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# Trends in utility-scale applications

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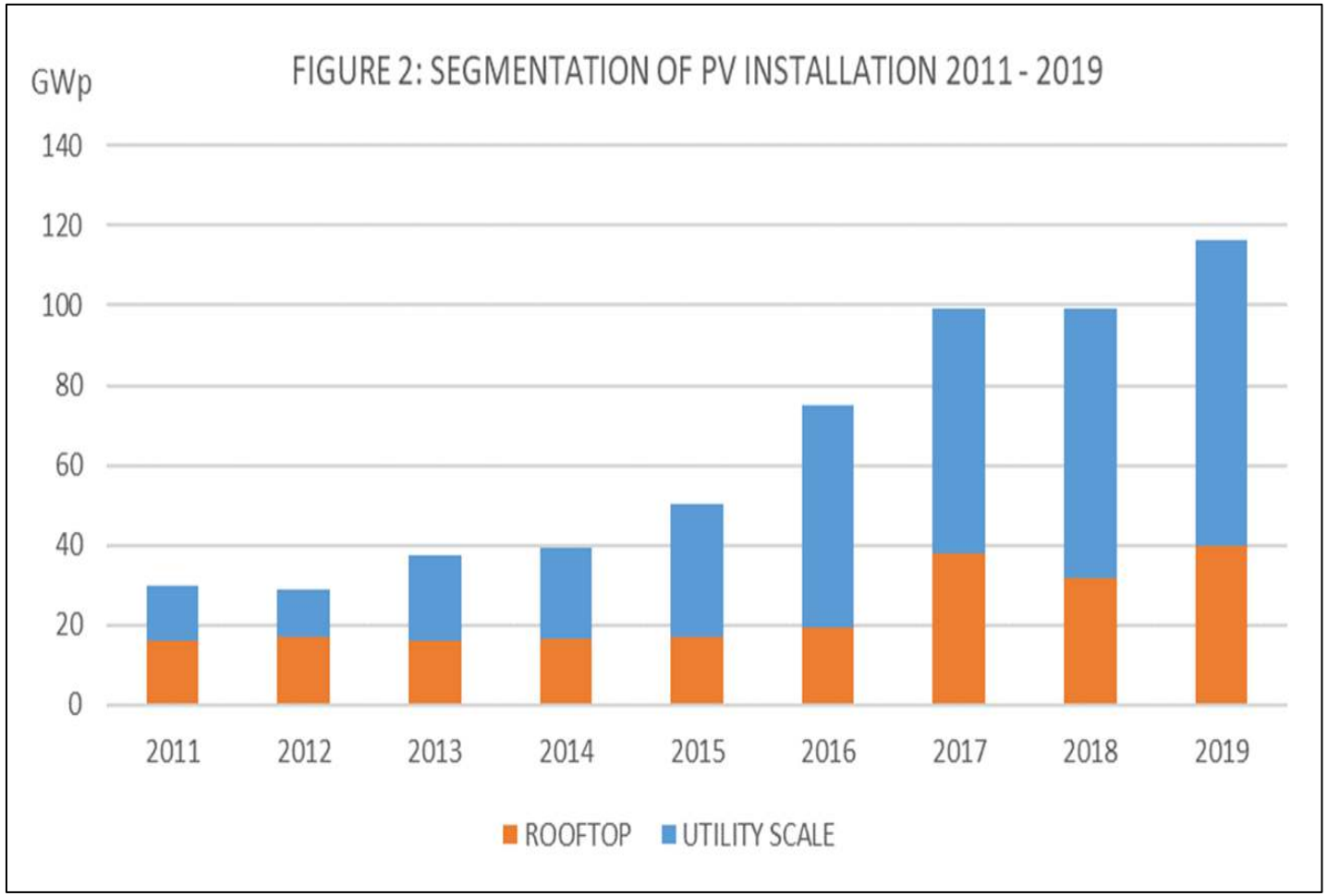
- Research and strategy consulting about PV technology, policies and markets.
- Europe, Asia, Middle-east, Africa, America.
- Based in Belgium

# Segmentation




- Market segmentation has been dominated by utility-scale PV plants in the last 6 years, with a change coming from China in 2017.
- 2019 growth shared
- Floating < 1 GW
- BIPV < 1 GW
- AgroPV is new and growing slow

# Utility-scale PV ?

- No univocal definition
  - It started with ground-mounted PV installations, sometimes with small sizes
  - It used to be remunerated with feed-in tariffs (even in case of local self-consumption)
  - Characteristics?
    - Ground-mounted, but large-scale roofs have been seen (up to 50 MW)
    - Electricity injected into the grid (distribution, transmission) but some self-consumption can be defined
    - Three majors drivers:
      - Call for tenders, competitive, with or without additional constraints
      - Options for virtual self-consumption with UPV delivering into the distribution grid for smaller consumers' self-consumption
      - Merchant PV: electricity sold either through PPAs or directly on the wholesale market
    - Floating, agro-PV…

