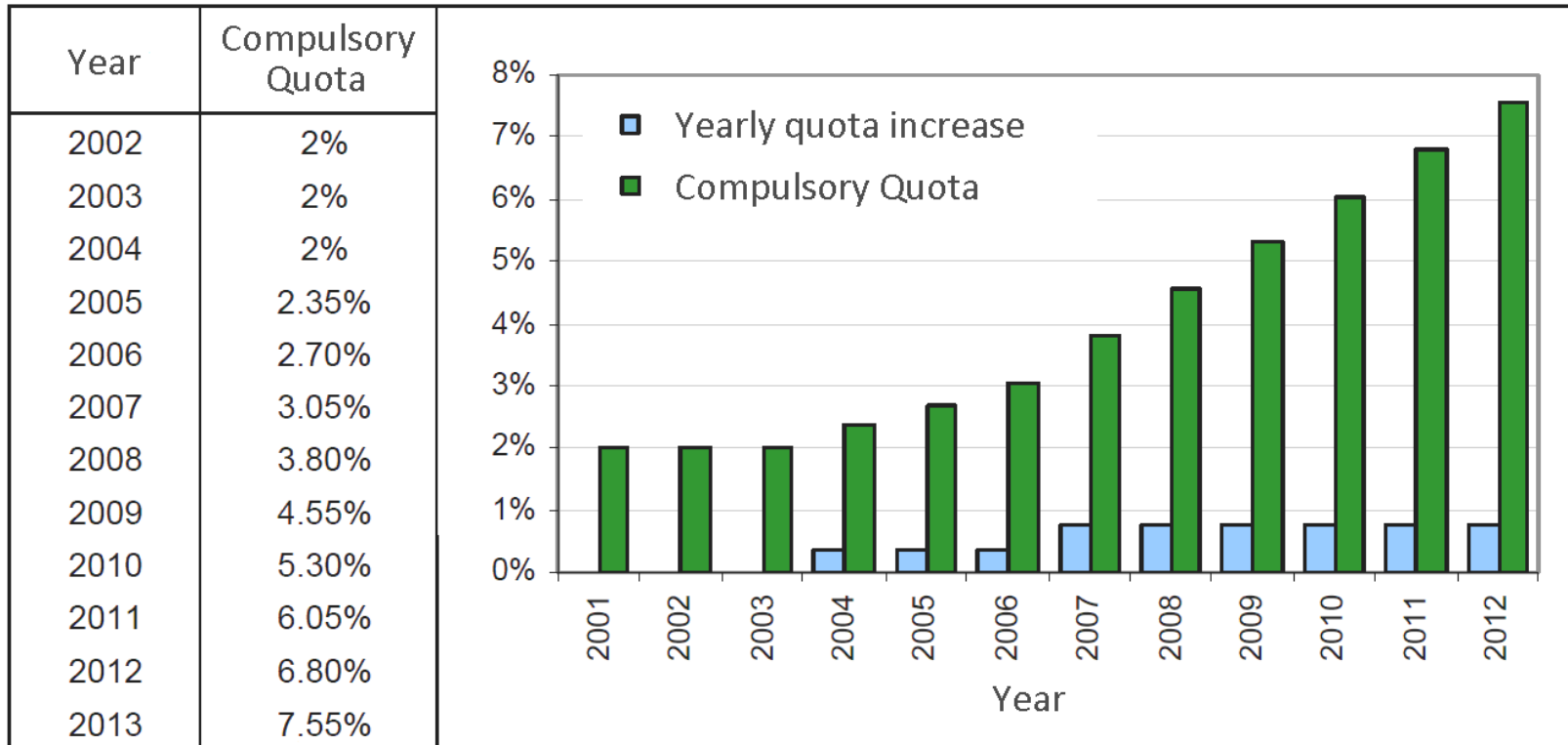


4. System of incentives for renewable energies in Italy: main steps

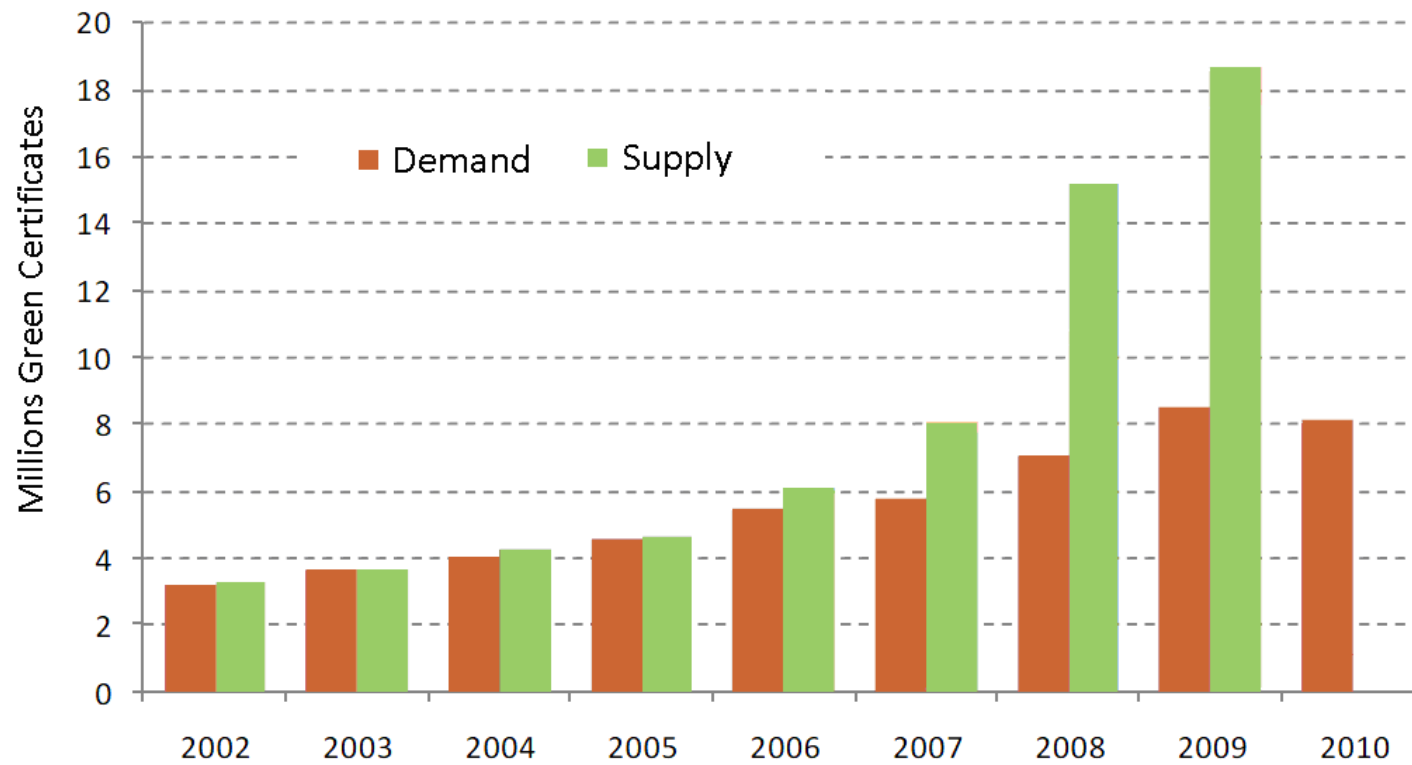
- CIP 6/92: first system of incentives;
- Decree n. 79/99 (Bersani's Decree): introduction of the quota incentive system;
- Law n. 244/2007:
 - Differentiation of the system of incentives for energy sources;
 - Increase of compulsory quota from 0.35% to 0.75%/year.
 - introduction of the feed-in-tariff for plants with a size not exceeding 1 MW of installed capacity (200KW for windpower).



