

A stylized world map in shades of blue. Overlaid on the map are several glowing cyan nodes, each with a small square icon. These nodes are connected by thin, curved white lines that arc across the map, suggesting a global network or data flow. The background is a gradient from dark blue at the top to light blue at the bottom.

Global PV Market Outlook

EUPD Research

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EUPD Research Sustainable Management GmbH

DII Partners' Meet

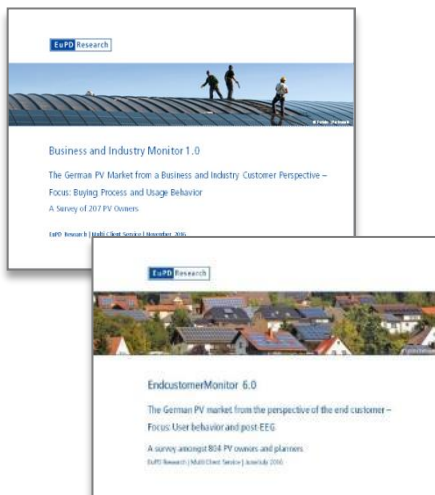
9th February, 2021

About Us

EUPD Research

Market Research

- Global PV InstallerMonitor
- Endcustomer Monitor
- Global Energy Transition (GET) Matrix



EUPD Cert

Certification

- Top Brand PV
- Top PV Supplier
- Customer Satisfaction



EUPD Consult

Exclusive consulting

- Market Entry Strategy
- PV Market Analysis
- Workshops

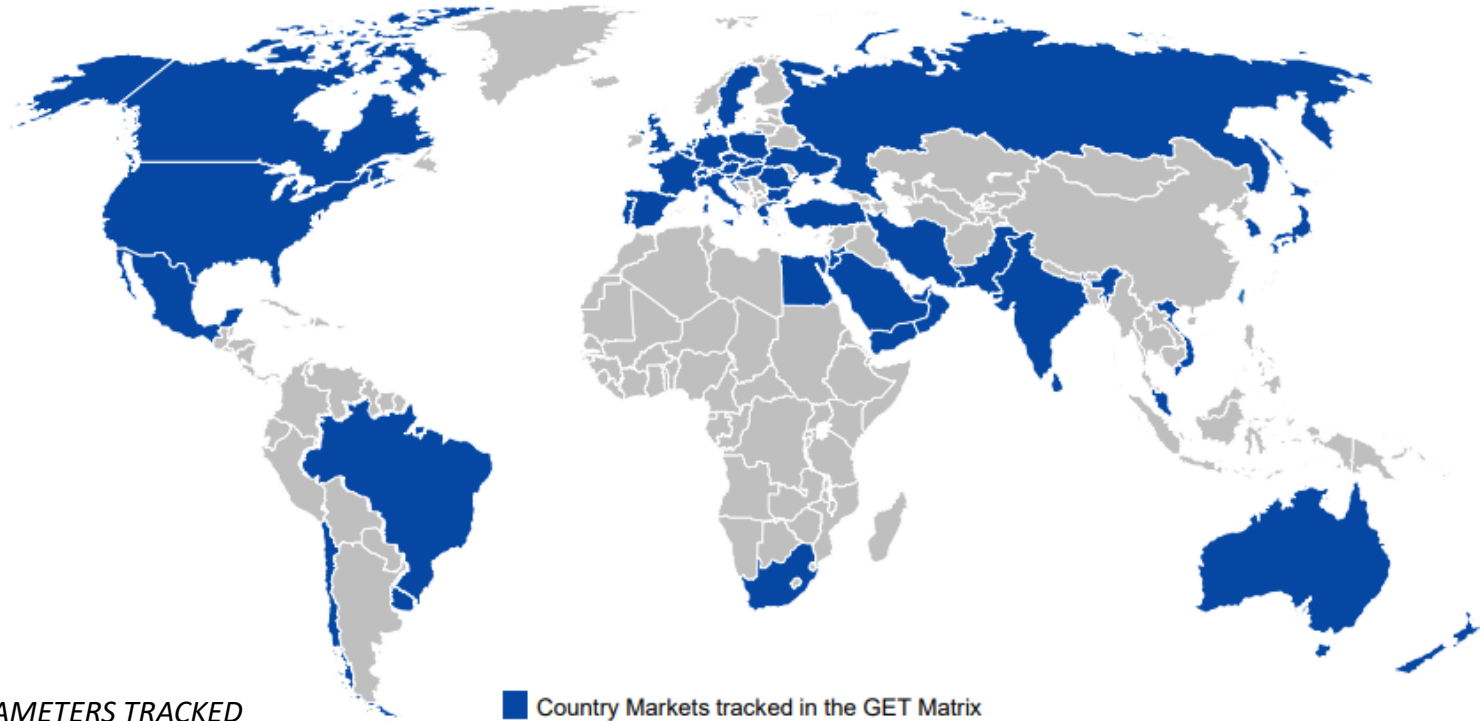


EUPD Research: References (Extract)



About Global Energy Transition (GET) Matrix

- **Online Tool:** Comprehensive info on 50+ Global PV Markets
- **Availability:** 24/7 365 Days
- **Benefits:** Highly Precise data by EUPD Research
- **Updated:** Continuously



