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STAGE
TE 
EERA

Moving forward towards low cost STE

*Latest joint efforts between Research and
Industry for strengthening European CSP
leadership (STAGE-STE Workshop)*

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*Comité économique et social européen
European Economic and Social Committee*

Why STE- Solar Thermal Electricity?



In general:

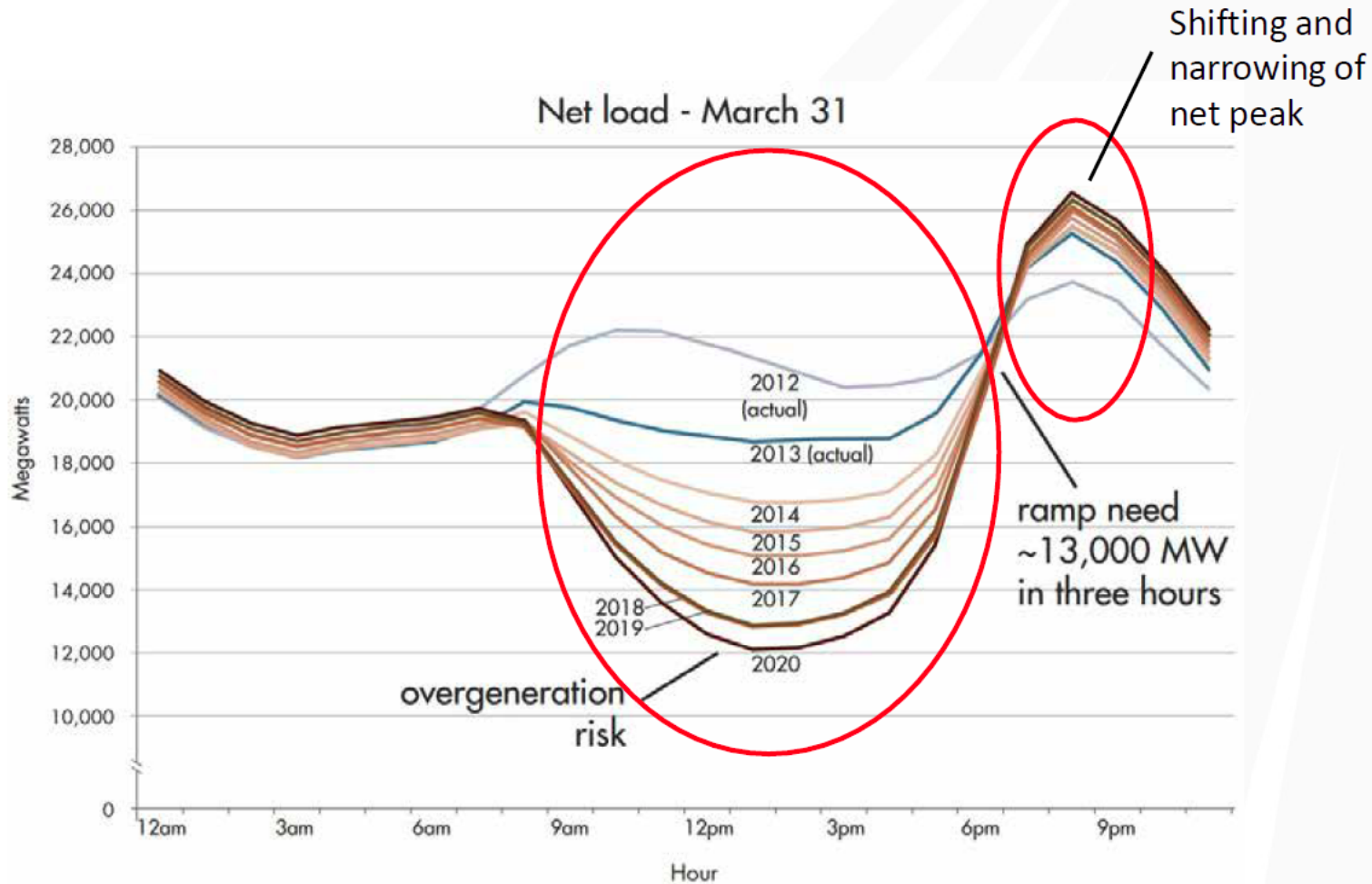
Climatic Changes and the need to **decarb the economy**

In particular:

Solar Technologies for electricity production are a very good renewable and clean solution.

