European Energy and Climate Policies Need a Strategic Industry Policy Approach

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Different Perspectives

Science | ***Economics Industry Technology*** | **Politics Society**

materials, processes, concepts	compo-nents	devices, machines	technical systems	socio-technico-political systems
Nanotechnology	Integrated circuits	PC	Mobile phone network	The internet
Semiconductors	Memory chips	Smartphone	Operating System	Telecommunication system
Recycling	Operating Systems		Railway system	
Artificial Intelligence			Warehouse	Transport system
	Power electronics components		Logistics system	
High-Tech ceramics		High-speed train		Public electricity supply
			Charging infrastructure	
3D printing		Electric car		
	Lithium-Ion-Battery		Electricity distribution grid	
		PV power plant		Water supply and wastewater treatment
	PV module	Wind turbine		

A changing framework at global scale

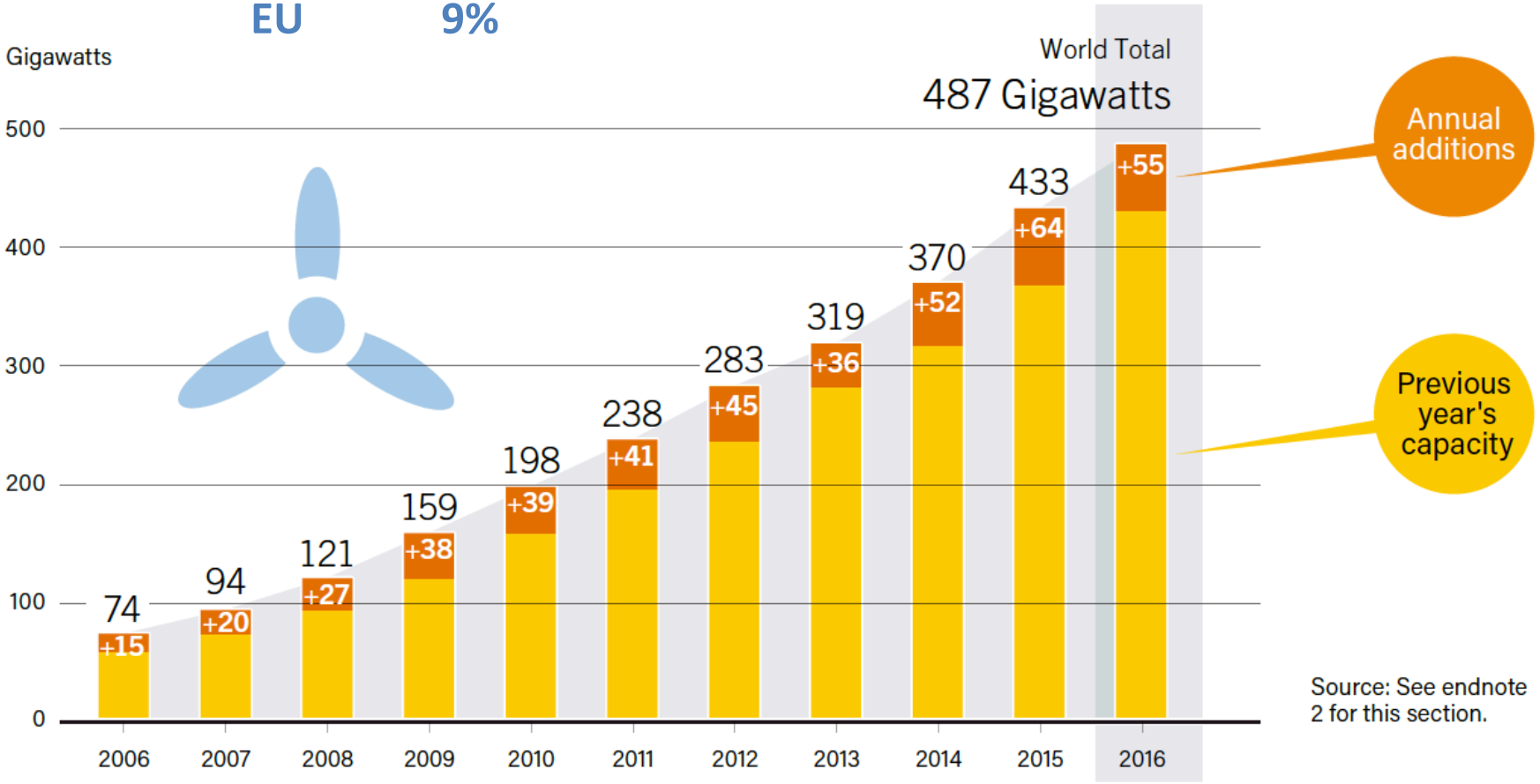
- For decades politics in Europe, the US and Japan was the main driver of change in national and global energy and climate issues
- Meanwhile, technology and new industries have become much more important as drivers
- A technological revolution is bringing deep changes:
  a combination of maturing nano-level material science and informatics brings a new generation of technologies challenging the economies of scale of the era of electro-mechanical and chemical macro-technologies
- In a globalised world, the capability of European, American or Japanese politics to control the rate of change has dramatically decreased → influential incumbent companies loose control, but damage their economies in trying to save old investments
- In seizing the opportunities of technological disruptions Chinese politics and industries have become very influential

Maturing nano-level science and informatics reduce scale effects, enable REN and E-Mobility

	Main enabling technologies
Renewable Energy	
– **Solar PV**	PV semiconductors: nano-level material science power electronics: nano-level material science
– **Wind**	conventional electromechanical engineering composite materials: chemistry, nano-physics power electronics
– **System integration**	
• **Storage**	electrochemistry: nano-level science power electronics
• **Grids**	power electronics controls: digitalisation, telecommunication
• **Sector coupling**	electrochemistry: nano-level material science controls: digitalisation power electronics
E-Mobility	
– **Powertrain**	conventional electromechanical engineering power electronics
– **Storage**	electrochemistry: nano-level science power electronics
– **Lightweight vehicle**	composite materials: chemistry, nano-physics
– **Autonomous driving**	sensors: nano-physics, electronics digitalisation, telecommunication, artificial intelligence

