The Evolution of Energy Storage: A Holistic View into the Past, Present and Future

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IBESA – International Battery & Energy Storage Alliance

IBESA International Alliance | BATTERY & ENERGY STORAGE

The International Battery & Energy Storage Alliance

» Connect directly and easily with potential business partners.

» Positive positioning in markets and market segments as initiator, driver and accelerator.

» Increased attention by being listed on IBESA website.

» Being continuously present amongst important target groups.

» Focused use of marketing budgets without money being wasted and with a positive ROI.

» Participation at key industry trade events as speaker and/or panellist.

» Extensive access to market data for many relevant markets.

» Huge saving effects through the provision of key figures.

» Free-of-charge market intelligence studies.

Proud Partners (Excerpt)

IBESA International Alliance | BATTERY & ENERGY STORAGE

Our global network:

>7 years

17 countries

> 30 locations

150 events

and more than 25,000 delegates

A. Market drivers

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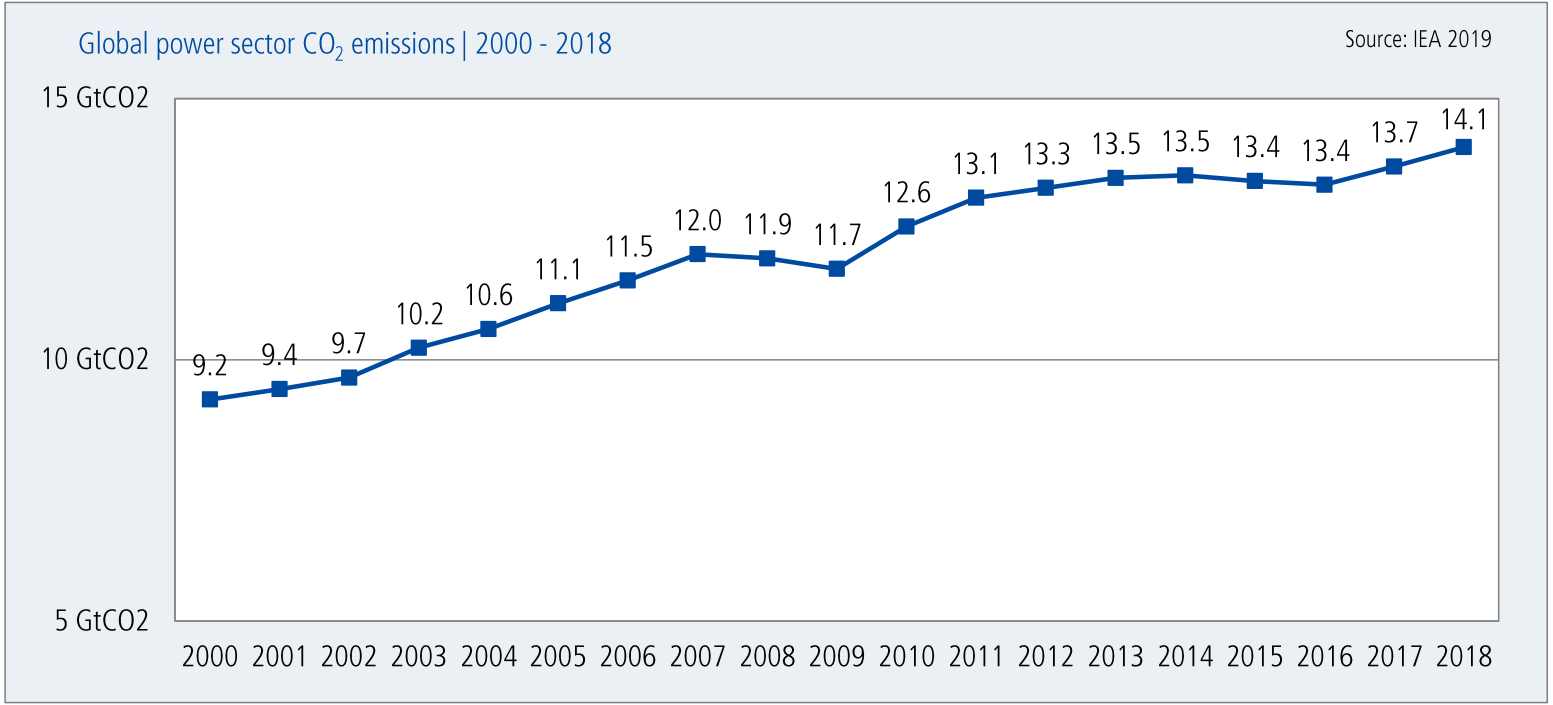
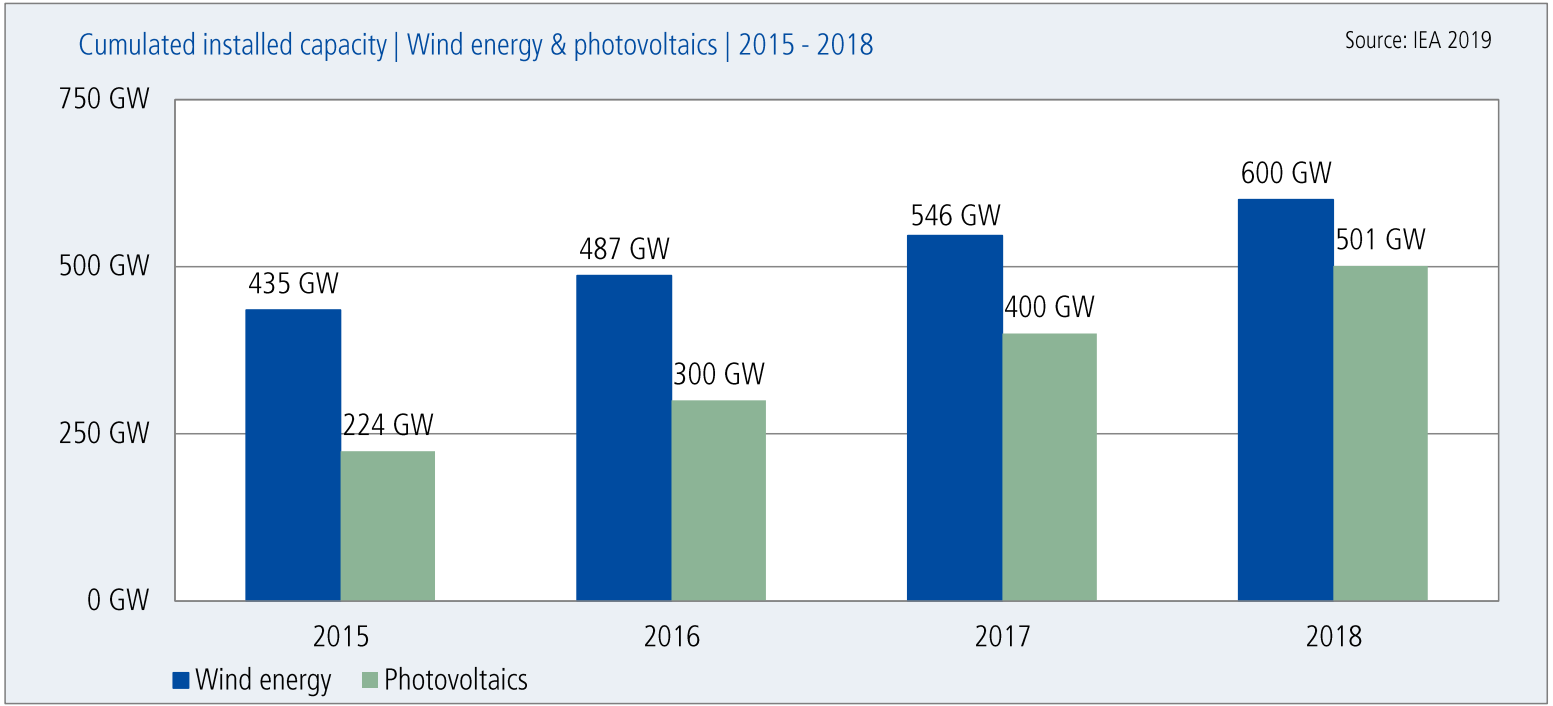
Only in the context of the global financial crisis in 2008/ 2009 CO_2 emissions decreased slightly.



