Electricity & Sustainable Energy Sector: Regulation & Strategic Goals for Greece & EU

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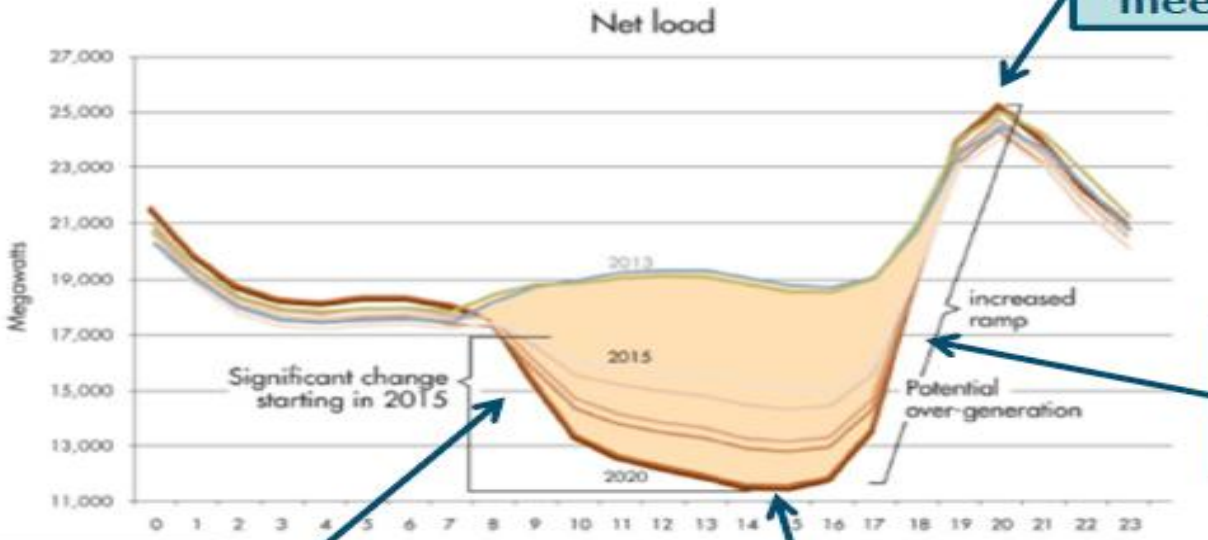
The Key Greek Electricity Sector Dilemmas

- ✓ Slow economy has stalled energy consumption
- ✓ Efforts to meet EU 2020 targets and high subsidies have led to uncontrollable and expensive Renewable Energy Sources (RES) growth and have unbalanced the structure of the electric generation
- ✓ Currently the system is experiencing an over-supply of generation
- ✓ Market prices are falling and retail prices are rising
- ✓ Development in RES threatens gas-fired plants' profitability (flexible generation)
- ✓ Currently we have a highly subsidized market

Market/System Problems Due to RES: The Anatomy of the “Duck”



Need capacity to meet peak load

Need upward ramping capability

Need downward ramping capability

Need Pmin (minimum production) flexibility to avoid overgeneration

Unstable Energy Markets: Consequences

- ✓ Conventional generation plants will be forced to close except if they are subsidized
- ✓ RES energy subsidies are reaching unsustainable levels leading to higher energy prices for consumers and industries
- ✓ The differential in energy prices between the EU and other markets (such as US) is creating a real emergency for Greece and Europe which is losing competitiveness and energy-intensive industries are shifting elsewhere
- ✓ Erratic prices are appearing in the market

Unstable Energy Markets: Consequences

CO_2 Reductions

- ✓ High energy prices create a problems for Greece and EU as it tries to attract (and retain) investors who are big energy users
- ✓ Utilities are losing large shares of their revenues
- ✓ Needed infrastructure investments are implemented too slowly
- ✓ CO2 emission rights prices are too low to trigger low carbon investments