5. Compulsory quota evolution



6. Demand and Supply Evolution



7. Green Certificates market per Certificate

- Our elaboration

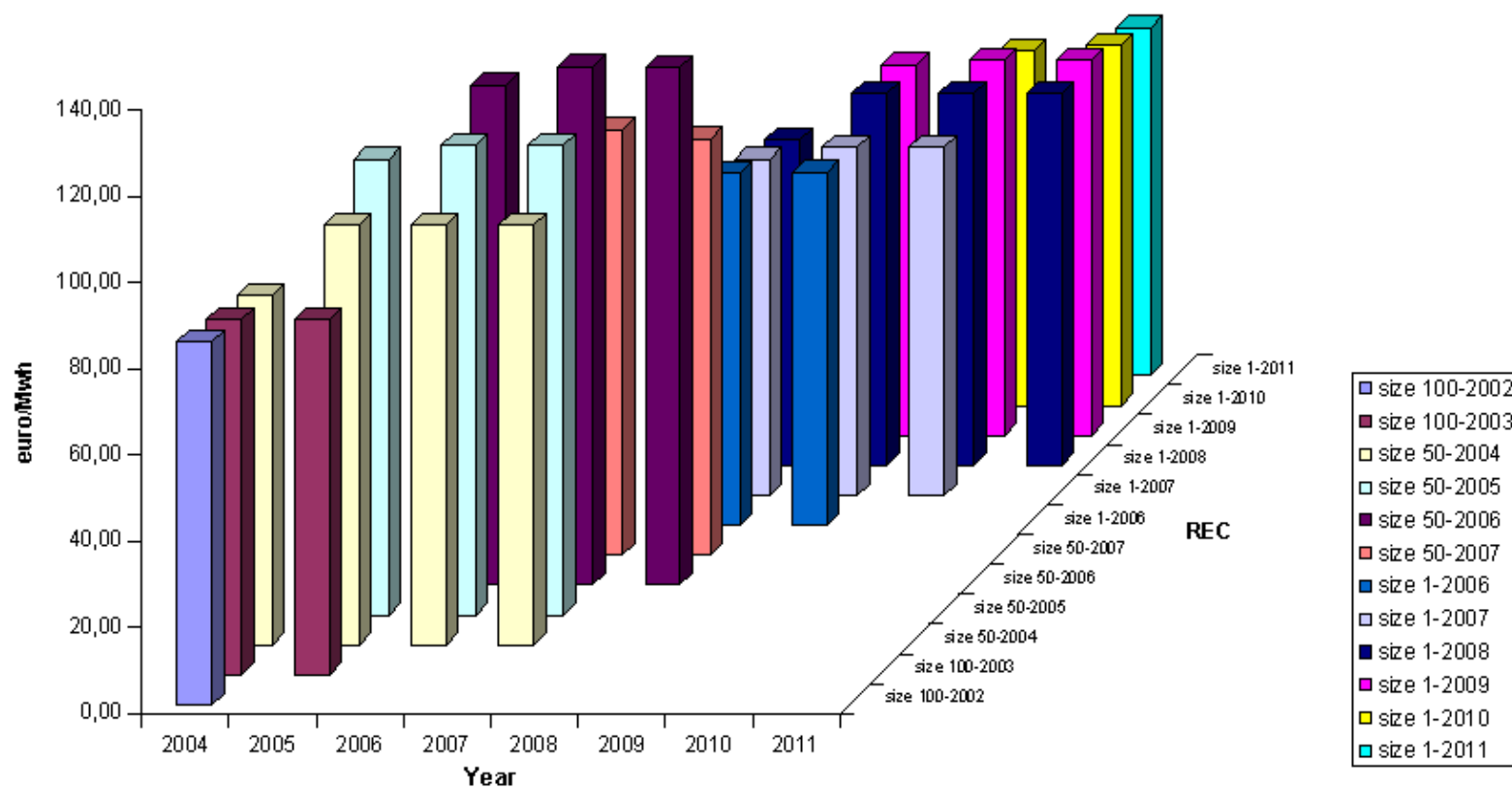
| Type | Size (Mwh) | Total Average price (€/Mwh) (excluding VAT) | Total volume traded (number of RECs) | Turnover (excluding VAT) |
|------|------------|---|--------------------------------------|--------------------------|
| 2002 | 100 | 84.18 | 46,994 | 197.804.452 |
| 2003 | 100 | 82.40 | 20,780 | 171.236.533 |
| 2004 | 50 | 97.35 | 22,901 | 111.492.295 |
| 2005 | 50 | 109.40 | 8,065 | 43.972.207 |
| 2006 | 50 | 120.19 | 9,813 | 58.971.717 |
| 2007 | 50 | 96.48 | 1,255 | 6.054.301 |

