« STORAGE SUPPORTING PV DEPLOYMENT »

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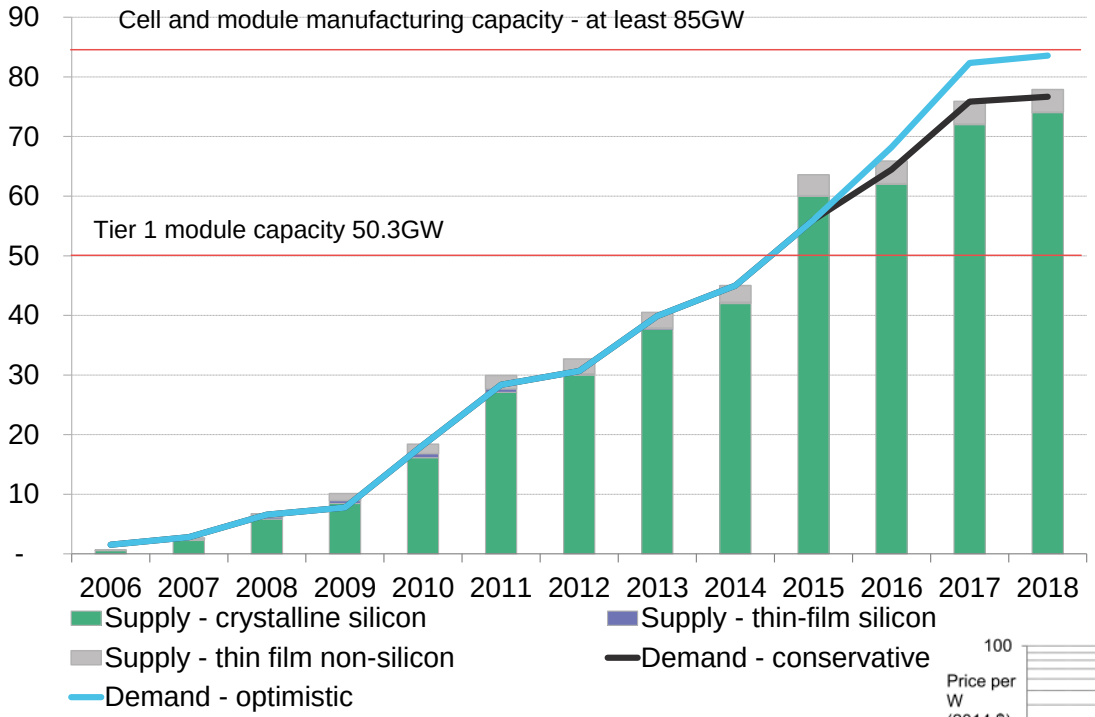
REPOWERING EUROPE- 18 mai 2016

OUTLINE

Photovoltaic market

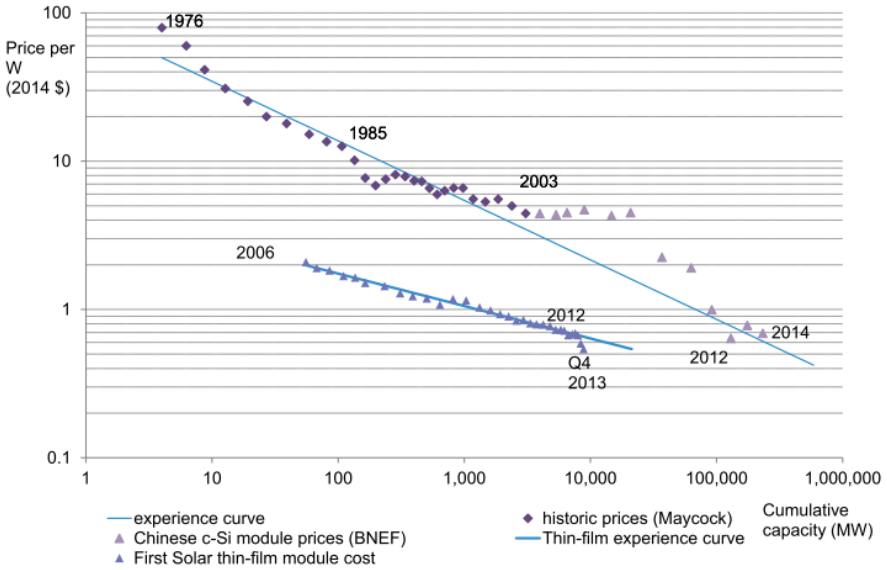
Photovoltaic market. Competivity?

