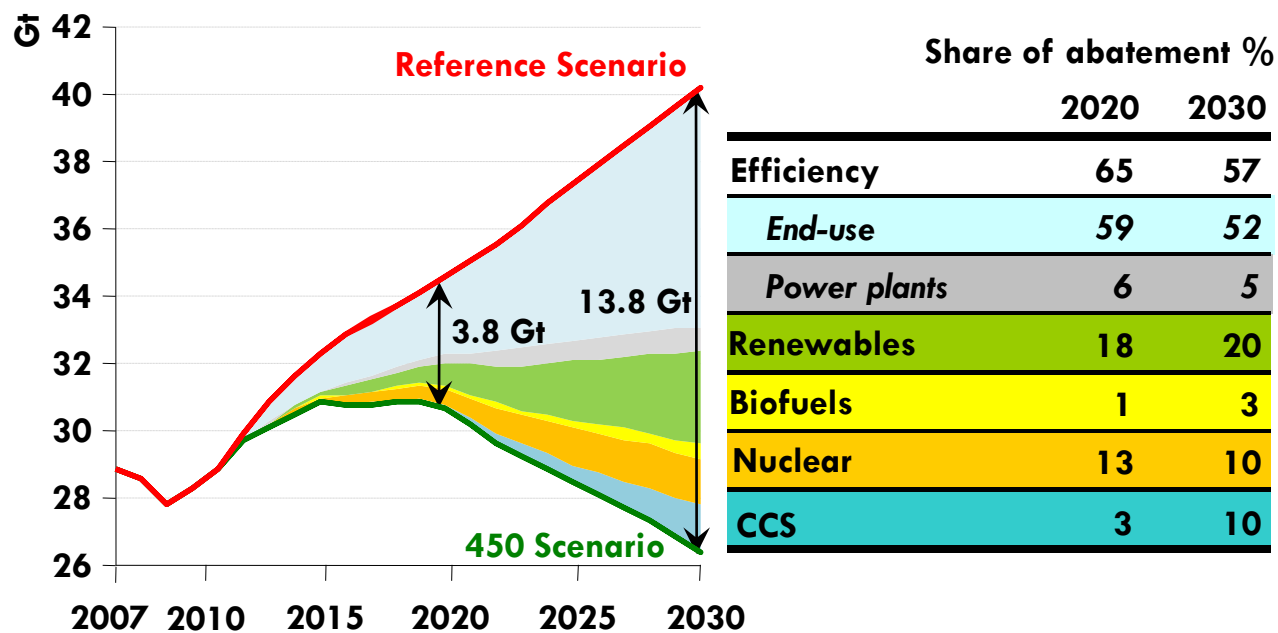


Critical Role of Renewable Energy to Climate Change Mitigation

Paolo Frankl & Cedric Philibert
Renewable Energy Division
International Energy Agency

COP 15 IEA Day Side Event
Copenhagen, 16 December 2009

World abatement of energy-related CO₂ emissions in the 450 Scenario



Renewable energy is the second largest contributor to CO₂ emissions abatement after energy efficiency

Critical Role of Renewables

- Part one: Critical Role of Technologies
Renewable Energy Technology Roadmaps
 - Wind
 - Solar PV
 - CSP
- Part two: Innovative drivers and policy instruments –
Cities, Towns and Renewable Energy - YMFY



RE TECHNOLOGY ROADMAPS

Wind, Solar PV, CSP

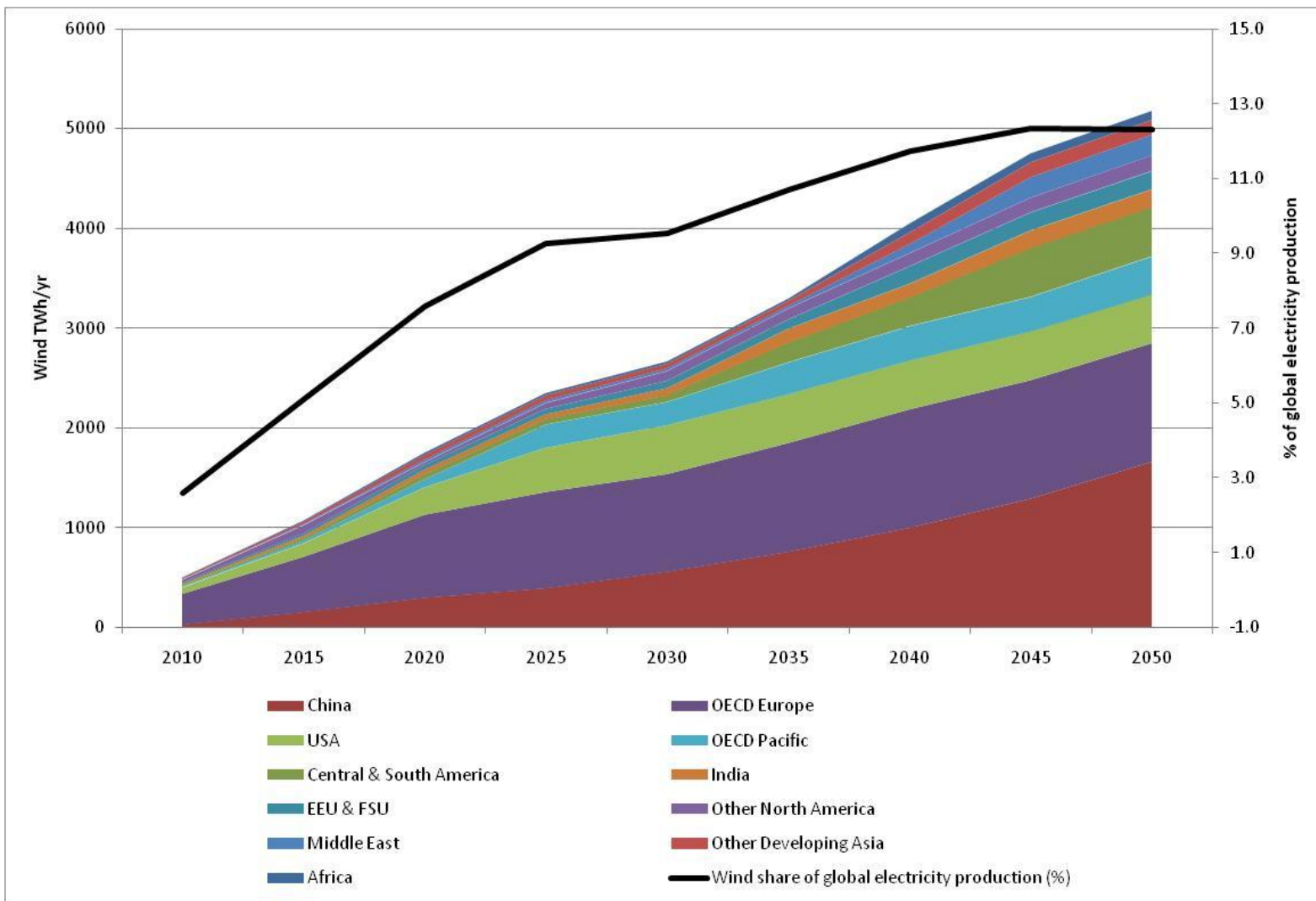
Contributions from

Hugo Chandler, Paolo Frankl, Tobias Rinke

Zuzana Dobrotkova, Stefan Nowak, Marcel Gutschner, Stefan Gnos

Wind roadmap targets

Regional wind electricity production to 2050 (TWh)

