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Διαχειριστής Συστήματος Μεταφοράς Κύπρου
Transmission System Operator - Cyprus

11ο ενεργειακό συμπόσιο
Κύπρος 2023

31 Οκτωβρίου 2023
The Royal Hall, Λευκωσία

Challenges and Needs of the Cyprus Power System

Transmission System Operator of Cyprus

Stavros Stavrinos – Executive Director TSOC

THE ROYAL HALL
31/10/2023

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The TSOC – Introduction (1/2)

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- Established in 2004 (Law N.122(I)/2003)
- Legal Entity under Public Law (Non-profit organization)
- Founding member of ENTSO-e association of TSOs
- Directed by the Executive Director appointed by the Council of Ministers
- October 2021 - New legislation put into force (Law N.130(I)/2021)
- Small Organization: present staff 50, future staff 120
- Two exclusive Roles:
  1. Transmission System Operator
  2. Market Operator

The TSOC – Introduction (2/2)

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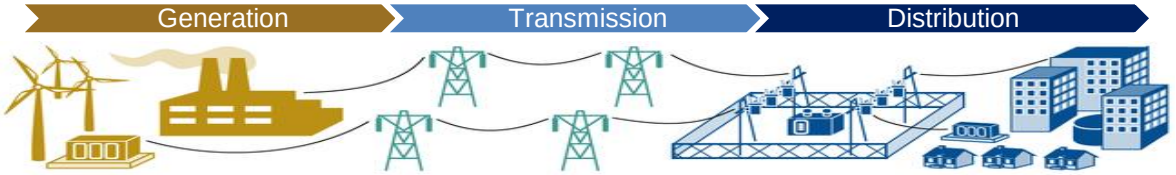
- Responsible for the operation, development and maintenance of an efficient, coordinated, safe, reliable and economically viable Transmission System.



- Responsible for the operation and management of the Electricity Market.

Electricity Market under a new Model

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- Hybrid Model with two Financial Markets:
  - Forward Market with Bilateral OTC Contracts

  (Προθεσμιακή Αγορά με Διμερή Συμβόλαια)

  - Day Ahead Market with Net Pool (Προ-Ημερήσια Αγορά με Κοινοπραξία Ισχύος)

- Real Time Balancing Market

(Αγορά Εξισορρόπησης)

Basic Market Structure

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Προθεσμιακή Αγορά
(Forward Market)

Προ-Ημερήσια Αγορά
(Day-Ahead Market)

Ολοκληρωμένος Προγραμματισμός
(Integrated Scheduling Process)

Αγορά Εξισορρόπησης Πραγματικού Χρόνου
(Real Time Balancing Market)

Ευθύνη ΛΑ (MO Responsibility)

Ευθύνη ΛΣ (SO Responsibility)

Εκκαθάριση (Settlement)

Characteristics of the Cyprus Power System

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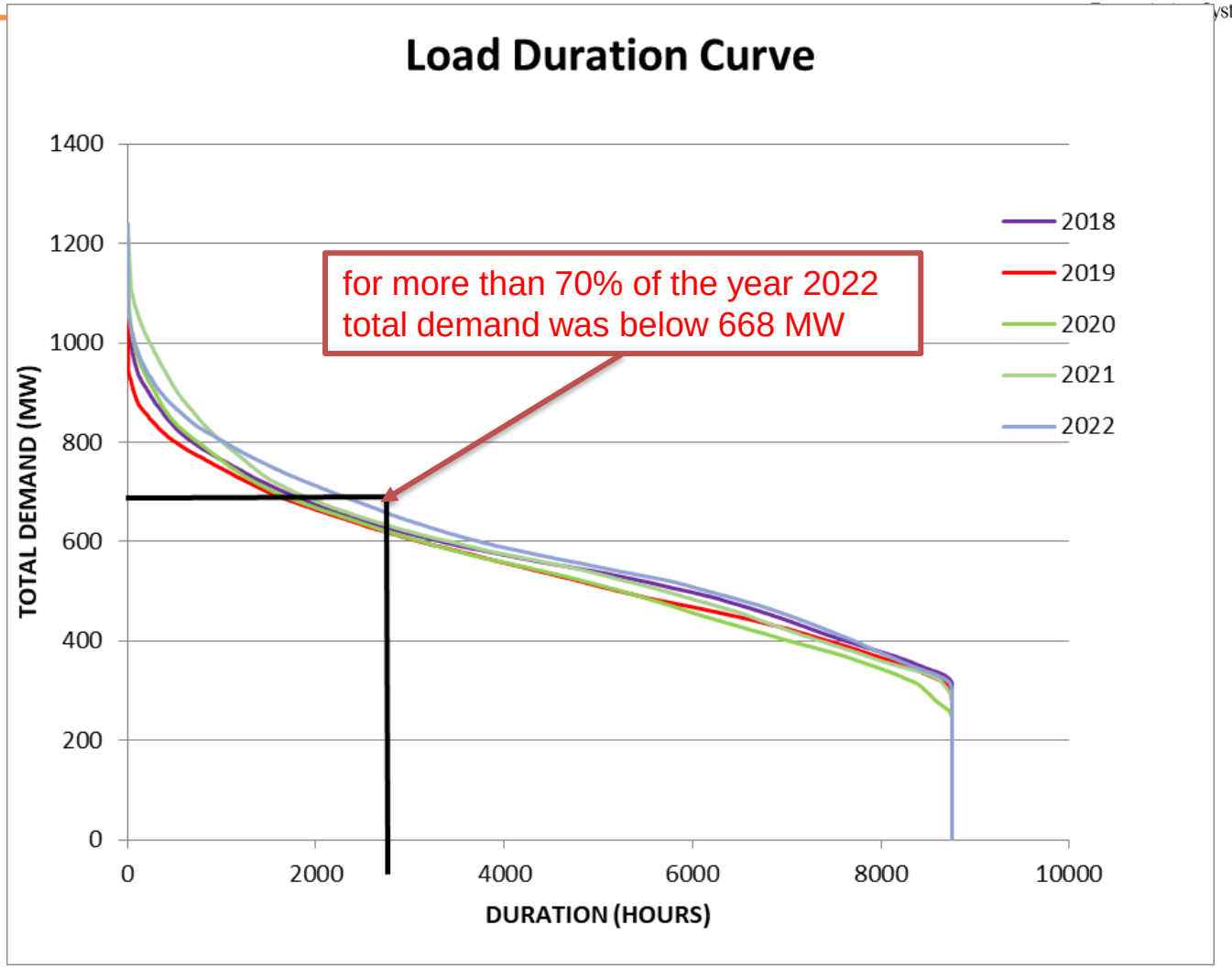
- Small & Isolated (no interconnections)