SOLAR MARKET BRIEFLY



Despite industry consolidation, the whole PV value chain is in oversupply and is expected to remain so until 2017

Source: Bloomberg New Energy Finance



Source: Paul Maycock, First Solar, Bloomberg New Energy Finance. Note: Prices inflation indexed to US PPI.

DISTRIBUTION OF PV MARKET

- We observe 3 trypes of main photovoltaic applications, that can be (or not) grid connected.

Utility-scale

- Grid connected
- Strong development where the land is available (*e.g.* USA, China, under transformation lands)
- ~36 % of installations

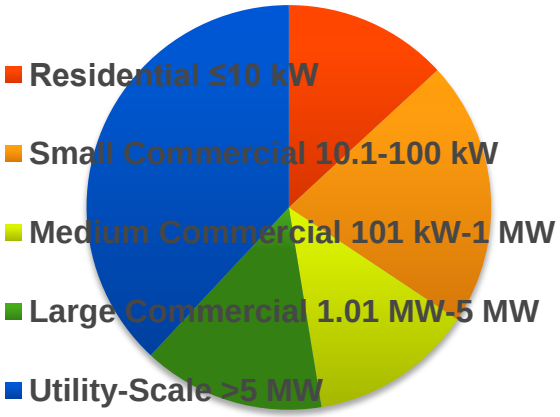
Buildings

- Grid connected (but also self consuming
- Residential and commercial
- Most of installation

Isolated areas

- Non- grid connected
- Isolated solutions, telcom antennaes, …
- A few % of installations.

Cumulative Demand by Segment 2015-2019



Source: IHS

TARGETS TO REDUCE COSTS OF PV

DOE: Sunshot (2020)	target
Utility-scale PV system	US1$/$W_{DC}$
Commercial-scale PV system	US1.25$/$W_{DC}$
Residential-scale PV system	US1.5$/$W_{DC}$
LCOE (utility-scale system)	US0.06$/$W_{DC}$