# Some Global Market Trends 2019-2020

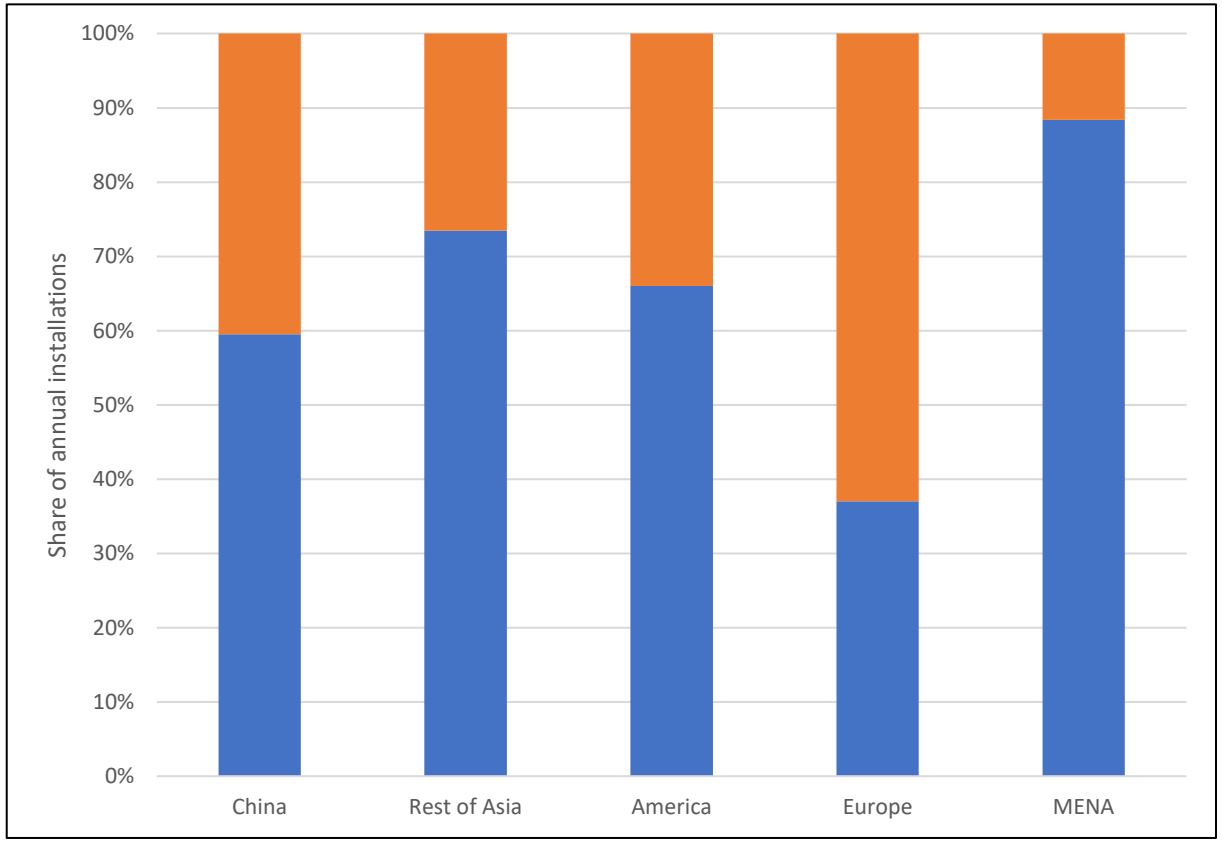
- Market continues to develop in key locations with new countries being added to the list, mostly for utility-scale PV applications until tenders.
- Some key examples: Egypt, UAE, Morocco, Vietnam, Mexico…
- Middle-East sees a fast development in UPV, driven by competitve call for tenders
- China is again the major unknown equation but the market should reach at least 30 GW with new tenders, front-runner program and poverty aleviation policies.
- Europe sees a tender-driven development, starting from Germany and the Netherlands with opportunities in France and Turkey.

# Segmentation

- Statistics depend on the country
- Some use system size, others use the qualification
- Some use AC, others DC to report system size
- But in general systems above 10 MW are ground-mounted, utility-scale in their large majority

- In general, utility-scale refers to large ground-mounted, or floating power plants, injecting either in the grid or for self-consumption, with a size > 1 MW.

