NATIONAL TECHNICAL
UNIVERSITY OF ATHENS (NTUA)
GREECE

COMPETITIVE ELECTRIC ENERGY MARKET IN GREECE

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Competitive Electric Energy Market

European Union

Directive 96/92 / 19.12.1996 concerning the common rules for the internal market of electric energy.

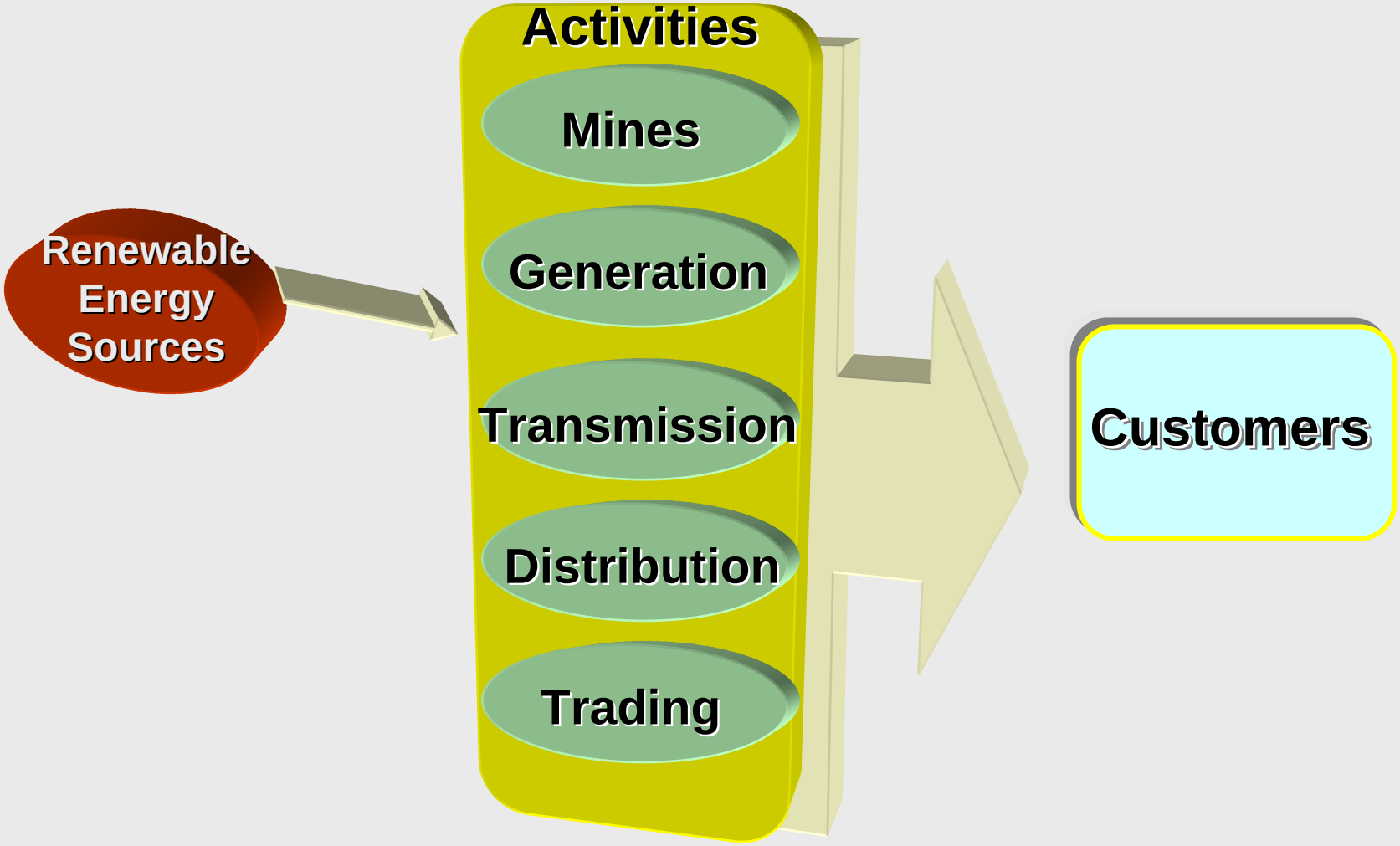
It is in effect from 19 February 1997 with a final date of 19.02.1999. For Greece, it is in effect from 19 February 2001 (two years delay).