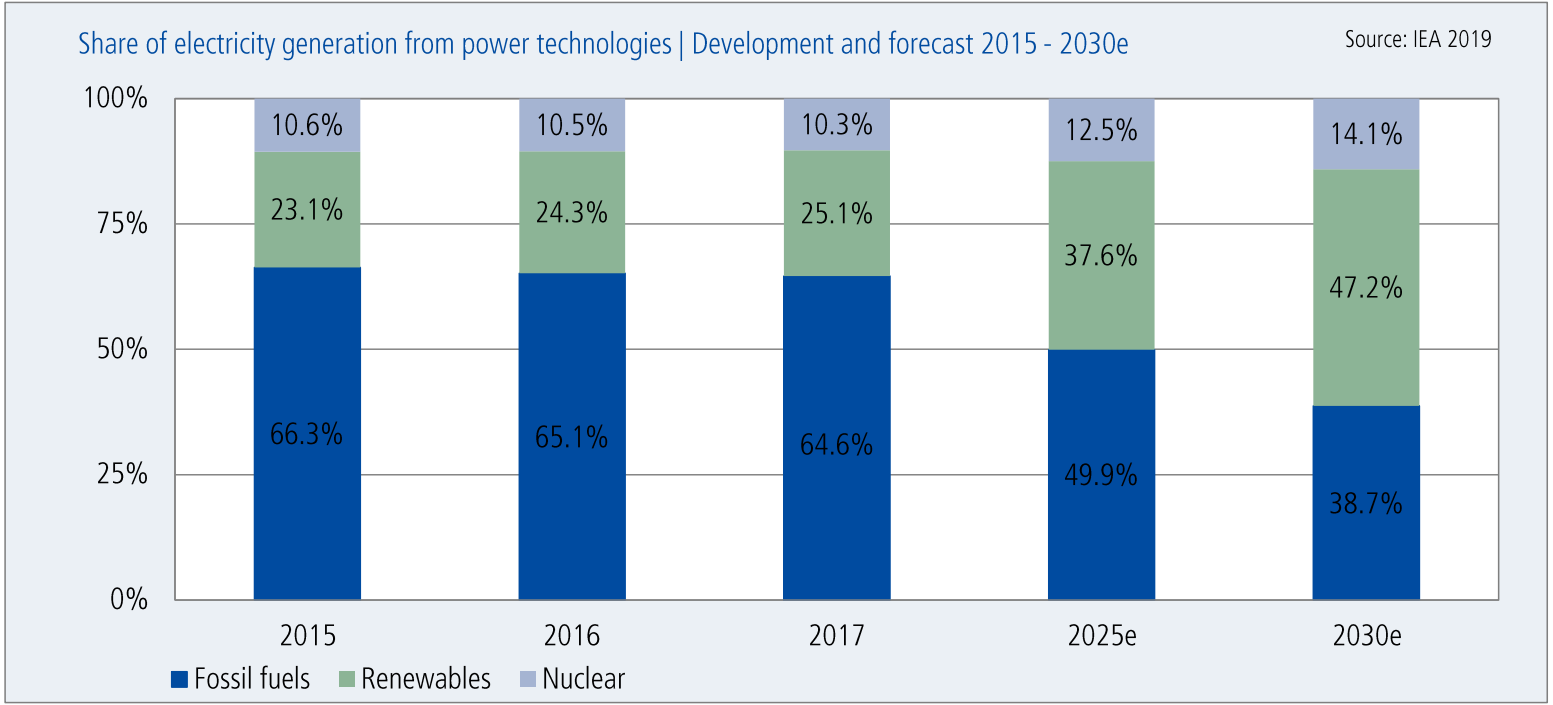
A. Market drivers

The cumulated capacity of global photovoltaics has more than doubled within the last 4 years.



A. Market drivers

On a global level renewable energies cover one quarter of electricity generation and is expected to double until 2030.



A. Market drivers

Model calculation replacing a fossil fueled base load power plant

A typical fossil fueled power plant operating as a base load power plant generates with an installed capacity of 1 GW around 8,400 GWh per year.

1 GW

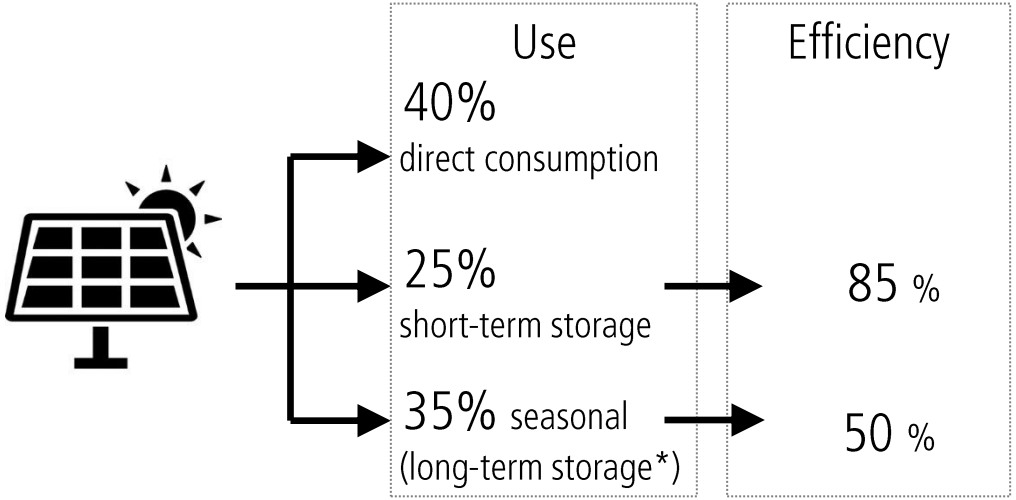
=

8,400 GWh

A. Market drivers

Model calculation replacing a fossil fueled base load power plant

To replace a base load power plant with photovoltaics it must be taken into account, that the largest part of electricity generated has to be stored to be available at night or according to match seasonal fluctuations in solar radiation. Storing electricity is linked to efficiency losses.