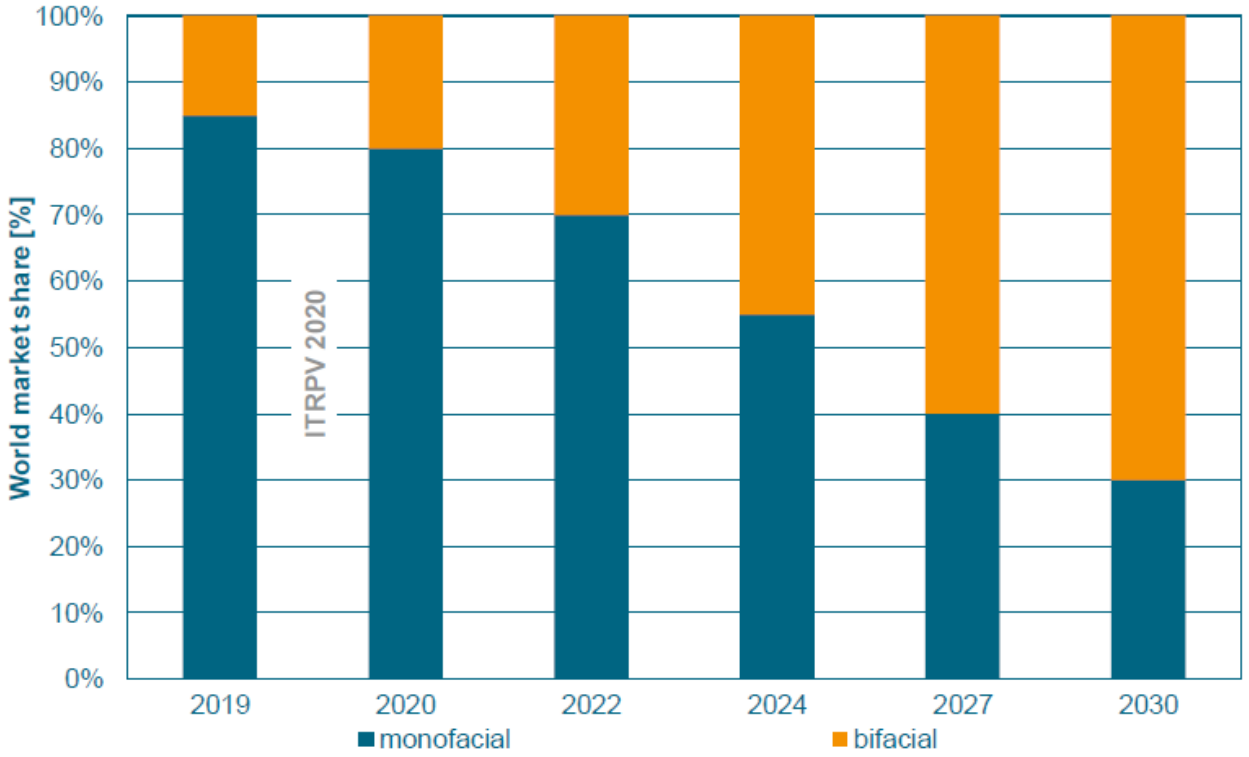
# Segmentation per region?




- Europe is the leading region for distributed PV, with Japan following and China depending on the year.
- New markets are developing in the utility-scale segments before moving slowly (when they do) to distributed PV.
- Complexity of distributed PV is the main « undriver » to their development.

# Technology trends

- Trackers 1-axis
- Bifacial becomes mainstream
- New module formats
- Diversification per region
- More string inverters
- Mono > Multi
- Cdte
- Storage ? Competitiveness?




