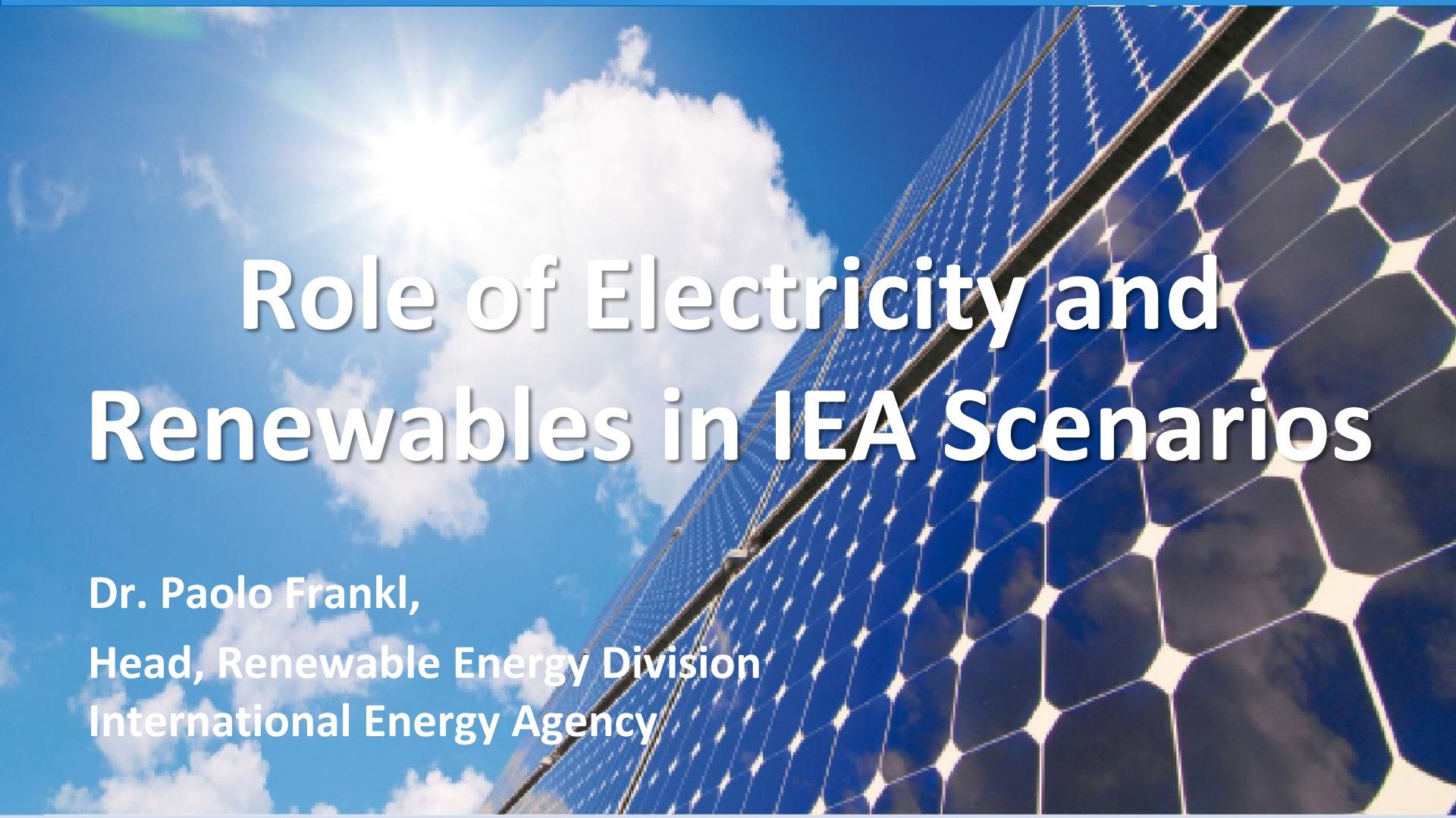
RENEWABLE ENERGY

International Energy Agency



Role of Electricity and Renewables in IEA Scenarios

Dr. Paolo Frankl,

Head, Renewable Energy Division

International Energy Agency

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Contents

- Towards COP21 - Climate pledges: a first step in the right direction
- Renewables deployment: drivers, recent trends and medium-term forecast
- The role of electricity in long-term scenarios
- Flexible power systems to integrate large shares of wind and solar
- The importance of transmission and interconnections

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Climate pledges shift the energy sector