Wind installations grow steadily – Europe slightly slower

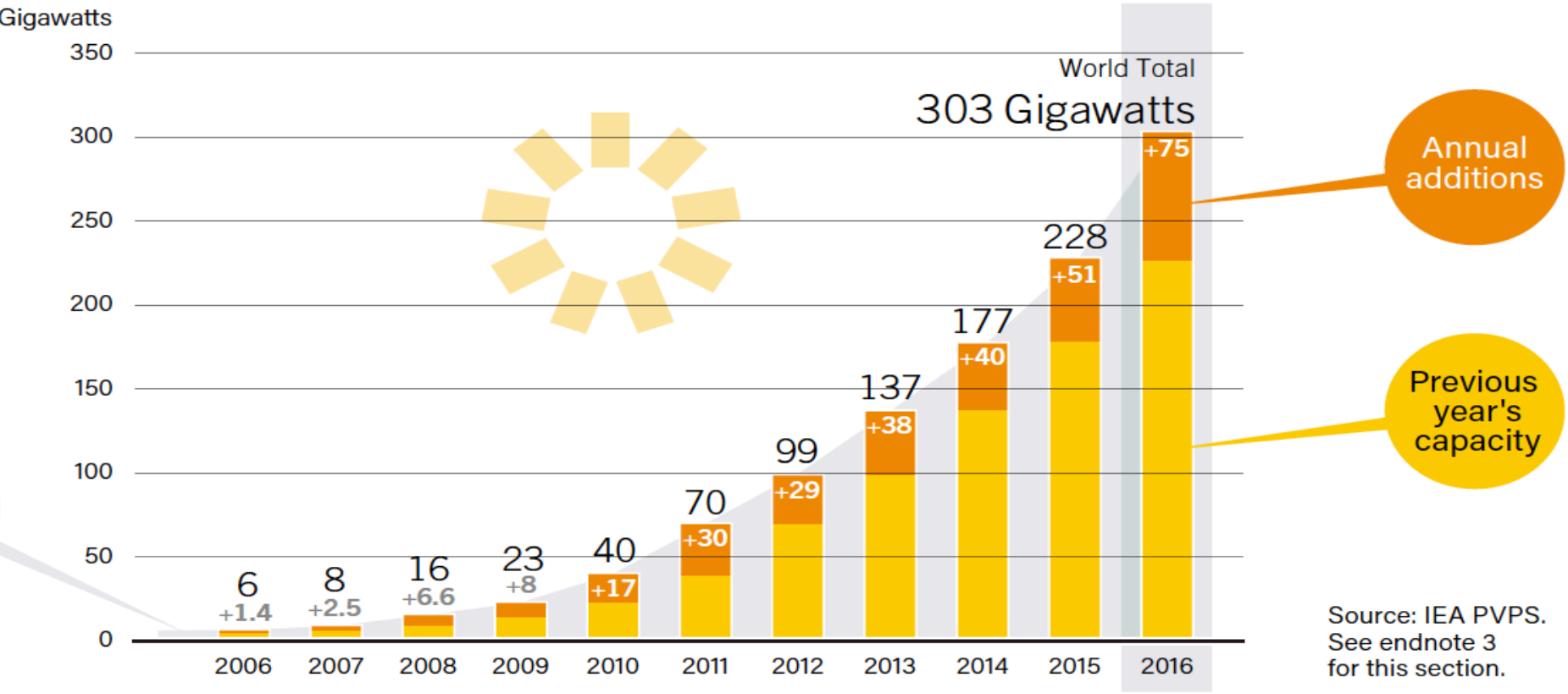
Capacity added in 2016
World 13%
EU 9%



Source: REN21 2017

Solar PV grows rapidly – but not in Europe

Capacity added in 2016:
World 33%
EU 6%



Source: REN21 2017

Comparing Wind and Solar PV development

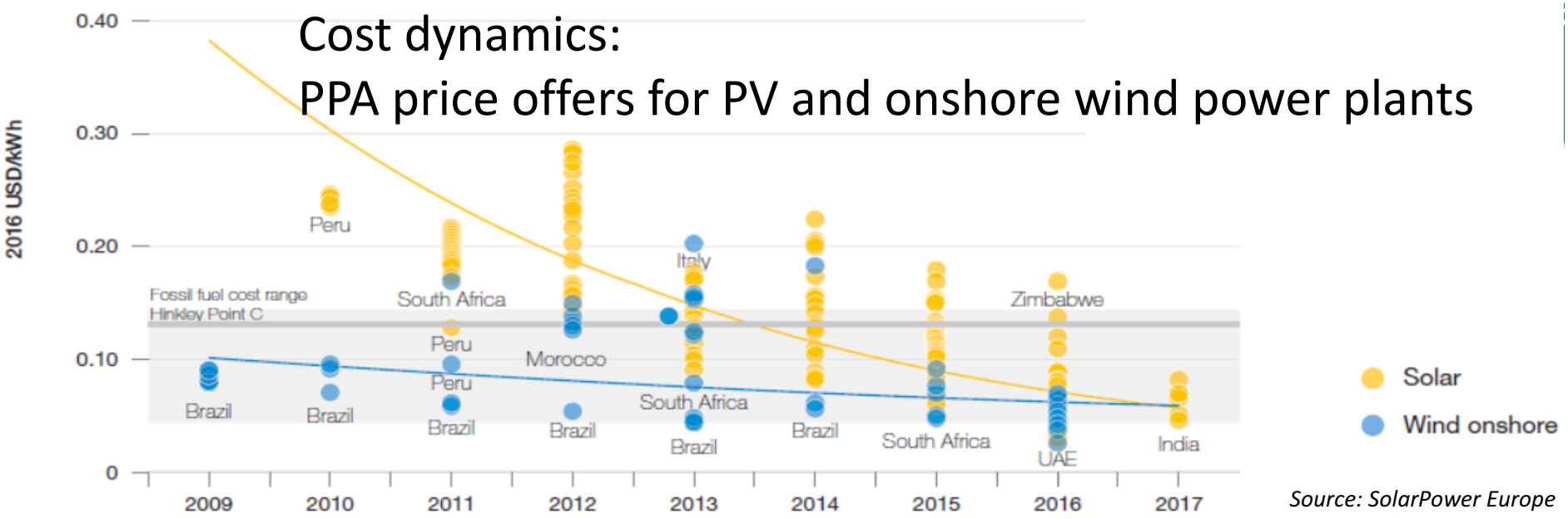
CAGR Compound Annual Growth Rate	Wind	Solar PV
2006-2011	26%	63%
2011-2016	15%	34%
2006-2016	21%	48%

- Global growth rates of Solar PV are always more than double than those of wind
- Both growth rates are decreasing

Capacity added in 2016	Wind	Solar PV
World	13%	33%
Europe	9%	6%
Europe/World	0,69	0,18

- Europe lags behind world growth rates: slightly in wind, massively in solar
- Europe bets on the less promising technology, neglects the technology with most growth and potential. Why?

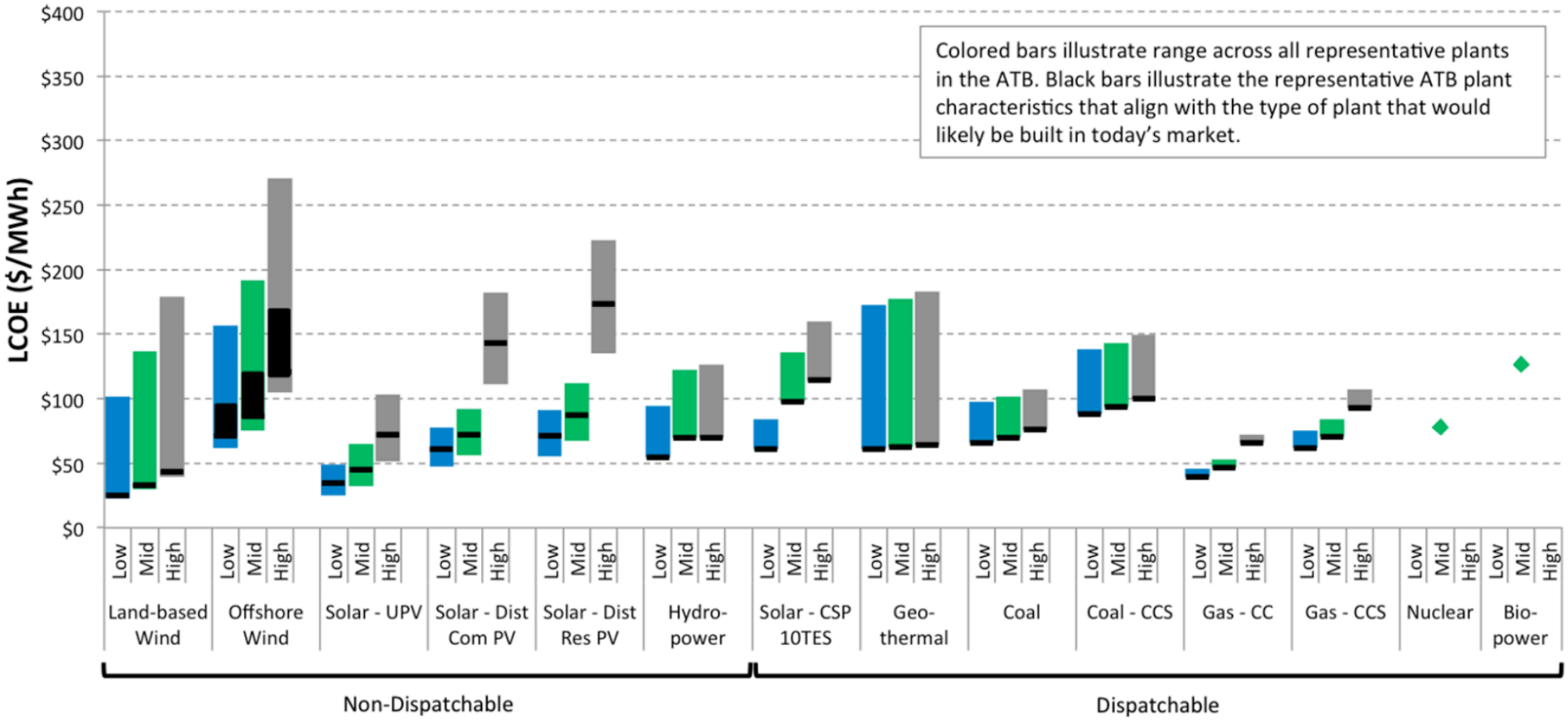
Disruptive Dynamics of Photovoltaics 2017: PV cheaper than wind



Source: SolarPower Europe

- The difference in cost reduction dynamics reflects the difference in the technological base
- The high content of conventional macro technologies in wind energy limits its cost reduction potential
- Photovoltaics has a high potential for further cost reduction:
  - Improved nano-scale processes can further raise the efficiency
  - Expenses for conventional mechanical support can drop with the integration of extremely thin PV layers into existing structures (buildings, roads, textiles)
- Concentrating Solar Power (CPV) – which mainly relies on conventional processes – has already been outcompeted by Photovoltaics
- The crossing of the cost curves will further accelerate global dominance of PV – expect a shift from wind to PV except for wind needed for seasonal balancing

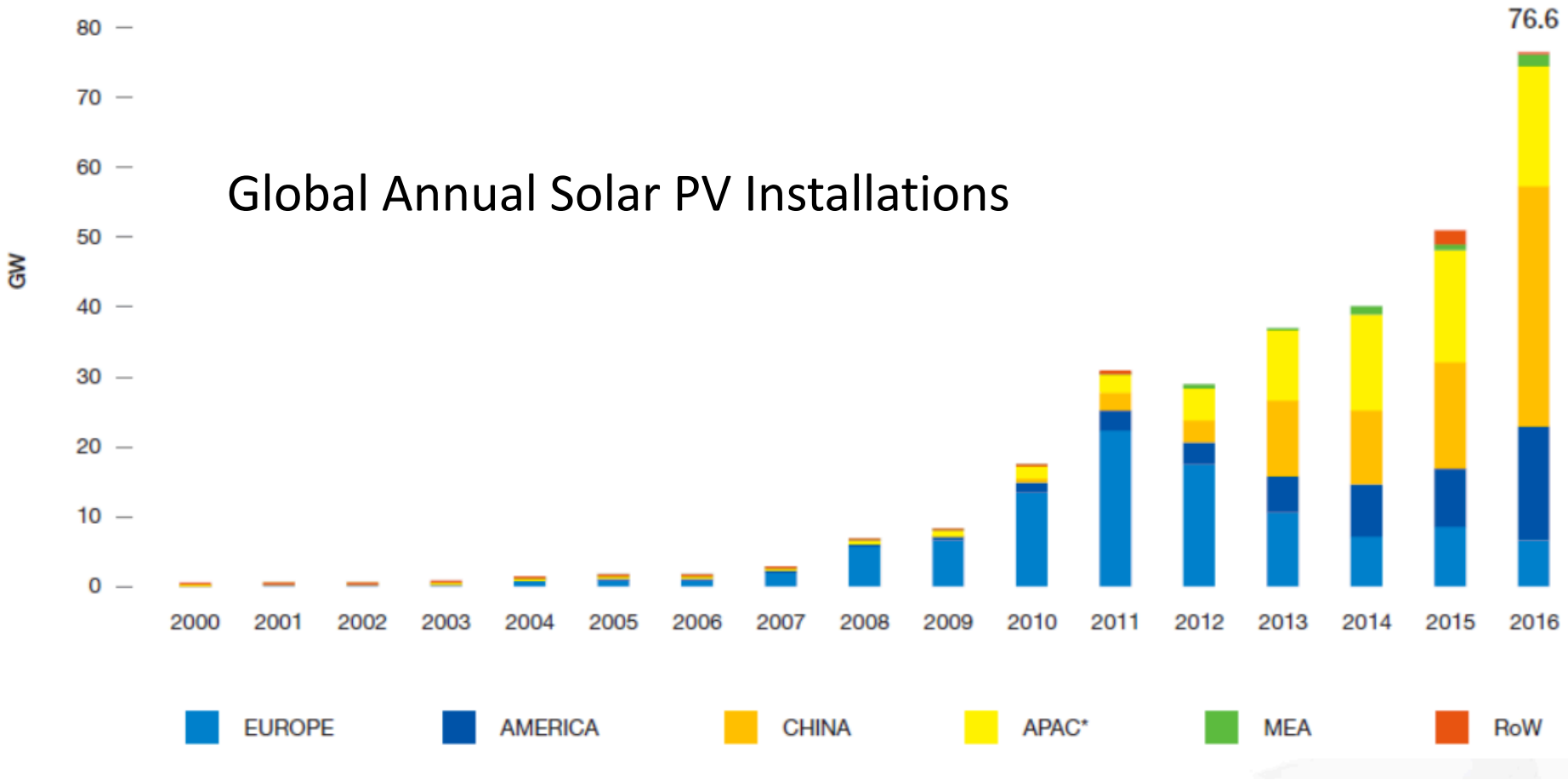
NREL: Solar Utility PV in the US cheaper than coal and gas



