Bundesministerium für Wirtschaft und Technologie

German-British Chamber of Industry & Commerce
Deutsch-Britische Industrie- und Handelskammer

Energy

The big picture – Needs for and benefit of solar PV for Germany and the UK

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United Kingdom & Germany: Expert Workshop Photovoltaics
Department of Energy & Climate Change, London

November 3, 2011

BPVA British Photovoltaic Association

eclareon

sustainable strategies
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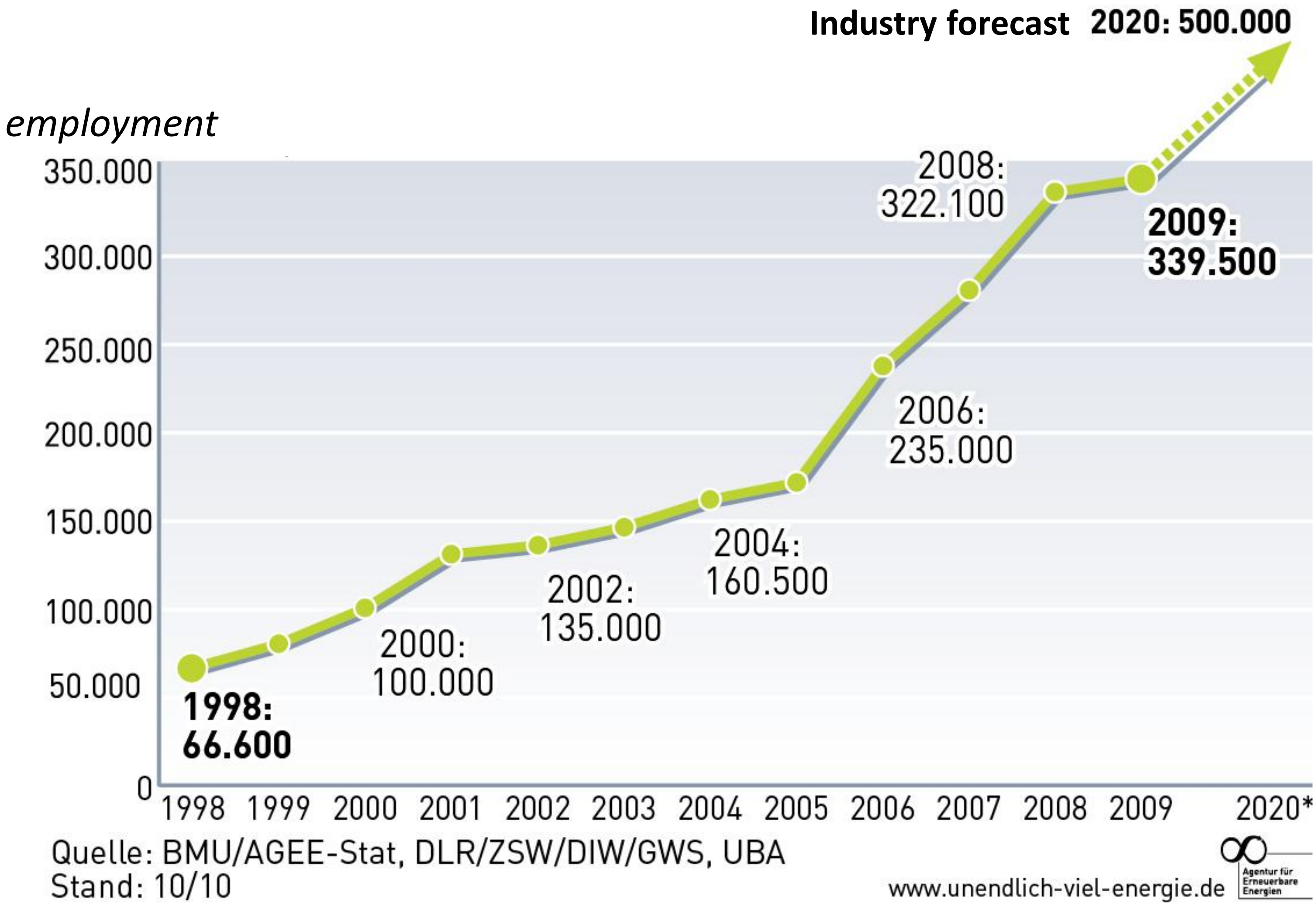
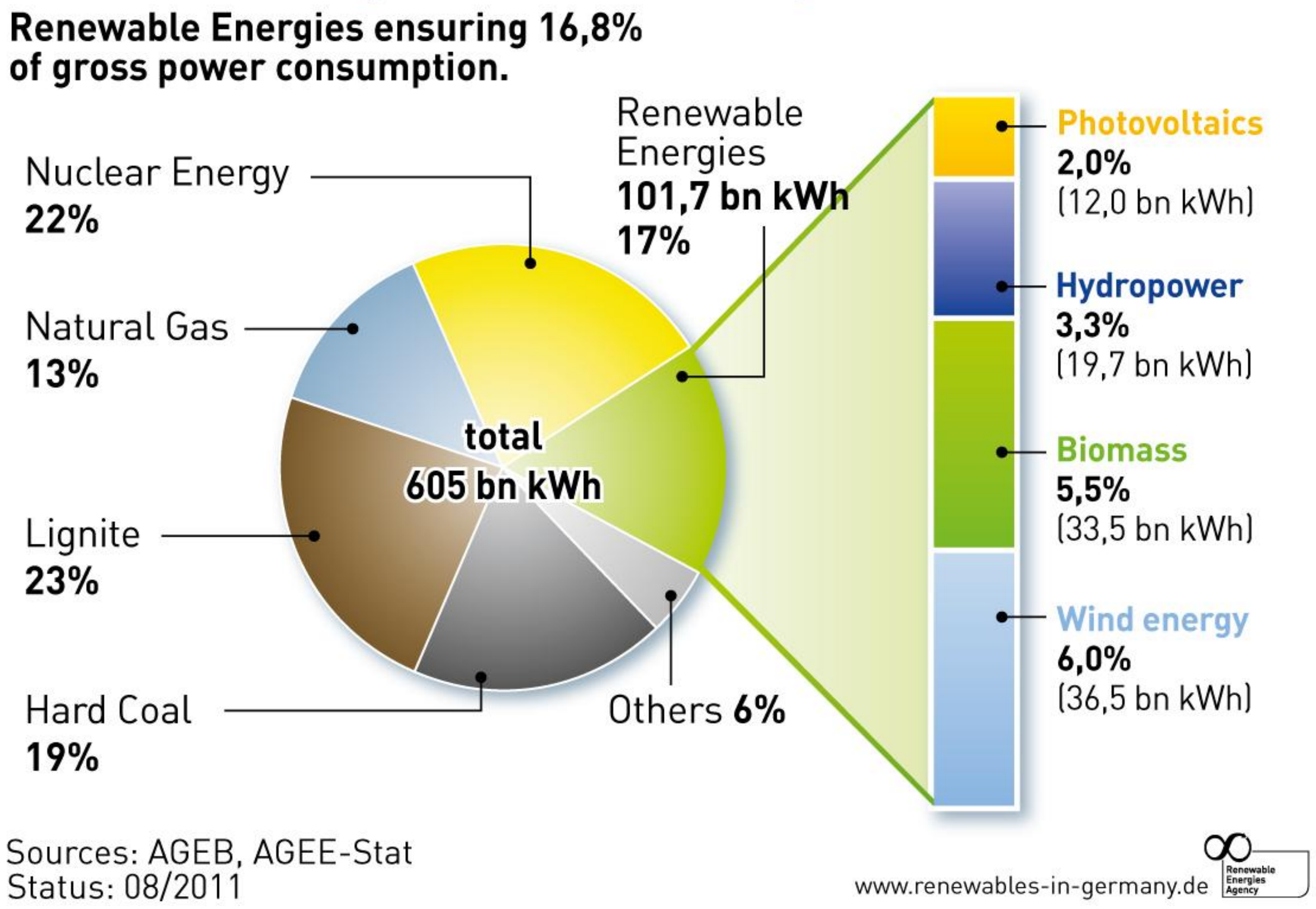
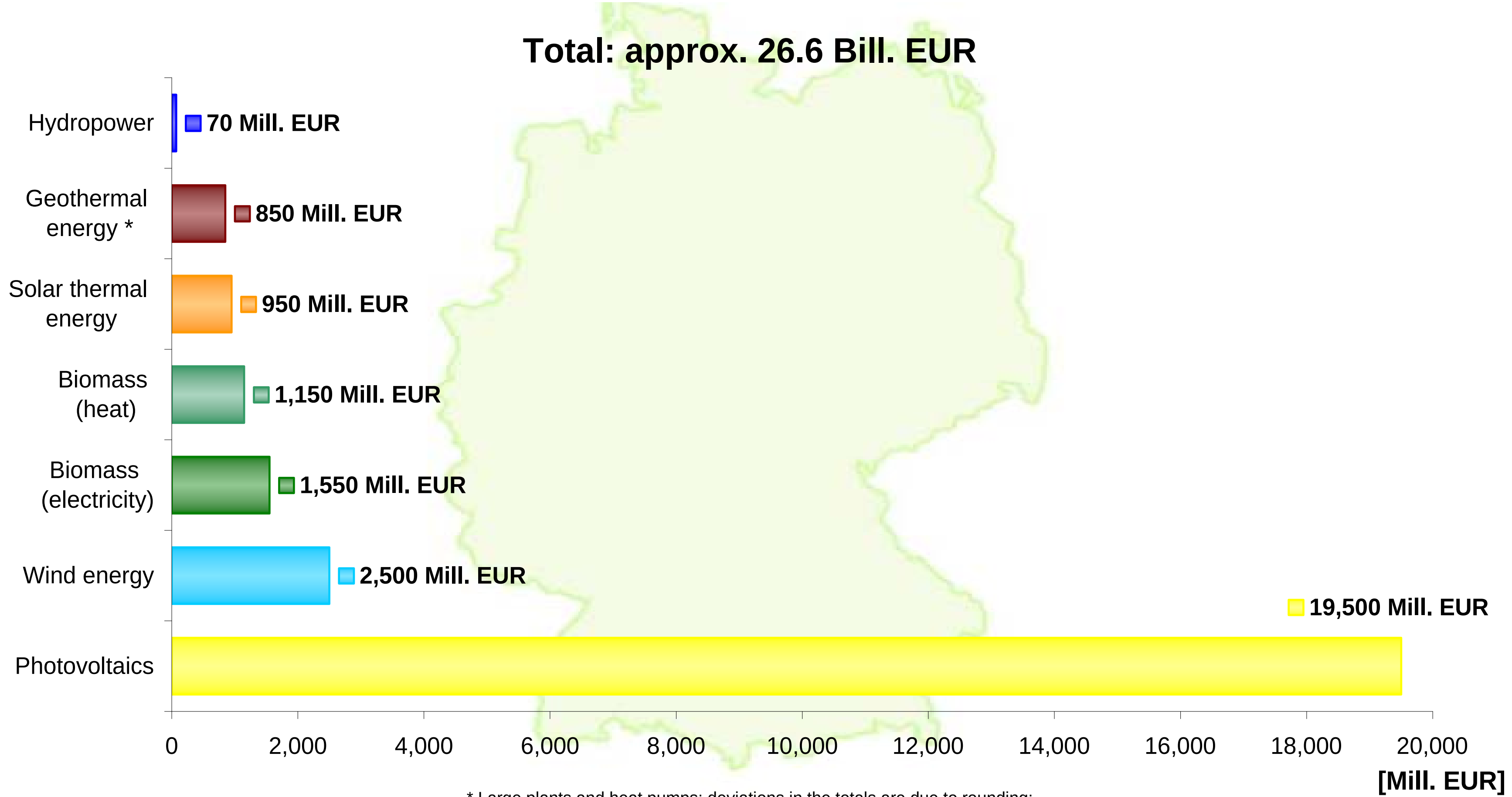
Employment in renewable energies in Germany



Electricity production mix in Germany 2010



Investments in renewable energy installations in Germany 2010



* Large plants and heat pumps; deviations in the totals are due to rounding;
Source: BMU-KI III 1 according to the Centre for Solar Energy and Hydrogen Research Baden-Wuerttemberg (ZSW); as at: July 2011; all figures provisional

PHOTOVOLTAICS –
A DISRUPTIVE TECHNOLOGY

Germany has triggered the take-off of the world PV market

Total PV capacity installed in Germany

Milestones

1991: First Feed-in Law (FIT with low tariffs)

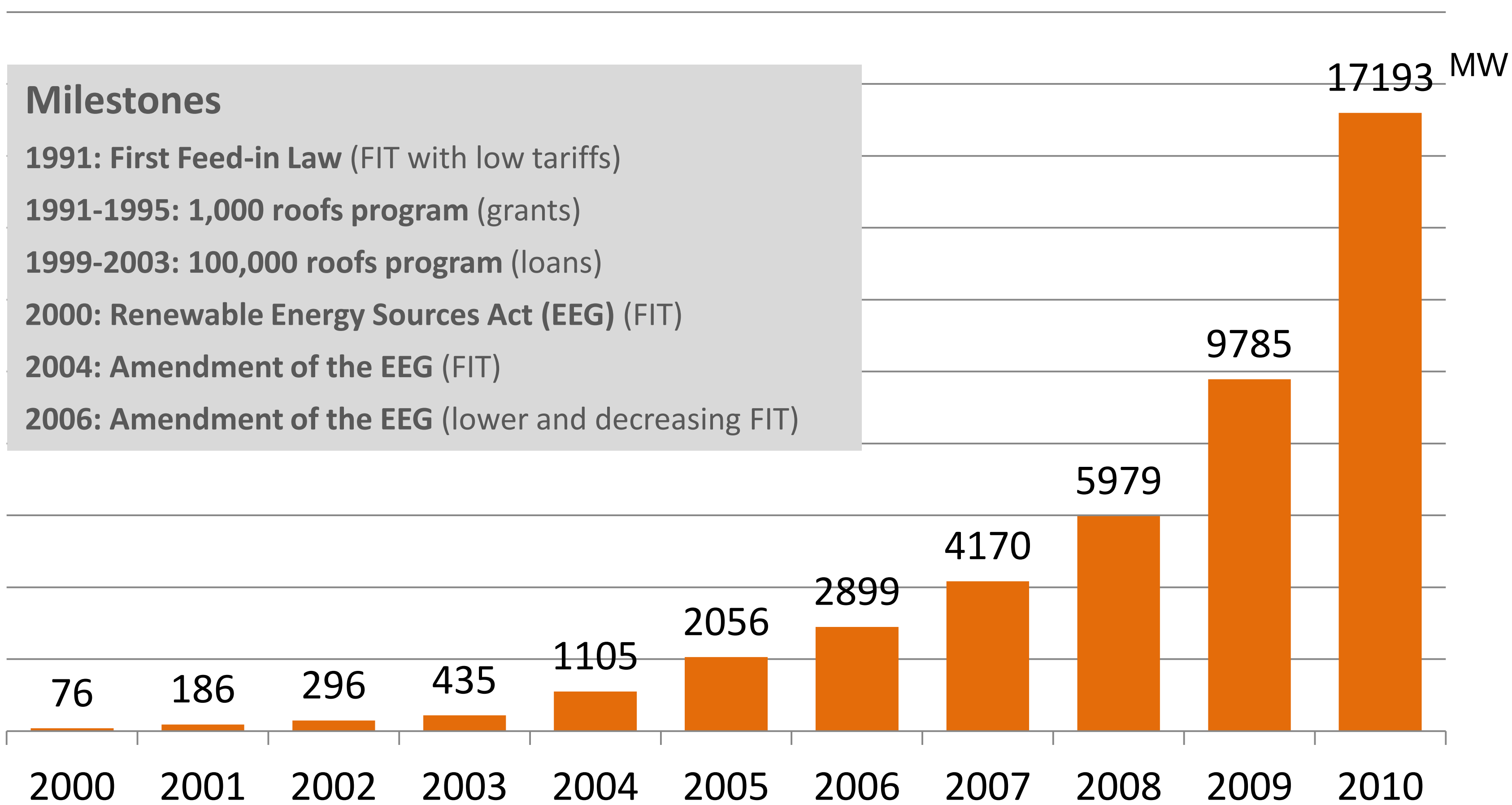
1991-1995: 1,000 roofs program (grants)