Proposals for Resolving the Electricity Sector Dilemmas

Resolving the Electricity Sector Dilemmas

- ✓ Electricity Market and Regulatory Reforms
- ✓ FiTs/Subsidies vs. Market Based RES Incentives
- ✓ Green Credits Trading vs. Physical Transfer of RES
- ✓ Net Metering vs. Traditional Charging for Energy

Electricity Market and Regulatory Reforms

CO_2 Reductions

- ✓ Reform the ETS market and adapt allocation levels to economic situation
- ✓ Implement a capacity market throughout Europe
- ✓ Reduce RES subsidies
- ✓ Institute major electricity market reform and remove the structural problems of the current design
- ✓ Adopt a business model and a regulatory framework to enable the smart energy systems financing and deployment

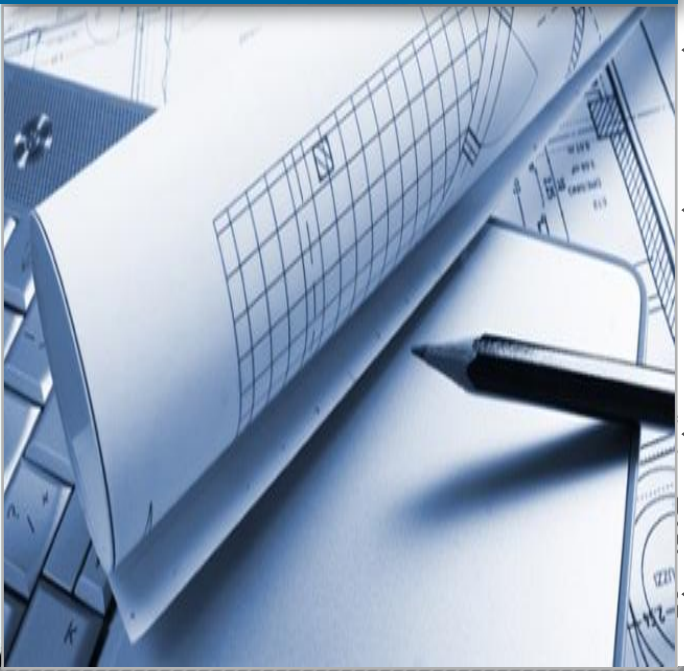
Smart Energy Systems Can Provide Solutions

Invest in smart energy systems

- ✓ Have the potential to be backbone of the future decarbonized power system
- ✓ The reason is that they can allow smart energy (the ultimate solution) to move load around to match generation
- ✓ This will result in reduced generation and grid investments, thus reducing customers' bills
- ✓ Improve security of supply
- ✓ Finally smart grids have the potential to create an explosion of innovation opportunities and economic growth

Electricity Market and Regulatory Reforms

Market & Regulatory Reforms



- ✓ Implement the Target Model to include a Forward Market, a Day-Ahead Market, an Intra-Day Market and a Balancing Market
- ✓ Abolish the current market clearing in favor of a Power Exchange to clear the Day-Ahead market
- ✓ Gradually introduce a Bilateral market to establish an equilibrium between the volumes cleared in the Exchange and the Bilateral market
- ✓ Implement the privatization plan of PPC as soon as it is feasibly possible
- ✓ Give access to inexpensive fuel sources to IPPs

Virtual Power Plant Auctions (VPPs)

- ✓ With this instrument PPC can sell part of its production capacity via Auctions to other market participants
- ➢ The divestiture of generation capacity remains virtual since no ownership or production capacity changes hand
- ➢ The key reason that a VPP Auction is an effective alternative to a physical divestiture is the fact that the VPP capacity reduces the incentives and ability of the seller (PPC) to influence wholesale market prices
- ✓ We can implement Financial VPPs or Physical VPPs