2017 ATB LCOE range by technology for 2030 based on current market conditions

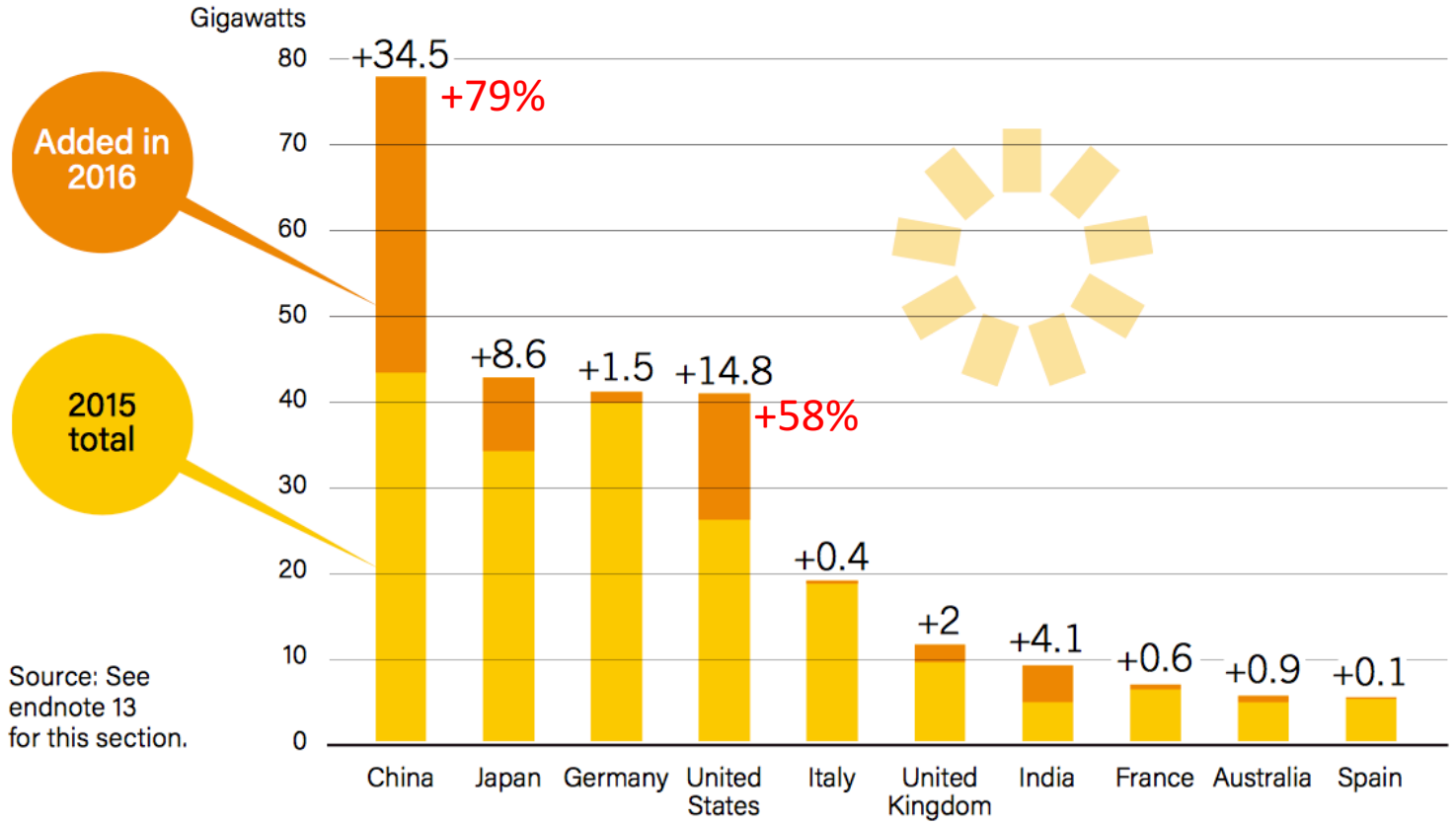
Source: National Renewable Energy Laboratory Annual Technology Baseline (2017), http://atb.nrel.gov

Solar PV markets: China is taking over



Source: SolarPower Europe 2017

Disruption in China:
79% capacity added, 46% of global new PV capacity

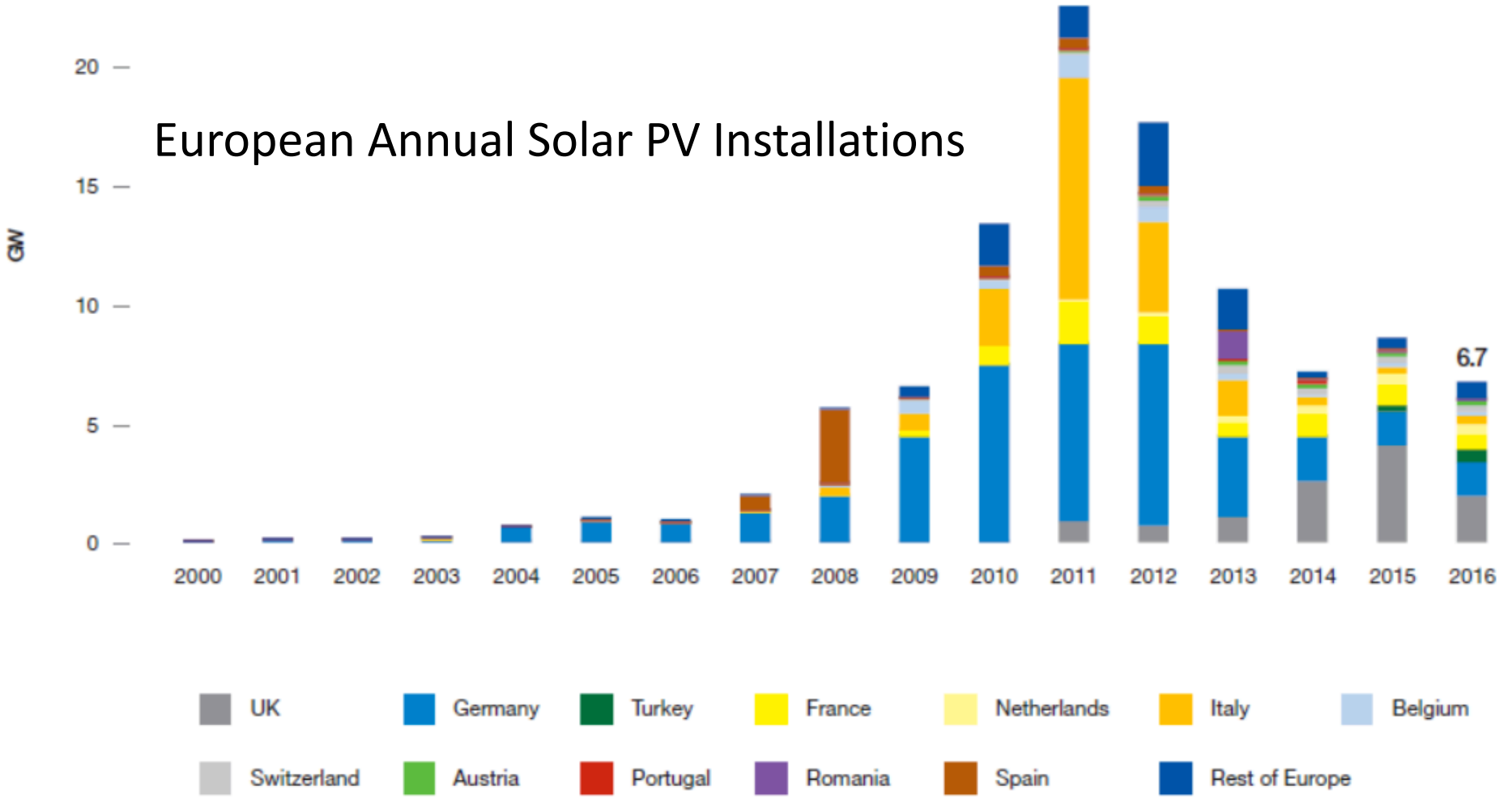


Source: See endnote 13 for this section.

CHINA ACCOUNTED FOR **46%** OF NEW CAPACITY.

