COMPETITIVENESS OF EUROPEAN PV MANUFACTURERS

Jochen Rentsch

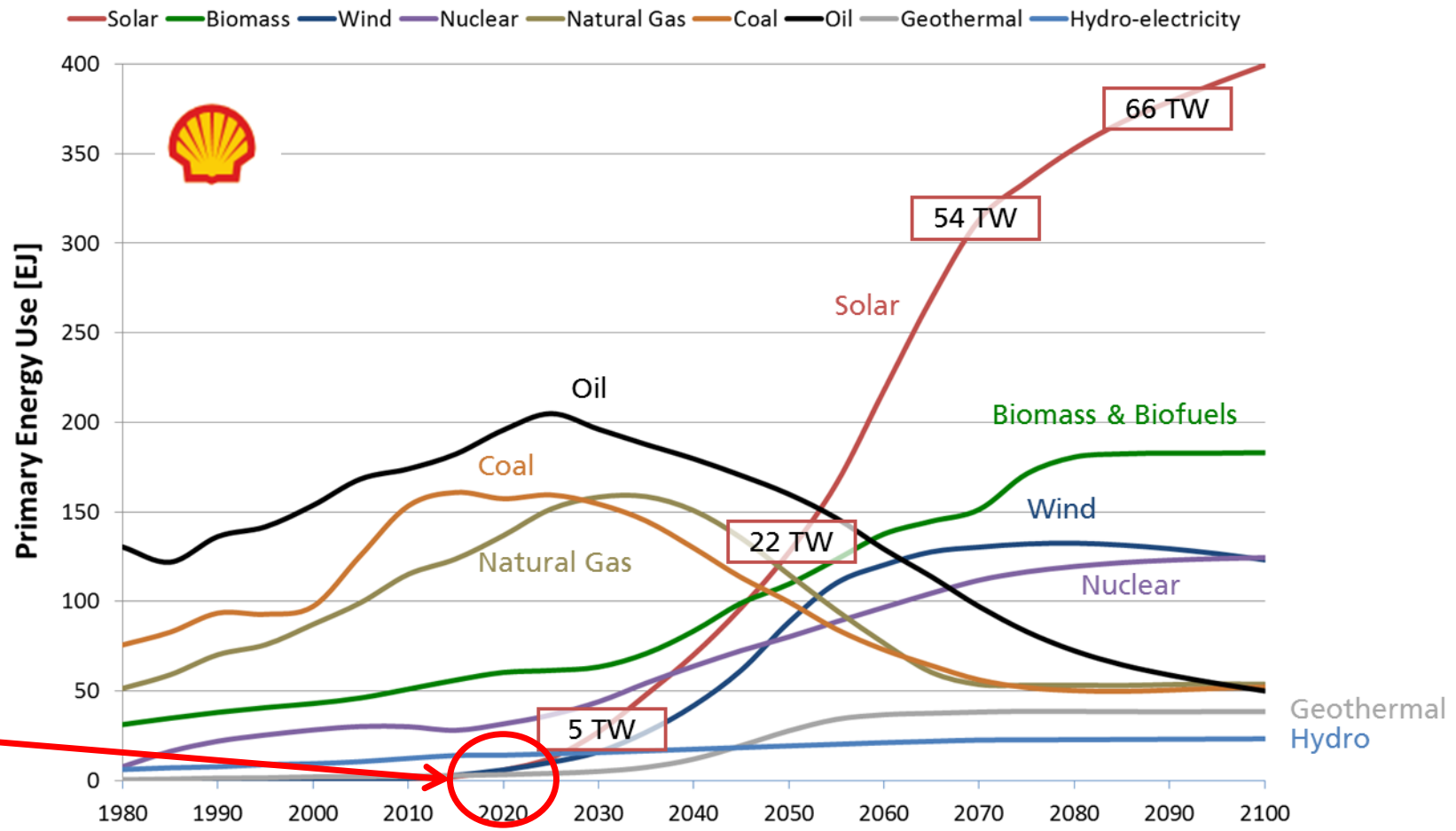
Fraunhofer Institute for Solar Energy Systems ISE

Intersolar Europe
München, 15.05. 2019

Fraunhofer ISE

PV Heading into the Terawatt Range – This is a Disruption!

- Rapid introduction of PV globally is fueled by availability of cost-competitive, distributed energy
- By 2018, about 500 GW_p have been installed!