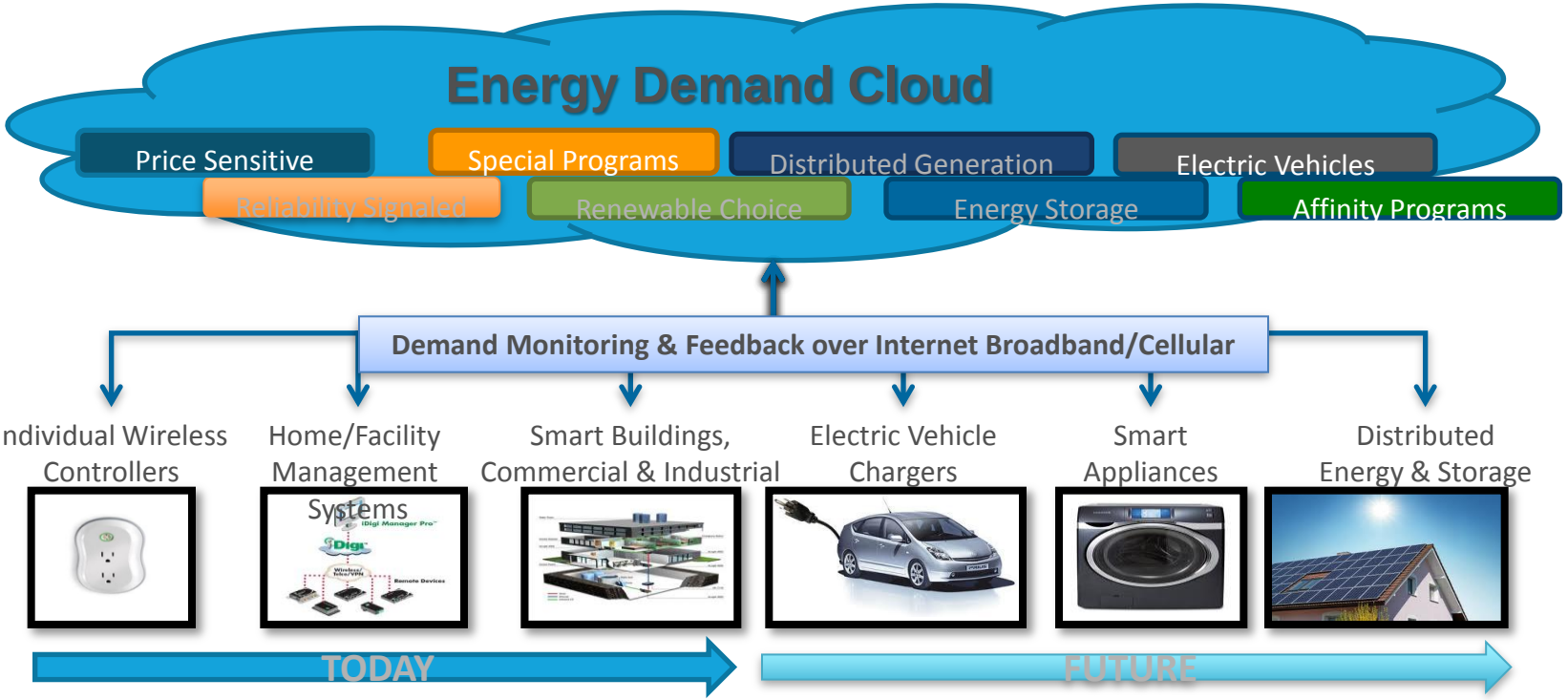
Financial VPPs vs Physical VPPs

- ✓ With financial VPPs the buyer remains a passive observer in the market while PPC retains ownership and even physical dispatch of the plant
- ✓ If the spot price is higher than the strike price of the VPP, PPC pay the buyer the difference
- ✓ With physical VPPs the buyer becomes an active participant in the market where it can sell physical capacity in the bilateral or the spot market
- ✓ Physical VPPs can activate the retail market