PARAMETERS TRACKED

Solar PV



Electricity market



Economic & Political parameters



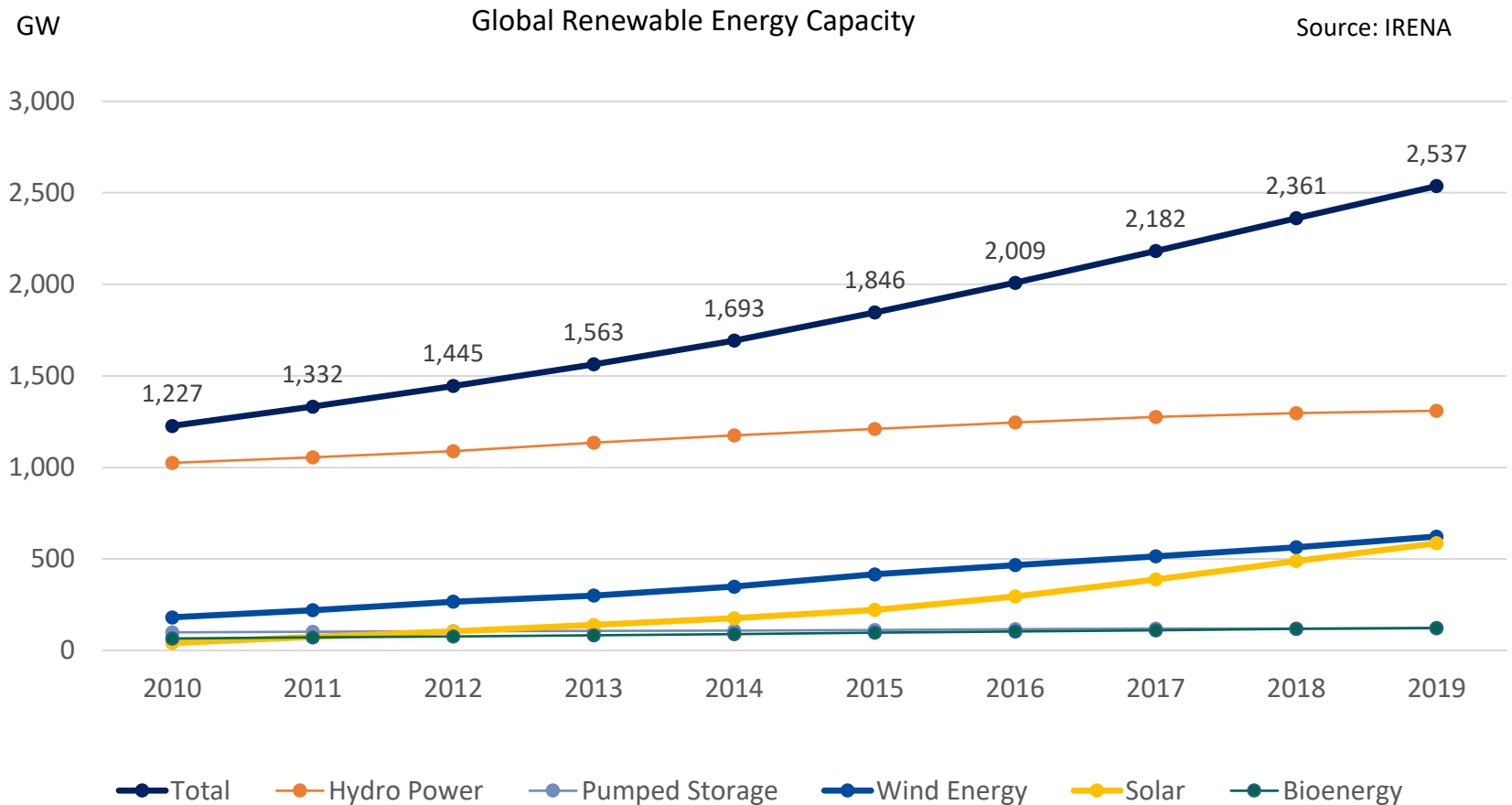
Stakeholders



Top News

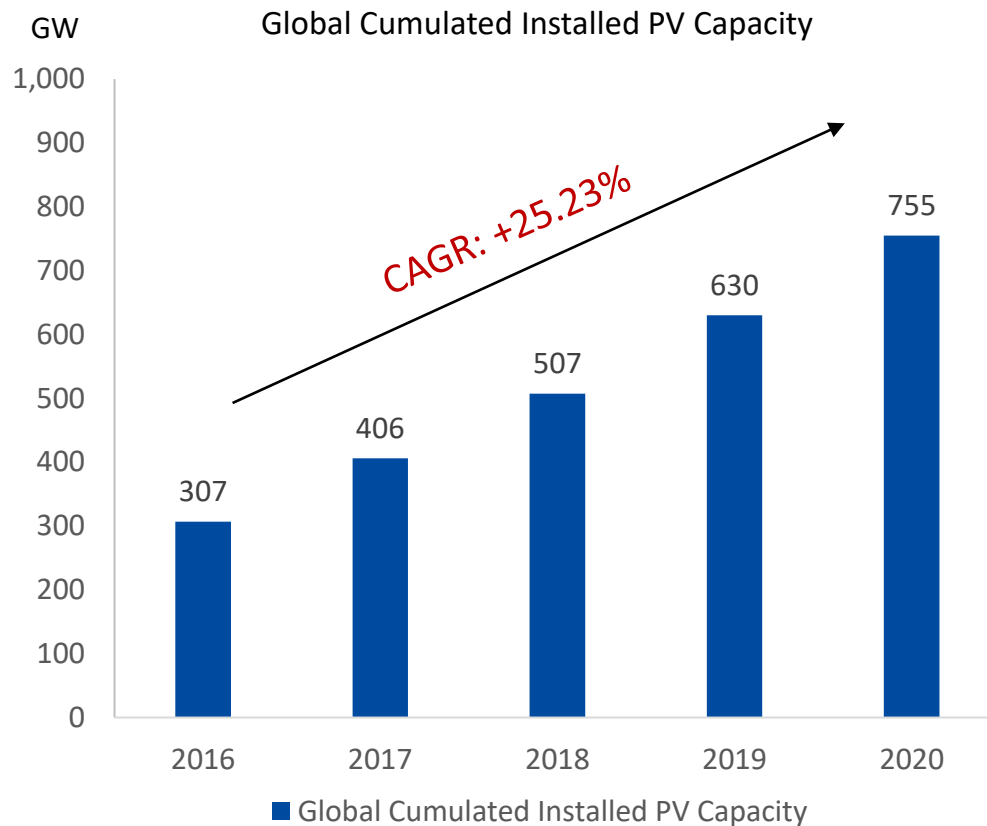
Global RES Capacity

Renewable Energy Sources particularly Solar and Wind has seen rapid growth since 2010.



Global Cumulated Installed PV Capacity 2016-2020

PV Deployments have grown at a CAGR of +25.23% over the last 4 years. Globally, the markets have added more than 100 GW+ per annum over this period.



Major Reasons:

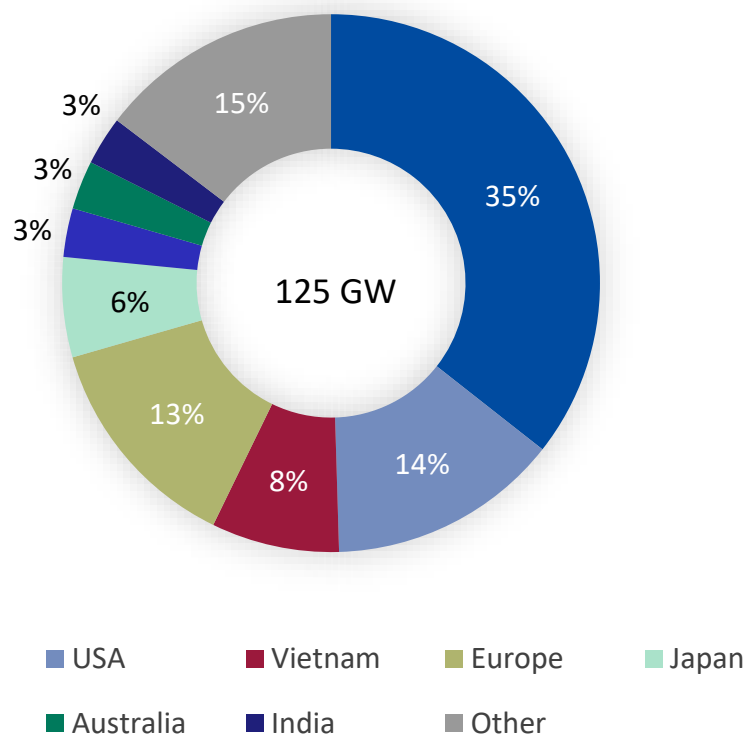
- 1 Strong support mechanisms
- 2 Economies of scale leading to reduced costs
- 3 Technological improvements

Source: EUPD Research 2021

Top PV Markets – 2020

Despite the COVID-19 pandemic, 2020 was a relatively strong year for PV, although some large projects were delayed and deadlines extended. The momentum is further expected to increase in 2021.

