

The European Commission's science and knowledge service

Joint Research Centre

Renewable Energy deployment now and in the next 5 years

4-5 July 2016
Karlsruhe/Ettlingen, Germany

*Heinz Ossenbrink, Head of Unit
Energy Efficiency and Renewables*



Europe after COP21

Progress up to now: Europe on Track (so far)

Investments in Renewables: Some clouds

Next 5 years: European Roadmap

Factors to increase renewables' share

- **Cost decrease**
- **Transport / Storage / Self-consumption**
- **Renewables as a part of an integrated Energy System**
- **Market Design**

Bringing it together:

- **Buildings**
- **Covenant of Mayors**

Europe after COP21

Mandatory Target:

GHG emissions down by 40%

Memberstate individual Target for Renewables:

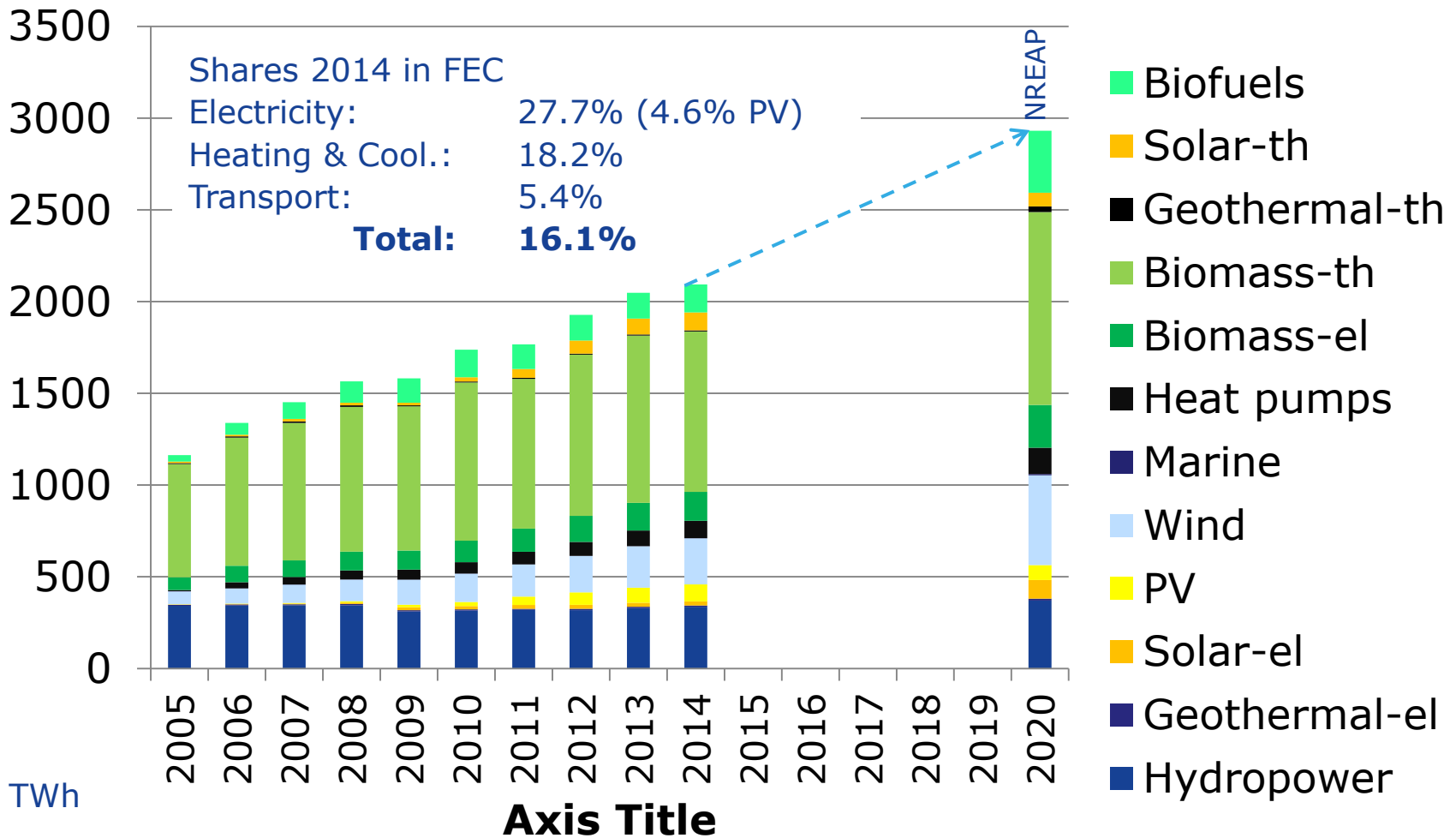
sum up to 27%

Reduction of Energy Consumption:

at least 27%


Review for a **below 2 degree** target

Progress Renewable Energy in Europe



JRC's Renewable Energy Data Portal

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JOINT RESEARCH CENTRE
Institute for Energy and Transport (IET)


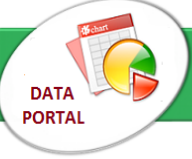

European Commission > JRC > IET > REMEA > Activities

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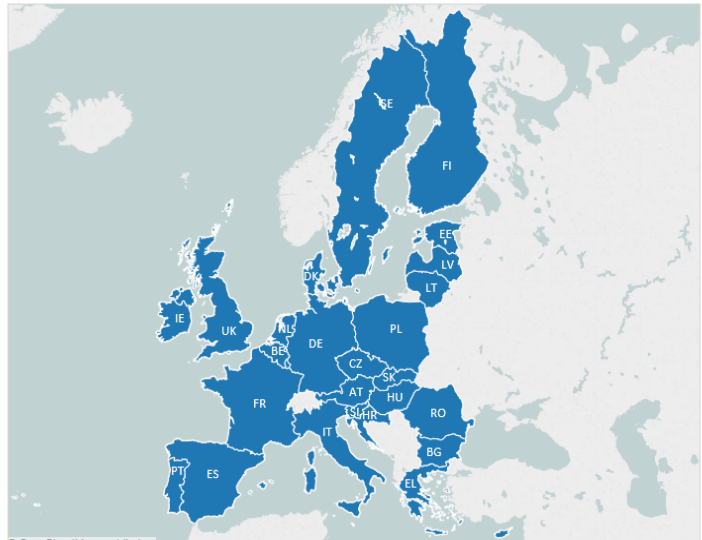
National Renewable Energy Action Plans (NREAPs)

According to Article 4 of [Directive 2009/28/EC](#) each Member States have submitted in 2010 to the European Commission a National Renewable Energy Action Plan (NREAP). As stipulated in the Directive 2009/28/EC, article 24, the European Commission has created an online [Transparency Platform](#) which makes public information relevant to the implementation of the Directive (including the NREAPs). A Template for reporting containing 12 tables is established according to the European Commission [Decision 2009/548/EC](#). According to Article 22 of the Directive 2009/28/EC each Member State has to submit to the European Commission every two year a progress report on the developments in renewable energy sources in that country compared with the interim targets in its NREAP. All the original progress reports submitted (up to now in years 2011, 2013 and 2015) can be found at the Transparency Platform of European Commission.

Find featured information at the [NREAPs and progress reports DATA VIEWER](#) and follow the latest development at the news dedicated space at IET REMEA webpage. Start downloading data and for more information please [contact us](#).




RES_shares Ranking_MS Above or Below NREAPs Overall RES Above or Below NREAPs RES-E Above



© OpenStreetMap contributors

NREAPs Interactive Map



[Click on the interactive map](#)

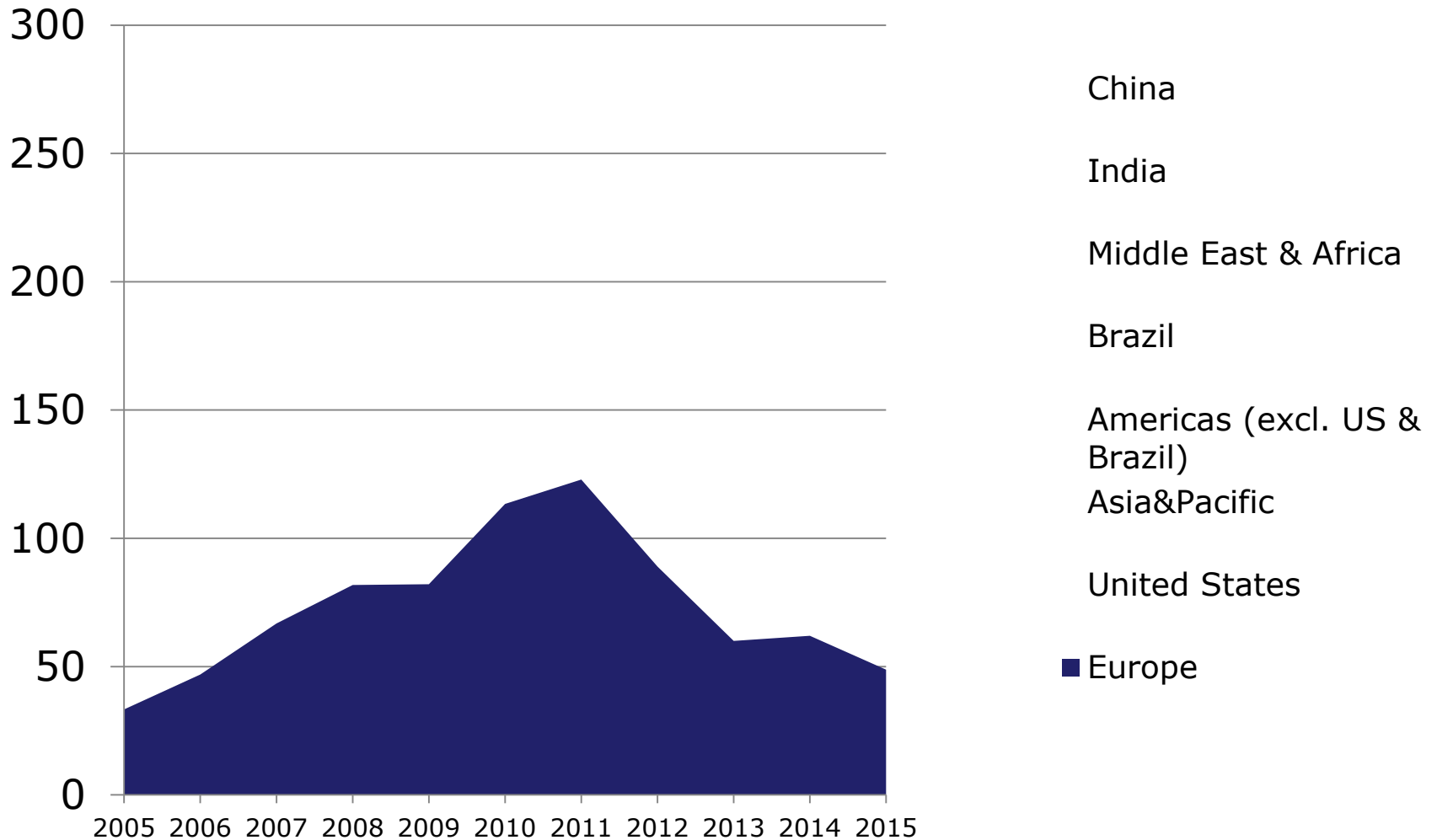
REMEA Activities Menu

- [African Renewable Energies](#)
- [Bioenergy availability and sustainability](#)
- [EUROCLIMA](#)
- [National renewable Energy Action Plans \(NREAPs\)](#)
- [Renewable Energies Monitoring](#)
- [Support to EU Strategy for the Danube Region \(EUSDR\)](#)

