Energy Policy and Industry Policy in Europe – The Case of Photovoltaics

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THE BACKGROUND

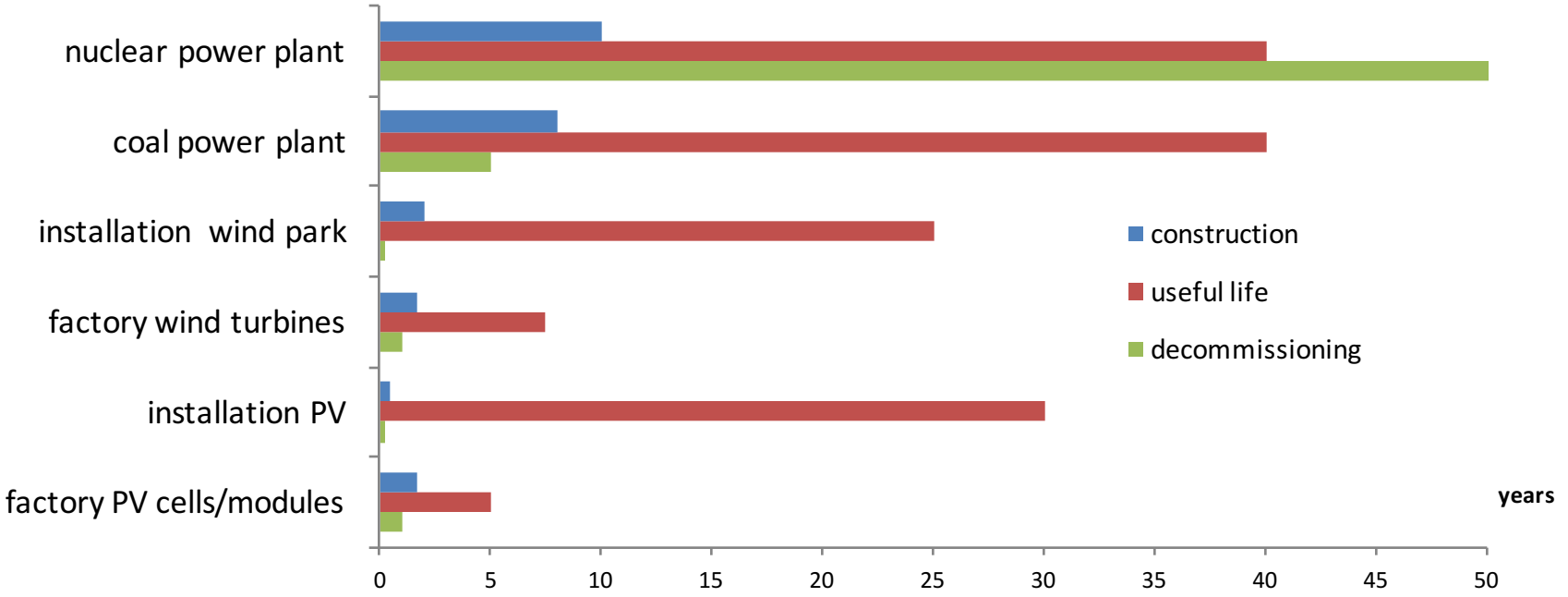
Unfamiliar to business and government: 5 to 10 times shorter innovation cycles

→ More rapid build-up of capacities (e.g. Dec. 2011 in Germany: 3,5 GW PV)

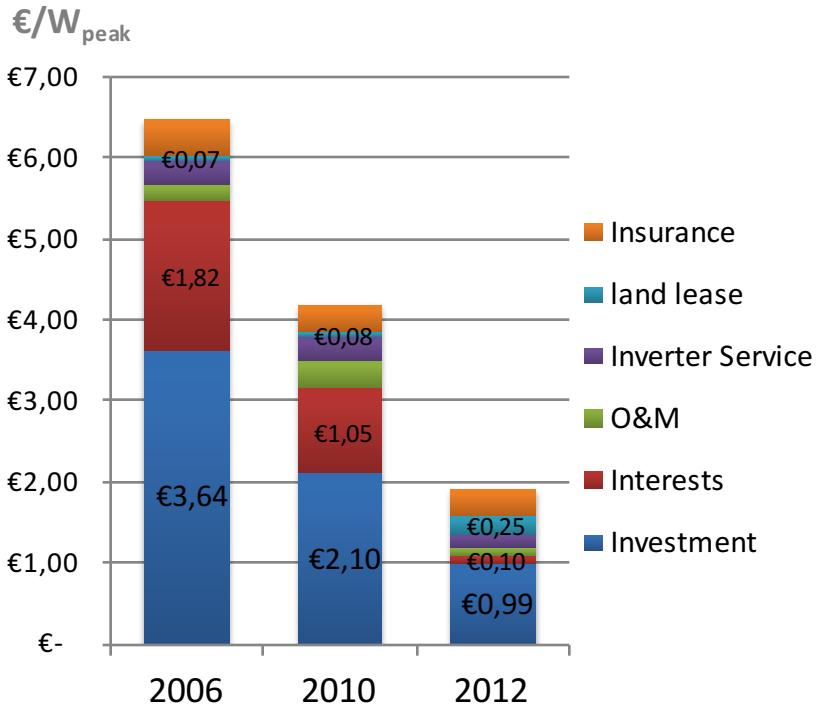
→ More rapid decrease of costs

→ More rapid transformation of the electricity sector

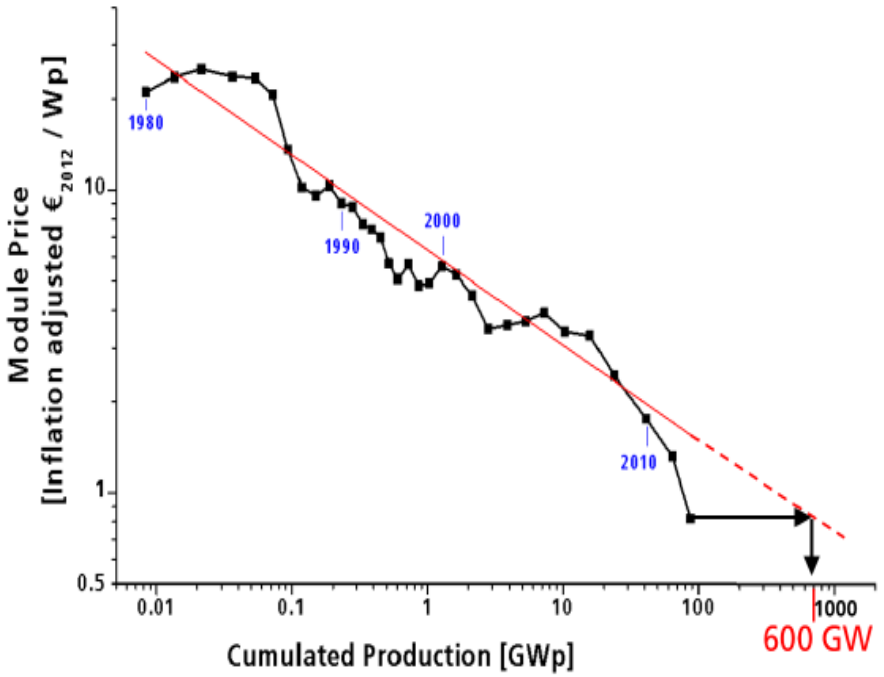
Dramatic acceleration compared to traditional energy technologies