Newly Installed PV Capacity in 2020



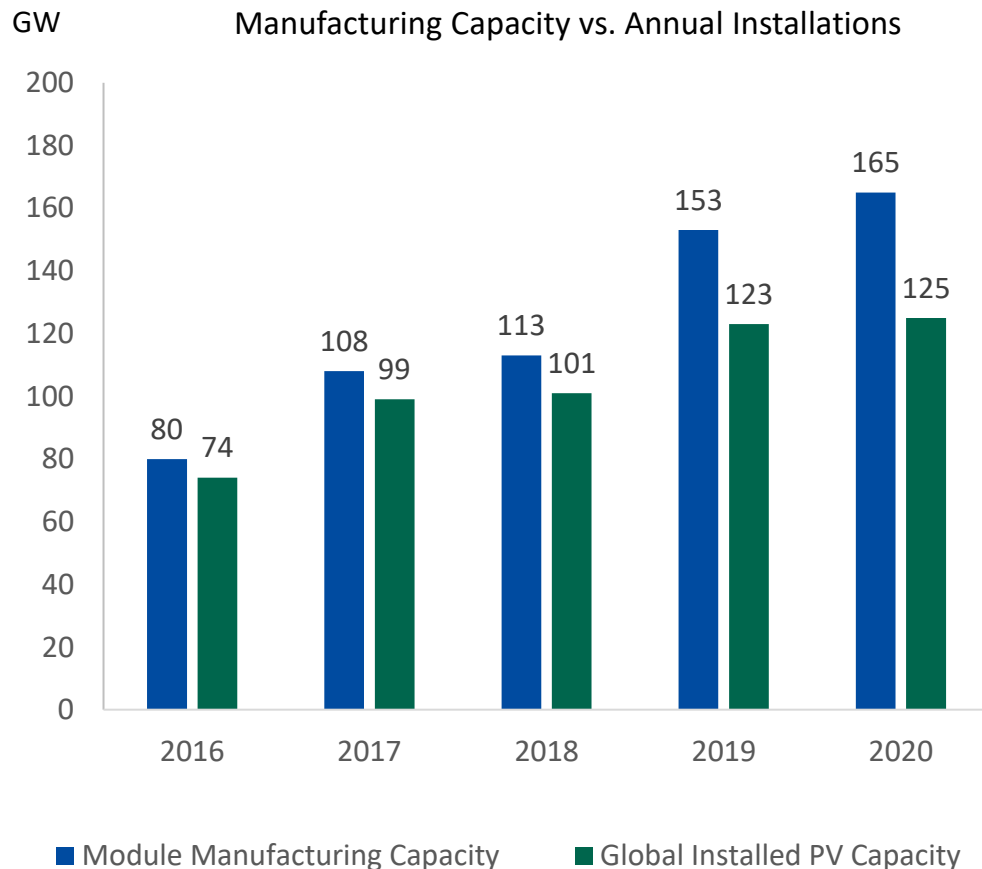
Top GW Markets (2020):

- China – 48.2 GW
- USA – 19 GW
- Vietnam – 10.5 GW
- Japan – 8.2 GW
- Brazil – 4 GW
- Australia – 4 GW
- India – 4 GW
- Germany – 4.9 GW
- Netherlands – 2.93 GW
- Spain – 2.5 GW
- Poland – 2.2 GW

Source: EUPD Research 2021

Global PV Manufacturing Capacities

Several Tier-1 module manufacturers have announced ambitious plans to scale production in China.



Source: IEA & EUPD Research 2021

Major Trends:

- Top 10 Module Manufacturers (Tier 1) accounted for 80%+ of the market

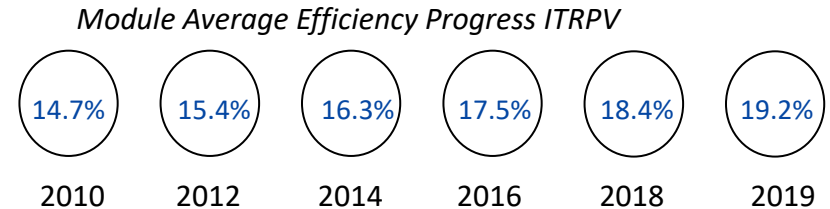


- Tier 2-3 will find it hard to compete in 2021 unless working in a niche segment / market

PV Module Technologies

Key Metric(s)

- **Efficiency** – Ability of the solar module to convert incident solar light into electrical energy per unit area



Key Trends

- Increasing module power and sizes based on larger wafers is spreading rapidly



Wafer Size

M2 (156.75mm)
M6 (166 mm)
M10 (182 mm)
M12 (210 mm)



Power Rating

400 Wp+
450 Wp+
500 Wp+



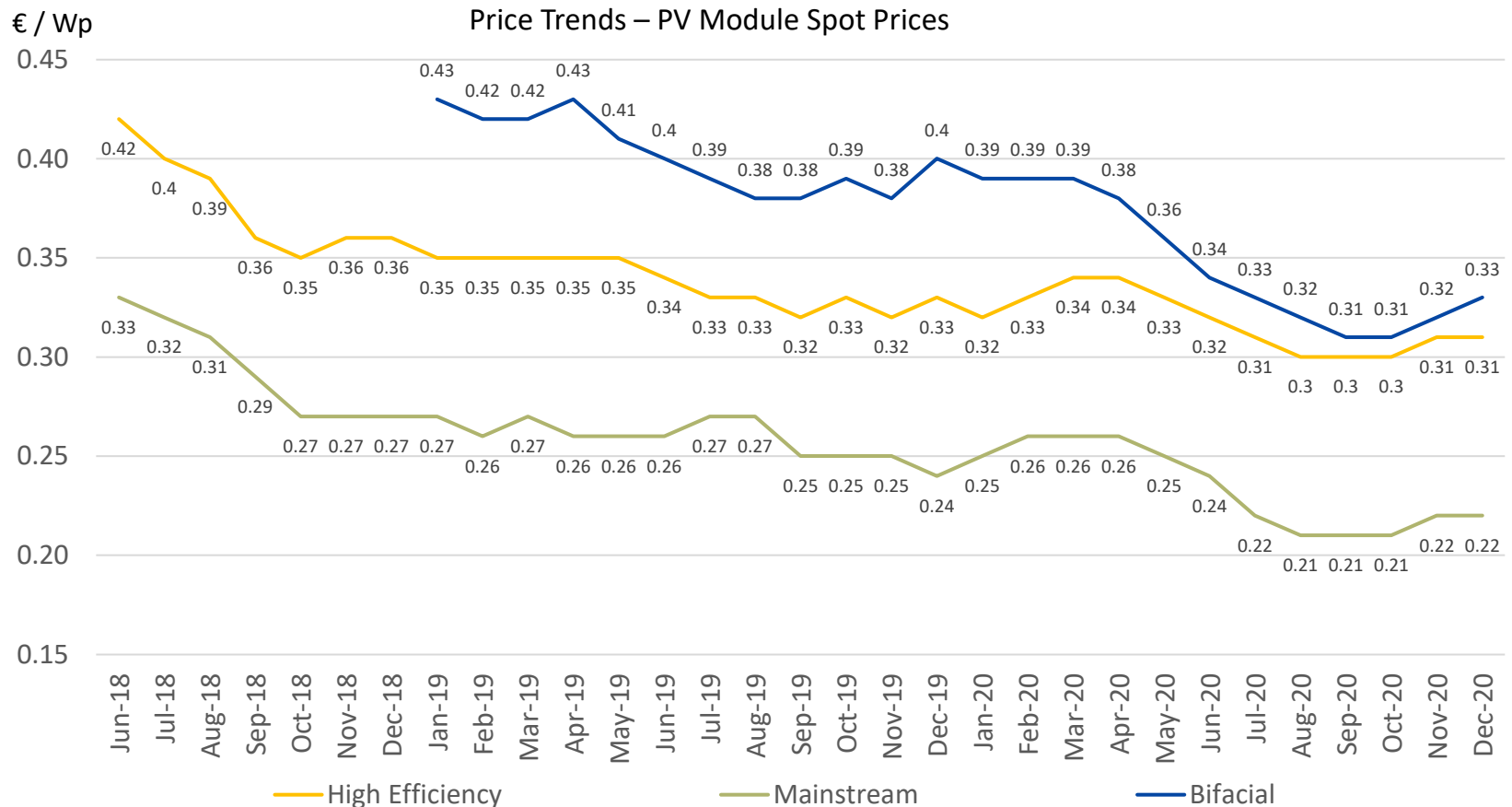
BOM Costs

- Move towards PERC (Passive Emitter Rear Cell) Technology
- HJT (Heterojunction Technology) and IBC (Interdigitated back contact) technology based on the application are gaining traction
- Migration from multi-crystalline to mono-crystalline is almost complete
- Increasing number of manufacturers are developing application oriented PV modules