<http://iet.jrc.ec.europa.eu/remea/national-renewable-energy-action-plans-nreaps>

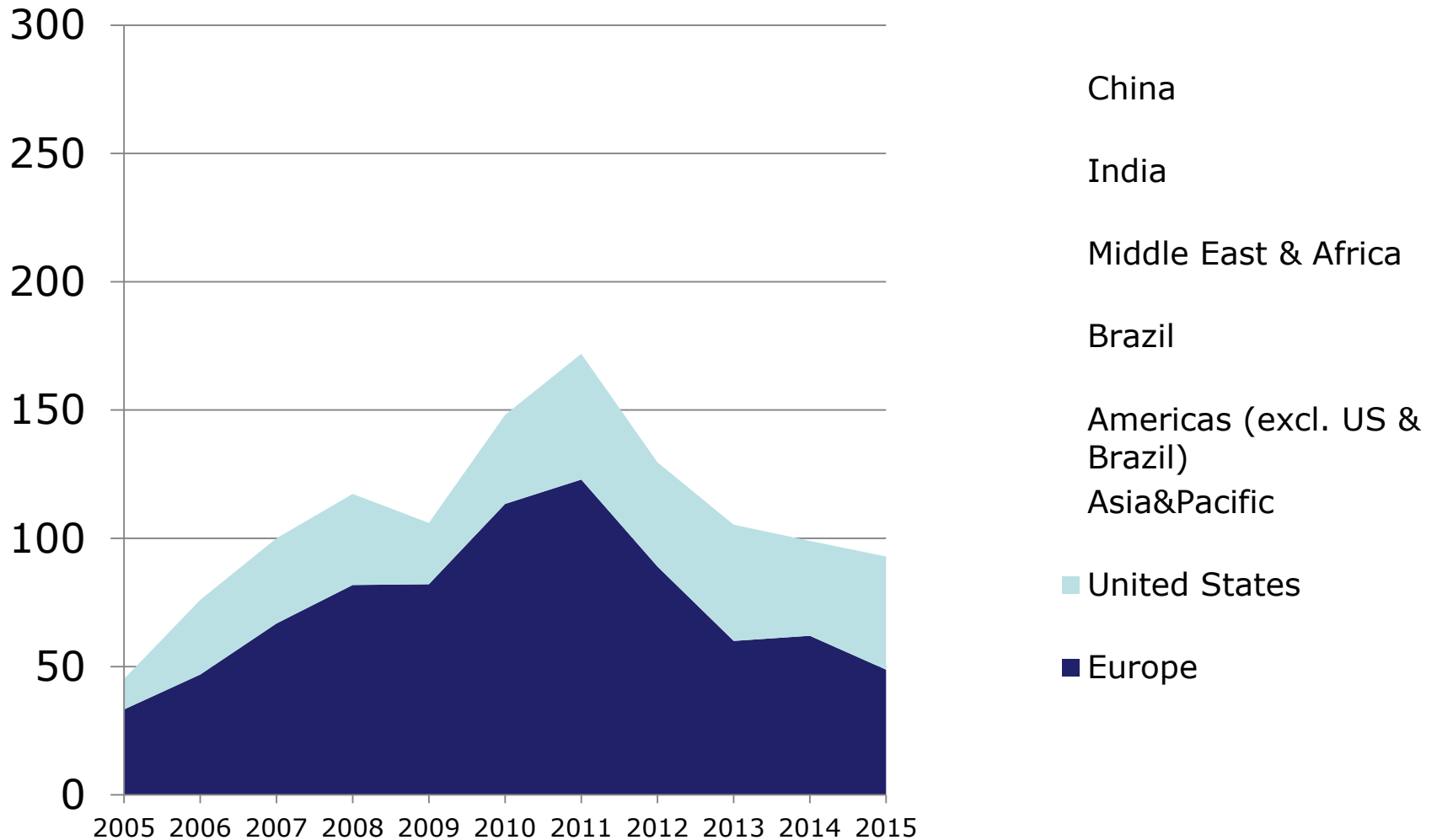
Renewable Energy Global Investments

(Bio \$)



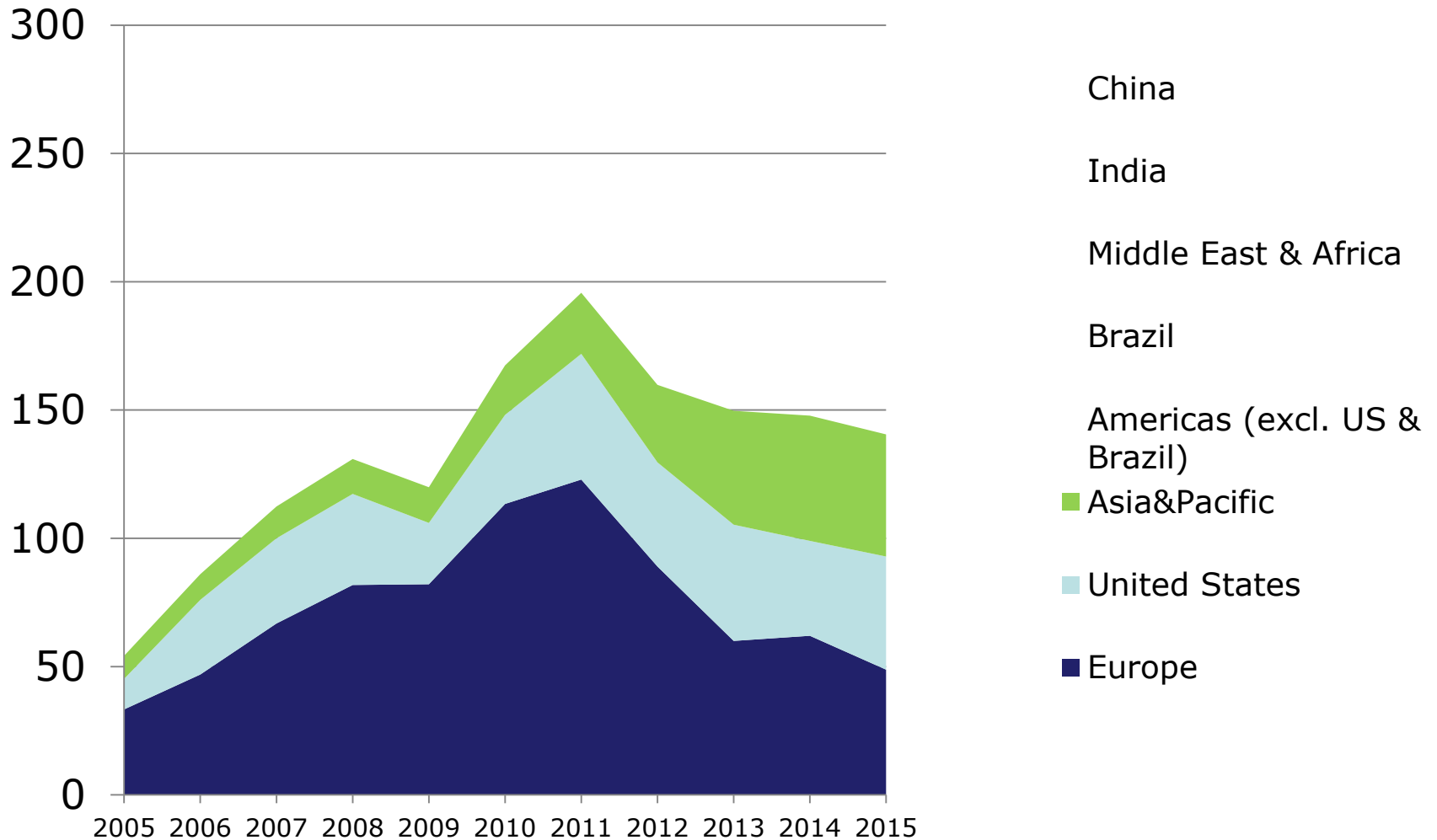
Renewable Energy Global Investments

(Bio \$)



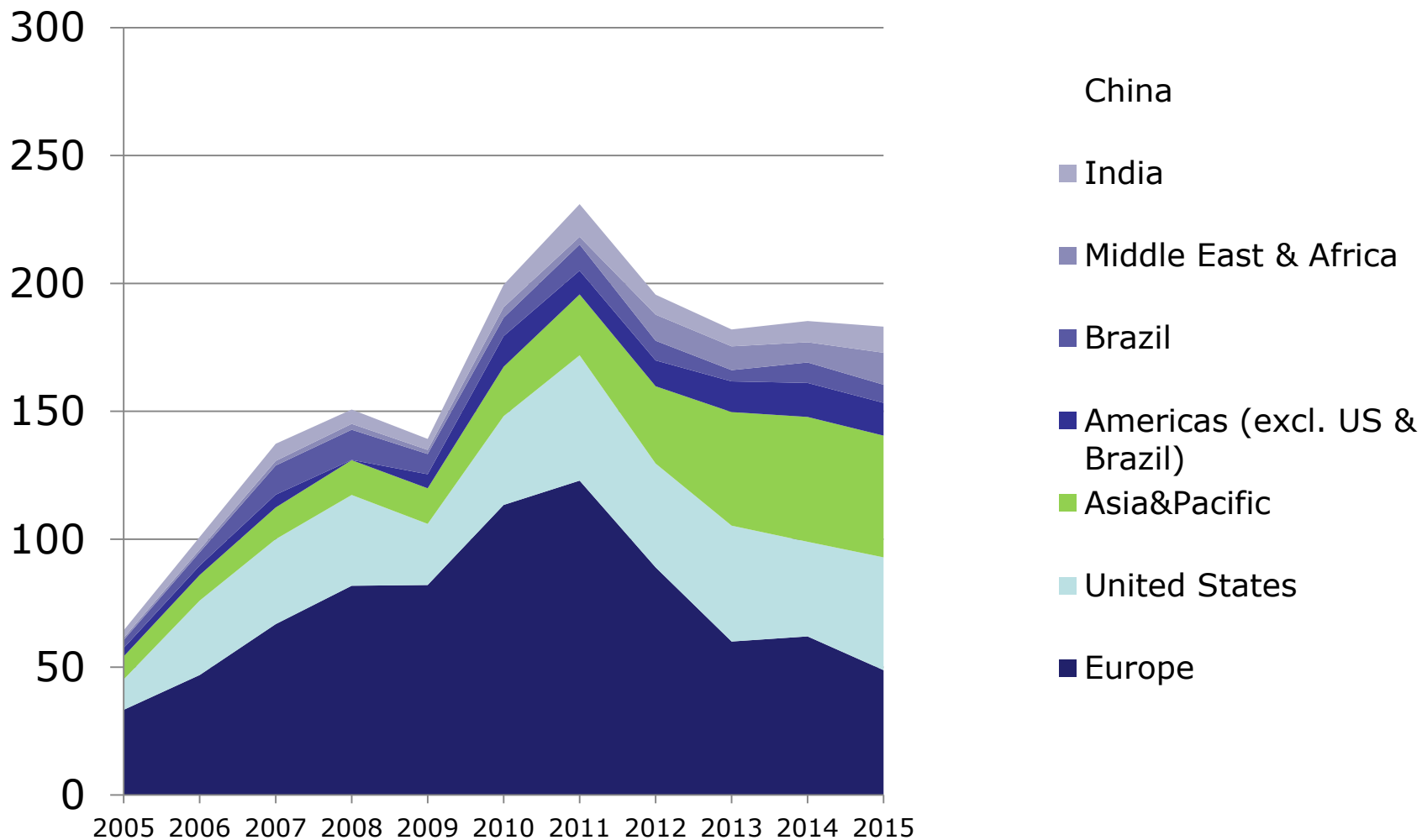
Renewable Energy Global Investments

(Bio \$)