Dramatically falling costs of PV change the competitive landscape



Data: Bächler (2013), PV-magazine.de

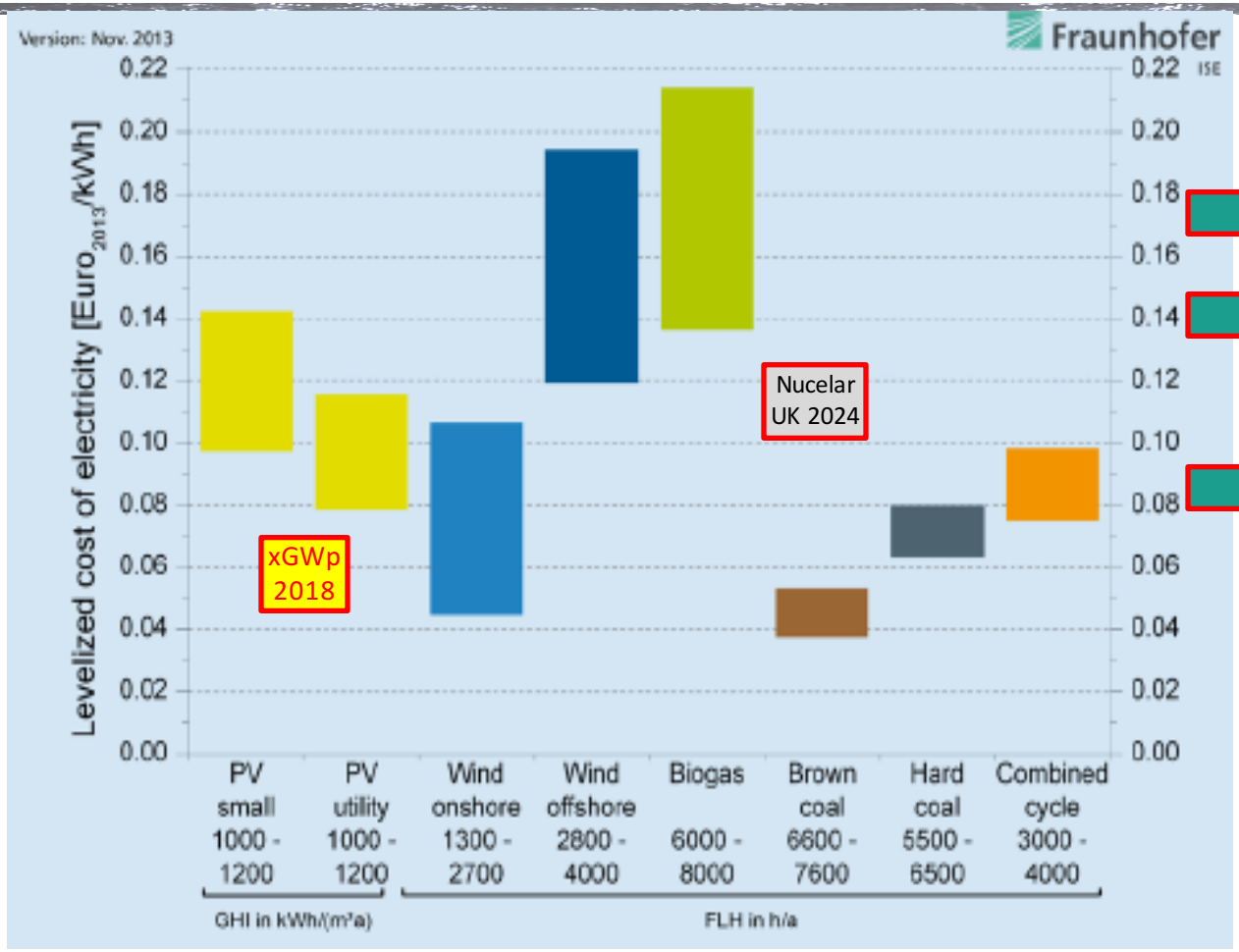


Source: Navigant / PSE 2013

Falling costs of ownership over 6 years in Germany

The long-term PV experience curve:
Volume +100% → Price -20%
Prices may remain stable for some time...