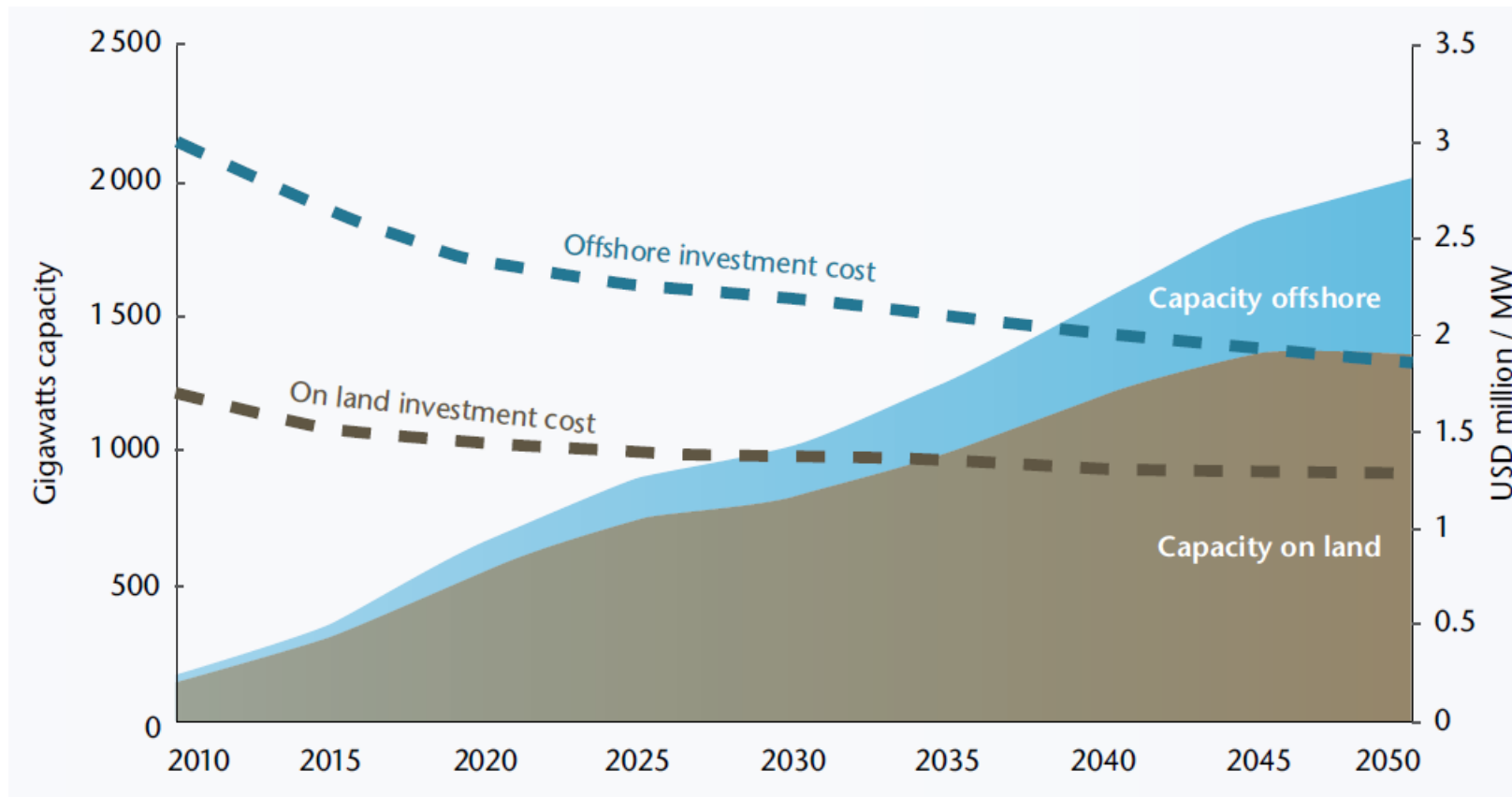


Source: IEA, Wind Energy Roadmap (forthcoming).

Wind has the potential to provide 12% of global electricity production in 2050

Global onshore and offshore deployment

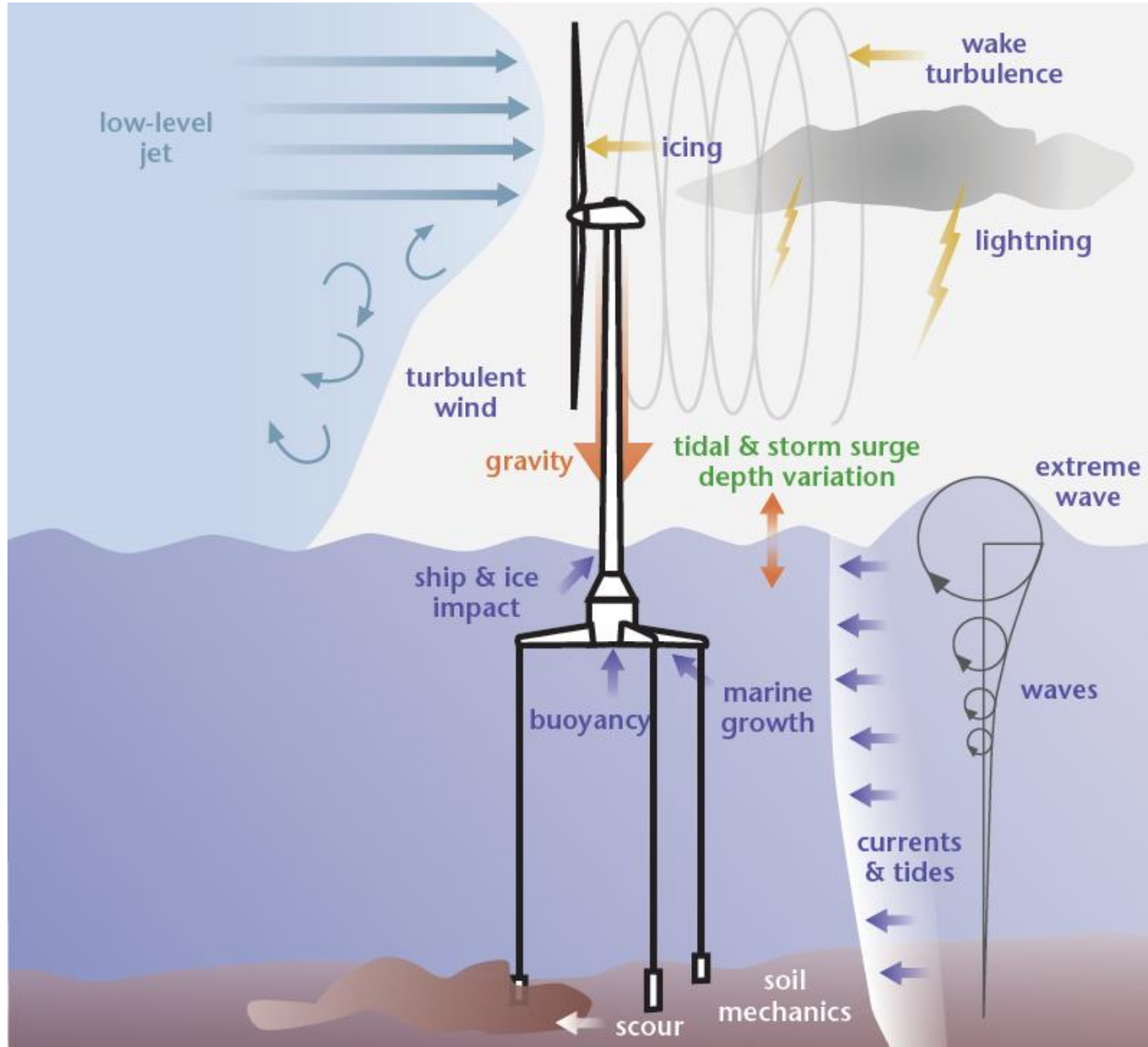
Wind power capacity development and investment cost reduction offshore and on land in the BLUE Map Scenario, to 2050