1999-2003: 100,000 roofs program (loans)

2000: Renewable Energy Sources Act (EEG) (FIT)

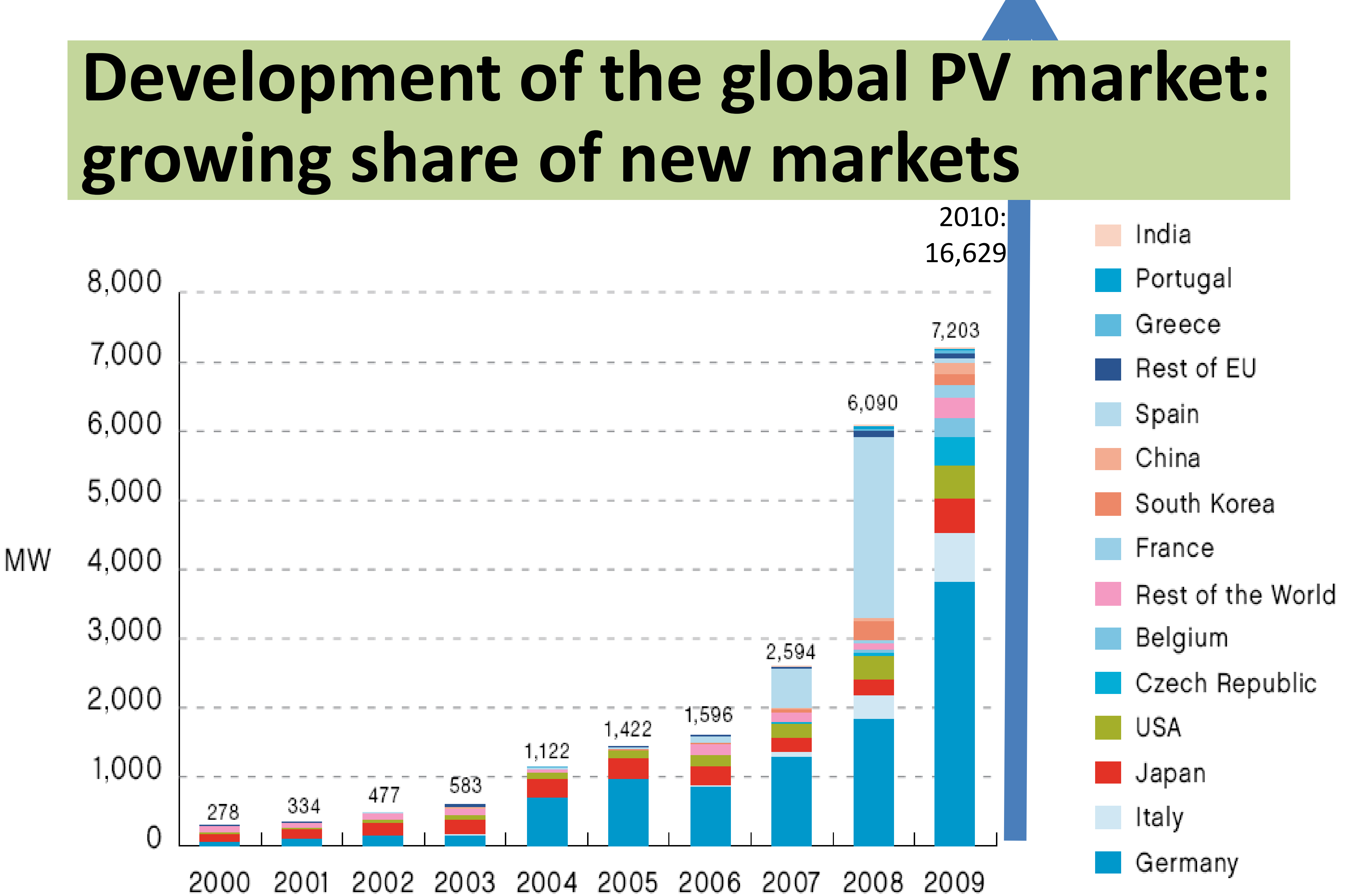
2004: Amendment of the EEG (FIT)

2006: Amendment of the EEG (lower and decreasing FIT)



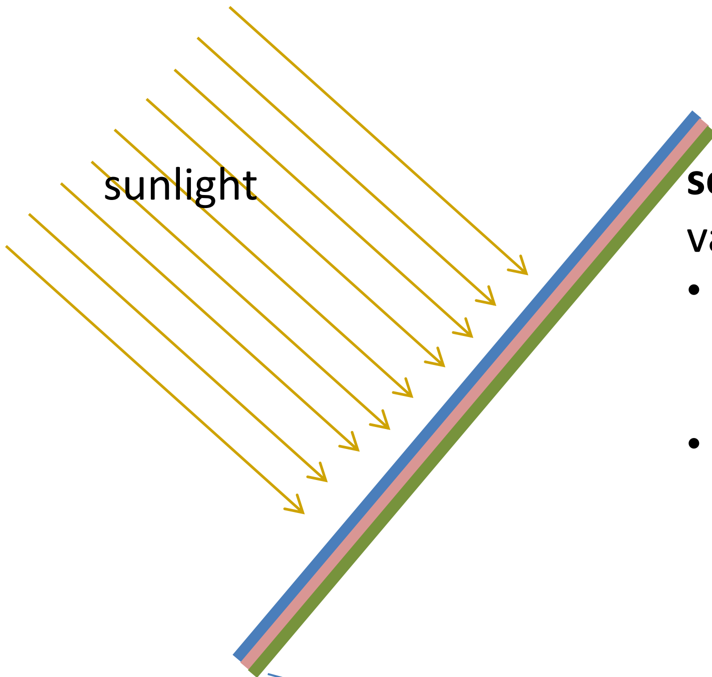
Source: BMU, BSW

Development of the global PV market: growing share of new markets



© EPIA

PV is a Semiconductor technology: Direct transformation of sunlight into electricity

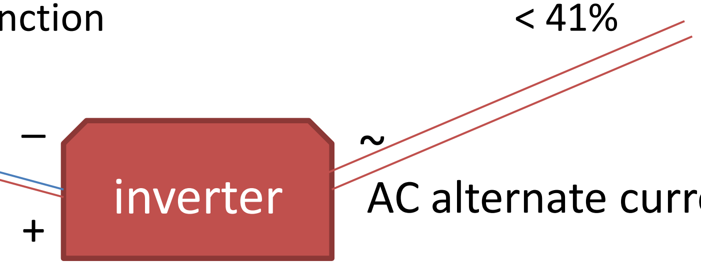


several layers of semiconductors

variety of different technologies:

- crystalline silicon c-Si (ingot-wafer)
  - monocristalline < 24% efficiency
  - polycristalline < 20%
- thin-film technologies
  - amorphous Silicon a-Si, also comb. < 12%
  - CdTe Cadmium-Telluride < 16%
  - CIGS, different combinations < 20%
  - GaAs, Gallium-Arsenide < 24%
  - poly-junction < 41%
  - …

DC direct current

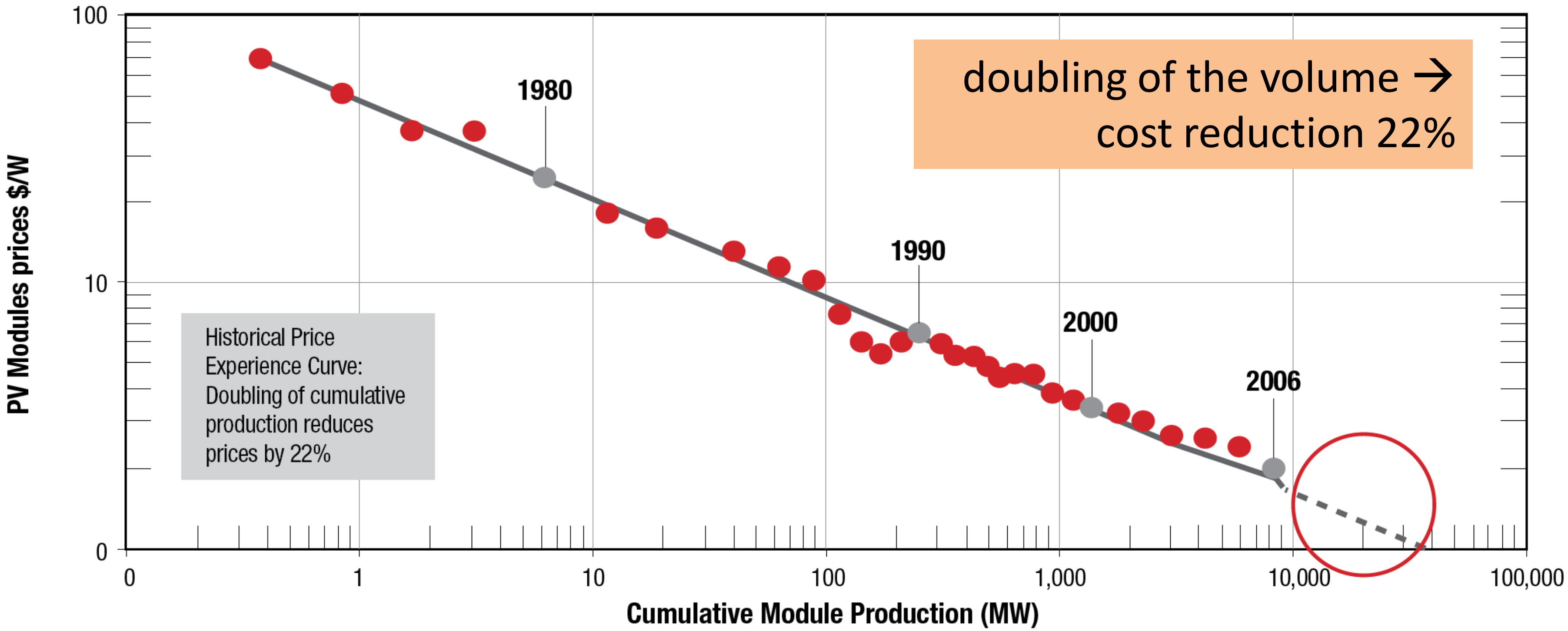


AC alternate current

- **no moving parts**
- **no maintenance**
- **no fuel**
- **high cost reduction potential**