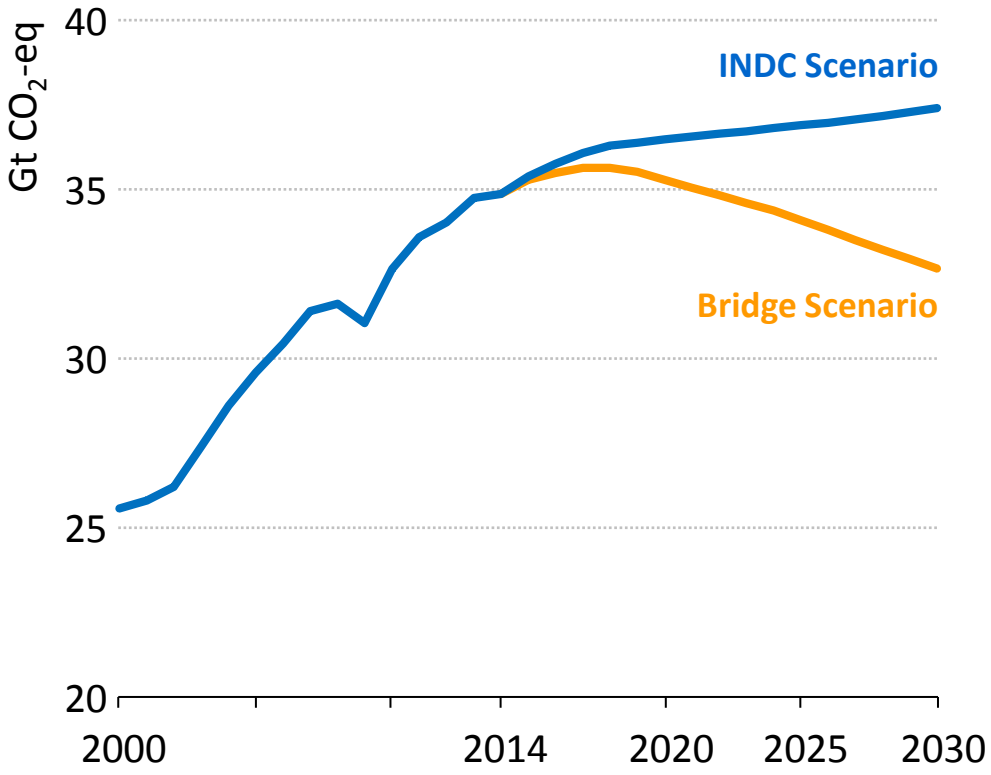
- One-quarter of the world's energy supply is low carbon in 2030; energy intensity improves three-times faster than the last decade
- Renewables reach nearly 60% of new capacity additions in the power sector; two-thirds of additions are in China, EU, US & India
- Natural gas is the only fossil-fuel that increases its share of the global energy mix
- Total coal demand in the US, Europe & Japan contracts by 45%, while the growth in India's coal use slows by one-quarter
- Climate pledges for COP21 are the right first step towards meeting the climate goal

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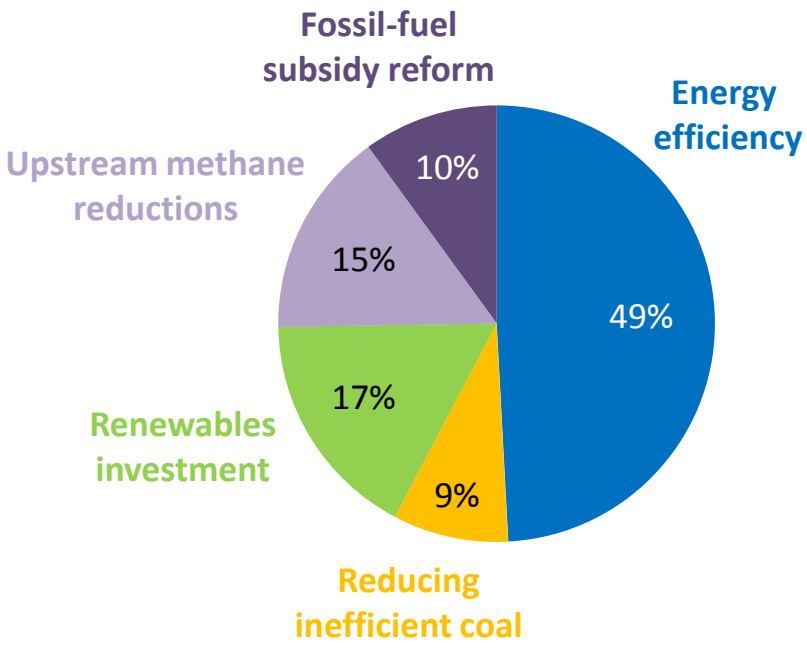
1. Peak in emissions:
IEA strategy to raise climate ambition