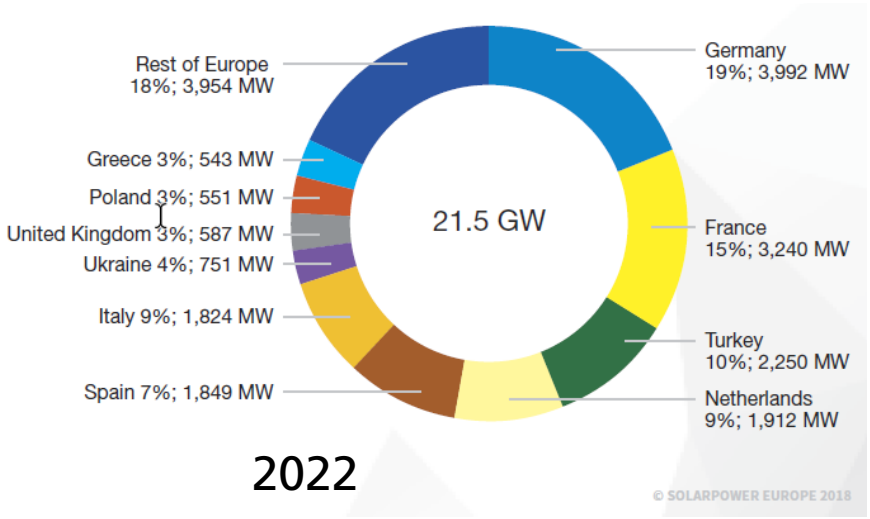


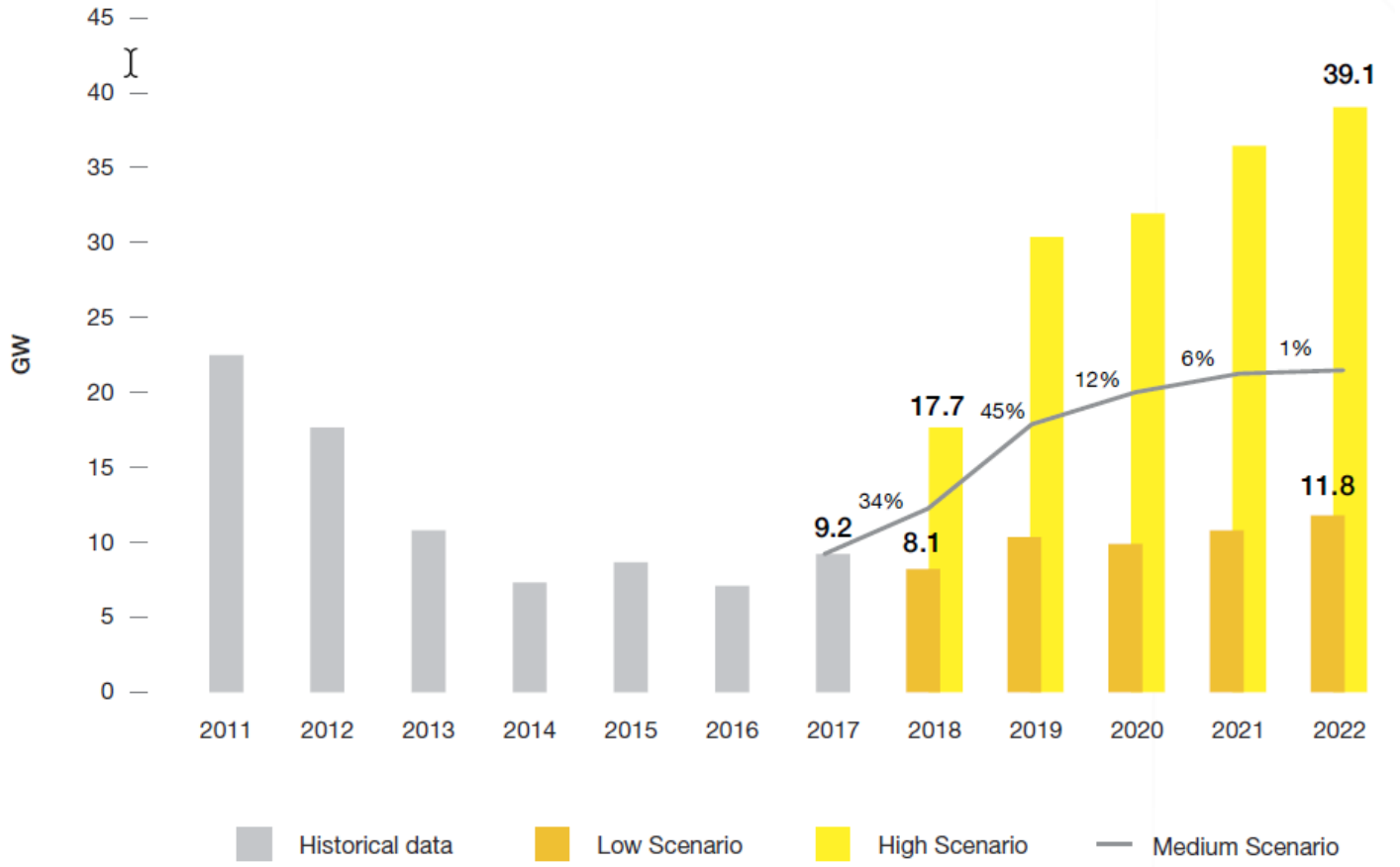
We are just at the beginning of the global growth curve!

https://www.carbonbrief.org/in-depth-is-shells-new-climate-scenario-as-radical-as-it-says

Status Quo and Outlook
European PV Market

- EU represents the second largest PV market after China
- In order to meet climate goals, medium to high market development seems reasonable