Source : ITRPV 2020

# Prices

# HOW TO READ RECENT TENDERS


Traditional PV business model

Future PV business model

0,0157 USD/kWh in Qatar

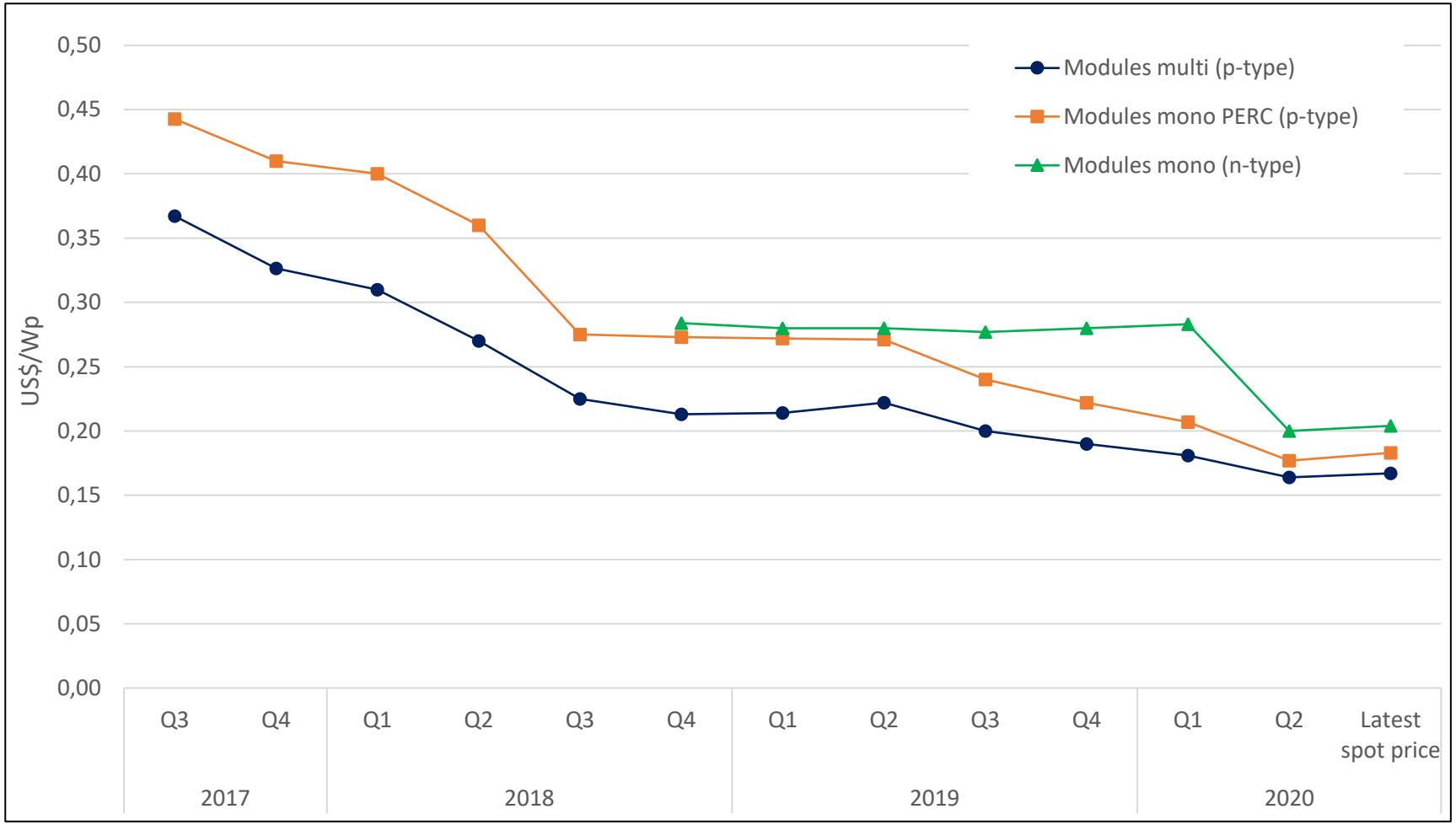
Could be achieved with 2500 kWh/kW/Y – Capex at 0.5 EUR ) 3% WACC etc.

In theory: doable

0,0112 EUR/kWh in Portugal

Out of reach without additional grid revenues, storage revenues and permanent grid connection after the 15 years of the tariff.