Segment(s)	Drivers	Technology
Residential	Aesthetics, light weight	High Efficiency
C&I and Utility	High Power, Lower BOS Costs	Bifacial, MBB, Half Cells, Glass-Glass
Utility	High Power, Lower BOS Costs	Bifacial, MBB, Half Cells, Glass-Glass

PV Module Price Development 2018-2020

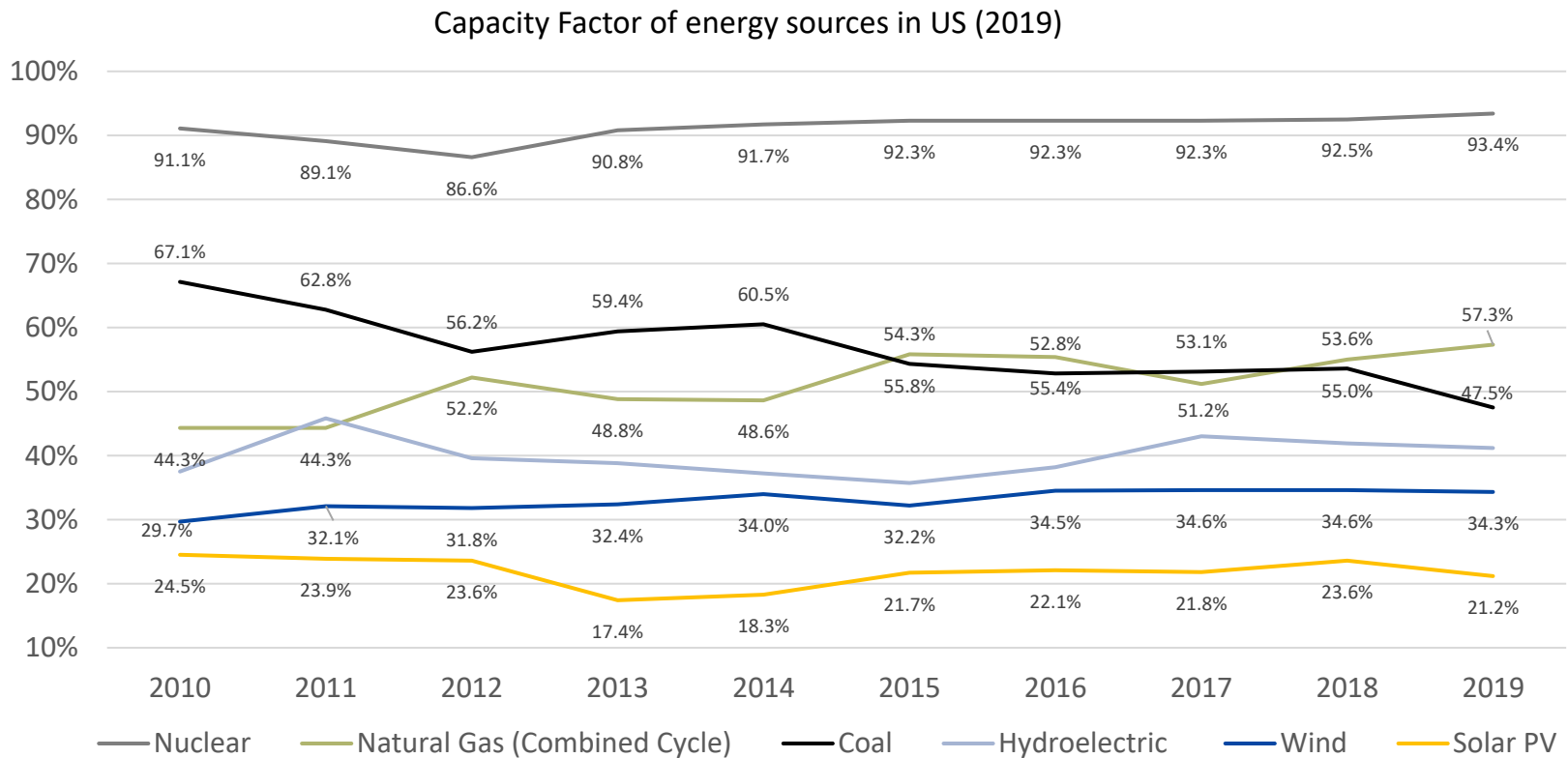
PV Module prices have dropped approx. 33% over the last couple of years in European markets. However, spot prices have slightly increased in recent months due to shortage of polysilicon and glass



Source: www.pvexchange.com

Capacity Factor – Solar PV vs. Other Forms of Energy

Due to lower capacity factor of solar PV compared to other forms of energy, Solar PV requires greater and greater level of storage as they diffuse to compete against baseload capacities