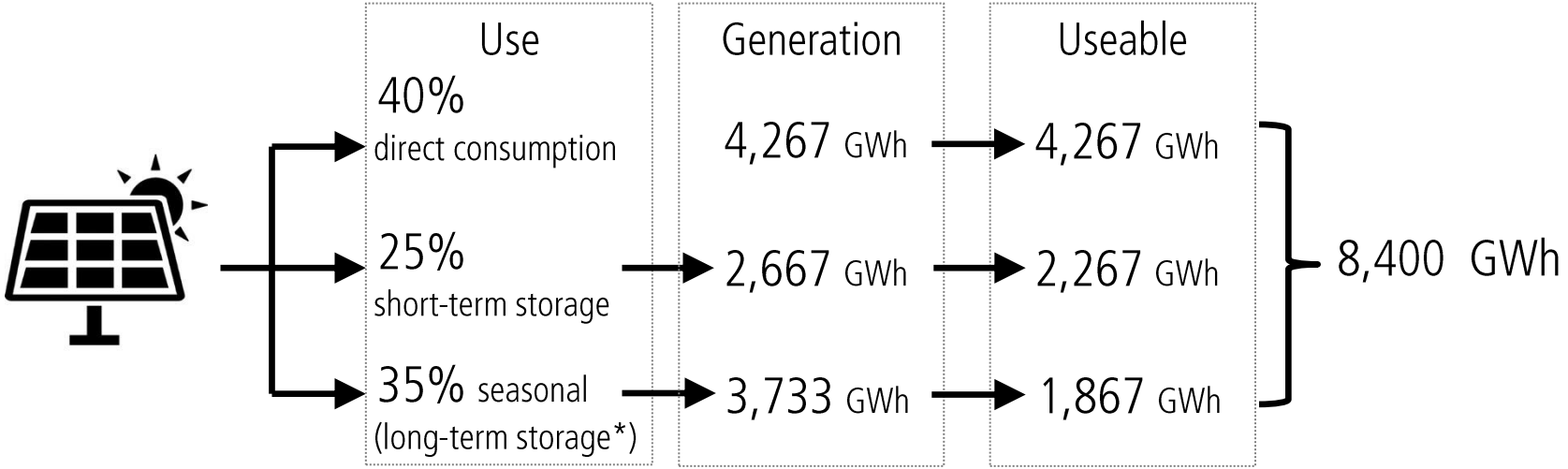


*power to gas and pumped storage

A. Market drivers

Model calculation replacing a fossil fueled base load power plant

Based on electricity losses by charging and discharging short- and long-term storage systems an amount of 10,700 GWh photovoltaic generation is required to receive a useable electricity amount of 8,400 GWh.



*power to gas and pumped storage

A. Market drivers

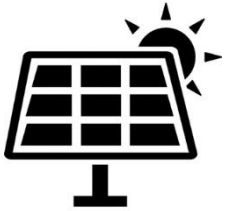
Model calculation replacing a fossil fueled base load power plant

In Mexico, with an high solar radiation of 1,800 kWh/ kWp, an installed capacity of 5.9 GW photovoltaics is needed to replace a typical base load power plant with an installed capacity of 1.0 GW.

1 GW

=

8,400 GWh



5.9 GW

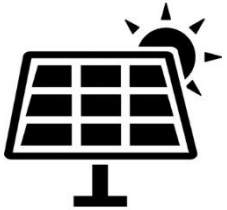
A. Market drivers

Model calculation replacing a fossil fueled base load power plant

An additional capacity of short-term storage of 4.7 GWh and 3.8 TWh of long-term storage is required in order to replace a base load power plant by 5.9 GW of PV capacity.

1 GW

=



5.9 GW

+

4.7 GWh
short-term storage

+

3.8 TWh
long-term storage

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B. Economics of Energy Storage Systems – Where are the Returns?

B. Economics of Energy Storage Systems

Why is energy storage being used?

+ Energy storage requires investment in storage units and causes operating costs
+ Energy storage needs to be constantly supplied with energy (charge)
+ Storage volume limits usage
+ During the storing process, loss of energy occurs
+ Safety and reliability

+ Alternative to energy storage: local energy generation or transfer from central power plants

B. Economics of Energy Storage Systems

So why?

1. Ecological reasons

+ Using energy storage allows the usage of renewable energies for mobility, flexibility (peak shifting)
+ Finite resources are spared, reduction of CO_2 emission

2. Economical reasons

+ Usage of energy storage saves costs

3. Socio-political reasons

+ Low-noise / silent electric mobility
+ Less particulate emissions in inner cities
+ Decentral energy generation with renewable energies minimizes energy distribution (grid expansion)

B. Economics of Energy Storage Systems

Levelized Costs of Electricity

$$LCOE = \frac{\$Cent}{kWh}$$

B. Economics of Energy Storage Systems

Levelized Costs of Electricity

$$LCOE_{PV} = \frac{I_{PV} + \sum_{t=1}^{n} \frac{A_t}{(1+i)^t} + R_n}{\sum_{t=1}^{n} \frac{M_{el} \times (1-d_{PV})^t}{(1+i)^t}}$$

I_{PV}: investment costs
A_t: annual total costs
R_n: removal costs

M_{el}: electricity output
d_{PV}: degradation rate
i: discount rate

n: lifetime in years
t: operating year

LCOE are calculated by accounting for all of a PV system's expected lifetime costs (including construction, financing, maintenance, taxes, insurance and removal), which are then divided by the PV system's lifetime expected power output (kWh).

