



Università
degli Studi
di Udine

Dipartimento DBEA
Dipartimento DISA

SISTEMI AGRO-ENERGETICI E ADATTAMENTI LOCALI

29 - 30 Novembre 2007

Centro Servizi Formativi
ENAIP FVG - Pasian di Prato (Udine)



Azienda agraria
universitaria
"A. Servadei"

Tommaso di Fazio - ENEL



Sistemi agro-energetici e adattamenti locali

**Valorizzazione energetica delle biomasse: certificati verdi,
altri strumenti e prospettive future**

**Tommaso Di Fazio
Enel**

Udine, 30 novembre 2007

Electricity generation from renewables in Italy

Evolution

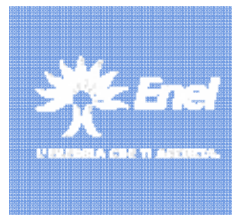
- First hydro kWh: 1887
- First geothermal kWh: 1916
- First kWh from wind: 1990
- Hydroelectricity has ranked first till 1966, when overall gross generation was 97 TWh
- Hydro generation is presently basically the same
- Generation from other renewables (basically from wind) started in 1990, three years after the Italian nuclear generation was banned
- Present coverage of overall electricity generation (over 300 TWh):
 - Fossil 82%
 - Renewables 16%
 - Hydro from pumped storage 2%
- Present coverage of electricity generation from renewables:
 - Hydro 72%
 - Biomass & waste 12%
 - Geothermal 11%
 - Wind 5%
 - PV ...%



Electricity generation from renewables in Italy

Precursor to liberalization

- Law no. 308 of 1982 allowed renewable power plants up to 3 MW to be commissioned by IPPs
- Law no. 9 of 1991 *de facto* liberalized electricity generation and established simplified licensing procedures and supporting incentives for renewables
- Actual liberalization of the electricity industry was enacted by the Legislative Decree no. 79 of 1999, transposing the Directive 96/92/EC on the internal market in electricity into the national legislation: the reserve granted to ENEL was abolished



Electricity generation from renewables in Italy

Necessity for supporting mechanisms

A larger and larger use of renewables is needed in order to:

- decrease dependence from hydrocarbons and enhance security of supply;
- comply with more and more stringent provisions against polluting and ghg emissions into the atmosphere.

A larger and larger availability of supporting mechanisms is requested in order to:

- face the higher capital expenses peculiar to renewable power plants;
- let them play their role in a liberalized electricity market.

Generalities on RES supporting mechanisms

Investment subsidies

Public support to capital investment

High burden on Government: funds can easily run out when investment volumes increase

Low efficiency: no guarantee that funds are allocated to productive investments

System getting abandoned

Feed-in tariffs

Guaranteed off-take price to generated electricity (finally to be paid by end users through regulated tariffs)

Possibility to differentiate incentives between technologies

Need to set appropriate incentives: stimulate investments, but avoid undue profits which could distort the market

Need to control efficiency: little pressure on reducing generation costs

Most used system in Europe

Tradable Green Certificates

Obligation to generate RES electricity to be fulfilled by redeeming certificates of origin (whose cost will finally be paid by end users)