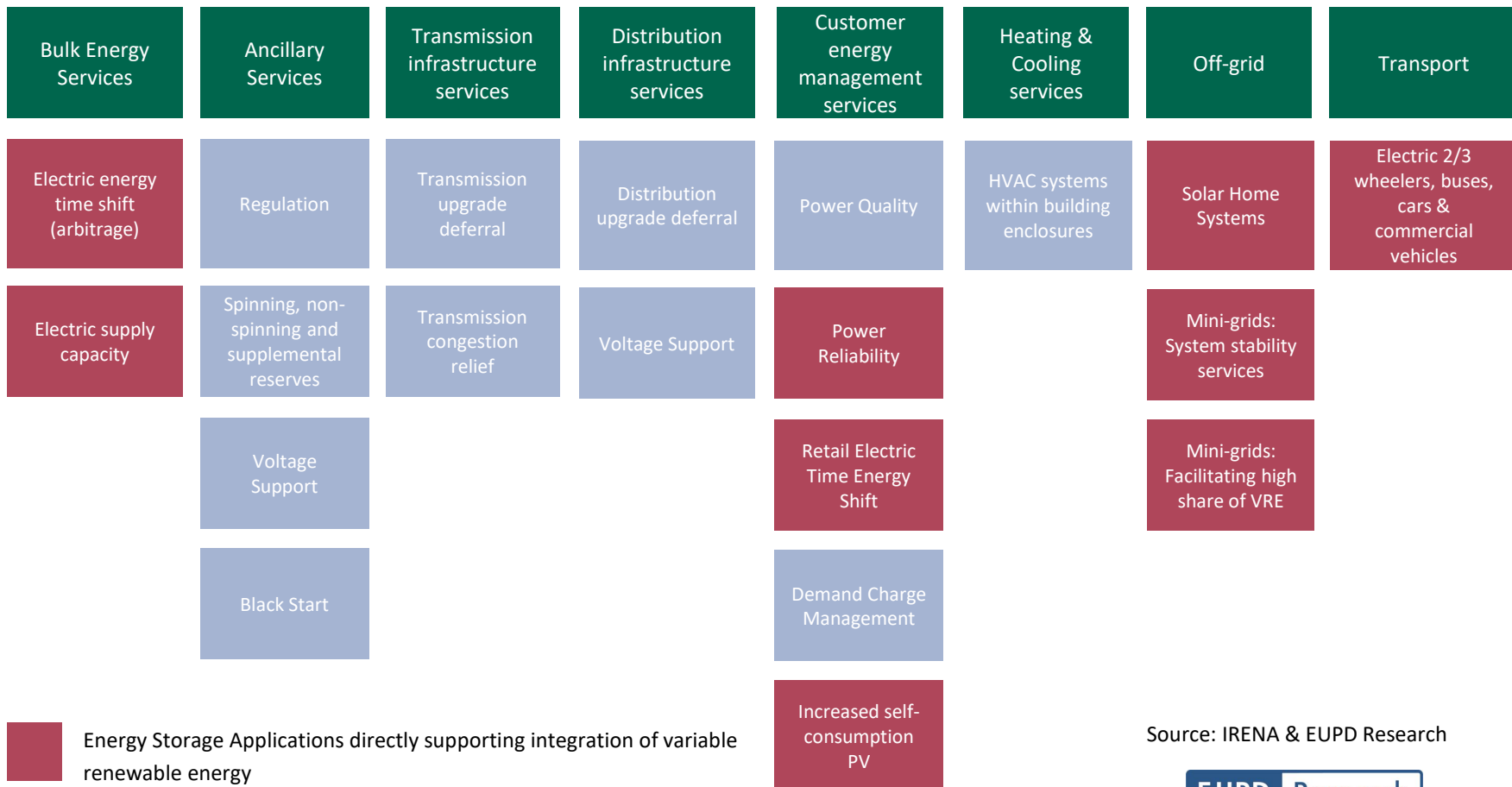


Source: US Energy Information Administration

Storage | Applications

Due to the intermittency of solar PV, storage technologies will play a crucial role in the global energy transition

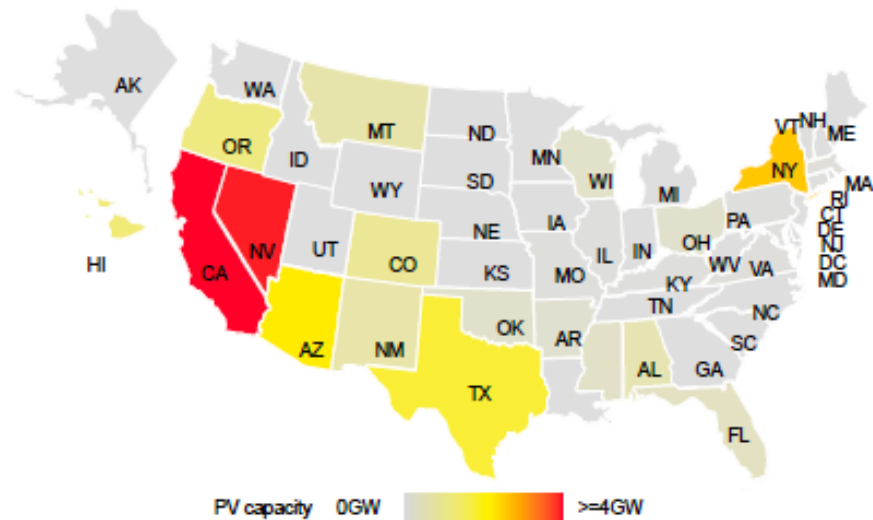
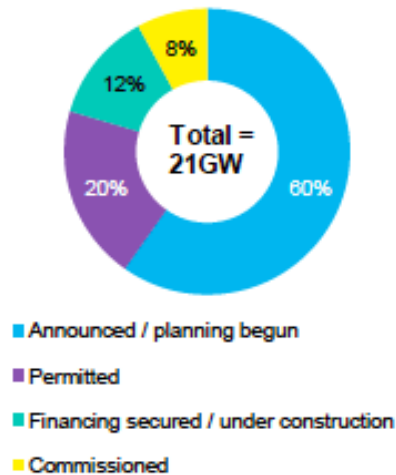
Range of Services:



Source: IRENA & EUPD Research

PV + Storage projects in the US

Increasing number of PV plus storage projects are being announced and in the next 2-3 years expected to be commissioned



Source: BloombergNEF

Pipeline Projects:

- Hawaiian Electric contracted 459MW of solar and 2.85GWh of energy storage to replace two coal plants totaling 435MW
- Southern California Edison announced seven contracts on May 1, 2020, for a combined 770MW/3,080MWh of battery projects to replace gas plants. Most of the winning projects were PV-plus-storage hybrids
- Italy-headquartered utility and generator Enel revealed a plan to add 1GW of batteries to its U.S. renewables fleet by 2022

Towards 100% Renewables...

In a handful of markets globally, renewables has started covering 100% of the demand

The image shows two web browser screenshots side-by-side. The left screenshot is from PV Magazine, dated January 4, 2021, titled "One perfect 100% renewable day in South Australia". It features a sub-headline "As Christmas lights twinkled their last, South Australia's electricity grid spent a day basking in sunshine and turning towards brisk summer breezes. Renewal ruled — a taste of future feasting on clean energy." and a photo of wind turbines at sunset. The right screenshot is from Clean Energy Wire, dated January 1, 2021, titled "Renewables briefly cover 100% of Germany's power demand for 2nd time". It includes a sub-headline "Germany again meets around 100 percent of power demand with renewables" and a detailed paragraph about Germany's renewable power production exceeding electricity demand on May 1st. Both articles cite the Federal Network Agency (BNetzA) as the source of the data.

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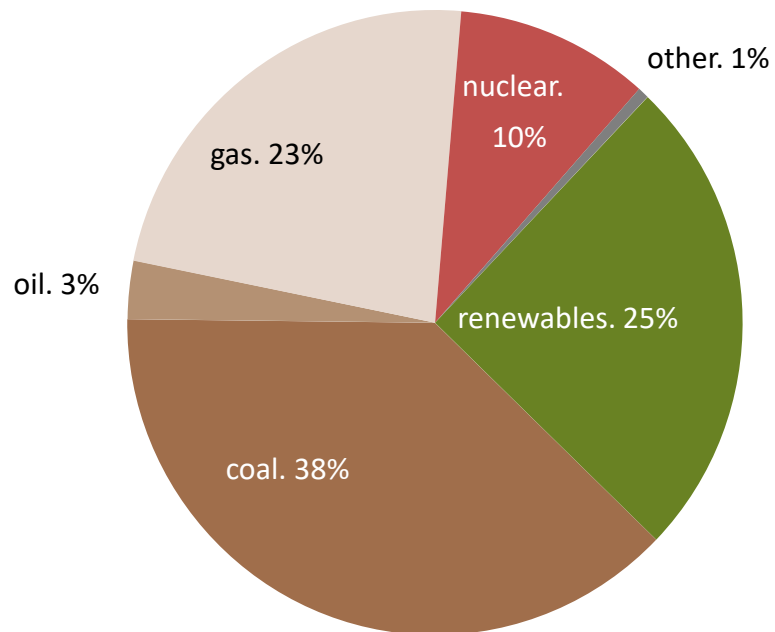
One perfect 100% renewable day in South Australia
As Christmas lights twinkled their last, South Australia's electricity grid spent a day basking in sunshine and turning towards brisk summer breezes. Renewal ruled — a taste of future feasting on clean energy.
JANUARY 4, 2021 NATALIE FILATOFF
MARKETS AUSTRALIA

Renewables briefly cover 100% of Germany's power demand for 2nd time
Germany again meets around 100 percent of power demand with renewables
Germany's renewable power production briefly exceeded the entire country's electricity demand on 1 May, data provided by the Federal Network Agency (BNetzA) suggests. Renewable power output on the windy and sunny public holiday reached 53,987 megawatt hours (MWh) at 1pm, while consumption reached 53,768 MWh, according to the BNetzA's live energy data portal smard.de. The data suggests that renewable power production exceeded consumption for about two and a half hours. Germany's economy and energy minister Peter Altmaier said on social network Twitter that it was "great" that the country was able to cover its demand with renewables. "Now transmission lines take precedence so that the power can flow," Altmaier added. Germany briefly covered 100 percent of its power demand with renewables on 1 January, another public holiday, when wind power alone covered 85 percent of demand. However, the data presented by the BNetzA is still preliminary and energy generation analysts disagree how accurate certain supply and demand measurements are. This means the actual renewables share could be below 100 percent, depending on the methodology and data accuracy.