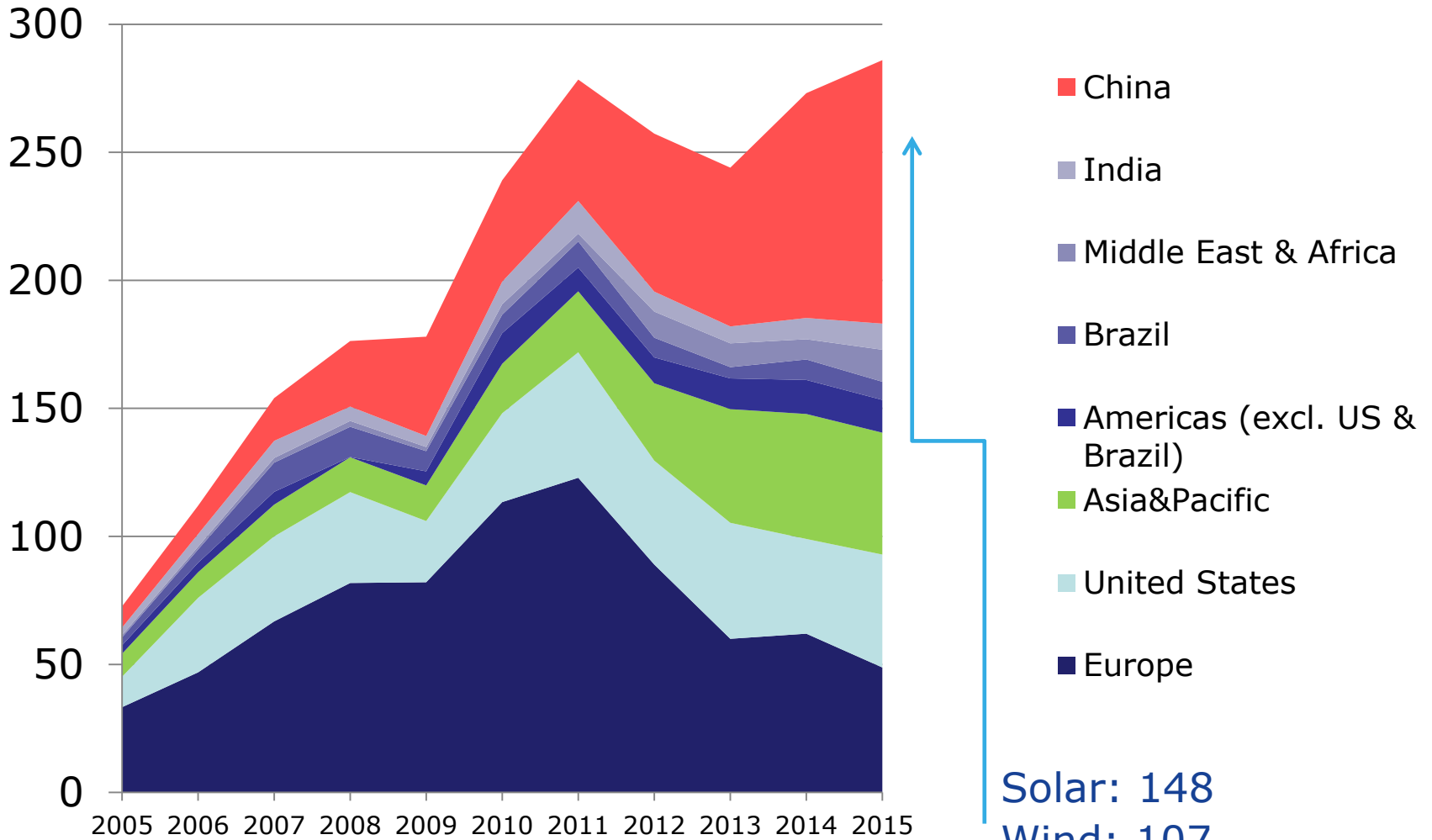
Renewable Energy Global Investments

(Bio \$)



Renewable Energy Global Investments

(Bio \$)



Next 5 years: Energy Union Package

Framework Strategy (COM(2015) 80)

1. Energy that is Secure for all Citizens

2. Fully Integrated Markets

More control for consumers and ESCOs of consumption and (self) production

3. Energy Efficient Products, technologies

4. Clean Low Carbon Economy

Renewables at least 27% by 2030

Sustainable Bioenergy

5. New Technologies

Europe world leaders on renewable technologies

Prosumer: Smart appliances, -homes -cities, -grids

Energy-neutral buildings

Factors to increase Renewables' share

1. Cost decrease
2. Renewables as a part of an integrated Energy System
 - Transport / Storage / Self-consumption**
 - Market Design**
3. Integrated Deployment Approaches
 - Buildings**
 - Covenant of Mayors**
 - Smart Regions**

Cost decrease of RE electricity

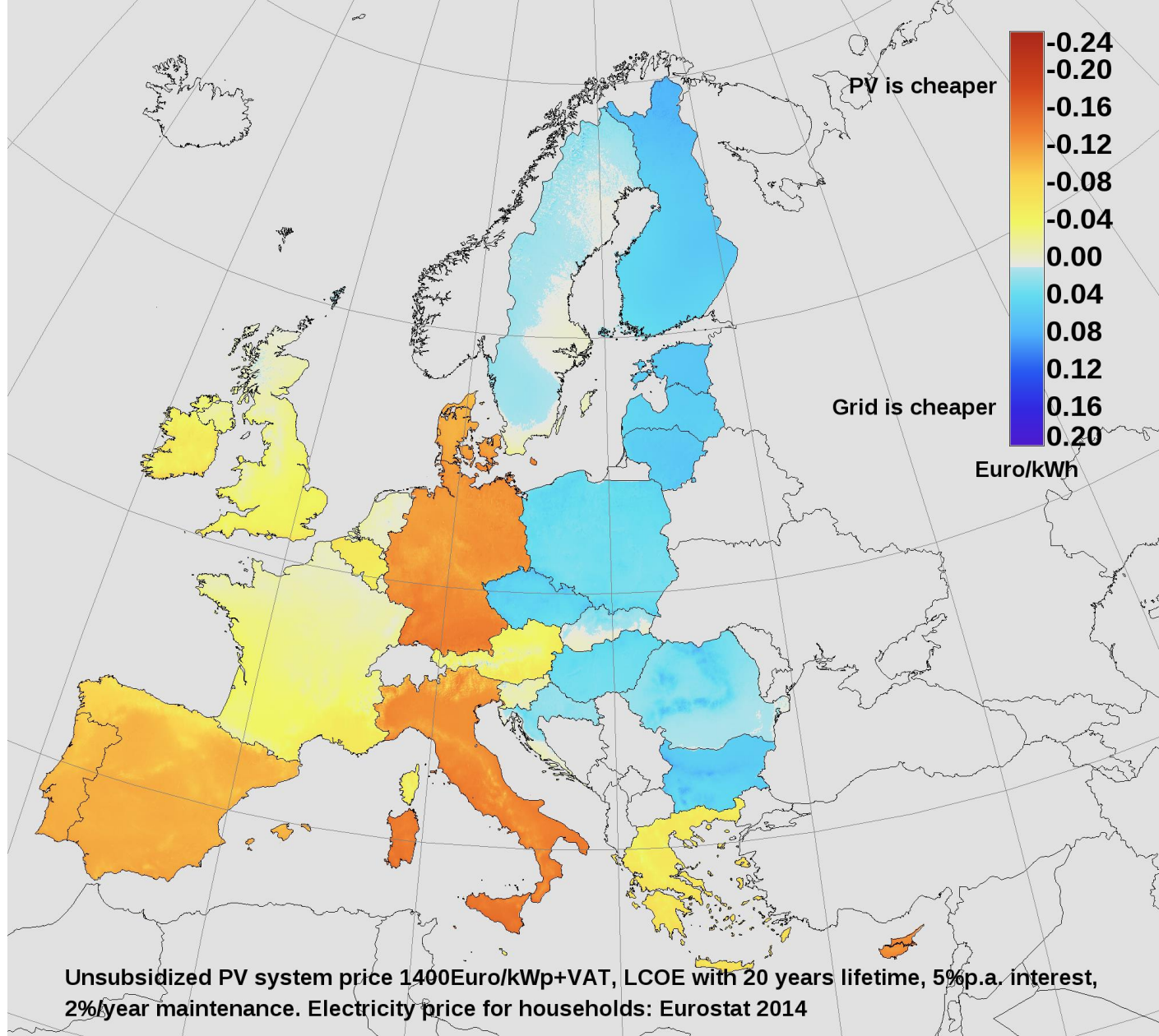
€/MWh

Landfill gas	50
Wind onshore	72
Municipal Solid Waste	90
Solar PV	90
Biomass	110
Biogas	130
Wind Offshore	150
Solar Thermal Power	180
Tidal/Wave	400
CCGT:	50...100
Coal:	40...90
Nuclear:	120

BNEF H1 Global LCOE
Outlook
Central Scenario, Global
New Investments Only

Retail Parity

*Difference
between PV
LCoE and
current
Household
Electricity
Prices*



Depends more on Longitude than Latitude?