WEO Special Report on Energy & Climate Change

Global energy-related GHG emissions



Savings by measure, 2030

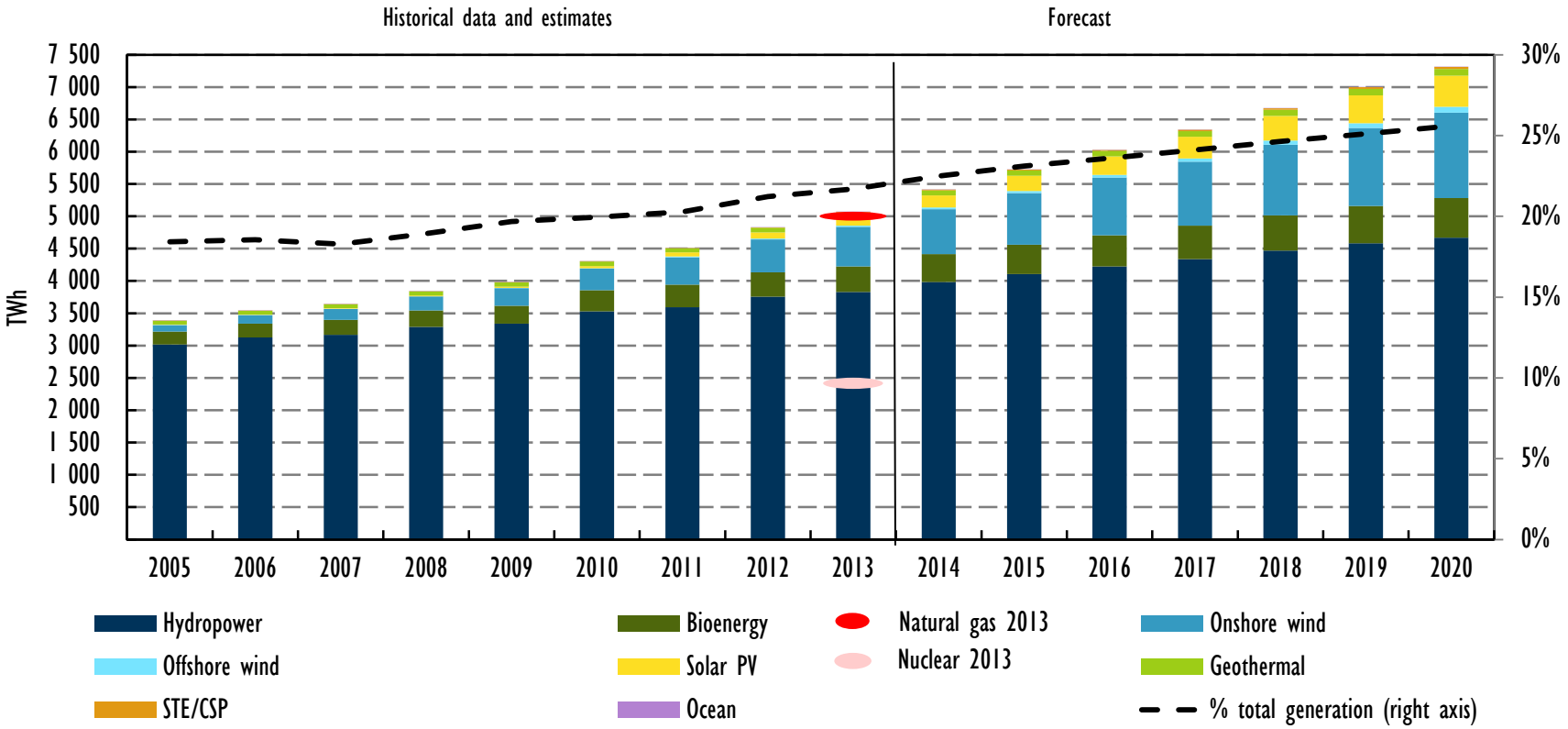


Five measures – shown in a "Bridge Scenario" – achieve a peak in emissions around 2020, using only proven technologies & without harming economic growth

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Strong momentum for renewable electricity

Global renewable electricity production, historical and projected

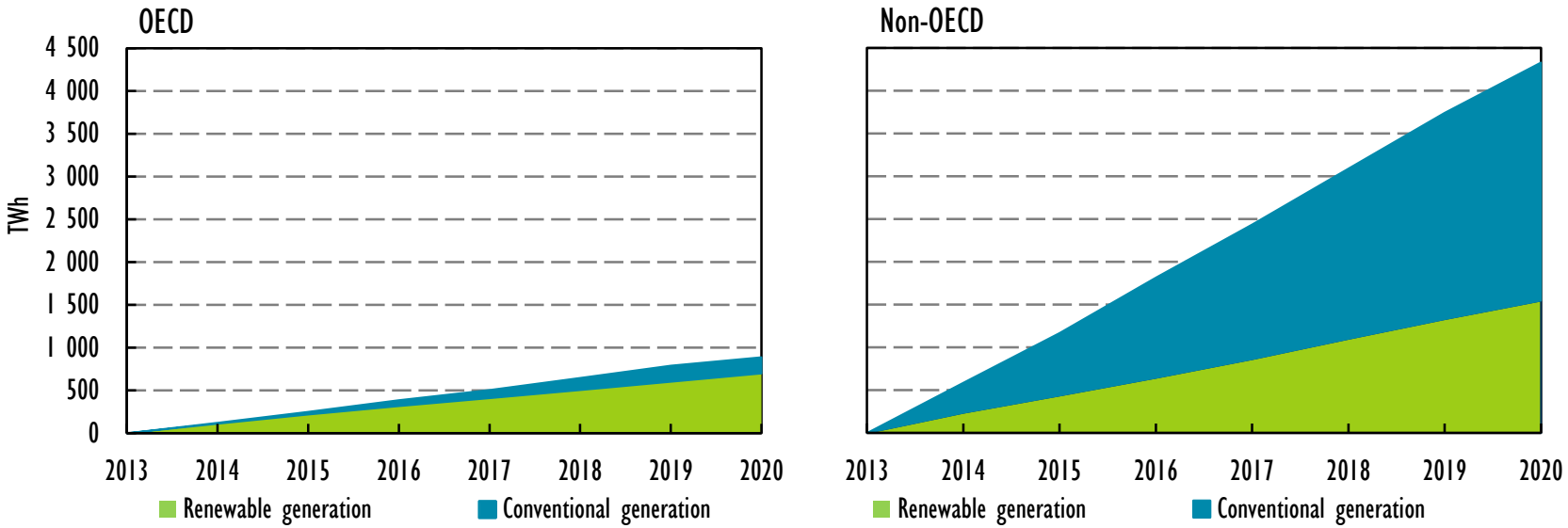


- Renewable electricity projected to scale up by 45% from 2013 to 2020
- Around 26% of world electricity from RE in 2020

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Different Drivers and Growth Trends