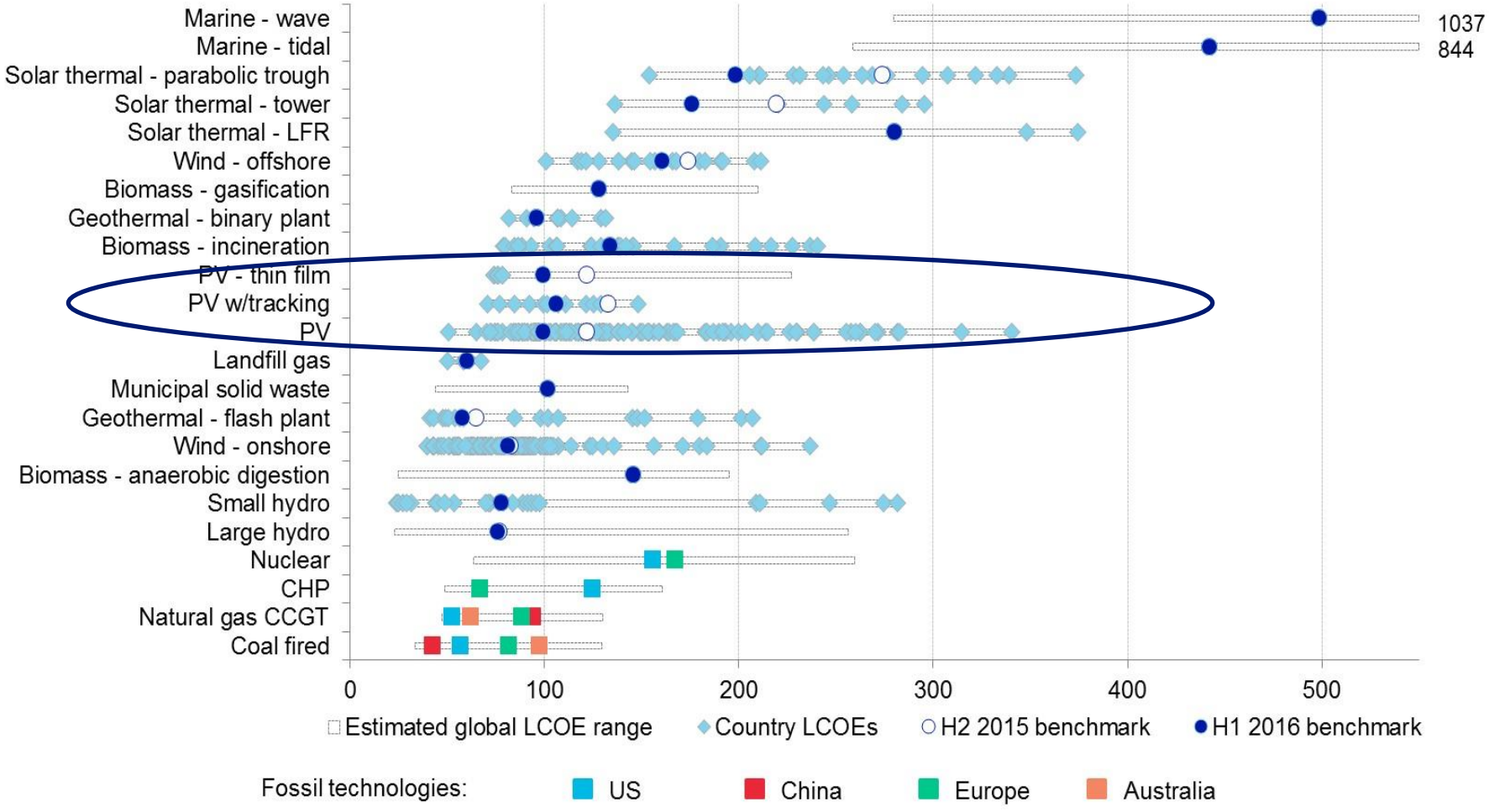
1. Reducing technology costs
2. Reducing grid integration costs
3. Accelerating deployment.

NEDO	target	year
LCOE commercial-scale	JPY14/kWh	2020
Module % and lifetime	22%, 25 yrs	
LCOE utility-scale	JPY7/kWh	2030
Module % and lifetime	25%, 30yrs	

1. Reducing the levelized cost of electricity (LCOE) from solar PV
2. Enhancing system reliability
3. Enlarging the range of applications of PV
4. Establishing a recycling system.