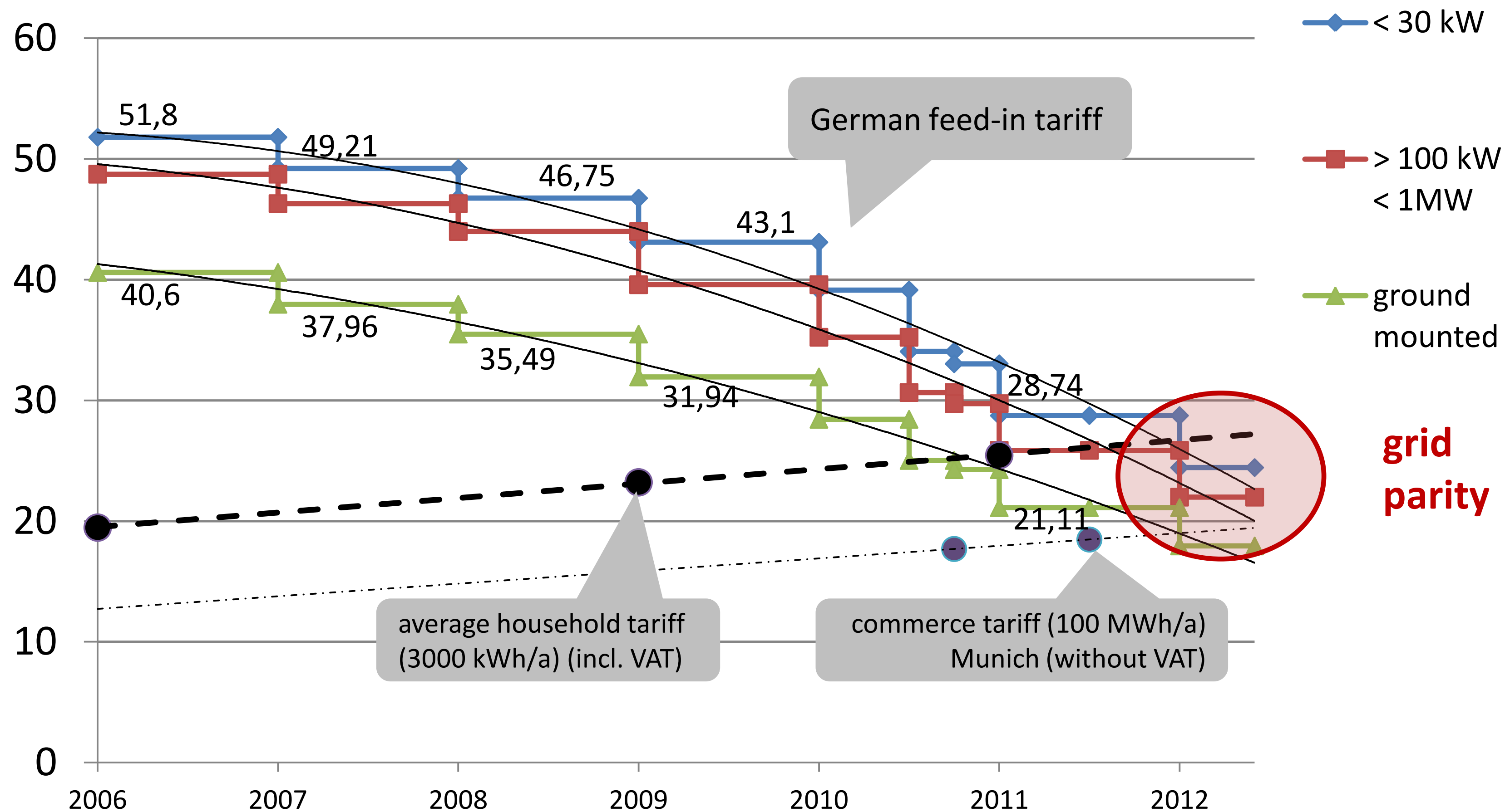
A scalable technology

Rapidly decreasing Costs: The historical learning curve of PV

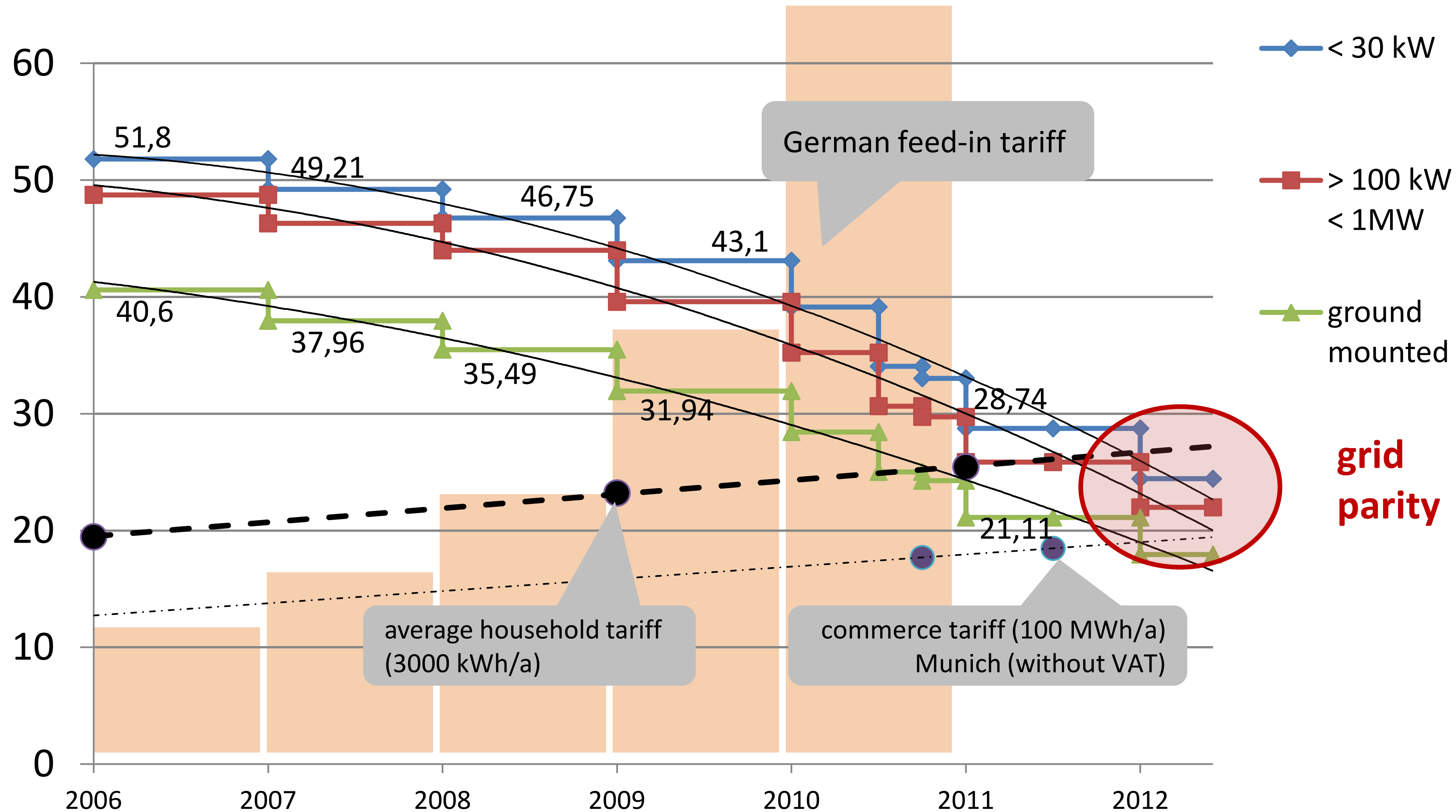


Sources: EU Joint Research Centre - EIA - National Renewable Energy Laboratory - A.T. Kearney analysis.

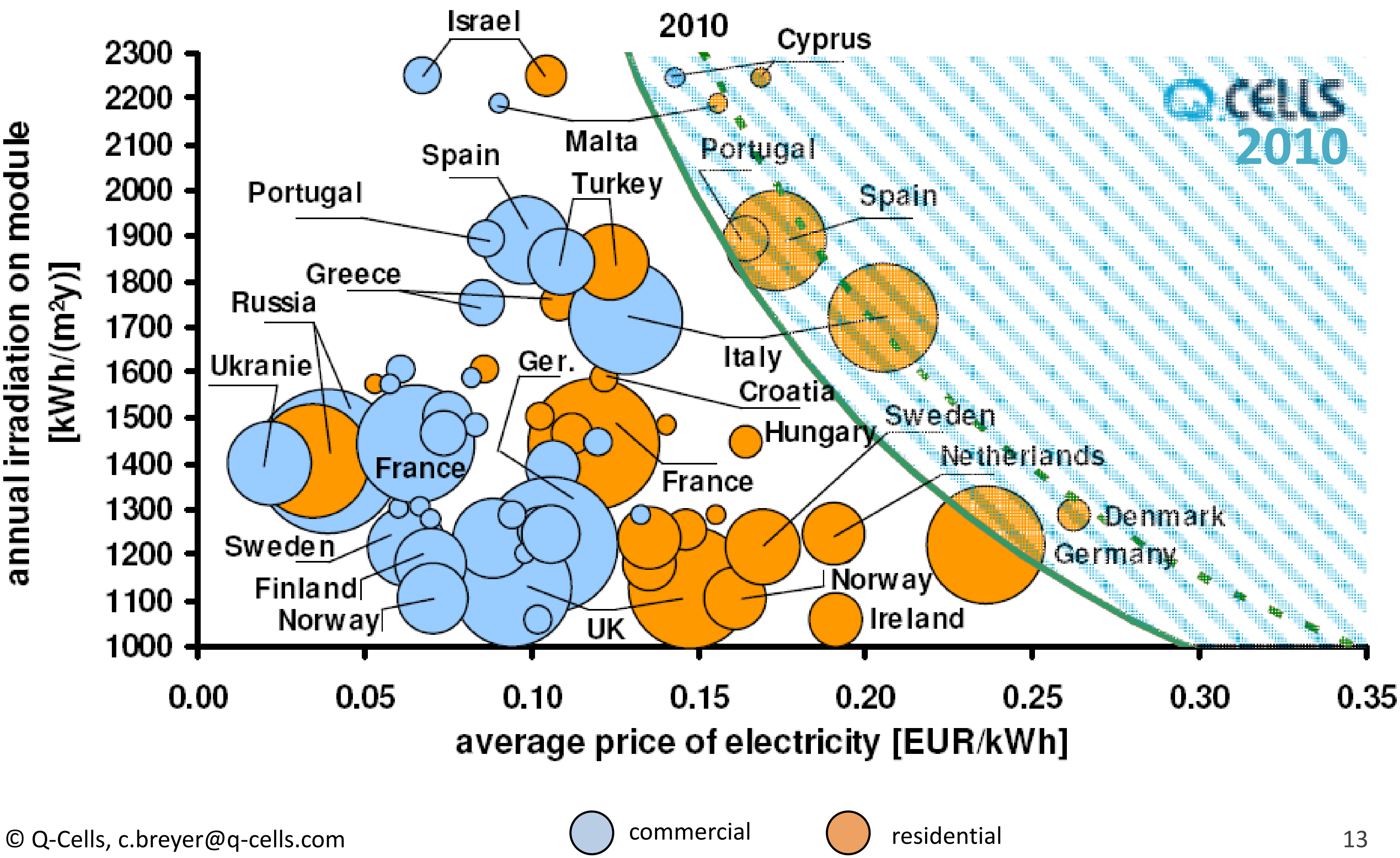
Rapidly decreasing German feed-in-tariffs: grid parity residential in 2012



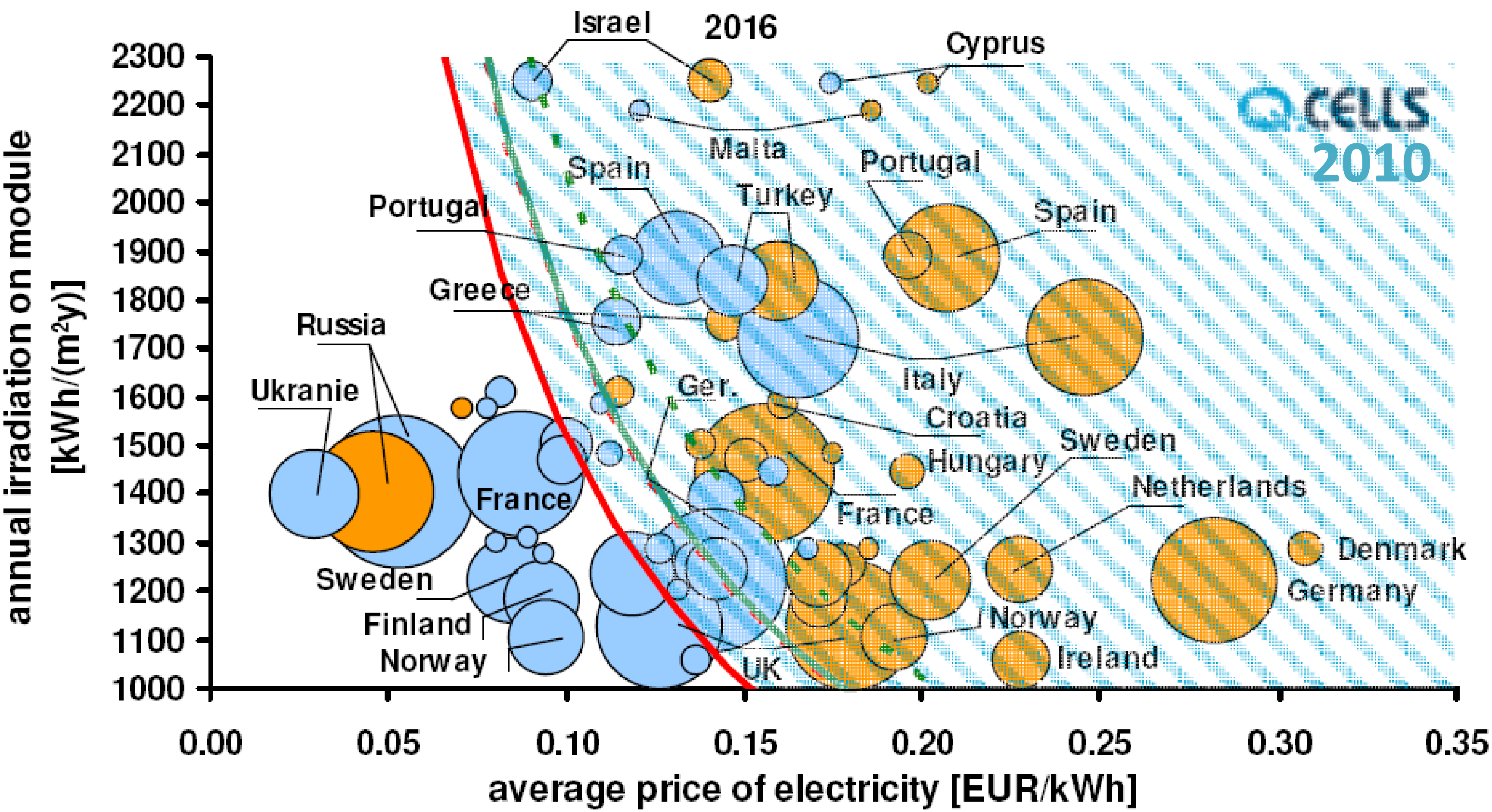
Rapidly decreasing German feed-in-tariffs: grid parity residential in 2012