Market Design

Wholesale Market

- Participation of Renewables ?
- Larger Storage
- Aggregators, ESCO's, Municipalities

Retail Markets

- Self-Consumption of own RE production
- De-regulation of feed-in markets
- Local Storage (electricity, heat, cold)
- virtual Storage
- "after feed-in" time

RE Electricity: The need for balancing

Balancing Option	Features	Short (ms-min)	Medium (hours)	Long (days, weeks)
Conventional Generation	Coal, Gas, Oil, Biomass	Poor, too slow	Good – very good	Very good
Interconnection	from high supply/low demand to low supply/high demand	Capacity limited	Very good	fair
Demand Response	Commercial users, premium for high/low demand, Self-consumption	Unsuitable, slow	Good-very good (smart buildings)	poor
Storage	Charge when surplus, discharge when high demand	Good	Very Good, expensive	Expensive (Batteries) Limited (Pumped Storage)

RE Electricity: The need for balancing

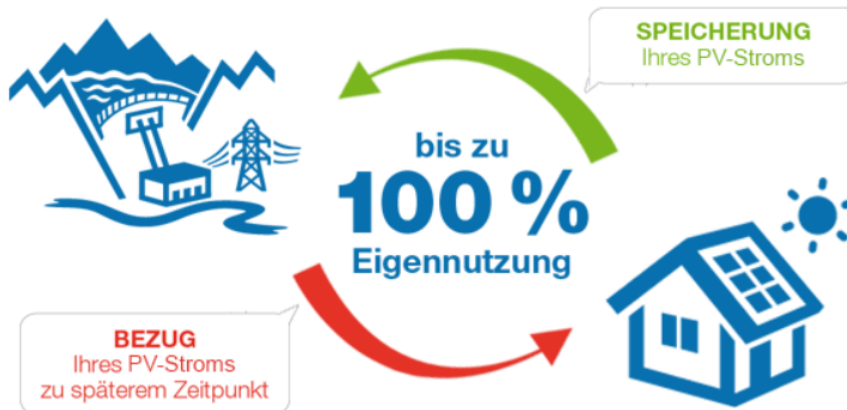
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Storage and Self Consumption


Kelag Sonnenplus-Speicher

 JETZT SPEICHER KAUFEN

So funktioniert's



So nutzen Sie bis zu 100% Ihres Photovoltaik-Stroms selbst!*

 **Sonnenplus-Speicher erwerben**
Durch eine einmalige Zahlung erwerben Sie von der Kelag die von Ihnen gewählte

Servicebereich

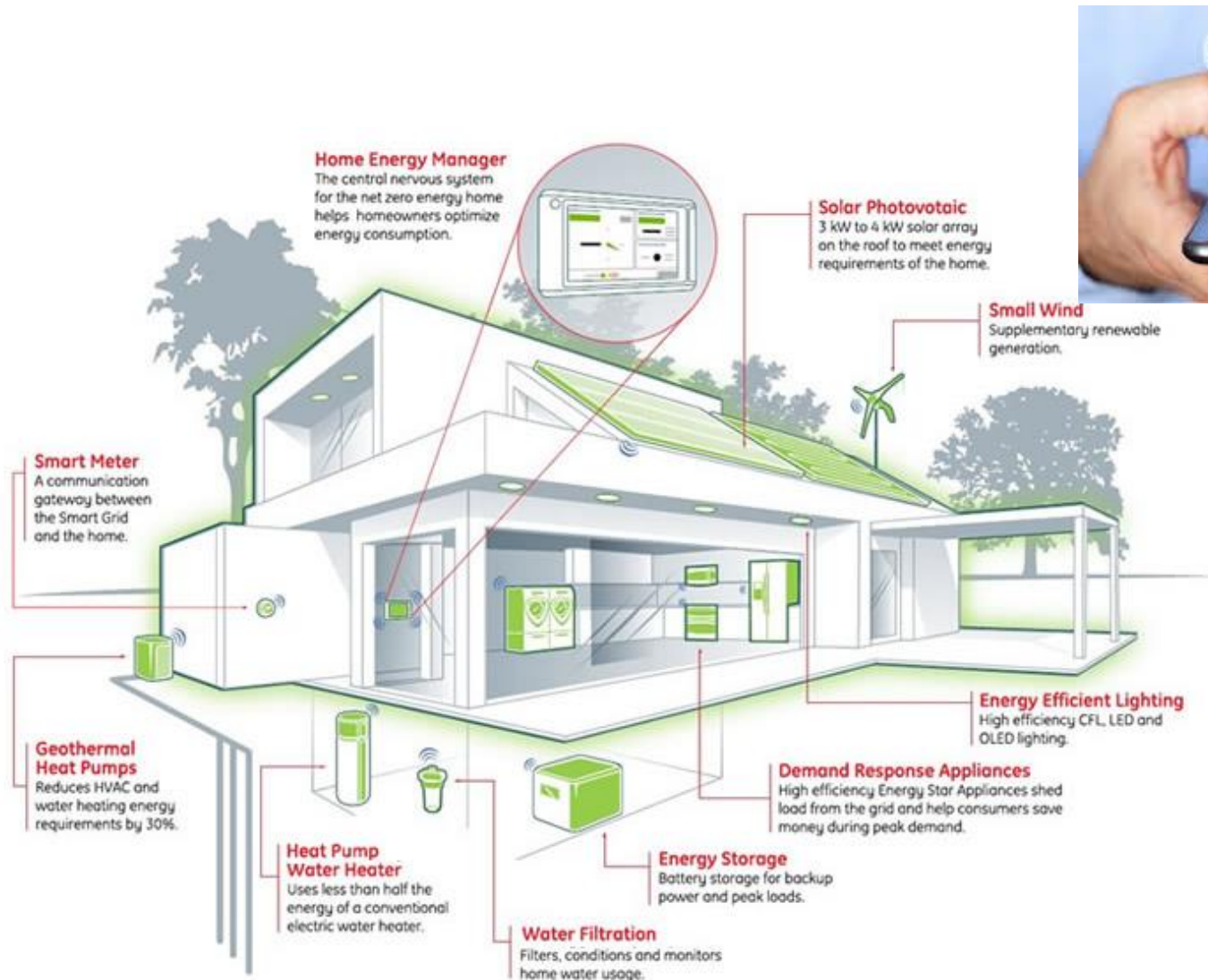
TESLA Powerwall ®



e.on

Aura: Profitieren Sie von Solarenergie – produzieren Sie Ihren eigenen Ökostrom
E.ON Aura ist die Komplettlösung für Ihre persönliche Energiewende: **Erzeugen, speichern** und **managen** Sie **effizient** Ihren eigenen Solarstrom für Ihren Haushalt.

Trend: Smart, positive energy buildings



Putting it all together locally

The Covenant of Mayors

Mayors commit to go beyond EU energy and climate objectives through Energy Efficiency and Renewable Energy use in their territories

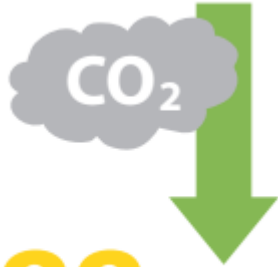


54
Countries

6 690
signatories

211 million
citizens

SEAP indicators



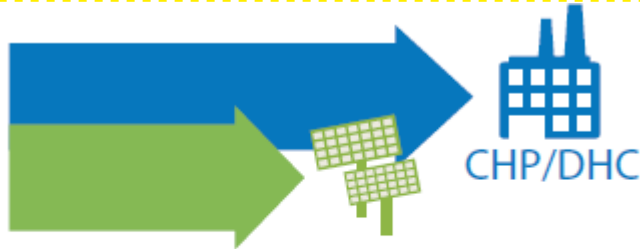
188

Mt CO₂ eq. reduction, which means a 28% reduction target.



20%

Reduction of energy consumption as a result of energy savings in building and transport sectors.



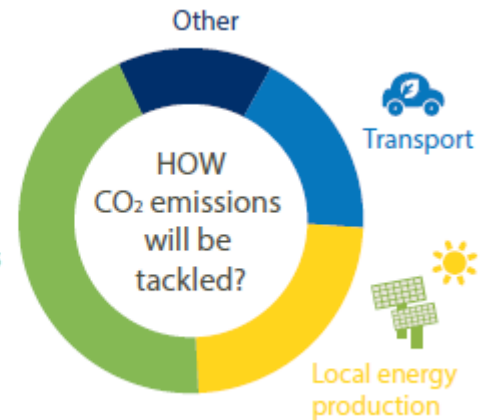
133

TWh to be locally produced, which will contribute to meet 18% of future energy demand from local production.



44%

of the overall CO₂ reduction will derive from actions in buildings.



3421 SEAPs received as of mid-May 2014

SCIENCE IS NOT
ENOUGH
MAKING
SUSTAINABILITY
SUPER SWEET

LAWRENCE SCARPA



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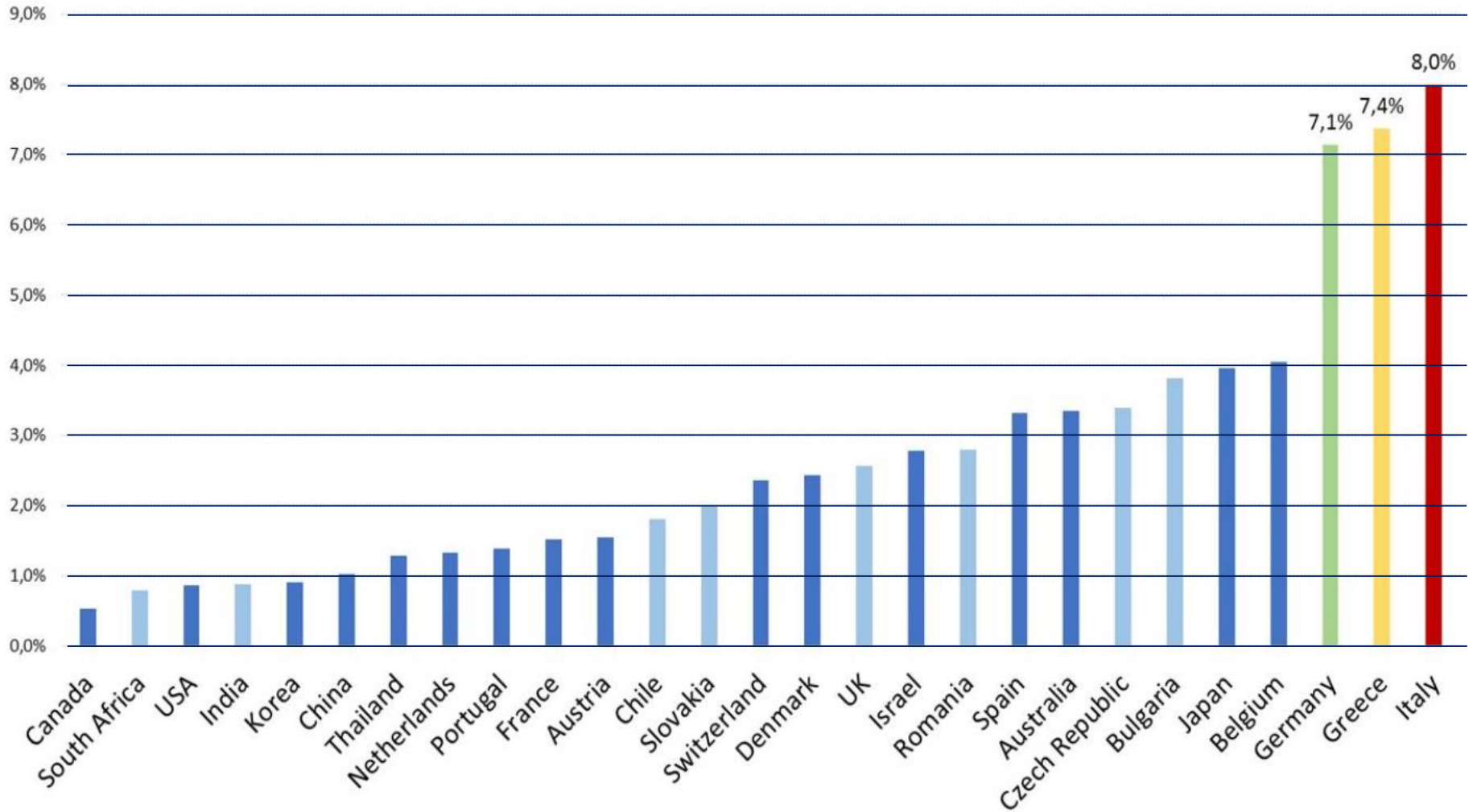