Levelized Cost Of Electricity (LCOE): PV is rapidly getting very competitive



Levelized Cost of Electricity (LCOE), Germany, 2013

Source: Fraunhofer ISE, November 2013

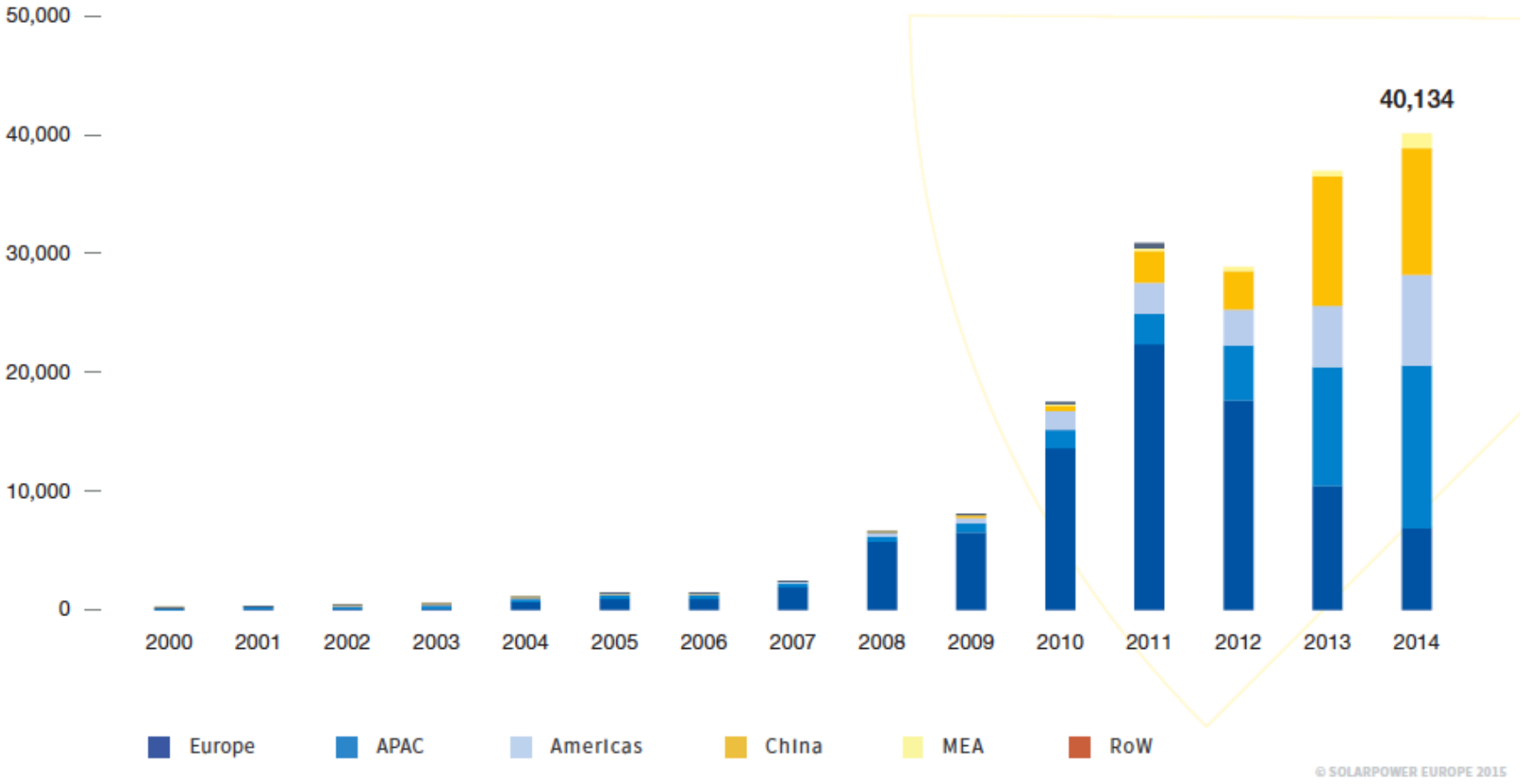
Worldwide 23% of electricity generation capacities are based on oil and Diesel

- Oil at 100 $/barrel (only fuel costs)
- Oil at 80 $/barrel (only fuel costs)
- Oil at 50 $/barrel (only fuel costs)

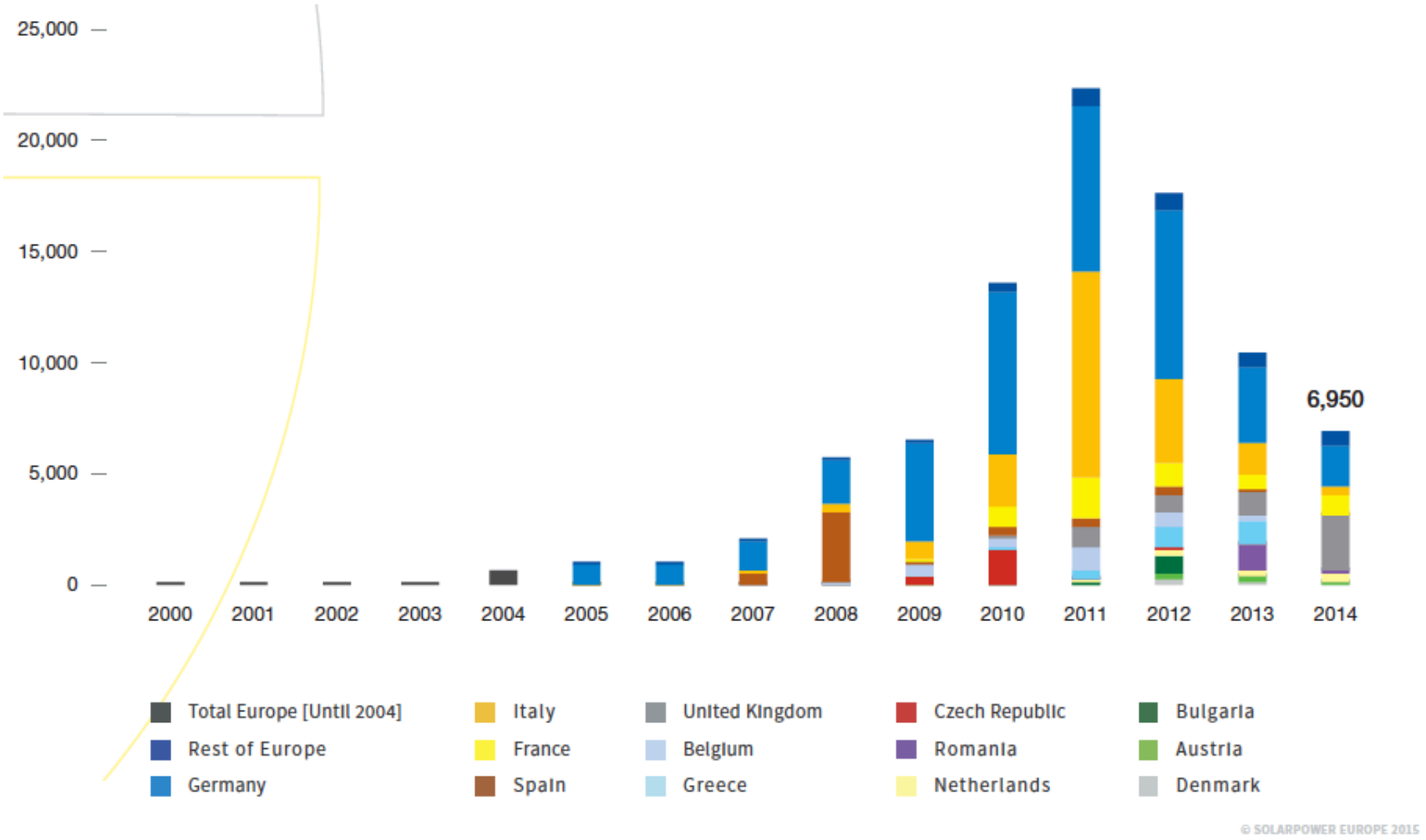
LCOE with xGWp modules in 2018 (100kW plant)
Freiburg: ca. 6 ct/kWh
Sevilla: ca. 4,5 ct/kWh

→ Despite additional costs for managing fluctuation, PV power gets very attractive **However, markets need time to adapt**.