# Average PV modules spot prices are now below 0,2 US$/Wp

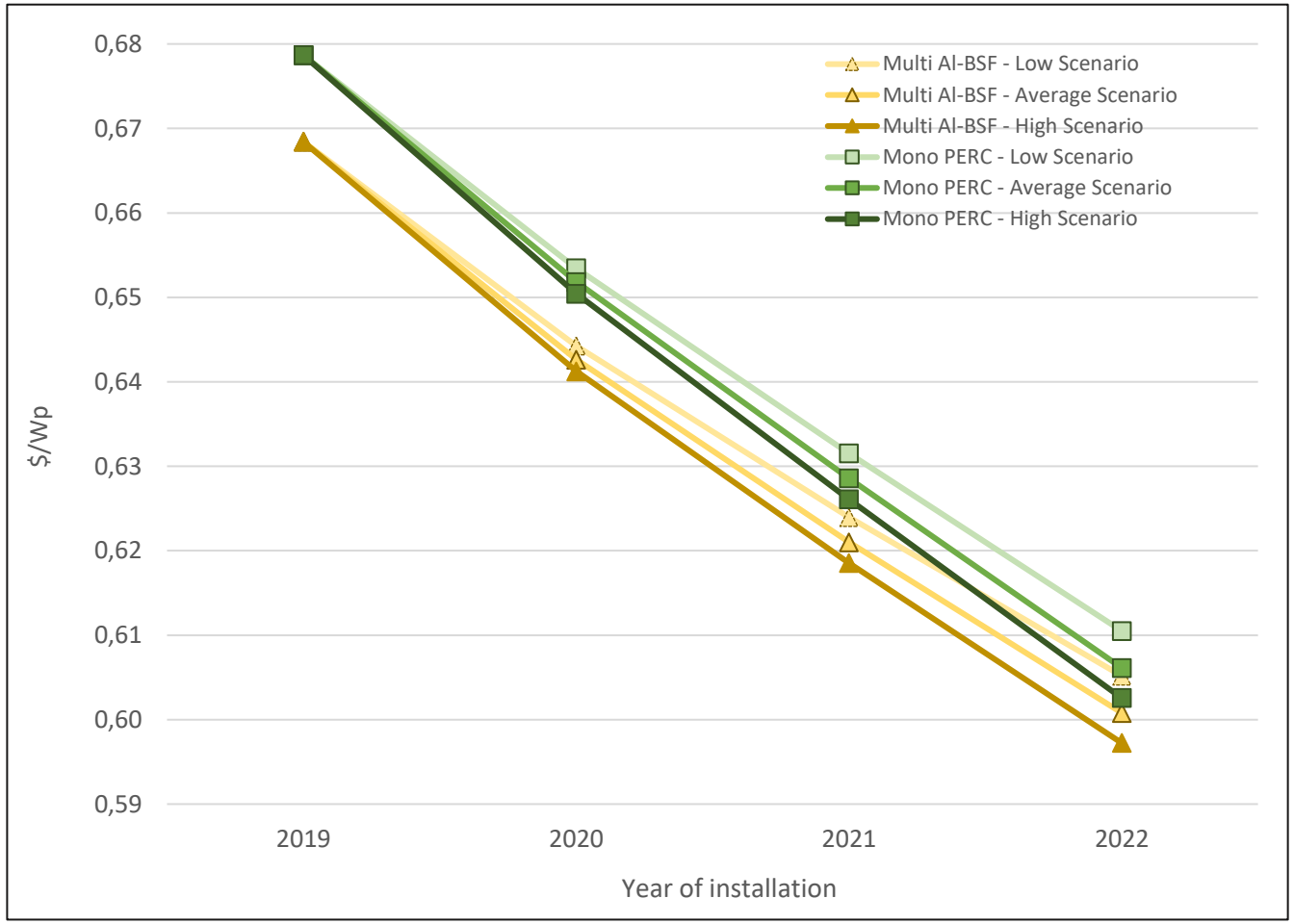



- A rapid price decline is always followed by a stabilization period: " the reality check"
- Market and production imbalances always end up in profit making periods.
- Further gains will require technology push, not only economies of scale
- Transport costs can become a key factor for modules