(definition provided by Article 2 of Directive (EU) 2019/944)

- Conventional Installed Generation Capacity **~1478 MW**
  - Large inflexible Generating Units
- PV installed capacity of the order of **600 MW**
- Biomass installed capacity of the order of **12 MW**
- Applications pending for approval/connection of approximately **800 MW** PVs and **12 MW** Wind
- No Battery or other Storage
- **Only Variable RES (weather dependent)**

Load Duration Curves



Evolution of Annual RES Energy Penetration in the Cyprus Power System

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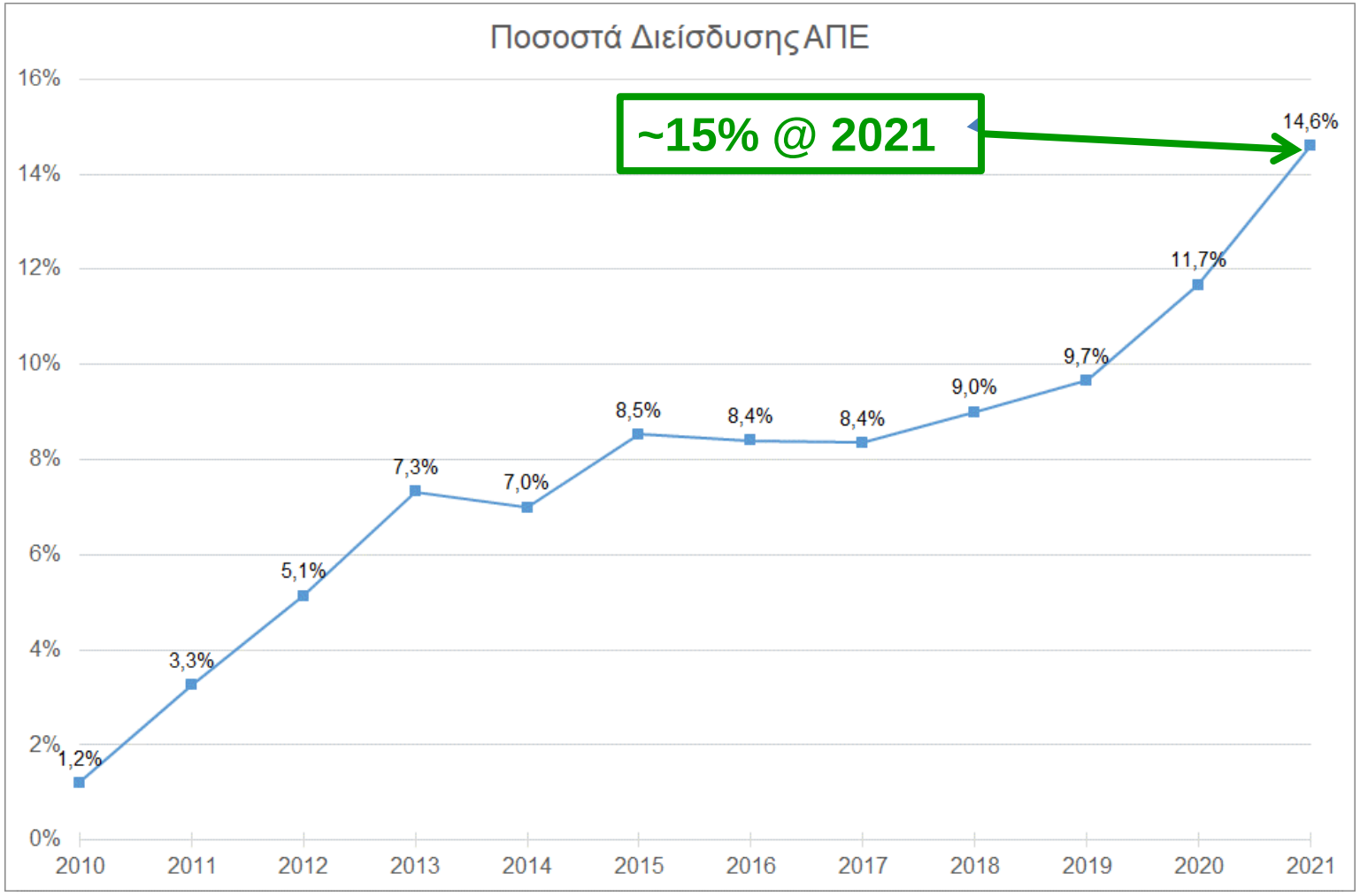