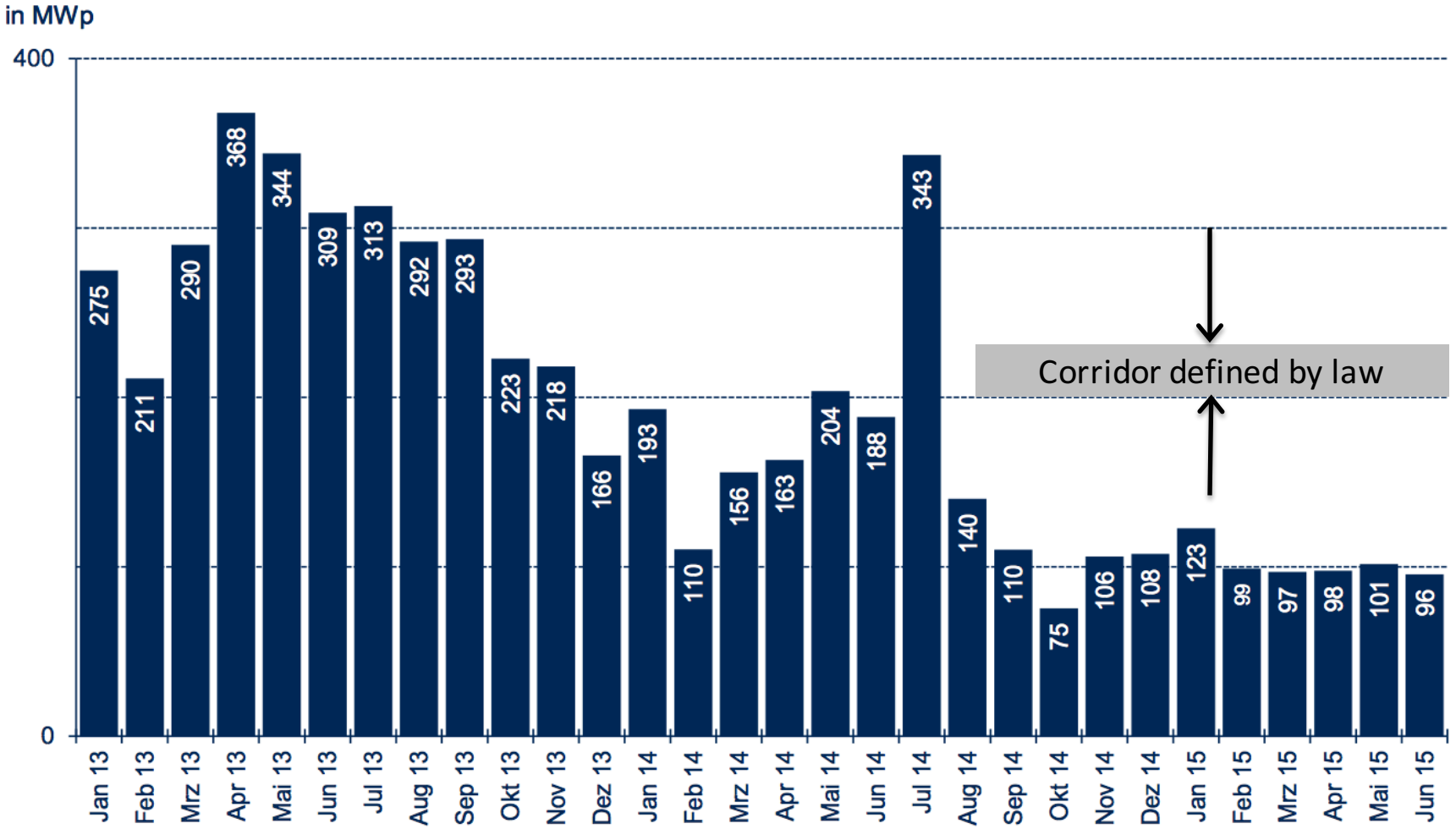
Global PV markets get traction with increased PV competitiveness – despite European decline