Grid parity in Europe 2010

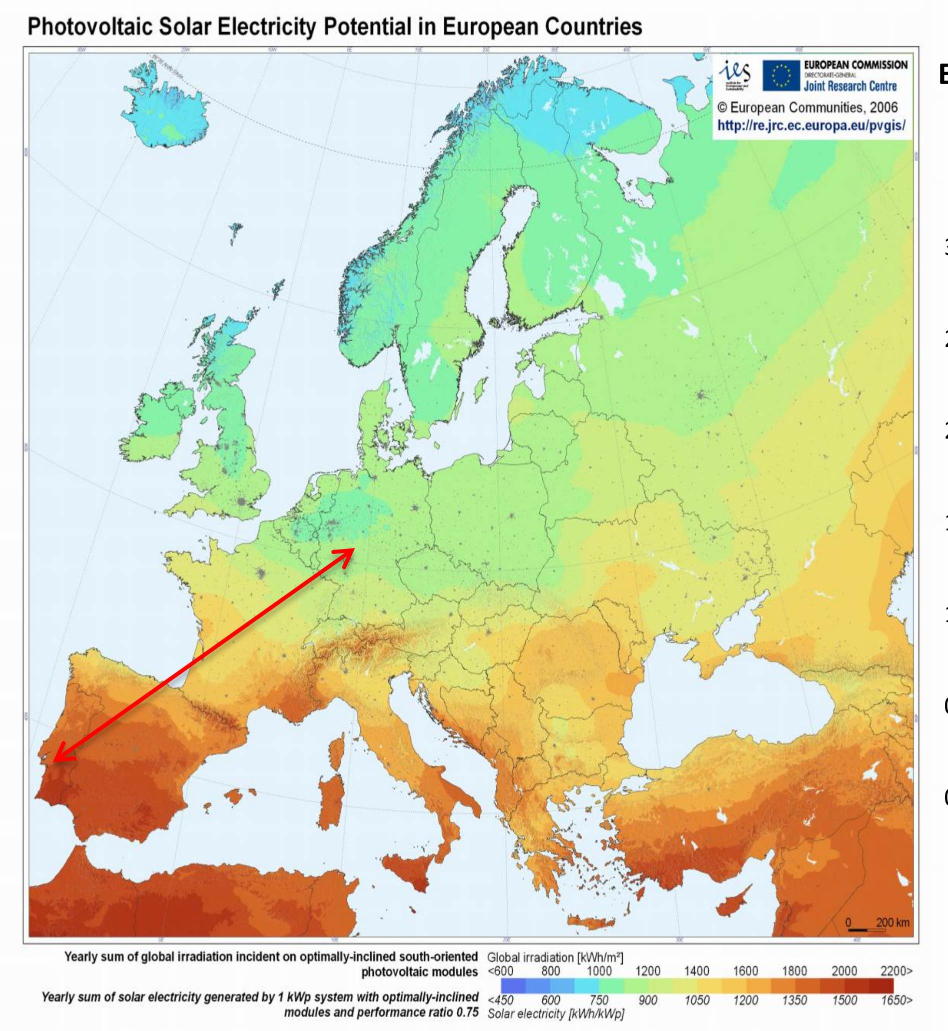


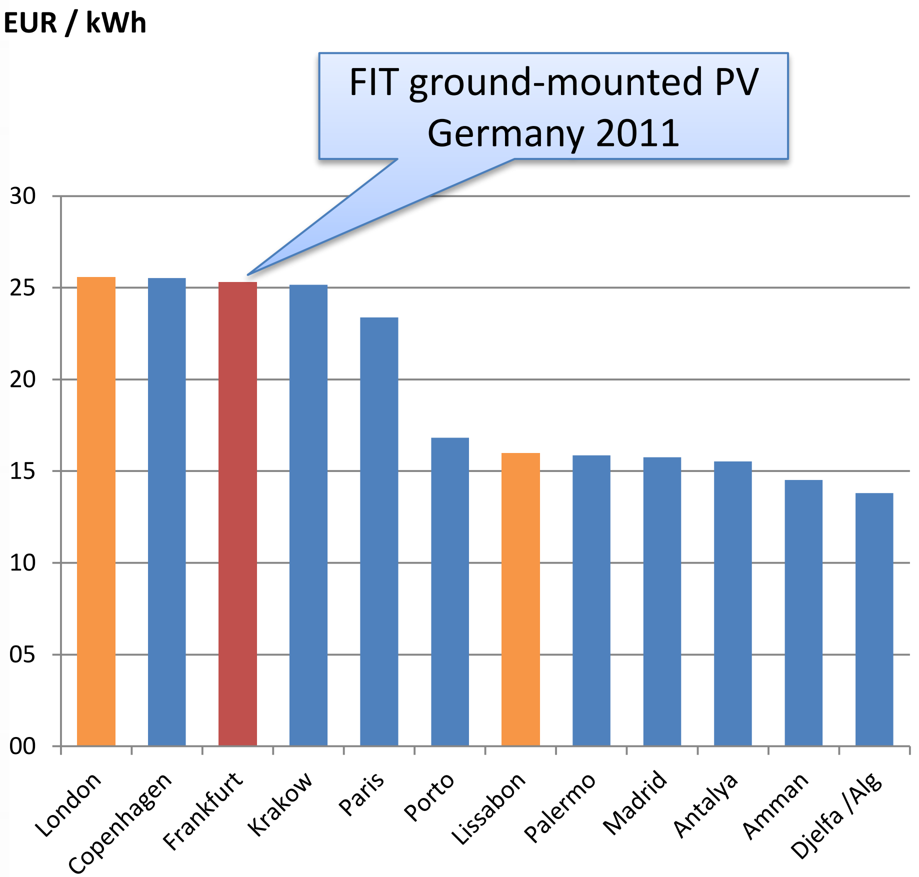
Grid parity in Europe 2016
(forecast in 2010)



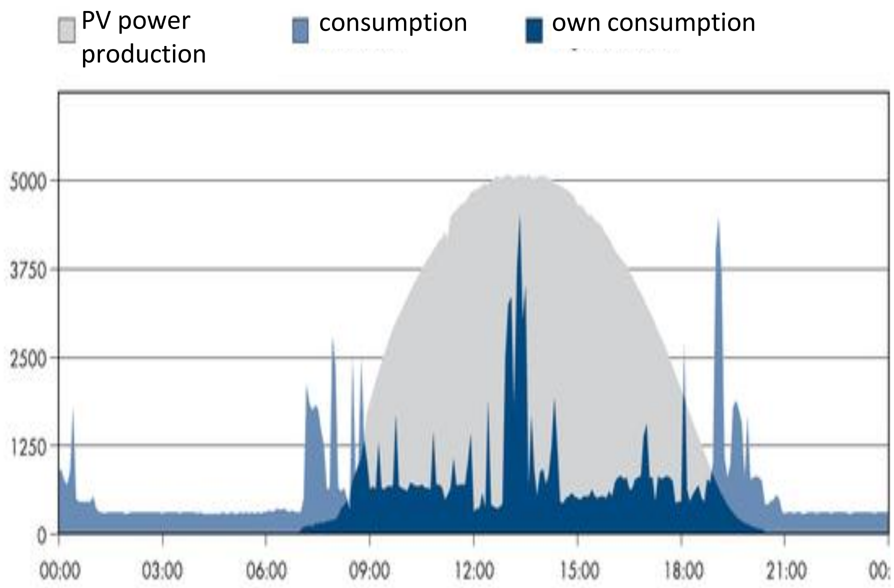
commercial
residential

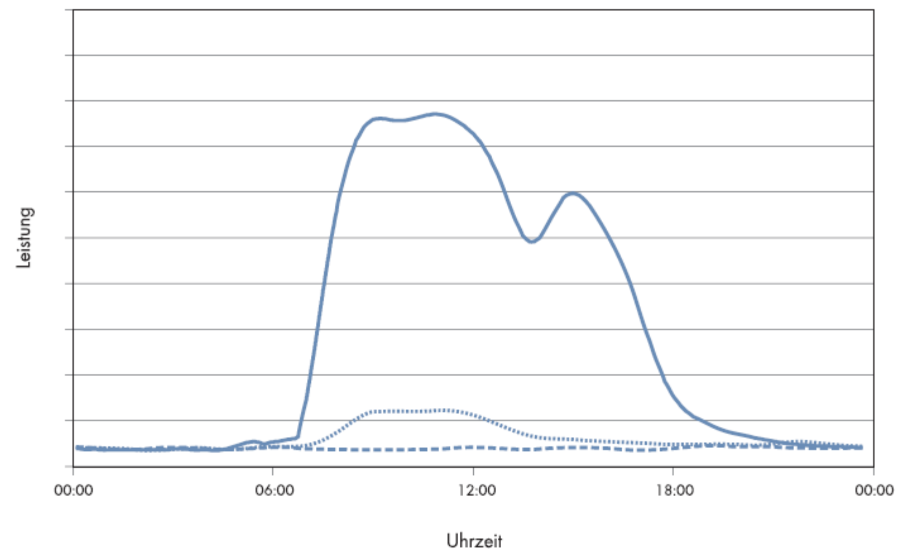
The influence of differences in solar radiation on the LCOE (levelised cost of electricity)





Power need when the sun does not shine: different potentials for own consumption





Private household
clouless summer day, 4 persons,
PV installation 5 kWp

→ Efforts needed for > 30% of own consumption

Commerce
working day 8-18h
BDEW Lastprofil G1

→ Good conditions for high share of own consumption

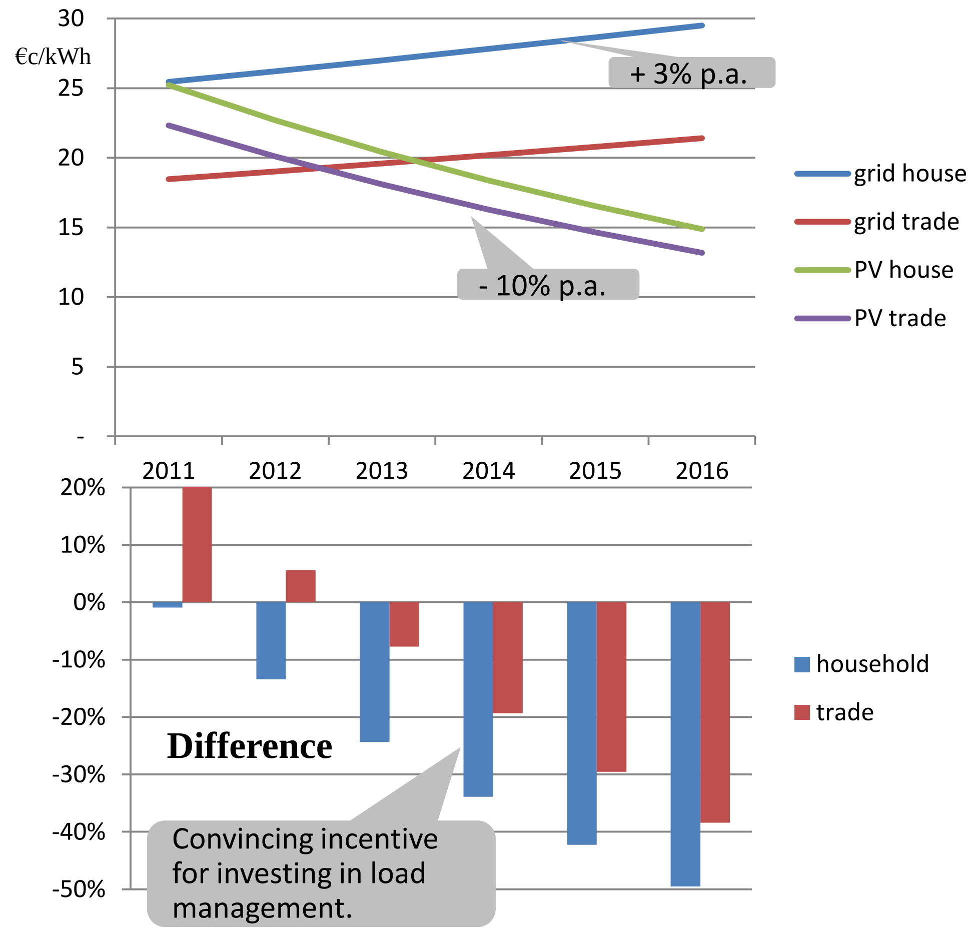
Attractiveness for own power production: Germany - Scenario for the next five years

- <u>In the last four years</u> the average PV <u>system price declined by 50%</u> (3Q07-3Q11, <100kWp, Germany) corresponding to <u>*-16% p.a*</u>.

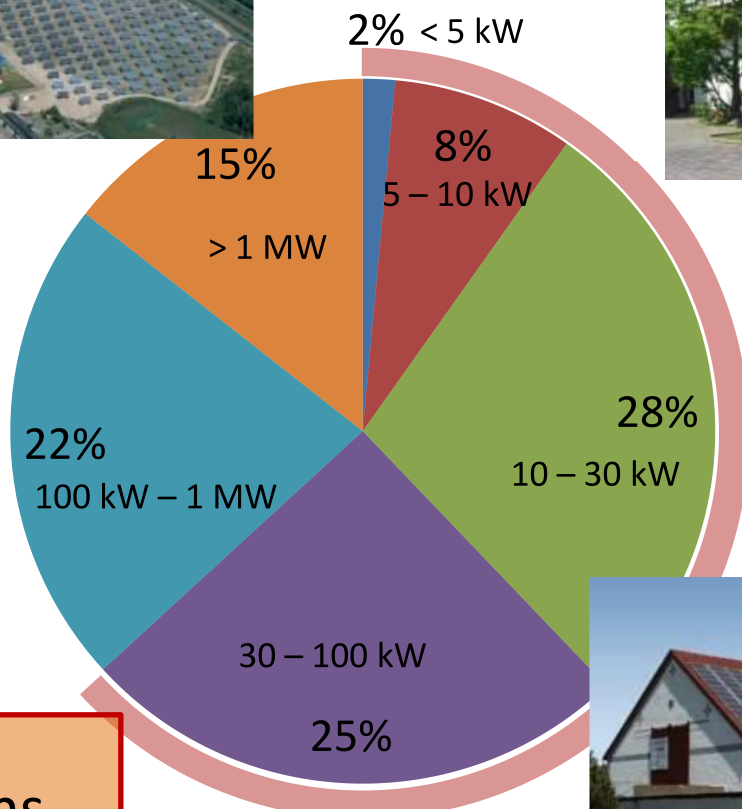
- Scenario assumptions
  - System price development: <u>*-10% p.a*</u>.
  - Power from the grid: + 3% p.a.
  - present FIT in Germany represent present PV power costs

➢ In five years PV power from the roof could cost 40% less than power from the grid

Evolution of the difference between grid tariffs and own PV power costs



From 2013: large shares of the German PV market interesting for own consumption



Installations
january – september **2010**

60% of
new installations
< 100 kW

data: BNetzA 2010

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The coming boom: captive power generation

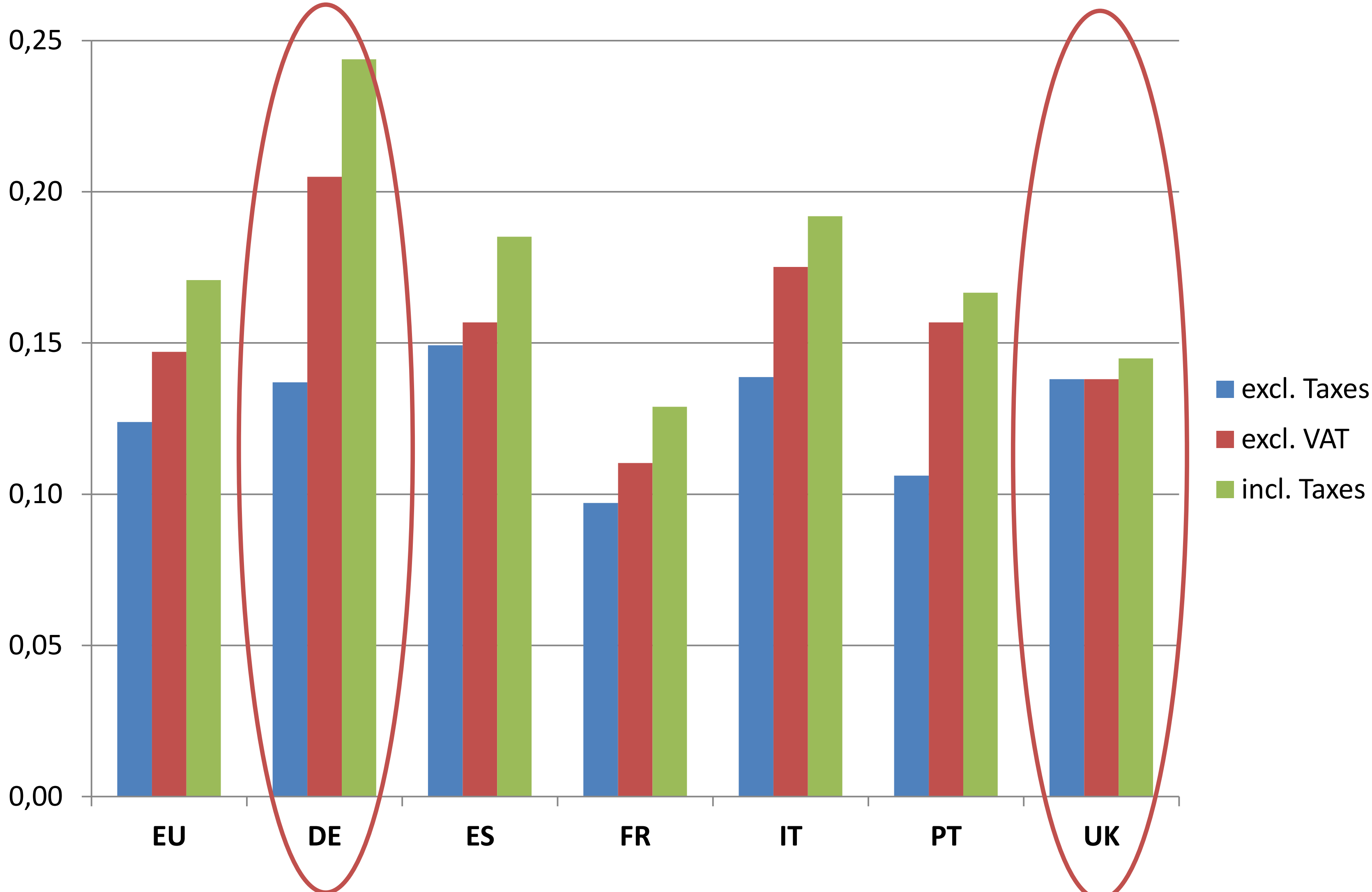
Attractive investments even without incentives:

- In two years: PV power for own consumption in commerce and services
- In three years: Supplementary investments for increasing the share of own consumption

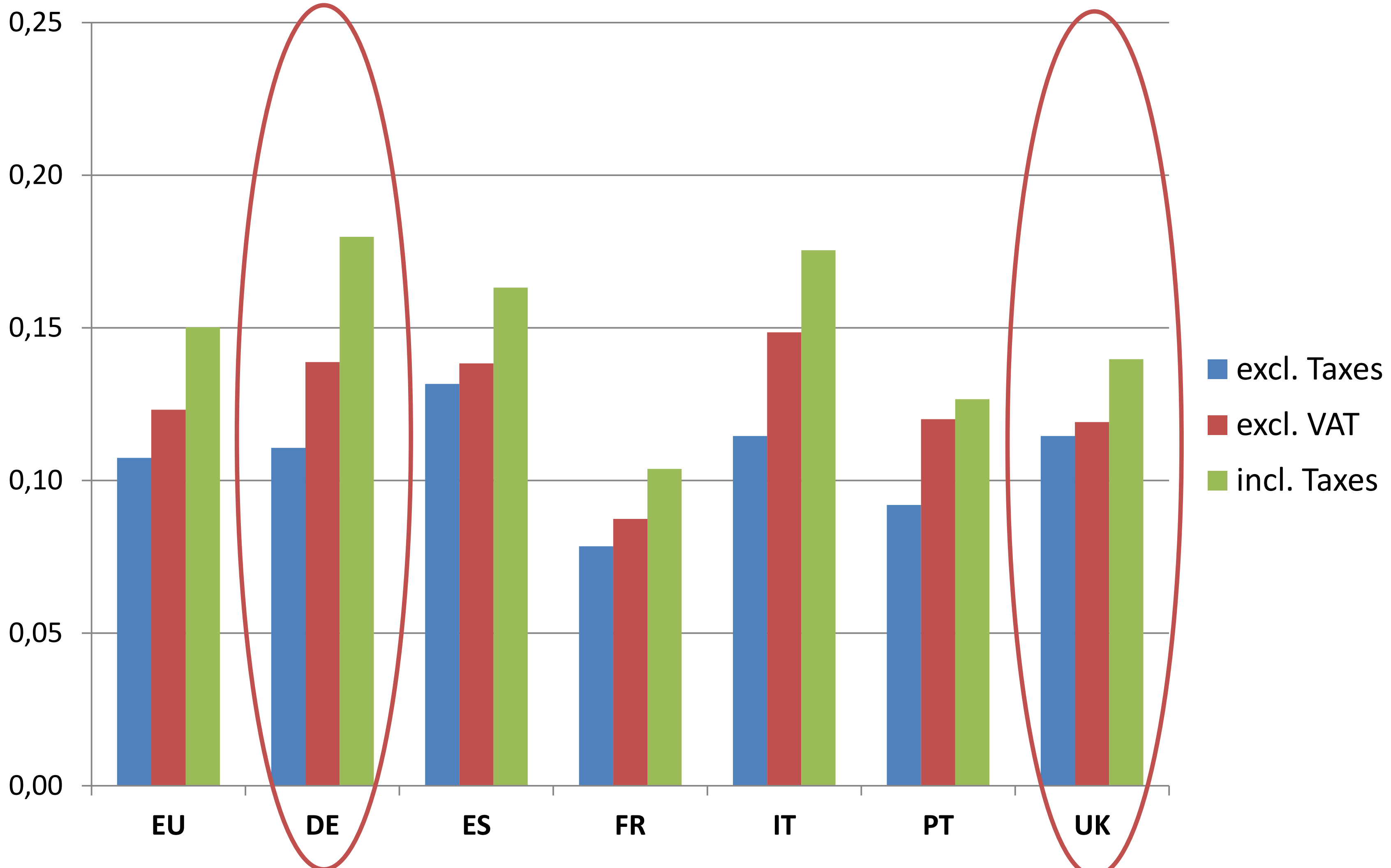
➢ PV growth independent from incentives

➢ Boom in power management technologies

Composition of electricity tariffs: household 2500 … 5000 kWh/a in 2010

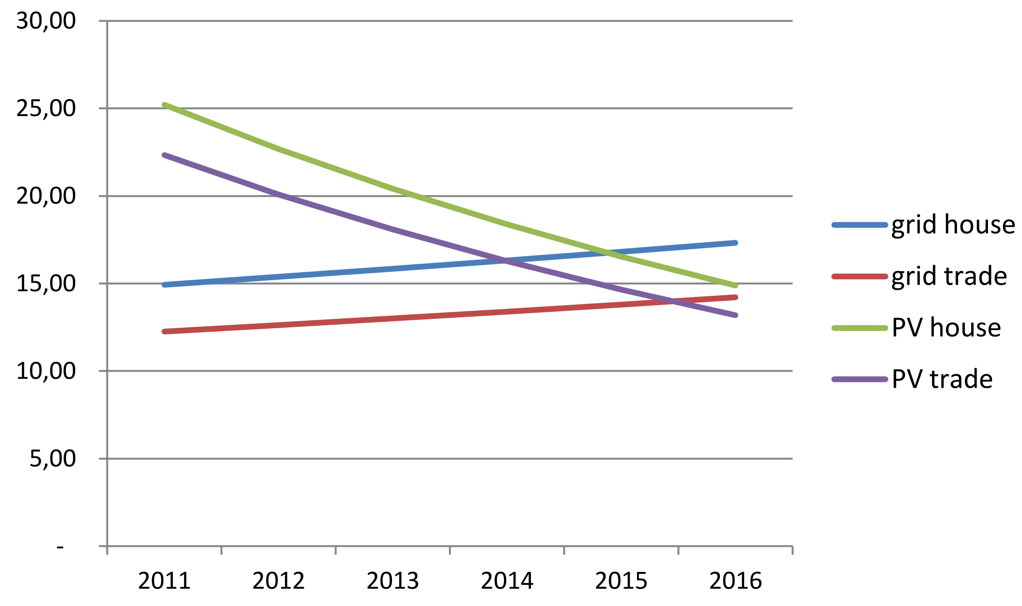


Composition of electricity tariffs: trade/ industry < 500 MWh/a in 2010



Grid Parity in the UK

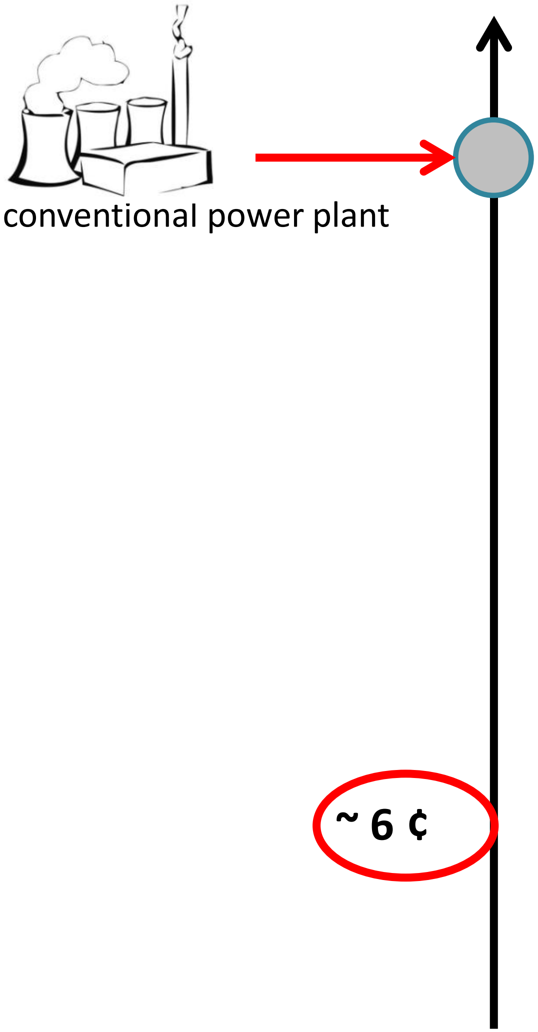
- Scenario: Grid parity in the UK will be reached before 2016 for households and for trade



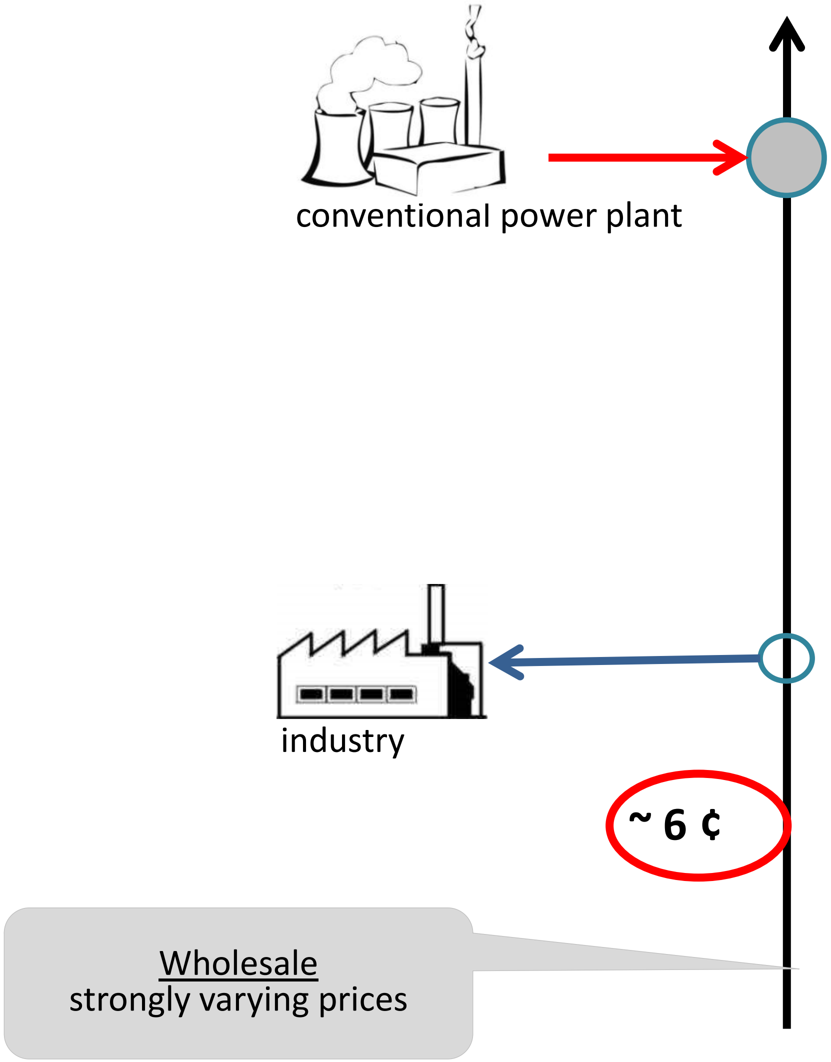
- Probably more quickly since low British grid tariffs will rise more than 3% p.a.

TOWARDS A NEW CONTROL LOGIC OF THE ELECTRICITY SYSTEM

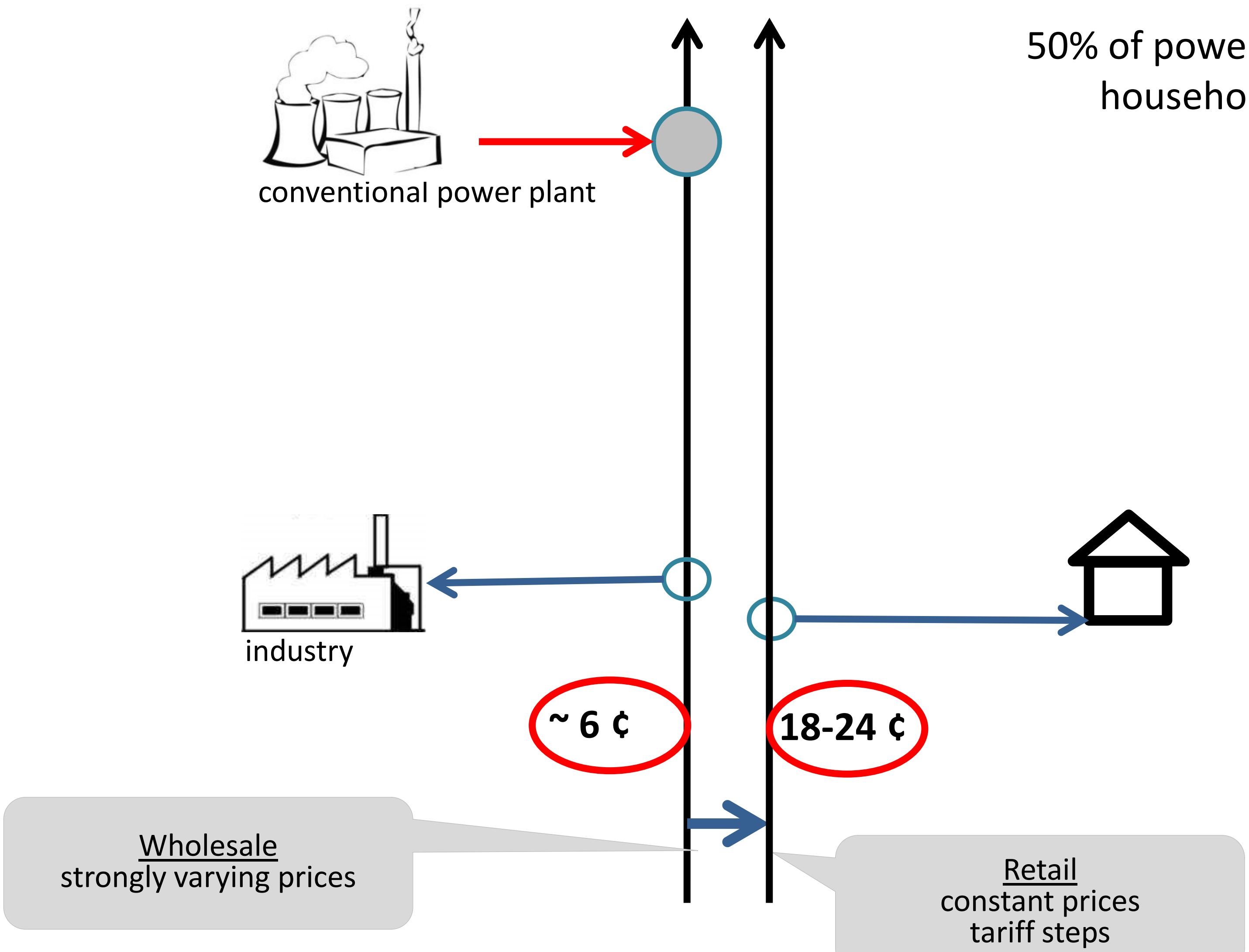
Photovoltaics is a modular technology: competing on the retail side