REN21 Renewable Energy Policy Network for the 21st Century

European PV markets have collapsed after 2011



Source: SolarPower Europe 2017

Solar PV: Industry structure

Shares in global module production

- Asia 90% --- China 65%
- Europe 5%
- US 2%

Top ten module manufacturers

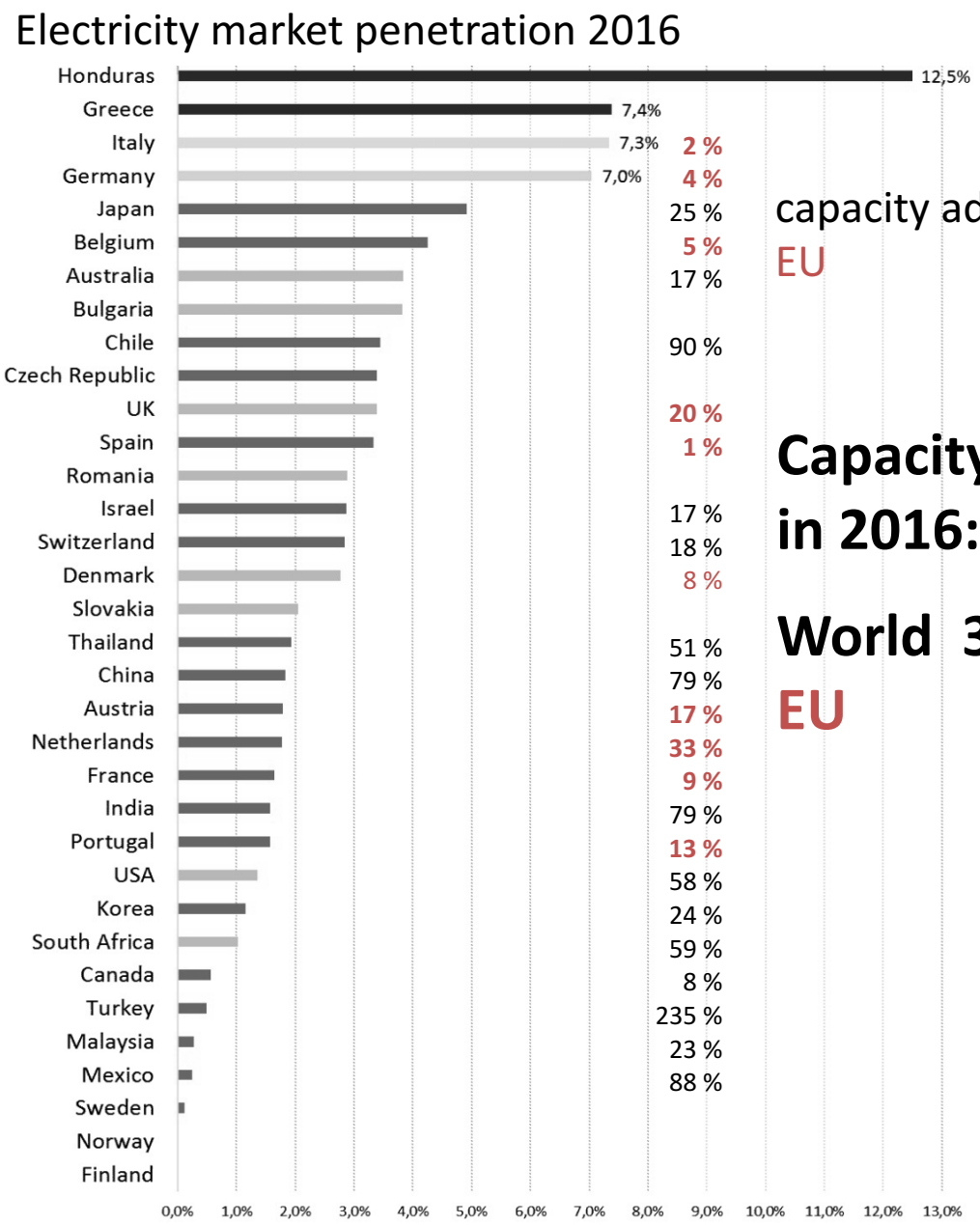
- 50% of global shipments
- 8 Chinese, 1 American, 1 Korean

Equipment manufacturers

- European companies still leading
- Chinese start to buy them (Manz)

Source: REN21 2017

Market collapse in Europe can not be explained by high market penetration, nor by climate



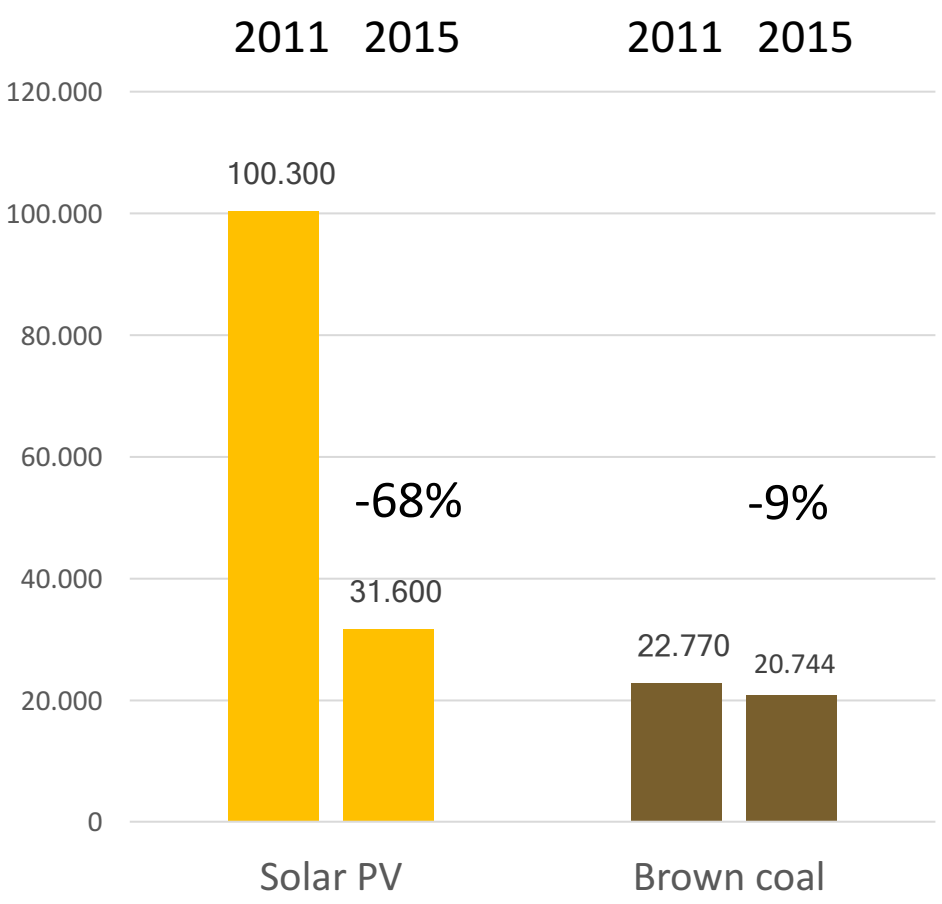
Capacity added in 2016:

World 33%

EU 6%

Source:
IEA PVPS 2017 / own calc.

Political priorities in Germany: Employment evolution in PV and Brown Coal

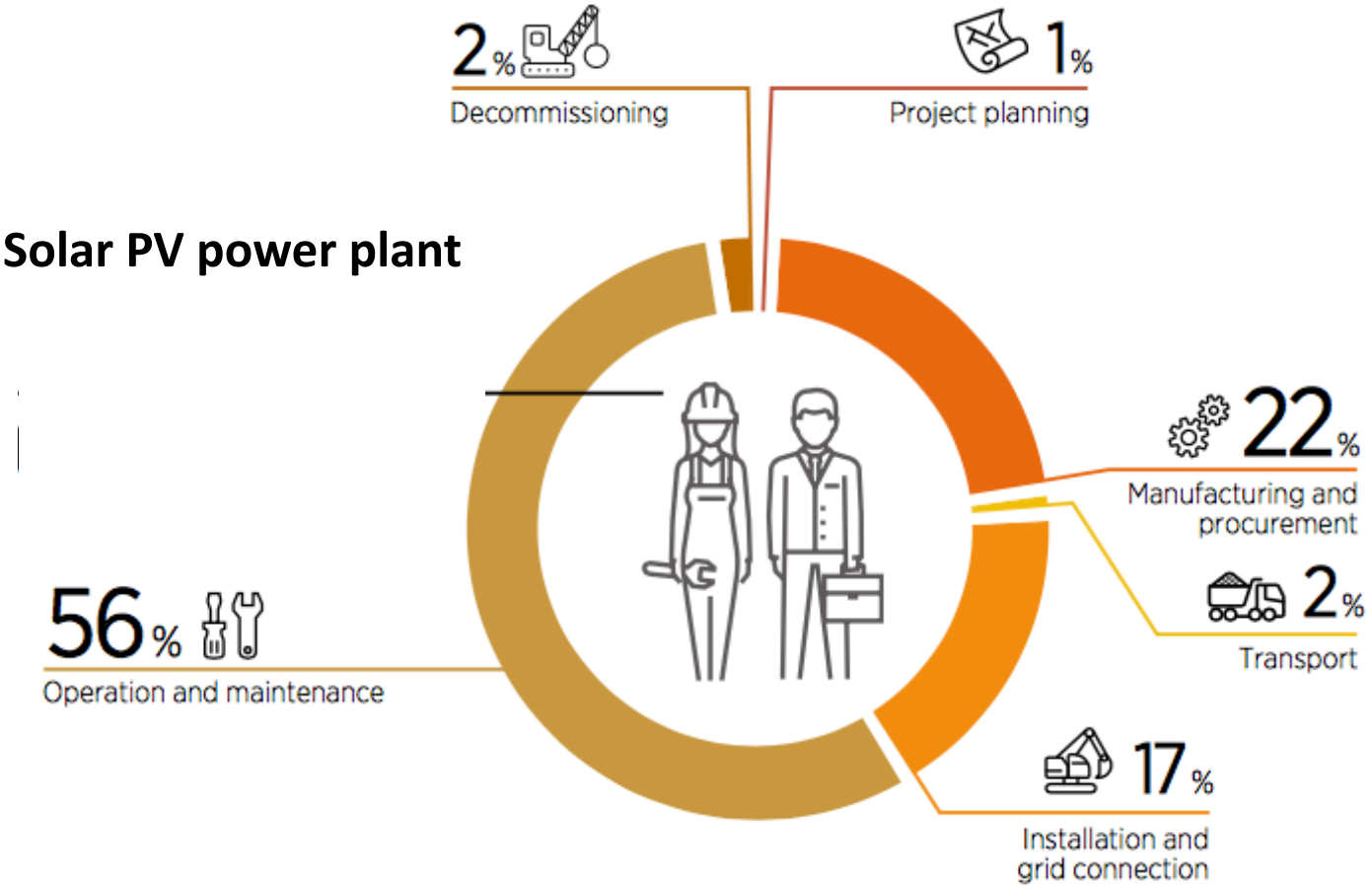


- Brown coal (lignite) in Germany accounts for 17,4% of GHG emissions
- Employment plays a key role in the intense political discussion about shutting down lignite mines and power plants
- Coal miners and utility workers have very strong trade unions. PV workers have not.
- Long grown political and personal connections between companies, unions, the conservative and the social democratic party