Directive 54/2003

GREECE

The pre-liberalisation market structure

Public Power Corporation (PPC)



Recent Legislation for Electricity in Greece

Law 2773/22.12.1999 (Basic law)

Liberalisation of electric energy market - Regulation of matters concerning energy policy.

- **Independent Regulatory Authority of Energy (RAE).**
- **Hellenic Transmission System Operator (HTSO).**
- **Hellenic Distribution Network Operator (HDNO).**
- **Codes for Management and Operation of Transmission System, Trading Arrangements, Management and Operation of Distribution Network, Transmission Connections.**
- **Two types of Customers (Eligible, Non-Eligible).**
- **Tariffs.**
- **Cogeneration and Renewable Energy Sources.**

- **Production of electric energy by Producers (after authorisation has been granted).**
- **Supply of electric energy by Suppliers (sales to customers after authorisation).**
- **Access to the Transmission System and the Distribution Network on an equivalent basis.**

<u>Modifications and extensions of the basic law</u>

Law 2837/2000

Law 2941/2001

Law 2992/2002

Law 3175/2003

Law 3426/2005

Greek Power System

Transmission System: Contains the Interconnected Transmission Network (400kV, 150kV) covering the mainland and all interconnected islands.

Distribution Network: Contains all distribution networks (15kV, 20kV, 400V), sub-transmission network (150kV) in Athens, Transmission Networks (150 kV) in two isolated islands (Crete, Rhodes) and more islands in future.

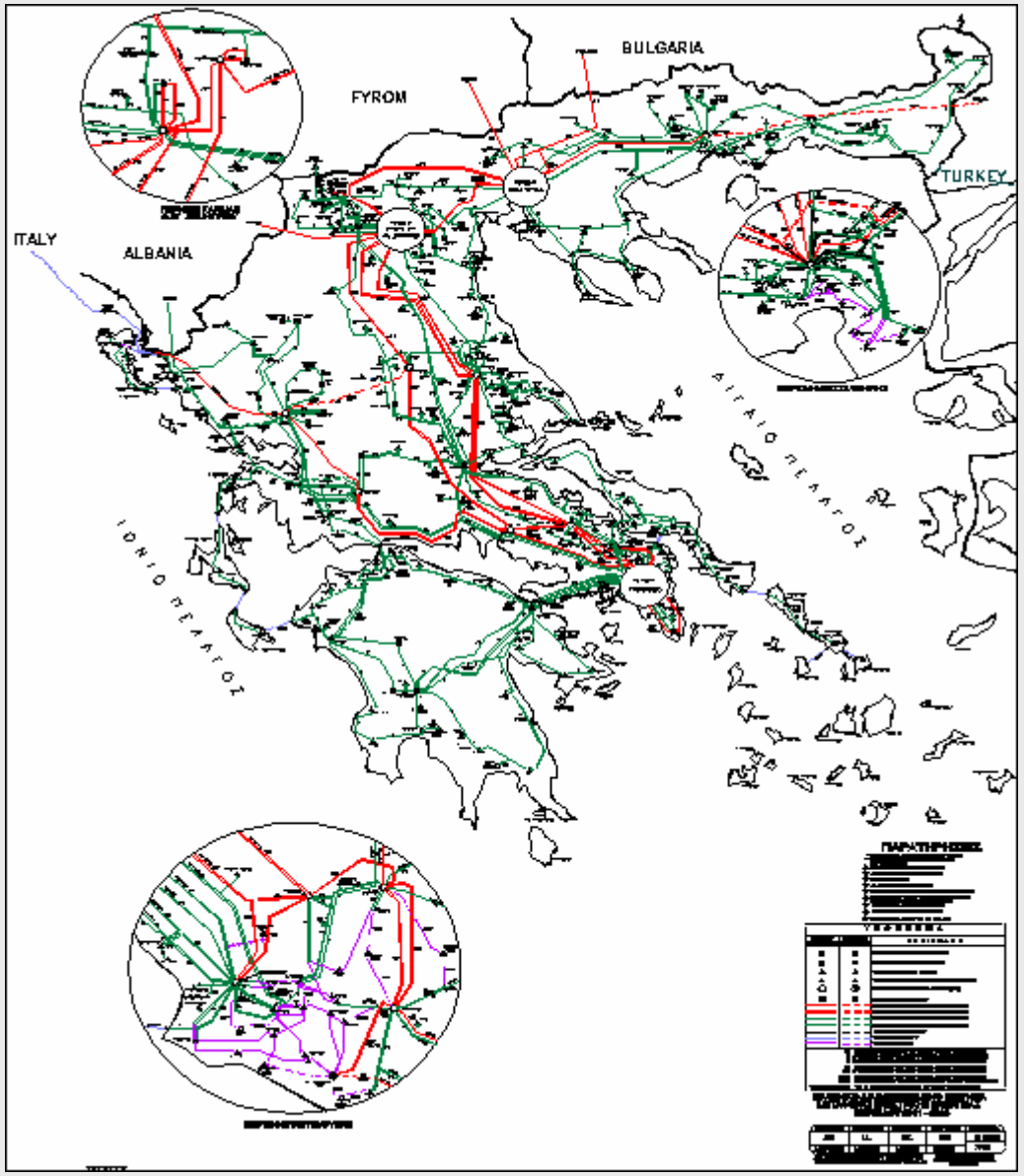
Eligible Customers in mainland and all interconnected islands:

- **All High Voltage and Medium Voltage consumers (since 2001).**
- **All consumers except residential consumers since May 2005.**
- **All consumers after July 1st 2007.**

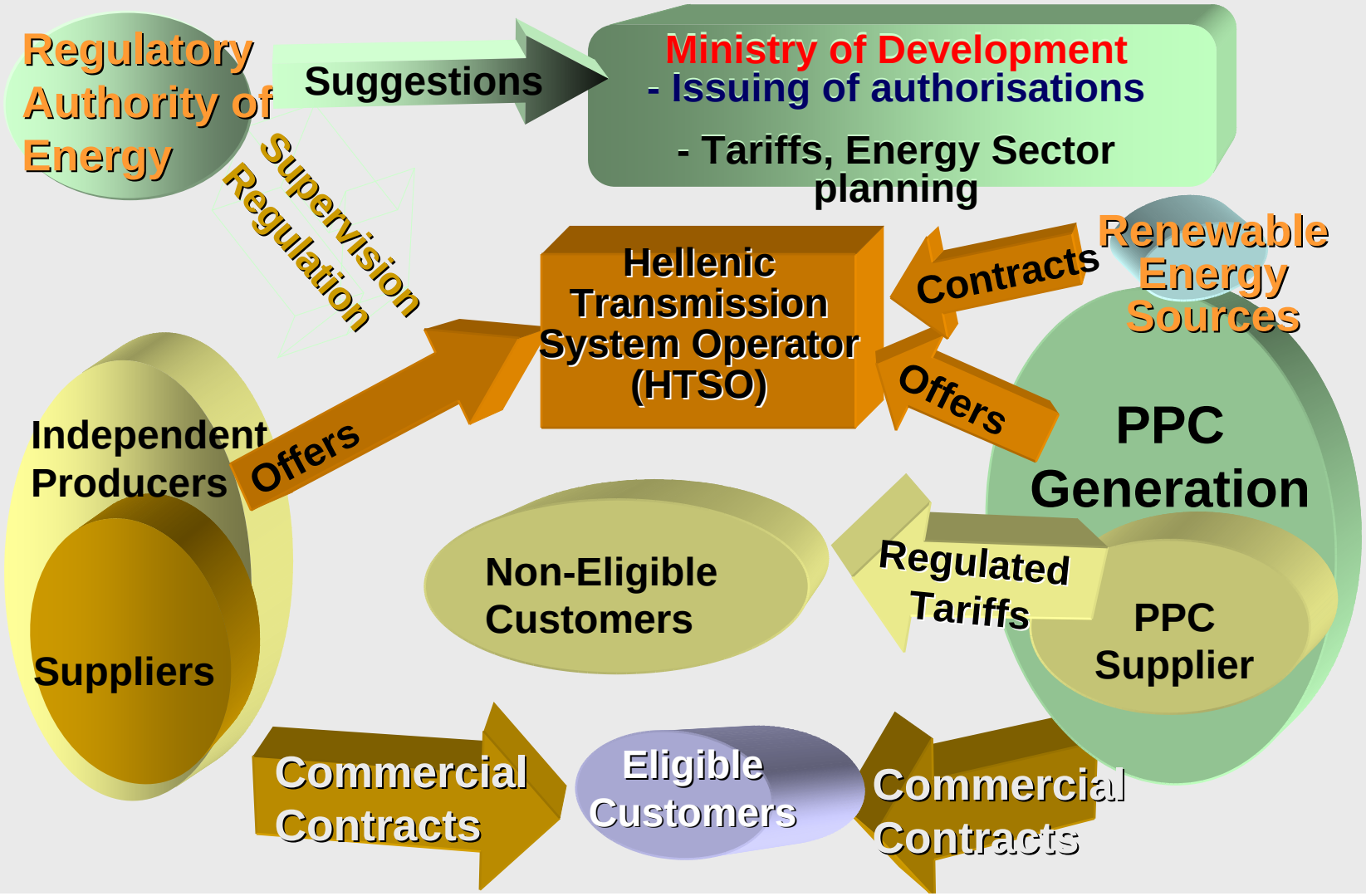
Special arrangements are applied for the consumers of the power systems in the non interconnected islands.