Cumulative change in gross power generation by source and region, 2013-20



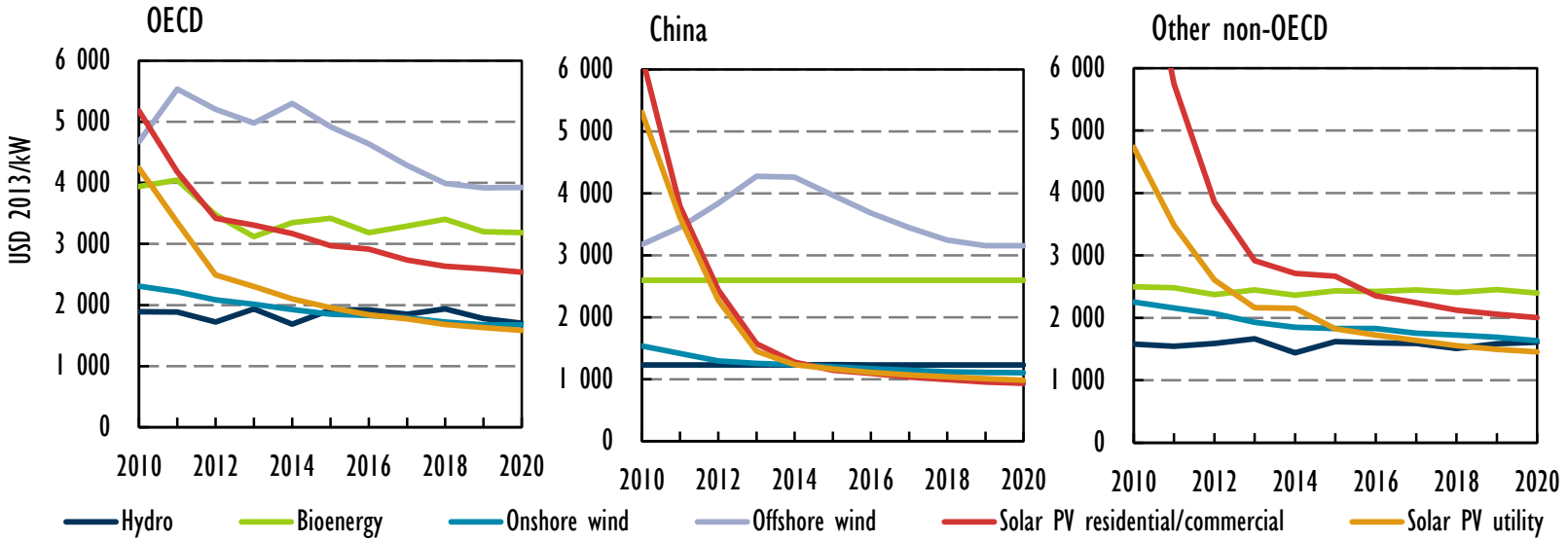
- Renewables account for 80% of new generation in OECD
- Decarbonisation main driver
- Limited upside in stable markets with slow demand and growing policy risks

- Renewables are largest new generation source in non-OECD, but meet only 35% of growth
- Main drivers:
  - Fast-growing demand
  - Energy security and diversification
  - Local pollution

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Renewable investment costs falling

Weighted average annual renewable investment costs, historical and projected

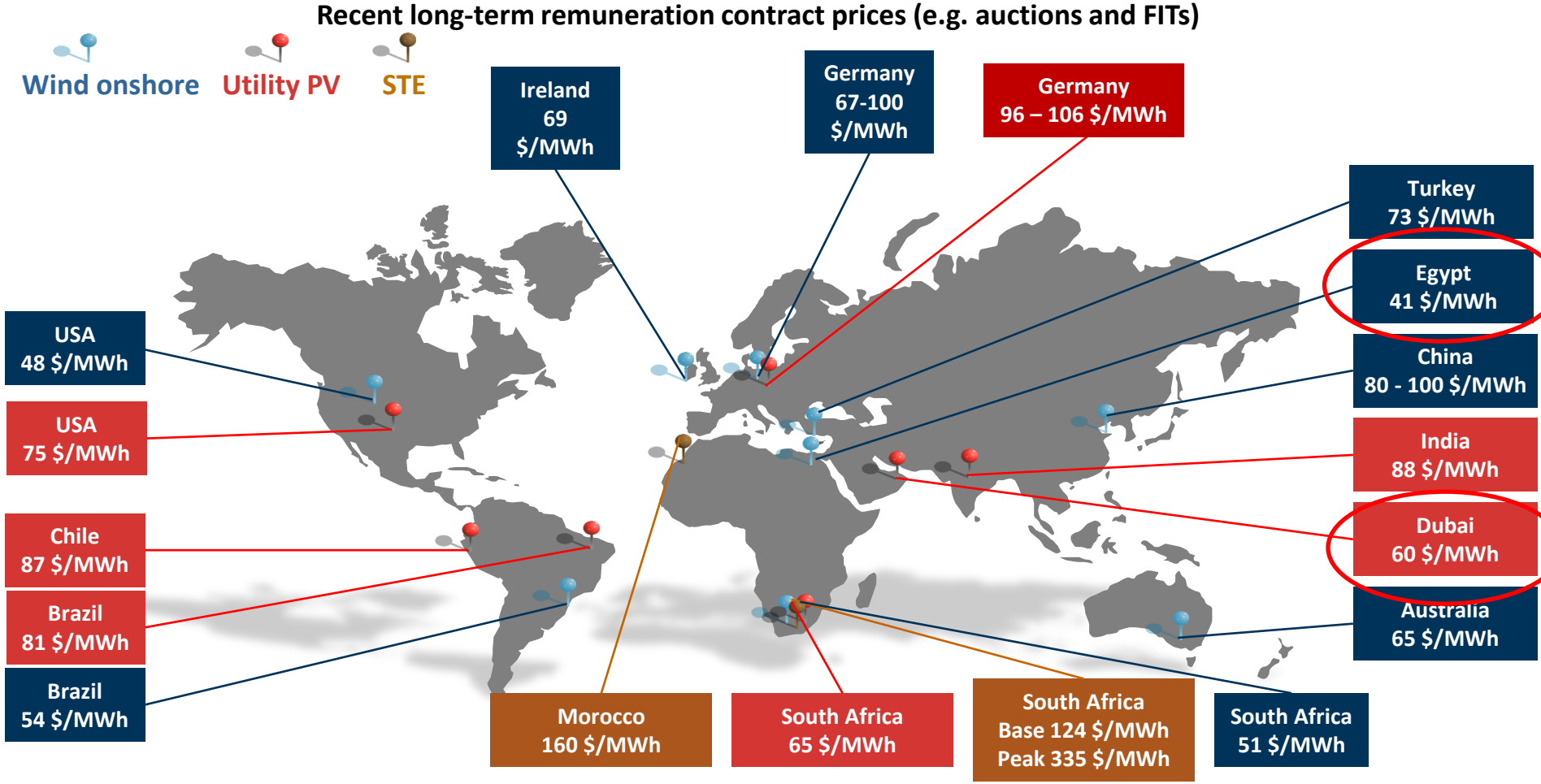


Notes: Average unit investment costs are based on gross additions, which include capacity refurbishments that are typically lower cost than new capacity. Costs vary over time due to technology changes as well as where deployment occurs in a given year..