Very high RES penetration levels have been recorded

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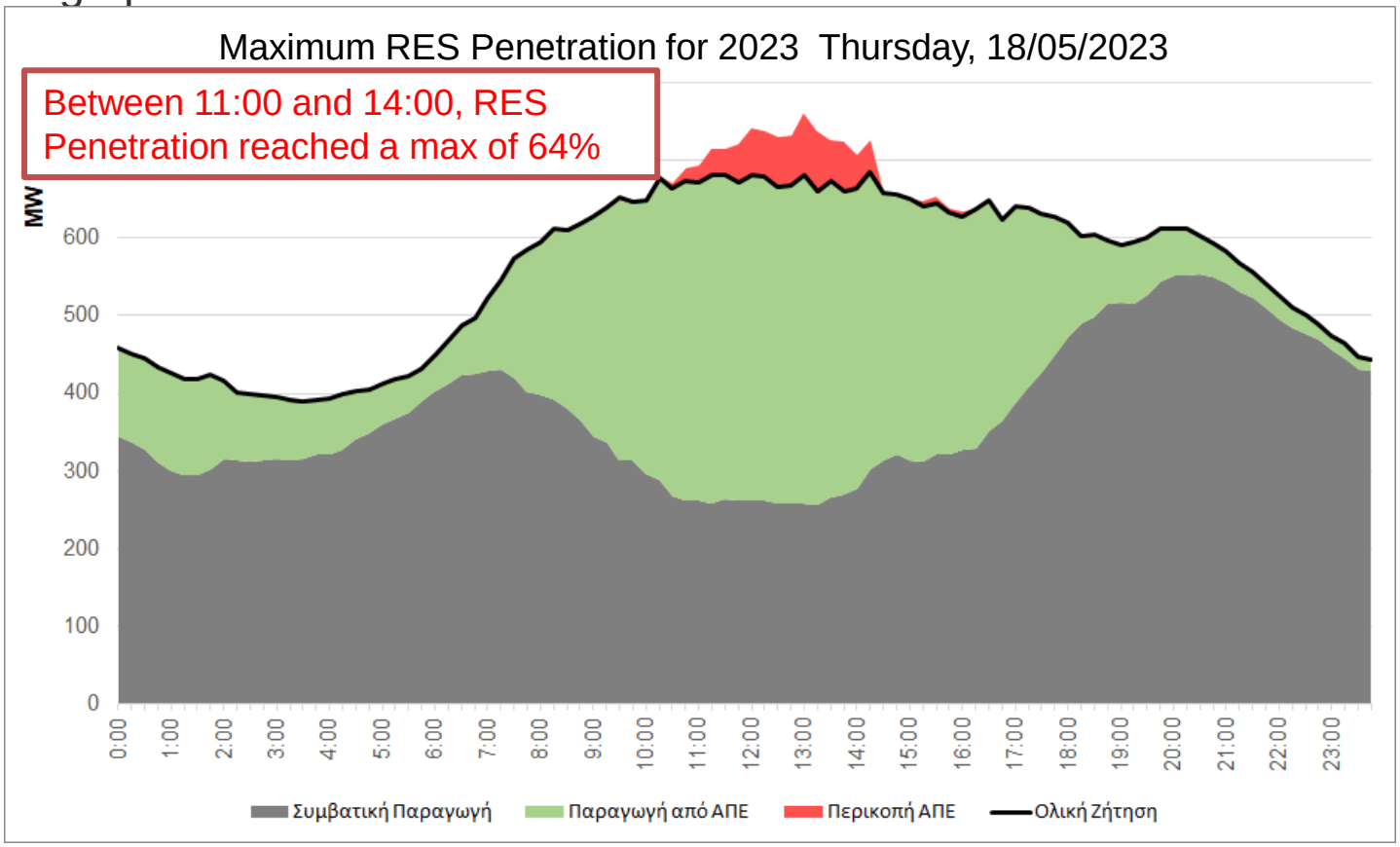
- To achieve an Annual RES Energy Penetration of the order of 17% (2022) very high penetration levels are allowed on the short term:



Recorded RES Duration Curves

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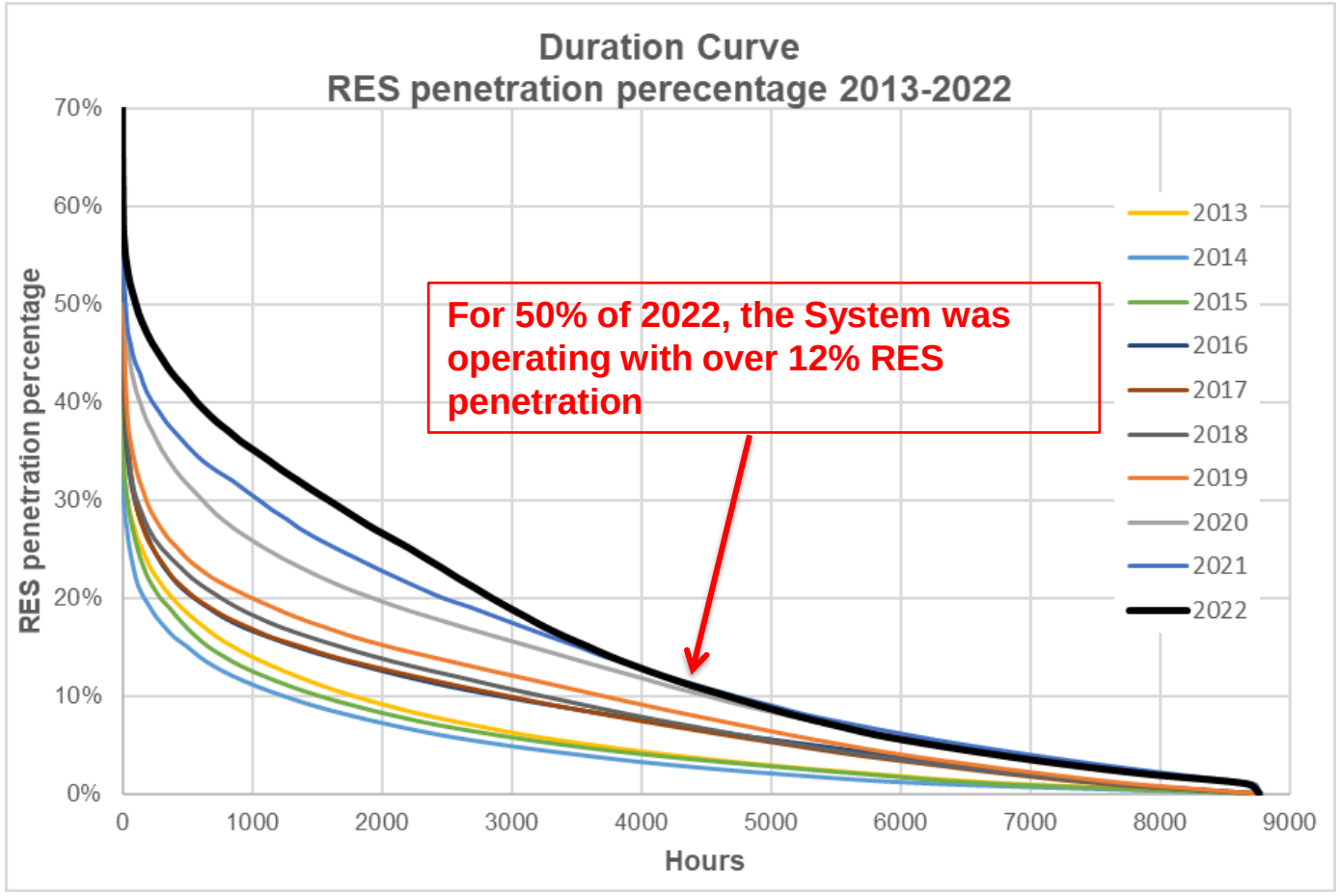