FiTs/Subsidies or Market Based RES Incentives

- ✓ FiTs need to be reduced
- ✓ Large RES will have to market their output – no protection and guaranteed tariffs
- ✓ Eventually large RES need to participate in the DAS market with a price
- ✓ Use net revenues raised from the carbon market to subsidize tariffs for small RES, if necessary
- ✓ Extend binding RES targets or abolish them all together
- ✓ Focus should be to promote climate change without sacrificing economic competitiveness

Demand Response: Energy Demand Cloud -> VPP



DR client is ~10kb—virtually any embedded device can run it

Green Credit Trading vs. Physical Transfer of RES

- ✓ In a perfect market, product can move freely from any supplier to any consumer
- ✓ The grid is not a perfect market, it is a constrained market with major bottlenecks throughout the system
- ✓ Renewable Energy tends to be decentralized compared to traditional generation and as a result significant capital expenses of additions to the grid are required to aggregate the Renewable Energy and transmit it to Load
- ✓ Allowing the production and trade of Green Energy Credits helps to “perfect” the market, as they are easily transferrable
- ✓ Credits can be traded through Annual and Quarterly Auctions, as well as OTC

Green Credit Trading vs. Physical Transfer of RES

- ✓ Specialty Products could be developed with different pricing, such as an “On-Peak Solar” or “Off-Peak Wind” Credit
- ✓ Green Credit Trading results in meeting RES targets at least cost since zones may sell excess green credits to other areas to meet their own requirements without exporting physical energy, thus without impacting the existing grid infrastructure
- ✓ Renewable Generation qualification and metering must be certified through an impartial third party
- ✓ The Exchange for Trading of Credits must be impartial, ransparent and have sufficient financial backing

Net Metering vs. Traditional Charging for Energy

- ✓ Net Metering is already applied in many countries (Australia, Belgium, Brazil, Denmark, USA, Israel, Italy, Canada, Cyprus, Mexico, Thailand, Turkey)
- ✓ Net Metering simply nets the produced and the consumed energy for a certain period, usually a billing cycle
- ✓ Given that most meters are bidirectional, the application of net-metering shall not necessitate major investments from the consumers
- ✓ Net Metering is another regulatory tool to suppport the develpoment of renewable energy
- ✓ It can be effective under certain conditions

Net Metering vs. Traditional Charging for Energy

- ✓ Determine the netting period (**Billing Cycle**)
- ✓ Shoulld the excess energy be allowed to roll over to the next billing cycle? For how long? (**Yes, for a year or for ever**)
- ✓ Should there be any restrictions of Net Metering ? (**No**)
- ✓ Will the Net settlement include taxes, usage charges? (**It should**)
- ✓ Will Virtrual Net Metering be allowed ? (**Yes**)
- ✓ Should there be any compensation for the excess energy injected into the grid? At what price?

Net Metering vs. Traditional Charging for Energy

- ✓ The surplus of injected energy in the network can:
  - ✓ be compensated in the feed-in tariffs, in the wholesale market prices (avoidable cost) or in the retail market prices
  - ✓ not be compensated, but credited to the consumer for a certain period of time (e.g. one year), at the end of which (if positive) one remuneration takes place
- ✓ International practice has shown that compensation of the excess energy is NOT necessary as long as roll over of excess energy extends for a long period of time

EU Energy Agenda and Policy Goals

- ✓ Develop a clear carbon signal (revamp the ETS market)
- ✓ Reduce subsidies for RES (they are currently unsustainable and have unbalanced the structure of electric generation)
- ✓ Large RES should have to market their output - no protection
- ✓ Harmonize EU energy markets (Target Model)
- ✓ Use net revenues raised from the carbon market to subsidize domestic tariffs, only if necessary
- ✓ Implement policies to address the energy issue and the competitiveness of the EU industry
- ✓ Implement Capacity Market Mechanisms
- ✓ EU should concentrate on R&D and new technologies such as CCS, Storage and smart energy technologies