European PV markets have collapsed: successful campaign of incumbent industries

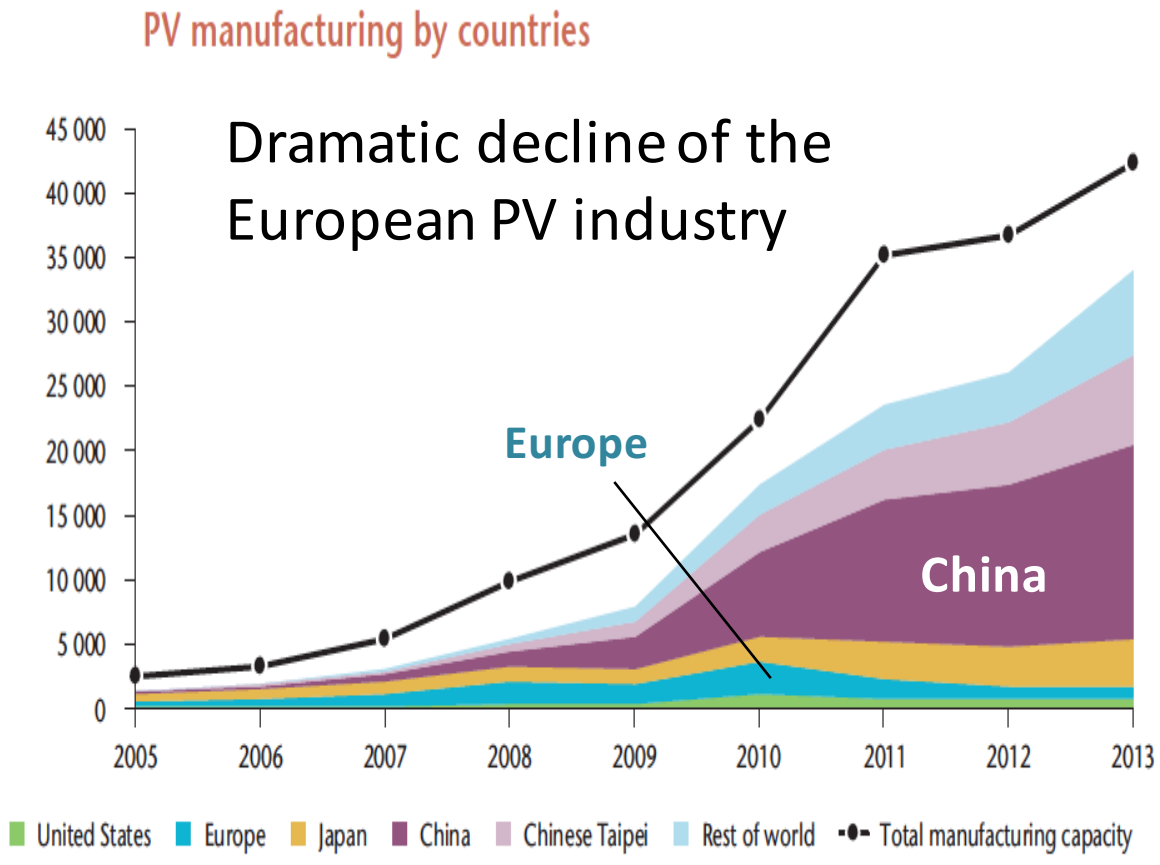


PV Installations Germany 2013-01 to 2015-06: New EEG a „reliable framework“?



Quelle: Bundesnetzagentur, BSW-Solar Stand 7/2015

Europe was decisive in developing PV !
Really give up when it's getting a big thing ?



Source: SPV Market Research (2014), *Photovoltaic manufacturer Shipments: Capacity, Price & Revenues 2013/2013*, Report SPV-Supply 2, April.

Source: IEA 2014

Turnover of PV manufacturers and manufacturing equipment providers in the EU:

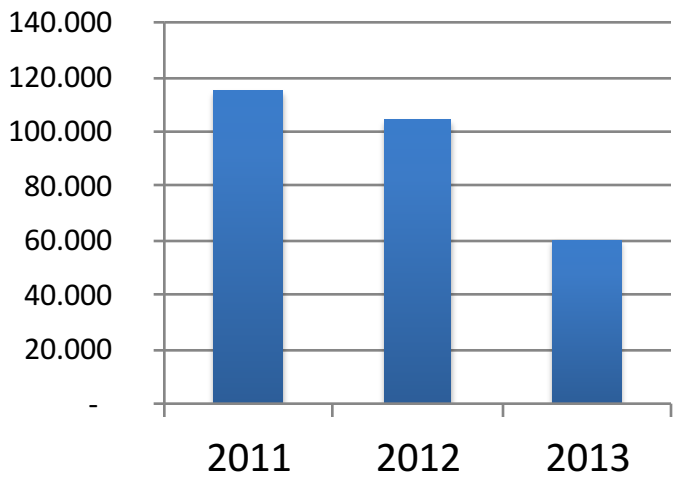
2010: € 20 billion
2012: € 2,5 billion

2014:

- Top Ten PV manufacturers:
  8 Chinese / Taiwan
  1 South Korea
  1 US
- Japanese, Korean, US companies expanding

However, European Technology is still leading. For how long?

European PV industry crisis creates divides and threatens technology leadership



Employment in the PV sector in Germany (Source: AEE 2014)

- Manufacturing collapsed
- Installers struggling with shrinking markets
- Big divide on how to react to Chinese dumping prices

European technology leadership at risk:

- Missing PV manufacturing networks threaten the future of research centres and equipment manufacturers
- China requests 80% local sourcing for manufacturing equipment
- Large manufacturers are buying downstream companies

↓ Research institutes	international
↓ Manufacturers of production plants	international
↓ Banks and financing companies	can be local
↓ Manufacturers	
– silicon	international
– wafers, cells	international
– modules	can be local
↓ Traders	can be local
↓ System integrators, EPC contractors	can be local
↓ craftsmen in the construction business	local
▪ operating company	can be local

Gigawatt Factory

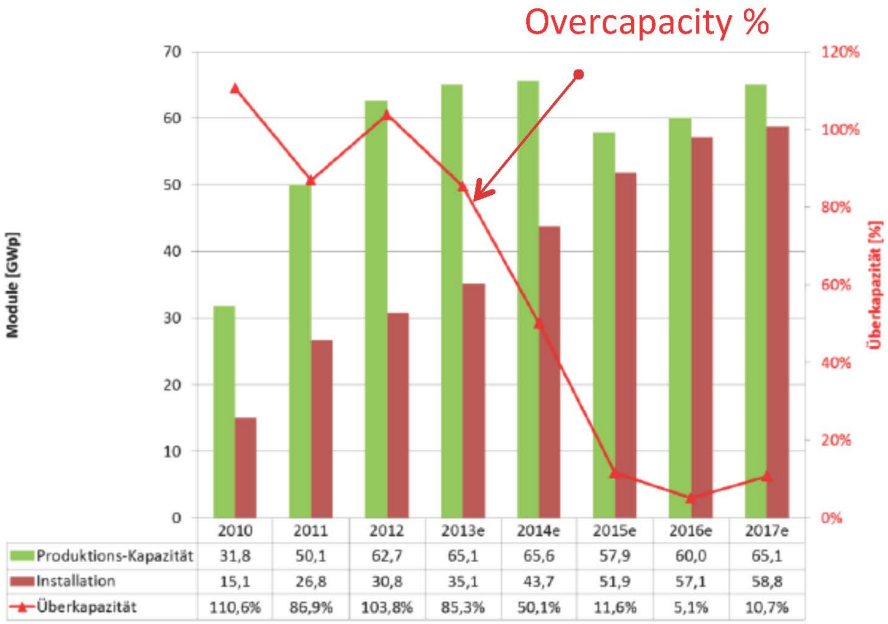
EUROPEAN INITIATIVE FOR A NEXT GENERATION PV INDUSTRY

2017/18: The big opportunity for Europe
Shrinking overcapacities & new technology

xGWp
European Gigawatt Fab

The market is recovering from a heavy shakeout

- Shrinking overcapacities → sustainable margins
- Massive growth ahead → opportunity for new approaches



	2010	2011	2012	2013e	2014e	2015e	2016e	2017e
Produktions-Kapazität	31,8	50,1	62,7	65,1	65,6	57,9	60,0	65,1
Installation	15,1	26,8	30,8	35,1	43,7	51,9	57,1	58,8
Überkapazität	110,6%	86,9%	103,8%	85,3%	50,1%	11,6%	5,1%	10,7%