Social obligations are imposed on PPC.

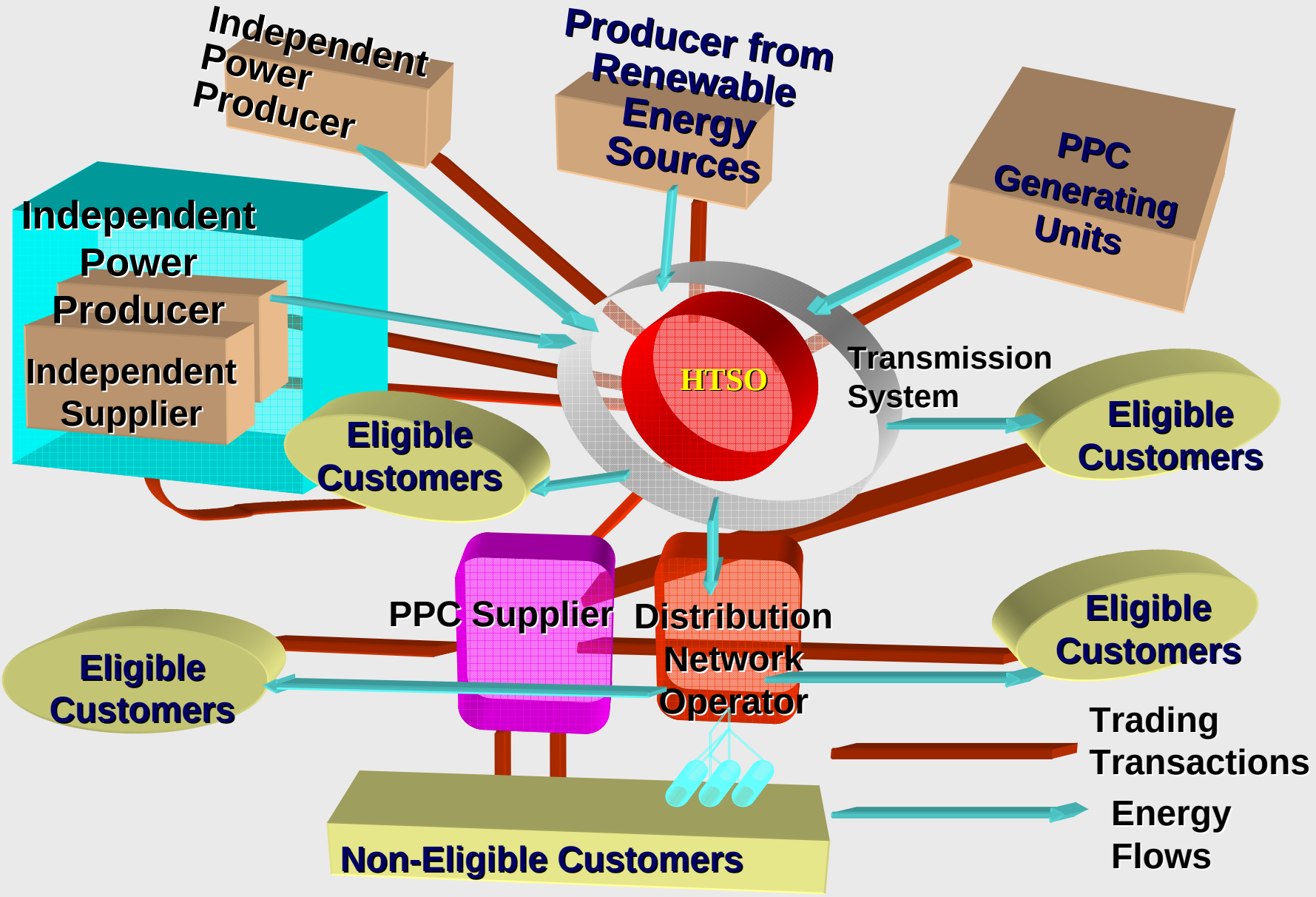
GREEK POWER TRANSMISSION SYSTEM