Source: IEA, Wind Energy Roadmap (forthcoming).

By 2050, 32% of wind capacity will be located at sea, up from 19% in 2030
Offshore technology is currently further from market than land based technology.

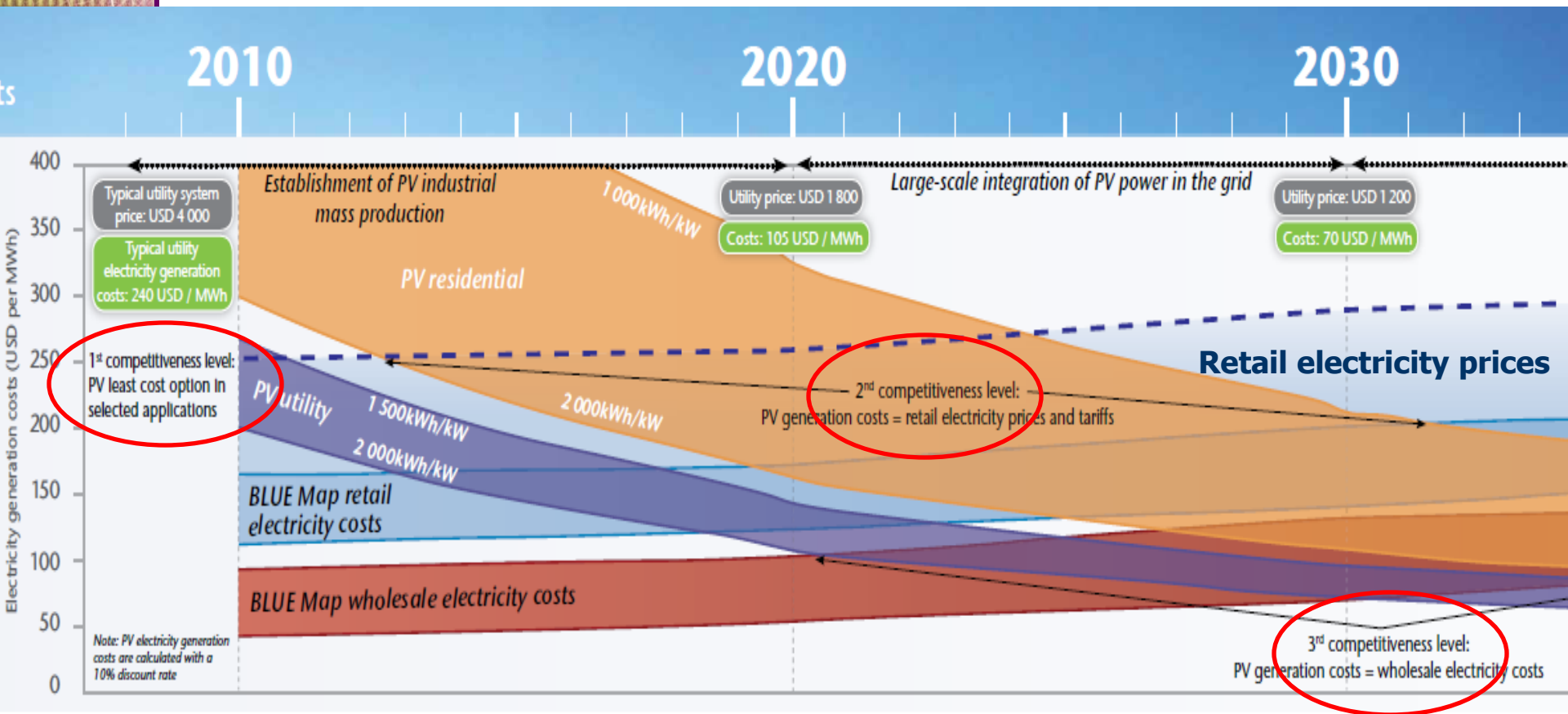
Off-shore raises challenges



Wind roadmap actions

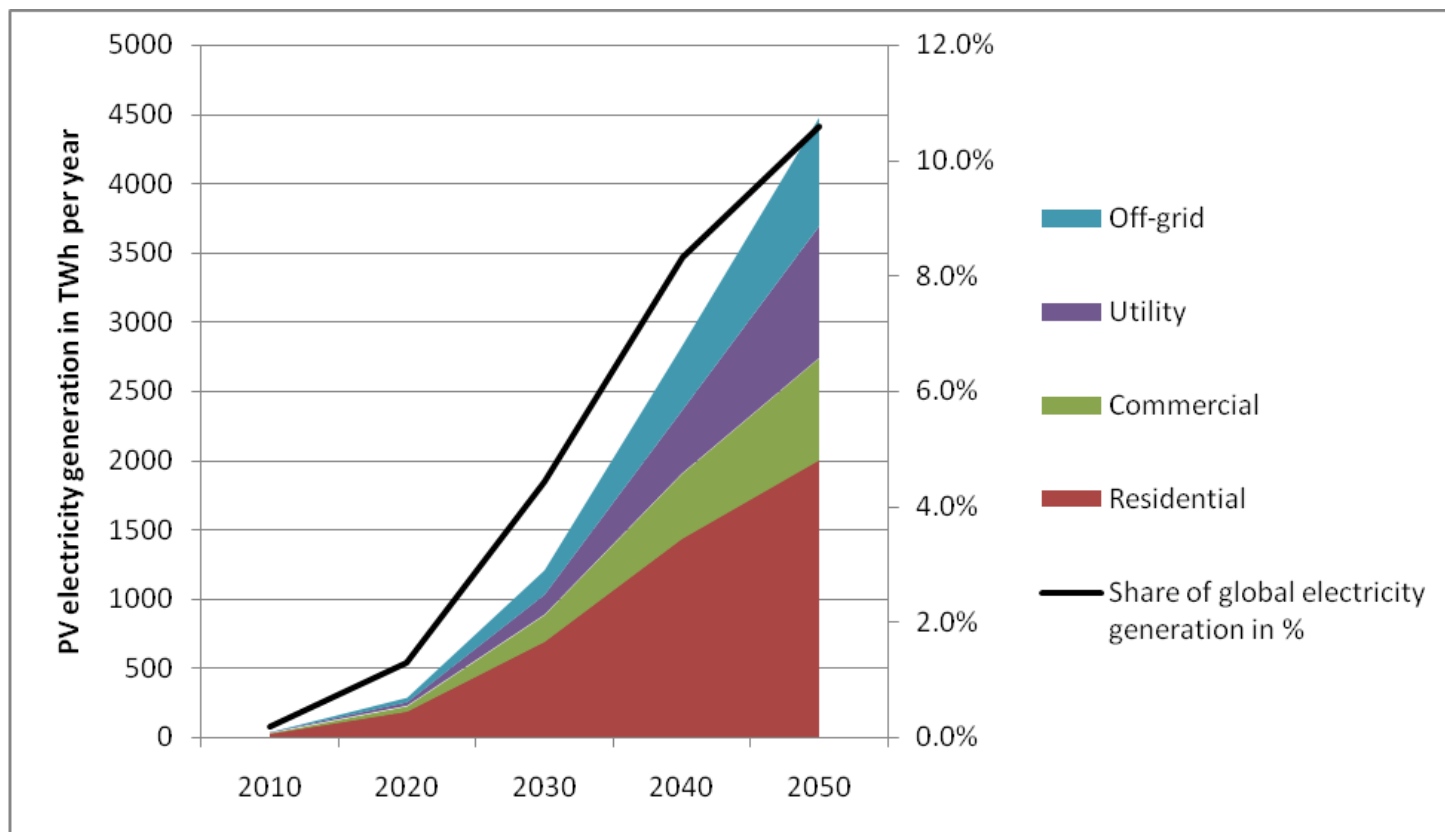
- Set long-term targets, supported by **predictable** policy
- Develop long-term, **strategic grid expansion plans**
- Increase the **flexibility of power systems** where large wind energy shares are targeted
- Raise **public awareness** of the benefits of wind power and of the need for new transmission
- Share best policy and technology practice with **developing countries**
- Strengthen **RD&D efforts** to drive targeted cost reductions particularly in the offshore sector