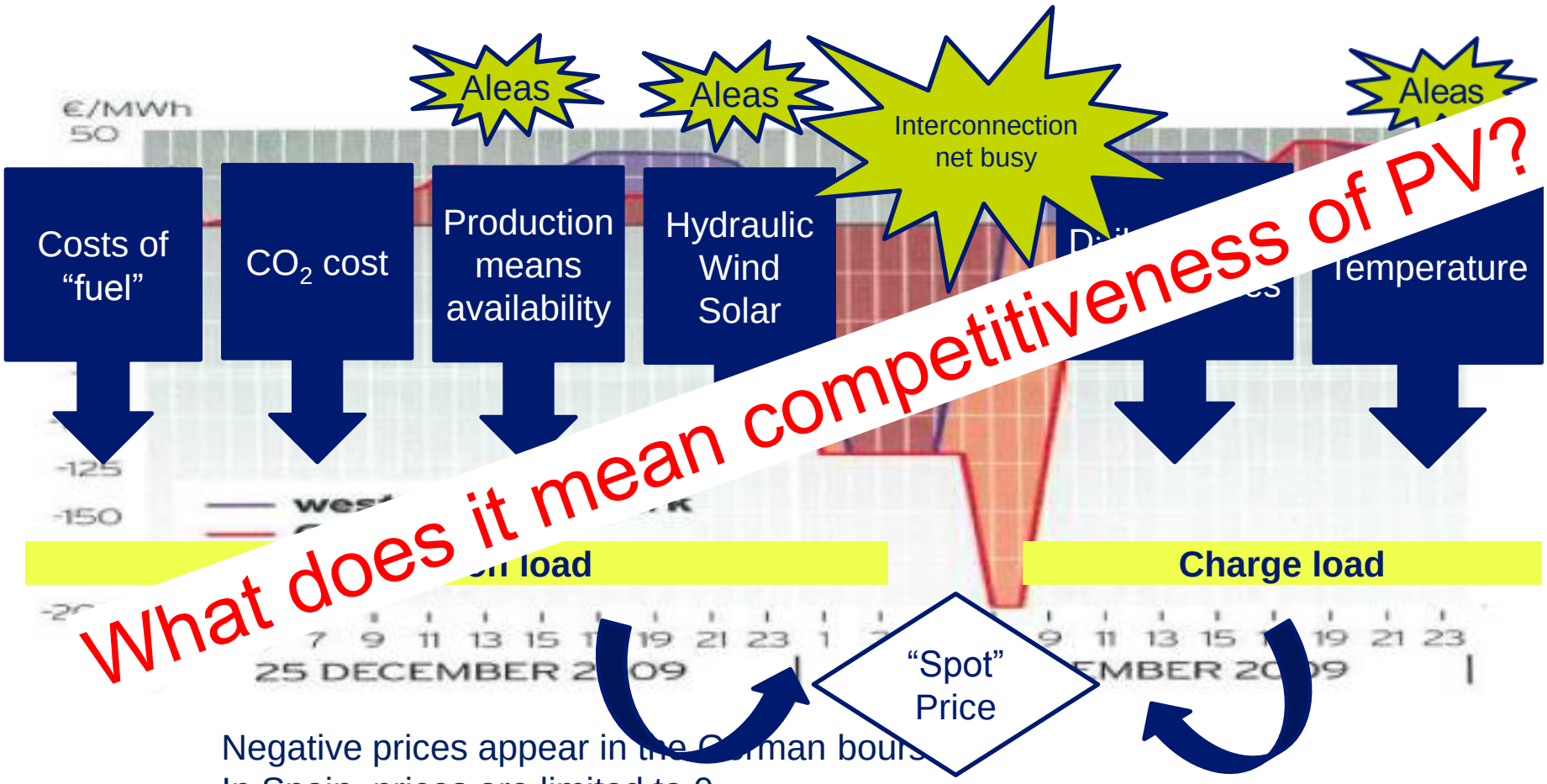
Technologies to support PV deployment

BUT, WHAT REALLY COST MEANS?. LCOE



Source: Bloomberg New Energy Finance

SPOT PRICE OF ELECTRICITY



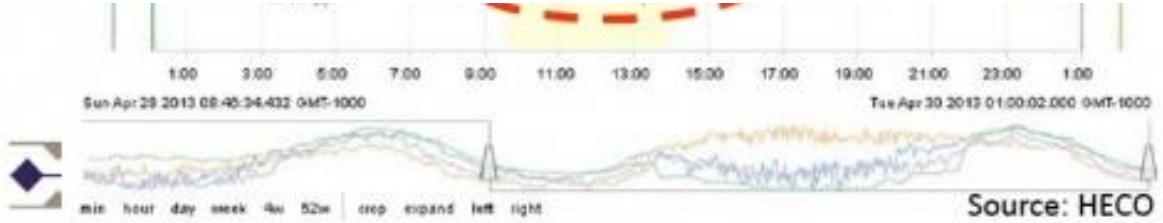
Negative prices appear in the German hours
In Spain, prices are limited to 0
In California, the regulator has modified minimum prices from –30 $/MWh to –300 $/MWh.