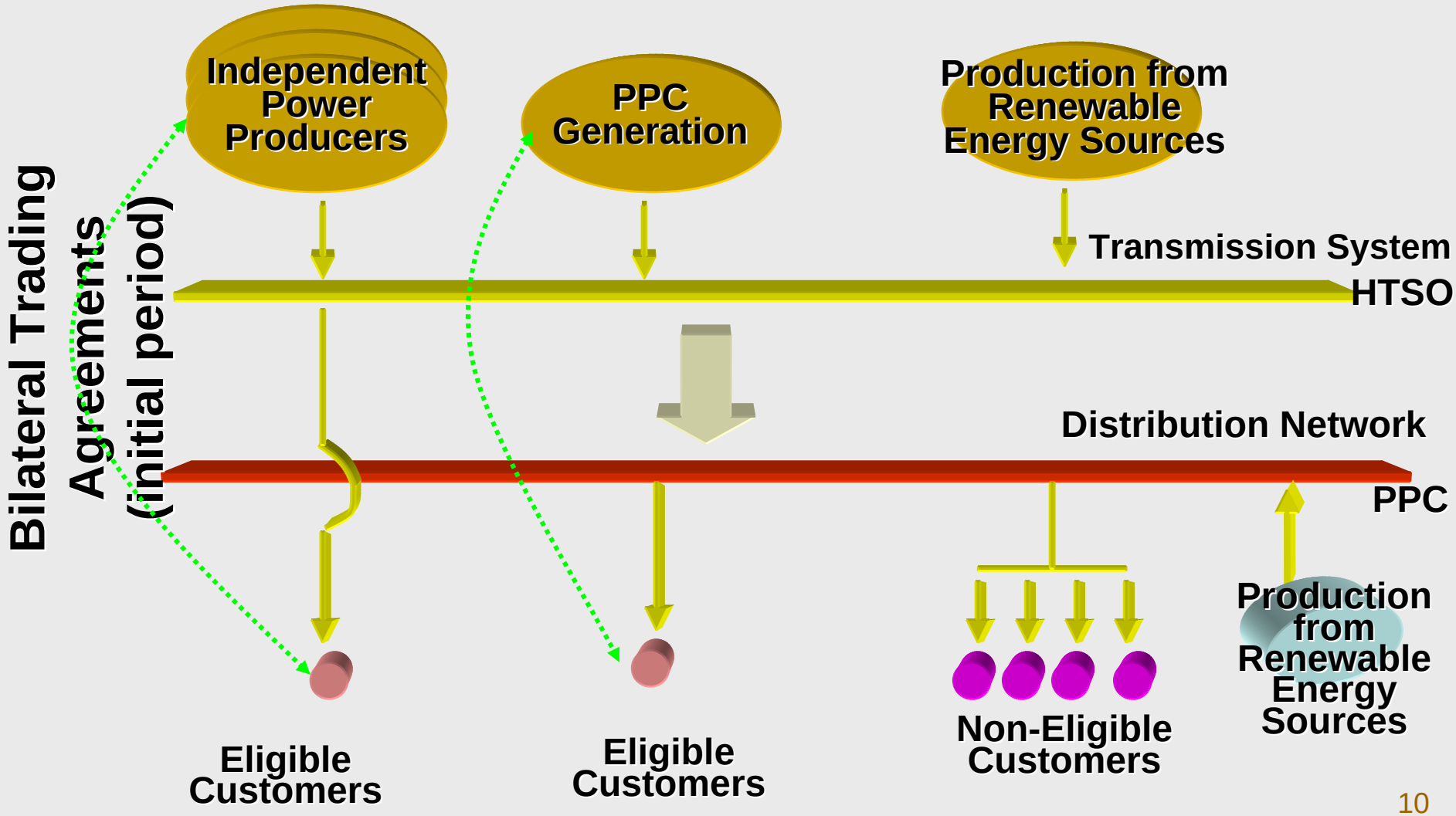
Electric Energy Market in Greece Authorities and Participants