LinkedIn: [Joint Research Centre](https://www.linkedin.com/company/joint-research-centre)



YouTube: [EU Science Hub](https://www.youtube.com/EU_Science_Hub)

FIGURE 4: NATIONAL PV PENETRATION IN % OF THE ELECTRICITY DEMAND BASED ON 2015 CAPACITIES



24 %=(Y2 [cm]+(-/+Y2)[cm])/1.269



The Versatility of GIS



European
Commission

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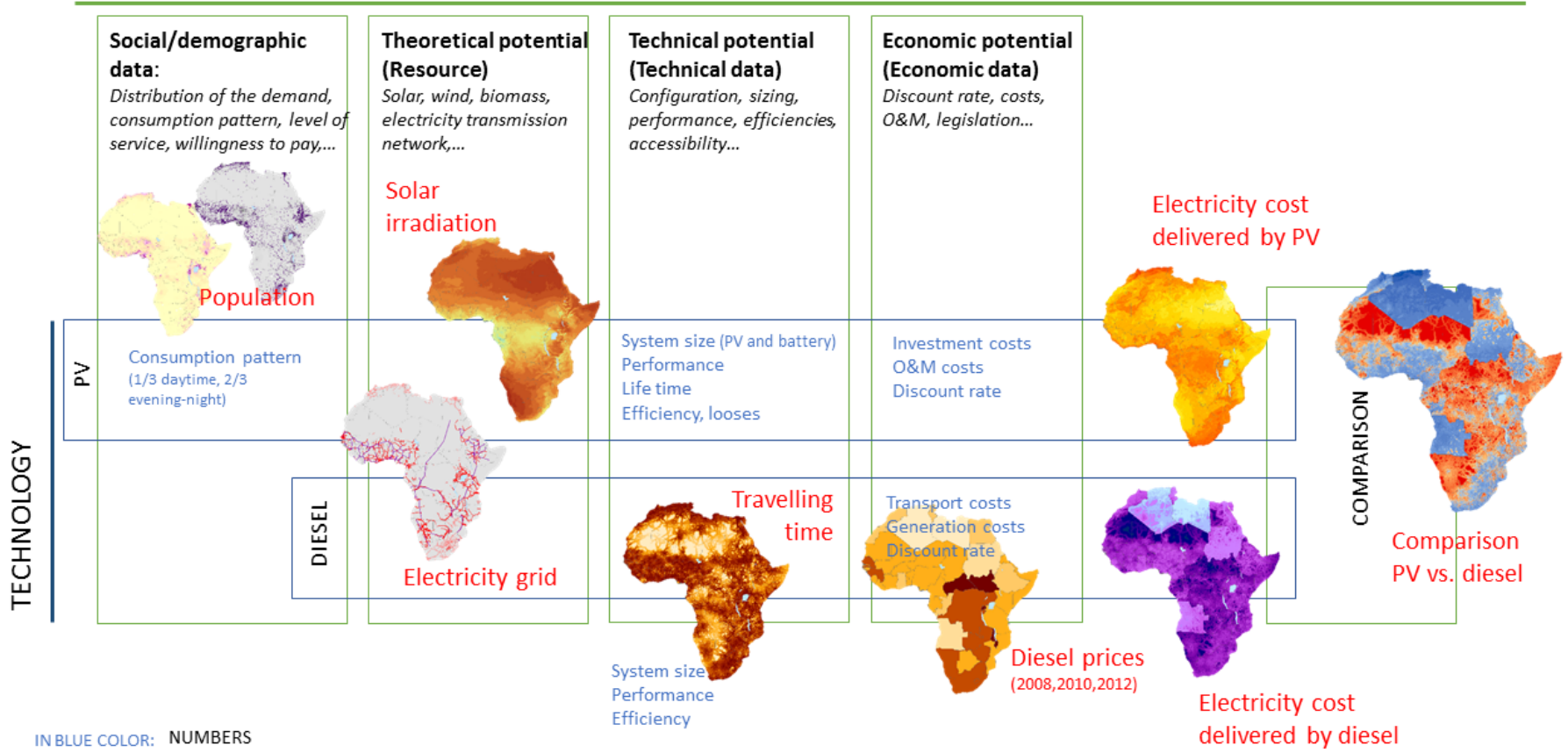
RE²nAF renewable energies
rural electrification
africa

European Commission > JRC > IET > REMEA > RE2nAF

The screenshot displays the RE2nAF GIS interface. The main map shows a color-coded overlay on a physical map of Africa and the Middle East, with red and orange areas indicating higher values and blue areas indicating lower values. The map is titled 'Base layer: Google Physical'. On the left, the 'Data' panel shows a tree view of layers, including 'Country profile', 'Population', 'Administrative boundaries', 'Infrastructure', and 'Energy profile'. On the right, the 'Roadmap' panel contains interactive controls for selecting a country, diesel price, and PV module price, along with an 'Add layer comparison pv-diesel' button. The bottom of the interface shows a scale bar (1000 km / 1000 mi), coordinates (14°50'19"N, 65°18'29.6"E), and a 'Full Screen' button. The footer includes the Google logo and copyright information: '©JRC, EC 2013' and 'Map data ©2013 Google, INEGI, MapLink, Tele Atlas - Terms of Use'.

The engine behind

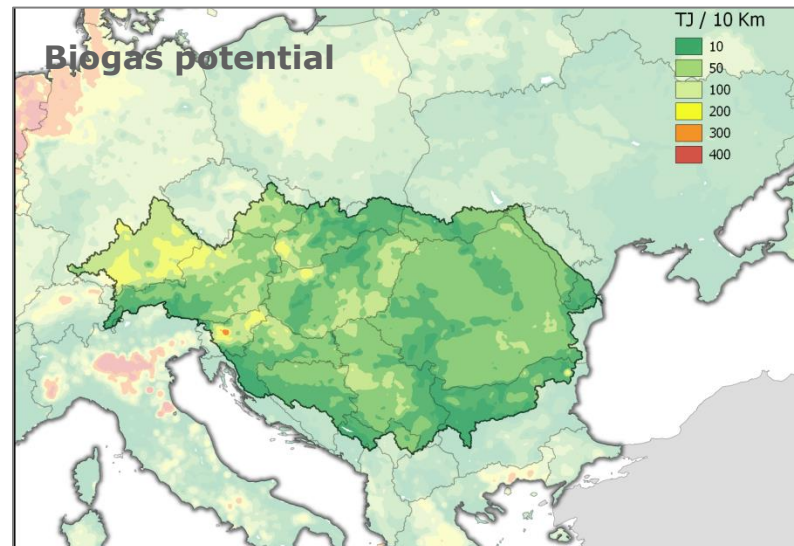
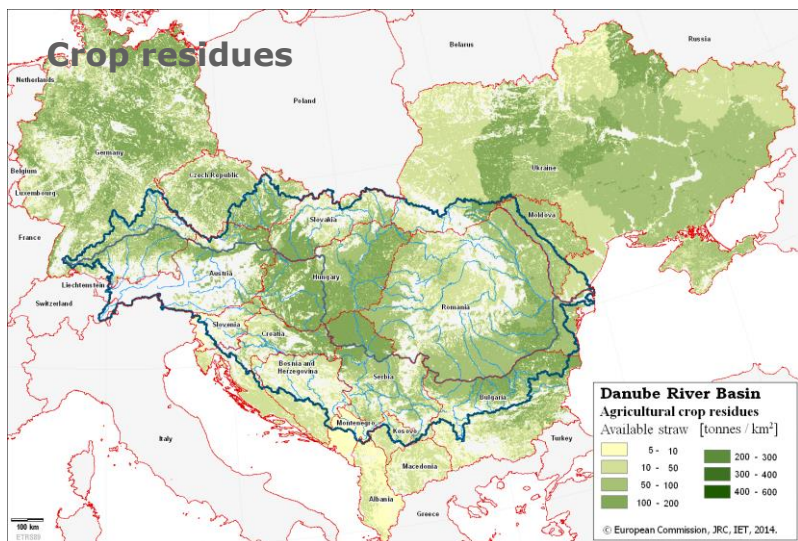
DATA



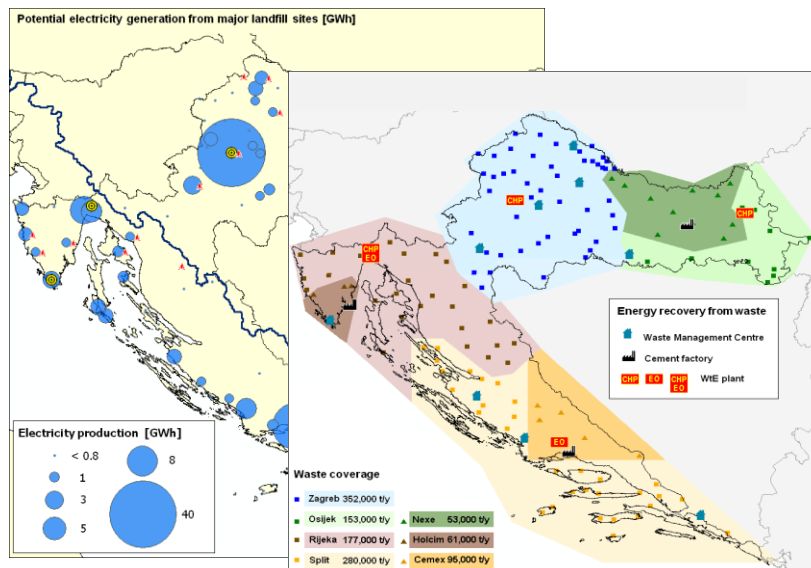
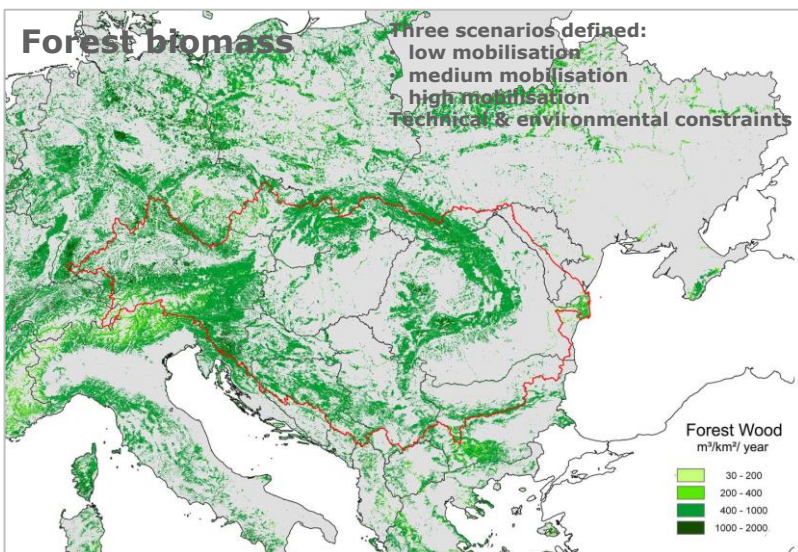
IN BLUE COLOR: NUMBERS