Photovoltaics is a modular technology: competing on the retail side

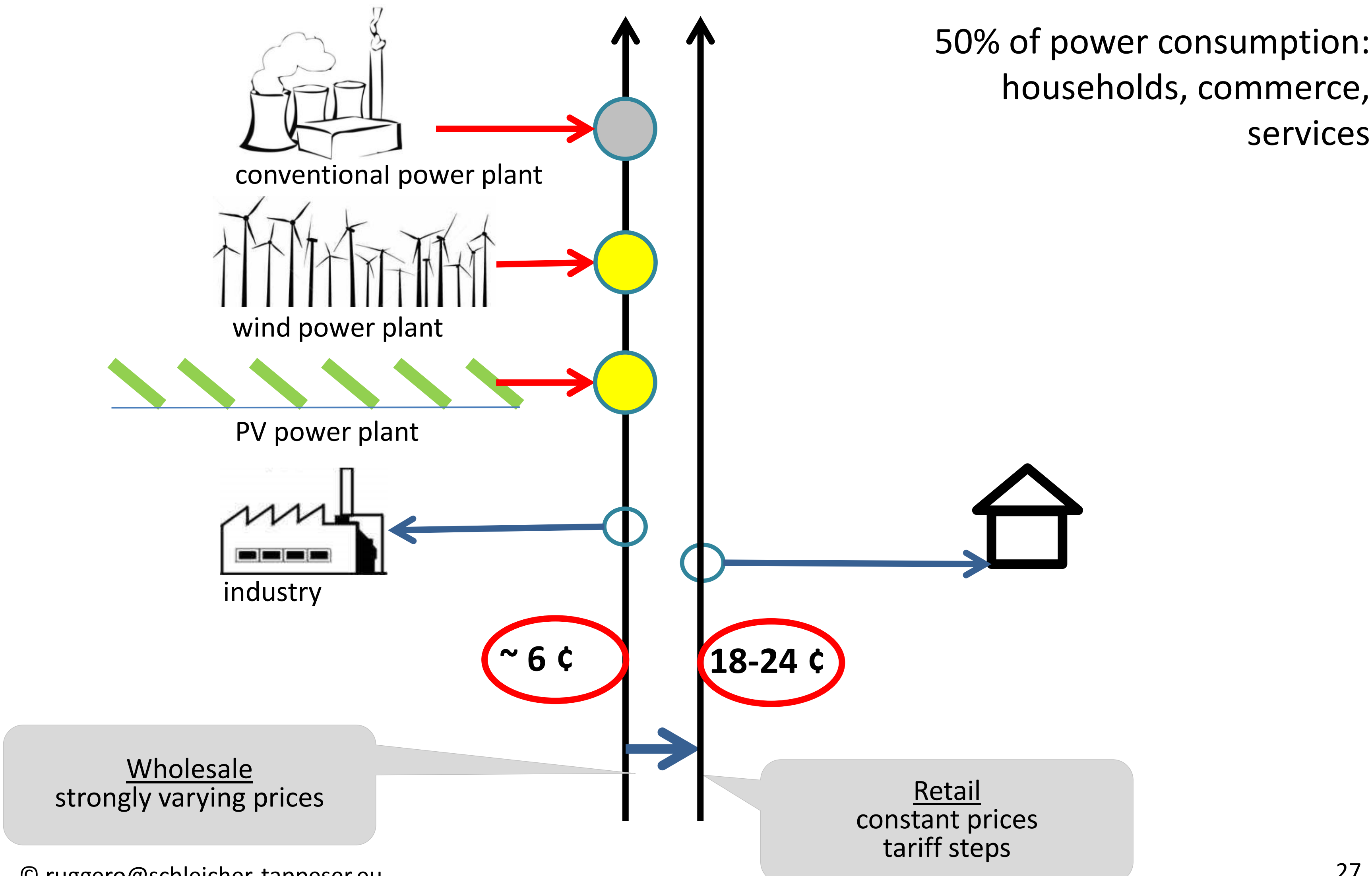


Photovoltaics is a modular technology: competing on the retail side

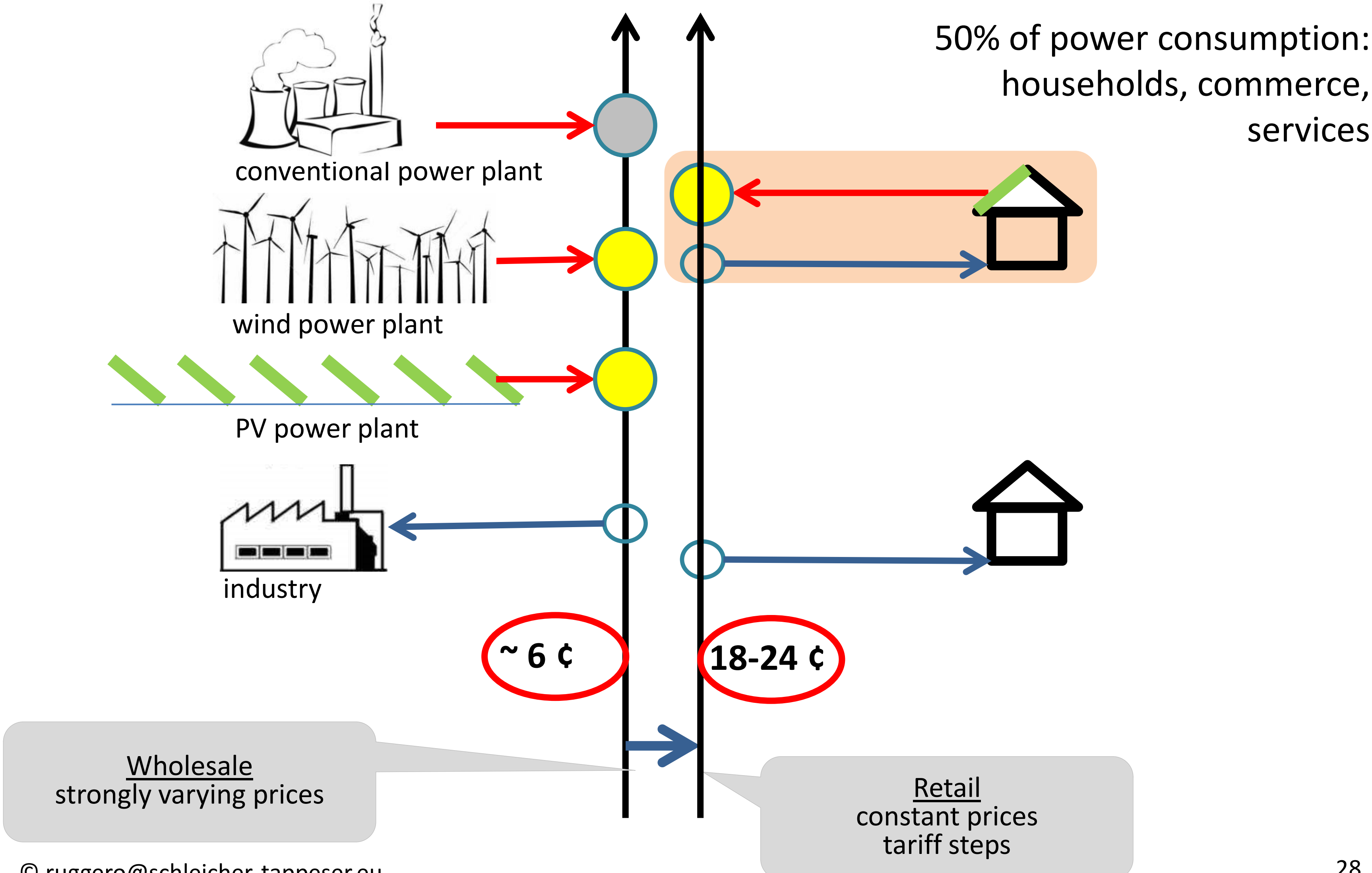


50% of power consumption: households, commerce, services

Photovoltaics is a modular technology: competing on the retail side



Photovoltaics is a modular technology: competing on the retail side



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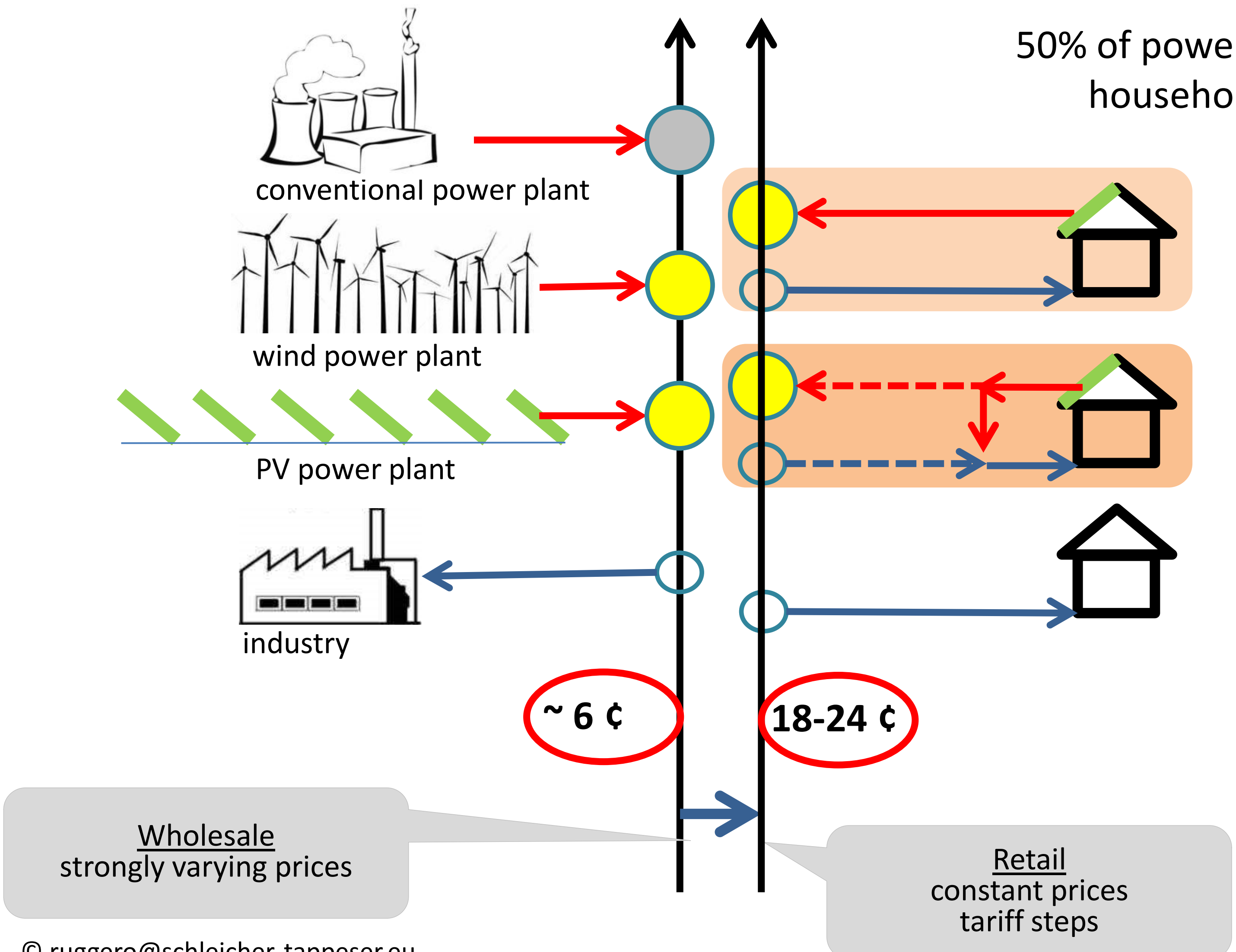