New chance with next technology generation

- Large manufacturers rely on incremental improvement of present technologies & equipment
- Conventional c-Si technologies approach efficiency limit
- New high-efficiency technologies – mostly “Heterojunction” family – emerge in niche markets, are still expensive
- High efficiency markets → high growth rates, no overcapacity
- **European Leaders united in xGWp have production-ready top technology package: High efficiency, high quality, moderate cost, unprecedented low LCOE**

xGWp – Technology leaders take action: Whole PV value chain in EU is threatened

xGWp
European Gigawatt Fab

European technology leadership at risk:

- Missing PV manufacturing networks also threaten the future of research centres and equipment manufacturers
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Gigawatt Factory	
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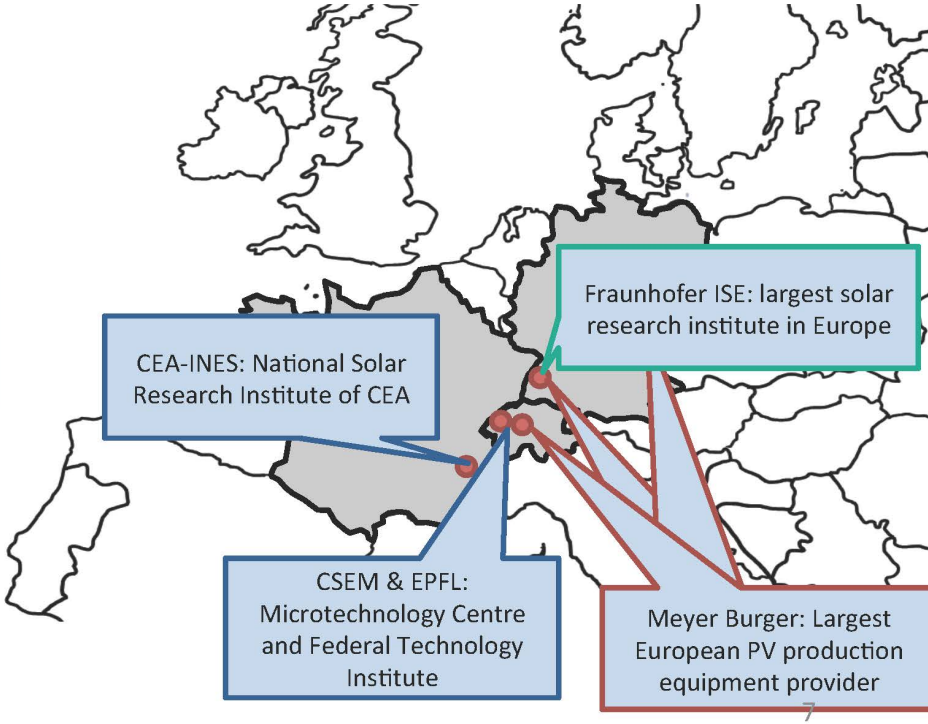
2013: Technology leaders take action

- Founding Partners of an industrial initiative for a Gigawatt PV factory in the EU
- New technology generation: high efficiency, high quality, high speed, high volume, low cost



www.xGWp.eu

Accepting the new dimension of challenge

- New technology generation
  - Process and product innovation, cost advantage, new qualities
- Permanent innovation
  - Keep advance over competitors
- High automation
  - Keep labour costs low
- Large-scale production
  - Technical scale economies → size 600-1000 MWp/a
  - Commercial scale economies → strive for > 4 GWp/a
- Fierce competition over years
  - Be prepared to stand through trade battles
- New financial dimension
  - 500 – 1000 M€

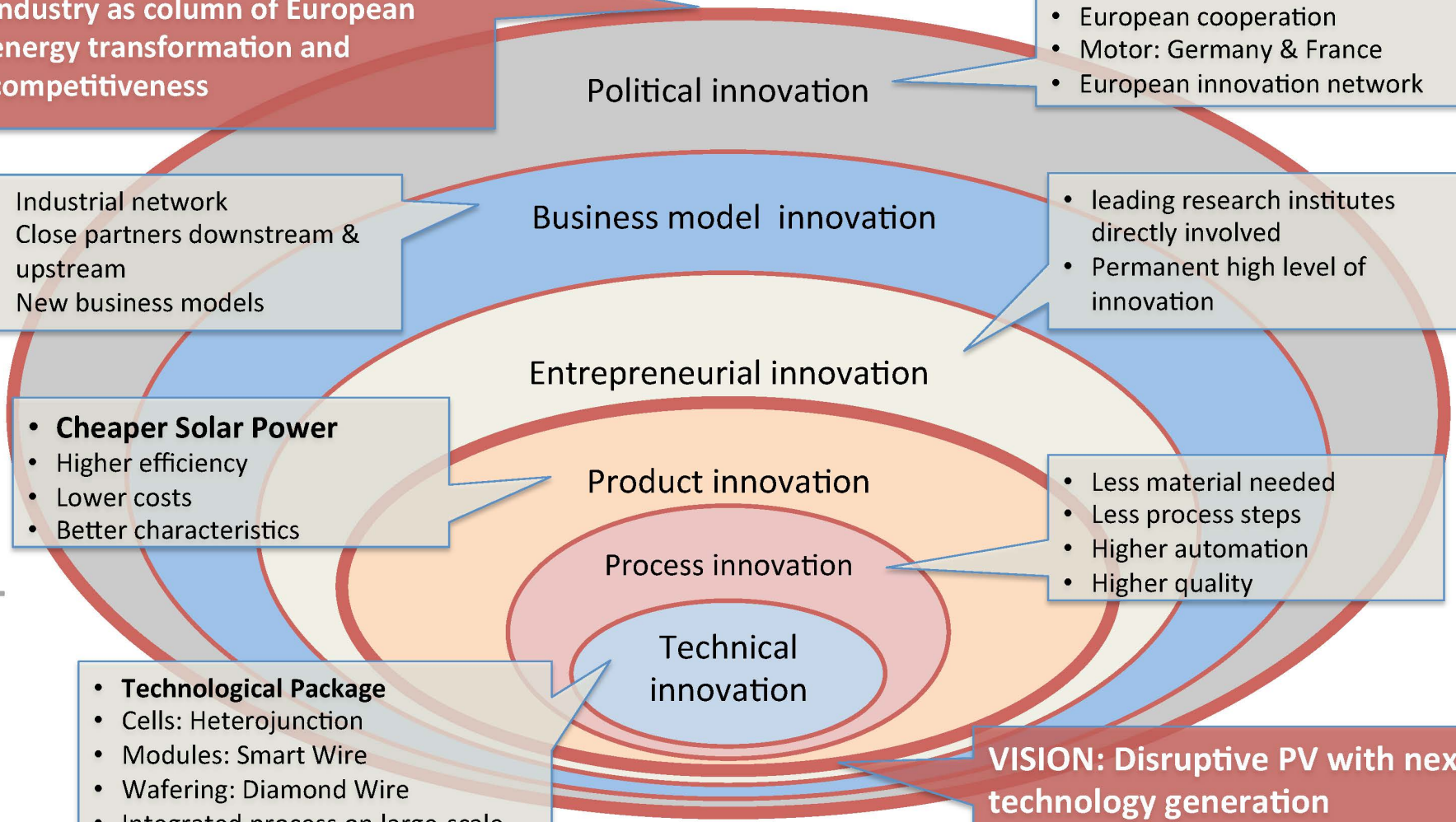
Avoid the commodity trap
Developing new kinds of systems