PV deployment and competitiveness levels



Solar PV Roadmap Vision Scenario

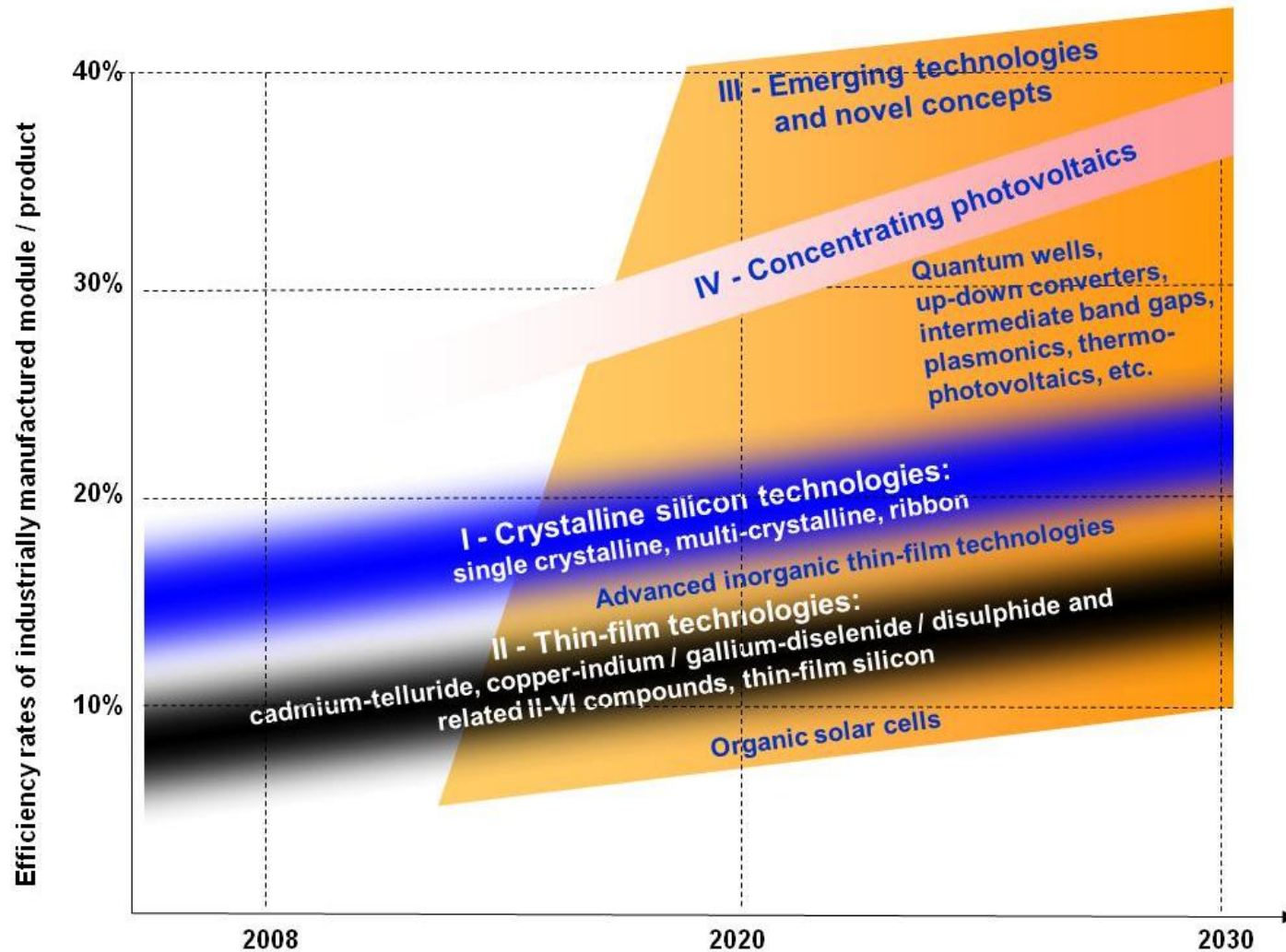
Solar PV electricity production by end-use sector (TWh/yr)



Source: IEA, Solar PV Roadmap (2009).