DISPATCHABILITY: BUT NOT ONLY

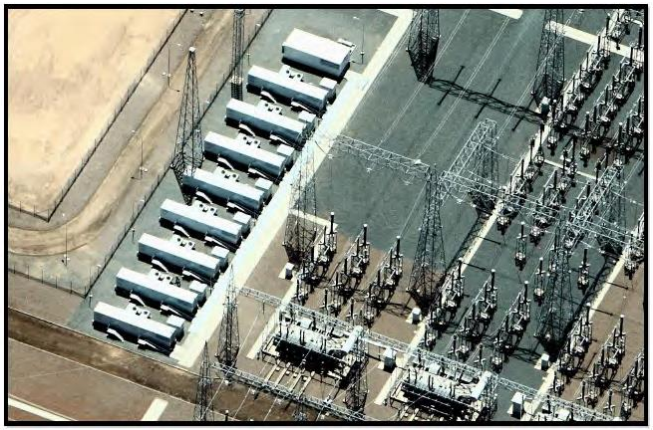
1. Storage of tens of seconds or a few minutes, to remove fluctuations due to cloud cover, if this is important for the electricity sales agreement or the grid connection agreement.

2. To provide ancillary services such as frequency response or reserve, if a market or a mandatory requirement exists.

3. Storage of a few hours, in order to time-shift production to times of the day when the price is higher. Electricity systems with a high penetration of PV already show a strong impact on spot prices.



Tomorrow : application of new technologies, diffuses or centralized, on board or static



SELF-CONSUMING PV IN THE TIER RESIDENTIAL SECTOR

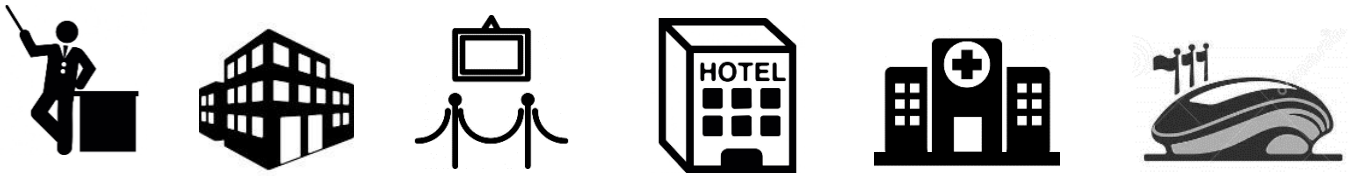
Tier Sector : load profiled are very different from on building to another

The self-production/ self-consumption ratio varies as a fonction of the analysed sector :

- Office
- Cultural buildings
- Educational buildings
- Health related buildings
- Sport centers
- Hotels / restaurants

…but also within the same sector:

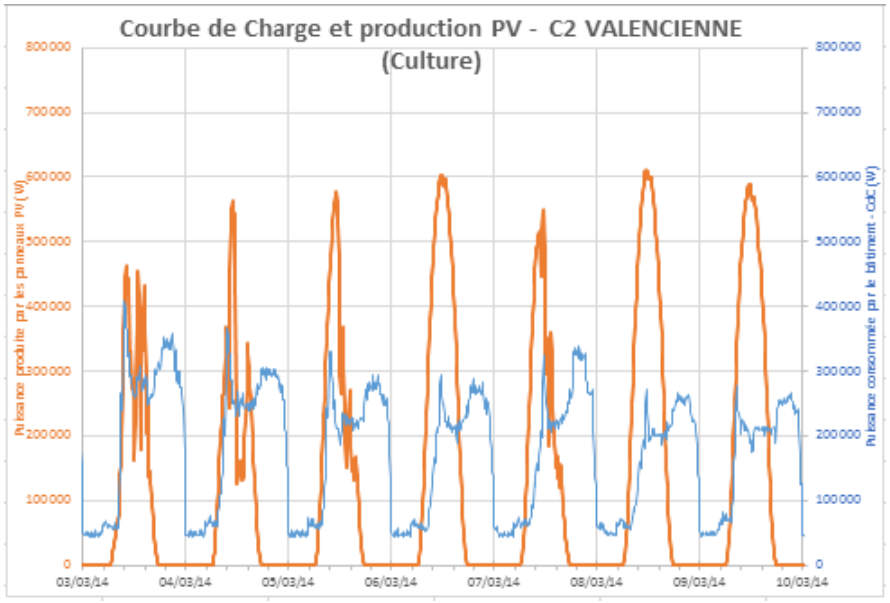
- Installations : specialised equipments (Hospitals, Swimming pools, …)
- Electrical heating and/or climatization
- Yearly occupancy: holydays
- Building age
- PV production capacity [kWh/m²]
- Available roof surface



