Off-peak energy consumption reduces capacity curtailments of RES units

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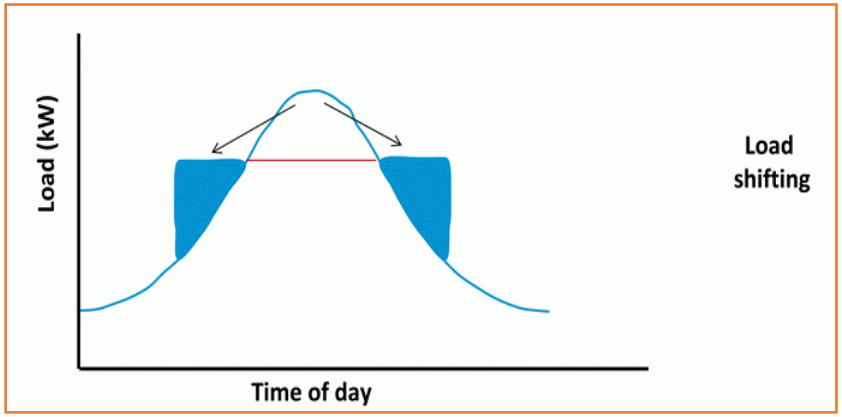

- *Calculation of a 5% shift of household loads from a peak zone on 26/07/2023.*
- *How much the penetration of renewables in the electricity mix is increasing by shifting 5% of household loads on 26/07/2023?*
- *How much battery storage investment do we save and how does it affect the level of state participation by using dual–zone meter (night-tariff)?*
- *How much would the curtailment of renewable energy units be if we had moved 5% of household loads off-peak by using dual–zone meter (night-tariff) for the whole of 2023 in Hellenic energy market?*
- *Enhance competition in wholesale energy market by load shifting.*

Power system data on 26/07/2023 in Hellenic market (Highest summer day energy demand)

Total RES units in the electricity mix	*Total RES units in the peak zone*	*Maximum hourly demand at 3pm*	*Hourly demand in the Peak Zone Between 14pm -16pm*	*Total domestic demand from household consumers*
25% 42.955 (MWh)	47%	10.385 (MW)	10.343 10.385 10.205 (MW)	65%

Load shifting is mostly found in industrial process reducing a company's cost.

How does the attitude of household customers impact on wholesale market reducing the curtailment of RES unit as well as the needs of battery storage?

Calculation of the energy transferred from the peak zone

Energy transferred $= E x \Theta x 0{,}0325$ (MWh)

- ***E*** *= The energy (area) of the peak zone* $E=\sum_{i=1}^{24} p^i\, t^i$

  E*= 10.345+10.385+10.385+10.205= 30.935 MWh*
- ***Θ****= The percentage of thermal units in the peak zone.*
- ***0,0325*** *= Constant Coefficient.*

The energy corresponding to 5% of the load shift

Peak zone area (MWh)	*Percentage of thermal units and imports in the peak zone*	*Percentage of consumption absorbed by household consumers*	*Percentage shift from the peak zone*	Energy that shifts (MWh)
30.935 MWh	53%	65%	5%	**533 MWh**

1. ***If 400,000 consumers participate then: 533,000 KWh / 400,000 = 1,332 KWh. Each household consumer transfers 1332 Wh which corresponds to 444 W / 3h. - It is realistic -***

2. ***This energy can be covered by renewable energy units, increasing RES units by 1,24%. (533 MWh / 42,955 MWh = 0,0124 = 1,24%)***

Transmitted energy - battery installation mismatch

The transferred energy of 533 MWh corresponds to:

533MWh / 0.9 = 593MWh of batteries.

These yield:

593MWh / 3h = 200 MW for 3h or

593MWh / 2h = 300 MW for 2h

Therefore, *if the 400,000 consumers transfer 5% of their consumption away from the peak zone, they will be covered 1/3 of their energy storage needs for two hours, at no extra economic cost.*

* *The National Energy and Climate Plan foresees 1000MW/2-3h batteries behind the meter.*

As the battery storage is defined based on total RES unit production, addressing over-generation, rather than the actual size of consumer demand, the requirements for storage will increase further and further with a significant impact on overall cost of energy and viability of investment.