PV provides 5% of global electricity generation in 2030, 11% in 2050

PV technology status and prospects

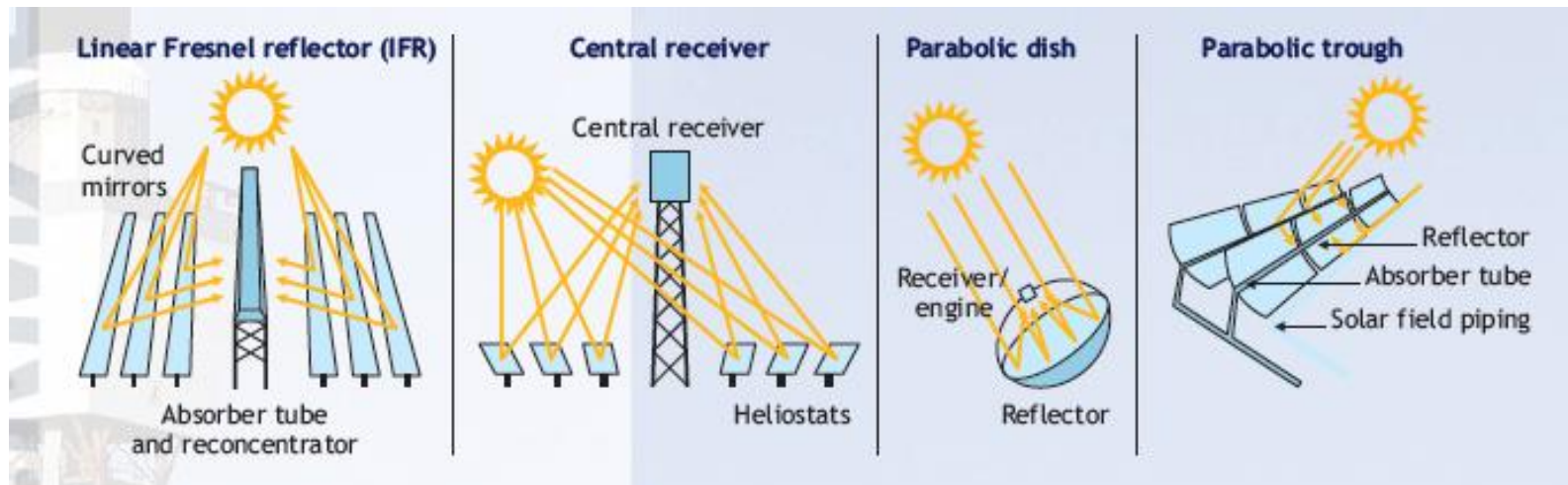


Source: IEA, Solar PV Roadmap (2009).

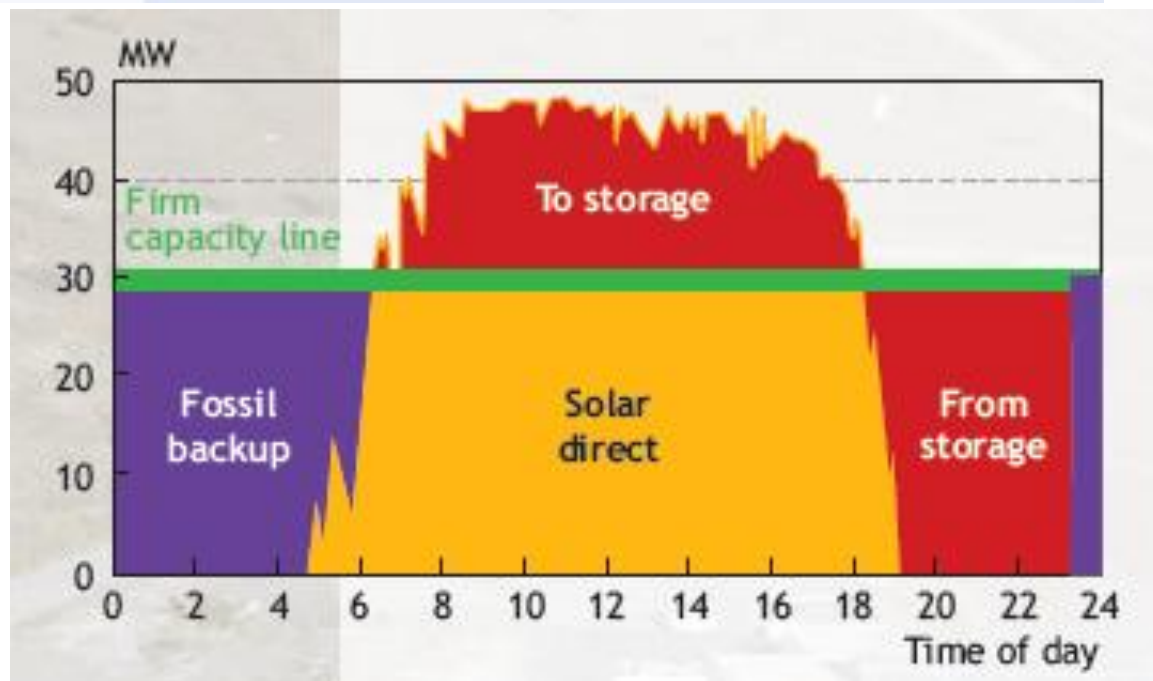
Key actions - Achieving grid parity and beyond

- Provide **long-term** targets and supporting policies
- Apply **effective incentive schemes** and create appropriate financing mechanisms
- Increase **R&D efforts** to accelerate deployment and cost reductions, while supporting longer-term breakthroughs
- Enhance **education and training** programmes
- Implement **efficient** administrative procedures