PV SELF-CONSUMPTION IN TIERS SECTOR

Weekly period

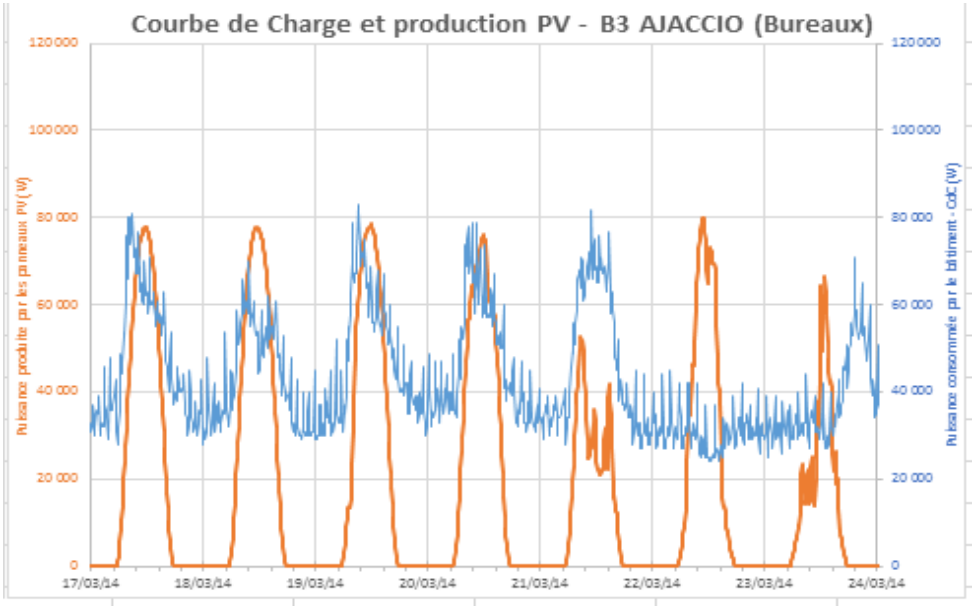
Cultural building: day/night out of phase



Self-consuming ratio= 46 %
Self-production ratio= 38 %

Adding more PV modules will not cover the consumed power excess.

Offices : Conso/production are syncronised



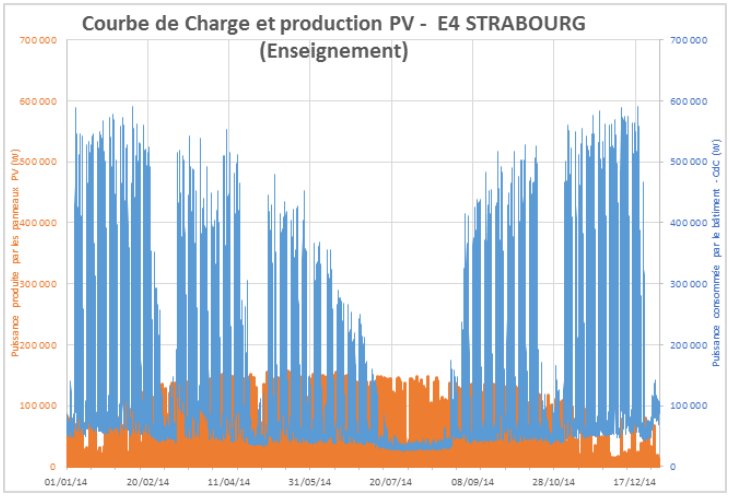
Self-consuming ratio= 69 %
Self-production ratio= 35 %

Under consumation during WE.