Electric Energy Flow and Trading Transactions



Functioning of the Electric Energy Market in Greece



Basic Aspects of Interconnected Transmission System (end 2006)

Authorised (Licensed) Producers

Public Power Corporation (PPC) and Independent Power Producers (IPP)

- PPC operates 31 thermal generating units (7440 MW) and 22 hydroelectric generating units (3045 MW) – Total Capacity 10485 MW.
- 2 IPPs operate two thermal stations - Total Capacity 540MW.
- PPC and IPPs operate power stations using Renewable Energy Sources such as Wind Parks (560 MW), Small Hydroelectric plants (124 MW), Small Cogeneration plants (46 MW), Biomass plants (37 MW) - Total Capacity about 780 MW.

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Authorised (Licensed) Suppliers

PPC as Supplier and Private Companies

- They sell energy to the Greek consumers.
- They import energy from neighbouring countries through the existing interconnections.
- They export energy to neighbouring countries through the existing interconnections.

Peak Load Demand (August 2006): 9965 MW

Installed Generating Capacity: 11800 MW
(48% Lignite, 26% Hydro, 21% Natural Gas, 6% Oil, 6% Renewable Energy Sources)

Capacity of Interconnections:

- 600 MW (with the countries in the northern borders)
- 500 MW (with Italy)

Suppliers

- Only Authorised Suppliers may sell electricity to consumers and may participate in the trading arrangements.
- Ministry of Development issues the Authorisations to Suppliers after recommendation of RAE.
- Suppliers must provide Power Availability Certificates (PAC) of appropriate size that correspond to a long term guarantee of system load demand supply (requirements with new legislation).

Initial Aspects of Electric Energy Market in Greece (2001-2005)

- Bilateral contracts between Producers or Suppliers and their Customers.
- In real time operation, HTSO was responsible for managing the imbalances between generation and load demand by applying a unit commitment programme based on the respective generation offers.
- Settlement period was one hour.
- Settlement was based on the cost of the most expensive generating unit to meet the load demand (System Marginal Price - SMP).

Modifications in the Legislation for the Electric Energy Market (2003-2005)

- PPC has become a joint stock company and its stocks have been introduced in the Athens, London and New York Stock Exchanges – More than 50% of the stocks belong to the Greek Government.
- The parts of PPC concerning power generation (Producer) and power supply (Supplier) have become operationally independent.
- Development of an electric energy market and a market for ancillary services through a daily market followed by an appropriate settlement of deviations.
- A new organisation will be formed from July 1st 2007 that will be responsible for the Operation of Transmission and Distribution Networks (HTDSO) in mainland and all interconnected islands.
- A new organisation will be formed that will be responsible for the Operation of Networks in the non – interconnected islands.

New Aspects of Electric Energy Market (2005)

Objective: To minimise the cost for supplying the load demand for each Dispatch Day and provide a secure system operation with appropriate reserve levels.