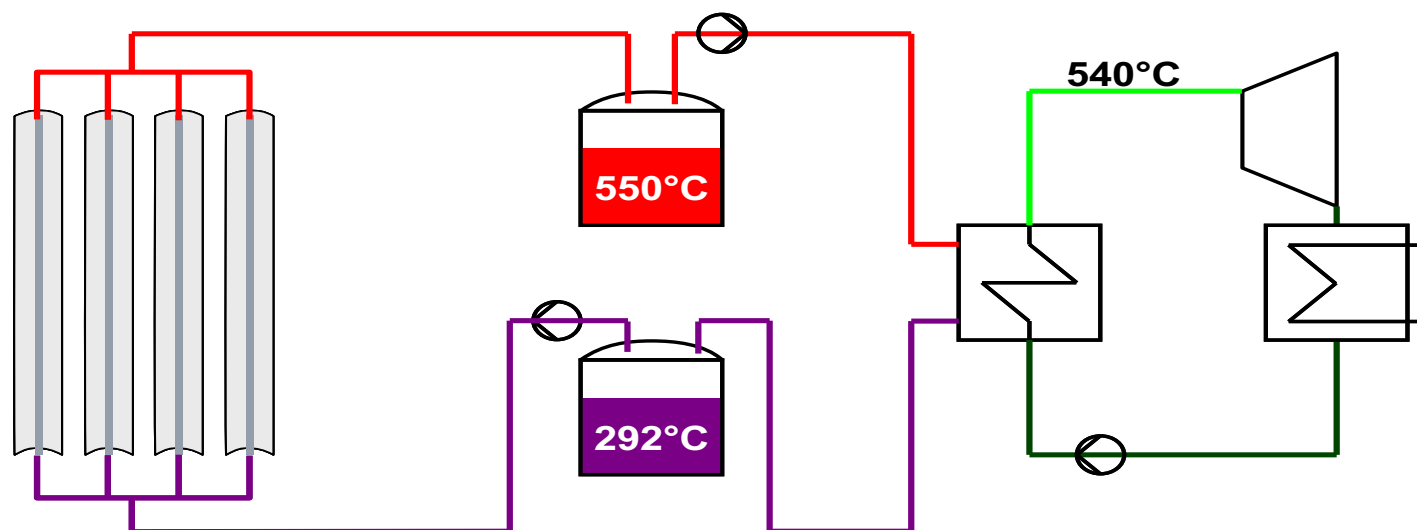
- It can already be done with **Solar PV**...at a cost which, in many places, is already below that of fossil fuel based production, but...
...storage of energy (**dispatchability**) is the problem...

CAISO Duck Curve – circa 2013



Storing Energy

- Storing electricity directly: in batteries!
- Or a convenient alternative:
- Heat



Storing Energy: electricity, heat

- *In batteries*
- Today: 300-600 €/kWhe stored
- Soon (2-3 years) (?!) – 150 a 200 euro/kWhe
- Batteries lifetime: 10 years?
- *As heat:*
- Today : 20 a 40 €/kWhe
- Within 2-3 anos: 10 a 15 euro/kWhe
 - Lifetime: 20 years?

**Factor 10-20 X
of difference
in cost, today
(and in the
future?!)**

- Dispatchable STE is, thus, a necessity!
- R&D: to bring down costs in several fronts
- **Concentrator technology**
- Components, heat transfer fluids/ fluids for heat storage (binary, ternary... mixtures of molten salts)
- **Storage (temperature, materials, configurations, durability, liquids/solids, operating experience, etc)**
- Engineering (system configuration and integration, controls, operation and maintenance)

Main STE Technologies



PT



LFR

2D- linear concentration technologies, PT and LFR

3D- tower technology



The cost challenge: a brief technical road map

Low cost STE electricity:

- 1) Increase efficiency in solar to electricity conversion
- 2) Simplify, reduce the number of components and system cost + O&M costs

Add storage (it adds value: **dispatchability**).

Technical answers to 1) and 2):

- 1) This really means going up in temperature (today: 565°C!)
- 2) Reduce costs: the three main technological options have different costs today; LFR is the least developed, but has a real low potential cost, not really achieved yet...

The cost challenge: a brief technical road map

T= 565°C? (limit imposed by the molten salts...)

High Concentration is necessary!

Thermal losses are proportional to receiver area ($A_{receiver}$)

$$C = \frac{A_{aperture}}{A_{receiver}}$$

Low thermal losses means a **smaller receiver** and that means **higher C**

- This has already been proposed and in many ways achieved with 3D- tower technology
- It can be improved for lower costs

2D -linear concentrator technology- can also do it, but it requires R,D&D+I



PV versus STE?



- **Not in competition!**
- Complementarity is clear
PV – decentralized (roof top, etc) and centralized production for direct grid injection
STE – centralized dispatchable production

In conclusion...

- **PV, no batteries**: the cheapest solar electricity, today (i) **grid parity on** “roof top” self consumption (ii) **centralized production costs for grid injection already at or below fossil fueled production**
- **STE-CSP with storage** (8 to 16h at nominal power); **dispatchable electricity**, much cheaper than PV with batteries; **closer to being competitive by itself...**
- but still requires a strong effort and commitment from R&D institutions and companies!

Thank you for your attention!