| Type | Size (Mwh) | Total Average price (€/Mwh) (excluding VAT) | Total volume traded (number of RECs) | Turnover (excluding VAT) |
|----------|------------|---|--------------------------------------|--------------------------|
| CV 2006 | 1 | 98.19 | 22,392 | 1.832.186 |
| CV 2007 | 1 | 96.90 | 589,363 | 47.588.868 |
| CV 2008 | 1 | 103.61 | 708,910 | 61.208.449 |
| CV 2009* | 1 | 104.52* | 2,224,087* | 193.710.689* |
| CV 2010* | 1 | 100.35* | 3,162,800* | 264.491.734* |
| CV 2011* | 1 | 96.85* | 1,235,125* | 99.687.602* |

* Last update October 2011



8. Price trend of Green Certificates

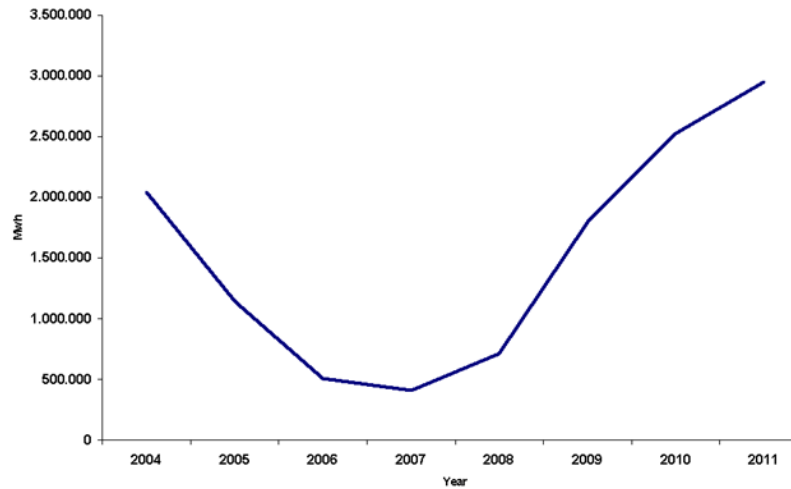


Yearly Price fluctuations for the different RECs emitted by GSE (2004-2011). Source: Own elaboration on GME data

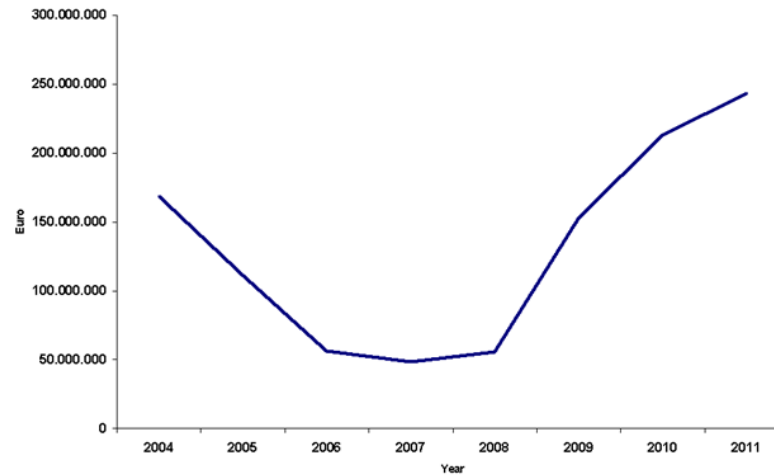


9. Value and volume traded per year

- Volume



- Value



10. Problems

- Mismatch between demand and supply
- Exemptions
- Market failure avoided by the introduction of the Ministerial decree 18/12/2008 obliging the GSE in purchasing the unsold GC at the average price of the three years before.
- Increasing costs for the GSE