Economic benefits of implementation

Reduced investment costs creating a sustainable environment for energy storage.

1000 MW/2h – 300 MW/2h = 700 MW for 2h.

- ***The cost of equipment** (converter, batteries) that will satisfy 200MW for 3 hours is 200 million euros. (According to current market data)*

- ***Lowest state support.***

Reduction of the percentage of state aid, currently estimated at 50% of the investment cost for 1000 MW/2-3h batteries.

* *While we are facing an investment deficit in the European energy grid of 800 billion Euros by 2030 (European Round Table Report)*

Calculation of converter costs according to BloombergNEF forecasts

By the Numbers

$152/kWh — BNEF's volume-weighted lithium-ion battery pack price forecast for 2023

28GW/ 69GWh — BNEF's stationary energy storage installation forecast for 2023

$300/kWh — BNEF's forecast turnkey energy storage system costs for a four-hour duration system in 2023, on a usable basis

Near-term lithium-ion battery cell and pack price forecast

Source: BloombergNEF

How much does load shift affect in RES units' curtailment for the entire period 2023?

Current data:

- *The annual production of RES units reached a level of 21 TWh for 2023, according to data from IPDO, (occupied 43% of total energy demand).*
- *The curtailments of RES units in total production reach to 1.1% for the year 2023 corresponding to 0,231TWh (231.000 MWh).*

Under the following assumptions:

- *The average daily energy in the peak zone 20.000 MWh*
- *Average renewable energy participation in the peak zone 60%*
- *The average of the total RES participation in the daily energy mix.*

  (21TWh/365 = 0,057534 TWh)

The growth rate of renewables with 5% load shift

$$\frac{E \times \Theta \times 0{,}0325}{\Psi} = \textbf{Increasing the share of RES units in the total energy mix} \times 100$$

E= The energy (area) of the peak zone $\mathbf{E}=\sum_{i=1}^{24} p^i\, t^i$

Θ = The percentage of thermal units in the peak zone.

0,0325 = Constant Coefficient.

Ψ = The total contribution of RES units in the energy mix.

Demand Response (D-R) results for the whole of 2023

Average daily energy area in the peak zone	Average daily contribution of clean energy sources in the peak zone	The total contribution of RES units in the daily energy mix	Percentage increase of RES units in the energy mix.
20.000 MWh	60%	43% (IPDO) 57.600 MWh	**0,45%**

RES power curtailments are limited to 0.65% instead of 1,1% for the whole of 2023

(RES curtailments - RES increased = 1,1% - 0,45% = 0,65%)

231.000 MWh – 94.500 MWh = 136.500 MWh

Economic benefit: 94.500 MWh x 90 Euro/MWh = 8.505.000 €.

Therefore, if we had implemented load shifting for the whole of 2023, the market would have reduced RES unit curtailment almost in half.

**While it is expected to be an aid of battery storage after 2026.*

Competition in the Wholesale Energy Market

Shifting load, from times zones of high energy demand to time zones of low energy demand :

- *Keep the total energy used constant enhancing competition.*
- *Force participants (thermal unit) to reduce prices to gain market share in the low – cost zone to meet the new characteristics of the load profile.*
- *lead to more rationalized energy prices and thus to the protection of the consumers.*
- *The organization of the wholesale market does not appear to be isolated from the social impact.*
- *The market price must be reduced through the competitive process.*

Recording the energy shifted using dual-zone meter (night-time tariff)

Dual –zone meter (night-time tariff), which are already in place :

- *Provide the clear target of smoothing out the peak zone relieves consumers of any economic signal from the market through artificial intelligence (smart meter), which indicates the time of entry into the market trading system.*
- *Provide management and energy savings, in the same way as smart meters, when home appliances supported by Wi-Fi or smart home technology (KNX).*
- *Increase the daily energy consumption when the limits of the night-time tariff are expanded.*

THANK YOU FOR YOUR ATTENTION

Technical study implementation

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