PV SELF-CONSUMPTION IN TIERS SECTOR

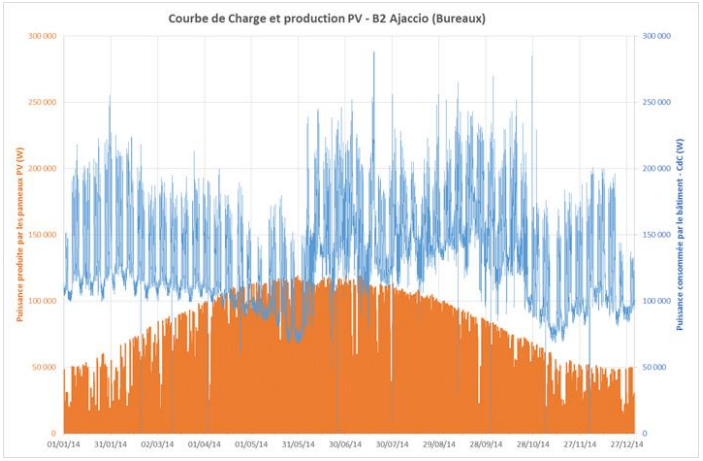
Yearly variations

Educational building: impact of school holydays



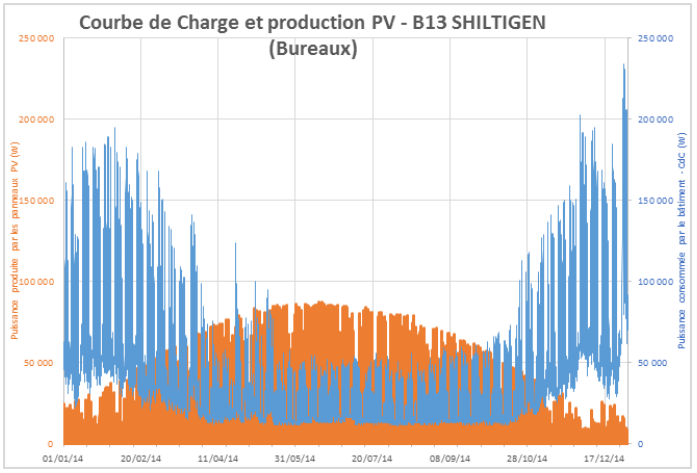
Self-consuming ratio= 75 %
Self-production ratio= 20 %