- **With scale up of deployment and learning, investment costs of most dynamic technologies (e.g. solar PV and onshore wind) continue to fall**

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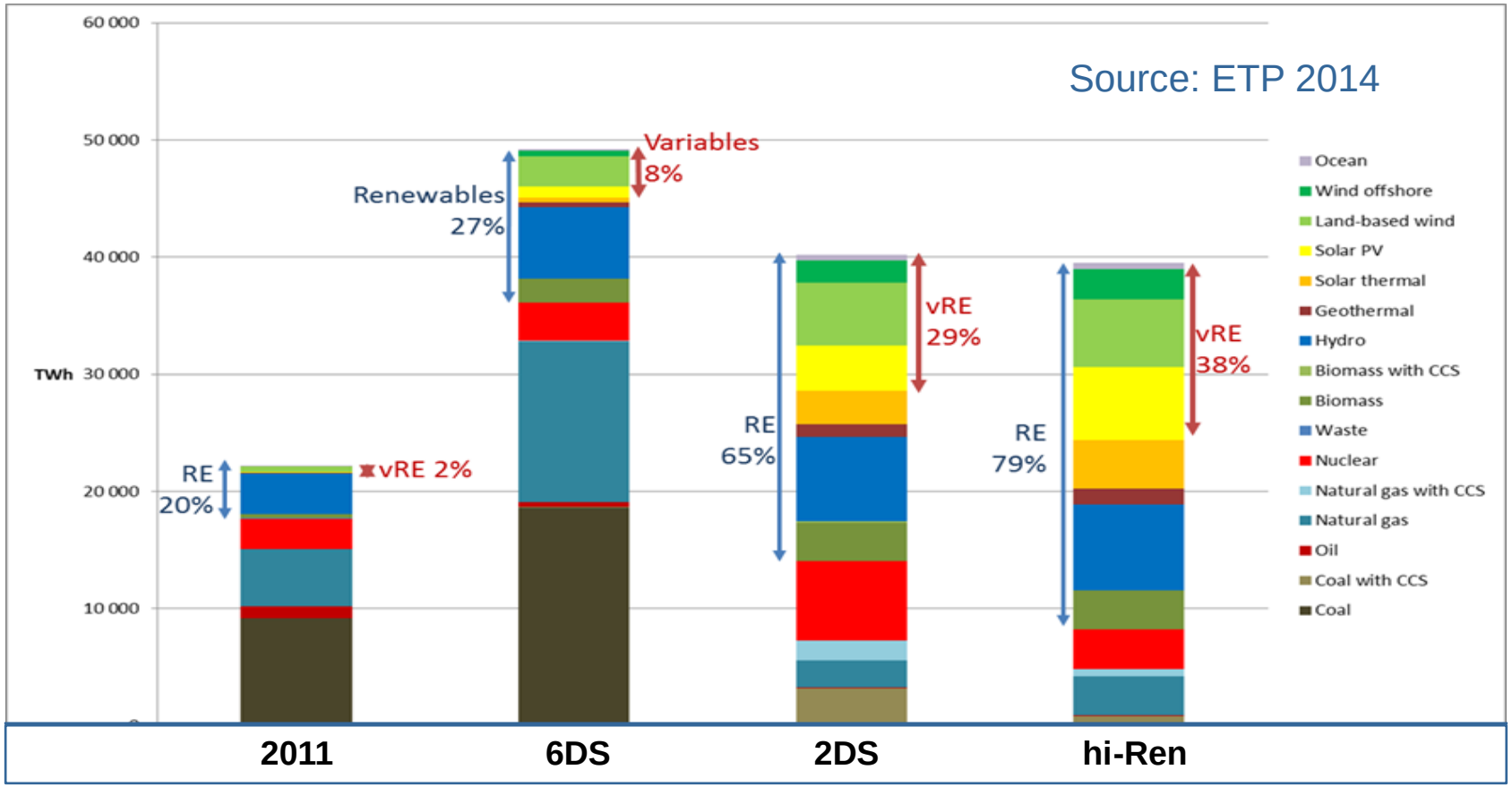
Recent progress in RE electricity generation costs



- Combination of technology cost reduction, better resources, appropriate regulatory framework attracting financing
- Long-term PPAs and price competition effective drivers for reducing costs