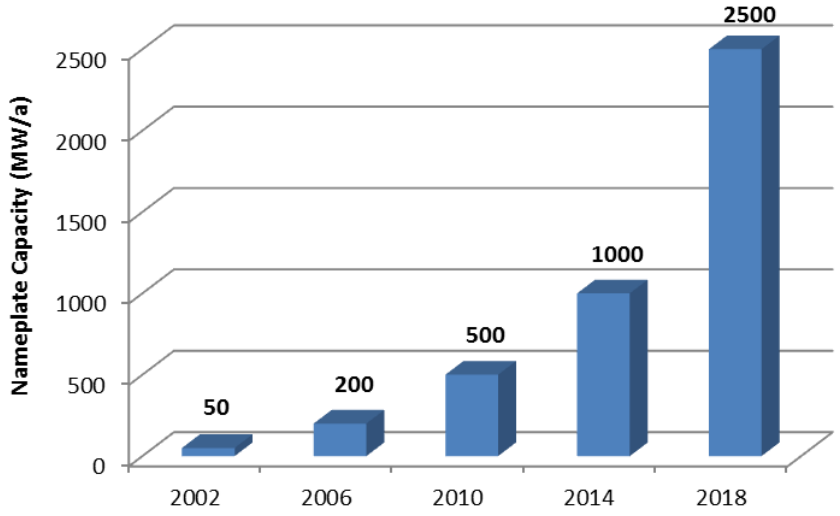


Source: SolarPower Europe

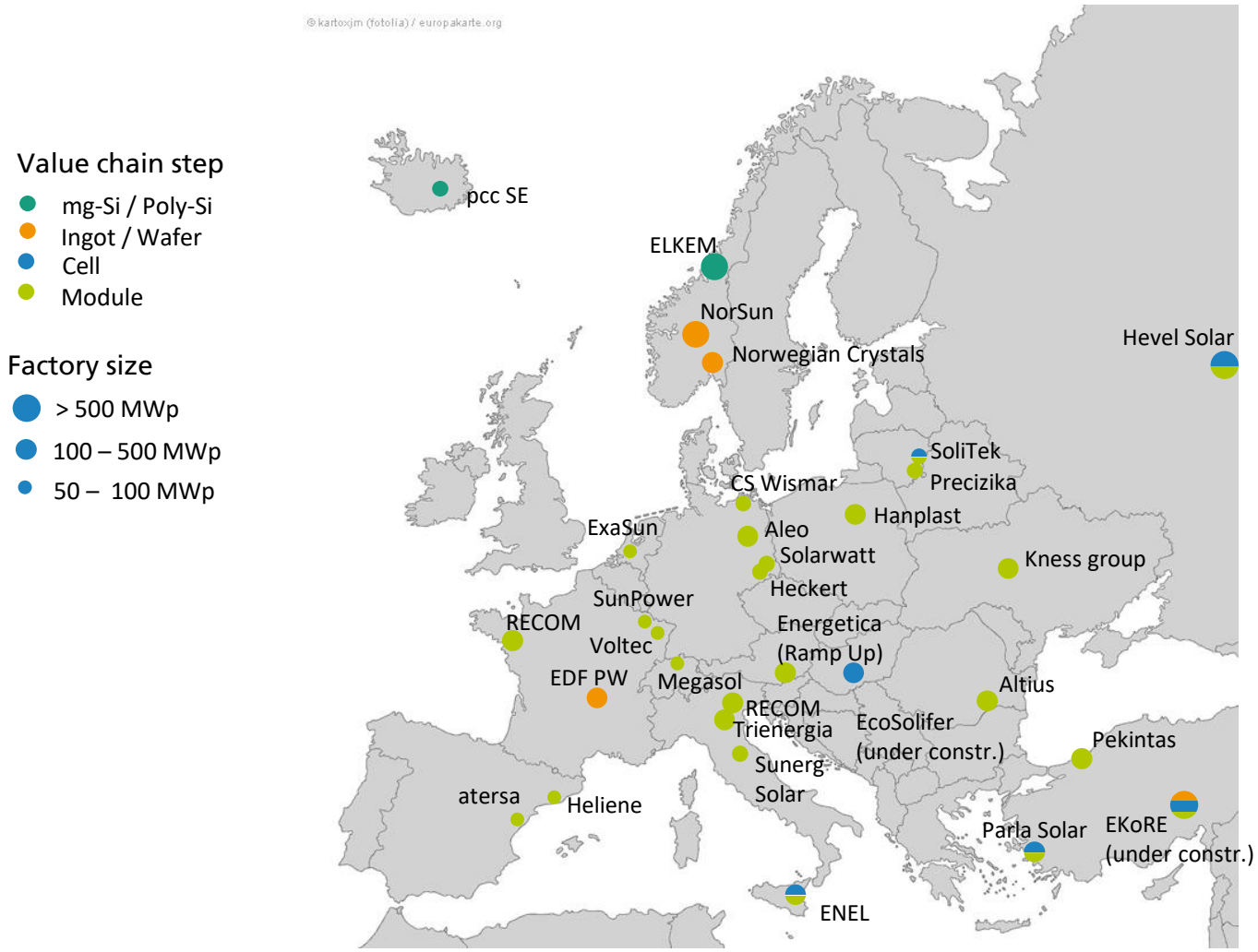
Status Quo

Current European c-Si PV Manufacturing Landscape

- Distribution of of small plants < 500 MW/a capacity
- Almost no cell production capacity left
- Silicon/wafer production in Scandinavia