Creation of two markets: power and green value

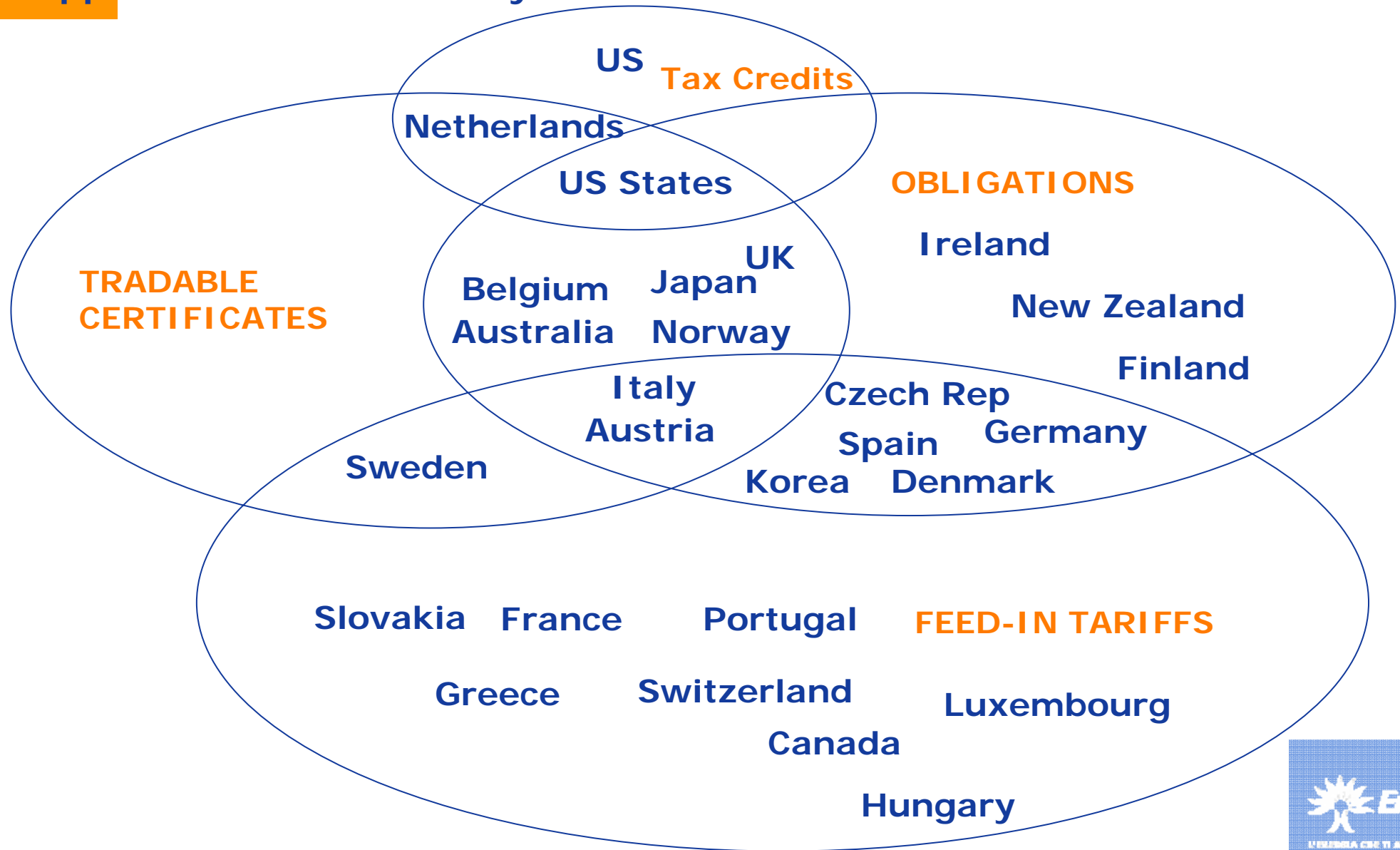
Favours less costly technologies

Need to control costs: progression in the obligation level and appropriate penalty regime

Relatively recently introduced system

Incentive to RES

Application of different systems worldwide



RES supporting systems in Italy

Early 1990s

Adoption of a **feed-in-tariff** system known as "**CIP6** ⁽¹⁾ ":
by guaranteeing high remuneration, new RES development was obtained

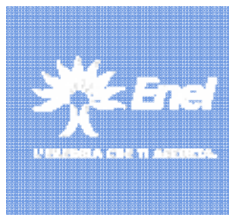
- First systematic instrument of RES support
- Incentives differentiated by source/technology (varying between 12.35 and 20.87 €/kWh)
- Costs covered by additional fee on end-user tariffs depending on consumer categories

Early 2000s

Introduction of a **Tradable Green Certificate (TGC) system**

- Generators and importers are **obliged** to feed into the national system a progressively increasing quota of electricity from new RES plants (in 2007: 3,05% of electricity generated and net imports from non-renewable sources in the previous year)
- Obligations are fulfilled by redeeming certificates issued to qualified electricity generation from RES
- Any deficit of TGCs can be faced by purchasing certificates (trading) from other operators
- Costs (~2.2 €cent/kWh on thermal generation in 2004) covered by prices on the liberalised market and by a tariff component set by the Regulator for supplies to captive customers

(1) CIP = Interministerial Committee for Prices (forerunner to the Regulator)



RES supporting systems in Italy

CIP6/92 provision - Characteristics of the System(1)