B. Economics of Energy Storage Systems

Levelized Costs of Electricity

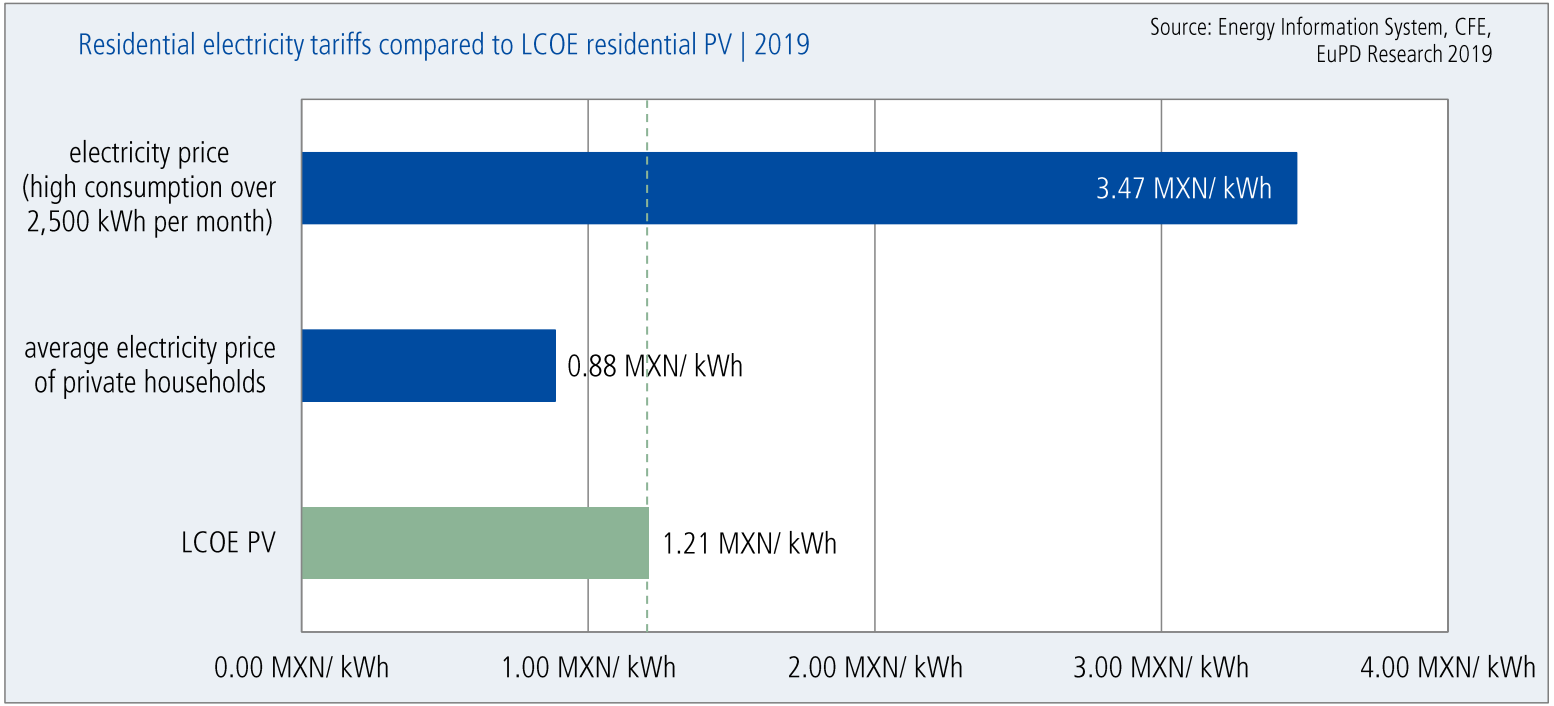
For calculating the LCOE of a residential PV system in Mexico, the following assumptions are made.

PV system (2019)

System costs incl. installation	33,000	MXN/ kWp
System size	7	kWp
Solar radiation	1,800	kWh/ kWp
Degradation	0.25	%
Life-span	25	years
O&M costs	1.00	%

B. Economics of Energy Storage Systems

Generation costs of residential PV systems are below the high consumption electricity tariffs in Mexico.



B. Economics of Energy Storage Systems

Levelized Costs of PV-Storage

$$LCOS_{PV} = \frac{\text{PV System costs} + \text{Storage costs}}{\text{PV Electricity generated} - \text{Storage Loss}}$$

B. Economics of Energy Storage Systems

Levelized Costs of PV-Storage

For calculating the LCOS of a PV + storage system in Mexico, the following assumptions are made.