Evolution of new cell fab size (Asia)[1]



[1]Jörg Müller, Presentation Hanwha Q-Cells, PVCellTech 2019, Penang, Malaysia

Technology Selection
Guideline: Latest ITRPV Roadmap 2019

Factory size: 1 GW

Wafer

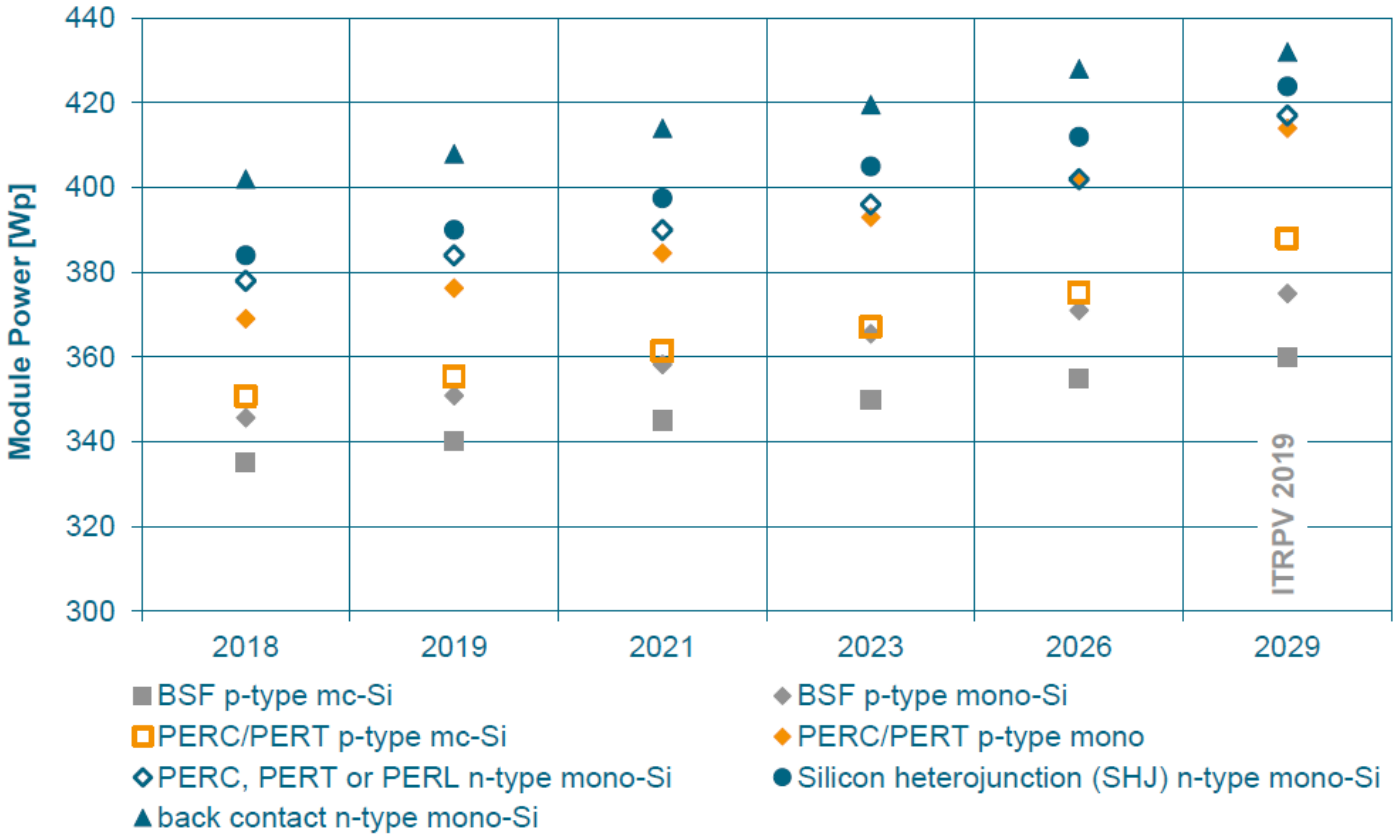
- p-type mono Si wafer (M2), 160 µm, DW cutting

Cell

- Half-cut PERC cell, average prod. Efficiency 22.3%

Module

- Glass-Backsheet, 380 W
- Aluminium frame
- 5-6 busbar stringing interconnection



Fraunhofer ISE

Scope and Different Scenarios under Consideration

Scope:

- Can a European based vertical integrated PV manufacturing facility for a mainstream product be cost competitive against China?