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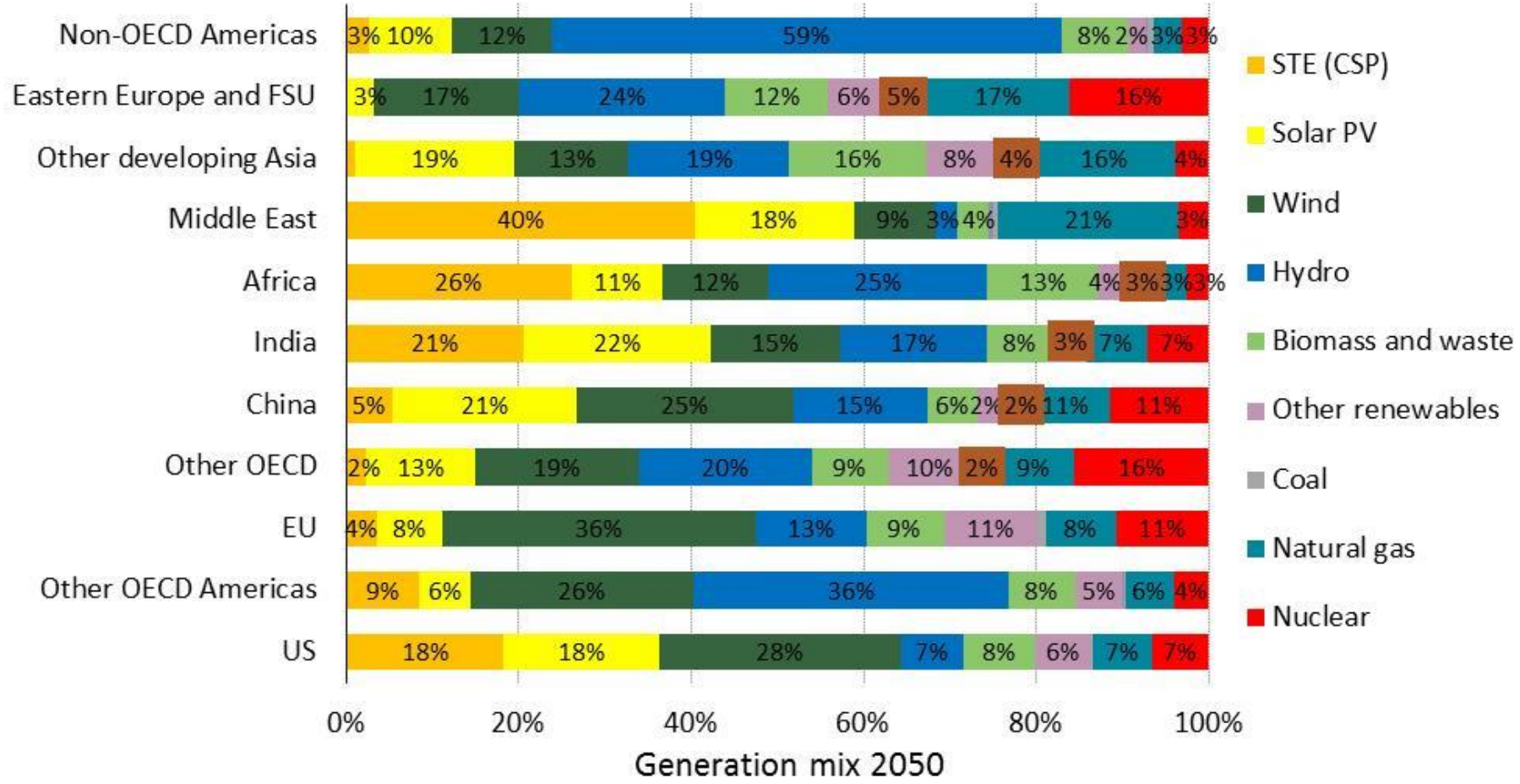
An Energy Revolution is needed



- **Generation today:**
  - **Fossil fuels: 68%**
  - **Renewables: 20%**
- **Generation 2DS 2050:**
  - **Renewables: 65 - 79%**
  - **Fossil fuels: 20 - 12%**

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Different optimal power mixes in different regions by 2050

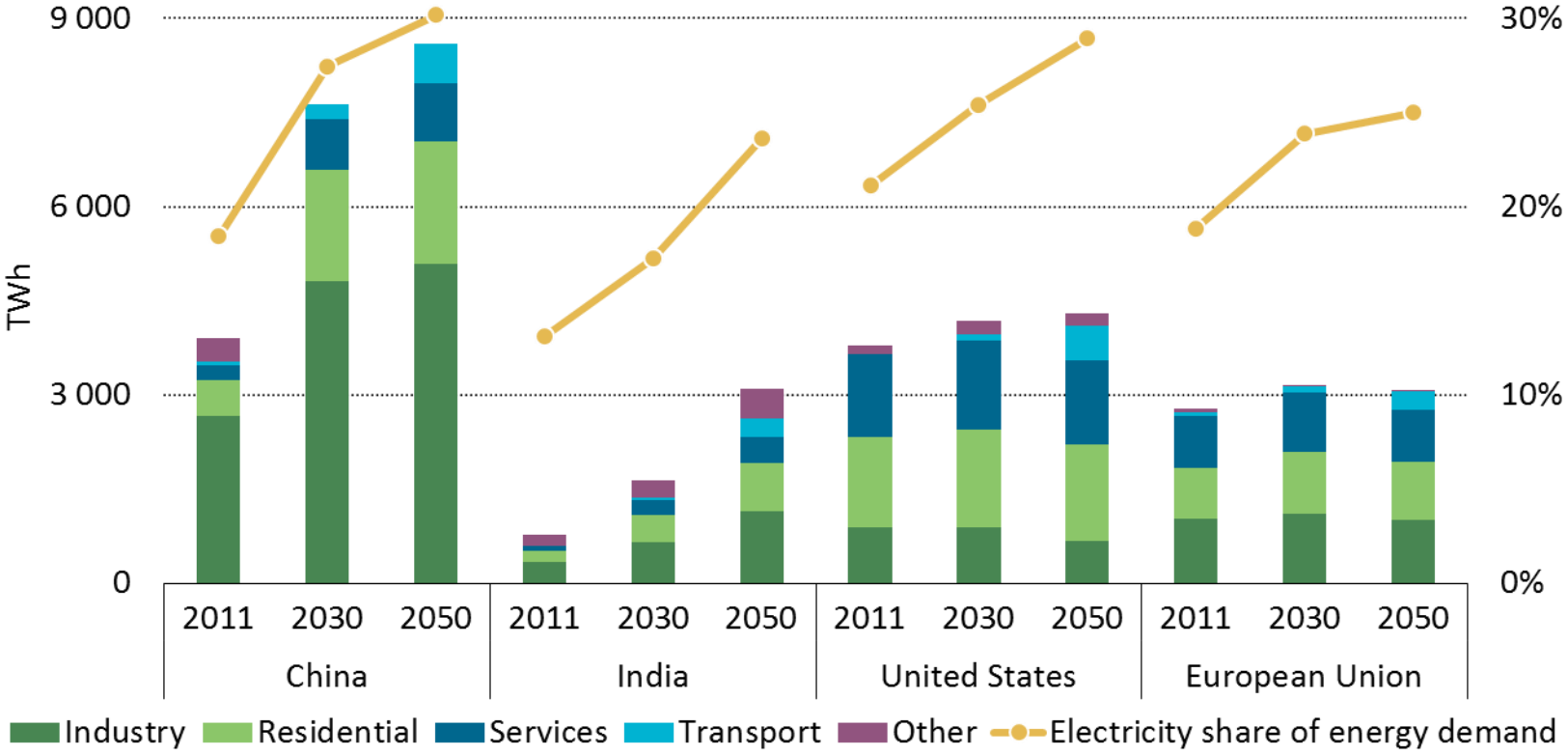


Source: *Energy Technology Perspectives 2014*

Source: ETP 2014

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Electricity Penetration increases everywhere in 2DS