Dispatch day: 24 hours from 00.00 until 24.00 of each calendar day.

Dispatch period: One hour.

Participants of the Market

- Producers owing generating units with valid authorisations.
- Suppliers with valid authorisations.
- Eligible Customers that have decided to buy electric energy for supplying their own load demand directly through the market.

For each hour of the Dispatch Day (and before 12.00 of the previous day):

- Producers submit Injection Offers for each generating unit with appropriate cost values that can not be smaller than the respective operational costs.
- Suppliers and Eligible Customers participating in the market submit Injection Offers for importing power through the interconnections.
- Suppliers submit Load Nominations for the supply of the respective load demand (their customers in Greece, own demand).

- Producers and Suppliers submit Load Nominations for exporting power through the interconnections.
- Producers submit Reserve Offers for each generating unit with two appropriate cost values (primary and secondary reserves).
- HTSO submits Reserve Offers for each generating unit that has a contract for providing ancillary services.

Following the Submission procedure of Injection Offers and Load Nominations, for each hour of the Dispatch Day, HTSO:

- determines the plan of reserve levels for system security
- determines the dispatch procedures for load demand supply and reserve allocation by accepting the respective offers and nominations
- calculates the System Marginal Price (SMP) in Euro/MWh that corresponds to the marginal cost of satisfying the marginal unit of load demand and reserves
- makes all the appropriates actions for debiting and crediting the accounts of the respective market participants by using the SMP.

Additionally, HTSO settles the existing deviations in the following days.

Comments on Market Operation (since 2001)

- Very small changes in the profile of generation structure.
- Ten Authorisations have been granted to Independent Power Producers (IPP) for thermal plants using only natural gas due to environmental constraints (245 MW - 440 MW). They are combined cycle plants or they use gas turbines (50 MW).
- One IPP with a combined cycle plant (390 MW) and one IPP with gas turbines (3x50 MW) started operating while one IPP with a cogeneration plant (330 MW) will start its operation during 2007 – Total capacity 770 MW (< 7%).

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- Authorisations have been granted to Suppliers (private companies) for importing energy through the existing interconnections (2000 MW).
- A small number of Eligible Customers (mainly commercial consumers) have changed their Suppliers (private companies and not PPC). However, due to certain reasons concerning the operation of the market and the customer tariffs, these customers decided to be PPC customers again.
- A small number of Eligible Customers import energy through the existing interconnections.

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- More than 500 Authorisations have been granted to Independent Power Producers (more than 1200 applications) for constructing wind parks and small hydroelectric plants (more than 7000 MW to be installed).
- Incentives for power generation have been discussed and appropriate actions were decided.
- HTSO will tender Capacity Availability Contracts (CAC) for new generating units in order to ensure the adequacy of power generation in the country.
- There will be three contracts concerning combined cycle plants (about 400 MW each) and PPC can not participate in the tender procedures.

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- The plants with CAC can participate in the electric energy market without any particular advantages or disadvantages. However, HTSO guarantees a part of their annual investment for 12 years through the profit gained during the daily market operation for 70% of their generation capacity.
- The first tender procedure for a combined cycle plant (about 400 MW) started in May 2006 and it will be finished shortly. The annual CAC value was set to lie in the range 35000 - 90000 EURO/MW. Four IPPs take part in this tender procedure. Two of them offer 35000 EURO/MW (430 MW, 399 MW).
- PPC can replace the old thermal plants (up to a generation capacity of 1600 MW) with new ones of recent technology and increased operational performance.

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- PPC Producer owns lignite power plants and large hydroelectric plants that cover more than 90% of system generation capacity.
- The Injection Offers of PPC Producer usually lie within the range 30 – 35 EURO/MWh depending on the hour of the day.
- The Injection Offers of existing IPP with gas fired generating units lie within the range 60 – 65 EURO/MWh (based on prices of natural gas in Greece).
- The operational period (hours) of IPP plant was quite limited.
- RAE decided to modify the method of calculating the SMP and this increased it to 60 – 70 EURO/MWh for a long period of the Dispatch Day.