Most labour required locally: around half is O&M

Distribution of human resources required along the value chain

Solar PV power plant



Source: IRENA 2017

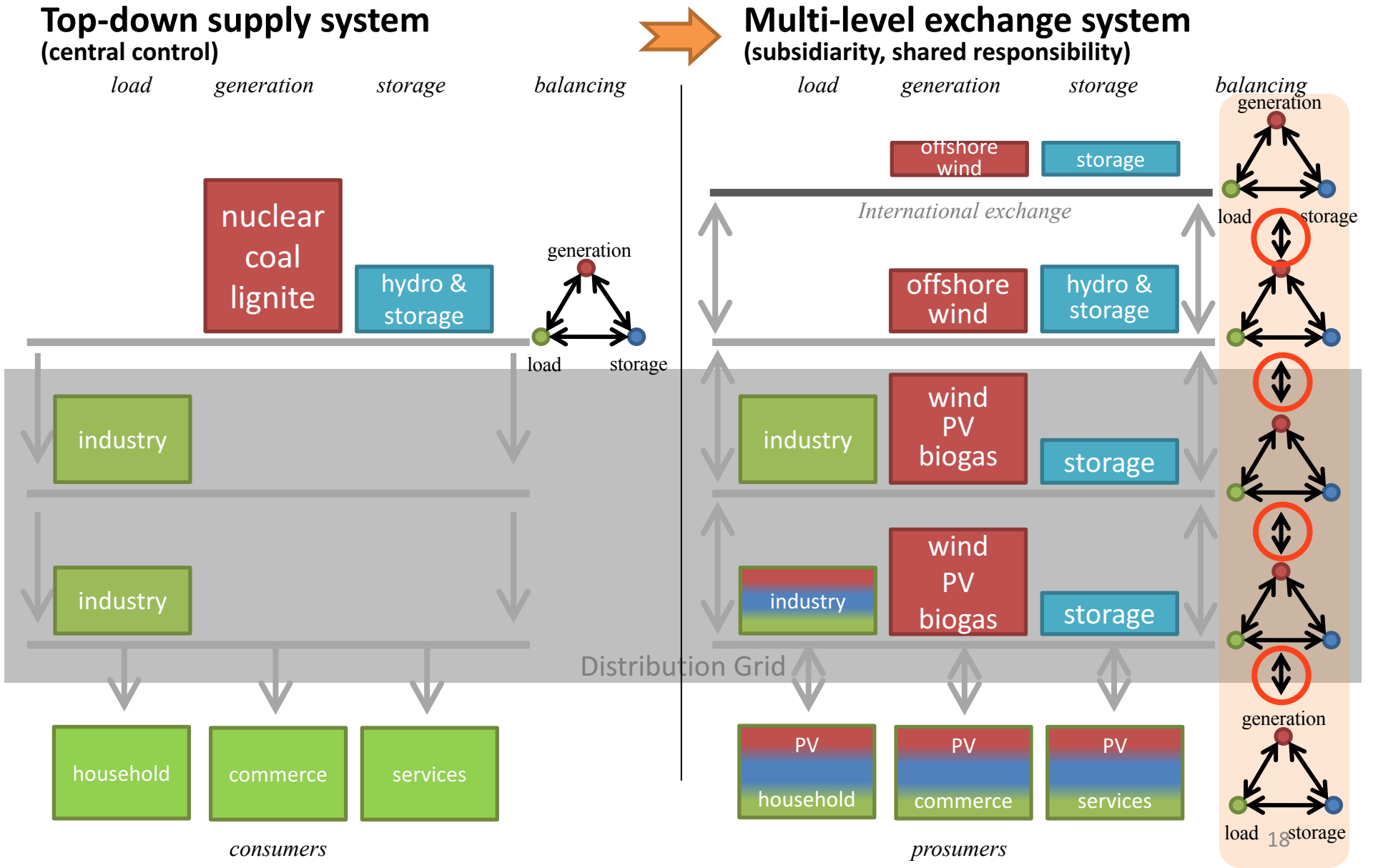
Was the collapse of PV in Europe inevitable? Did Europe miss an important opportunity?

- Employment was not the reason
- Climate in Europe was not the reason
- High penetration achieved was not the reason

- **INCUMBENTS HAVE STARTED TO FIGHT BACK IN 2010**
- Lower production costs for standard modules in Asia do not explain market collapse in Europe

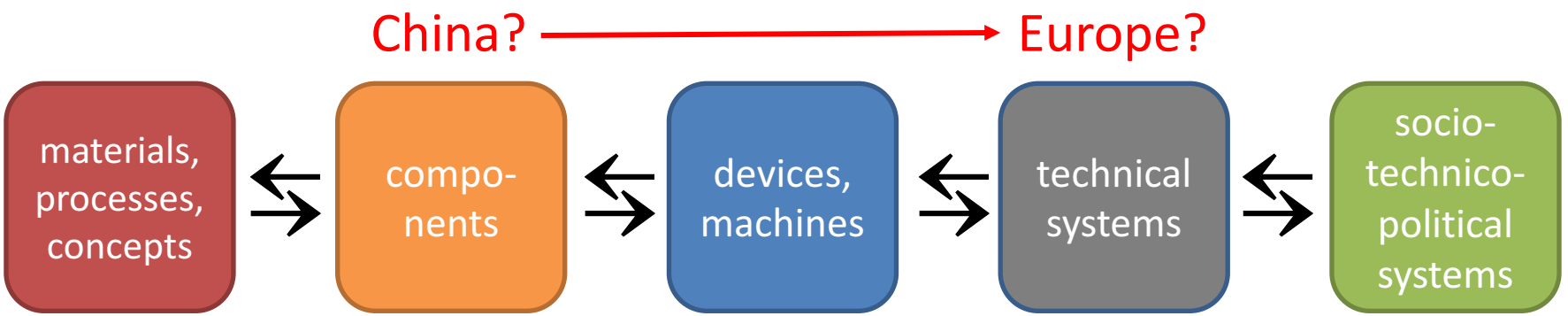
- Europe was not able and not willing to develop an answer to determined implementation of strategic priorities of China
- High quality production with advanced technologies in Europe would have been possible

Considerable recent progress on balancing at the distribution grid level



The Debate about European and Asian strengths

- Is Asia better at manufacturing commodities, high volume standard components?
- Is Europe better at developing complex technical systems?
- For how long is this division of labour viable?



Nanotechnology
Semiconductors
Recycling
Artificial Intelligence
High-Tech ceramics
3D printing

Integrated circuits
Memory chips
Operating Systems
Power electronics components
Lithium-Ion-Battery
PV module

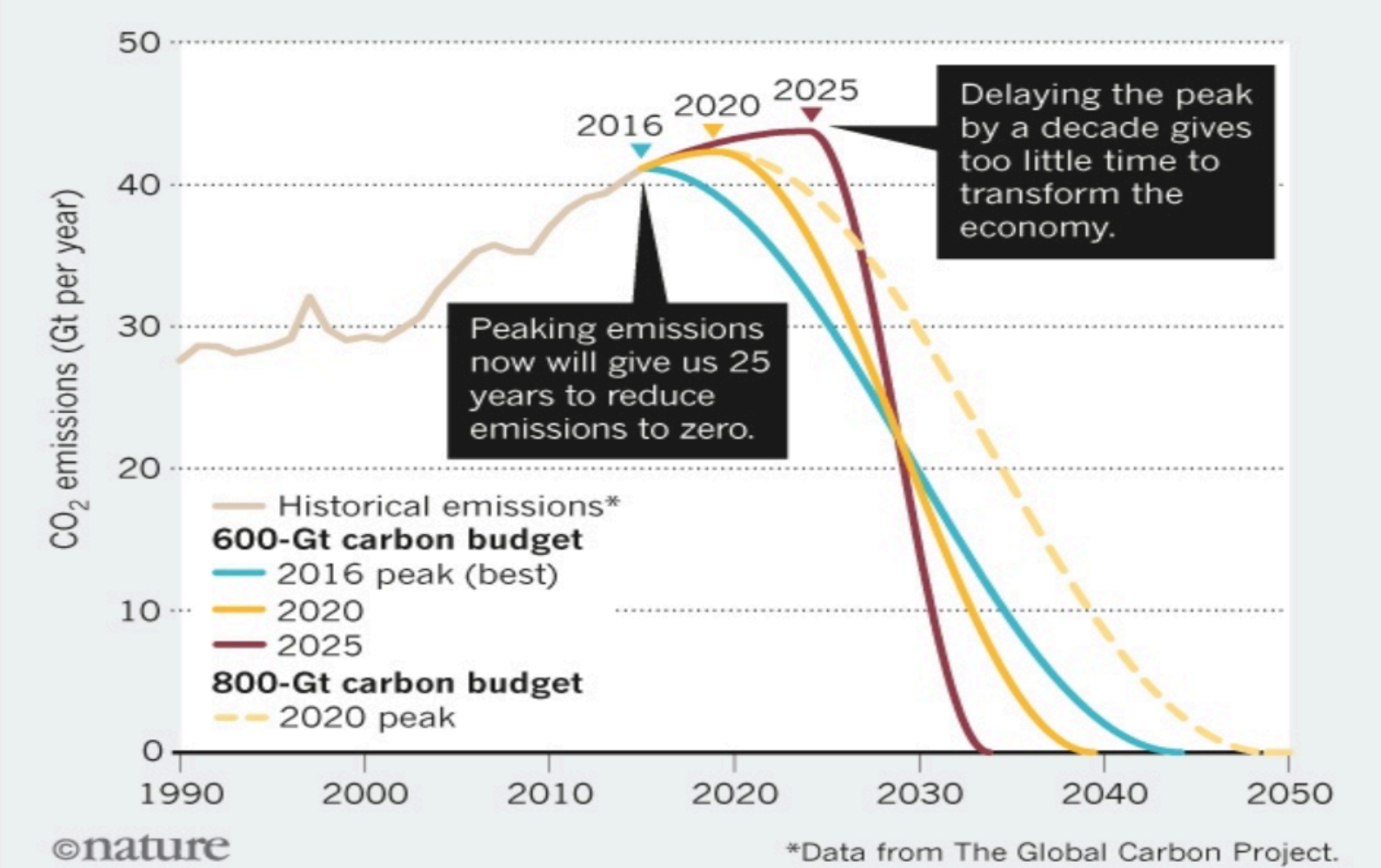
PC
Smartphone
Electric car
PV power plant
Wind turbine

Mobile phone network
Operating System
Railway system
Warehouse
Logistics system
High-speed train
Charging infrastructure
Electricity distribution grid

The internet
Telecommunication system
Transport system
Public electricity supply
Water supply and wastewater treatment

Climate Change:
No time to loose, when do we get serious?