3 different scenarios:

Scenario	Manuf. Location		Equipment		Supply Chain	
	EU	CN	EU	CN	EU	CN / ROW
EU	✓		✓		✓	
CN		✓		✓		✓
EU / CN	✓		✓			✓

Scope and Different Scenarios under Consideration

Scope:

- Can a European based vertical integrated PV manufacturing facility for a mainstream product be cost competitive against China?

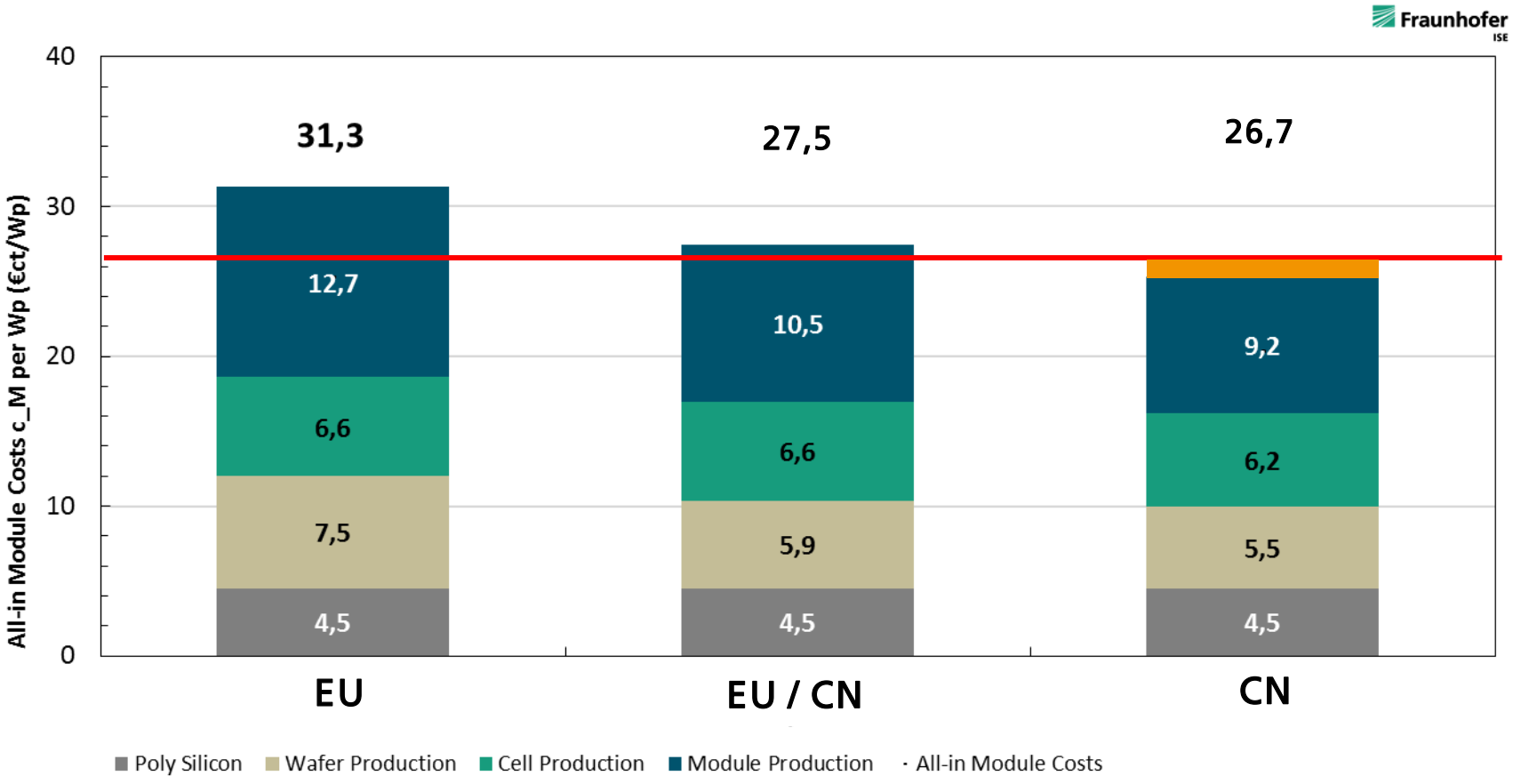
3 different scenarios:

Scenario	Manuf. Location		Equipment		Supply Chain	
	EU	CN	EU	CN	EU	CN / ROW
EU	✓		✓		✓	
CN		✓		✓		✓
EU / CN	✓		✓			✓

Remark: Calculation made under the following assumption: Greenfield site, no upgraded building facilities or already depreciated process equipment