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- This decision had four major effects by taking into account that the regulated tariffs for industrial and commercial Eligible Consumers lie within the range 40 – 50 EURO/MWh.
  - The thermal plant of IPP operates for a satisfactory number of hours during the year.
  - The Suppliers importing power through the interconnections decided to sell electric energy directly to the market by submitting Injection Offers and not to Eligible Customers through appropriate contracts.
  - The Eligible Customers being supplied by Independent Suppliers were forced to be supplied again by the PPC Supplier (market opening was effectively cancelled).
  - PPC suffers additional financial burdens (difference between SMP and consumer regulated tariffs).

- Average values of SMP:
  - 43 EURO/MWh during 2005
  - 64 EURO/MWh during 2006

This significant increase (50%) is due to the increase international prices for natural gas and oil, the increased participation of plants using natural gas in the market (it will continue increasing in the following years) and the new method for calculating SMP.

Certain actions were applied recently such as modifications to the existing method for calculating SMP and changes in the regulated tariffs (increase by 4% to the tariffs of industrial consumers was already decided).

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- The market concerning natural gas needs further development so that the respective prices could be decreased.
- All available energy resources could be used by IPPs for power generation (not only natural gas) by taking into account the respective carbon emission requirements of the country.
- Significant increases in the regulated tariffs of consumers are expected.

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Management of Interconnections with Neighbouring Transmission Systems

Interconnections with Countries in the Northern Borders (Bulgaria, FYROM, Albania)

Five Interconnections with HVAC lines
(3 in 400 kV and 2 in 150 kV)

Total Capacity: 600 MW

Interconnection with Italy

One Interconnection with HVDC overhead lines and a submarine cable (400 kV)

Owners: TERNA Spa (75%), PPC (25%)

Total Capacity: 500 MW

- During 2006, about 8% of total system energy demand was imported through the interconnections (about 70% from Bulgaria).
- This can not continue during 2007 due to the closure of nuclear plants in Bulgaria and the dry hydrological year.
- It is very difficult to determine the schedule for imports and exports for year 2007.
- Long term auctions take place on a monthly basis and, possibly, covering shorter periods of the month and time periods of the days.

Electric Power Generation from Renewable Energy Sources

Special Regime

- Subsidising of Investments.
- Contracts with HTSO.
- Priority in dispatching procedures.
- HTSO buys electric energy at stable prices (about 0.07 Euro/kWh) and especially 0.40 - 0.45 EURO/kWh for generation from photovoltaics.
- No charges for the Use of the Transmission System or the Distribution Network.
- No allocation exists for power losses.
- High level of wind penetration is expected and it is required to take appropriate measures for the connection of wind parks to the transmission system.

Conclusions

- Competitive Electric Energy Market in Greece: 19 February 2001.
- Legislative arrangements have been developed and applied.
- Eligible Customers: (Except non – interconnected islands)
  - All the consumers except residential ones.
  - All the consumers after July 1st 2007.
- Authorisations to Producers for thermal plants using only natural gas (about 3000 MW).
- Authorisations to Suppliers for importing energy through interconnections (2000 MW).

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Conclusions

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- No real competition in the generation sector has been shown - No significant changes in the Suppliers of Eligible Customers.
- Incentives or other measures have been studied to be implemented for establishing real competition and obtaining the appropriate generation capacity for load demand supply and reserves.
- One such incentive has already been applied concerning the construction of a combined cycle thermal plant (about 400 MW) through a Capacity Availability Contract.
- No congestion problems exist.
- Determination of fees concerning the Use of Transmission System and the Interconnections.
- Operation of a market for each Dispatch Day through Injection Offers and Load Nominations of the market Participants (Producers, Suppliers, Eligible Customers).

Conclusions

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- Calculation of System Marginal Price (SMP) for each hour of the Dispatch Day and financial settlements of all participant actions.
- Certain problems have been created from the method being applied for the calculation of SMP.
- IPPs could use all available energy resources (not only natural gas) while the carbon emission requirements of the country are applied.
- Special regime exists for IPPs using renewable energy sources and a significant number of authorisations has been granted (mainly wind parks - more than 7000 MW).
- High level of wind penetration to the transmission system is expected that needs appropriate measures to be taken.