The Carbon Crunch



Europe needs to accelerate the transition
No escape from changing structure of power generation

- Incumbent industries have delayed the transition – this will increase overall costs
- **When obliged to consider renewables, incumbent industries preferred wind – an older, less dynamic technology – and have used their influence to shape markets**
- For equipment producers and utilities wind (especially off-shore) has the advantage to preserve some economies of scale and to exclude small competitors
- Europe needs an important share of wind energy for seasonal balancing – however, photovoltaics will dominate globally and has huge potential in Europe
- European research is still top in PV technology, but despite considerable development potential, PV was declared to be a “commodity”
- **Europe missed an industrial opportunity loosing the leadership in Solar PV**
- Experts forecast a growing share of small and medium-sized installations in global photovoltaic markets, not least due to falling prices of local battery storage
  → economies of scale further loose importance in power generation
- Prices for photovoltaics, storage and power electronics will continue to fall
  → local power generation gets increasingly attractive

Incumbent industries in slow-grow industrial countries threaten further development

Lessons from the Renewable Energy history in Europe – so far:

- Europe's high variety, research capacity and democratic debate has produced a wealth of ideas, approaches, products, experiments and new structures reflecting urgent needs and new technological options
- European incumbent large industries were blind for coming disruptions, stuck to old structures, used long-established political influence for delaying change
- **Incumbent companies following short-term considerations, trying to save capital stock, caused long-term damage to the overall industrial tissue**
- **European policies were not able to make use of huge European opportunities**
- China had the foresight, the determination and the strategic means to take advantage of this situation after Europe had paid the bill for making renewable energy viable: A blessing for global climate and energy policy!

Can Chinese strategies threaten European economies, independence, political culture?

- Fear raises that Chinese strategic determination backed by an authoritarian system may threaten European economies and independence
- There are other areas where China successfully aims at strategic global domination of key infrastructure-related technologies:
  - Microelectronics
  - High speed rail
  - Mobile phone and internet networks
  - Distribution grid technologies
  - Battery cell manufacturing
- Electric cars and the transport system may be an area where technological disruptions may more seriously affect European economies
- Globalisation has changed the rules: Times are over, when western industries could control the pace of change through political influence
- **Europe has huge potentials but needs to develop effective strategic long-term industry policies in a new context**

Prepare for sudden change: History does not follow a smooth master plan

The end of the internal combustion engine

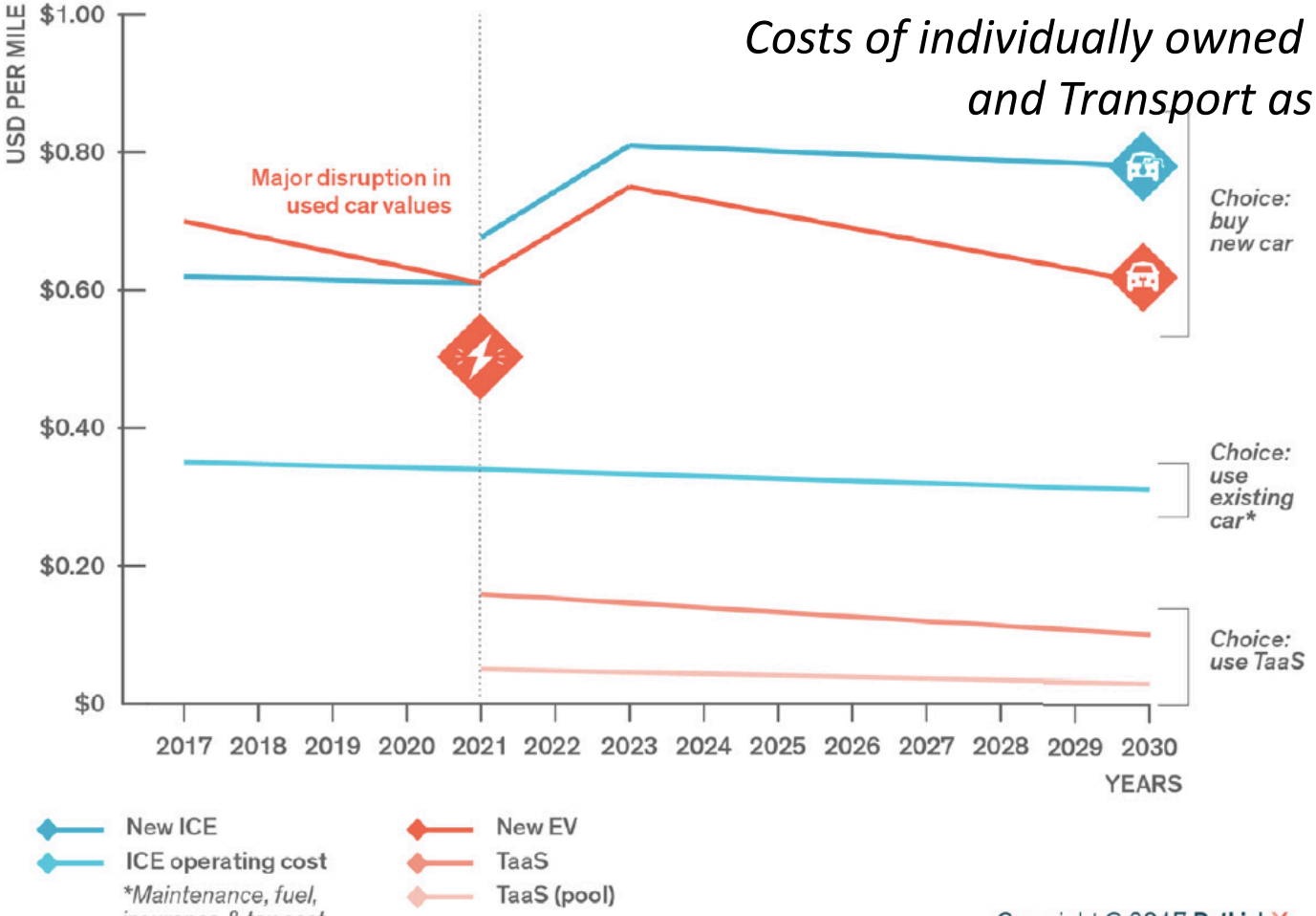
- Often change occurs suddenly: when tipping points are reached, a nudge is sufficient. Who has a plan B when windows of opportunity suddenly open?
- **Fukushima** was decisive for terminating nuclear power, suddenly in Germany, slower elsewhere
- The **financial crisis** was a lost opportunity for ecological investments: nobody had a Plan B
- In **Africa, intercontinental broadband links** and increasing internet availability since 2011 triggered massive migration to Europe
- **Trump and Brexit** have opened many eyes for progress and opportunities brought by the EU
- The coincidence of **Dieselgate and Tesla 3** may trigger a transition prepared by a 40 year-old transport debate + advances in battery, power electronics and AI technologies

Tony Seba (Stanford, RethinkX): imminent heavy disruption in the transport sector

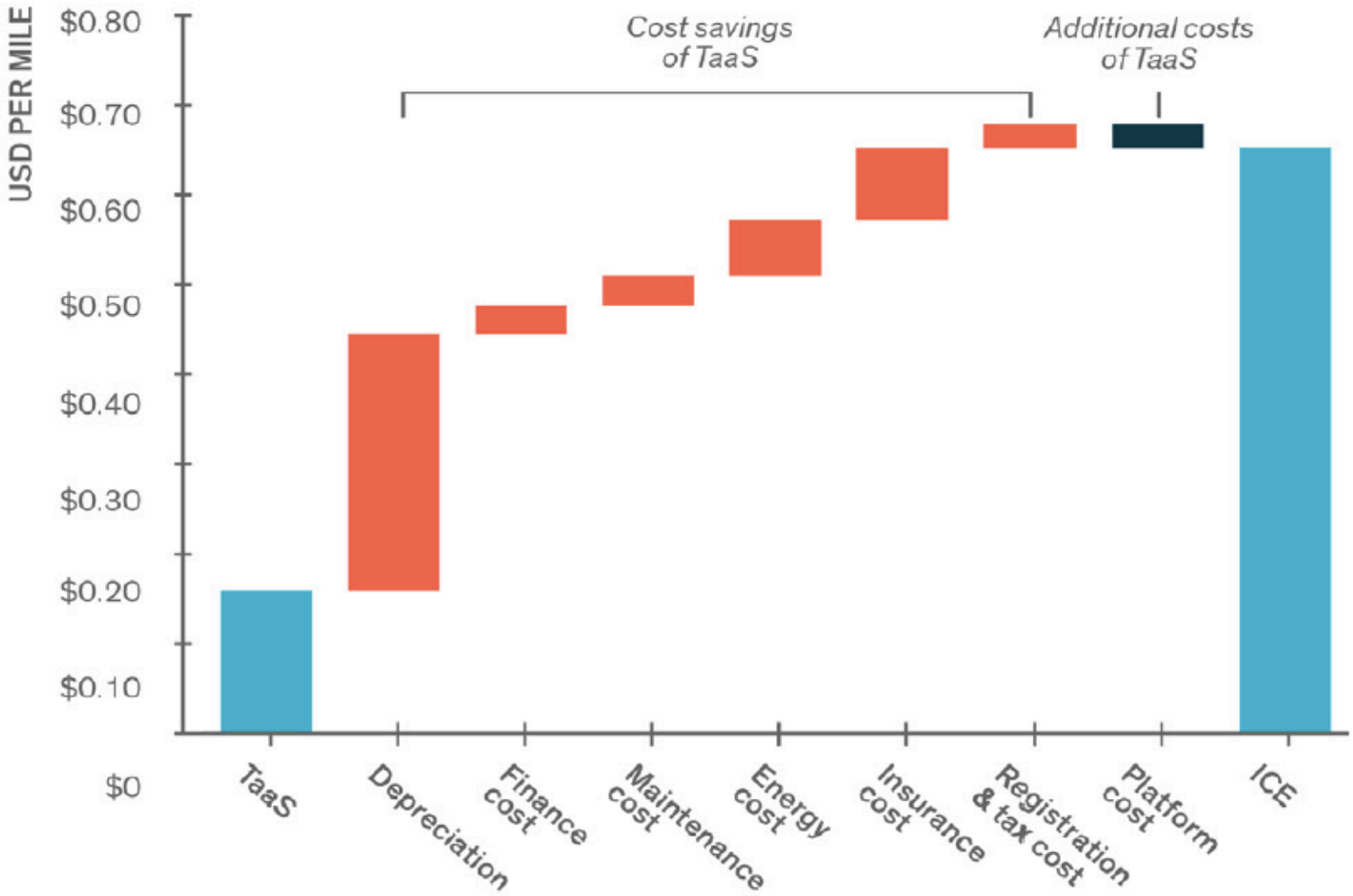
Basic Assumption: Autonomous driving becomes available by 2021