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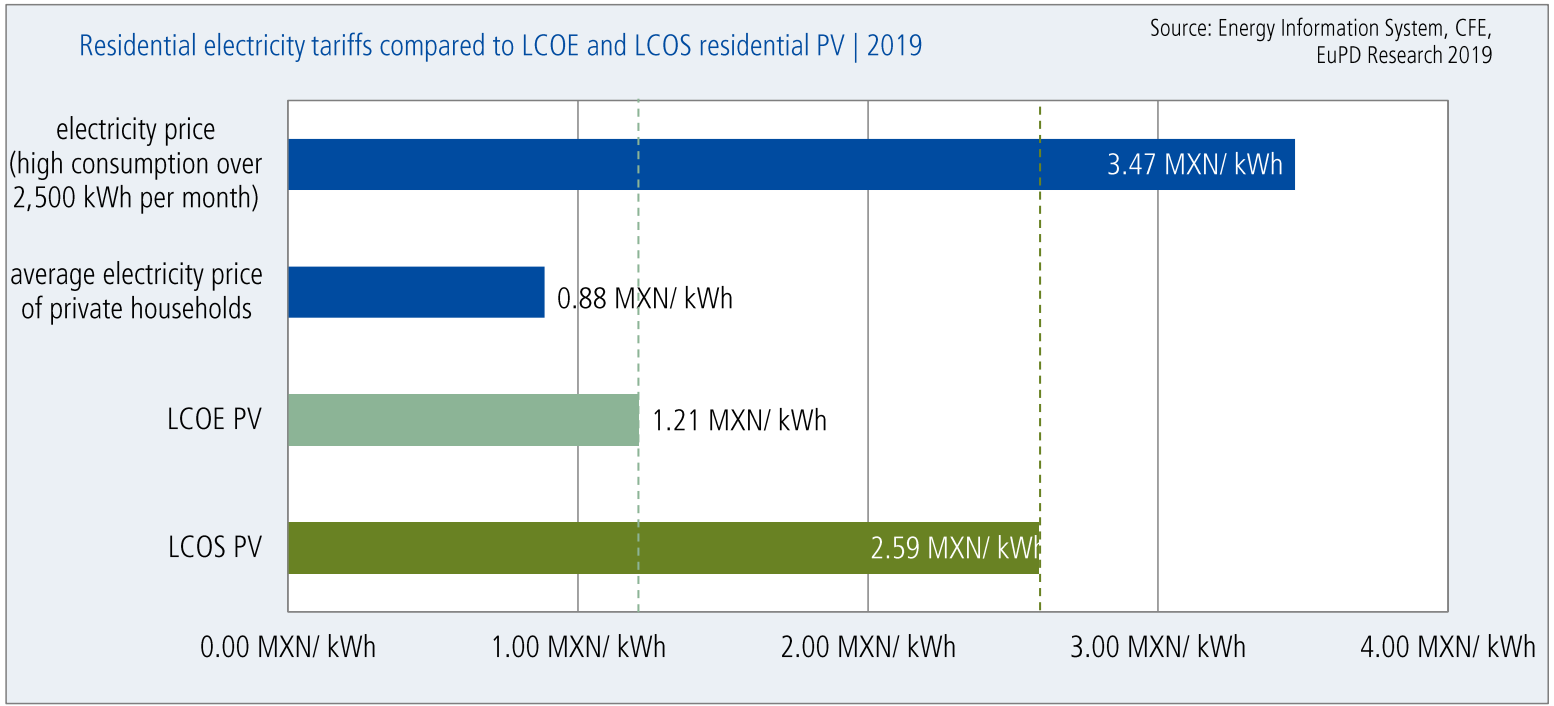
Lithium ion battery (2019)

Battery price incl. installation	26,000	MXN/ kWh (net capacity)
Battery size	6	kWh
Efficiency	85	%
Life-span	15	years

B. Economics of Energy Storage Systems

LCOS of residential PV systems including storage are below the high consumption electricity tariffs in Mexico.



B. Economics of Energy Storage Systems

Applications for Storage Systems

Application area	Effect	Market driver
Self-consumption	Minimization of grid power procurement	High electricity prices
	Maximization of the ROI	No feed-in tariff
	Maximization of self-consumption	No feed-in to the grid possible
Electricity price arbitrage	Utilization of electricity price fluctuations to load cheap electricity and to discharge electricity when prices are high	Electricity tariffs with fluctuating prices during the day
Energy market	Offer of services at the electricity balancing market	Prices and demand for control energy
Island operation	Access to electricity generation or replacement of classic off-grid supply (diesel generators)	Bad or no connection to the grid
		High diesel prices
Emergency power	Maintaining of the electricity supply when the grid breaks down	Vulnerable electricity supply / power outages
Capacity tariffs	Usage of energy storage to reduce the power input of consumption	Specific electricity tariffs