Challenges of the TSOC

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The goal is to increase the annual RES penetration to achieve the energy and climate targets **BUT** great challenges need to be addressed during system operation in order to safeguard system's stability and security of supply:

- Generation day-ahead scheduling of the system to maintain the minimum required system resources and at the same time maximize RES penetration → **has become very difficult due to the need to be able to manage the ramping requirements in the afternoon**
- Sudden Cloud Coverage → **resulted in shedding consumer load to balance the system**
- Ensure effective/intelligent RES Curtailment tools

Impact of RES penetration on Generation Scheduling – Current Situation

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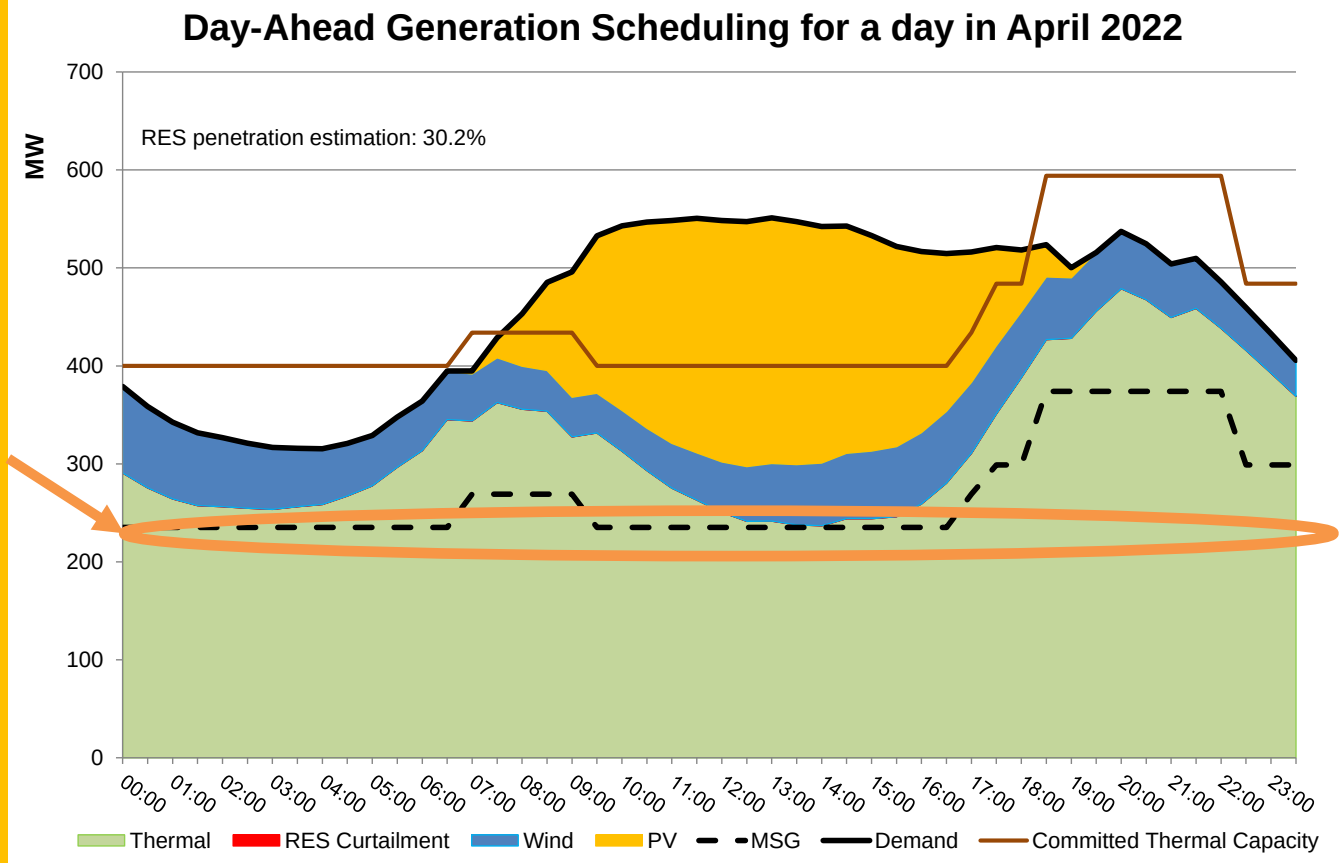
A required amount of conventional generation are always needed to provide for:

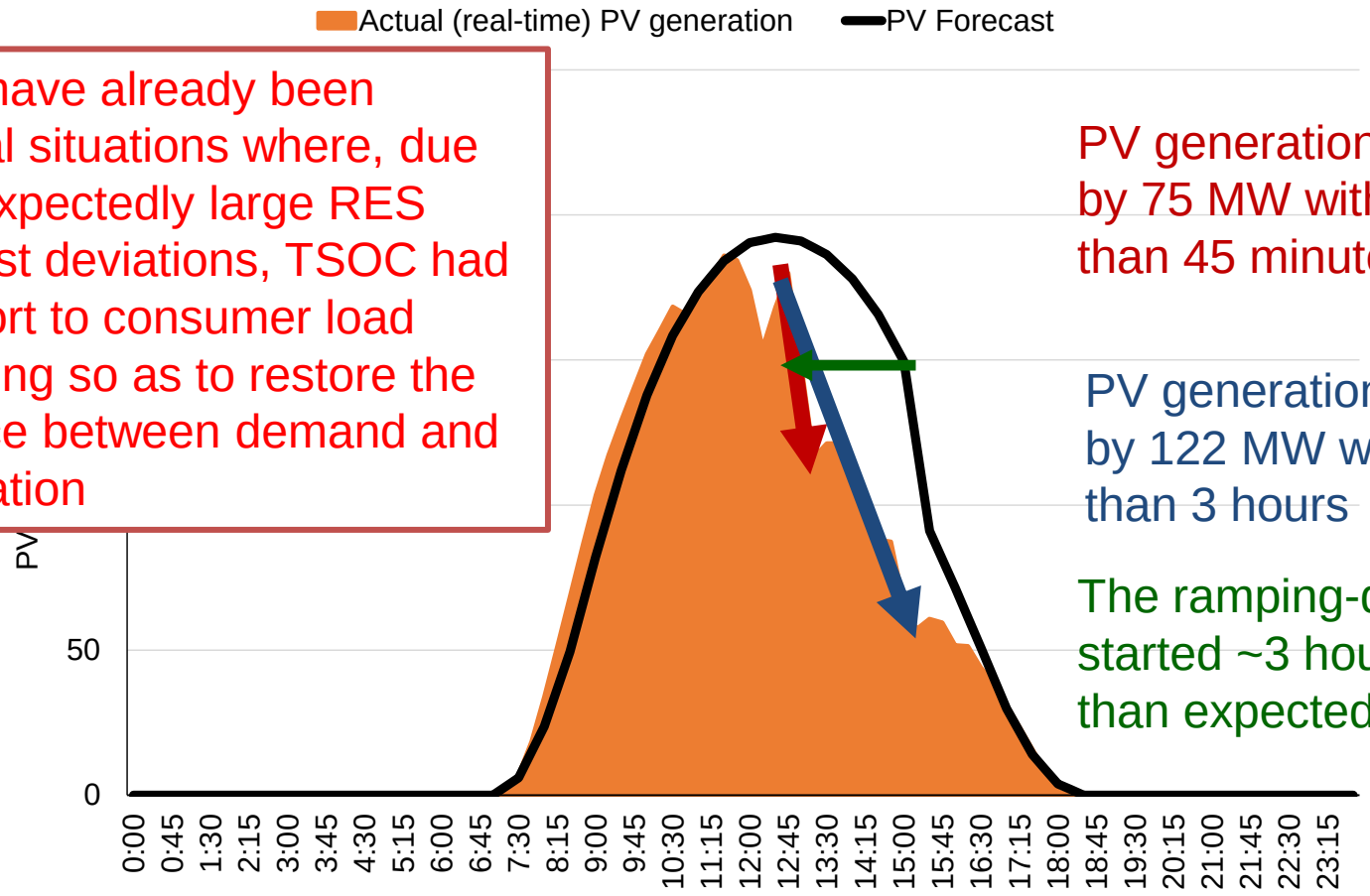
1) Critical inertia → keep RoCoF within tolerable limits
2) Short-circuit currents/capacity → satisfy protection requirements
3) Voltage support, and,
4) Voltage reference to grid-connected inverters to operate properly

The rest of the thermal generation is scheduled to serve the system's demand → curtailment also occurs when the units are committed to be ready for time of the peak demand



Cloud coverage impact on real-time operation

there have already been several situations where, due to unexpectedly large RES forecast deviations, TSOC had to resort to consumer load shedding so as to restore the balance between demand and generation

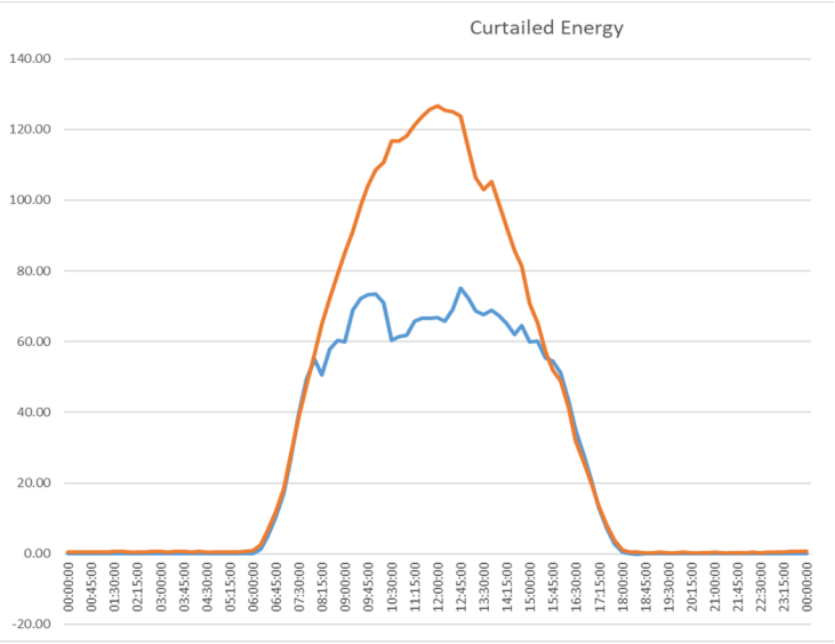


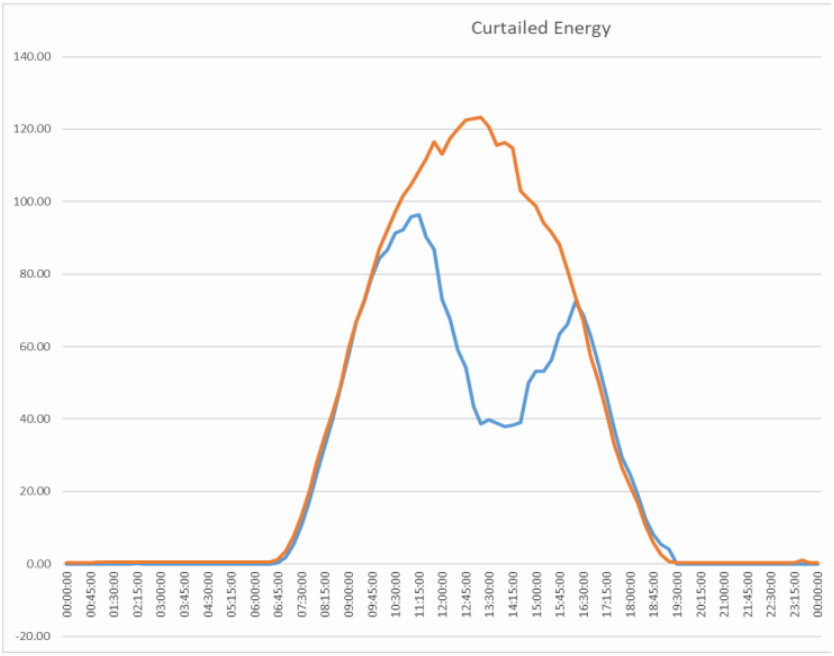
PV generation reduced by 75 MW within less than 45 minutes