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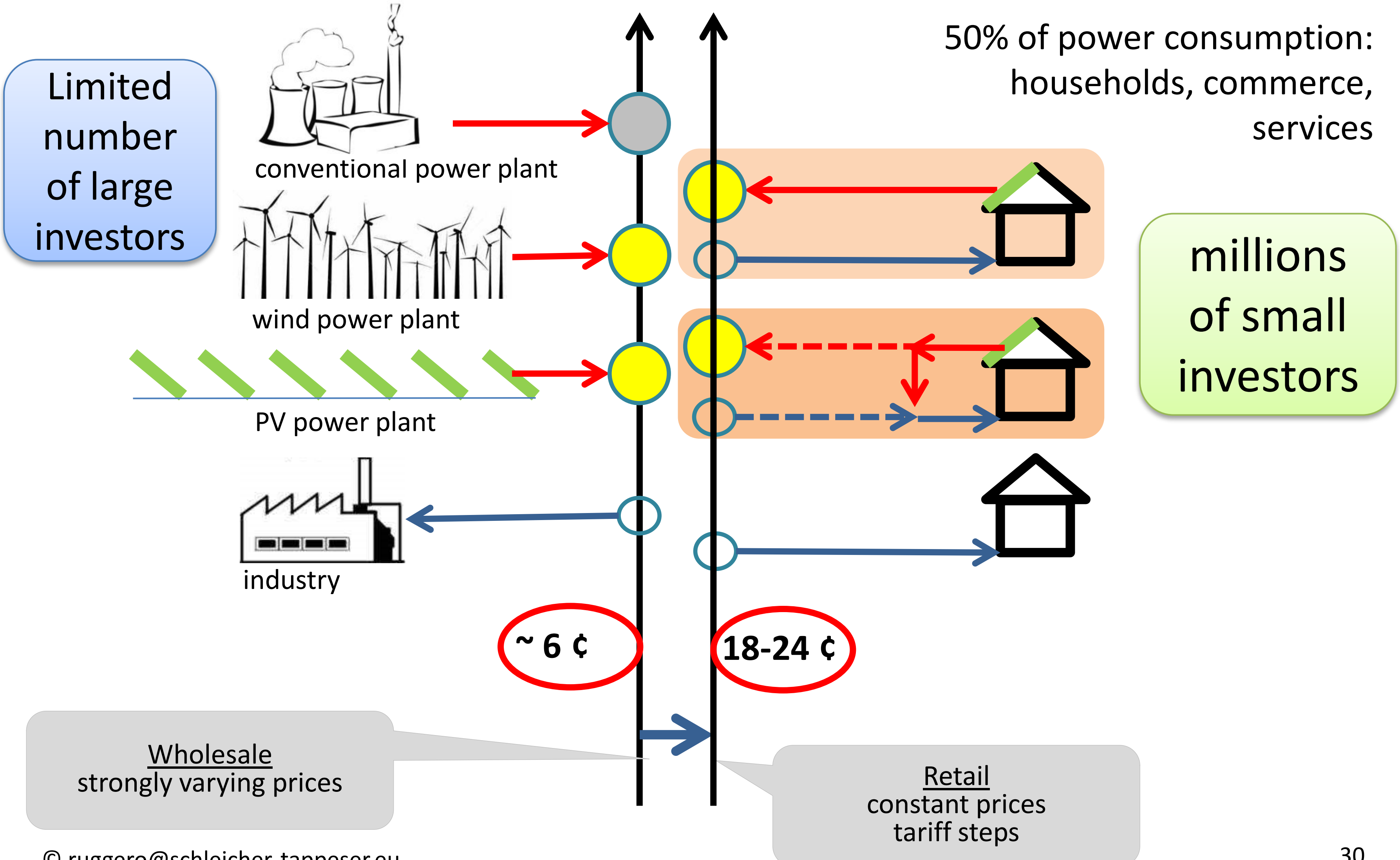

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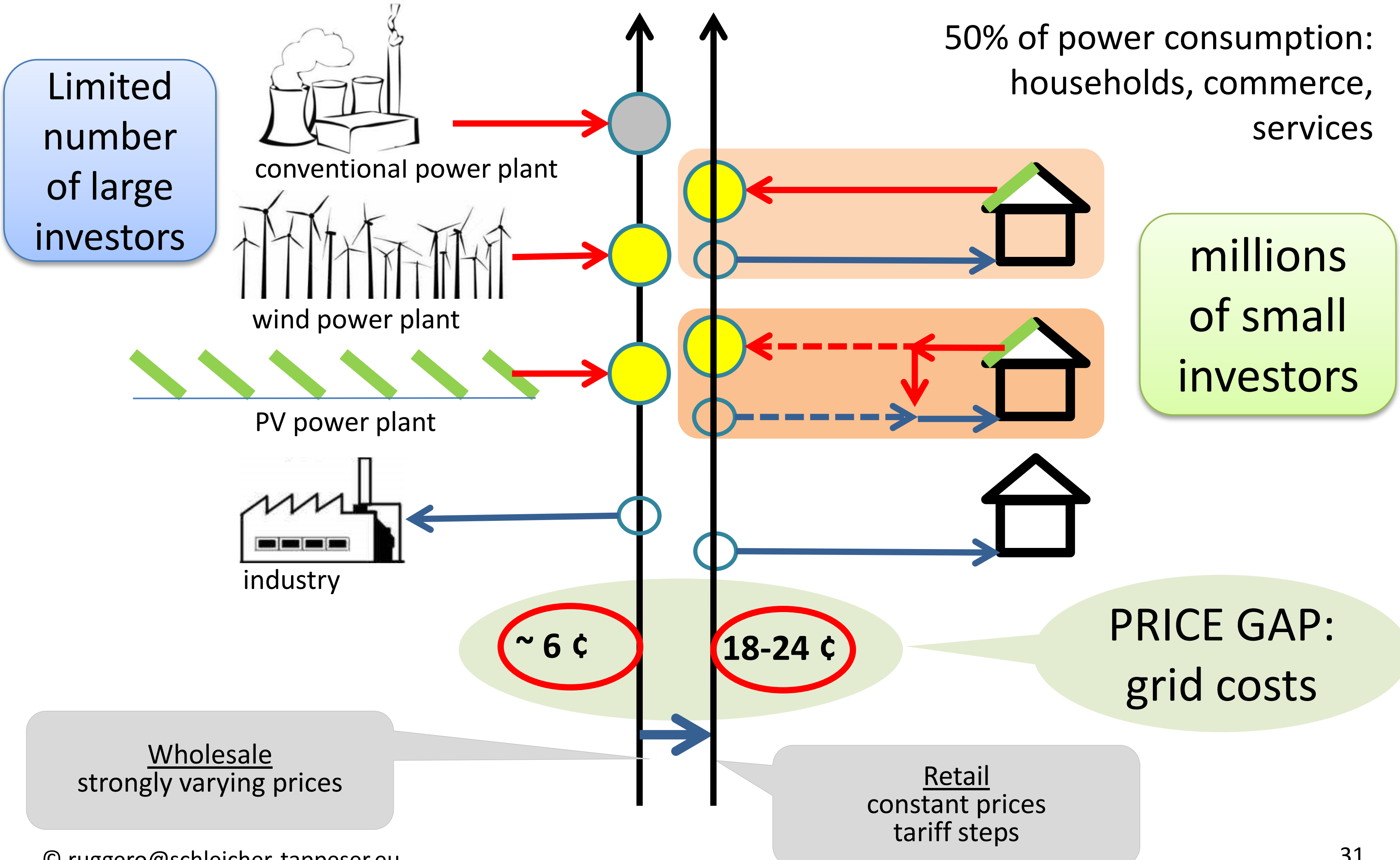
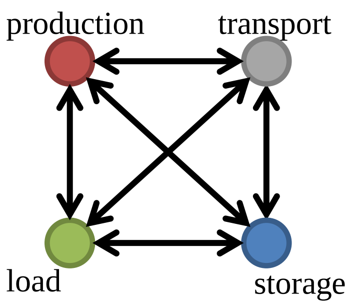


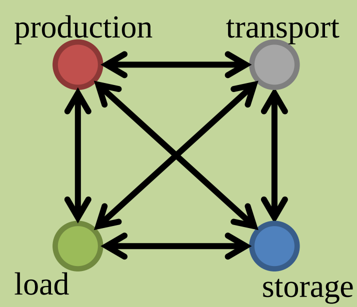
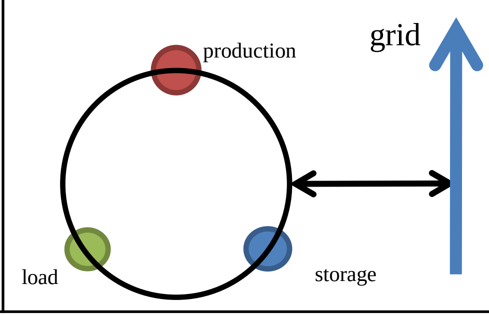
Captive power production can facilitate the system change …

- The <u>critical challenge for the whole system</u>: <u>fluctuating power supply</u> with sun and wind



- Captive power production brings flexibility
- Captive power production can
  - unburden the grids
  - contribute to load management
  - contribute to security of supply
  - strengthen competition
- For this to happen, frame conditions must set appropriate incentives

… but this implies a change of the control logic of the electricity system

Traditional Large power plants fossil and nuclear Transformation	• Production follows demand: base / middle / peak load • Load management only with large consumers • Central control	
Supply 100% REN Integrated optimisation of the whole system	• Fluctuating production with wind and sun dominates • Load management, storage • Complexity requires optimisation on several levels	
Contribution ***Captive power production*** *Optimisation on the consumption level*	• Optimisation subsystem • Partial buffering of fluctuations at the local level • Facilitation of optimisation at higher levels	

Captive power production challenges present market & control structures

- Grid increasingly reduced to buffer function → rising costs per kWh → need to use consumer flexibility for own optimisation
- Present tariffs favour new peak grid loads (in and out)
- FiT level looses control over PV growth
- FiT remains essential for installations with low own consumption

➢ Need for time-dependent and power-limiting tariffs guiding the input/output optimisation of private systems

❖ Every distribution grid has its own optimisation requirements: grid pattern, generation and consumption structures differ

→ → Under present rules, optimised private systems may rapidly produce new heavy burdens to the public grid infrastructure

Location matters – The centralistic approach is getting unsustainable

- Traditionally national monopolistic utilities planned central generation and corresponding grids for a given demand → coherent systems
- Liberalisation has brought diverging developments:
  - competition for use of conventional generation plants at national level
  - regulated monopolistic planning for construction and use of grids
  - slow unbundling of grid planning and power plant siting
- Feed-in-tariffs:
  - renewable power use: regulated priority for fluctuating sources
  - free choice of location for investors

➢ The real grid is not a copper plate – geography matters!
  - Plant siting not coherent with existing grid
  - Fluctuating renewables permanently change flow patterns
  - ❖ PV prosumers change demand patterns – but could mitigate fluctuations

➢ Need to consider existing grid structure → location-dependent prices

➢ Need for stronger coupling with European partners

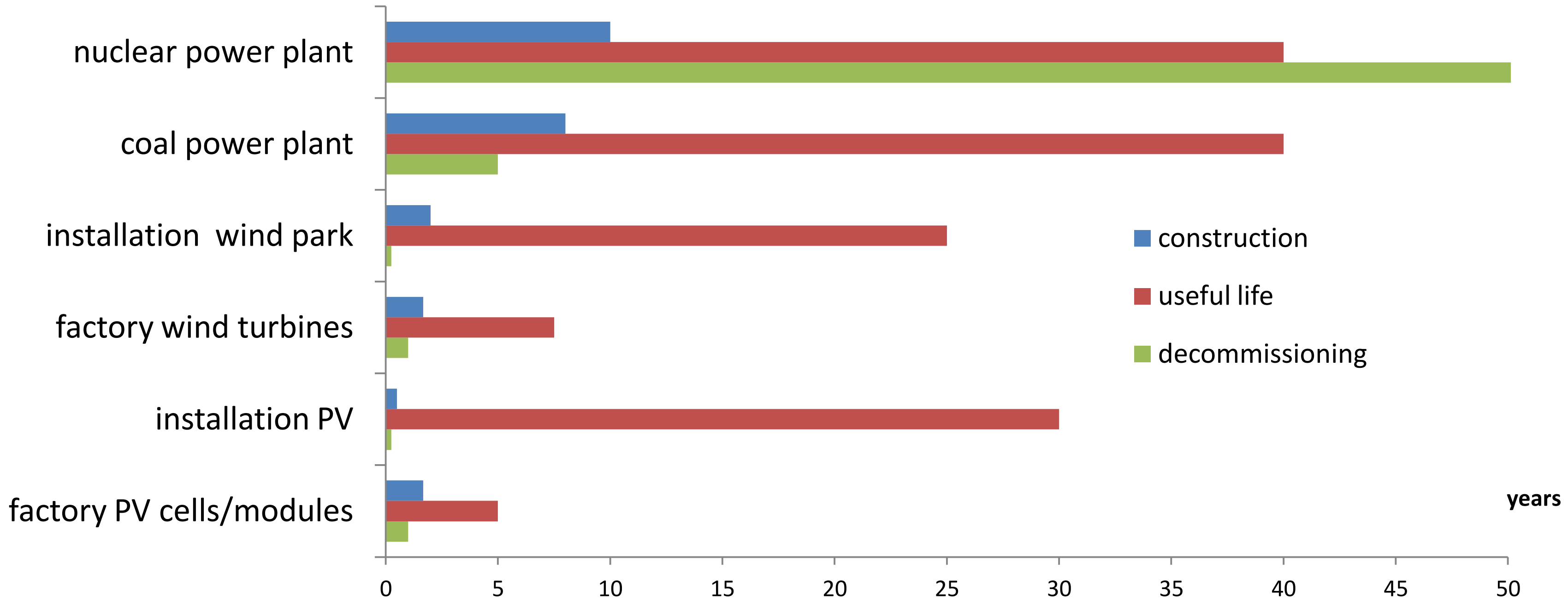
Unfamiliar to energy business: 4 to 10 times shorter innovation cycles

→ More rapid build-up of capacities

→ More rapid decrease of costs

→ More rapid transformation of the electricity sector

Dramatic acceleration compared to traditional energy technologies



Approaches for matching production and consumption of electricity

	conventional approach central power plants	future approach ? fluctuating renewables
Production management	central management	only in extreme cases, leads to losses
Spatial compensation over grids	central approach: predictable average loads	long distances: weather variations less important
Demand side management	widely abandoned, nearly no incentives	at all levels huge innovation potential
Storage	Central pump storage for buffering baseload nuclear	at all levels high innovation potential