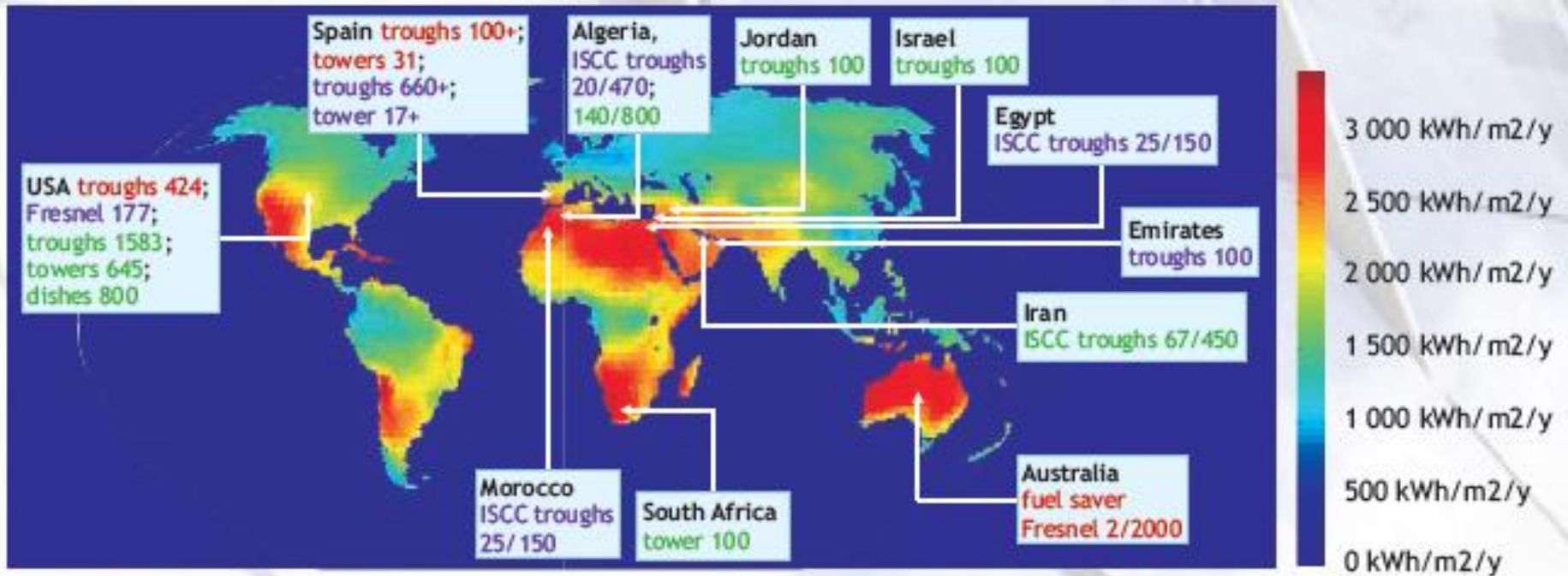
Concentrating solar power



**Storage &
back-up,
Power,
heat &
fuels**



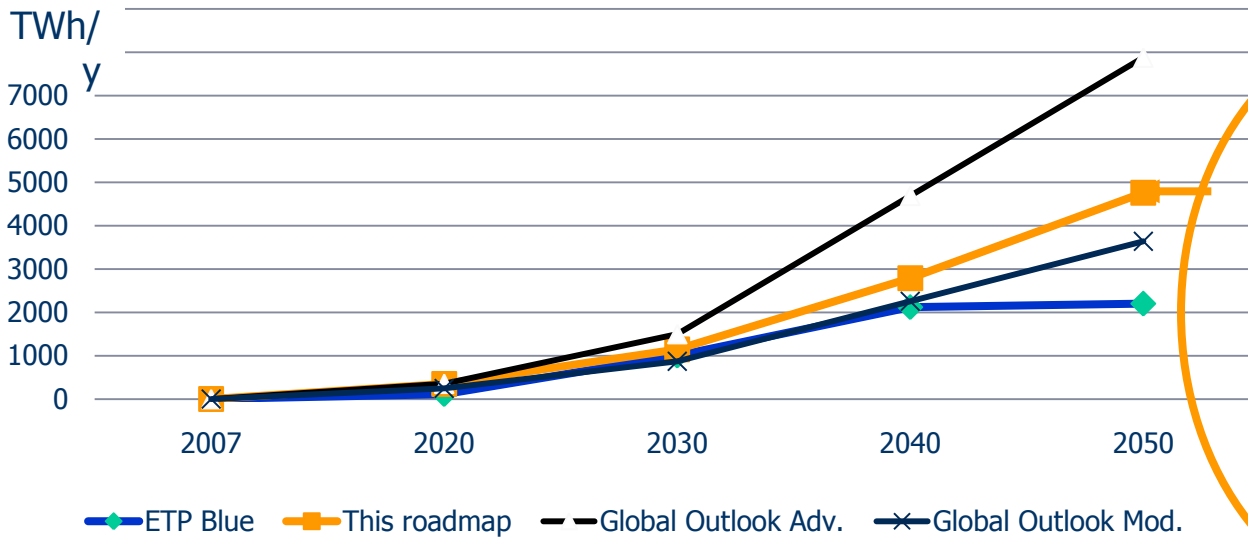
Resource and current market



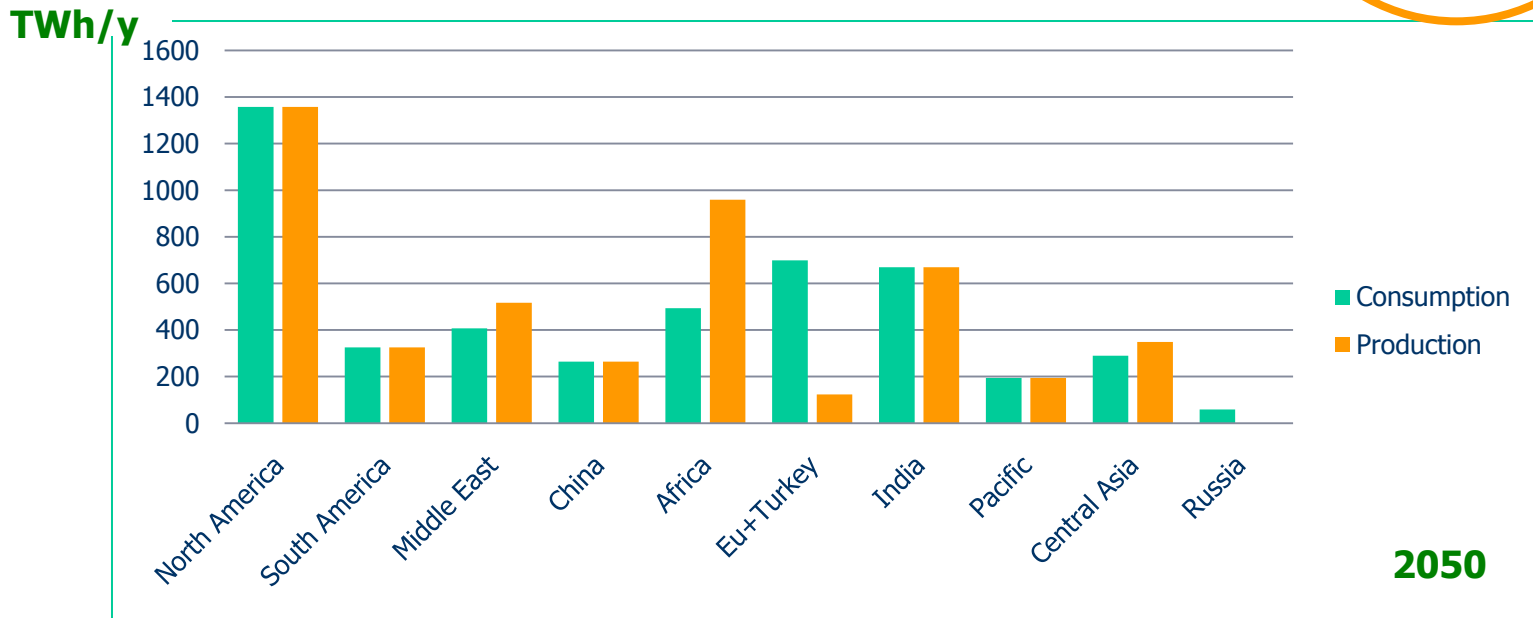
Legend: **existing capacities**; capacities under construction; **announced capacities**; xx: capacity in MWe. +: indicates large storage capacities (the capacity of the power plant is larger than the electrical capacity indicated); xx/yy: for Integrated Solar Combined Cycle or fuel saver systems, xx indicates the solar capacity, yy indicates the overall capacity.

CSP is where the sun shines and the sky is clear!