IN RED COLOR: MAPS

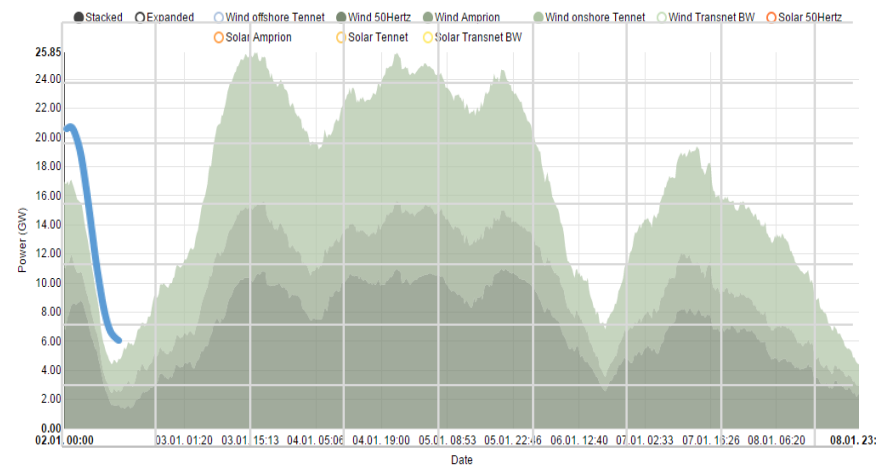
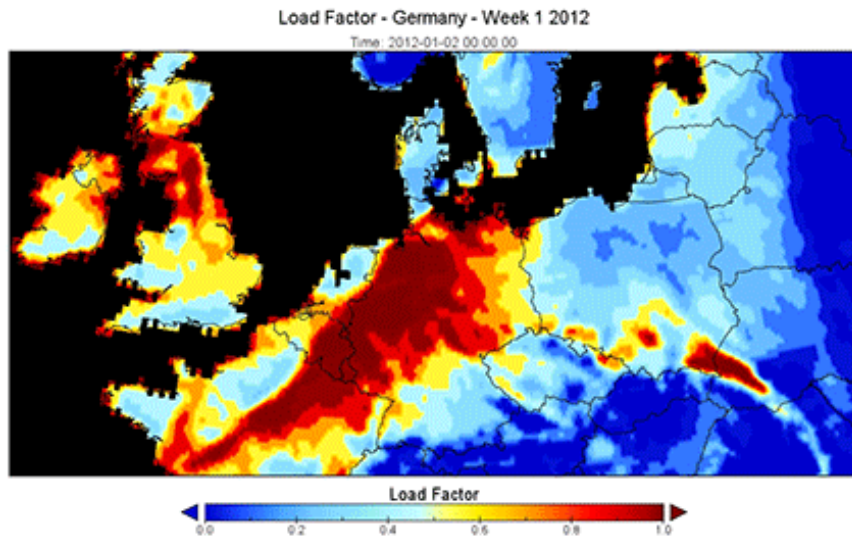
Example Bio-economy: Danube bioenergy resources



Energy potential of waste: Croatia



Wind energy production - case study ECMWF 100m wind dataset (2012 – 2014)

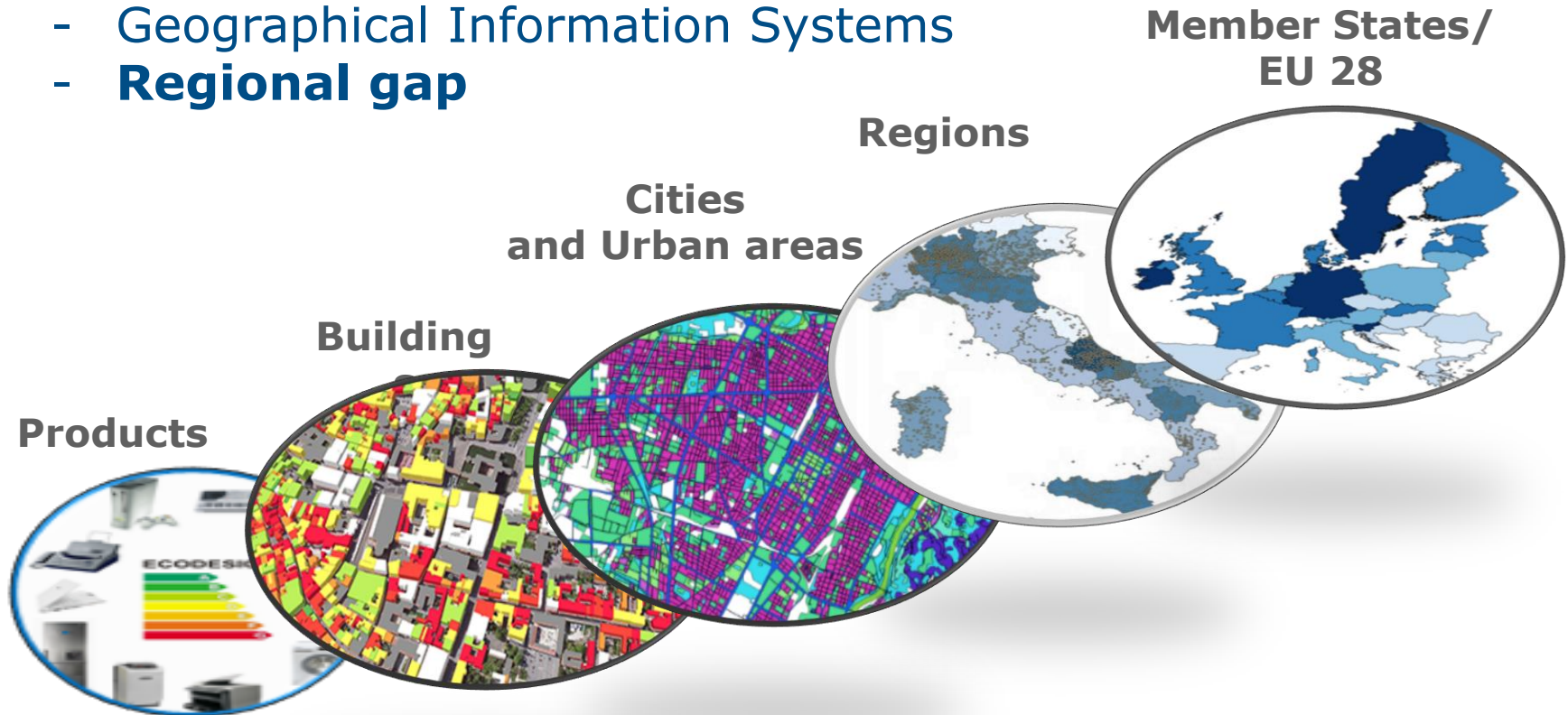


- Meteo data from ECMWF
- Wind turbines load factor data from F.06
- Model results (lines) vs.
- Wind energy production data from Fraunhofer

WARNING: offset and scale coefficient applied on the right panel!

Energy policies at different scales:

- **Coherent and integrated assessment**
- Geographical Information Systems
- **Regional gap**



Energy label
Ecolabel
Directives

Energy Performance of
Buildings Directive

Covenant of
Mayors (**Cities**)

Smart
Specialisation:
Covenant of
Mayors
(**Regions**)