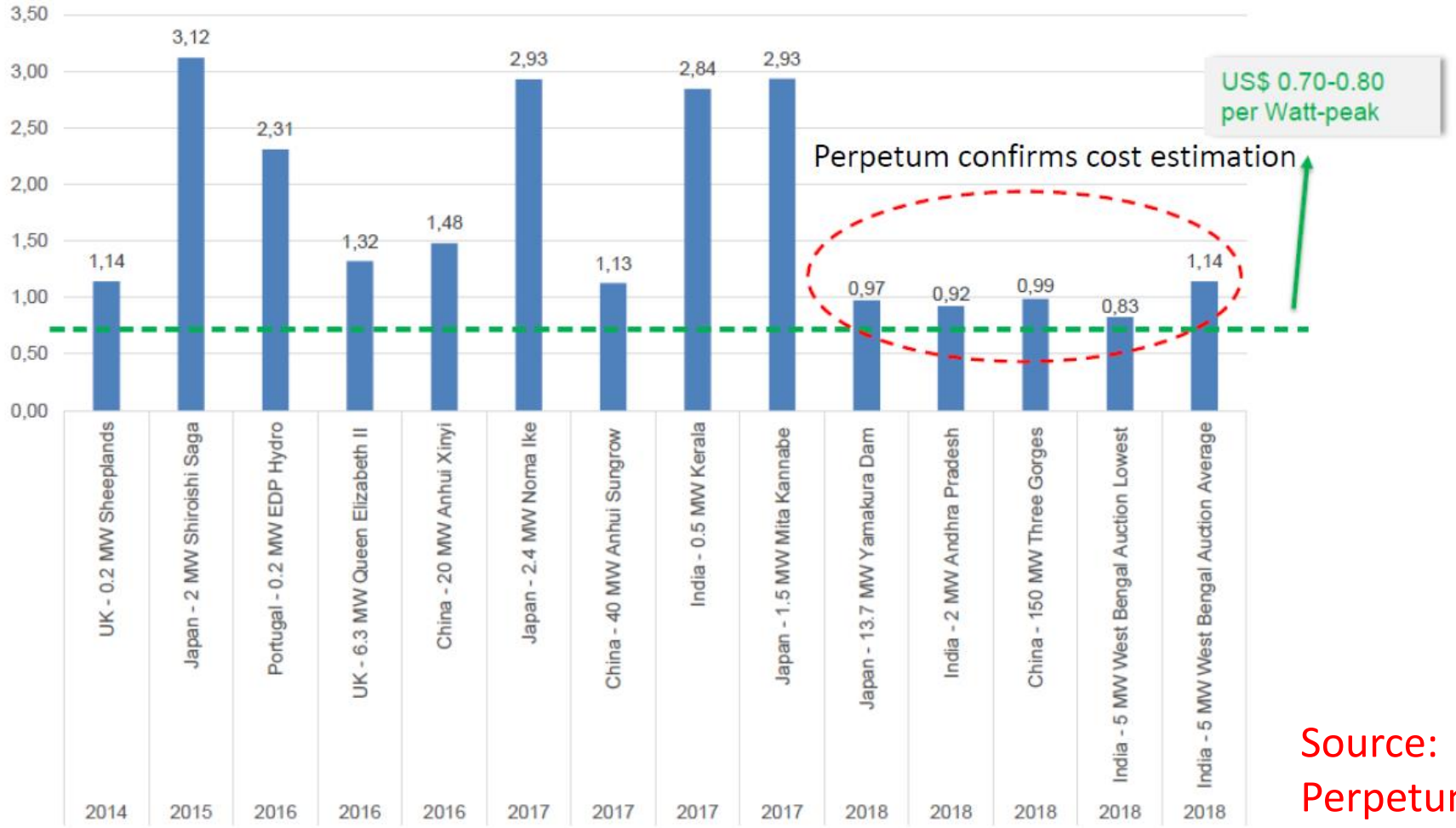
*Source: Becquerel Institute*

# CAPEX indications

- CAPEX target is 0.5 EUR/Wp in most European countries.
- 0.5 USD/WP could be reached in locations with lower labor costs.
- Tracking adds up to 0.1 EUR/Wp
- Technology is important
- Bifacial is offered at roughly the same price as monofacial mono-PERC
- Historically the decline of systems prices was in line with module prices decline



# CAPEX for floating PV

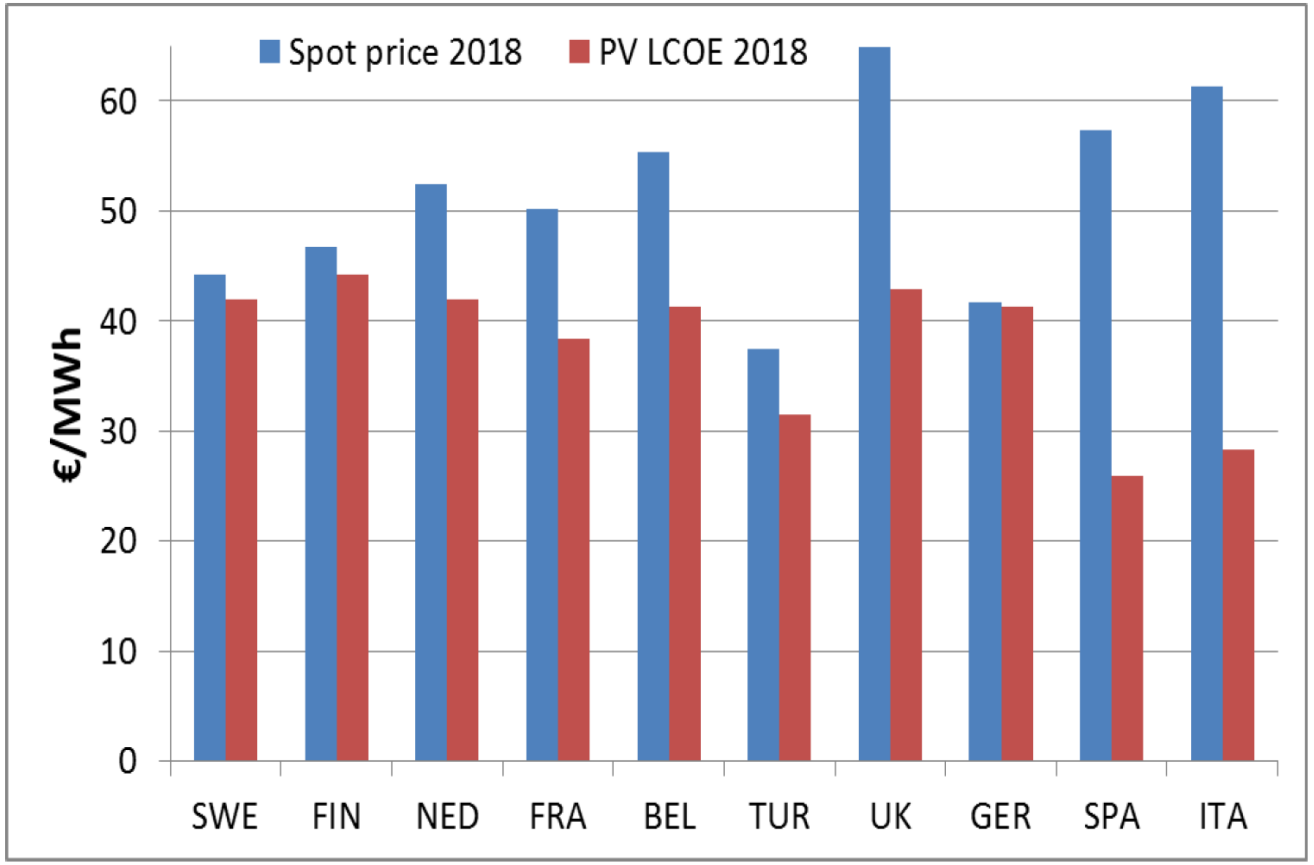



Source: SERIS

Source:
Perpetum

# System Prices and competitiveness

- LCOE depends on many factors, starting with CAPEX, OPEX costs and the cost of capital.
- How to be the most competitive? Select the best combination of technologies: but new constraints are coming: local content, sustainability, … This will influence choices.
- Competitiveness with wholesale prices is a moving target (and duck curve)