- Standard c-Si photovoltaic modules have become a commodity, competing by the €/W_p price
- Next generation xGWp devices will not be sold as a commodity as they have extraordinary characteristics
  - Higher kWh/kW_p yield, excellent performance at high temperatures
  - High variability of mechanical integration, geometry
  - High variability of electrical characteristics
  - Intrinsically bifacial
  - Extremely long lifetime
  - → → new options for system integration
- European industry excels in system competence and high quality
- Cooperation with partners for developing new systems making full use of these characteristics will be a key for success
  - Integration in buildings, vehicles and mobile devices
  - Power plants using bifaciality and low temperature dependence
  - …

Innovation

xGWp
European Gigawatt Fab

VISION: European PV system industry as column of European energy transformation and competitiveness



- European cooperation
- Motor: Germany & France
- European innovation network

- Industrial network
- Close partners downstream & upstream
- New business models

- leading research institutes directly involved
- Permanent high level of innovation

- **Cheaper Solar Power**
- Higher efficiency
- Lower costs
- Better characteristics

- Less material needed
- Less process steps
- Higher automation
- Higher quality

- **Technological Package**
- Cells: Heterojunction
- Modules: Smart Wire
- Wafering: Diamond Wire
- Integrated process on large-scale machines

VISION: Disruptive PV with next technology generation
Combining experiences: PV silicon technology, microeletronics, nanotech

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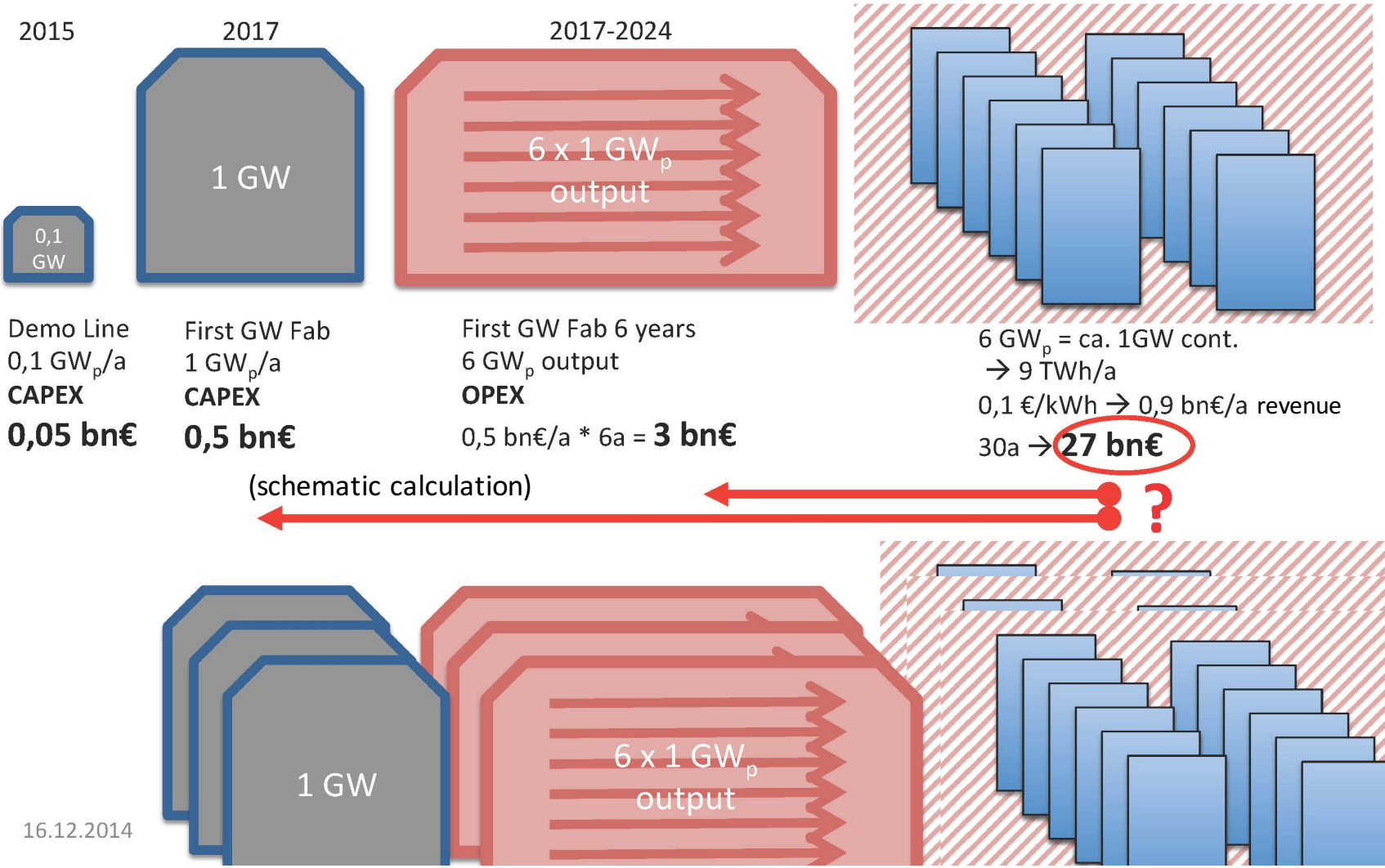
The Challenge: Bringing downstream earnings into PV manufacturing

xGWp
European Gigawatt Fab



16.12.2014

REACTIONS

Reactions: Politics

- Mobilisation of politicians at all levels: Regions, National level, EU
- Political institutions are ready to provide support with standard financing instruments if private investor takes risk
- No response to the request to send more clear signals that politics want growing PV markets in Europe
- Poor coordination in priorities between national programmes and EU programmes, extreme difficulty to align sources for research and demonstration projects
- Instead, the evolution PV policies has been deceiving
  - Retroactive cuts of support
  - New charges on generation for self-supply
  - No strong role of PV in market regulation
- In the EU commission: far-sighted people see serious problems for the sector. National governments under pressure by incumbent industries are blocking initiatives for more supportive policies