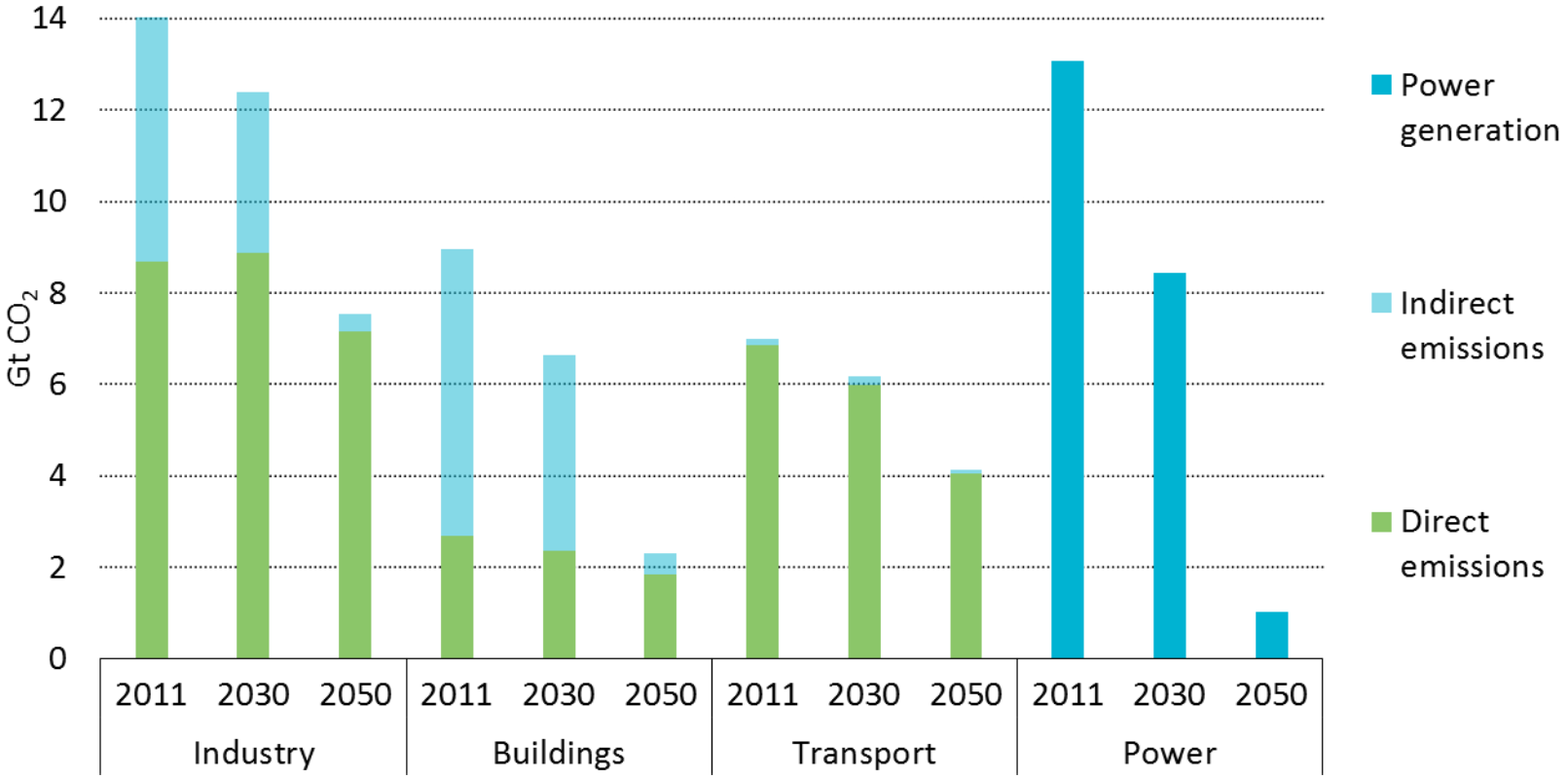


Source: ETP 2014

Differences in growth of *electricity* demand and sectoral distribution require targeted systems development plans

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Spillover effect of decarbonising electricity in the 2DS