- The Cip6/92 (implementing **laws no. 9 and 10 of 1991**) intended to foster electricity generation from **renewable and equated energy sources**:

- **Renewable energy sources:**

- » Hydro (excluding generation from pumped storage)
- » Solar
- » Wind
- » Geothermal
- » Waves
- » Tidal
- » Biomass & waste (biodegradable part)

- **Equated energy sources:**

- » Basically CHP and all power plants complying with the efficiency condition:

$$I_{en} = \frac{E_e}{E_c} + \frac{E_t}{0,9 E_c} - a \geq 0,51 \quad a = \left(\frac{1}{0,51} - 1 \right) \cdot \left(0,51 - \frac{E_e}{E_c} \right)$$

Ee= the **electricity generated**

Et= the useful **heat produced**

Ec= the energy provided to the power plant in terms of fuels.



RES supporting systems in Italy

CIP6/92 provision - Characteristics of the System(2)

- Electricity price structured as in the following:
 - **Avoided cost:** (construction, operation, maintenance, related general expenses, fuel) granted for the whole duration of the supply contract;
 - **Incentive:**
 - » for the first 8 years
 - » correlated to the greater cost of each technology
 - » reduced or cancelled in the case of contributions in capital account
- The incentives are paid **by the consumers** through **an appropriate component of the electrical bill**, which the Equalization Fund of the Electricity Sector collects and redistributes

RES supporting systems in Italy

CIP6/92 – Pros and cons

PROS

- Unlimited electricity generation guaranteed for sale
- Prefixed prices, which is annually updated according to c.p.i.

CONS

- Undue benefit to CHP
- Incentives unbalanced with respect to sources/technologies
- Avoided costs and variable costs (referred to fuel) exceptionally high



Unbalanced technology differentiation has resulted in the development of wind farms and small hydro power plants only



RES supporting systems in Italy

Transition from CIP6 to TGC

Art. 11 of Legislative Decree no. 79 of 1999

From Jan. 1, 2002:

- **Obligation** for generators producers and importers of non-renewable electricity to deliver to the national electricity system a quantity of electricity generated from **power plants using renewable sources and commissioned after Apr.1,1999**
- **Initial obligation: 2% of the non-renewable electricity generated or imported in the previous year (net of 100 GWh)**
- **Exemption for CHP**
- Producers and importers can also **fulfil obligation by purchasing the equivalent quota or the relative rights from other RES producers**, provided that they introduce the electricity in the national electric system, or from the GSE (Manager of Electrical Services), the latter issuing rights based on electricity generation from CIP6 power plants, for transition purposes

For the next years:

- Percentage increase of the obligation quota



An innovative cap & trade **mechanism** for the **support of renewable sources**



RES supporting systems in Italy

TGC - Tradable Green Certificates

GREEN CERTIFICATE

- A document **certifying the origin of the electricity** generated from renewable sources.
- **A legal title** for the bearer to be commercialized separately from the physical energy that it represents.
- **A tool be negotiated** in a purposely created **market** and can be exchanged more times before being cancelled (cancellation extinguishes the obligation).
- An **instrument of control** of obligations on the amounts of renewable energy to be produced.



RES supporting systems in Italy

TGC - Eligible options

Sources

- Hydro (excluding generation from pumped storage)
- Solar
- Wind
- Geothermal
- Waves
- Tidal
- Biomass & waste (biodegradable part)

RES according
to Directive
2001/77/EC

Types of plant (for the first 8 years of operation)

- Newly built
- Powered (additional generation only)
- Revamped
- Recommitted
- Existing (only additional generation from biomass & waste)

after 1 April 1999



RES supporting systems in Italy

TGC – Focus on the Italian present system

Characteristics of a Green Certificate:

- Issued by the **GSE**
- **Undifferentiated by source**
- **Exchanged by bilateral contracts or through the organized and regulated market in charge of the Italian Power Exchange**
- Size: **50 MWh** (initially 100 MWh)
- Bankability : **1 year** (referred to actual generation)
- Granted for **12 years, 16 for biomass** (initially: 8 years undistinguished)
- TGCs are recognized to **generation / importation** of electricity from RES
- **Conditions of reciprocity** shall be applied in case of imports
- Current average price for TGCs relevant to CIP6 power plants: about 115€/MWh (It acts as a reference for market price)
- Present obligation: 3,05% with 0,35 percentual points annual increase (initially: 2%)

RES supporting systems in Italy

TGC – Import-export of certificates. Penalties

Obligations can be fulfilled also by importing electricity from *new* RES plants, under the following conditions:

- The foreign country has adopted a *similar instrument* and applies *reciprocity*
- Certification is granted according to EU rules
- In case of non EU countries, certification must be granted by a local entity under an agreement with the Italian GSE

Penalties

- The Electricity and Gas Regulator is in charge of imposing penalties to defaulters, i.e. those who haven't submitted to the GSE the amount of TGCs relevant to their obligation.