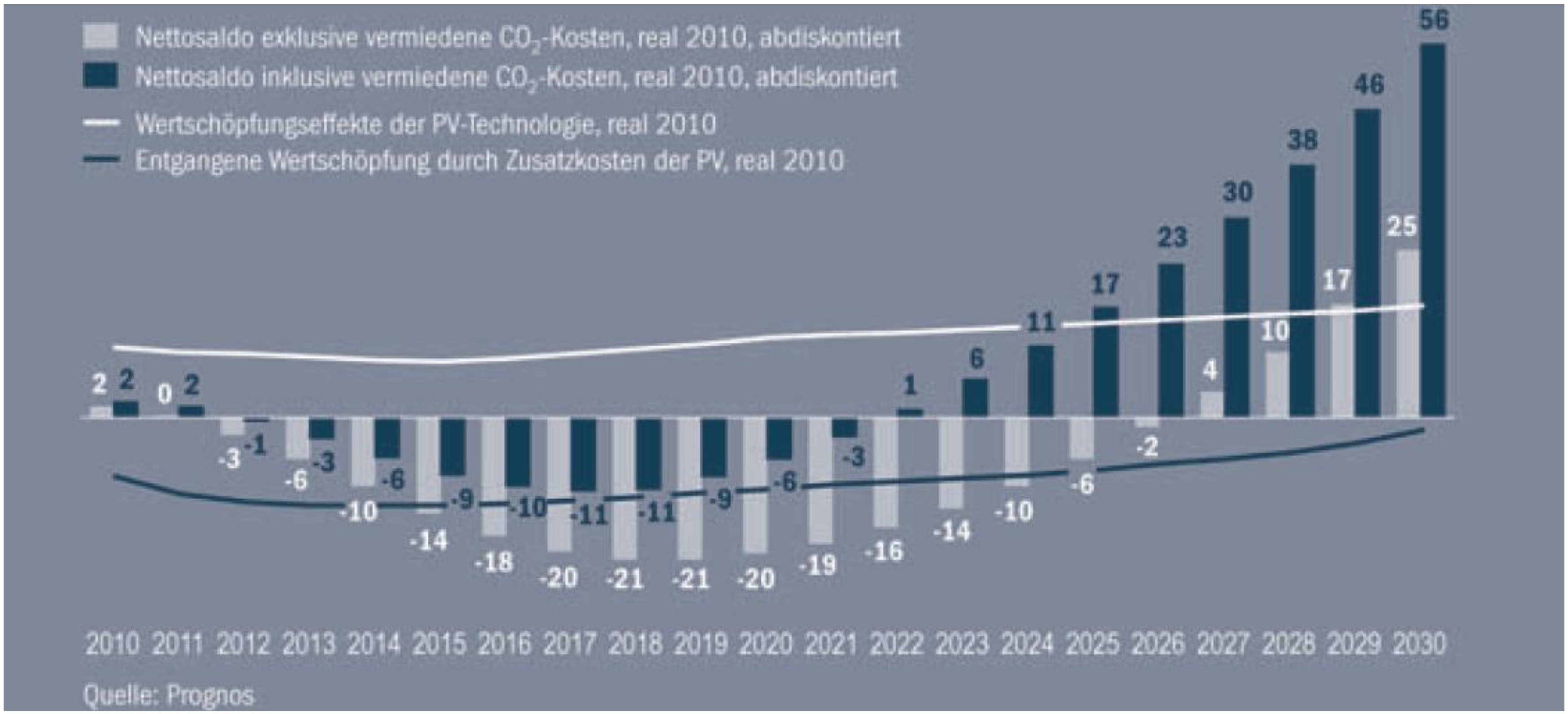
ECONOMIC IMAPCTS

Main economic advantages for society

- No fuel imports
- High value added at the regional level: employment, profits, taxes
- Several value-added steps with a broad variety of qualifications required
- Overall balance soon positive: start-up financing paid back rapidly
- High security of supply, avoidance of international conflicts
- No follow-up costs for future generations (e.g. climate damages, pollution, waste …)

Economic balance in Germany: despite expensive start phase positive before 2022

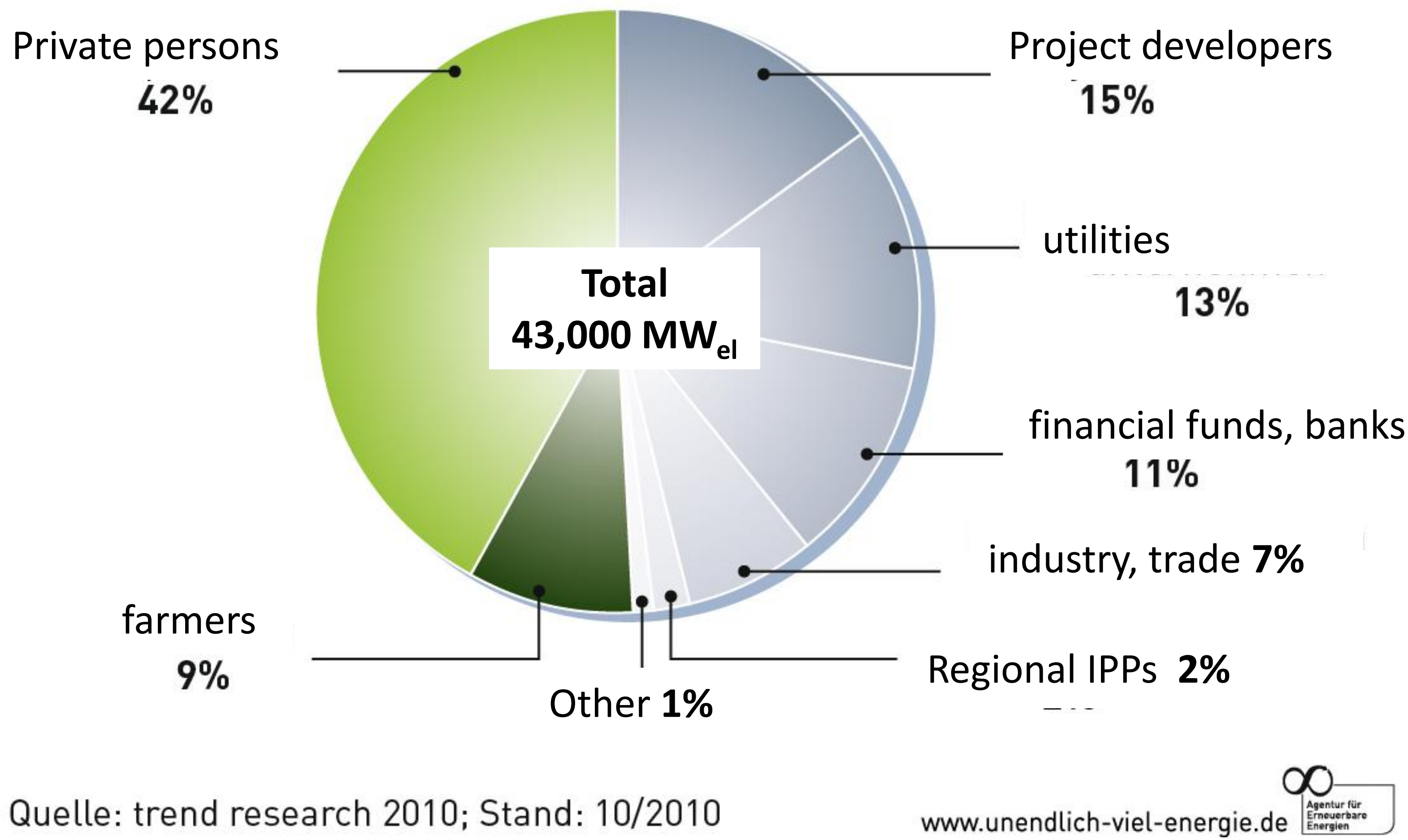
- Roland Berger / PROGNOS 2010 with very prudent assumptions:



- ATKearney 2010: <u>positive balance already in 2012</u>

Citizens initiative
Distribution of ownership and profits

Share of different groups in the owner ship of installation for renewable electricity production (43,000 MW, end of 2009)

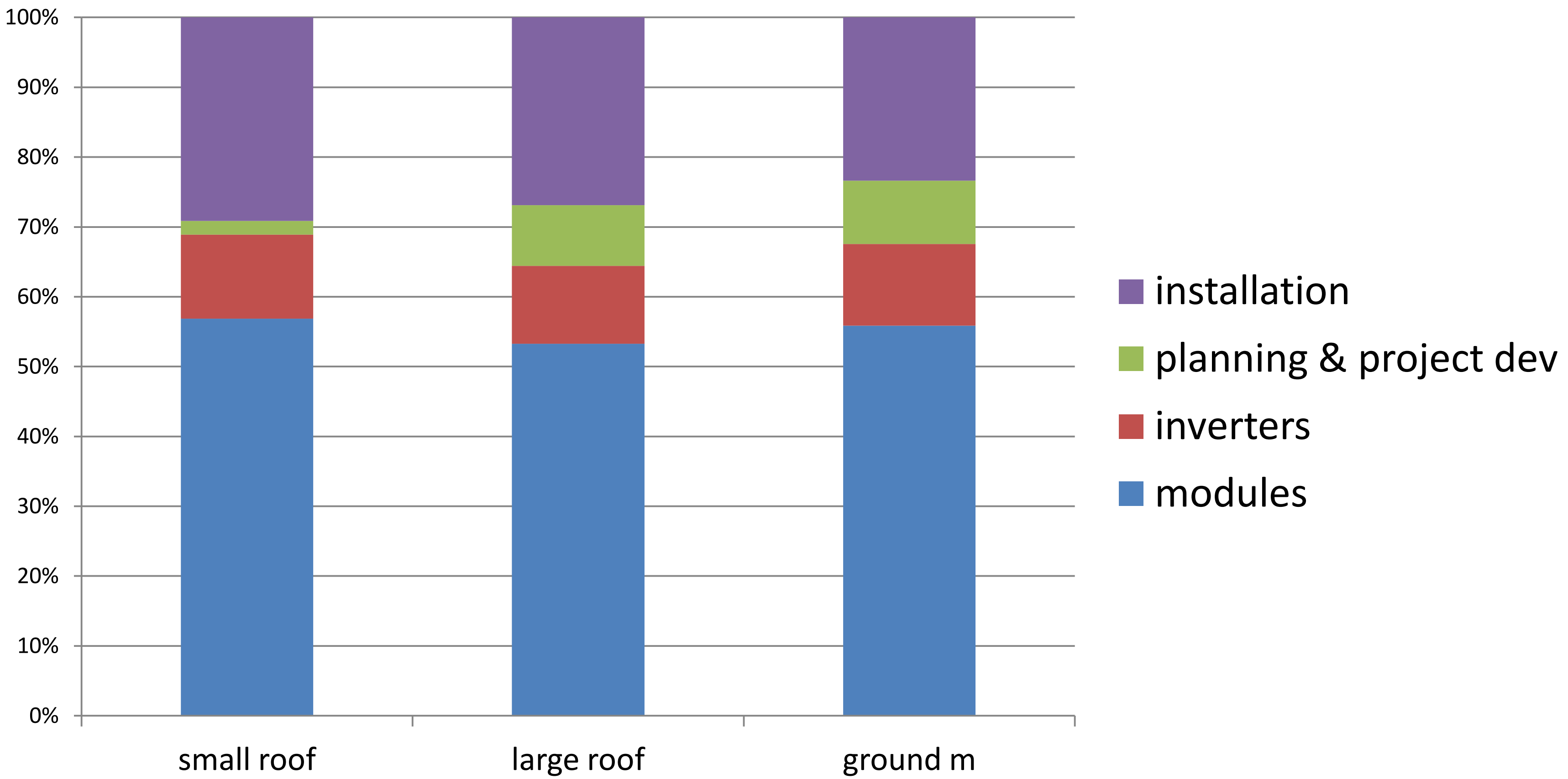


The value chain: smaller installations – more local content

↓ 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

smaller installations – more opportunities for local added value

Cost structure in different installation sizes, Germany 2009



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Data: IOEW 2010

CONCLUSIONS

Reasons for a determined PV policy

- Photovoltaics will play an important role in global future energy supply – it begins to become competitive in many markets
- Photovoltaics will transform electricity markets – rapidly and thoroughly
- Photovoltaics has important economic advantages for society (low costs, high share of local added value, energy security, less monopolistic structures, no hidden costs)
- Net support for creating markets is only necessary during a very short period
- UK is in a good position to take advantage from innovation wave – research, electronics, financing, international networks, regulatory skills are key
- No time to loose – Building up appropriate competencies and equilibrated markets takes time

Building blocs for a PV strategy

- Structures of electricity markets
- Financial support
- Technical aspects of grid connection
- Permitting procedures
- Industry policy, innovation policy
- Training, ensuring quality
- Financing and insurance
- Mobilisation of final customers, local gov.

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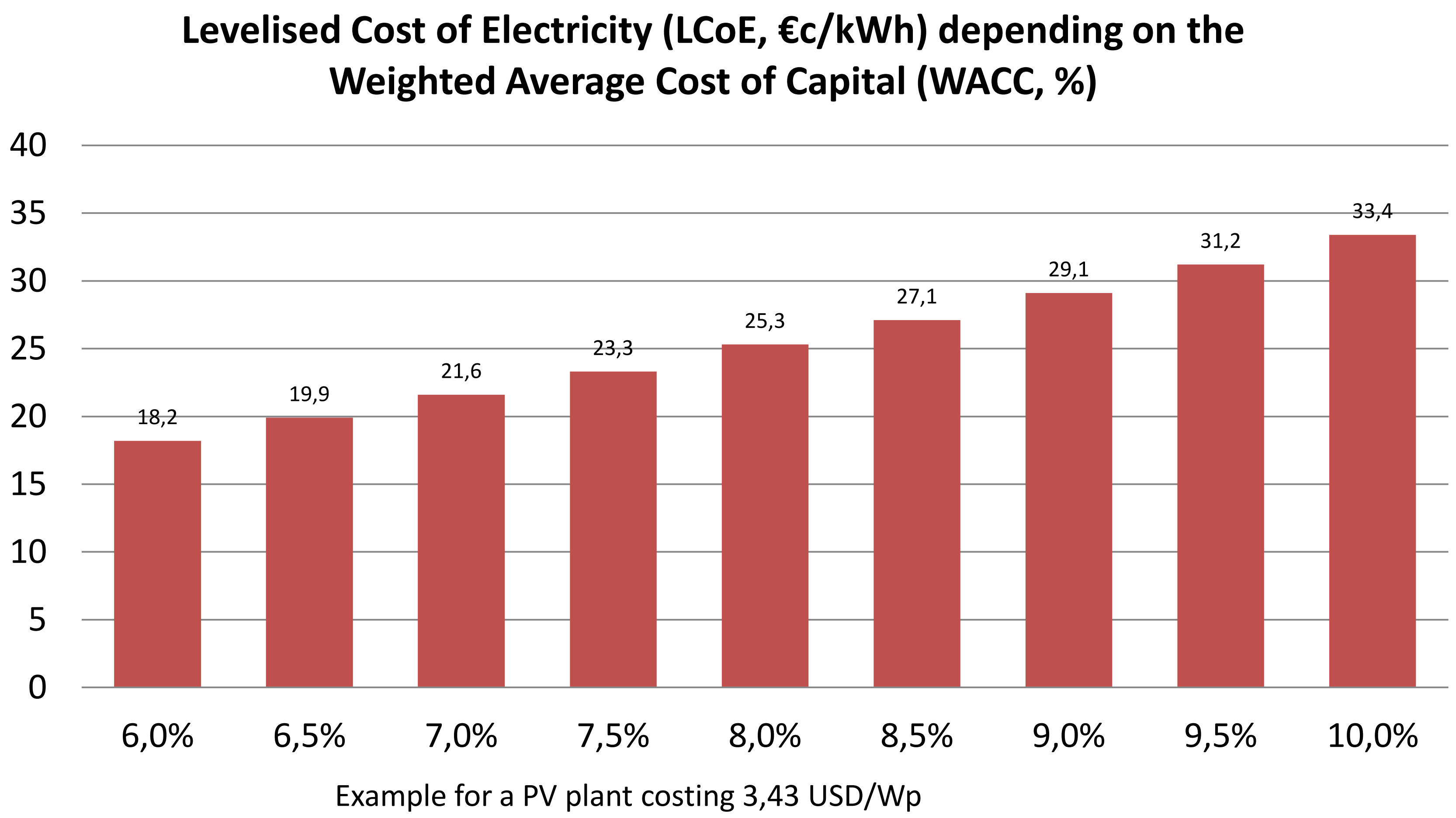
Strong influence of capital costs



Italy: estimated employment effect of the 20-20-20-package