Reactions:
The European PV industry

- Not many players left
- The sad story of the European PV Industry association:
  - Over-ambitious in the boom years, tried to become global association
  - Now dominated by installers and non-European manufacturers
  - Lost influence
- Solarworld is the main remaining player
  - Has considerably grown with the take-over of Bosch activities
  - Has initiated anti-dumping measures against Chinese manufacturers in the EU and the US
  - Relies on incremental improvement of present c-Si technologies, as all major companies. Leader in PERC upgrades
  - Friendly observation of xGWp progress
  - Joint policy paper with xGWp for the EU
- No potential large investor
- Highly skilled teams searching new activities

Reactions: Utilities

- No interest to invest in PV cell and module production: too far away in the value chain
- Clear preference for wind, better offshore than onshore
- Reluctantly and slowly, they start to deal with distributed solar
- Large utilities: struggling to develop new strategies, increasing panic after heavy losses
- Small utilities: very diverse
- Increasing fear concerning the growing importance of distributed PV not owned by them – especially as costs for distributed storage are declining

Reactions:
The electrical equipment industry

- ABB, Siemens, Bosch, Schneider etc.
- All are investing in PV system technology: inverters, storage, system control…, mainly for overseas markets
- The Bosch failure has scared all
- No interest to venture into mass manufacturing of PV cells and modules: heavy competition, high capital needs, see them as commodities

Reactions:
Financial investors

- Electricity markets are strongly dependent on politics. Energy policies have been inconsistent, unreliable. High risk, especially in renewables
- Despite strong goals, politics has succumbed to the pressure of incumbent energy sector industries. The European PV market has faltered. PV is not welcome in Europe
- The European advantage is technological leadership. This may not be sufficient, and may be lost. Europe has lost several mass-production industries, e.g. in the microelectronics.
- Stronger interest from financial investors overseas: European technology is attractive. PV perspectives are seen more positively than in Europe
- Strategies combining European innovation centre and deployment in other continents may be the solution → even larger sums needed

Reactions:
Chinese Manufacturers

- With markets taking off, Chinese manufacturers are getting heavily interested in HJT technologies
- Meyer Burger is reluctant to sell its new technology generation to partners who might copy. Increased efforts to maintain the advantage
- Seeing the dynamics in the HJT sector, new entrants into the market are to be expected in coming years

DO WE NEED A NEW KIND OF INDUSTRY POLICY IN EUROPE?

Europe is losing a great occasion

- Europe has invested over 100 bn EUR and succeeded to make PV competitive.
- This is a huge achievement for mankind, essential for overcoming the climate challenge. PV will not only transform the electricity sector but also heat supply and mobility.
- At essentially no additional cost Europe could have a striving PV industry if appropriate regulations would be in place.
- Instead, Europe is slowing down the transformation of its energy sector: strong incumbent industries fear the obsolescence of their capital stock and their own structures
- But Europe is no longer the centre of the world. Germany and Europe have to acknowledge that others are moving on

Others are moving on

- China is determined to use the opportunities of PV
  - It has made PV a national priority when the potential became obvious
  - It has not hesitated to heavily support Chinese industries on global markets
  - It massively expands own installations; constantly stepping up targets: the 100 GW capacity target for 2020 is about to be doubled
- The US are back in the game
  - New companies with new business models are showing rapid growth
  - The state of New York is spending $ 750 million for supporting SolarCity to build a PV Gigawatt factory (similar technology to xGWp)
  - Utilities are starting to fight back, but are in a weaker position than in Europe. California is more ambitious than Germany
- A series of countries are discovering PV as a cheap source of electricity
  - Especially where electricity consumption is rapidly growing
  - Global market growth depends less and less on European policy decisions

Europe is not just losing some factories

- PV and wind will become the two dominant energy sources in a renewable energy future
- PV, batteries and smart controls will make self-supply very attractive and will deeply transform the energy sector towards distributed generation
- Getting completely dependent on others for the core functional components of PV devices and batteries might be as uncomfortable as essentially depending on Arab oil and Russian gas
- The still strong position of European industries in providing manufacturing equipment for PV and battery cell production is severely threatened by clients efforts and local sourcing rules
- If at this stage we fail, only a completely new PV technology, based on very different manufacturing principles enabling small scale production, may offer another chance

Strong incumbents slow down change: PV is not the only case

- Europe's claims get less credible
  - The EU has set the target "to become No 1 in renewables"
  - Present policies are inadequate to reach this goal given the strong dynamics elsewhere. There is no idea how to coordinate different policies adequately
- Battery cells are a similar case: Electromobility now completely relies on Asian battery cells: there is not European producer anymore. Daimler decided to close Li-Tec. No joint effort.
- Storage chips are another example how Europe lost a leading position. Many say that all mass-produced components have little chance in Europe
- The story of telecommunication network equipment shows that also complex system technologies are threatened
- Smart grid technologies may become the next example. China has identified them as another national priority

Europe needs a more integrated and coherent industry policy

Caught in the complexity trap
What can trigger the determination to change?

- Energy policies in many European countries and at the EU level are caught in a complexity trap:
  - multiplicity of strong interests, multiplication of complicated rules and patches
  - Increasing difficulty to understand impacts of measures
  - Disinformation campaign by incumbents successfully troubled understanding
  - No clear priority for policy goals, increasing distrust towards policymakers
- Insufficient coordination between
  - Energy policies, research polices, industry policies
  - National policies of EU members
  - National policies and EU policies
- Essentially lack of a shared vision

Europe is cultivating illusions about its role in the world

The scenery may become more and more chaotic

New technologies are drivers of change

What kind of event could make Europe wake up?

Thank you

Ruggero Schleicher-Tappeser

sustainable strategies

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