RES supporting systems in Italy

TGC – Pros & cons

PROS

TGC system introduces the following advantages with respect to feed-in mechanisms:

- Higher overall **efficiency**
- more **contained impact on the electric bill**

CONS

- GSE “regulated” price hampers a real market systems and limits the market liquidity.



Limited technology exploitation has been confirmed

RES supporting systems in Italy

TGC – Criticities to be solved

- reserving the TGCs to the "true" renewable sources
- reducing exemptions
- providing accompaniment measures for technologies particularly distant from competitiveness
- proportioning the obligation quota to the real possibilities of development considering the difficulties of authorization
- making the authorization process easier

RES supporting systems in Italy

TGC – Expected evolutions of the system

- Increased quota of obligation
- Green Certificates diversification by source/technology (different grant period duration or granted amount of electricity)
- Mixed system: TGCs and feed-in tariffs for small power plants and innovative technologies
- Guarantee of purchase of the unsold certificates by GSE
- Co-existence of capital incentives and energy incentives for innovative and far-from-competitiveness technologies
- Obligation transfer from generating companies to companies supplying final consumers (as in the English and Danish models)

RES supporting systems in Italy

Solar PV: forerunner to a new feed-in tariff mechanism

Regulatory provision

- Ministerial Decrees of 28 July 2005 and 6 February 2006

Regulatory scenario

- Feed-in tariff differentiated by power plant capacity and degree of integration in buildings: 360 to 490 €/Mwh
- On-site exchange mechanism: the balance between electricity delivered to the network and electricity consumed is not billed

Incentive duration

- 20 years

RES power plants

Licensing process in Italy: legislative decree no. 387 of 2003

- Establishes, for power plants fed by renewable energy sources and the works connected to their realization, the

unique authorization

- released from Regions or delegates
- following a unique procedure
- involving a large amount of subjects and documents to be submitted

(the procedure is not regulated but guidelines exist for proper insertion of plants in the landscape)



RES Obstacles to RES development in Italy

Criticalities

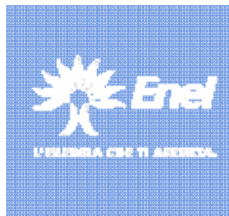
- **Cost coverage**
 - Higher costs of RES directly or indirectly impact electricity customers only
- **Barriers**
 - Basic oppositions; extreme cases: wind (also in France and Portugal)
 - Low "success rate" of new initiatives due to:
 - » length of licencing process (plants and connections to power network)
 - » number of subjects involved
 - » local oppositions
 - » different procedures in different Italian Regions
- **technological obstacles**
 - Scarce/geographically uneven potentialities
- **Power network operation**
 - Disfunctions created by the generally unstable/unpredictable electricity generation from RES

Conclusions

- **A feed-in-tariff-based system results to be the most appropriate particularly when:**
 - **fast and certain RES deployment is needed**
 - **small-medium enterprises are involved**
 - **industrial risk is to be kept as low as possible**
 - **former experience is scarce**

PROVIDED THAT PROVISIONS ARE ESTABLISHED CONCERNING

- **proper differentiation by source**
- **strict limitation of subsidies to RES proper**
- **licensing process simplification**
- **guaranteed take-off of the electricity generated**
- **minimum financial impact on final customers**
- **systematic monitoring of the system for possible adjustments**