(as Ford and other major car manufacturers have announced)

Costs of individually owned ICE cars, i.o. EVs and Transport as a Service (TaaS)

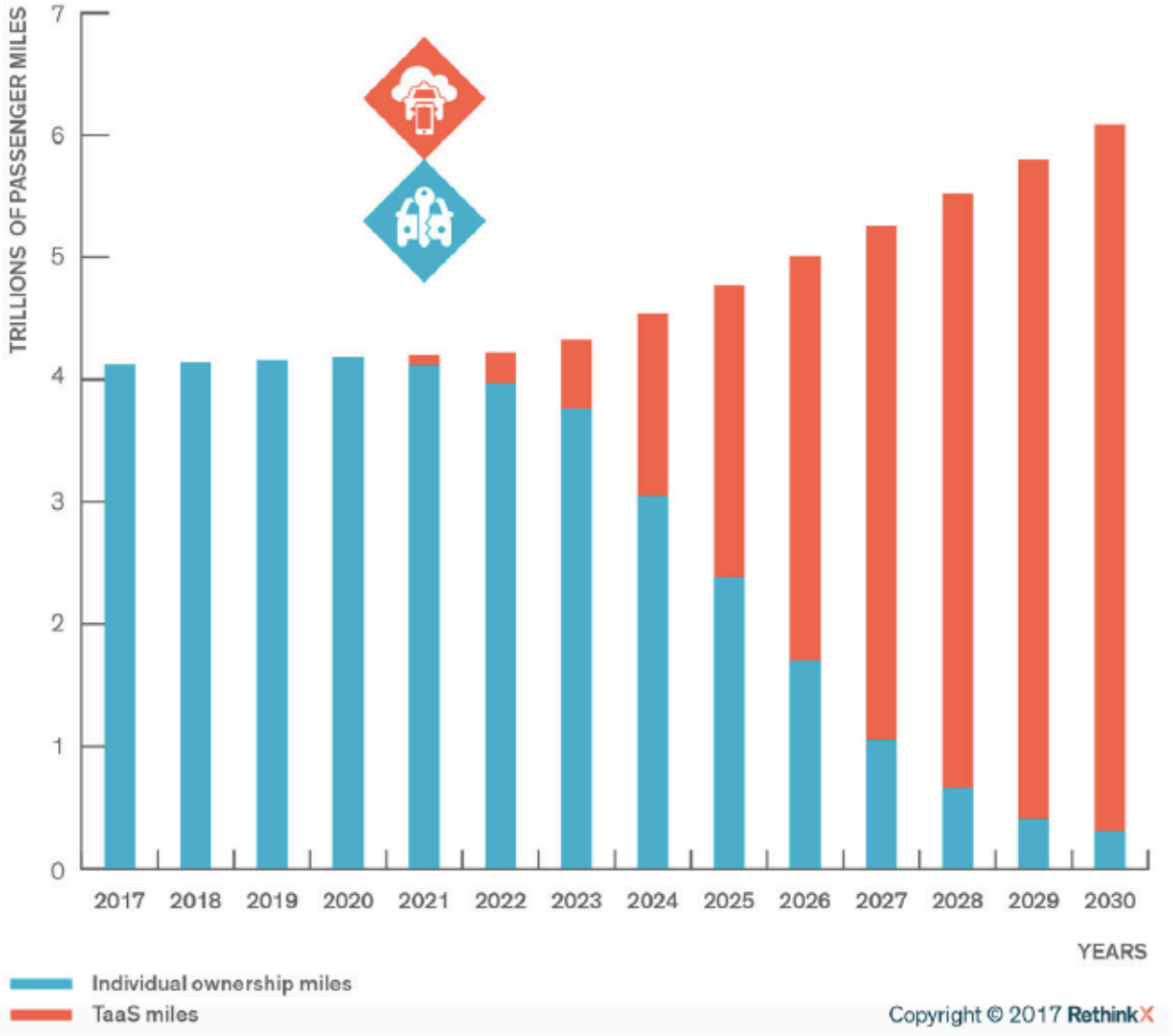


Price difference elements between conventional cars and transport as a service

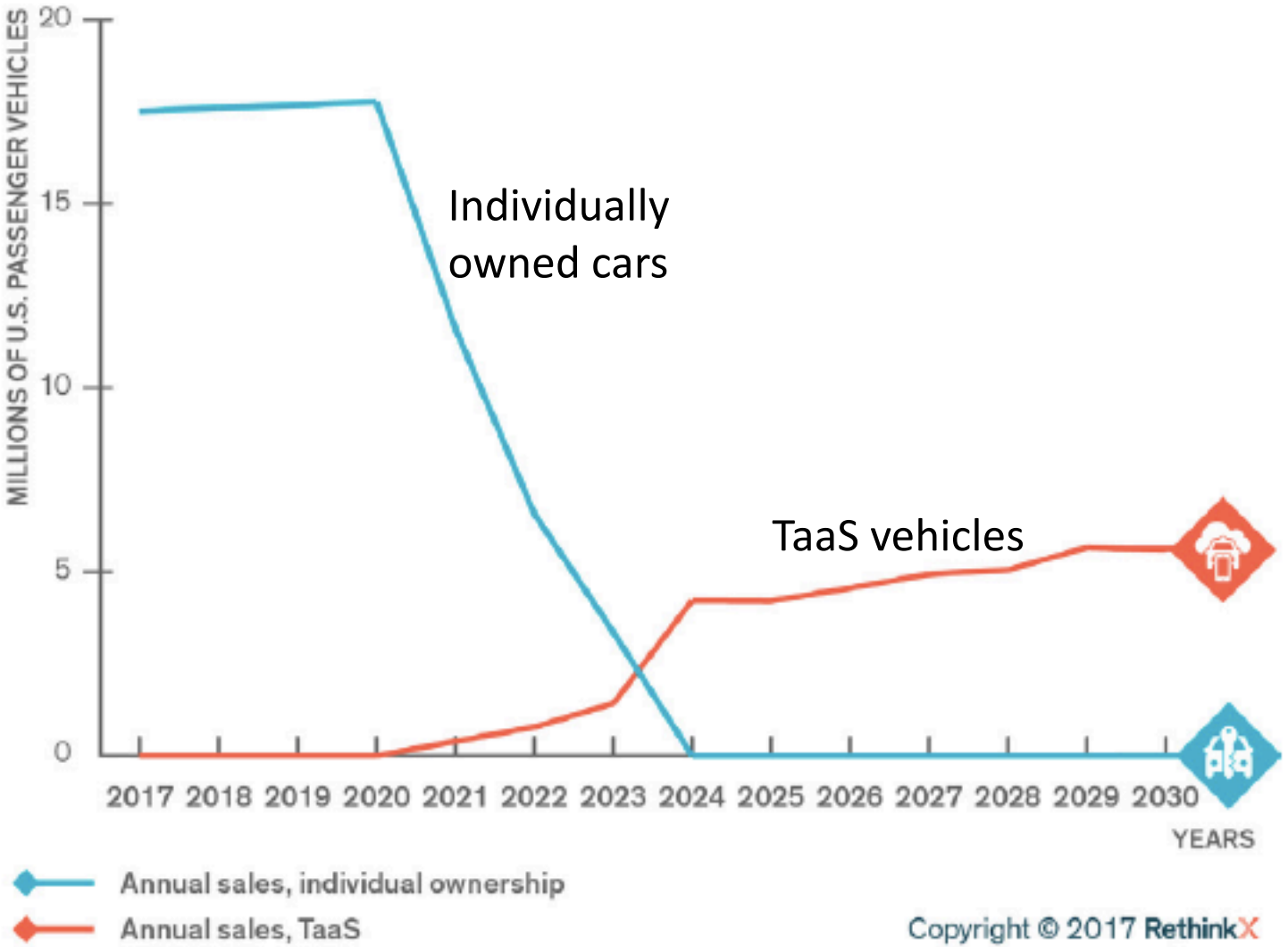


The consequence: rapid decline of individually owned cars

High speed adoption of transport as a service (TaaS)