PV generation reduced by 122 MW within less than 3 hours

The ramping-down started ~3 hours earlier than expected

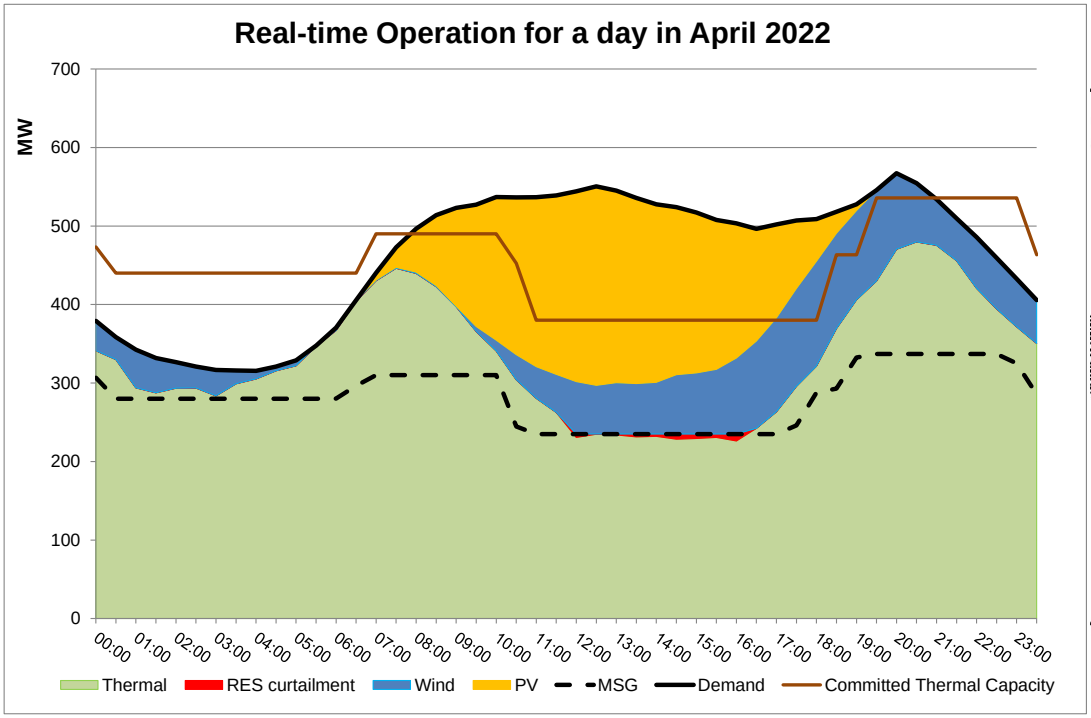
Examples of actual days with substantial PV Curtailment

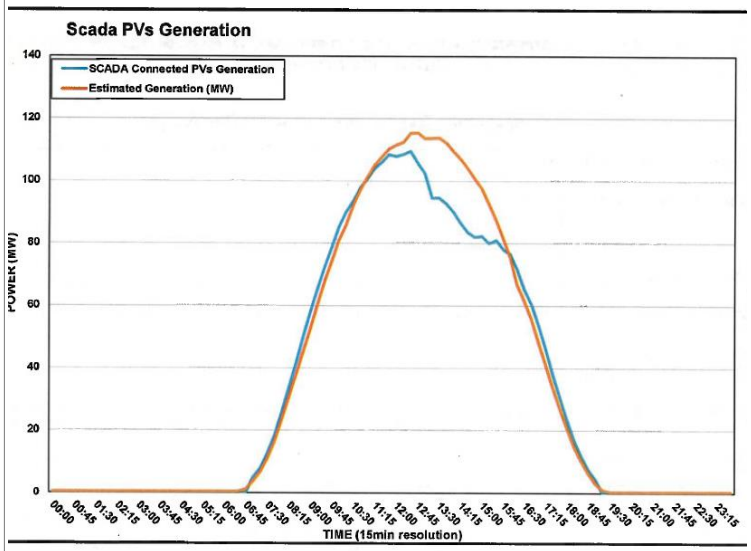




- Due to unexpected conditions, substantial PV curtailment may be required
- The total installed PV Capacity is currently about 600 MWp - the above examples refer to the controllable PV plants , currently ~300 MWp

Typical day in April 2022 with challenges during real-time operation





Despite the commitment/decommitment of thermal generators *(which results in increased maintenance)* to maximize RES penetration, Curtailment could NOT be avoided