RES supporting systems in Italy

BACK-UP



RES supporting systems in Italy

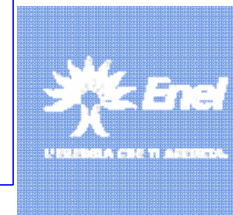
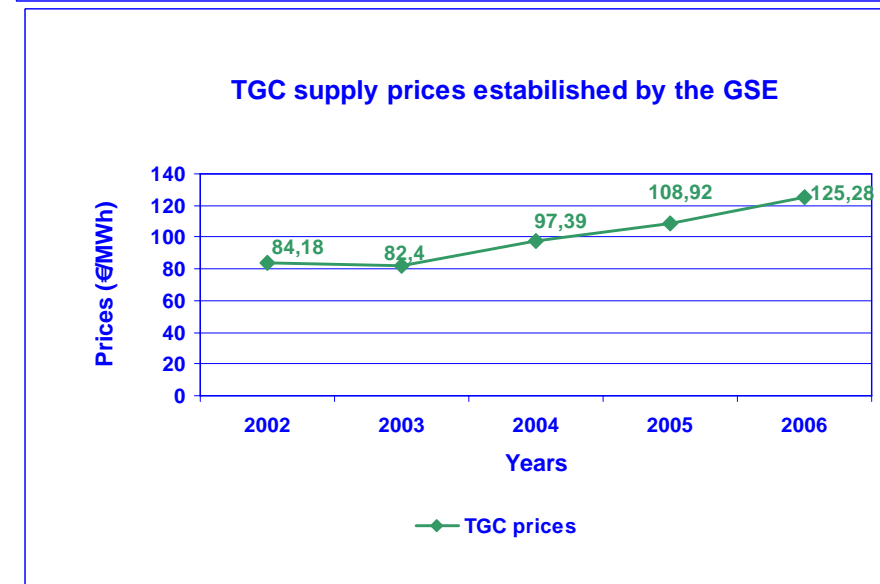