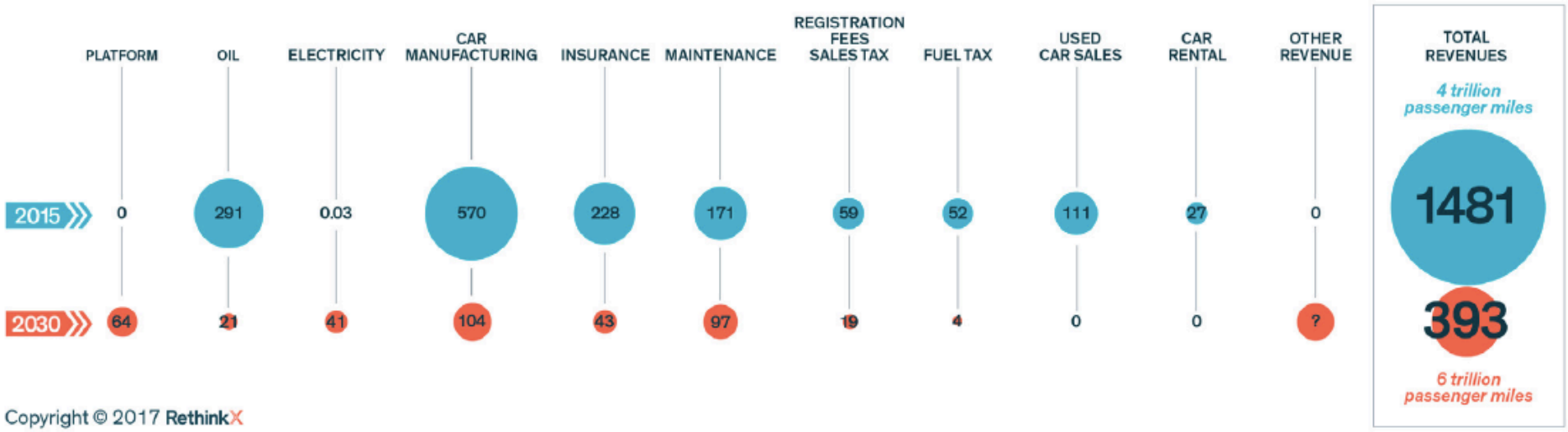
Projected trends in annual sales



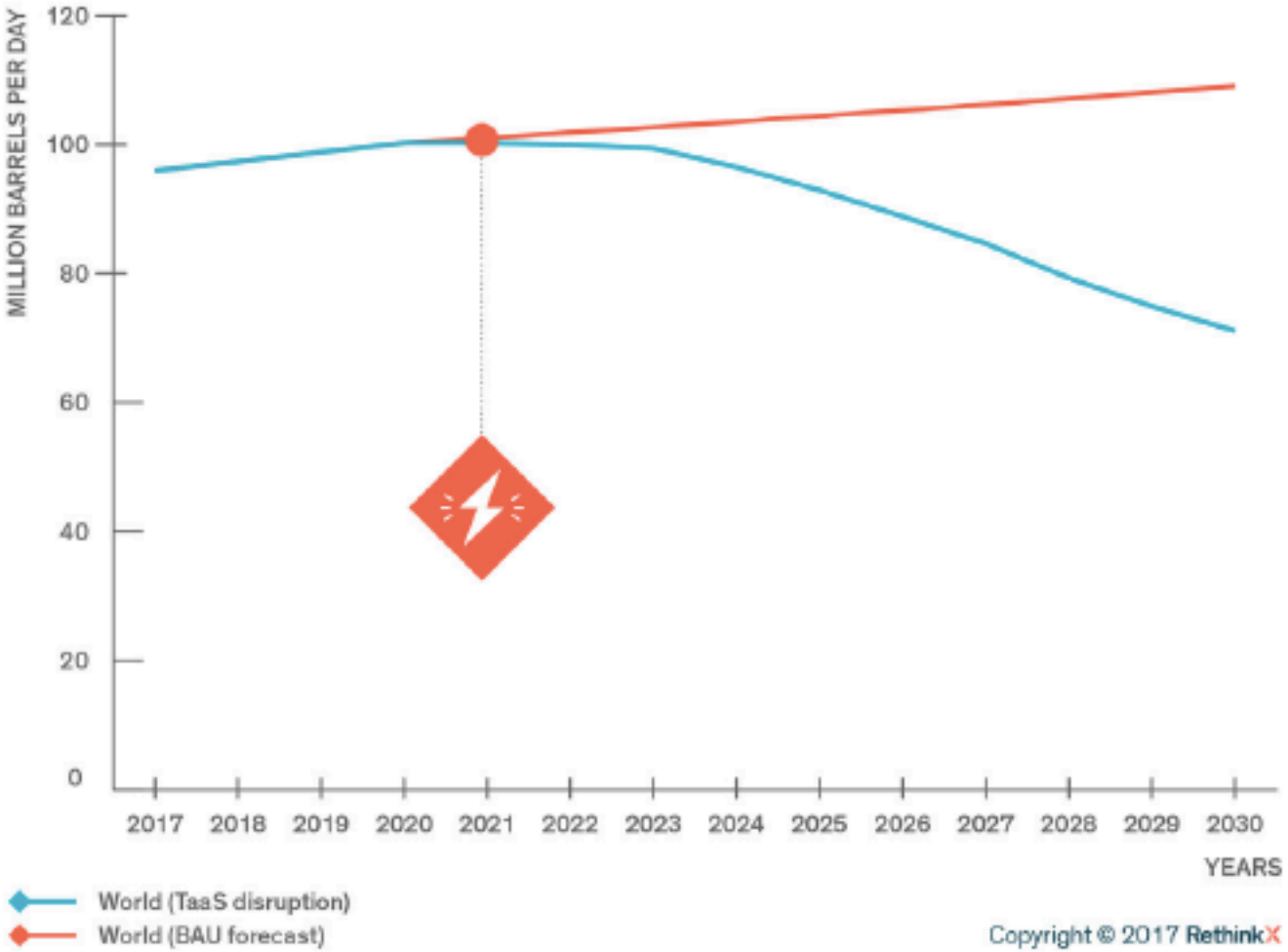
Projected trends in fleet size and composition

Plummeting revenues of car related industries

Revenue distribution along the car value chain in the US



Impact on global oil demand



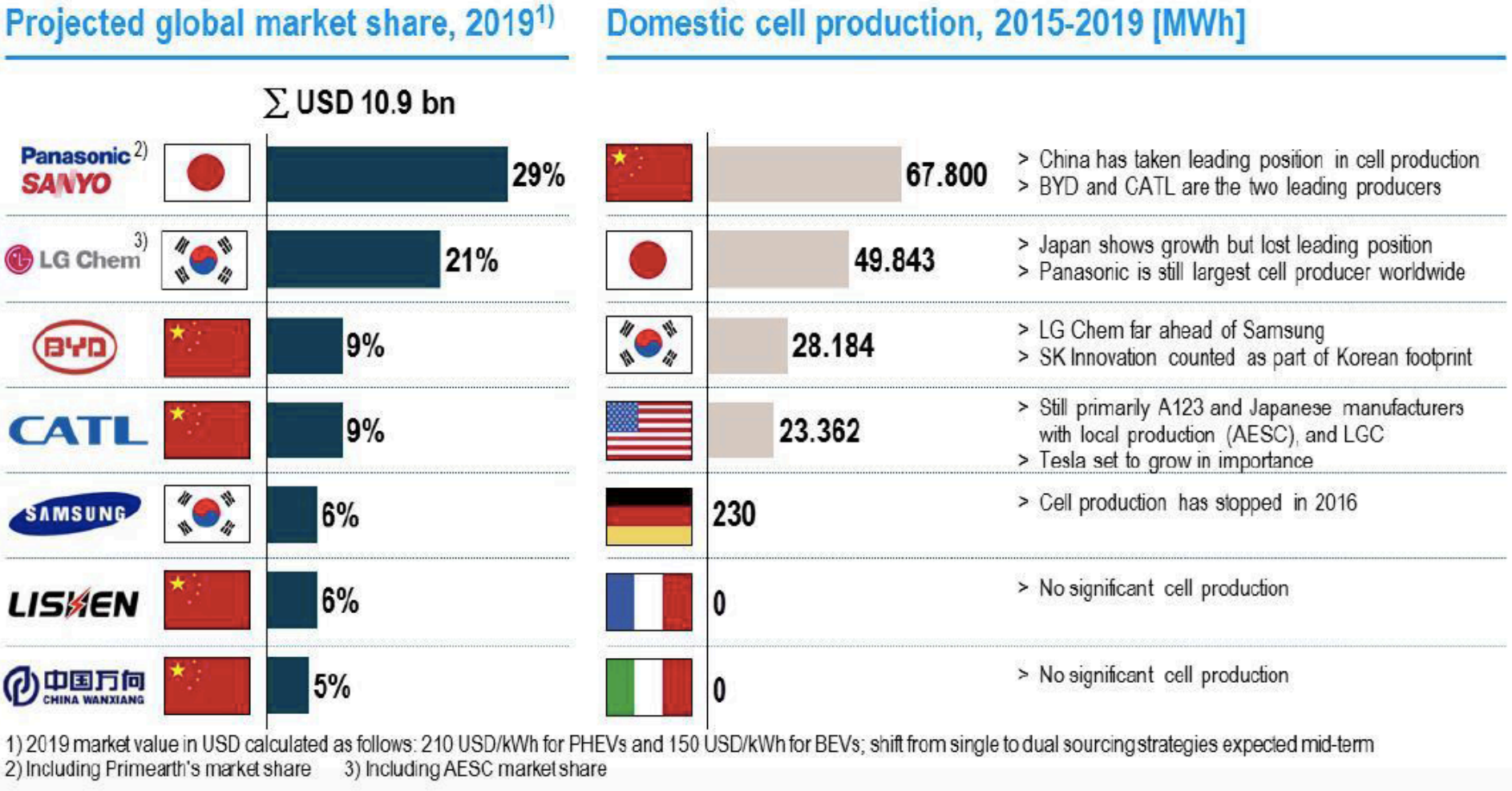
Deep impact on economy and society

Even if these dramatic forecasts become reality a decade later, impacts on a wide range of living conditions and policies will be huge and call for action now:

- Employment & Economic structure
  - EU automotive manufacturing: 3.3 million high-skilled jobs, 10.9% of EU manufacturing employment. Who will win the race for providing future autonomous e-vehicles and transport services?
  - EU automotive sector: 12.6 million, 5.7% of EU employment. Millions of low-paid jobs (drivers…) will be displaced by autonomous vehicles and transport systems
  - New manufacturing techniques as 3D-printing may additionally shrink supply chains
- Spatial patterns:
  - Plummeting passenger transport costs and improved transport comfort facilitate commuting
  - Improved accessibility for rural areas?
- Infrastructure:
  - Plummeting freight road transport costs → modal shift, pressure on road infrastructure
  - More efficient infrastructure use, especially in cities
  - Dramatic gain in freed parking space: new opportunities in cities
  - Conventional public transport has to adapt to new partners in intermodal mobility
- Energy supply:
  - Increased electricity consumption
  - Opportunities for sector coupling, especially with wireless charging

Discussing social and structural impacts and options in time will be essential for seizing opportunities and avoiding harmful disruptions and heavy loss of global competitiveness. Europe has all resources for tackling this challenge, but it needs to use them.

Who will shape these changes?
Asian Companies dominate battery cell manufacturing



1) 2019 market value in USD calculated as follows: 210 USD/kWh for PHEVs and 150 USD/kWh for BEVs; shift from single to dual sourcing strategies expected mid-term
2) Including Primearth's market share 3) Including AESC market share

Source: RolandBerger /fka 2017

Europe needs improved strategic capacities

Good political strategic capacities have three aspects/components:

1. **Long-term strategic evaluation of trends and options**
2. **Transparent & democratic discussion & decision on options and strategies at different levels**
3. **Coherent political implementation of strategies able to face incumbent and particular interests**

- Neo-liberalism has abandoned strategy making to large corporations
- Climate change concerns have triggered strong global efforts on aspect 1
- China has very effective strategic capacities – however neglecting aspect 2
- Japan had very effective strategic capacities – neglecting aspect 2 and key issues
- Best times of European strategic capabilities: Delors / “cellule de prospective”

Europe has excellent but scattered strategic thinking. More transparency and systematisation could be first step to strengthen aspects 2 and 3. A better understanding of multi-level governance will be essential.