Difficulty in scheduling the system on the day-ahead

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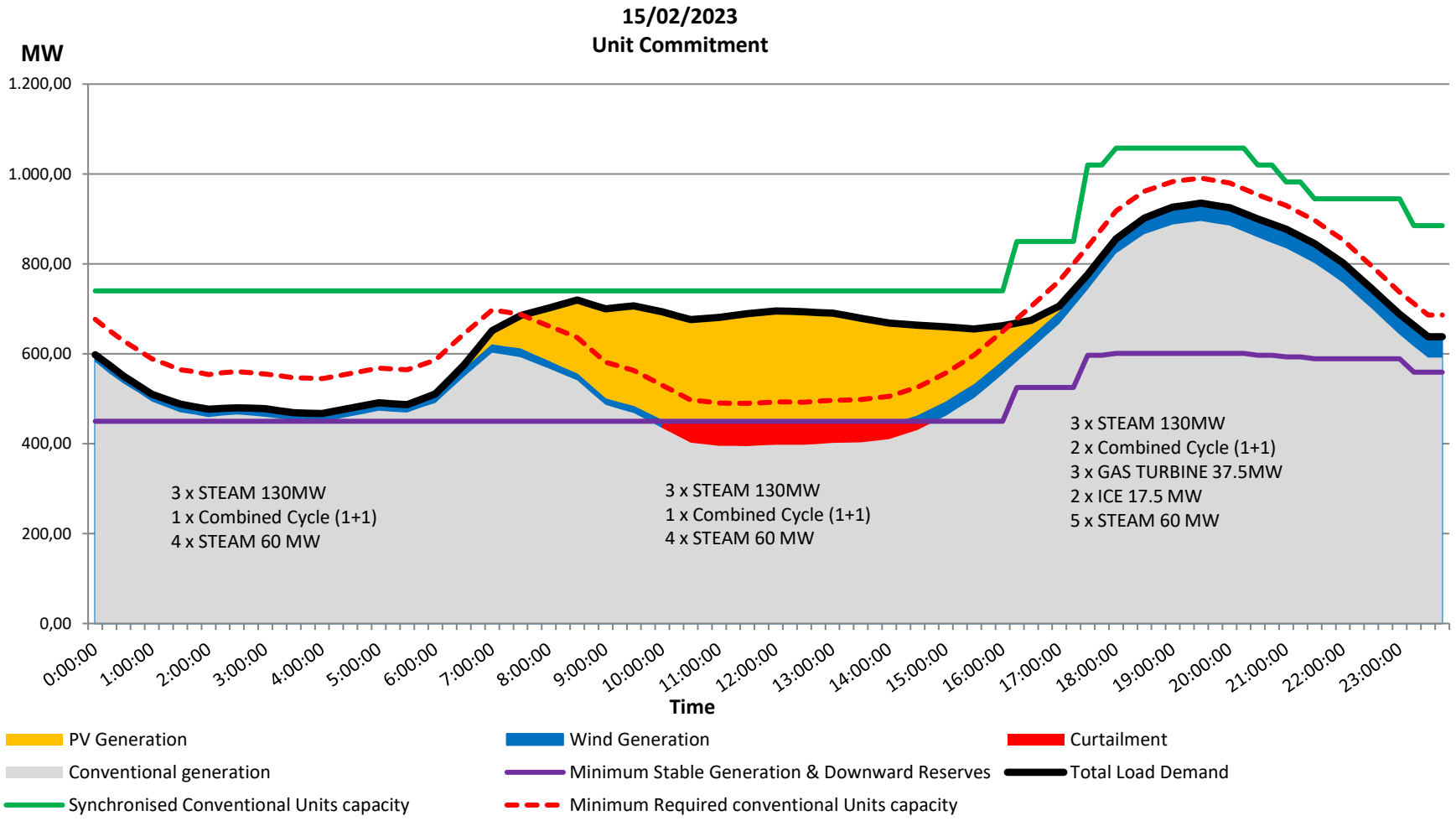

Consequences of limited availability of flexibility resources

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- Currently, there is limited availability of flexibility resources, therefore conventional generators provide, exclusively, the necessary power reserves. This means that an increase of the system reserves is only achieved through committing conventional generators, which in turn results:
- a) in an increase to the generation cost,
- b) in an increase in the Greenhouse Gas (GHG) emissions and
- c) in a reduction in the capability of the Power System to absorb the energy produced by renewable energy sources.

→ Achieving optimal generation scheduling, i.e. one that ensures system security and at the same time maximizes RES generation, is currently not possible.

Conclusions #1

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- Increasingly, the Cyprus small, isolated electricity system is facing substantial challenges with its operation:
  - in maintaining its stability and reliability.
  - In operating at the optimum conventional plant mix
- In the absence of suitable and flexible resources, the Cyprus TSO is forced to take measures such as RES Curtailment, in order to maintain an acceptable level of system stability and reliability
  - The TSO has developed intelligent curtailment algorithms for achieving the minimum required curtailment
  - The effective operation of the curtailment tools is based on the close cooperation between the TSO and DSO

Conclusions #2

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- In order for Cyprus to be able to achieve ambitious energy and climate targets, drastic interventions are required:
  - A framework for the integration of Storage Systems into the Transitional Electricity Market has been proposed by TSOC to CERA
  - A number of Transmission Projects has been included in the 10 year network development plan
  - The competitive electricity Market has been designed to integrate RES

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Ευχαριστώ για την προσοχή σας