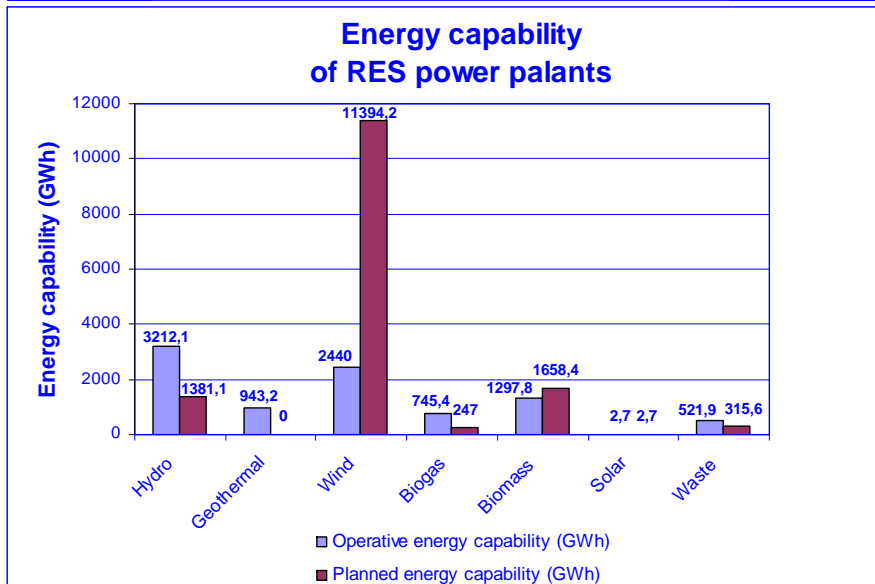
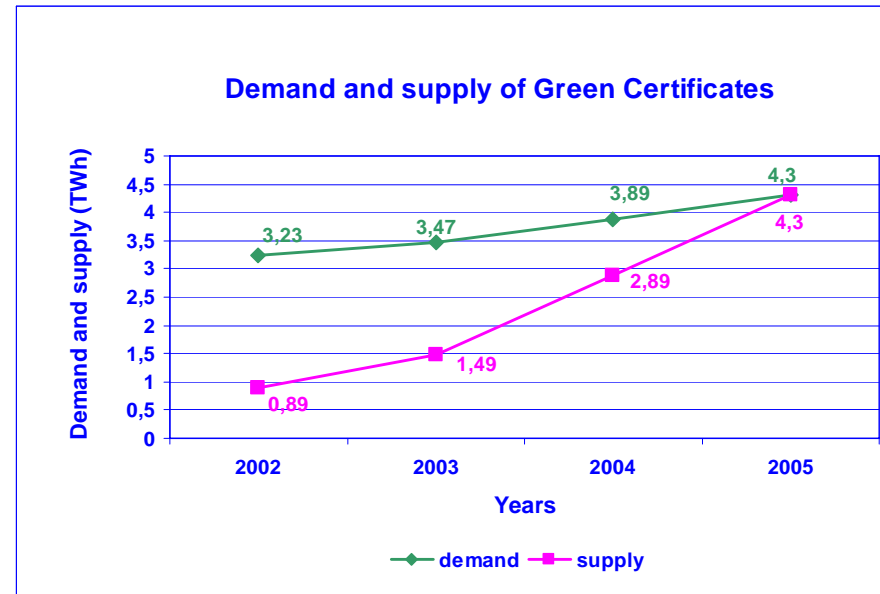
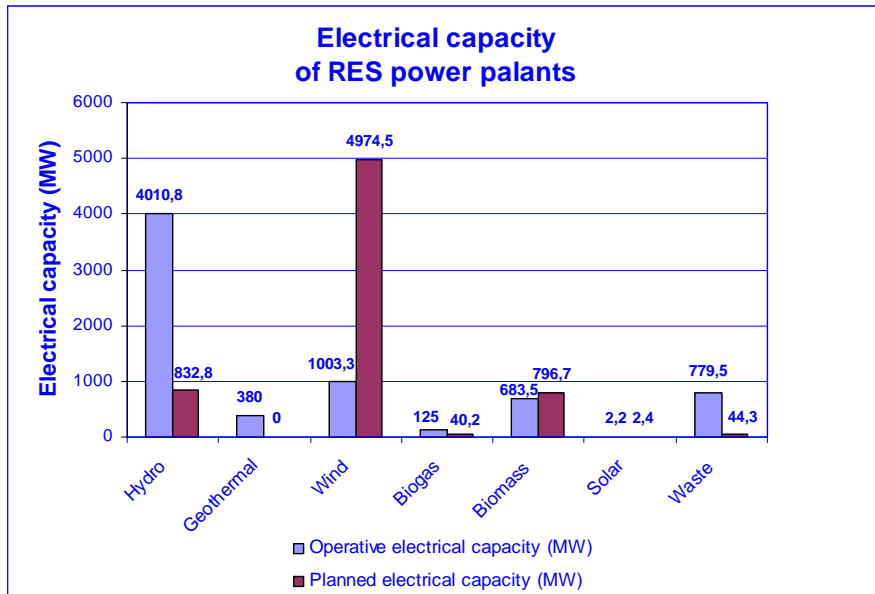
TGC – Focus On Italian System