C. Status Quo – Residential Energy Storage Market

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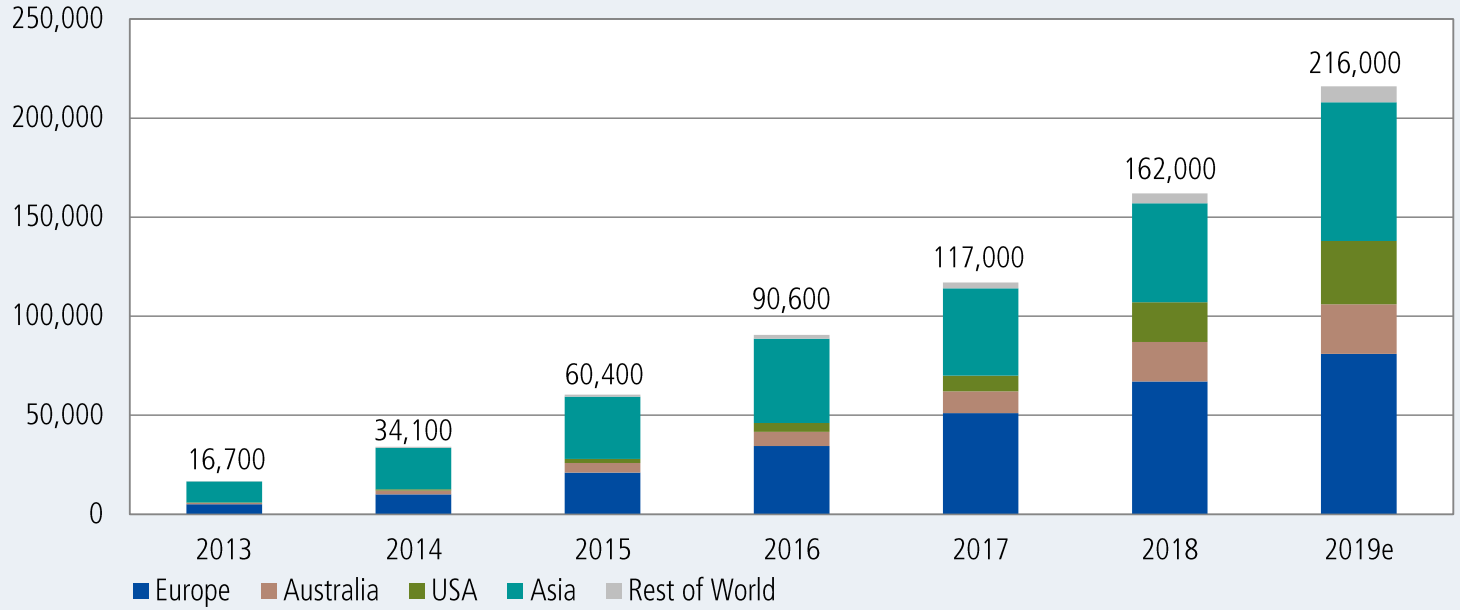
Between 2013 and the end of 2018 the annual worldwide installations grew tenfold.

Status quo and forecast of worldwide newly installed residential energy storage systems | 2013 - 2019e