Average spot price in day-ahead market
PV LCOE with 0.5 €/Wp CAPEX and 7% nominal WACC

# Business models

# How solar projects are financed

## "Balance sheet" (equity) vs. "non-recourse" (debt) (1/2)

Large projects are typically developed through a standalone project company

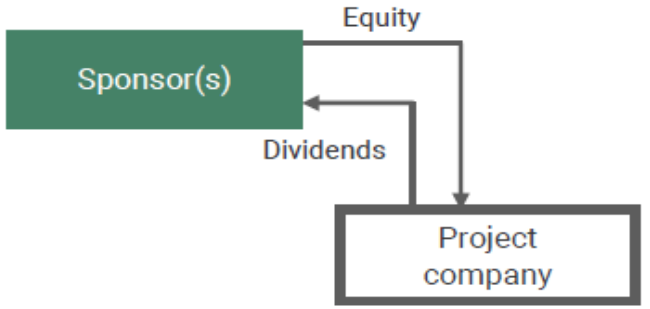
- Owned by the project investors
- With its own revenues & balance sheet and thus the ability to raise debt on its own merits

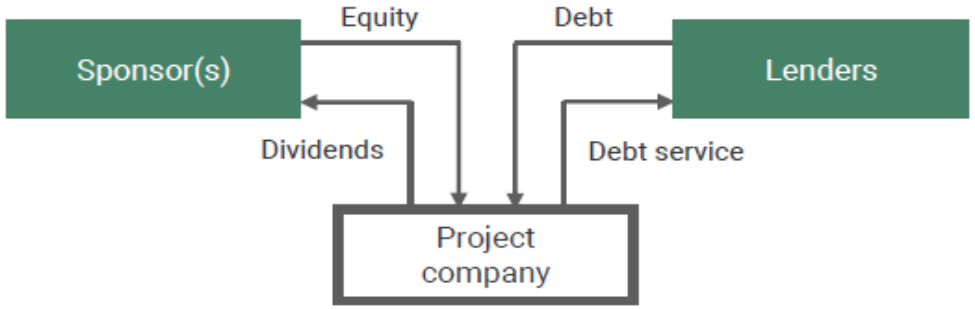
There are only two discrete sources of funding

- By the owners (directly via equity or shareholder loans, or indirectly via guarantees)
- By banks without recourse to the equity investors – this is "project finance"

The way a project is funded will have a material impact on how it deals with contractors

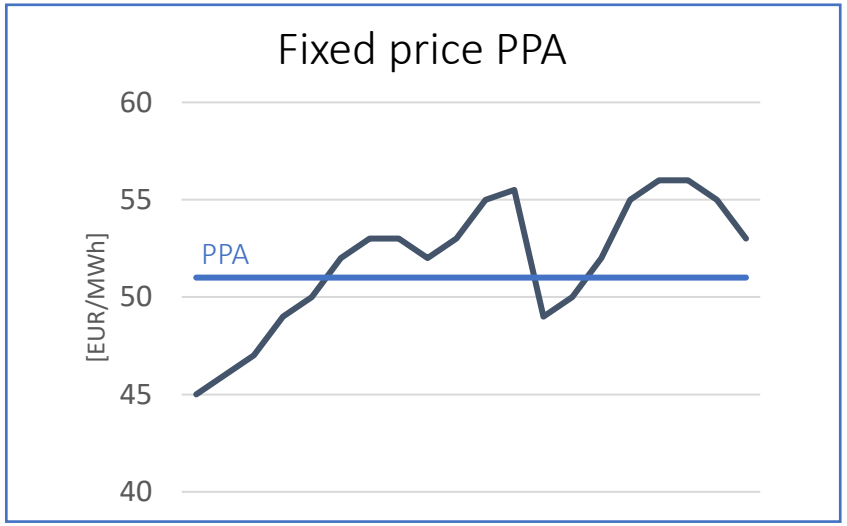
- In a project finance deal, you need to deal with the senior lenders' requirements!
- Tax, accounting, consolidation and rating issues