FROM 2002 ONWARDS (DECREE 79/99):

- Tradable Green Certificates (TGC) granted to RES plants built or renewed after 4/99 **over the first 8 years of operation.**
- TGC 2004 price around **9.4 euro cents** per kWh
- “New Energy Bill” increased **the quota by 0.35%/year** in 2005-2007 and set a penalty of 1.5 times the price of missing Green Certificates.
- Green Certificate market separate by energy with **no differences by technology and type of energy source.**
- Green certificate **price depend by market** but is influenced by ceiling mechanism.
- Generators and importers will sustain costs but final **consumers bear cost on final price.**

RES supporting systems in Italy

TGC – Focus On Italian System

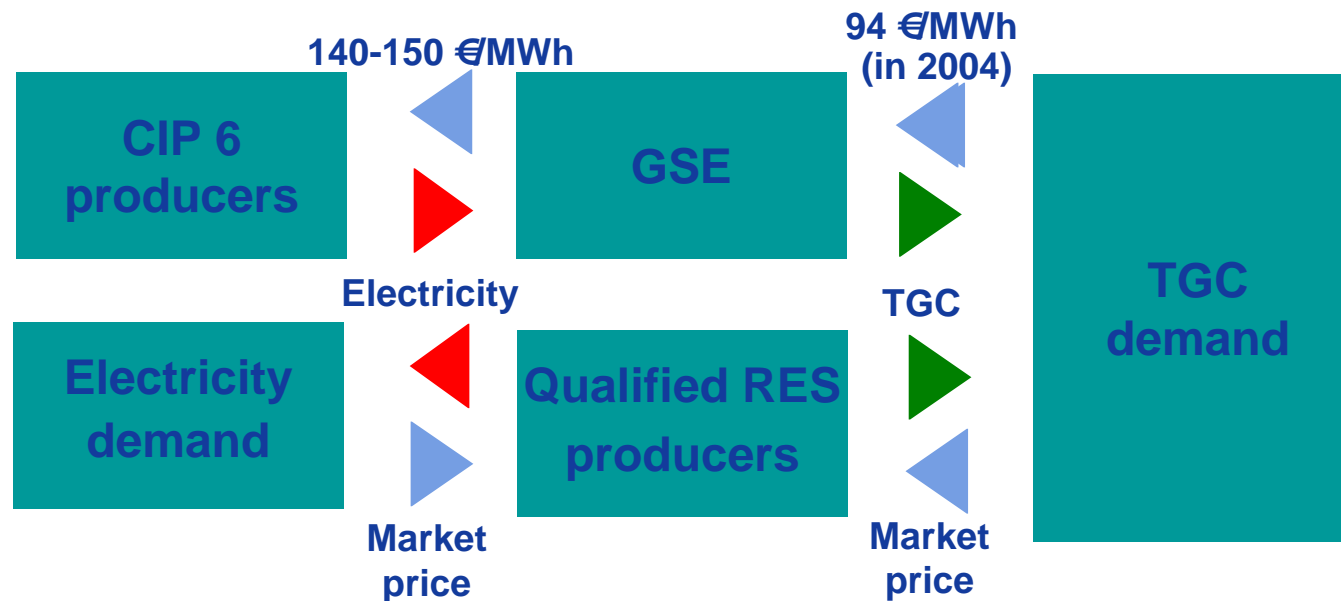


RES supporting systems in Italy

Italian case: coexistence of feed-in tariffs and TGC

“Special” TGCs

- are issued to support supply to TSO's own account for generation from *new* plants eligible for the *old* scheme (CIP6)
- can be acquired from the TSO at an administered price, corresponding to the average subsidy: *average purchase price of subsidised energy - average selling price*



RES supporting systems in Italy

Italian case: "special" TGCs help the transition from the feed-in system

Typical balance between demand and supply



Total thermal generation and net imports in previous year

Total exemptions in previous year: CHP, RE imports, 100 GWh exemption

- **Lack of supply** from qualified RES producers
- **Market price very close** to the administered price (close to the difference between CIP6 price and pool price)
- Regulation has de facto established a smooth transition to a TGC system: TGC prices give **similar incentives as feed-in tariffs**

RES supporting systems in Italy

Italian case: summary of supporting systems

	Source	Incentive	Duration
<p>CIP 6 (laws n. 9-10 of 1991 putted into effect with CIP 6 provision of 29 April 1992)</p>	<ul style="list-style-type: none"> ▪ RES (sun, wind, hydraulic energy, geothermal resources, tides, waves, transformation of the organic and inorganic refusals or vegetables products); ▪ Assimilated to RES: co-generation; use of heat of turns out, smoke of drainage and other shapes of recoverable energy in processes; use of refuse of working and/or processes; use of produced fossil sources exclusively from smaller isolate deposits) 	<p>Price guaranteed by electrical energy cession based on:</p> <ul style="list-style-type: none"> • Avoided cost of fuel • Incentive <p>With Financial institution of 2007 the assimilated sources will not enjoy more than incentives CIP6. MSE Decrees will define entity and duration of the incentives to the assimilated sources used in power plants already realized and operated to 1 January 2007.</p>	8 years
<p>TGC Lgs.D. 79/99; Lgs.D. 387/03; DM 24 October 2005; Lgs.D. 152/2006</p>	<ul style="list-style-type: none"> ▪ RES: for plants entered in exercise after the 1 April 1999 – wind, solar photovoltaic, biomasses, geothermal, hydroelectric (reconstruction and/or repowering) 	<p>The reference price, established from the GSE for green certifies for 2006, is equal to 125,3 €/MWh (to clearly of IVA)</p>	12 years
<p>Feed-in-tariff (Decree 28 July 2005; Decree 6 February 2006)</p>	<ul style="list-style-type: none"> ▪ Solar photovoltaic 	<p>Acknowledgment of the rate for electric energy production differentiated for nominal power plant power and degree of integration in the building structures, variable from 0,36 to 0,49 €/kWh</p>	20 years