Thank you for your attention

Supporting Slides

Beyond the duck curve…

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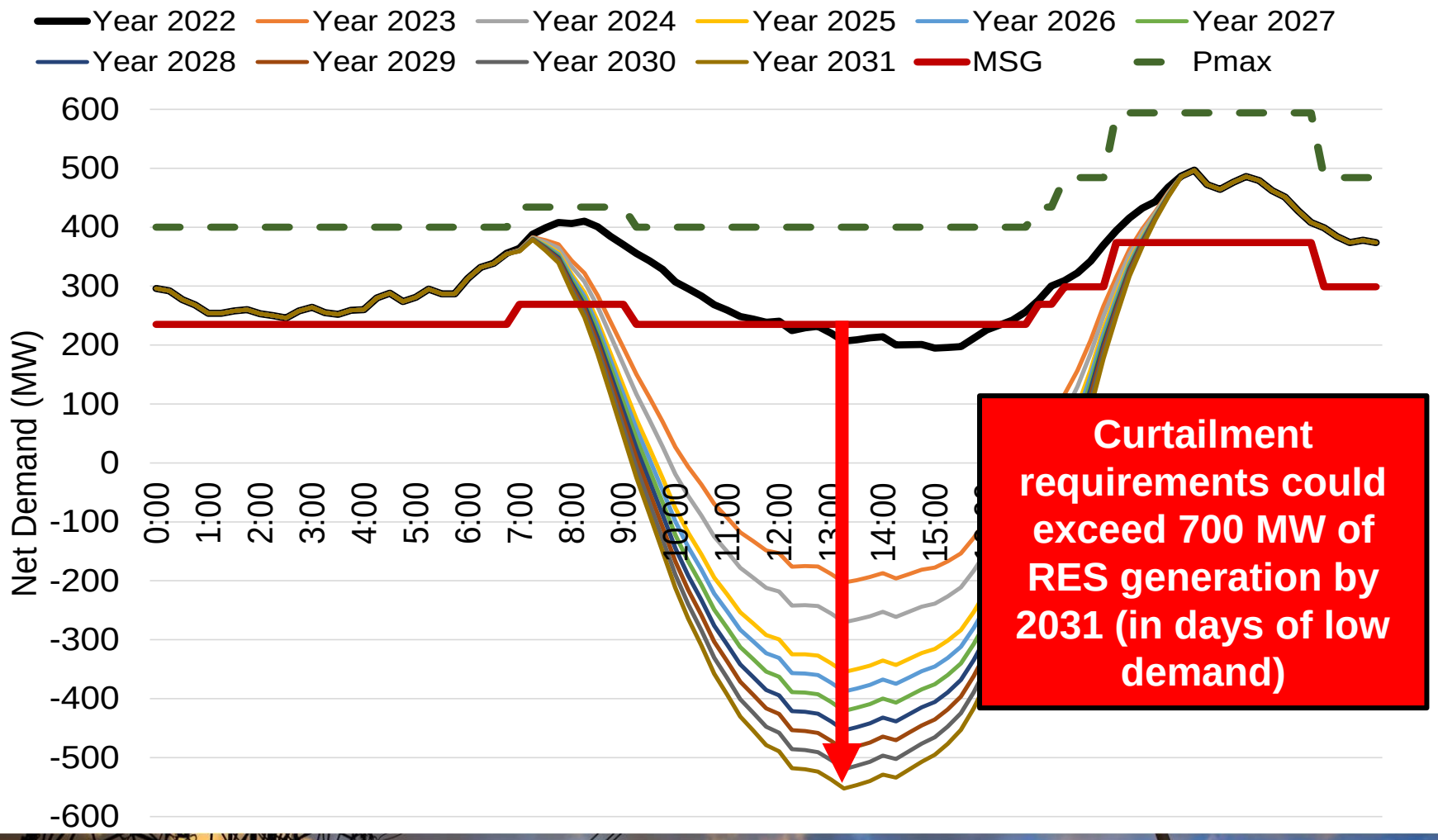

Even if the System was able to operate with no Must-Run Thermal Units…

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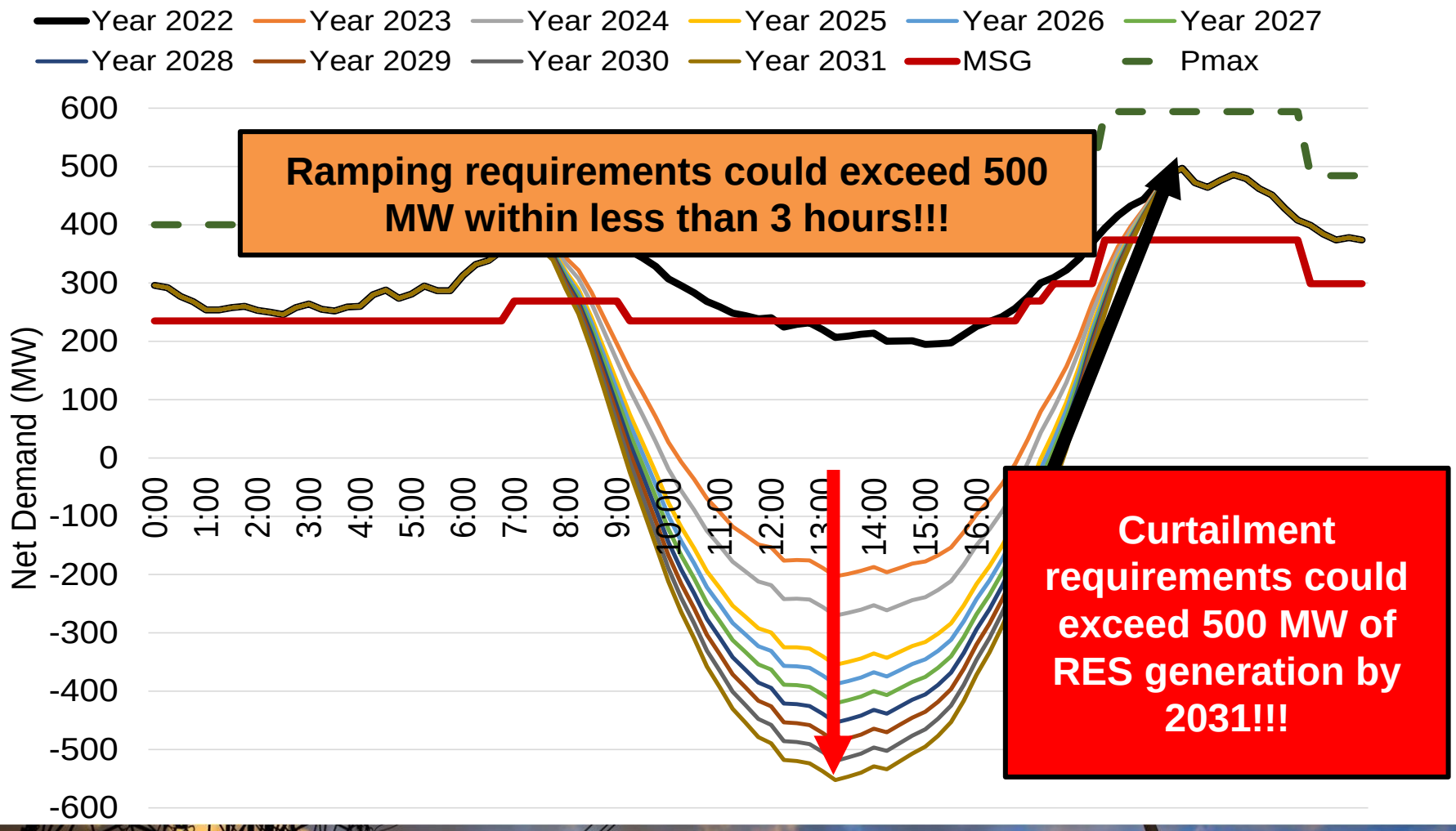

Distributed Generation Management via TSO-DSO coordination

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