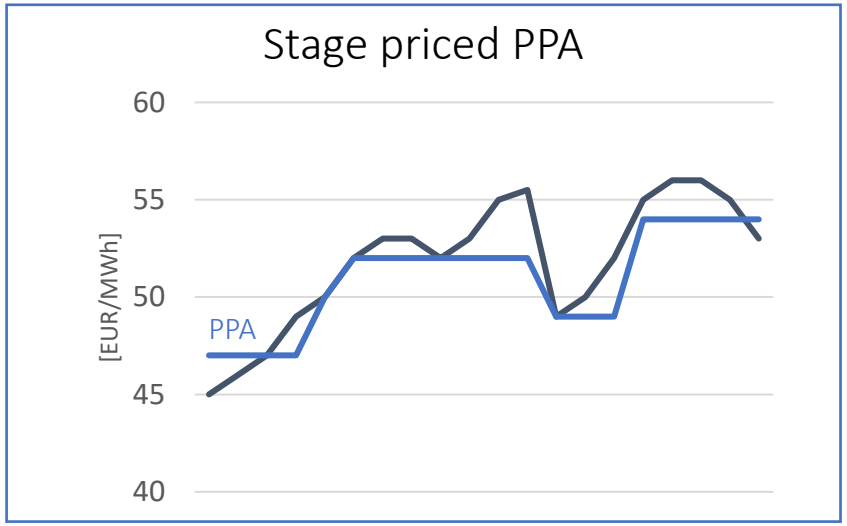


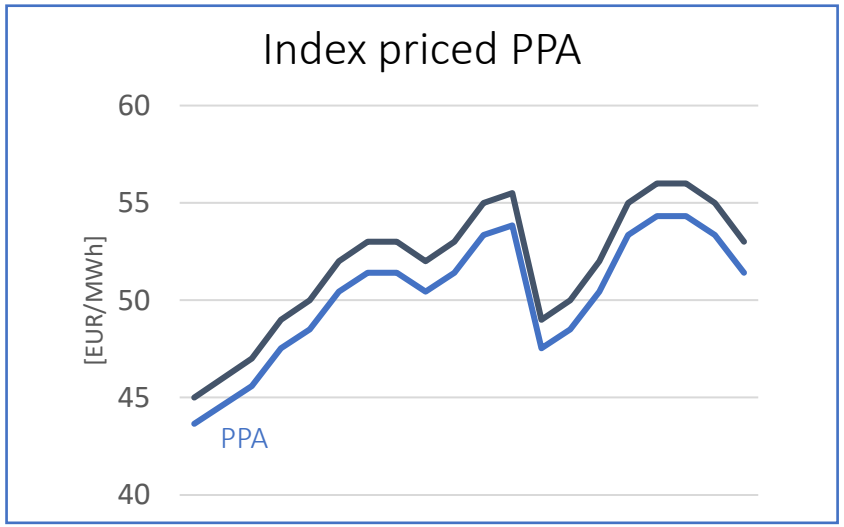



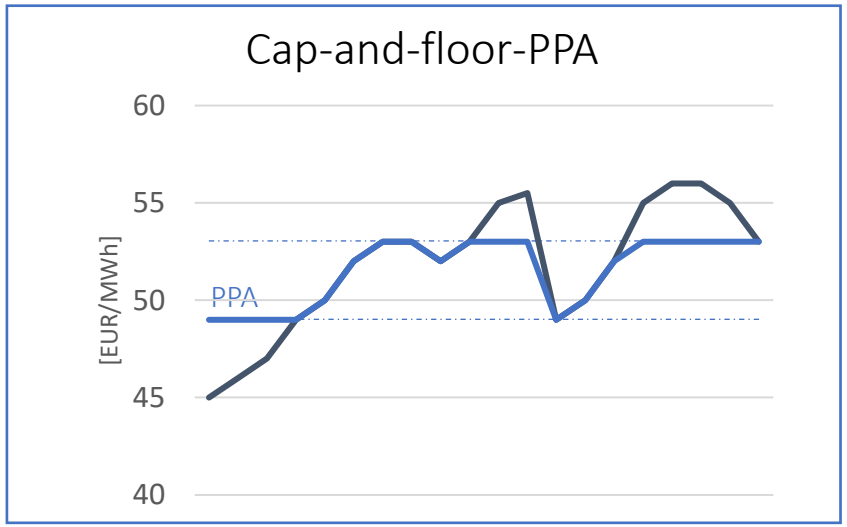

Source: Green Giraffe Energy Bankers

# How to realize subsidy-free solar? PPA options may be used




Source: Tilia

# Some key Challenges

- Which business model for utility-scale plants? Centralized or distributed? Remunerated through tenders or through the market?
- How to deal with the variations of the wholesale market price?
- The repowering case: after 15, 25 or more years? What about 50 years lifetime for PV plants with repowering steps.
- Bankability becomes a key issue: quality is not a given, so what rules to follow to be on the safe side? And what is the safe side?
- Technology choices: how to decide what to install with a number of technologies exploding in the coming years? Bifaciallity, a new degree of complexity.
- Competing in tenders: forecasting PV modules, PV batteries and BoS prices?
- Local content: the return?

# Business Models for Europe… or outside

- PV for hydrogen production (Green Hydrogen)
- PV+storage, with Li-Ion battery storage can be competitive depending on the uses.
- PV for large-scale virtual or collective self-consumption
- Can we move a PV plant (PV for mining sites)?
- Is merchant PV without PPA viable and how? Does it implies daily storage in any case?
- PV for energy intensive applications (data centers…)
- Agricultural PV: protect crops, double source of income, technology?
- Floating PV: 2 GW installed. And growing fast.


## CONTACT

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