Energy Efficiency –
Renewable Energy
Directives

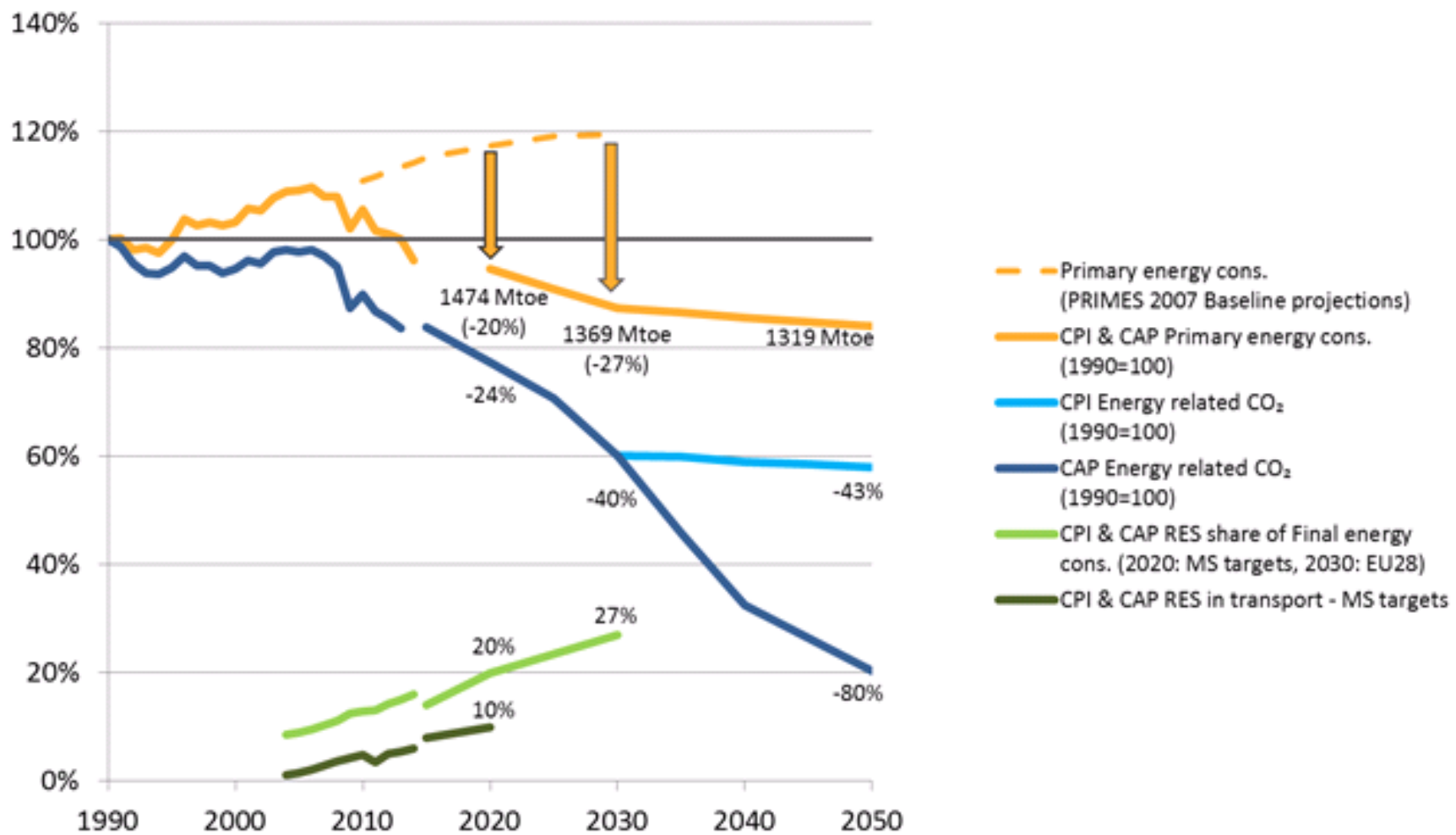
Bankability of PV

Power Purchase Agreements for 25 years

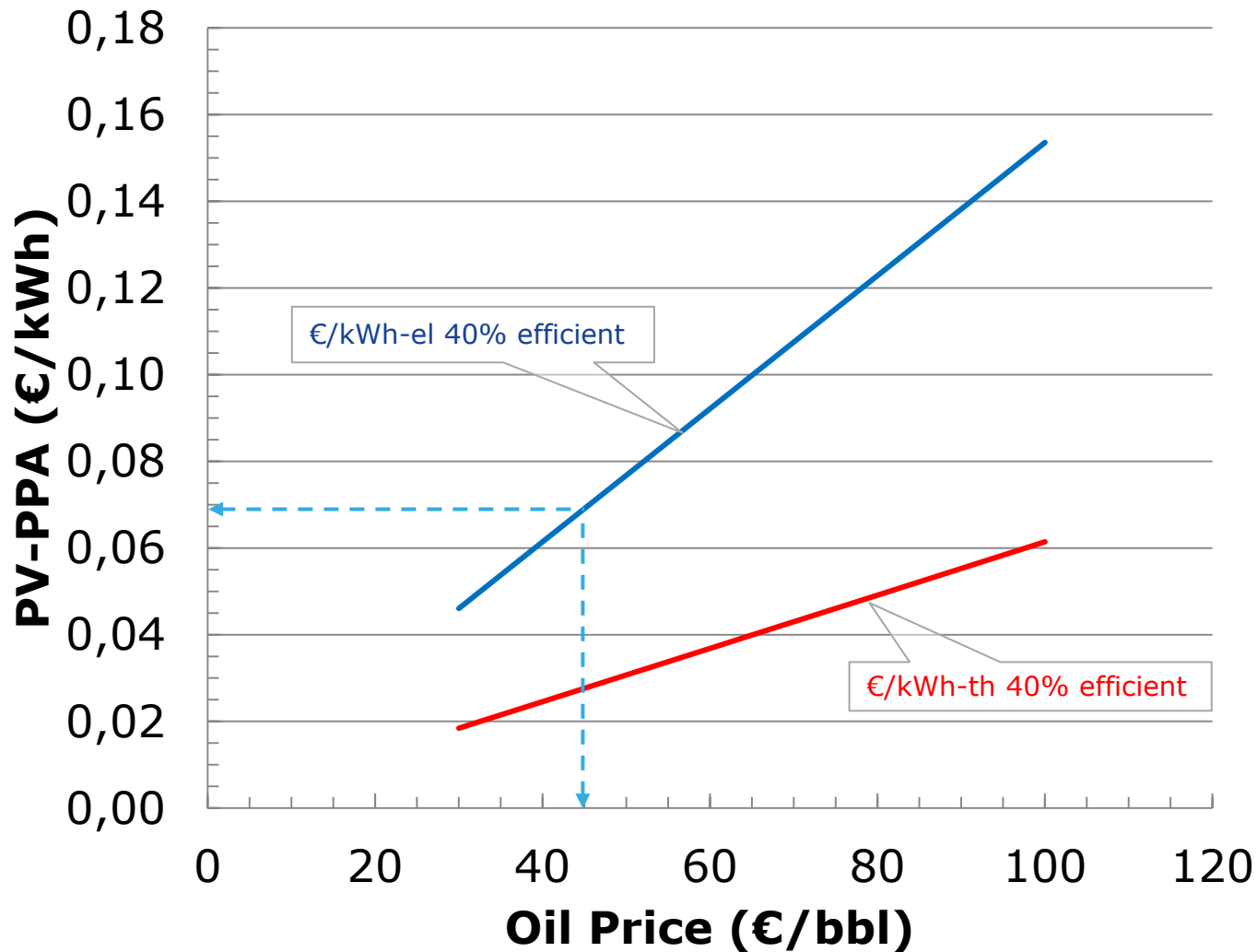
What is the generation cost after this time?

- Operation ESTI data
- Maintenance
- Degradation ESTI data
- Defects ESTI data

Estimated maximum of 2 c€/kWh

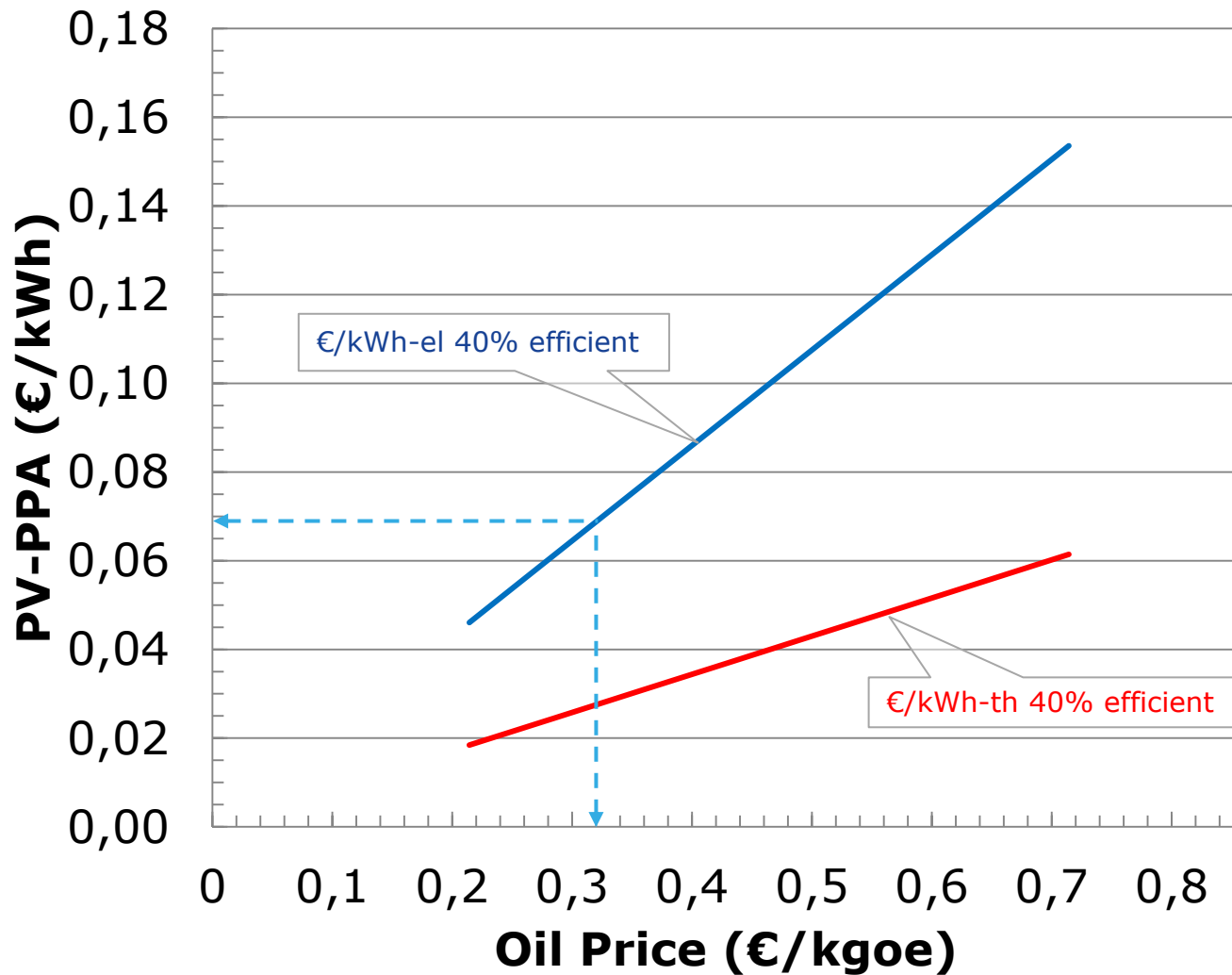


PPA's vs Oil-price – How Cheap is PV?



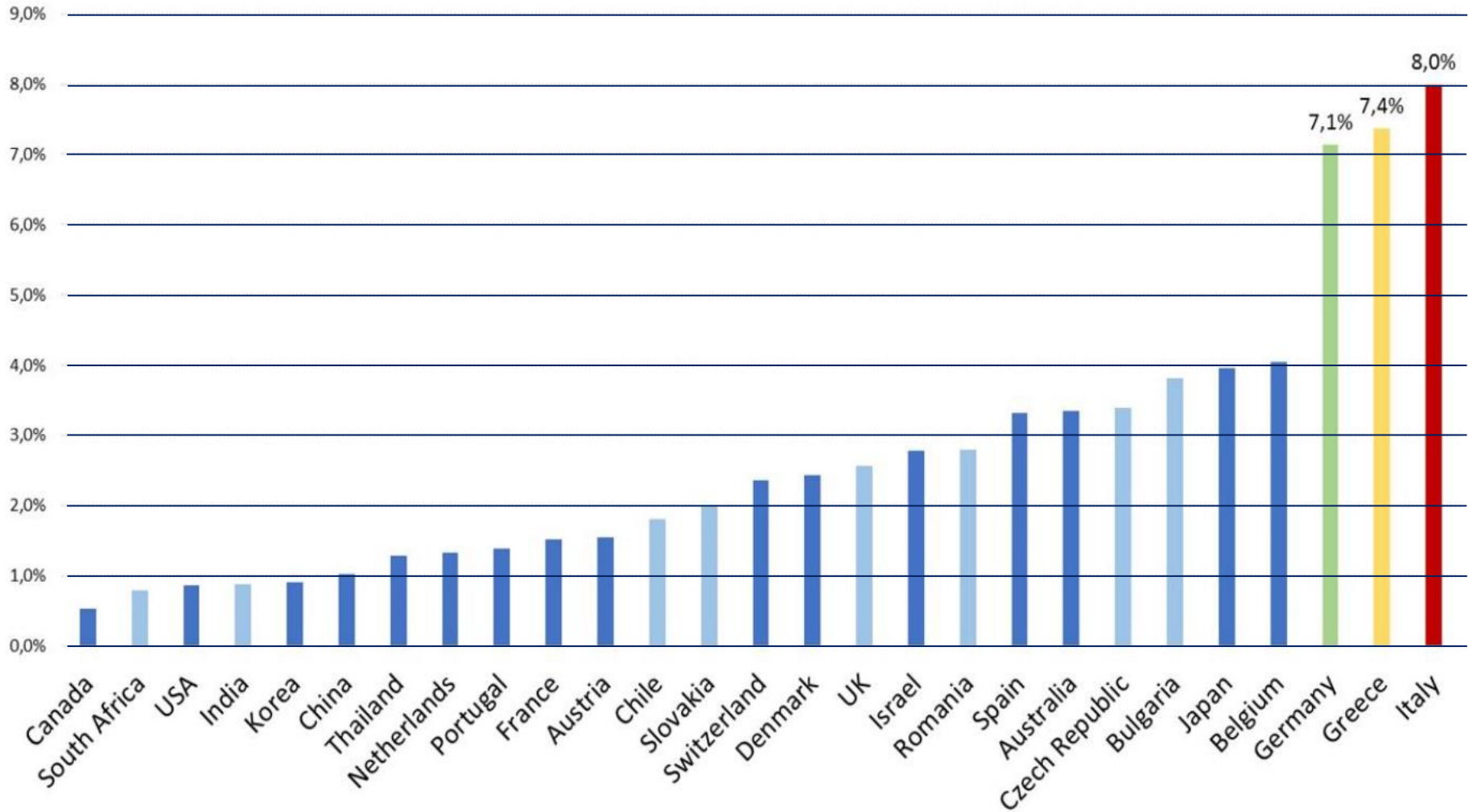
A PPA at 7 c/kWh corresponds to produce electricity from Oil which costs 45€/barrel or 0.50 €/kgoe