Status-Quo

In 2018 renewable energies reached one quarter of the global electricity generation ...

Global electricity generation mix 2018

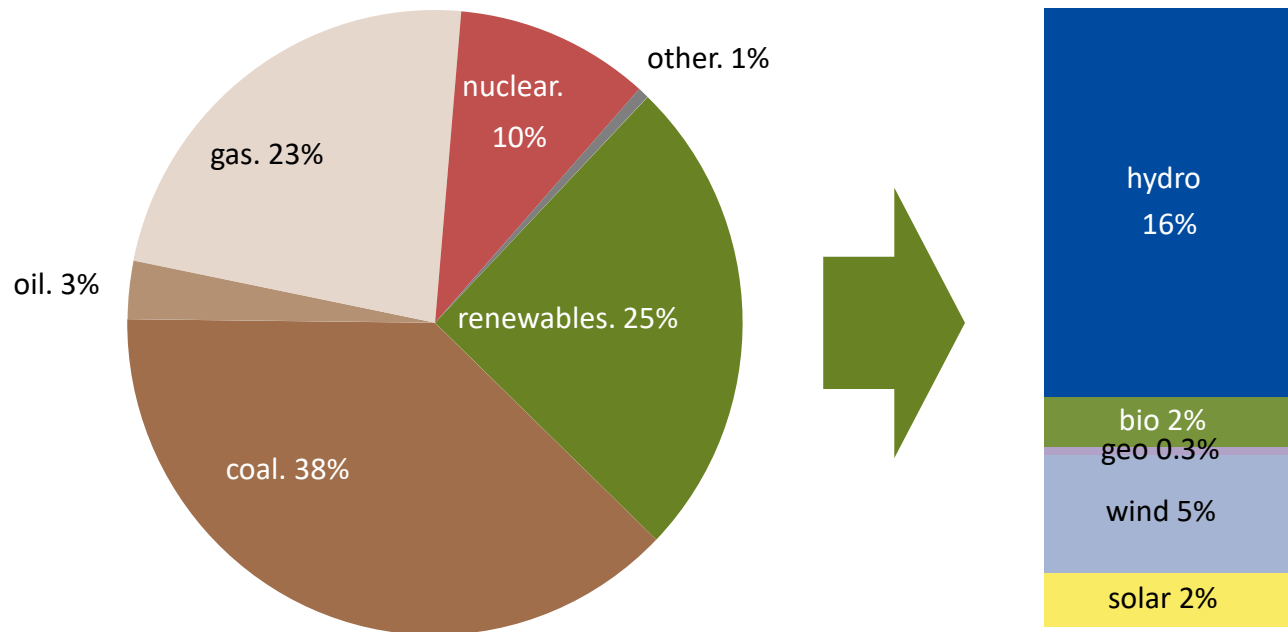


Source: BP 2019

Status-Quo

... whereas electricity generation through hydro power plants accounts for nearly 2/3rd of all renewables

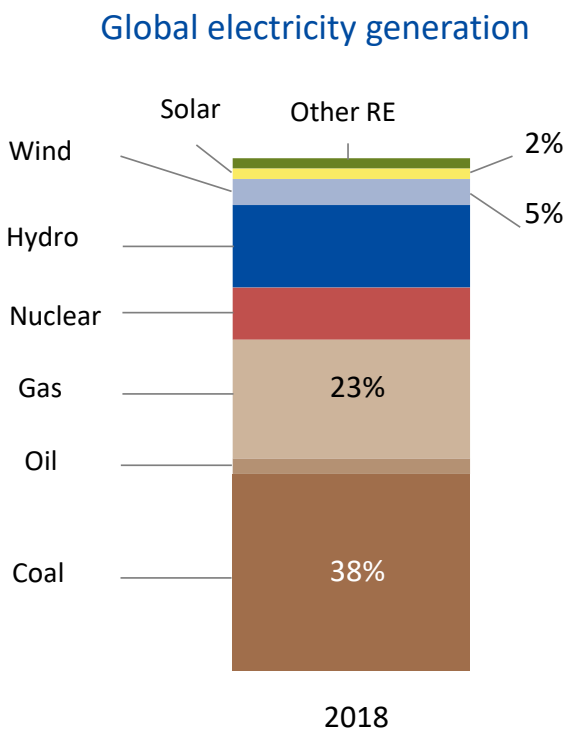
Global electricity generation mix 2018



Source: BP 2019

Status-Quo

In 2018 around 38% of the global electricity was generated by coal power plants

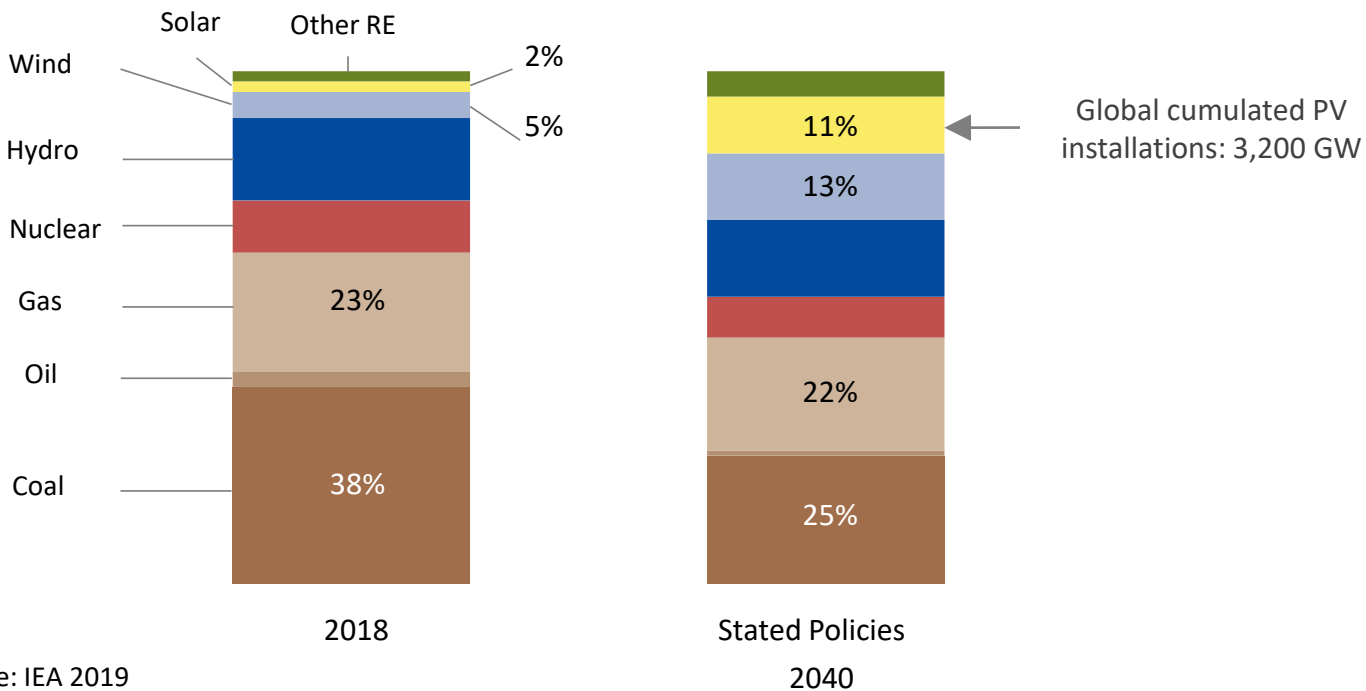


Source: IEA 2019

Market Drivers

Taking into account the stated policies world over, solar & wind are slated to account for approx. 1/4th of the total electricity generation by 2040