TCO Comparison of the Different Scenarios

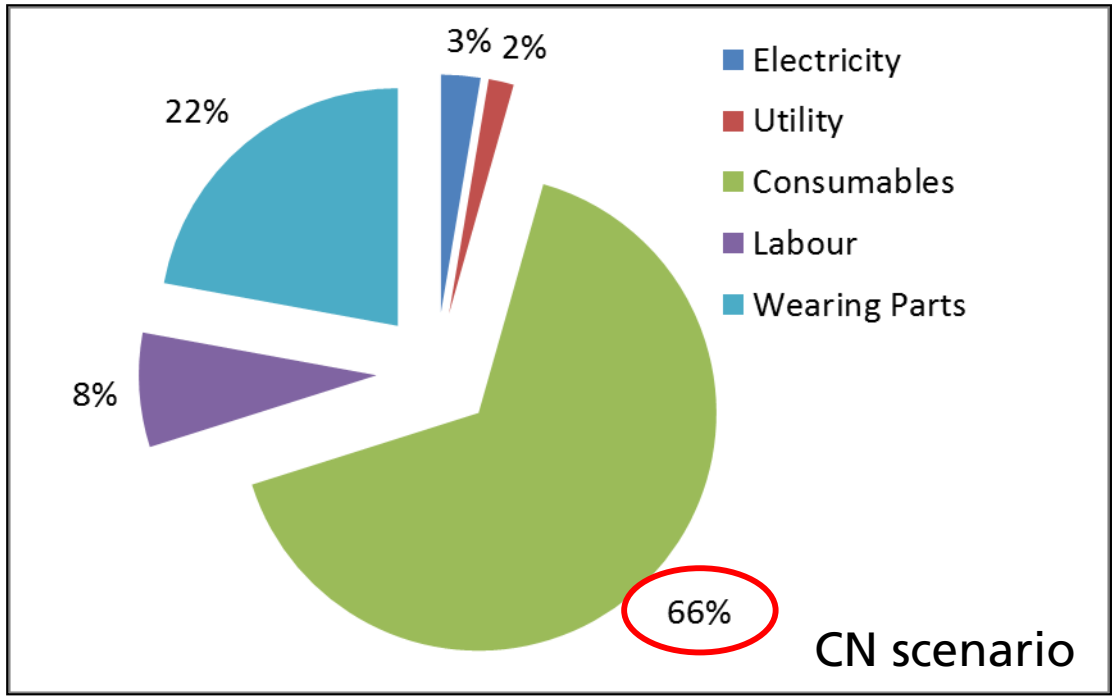
- Transporting cost for modules from China has to be considered
  - 1.2 €ct/Wp add-on on All-in module cost
- Remaining Cost-Gap of 0.8 €ct/Wp
- **Made-in-EU prize premium of ~1€ct/Wp possible ?**
- OPEX related difference of 3.8 €ct/Wp between EU und CN scenario