PPA's vs Oil-price – How Cheap is PV?



A PPA at 7 c/kWh corresponds to produce electricity from Oil which costs 45€/barrel or 0.32 €/kgoe

FIGURE 4: NATIONAL PV PENETRATION IN % OF THE ELECTRICITY DEMAND BASED ON 2015 CAPACITIES



©Snapshot of Global PV Markets – IEA PVPS



34 %=(Y2 [cm]+(-/+Y2)[cm])/1.269

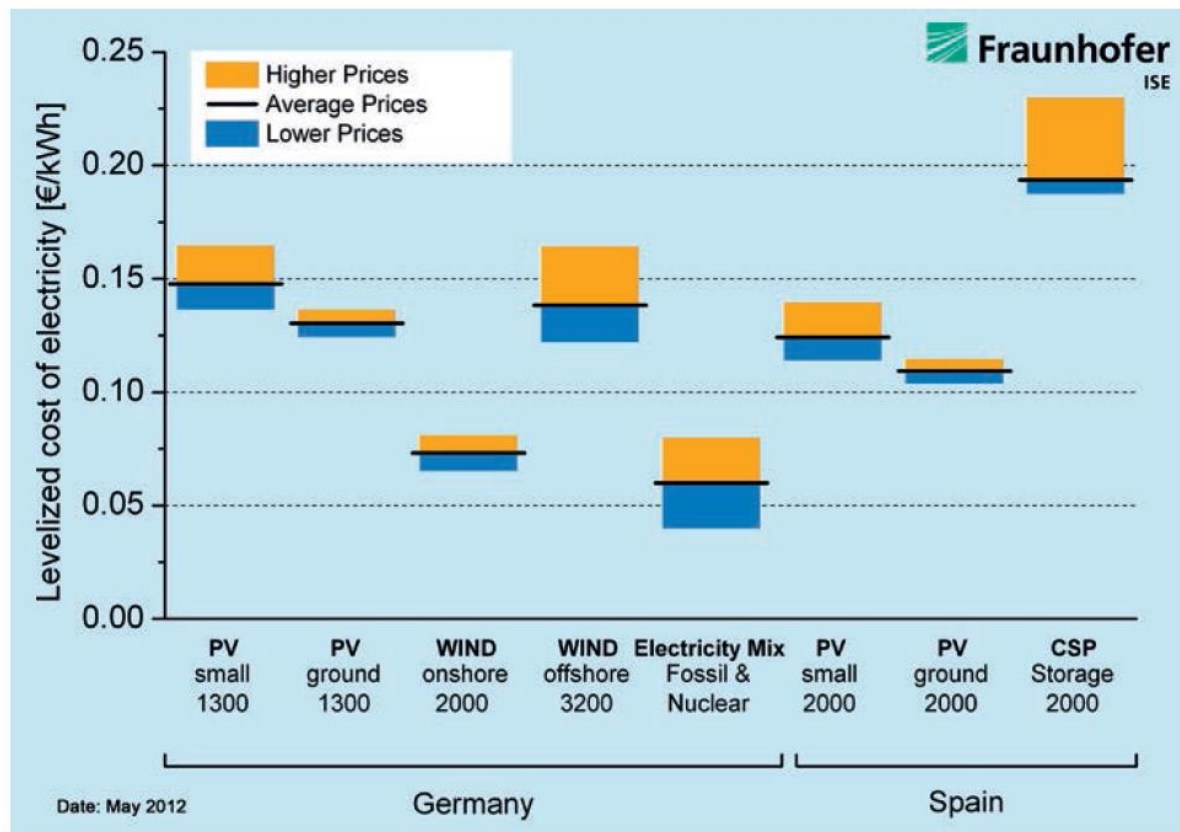


European Commission

2 GW Ground-mounted Smart PV Plant in Yanchi, China



LCOE for the dominant RE technologies



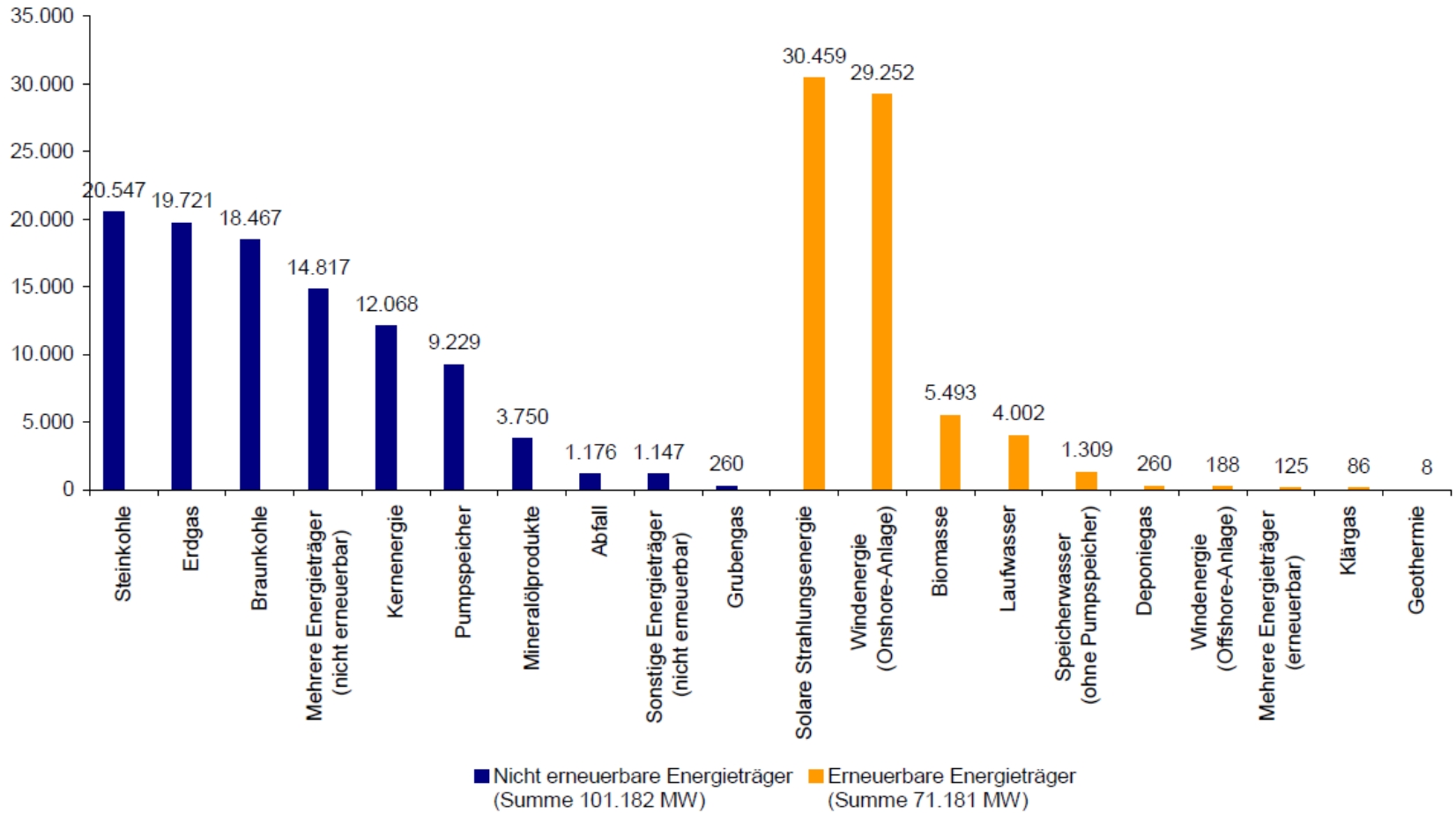
LCOE of PV generated electricity for residential systems

	Price [€/kWp]	LCOE Product [€ct/kWh]	LCOE Capital [€ct/kWh]			LCOE O&M 1.5% [€ct/kWh]	LCOE Total [€ct/kWh]		
			0%	3%	5%		10%	3%	5%
Return on Investment		0%	3%	5%	10%		3%	5%	10%
PV Module	600	2.3	0.7	1.2	2.6	0.7	3.9	4.4	5.8
Inverter	150	0.6	0.2	0.3	1.6	0.2	1.0	1.1	1.4
Balance of Systems	420	1.6	0.5	0.9	1.8	0.5	2.7	3.1	4.0
Engineering Procurement & Construction	370	1.4	0.5	0.8	1.6	0.4	2.5	2.8	3.6
Other (Fees, Permitting, Insurances..)	160	0.6	0.2	0.3	0.7	0.2	1.0	1.1	1.5
Total	1,700	6.5	2.1	3.5	7.5	2.0	10.6	12.0	15.4

LCOE of PV generated electricity for residential systems with a system price of 1,700 €/kWp kWh (excluding VAT, because the differences in various countries are too large), 1.5% Operation, Maintenance and Repairs (O&M) cost, an annual generation of 1,300 kWh/kWp/y and financial lifetimes of 20 years.

MW

Installierte elektrische Erzeugungsleistung (Netto-Nennleistung, Stand Juli 2012)



Selected Auction Results (2015-2016)