Offices : Climatization impact



Self-consuming ratio= 99 %
Self-production ratio= 17 %

Offices : electrix heating impact

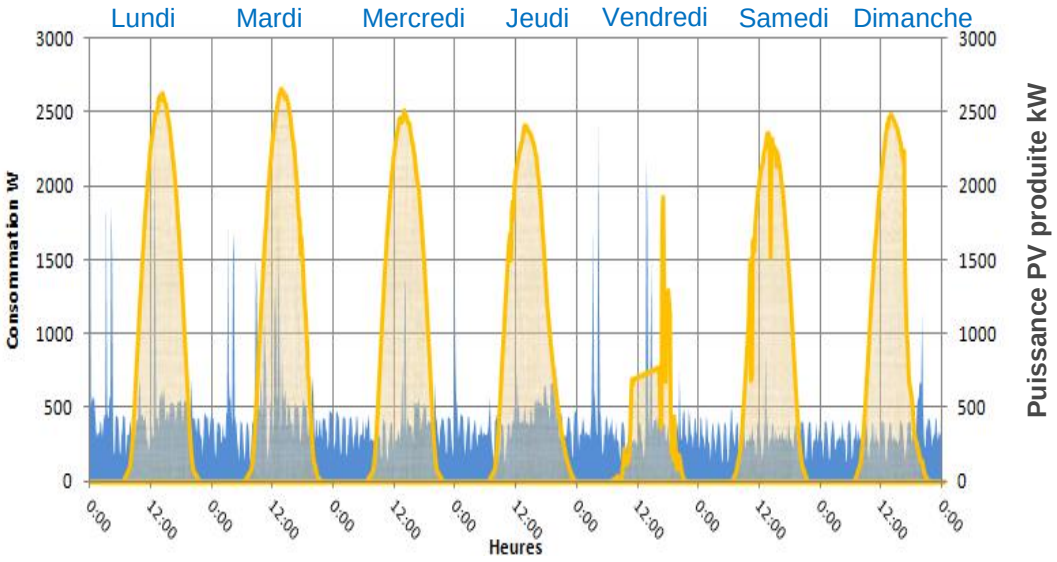


Self-consuming ratio= 71 %
Self-production ratio= 21 %

SELF-CONSUMPTION PV IN THE RESIDENTIAL SECTOR

For a residential installation- without storage system, nor uses controller - the most we can expect to consume is 40% of our slef-produced electricity.

The use of the grid will be necessary.



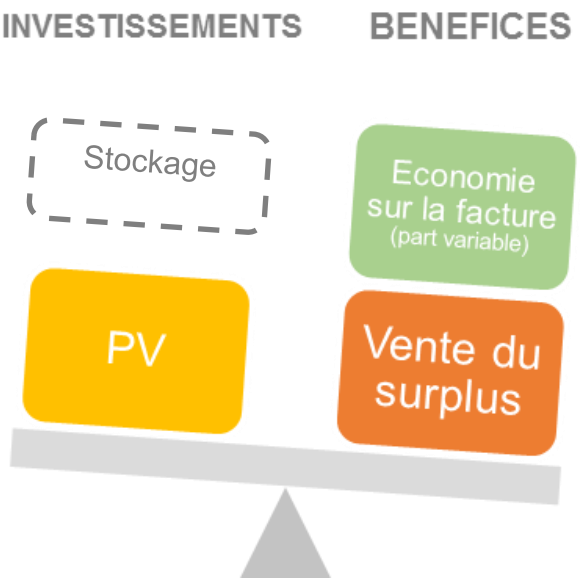
Source : EDF R&D

There are technical solutions that allow maximizing the ratio self-consumption/self-production :

- **Smart electrical control of buildings**
- **Adding adapted storage solution.**

PV SELF-CONSUMPTION
STRONG IMPORTANCE

- **For client: all kWh produced are not self-consumed:**
  - The promised « grid parity » is only theoretical if 100% of the production is not consumed…



SELF-CONSUMPTION PV « OPTIMISED »

ADDING A STORAGE UNIT (BATTERIE,….)

<u>Principle</u> : Storage excess non consomed PV power in batteries.

Multiple technological solutions in the market with limited performances, in particular in the load/unload strategies and the fitting wit loag management.

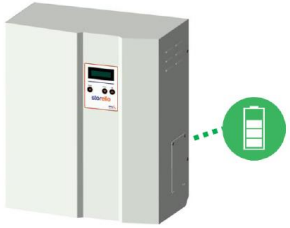
BOSCH V5
HYBRID

SONNENBATTERIE

SMART ENERGY

SUNNY HOME
MANAGER

POWERROUTER



STORELIO

CONCLUSIONS

- **The increasing contribution of PV to the global and regional power mix has caused a number of fundamental challenges, which can largely be addressed by the addition of energy storage.**
  - PV electricity is produced only during the day; energy is often needed during the night. The ability to store energy during the day for use at night is beneficial.
  - PV is an intermittent and unpredictable generation source. Storage allows fluctuations in supply to be reduced.
  - Off-grid PV is not connected to the grid and therefore the only way to use electricity at night is through storage.

- **The development of storage for PV is essential to increase the ability of PV systems to replace existing energy sources.**
  - Although introducing storage to grid-connected applications is a new development in the PV market, storage has been used in off-grid PV systems for some time.
  - New products targeted at the PV industry, technology advances, and the availability of less expensive storage solutions, will lead to the increased use of energy storage in the PV industry.
  - More storage solutions are becoming commercially available. They range from intelligent management systems which are coupled with a battery to large-scale turn-key solutions aimed at grid-scale applications.

Thank you