11. Economic cost of the incentive system

- In 2009 the system registered the values:
 - Indirect costs for 600 million Euro;
 - Direct costs for 1 billion Euro (AEEG 2010).
- 6% of the electricity cost for the final consumer.
- Cost for different final user in 2009 (GSE, 2010)

| 2009 | Unit | Voltage level | | | | | | | |
|-------------------------|------------------|---------------|-------------|----------------|-------------|-------------|-------------|-------------|-------------|
| | | Low voltage | | Medium voltage | | | | High | |
| | | Domestic use | other uses | | | | | | |
| Power | kW | 3 | 3 | 10 | 100 | 500 | 1,000 | 3,000 | 10,000 |
| Use | hour/year | 880 | 1,166 | 1,200 | 1,500 | 2,000 | 2,500 | 2,500 | 3,500 |
| Consumption | kWh/year | 2,640 | 3,500 | 12,000 | 150,000 | 1,000,000 | 2,500,000 | 7,500,000 | 35,000,000 |
| Incentive charge | cEuro/kWh | 0.73 | 0.94 | 1.7 | 1.36 | 1.09 | 1.09 | 0.99 | 0.99 |
| Monthly ave. cost | Euro/month | 1.6 | 2.7 | 17 | 170 | 911 | 2,274 | 6,204 | 28,937 |
| Annual average cost | Euro/year | 19 | 33 | 204 | 2,037 | 10,937 | 27,287 | 74,447 | 347,247 |



12. Environmental outcomes

Water is a natural resource with intrinsic values:

- chemical
- biological
- physical → **kinetic energy** for hydropower production

Its exploitation modifies surface water bodies in:

- morphology
- discharge regimes
- sedimentation processes
- eco-biological characteristics

Policy instruments to induce sustainable exploitation of hydropower.



13. Environmental outcomes – Hydropower production

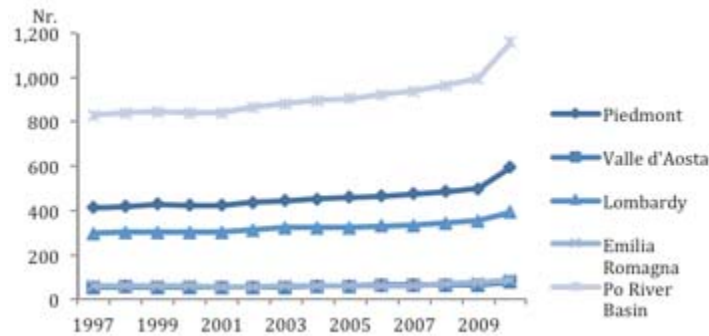
Hydropower generation is relative safe, efficient and flexible technology enabling water flow regulation, flood risk management and mitigation of droughts impacts.

Side effects are:

- River flow continuity disruption → water habitat interruption (fish migration routes)
- River flow modification → water levels, temperature, coastal subsidence, erosion, saltwater intrusion
- Greenhouse gases source from reservoirs (methane from decomposition)
- Landscape modifications (reservoirs, river flow plants)

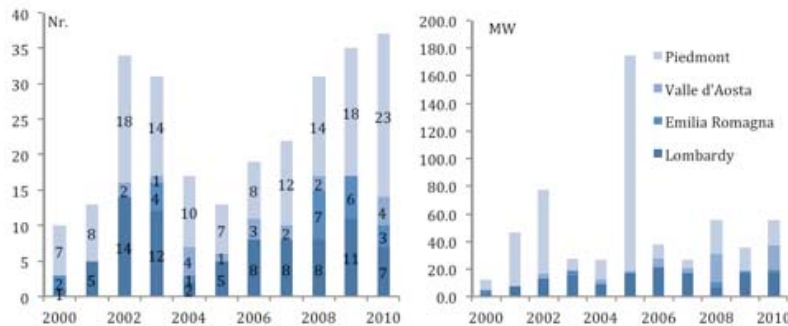
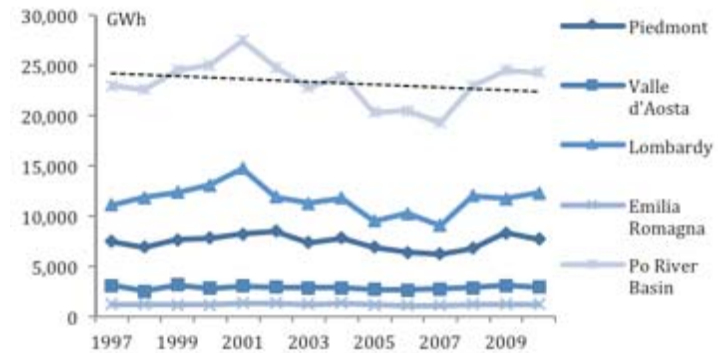


14. E. O. – Hydropower development in Po river Basin: increasing pressure



Energy production suffers from meteorological **variability**. Po river basin: energy production faces a reduction trend in the last decade. Droughts 2003, 2006/2007.