Roadmap preliminary results



11% global electricity by 2050, of which 9.5% solar only



Some Key Actions (*provisional*)

- ***CSP Industry***
- Increase **temperature** levels to reduce storage costs and increase efficiency
- Further develop **central receiver and storage** concepts
- ***Utilities***
- Reward firm **capacities**
- ***Governments***
- Ensure funding to public and private **R, D & D**
- Establish feed-in tariffs or binding RPS, on a **par** with large-scale PV
- Lift arbitrary limitation on plant **size** and on **hybridisation** ratios
- Streamline permitting **procedures**
- Develop incentive schemes for **process heat** and **fuels**
- Collaborate on **cross-border** HVDC lines and incentive schemes

Up to 9 Gt CO₂ emissions avoided by 2050

- From wind power
 - 2.1 Gt CO₂ per year in 2050 above reference
 - 2.8 Gt CO₂ per year in 2050 total
- From solar PV
 - 2.4 Gt CO₂ per year in 2050
- From solar CSP
 - 2.1 Gt p CO₂ er year in 2050 from power
 - 0.65 Gt CO₂ per year in 2050 from gaseous solar fuels
 - 0 CO₂ from liquid fuels (in the Blue scenario)
- Total:
 - **over 8 Gt CO₂ ₂ above reference**
 - **9 Gt CO₂ total**

Further info and contacts

- IEA PV Roadmap website
<http://www.iea.org/roadmaps>
- RE Roadmap Contacts
 - WindRoadmap@iea.org
 - PVRoadmap@iea.org
 - CSPRoadmap@iea.org
- IEA Roadmap Coordinator
 - Tom.Kerr@iea.org



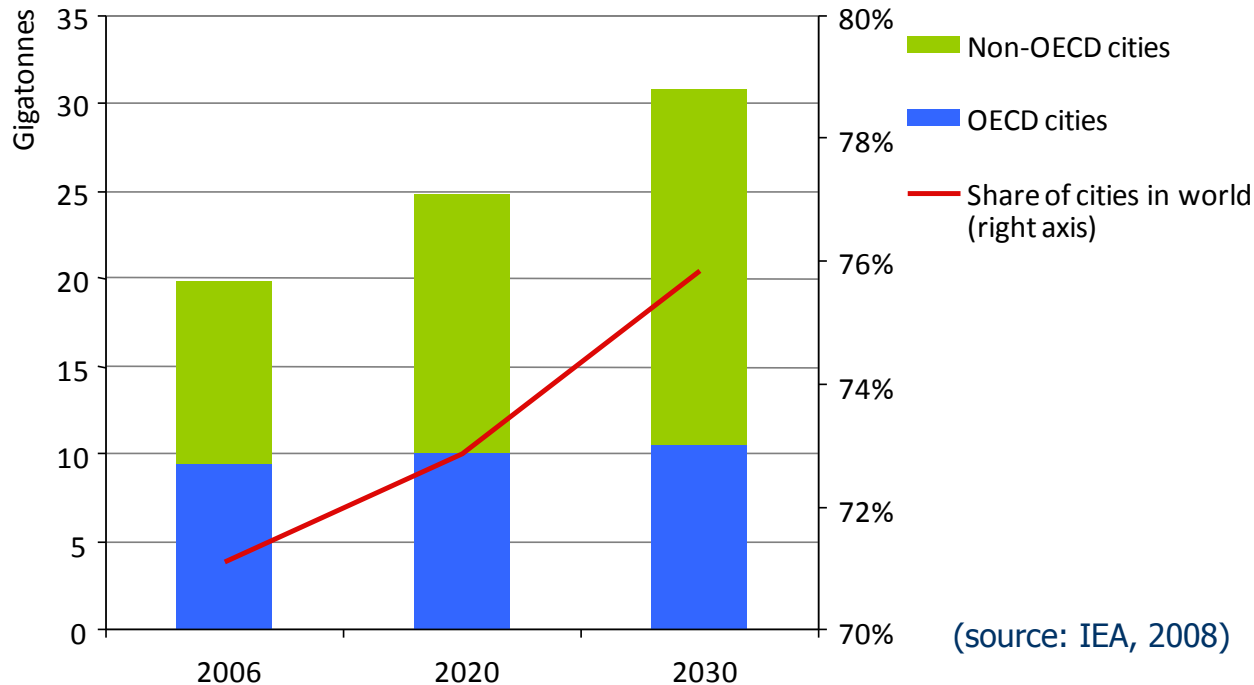
CITIES, TOWNS & RENEWABLE ENERGY

Acknowledgements

- Prof **Ralph Sims** – main author
- Rachel Hodas (RED) – case studies
- Milou Beerepoot, Cedric Philibert (RED) – review
- Many other IEA and external colleagues who provided input and review

Why cities & towns?

-> share of CO₂ emissions



(source: IEA, 2008)

- CO₂ emissions in cities grow by 1.8% per year (vs. 1.6% globally) between 2006 and 2030
- Share of global CO₂ from cities: 71% in 2006
76% in 2030

Why cities & towns?

-> local responsibilities

Cities & towns regulate

- Land use
- Infrastructure
- Public transport



Why cities & towns?

-> close to community

Cities & towns have proximity to

- Citizens
- Local business



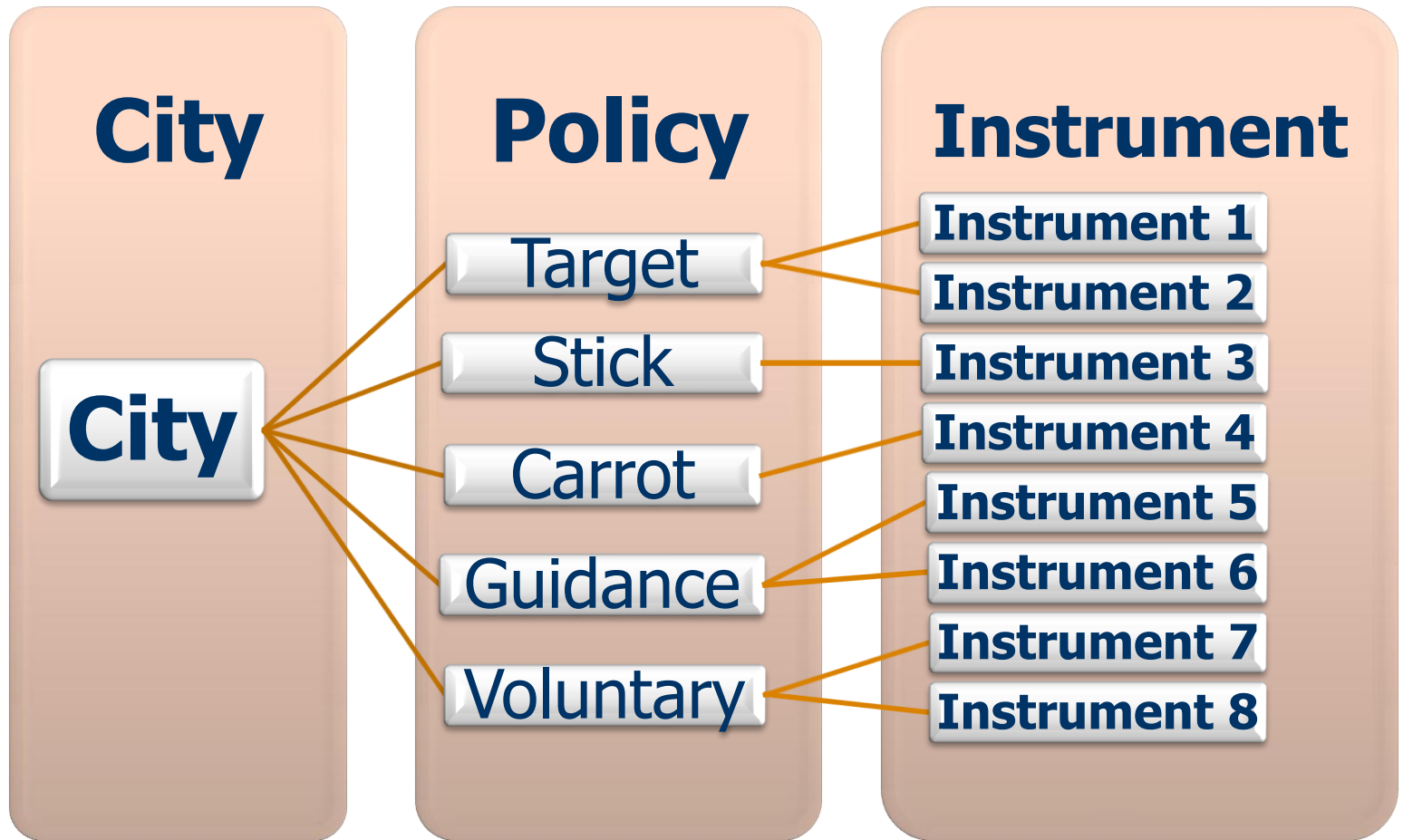
"Desirable and dramatic changes often come from a combination of bold moves by the city, together with thousands of individual choices made by the citizens and local market"