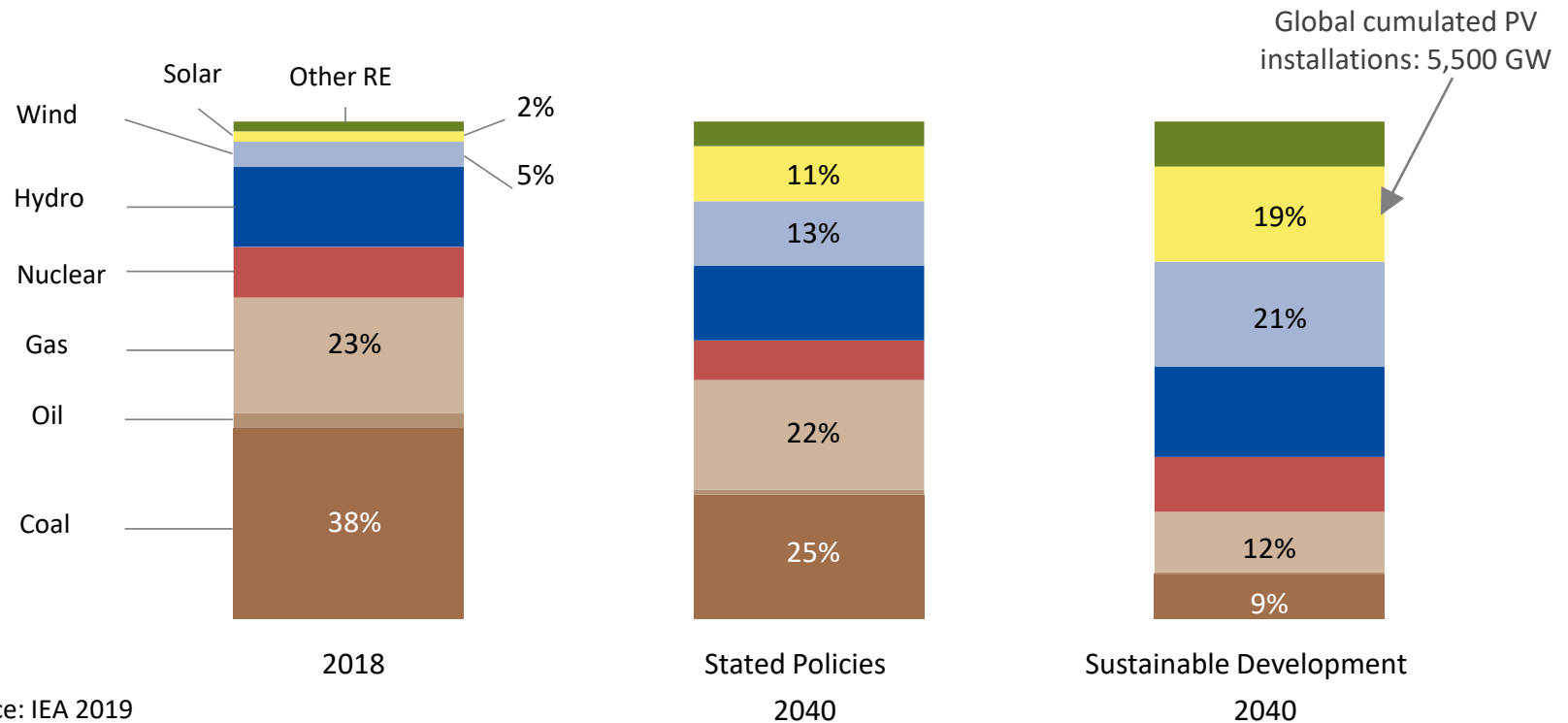
Global electricity generation scenario 2040