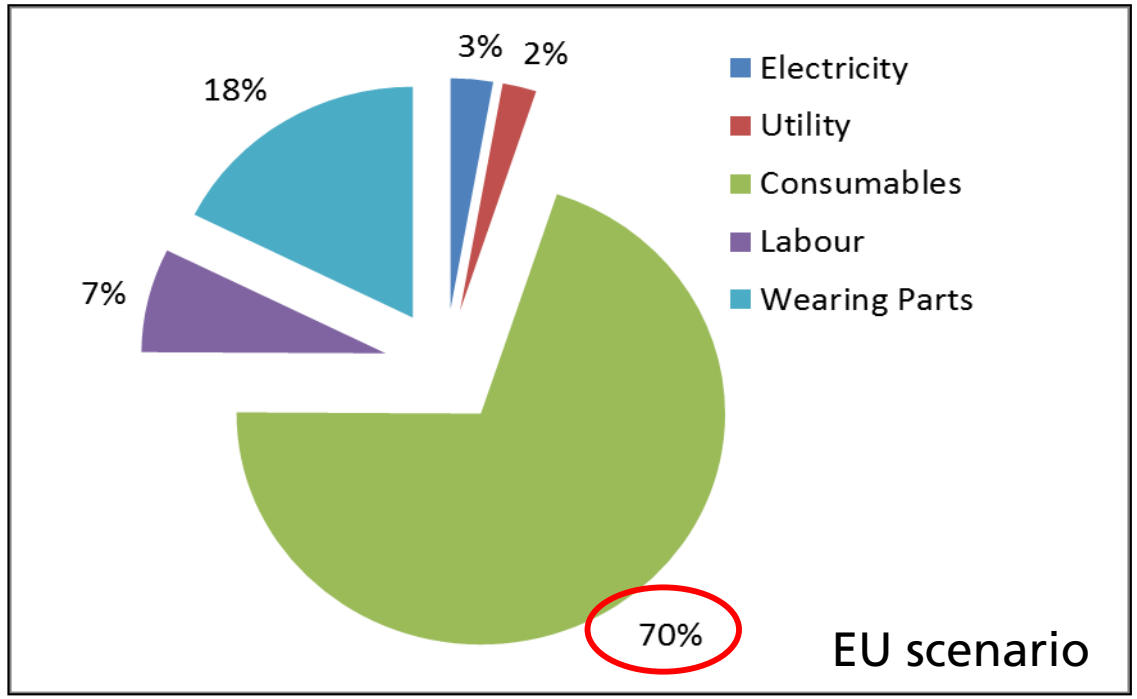


Fraunhofer ISE

TCO Comparison of the Different Scenarios

OPEX Cost Shares

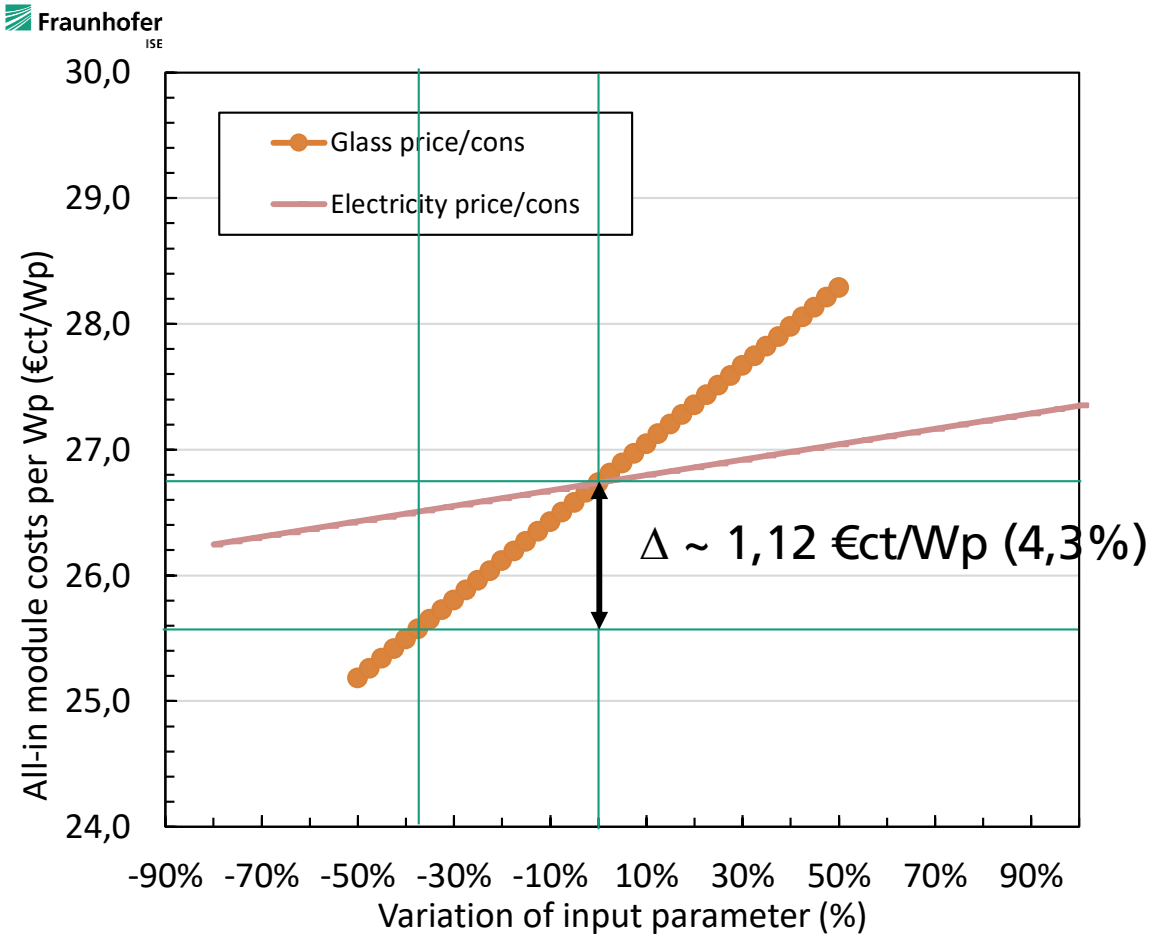




- Main contributors mainly from Module production: Glass, Al frames, Backsheet, EVA, Ribbons, Junction Box, Ag-Pastes
- Price differences mainly related to purchase quantity (economy of scale effect)