Mary MacDonald, Climate Change Advisor to the mayor of Toronto

Case-studies

City / town	Population	Category
Tokyo, Japan	12.400.000	Wealthy mega-city
Capetown, S-Africa	3.400.000	Developing mega-city
Nagpur, India	2.100.000	Developing large city
Adelaide, Australia	1.160.000	Wealthy large city
Merton, London, UK	200.000	Mega-city leading district
Freiburg, Germany	200.000	Medium town
Växjö, Sweden	78.000	Small town
Palmerston North, NZ	75.000	Small town
Masdar City, UAE	40.000	Urban planning from new
El Hierro, Spain	10.000	One of Canary Islands
Samsø, Denmark	4.400	Island for comparison
Güssing, Austria	3.800	Small community – rural
Greensburg, USA	1.600	Rebuilding after tornado

Case-studies



Why should they do it?

-> reducing air pollution

- Masdar City (UAE): No fossil-fuel vehicles allowed, underground - RES powered - transportation system



Why should they do it?

-> encouraging economy

- Foster the local economy
- Create employment for both skilled and unskilled workers



How can they do it?

-> leadership

City	City target RES	National target
Tokyo (JP)	20% RES by 2020	3% RES by 2010
Adelaide (AU)	33% RES-E by 2020	8% RES by 2020
Växjö (SE)	54% RES today	49% RES by 2020
Masdar City (UAE)	CO2 neutral (2013)	7% RES by 2020
El Hierro (ES)	100% RES-E today	20% RES by 2020
Samsø (DK)	100% RES today (except T)	20% RES by 2011
Güssing (AT)	100% RES today	34% by 2020

City	City target CO2	National target
London (UK)	60% CO2 reduction 2025 compared 1990	26% CO2 reduction 2020 compared 1990

How can they do it?

-> authority

- Barcelona:
Barcelona Solar Ordinance



How can they do it?

-> guidance

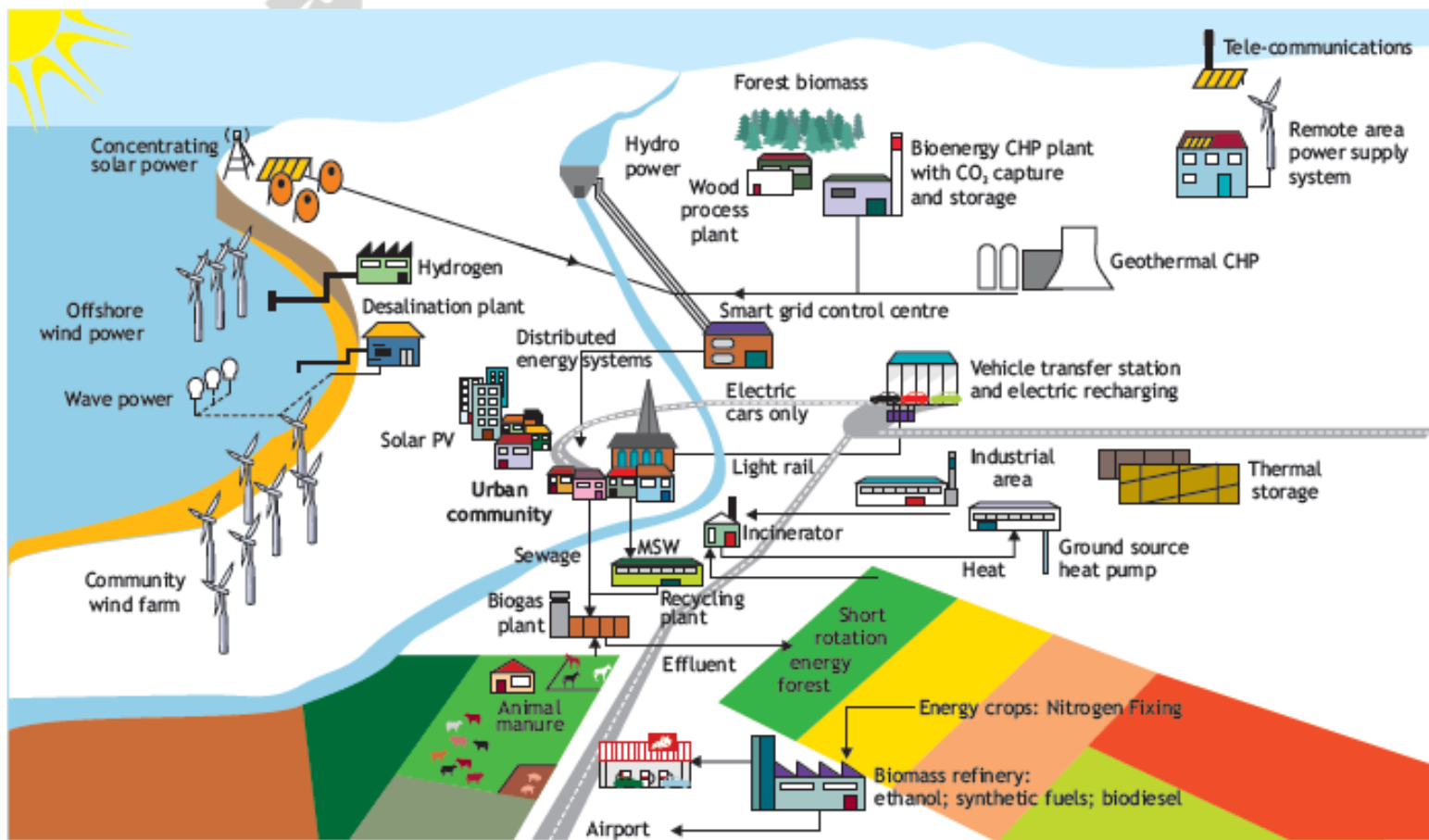
- Adelaide, Australia
1,16 million inhabitants



Conclusions

- Cities and towns can **do more** than national authorities!
- Cities and towns have the advantage of **proximity of citizens** and markets to create **YIMFY** effect
- Renewables can be **coupled with energy efficiency** measures
- Examples show strong **environmental measures** to go hand-in-hand with economic & social benefits
- If these successes could be **replicated** one hundredfold, then cities could become facilitators of change in the energy sector

City of the future?



Links

- www.iea.org
- Cities, Towns & Renewable Energy – Yes in My Front Yard
 - [Home](#) > [Publications](#)
- Contacts
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