Source: IEA 2019

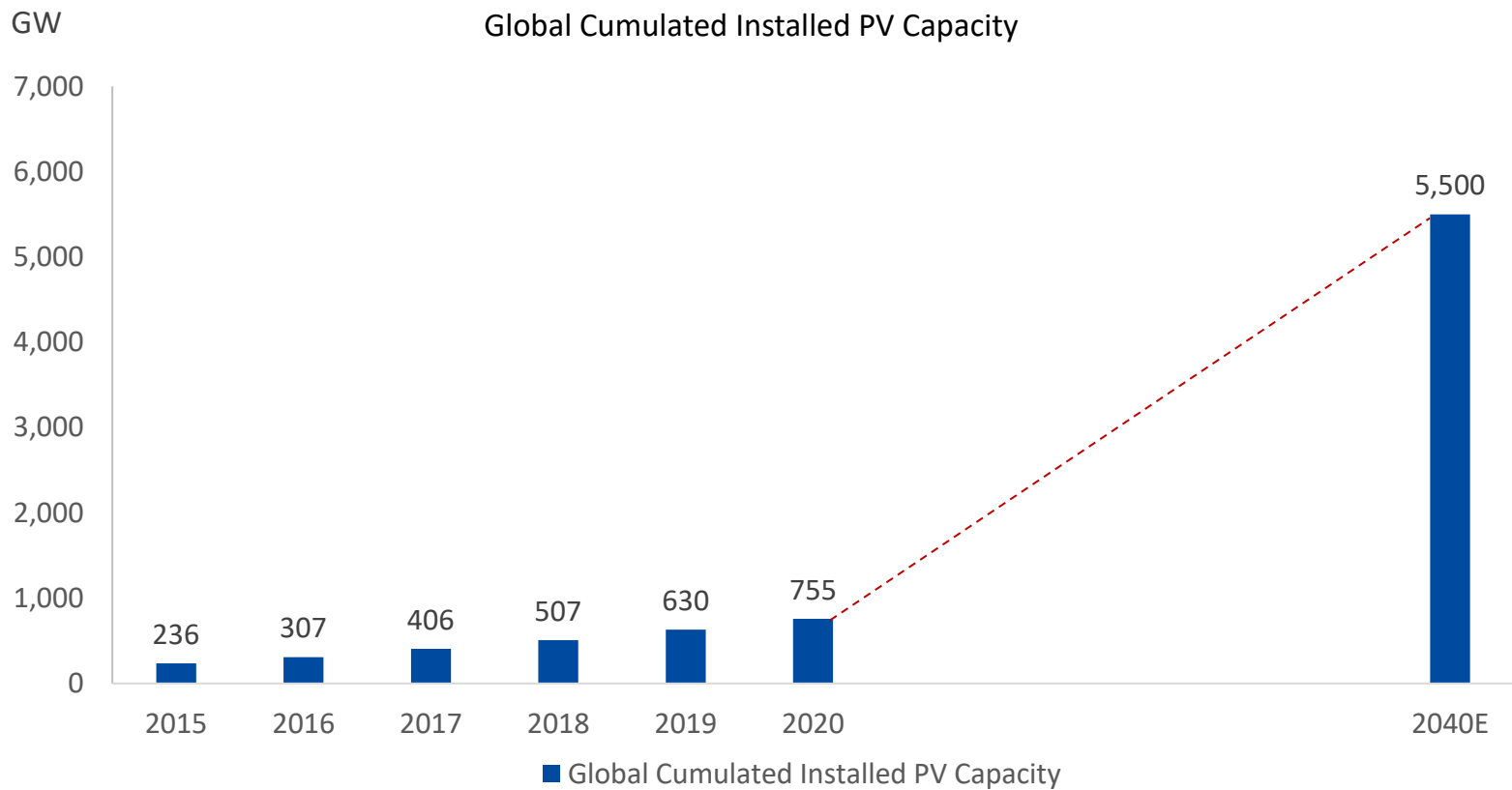
Market Drivers

Furthermore, if the Sustainable Development targets are to be reached this percentage could go as high as 40% by 2040. COVID-19 pandemic has further accelerated the target



Market Outlook 2040

Between 2020 and 2040, the globally the installations will increase by more 4,750 GW a huge opportunity for global solar stakeholders...



Source: EUPD Research 2021

Solar Stocks are Buoyant...

- The Guggenheim Solar ETF gained 233.6% vs. the S&P 500 and the Dow, which increased by 16.3% and 7.2% in 2020
- In December 2020, the ETF increased 23.2% vs. the S&P 500 and the Dow, which both increased 2.6%.

Guggenheim Solar ETF – TAN Holdings



Source: PV Magazine

Company	Ticker	Close price Dec 31, 2020	% change Dec 01–31, 2020	% change year to date
Risen Energy Co., Ltd.	SZSE:300118	28.83 CNY	+ 60.3%	+ 108.2%
Beijing Jingyuntong Technology Co., Ltd.	SHSE:601908	10.29 CNY	+ 58.1%	+ 243.0%
REC Silicon ASA	OB:RECSi	16.10 NOK	+ 53.3%	+ 501.2%
Sungrow Power Supply Co., Ltd.	SZSE:300274	72.28 CNY	+ 47.8%	+ 586.4%
ReneSola Ltd	NYSE:SOL	11.43 USD	+ 44.9%	+ 707.8%
Xinyi Solar Hold., Ltd	SEHK:968	20.25 HKD	+ 43.2%	+ 266.2%
Enphase Energy, Inc.	NasdaqGM:ENPH	175.47 USD	+ 36.2%	+ 571.5%
Jolywood (Suzhou) Sunwatt Co., Ltd.	SZSE:300393	12.99 CNY	+ 37.0%	+ 61.4%
GCL-Poly Energy Hold., Ltd.	SEHK:3800	1.23 HKD	+ 36.7%	+ 316.9%
Daqo New Energy Corp.	NYSE:DQ	57.36 USD	+ 42.3%	+ 460.2%
PVA TePla AG	XTRA:TPE	19.60 EUR	+ 34.2%	+ 28.1%
Shenzhen S.C New Energy Technology Corp.	SZSE:300724	145.60 CNY	+ 33.4%	+ 284.3%
LONGi Green Energy Technology Co., Ltd.	SHSE:601012	92.20 CNY	+ 31.9%	+ 271.3%
Sino-American Silicon Products Inc.	GTSM:5483	177.50 TWD	+ 22.8%	+ 78.6%
Sunrun Inc.	NasdaqGS:RUN	69.38 USD	+ 11.0%	+ 402.4%
Tongwei Co., Ltd.	SHSE:600438	38.44 CNY	+ 21.6%	+ 192.8%
Sunworks, Inc.	NasdaqCM:SUNW	5.12 USD	+ 20.5%	+ 309.6%
Sunnova Energy International Inc.	NYSE:NOVA	45.13 USD	+ 12.5%	+ 304.4%
TBEA Co., Ltd.	SHSE:600089	10.15 CNY	+ 18.3%	+ 52.6%
SolarEdge Technologies, Inc.	NasdaqGS:SEDG	319.12 USD	+ 16.4%	+ 235.6%
SunPower Corporation	NasdaqGS:SPWR	25.64 USD	+ 20.7%	+ 228.7%
SMA Solar Technology AG	XTRA:S92	55.95 EUR	+ 14.1%	+ 61.9%
Azure Power Global, Ltd.	NYSE:AZRE	40.77 USD	+ 11.3%	+ 224.1%
Tianjin Zhonghuan Semiconductor Co., Ltd.	SZSE:002129	25.50 CNY	+ 12.2%	+ 115.9%
JinkoSolar Hold. Co., Ltd.	NYSE:JKS	61.87 USD	- 54.2%	+ 175.1%

Information upon which this material has been compiled by pv magazine and is based was obtained from sources believed to be reliable but has not been verified. Additional information is available upon request.

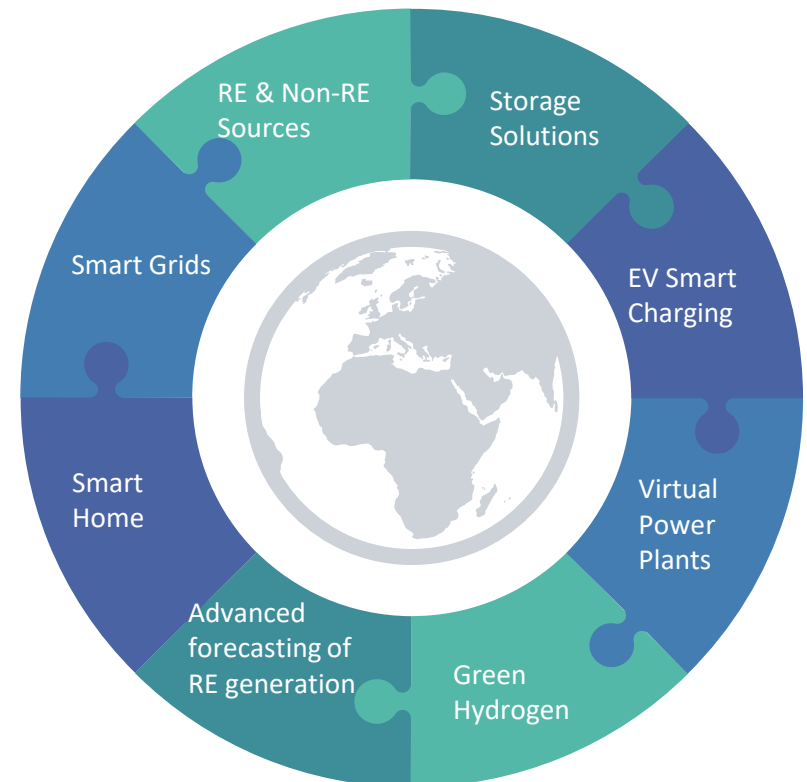
Future Challenges & Opportunities

Every country and various utilities world over will try to achieve their sustainable energy goals by increasing share of RE in their energy mix in the coming decades.

Some future Challenges:

- Integration of RE Capacity
- Grid flexibility

However the “Interplay of the RE, other emerging technologies and market design optimized through digital technology” will be the single most critical piece of the puzzle towards the global energy transition



Thank you for your attention!



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