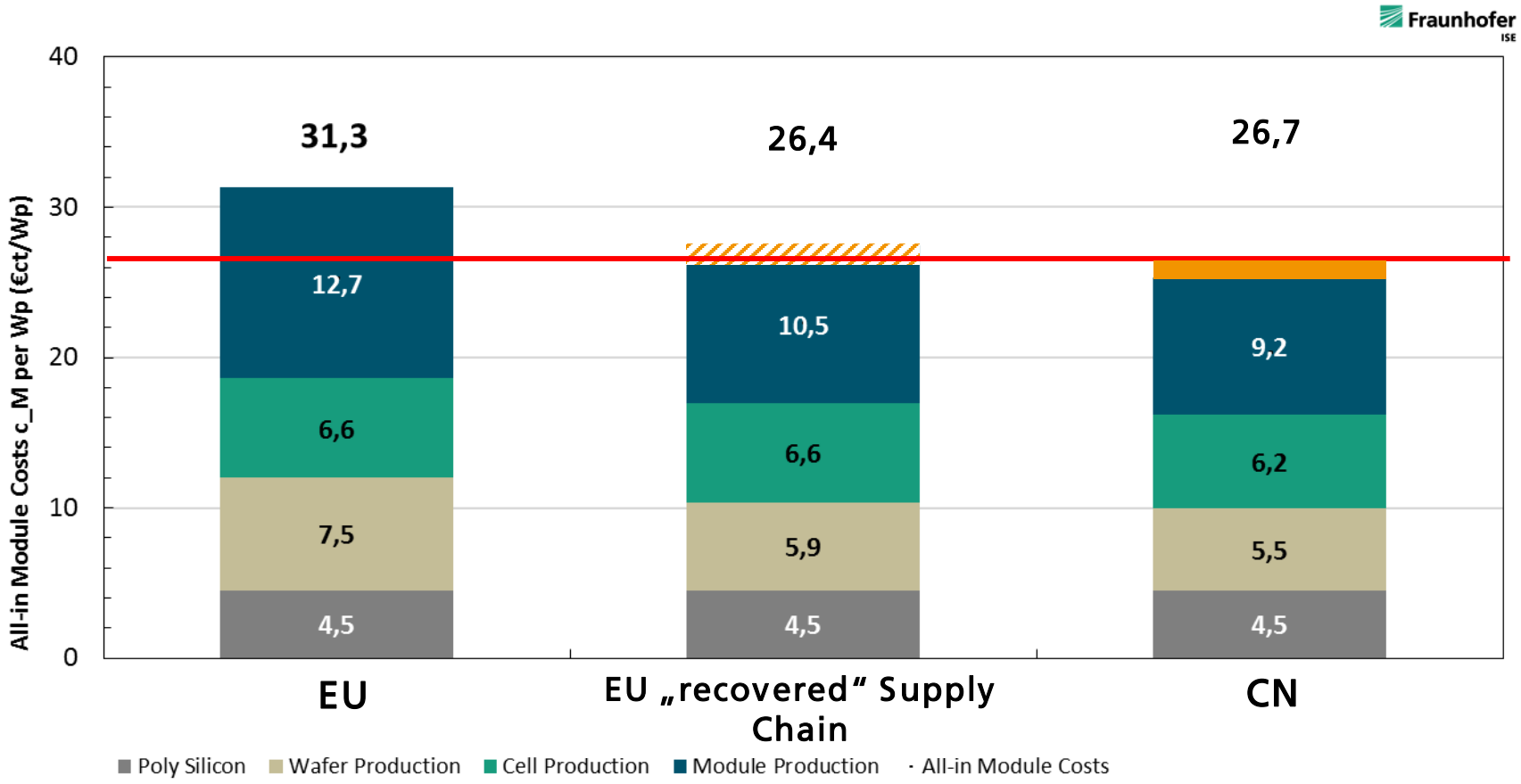
TCO Comparison of the Different Scenarios
Sensitivity Analysis – Example: Glass Price

- EU: Only a few supplier left for specialized PV glass
- Existing Glass producer in EU still large, but focussed on other products
  - Sufficient local (EU) demand might allow similar pricing than CN
  - More than 1,12 €ct/Wp cost reduction possible



TCO Comparison of the Different Scenarios

- **Development of supply chain** in Europe can bring down cost **below China benchmark**
- Strong local EU market perspective necessary

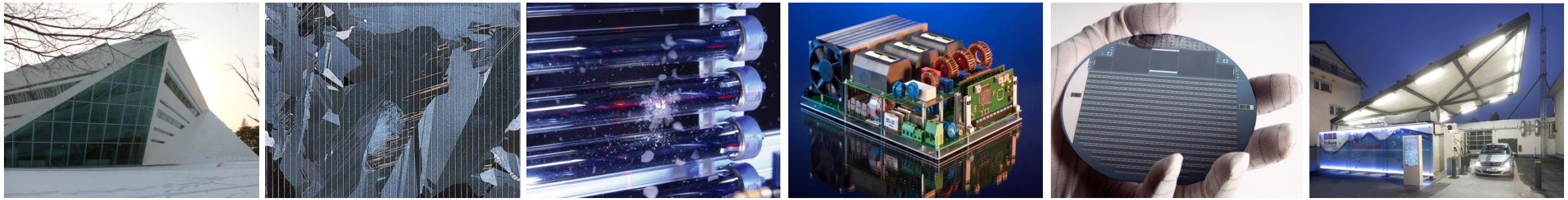


Fraunhofer ISE

Summary

- Strong future world-wide growth of PV expected, EU market development positive
- EU PV manufacturer landscape: Mainly remaining module manufacturing at relatively low production volumes (compared to China)
- Made-in-Europe premium (sustainable product) would fully compensate still existing cost difference between EU and CN based manufacturing scenario
- „Recovery“ of EU supply chain could lead to fully cost competitiveness even without premiums
  - Strong and sustainable EU PV market development necessary
- Further upside potentials:
  - Political support to achieve industrial level playing field for new entrants as well as PV promoting market conditions (no market caps, net integration)
  - Economy of scale effects for sustainable growing PV manufacturing landscape
  - Technology advancements: Fast integration of innovations into production

Thank you for your Attention!



Fraunhofer Institute for Solar Energy Systems ISE

Dr. Jochen Rentsch

www.ise.fraunhofer.de

jochen.rentsch@ise.fraunhofer.de