Po river basin (4 main regions):
 around 1,155 HPP
 26,000 GWh production
 48% of national production



From 1997 to 2010 HPPs number grew from 825 to 1,155. Peak in 2002, increment from 2006, new peak in 2010. Total capacity remains nearly constant.

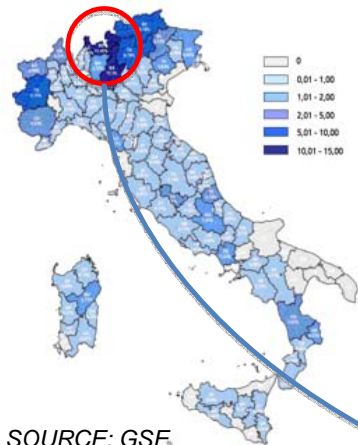


15. Environmental outcomes – Environmental flow

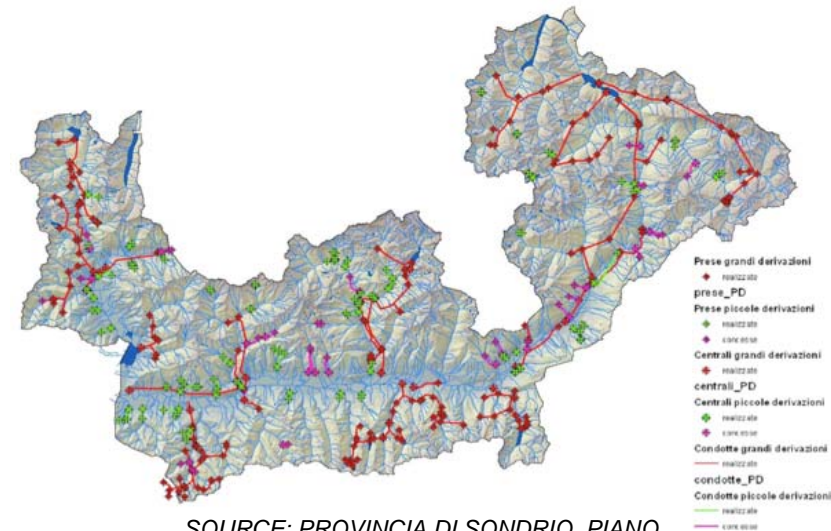
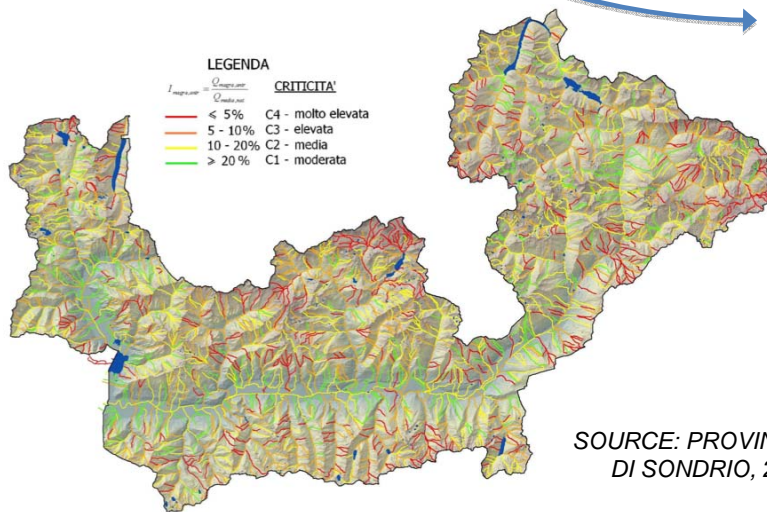
- Environmental flow as limitation of the Hydropower exploitation.
- “Environmental Flow is the water regime provided within a river, wetland or coastal zone to maintain ecosystems and their benefits” (adopted from Dyson et al., 2003).
- The authorisation process for new licences influenced by environmental constrains.