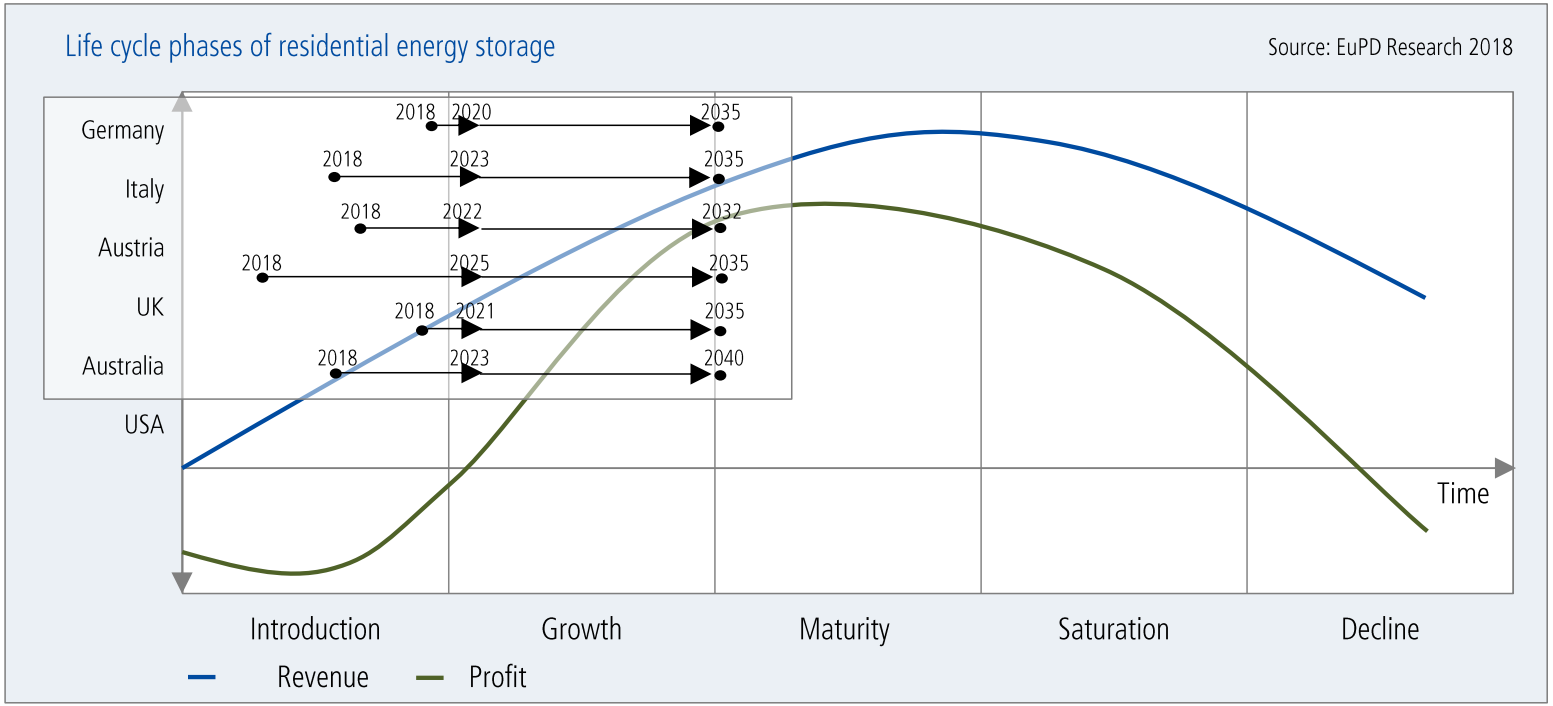
Source: EuPD Research 2019



For 2019 an ongoing growth driven by the U.S. and the Australian market is expected.

C. Status Quo – Residential Energy Storage Market

Already today Germany is facing the second phase of the life cycle - the growth phase.

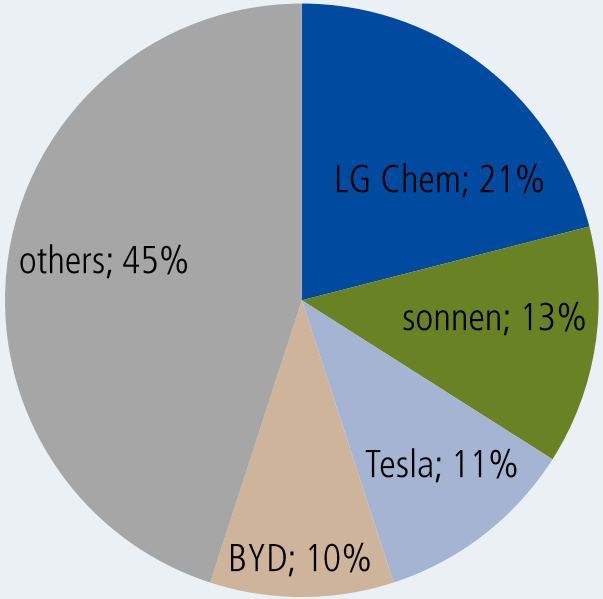


C. Status Quo – Residential Energy Storage Market

The global residential energy storage market is dominated by a few companies.

Global market share of residential energy storage provider* | 2018

Source: EuPD Research 2019

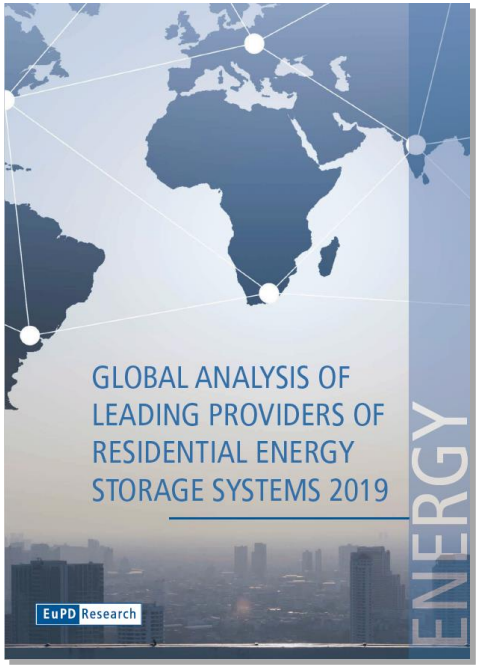


*excluding Japan

Around 100 companies are providing residential energy storage solutions on a local, national or international level.

Global Analysis of Leading Providers of Residential Energy Storage Systems 2019

Which providers are strongly positioned today and are these providers in the right position to exploit the future potentials of the global market for residential energy storage products?



Between 2013 and 2018 the global market for residential energy storage solutions, measured by the number of sold systems, grew tenfold. Until the year 2030 the annual global sales volume is expected to reach six billion euros.

For the first time, this report analyzes the worldwide top 20 providers of residential energy storage systems in a comprehensive approach.

Brand new report by EuPD Research:
"Global Analysis of Leading Providers of Residential Energy Storage Systems 2019"

Summary

- Huge storage installations are needed for the integration of higher shares of wind energy and photovoltaics.
- Residential PV electricity is already competitive regarding the high consumption electricity tariffs in Mexico.
- The average electricity tariffs of private households are too low for the usage of PV & storage systems.
- Current high consumption electricity tariffs for private households make the integration of storage systems in Mexico economical.
- The global residential energy storage market shows a high growth rate, dominated by a few global players.

Thank you very much for your attention!