16. Environmental outcomes – Province of Sondrio



- Province of Sondrio: **12.45%** of national and **40%** of Lombardy's production. 36% of large national HPPs (30 out of 82). 80 small derivations and 28 large reservoirs/dams. National higher production coefficient: 681 kW/Kmq, 11.97 kW/ab.



Province of Sondrio suffers from high **anthropization** level of its river network



17. Distributional Effects and Social Equity

Hydropower development beyond a sustainable level comes upon social resistance fuelled by perceptions of social and geographic injustice. Usually concentrated in less developed, mountainous areas, the hydroelectricity generation is associated with negative externalities in proximity of the plants whereas the downstream communities take most benefits.

Public opinion about hydropower technology saw a substantial change during last decades. In the first half of the XX century it was highly considered thanks to the impact on the employment rate in extremely poor areas of the country. Afterwards employment rate collapses and local communities became more aware of the hazards connected to the hydropower installations:

- Vajont disaster in 1963
- Val di Stava in 1985



18. Distributional Effects and Social Equity – Fees

- Water concession fee;
 - Different from region to region: 13 to 35 Euro per kW;
- Supplementary abstraction fee for mountainous basins
 - in 2011, 21.08 Euro per kW;
- Supplementary abstraction fee for local authorities
 - in 2011, 5.27 Euro per kW.



19. Distributional Effects and Social Equity

Monetary compensation for the local communities in hydropower project's influence areas.

- supplementary water abstraction fees
 - Municipality – three quarter (re-distribution)
 - Districts – one quarter
 - Mountainous basins

In some cases charges are collected by the central government to benefit local communities:

- 10% is equally distributed among the communities
- 20% is distributed in relation to the municipal territory
- 30% in relation to the number of inhabitants
- 40% in relation to size and impact of the plants installed in the municipal territory

The wealth from the supplementary fees is used to finance local infrastructures and economic development of the local communities.



20. Distributional Effects and Social Equity – Sondrio

Social acceptance till 70s because of economical development boosted by hydroelectric sector. Social resistance increased from the 80s.

- 1990: first moratorium from Senate. After flooding events in Valtellina in 1987. It suspends the new water concession fees till the approval of the Po river basin plan called “stralcio” for the Province of Sondrio.
- 1999: Regional Committee decision introduces an environmental flow of 50 l/s;
- 2006: Water Protection Plan introduces the duty to adapt the new concessions to the environmental flow and confirms the outflow threshold of 50 l/s for every catchment;
- 2006: second moratorium. Establishes the condition of the previous authorization of the Ministry of Environment, exclusively for the Province of Sondrio, from the first of January 2007 to the 31st December 2008;
- 2007: Agreement for a sustainable water use in the province of Sondrio through the integration of planning instruments: it contains the rules by which the Minister can give his technical opinion on new concessions requests (integrated plan “Strategic Environmental Assessment” subjected as reference for the authorization).
- 2010: Provincial Territory Coordination Plan with Plan for Water Budget approval. Monitoring of the plan is on-going. The plan received great approval from committees and local community.
- From 2005 to mid-2011, the Province received 68 abstraction requests for 31,445 kW. Only 22 concession were authorized, producing 2,079 kW. All authorized HPP, except one, are below 1MW. Mini-hydro only.



21. Distributional Effects and Social Equity – Sondrio

Public opinion in the Province of Sondrio is that the externalities of hydropower exploitation should have higher monetary compensation.

Energy production value in the Province is 500-700 million euros
Province of Sondrio income for energy production is 25 million euros

Growing demand for private-public (local administration) partnerships.
Demand for higher supplementary fees.

Regione Lombardia law 19/2010 defined public participation in hydroelectric sector.

Law 19/2010 is currently subject to legal argument.



22. Future development

What's next after "Romani's" decree?

Is small and medium hydropower convenient without incentives?

How many hydropower plant would have been requested/constructed in the Province of Sondrio without incentives?

How many in Italy? What's the impact on the production? And on water uses?

Why there are so many request for abstraction rejected in the Province of Sondrio?

Which is the best way to avoid "controller-controlled" contradiction?





Thanks!

The research leading to these results has received funding from the *European Community's* Seventh Framework Programme (FP7/2007-2013) / *grant agreement* n° 265213 – Project EPI-WATER “Evaluating Economic Policy Instrument for Sustainable Water Management in Europe”.