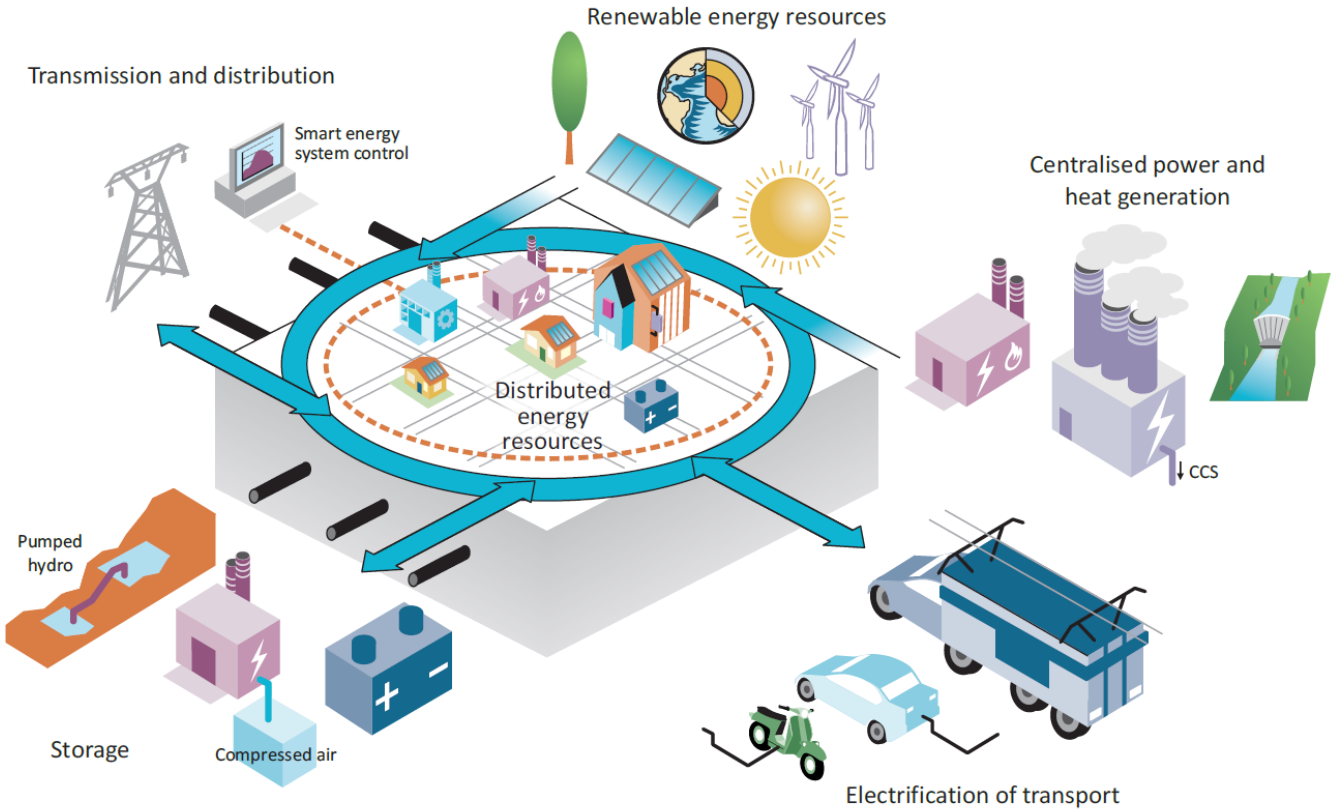


Source: ETP 2014

Electricity decarbonisation reduces emissions from sectors already electrified, without the need for further end-use investments.

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Systems thinking and integration



Source: ETP 2014

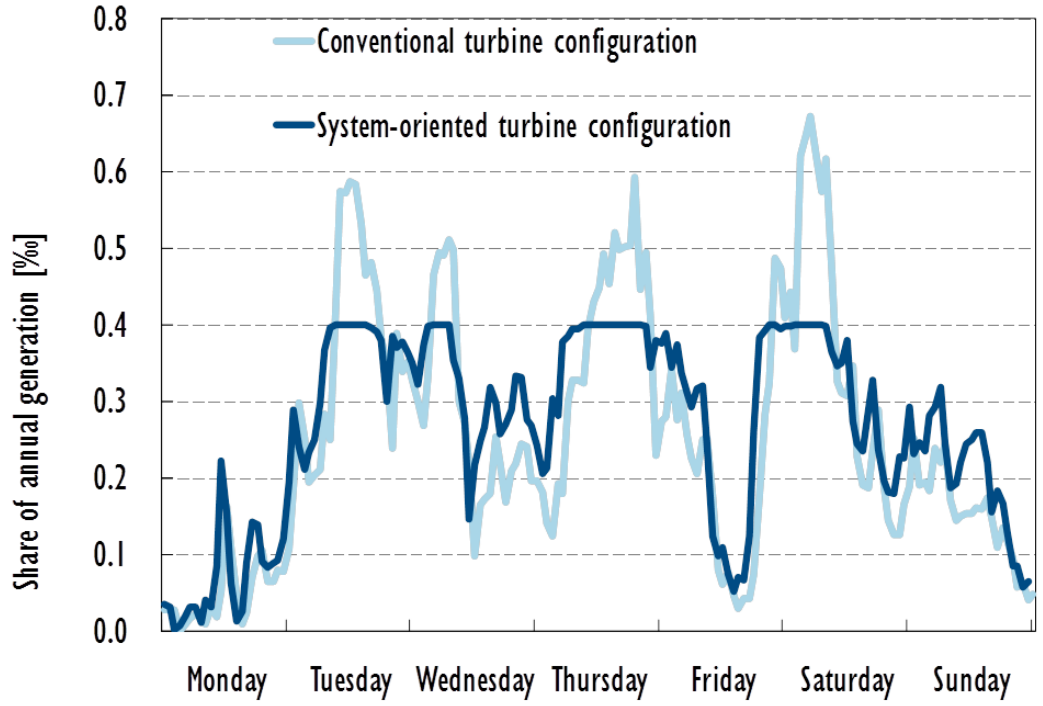
A sustainable electricity system is a smarter, multidirectional and integrated energy system that requires long-term planning for services delivery

Increasing variable RE will need more System Flexibility

1) Foster System-friendly RE

2) Better market design & operation

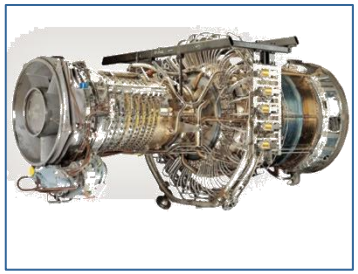
3) Increase flexibility of other power system components



Grids



Generation



Storage

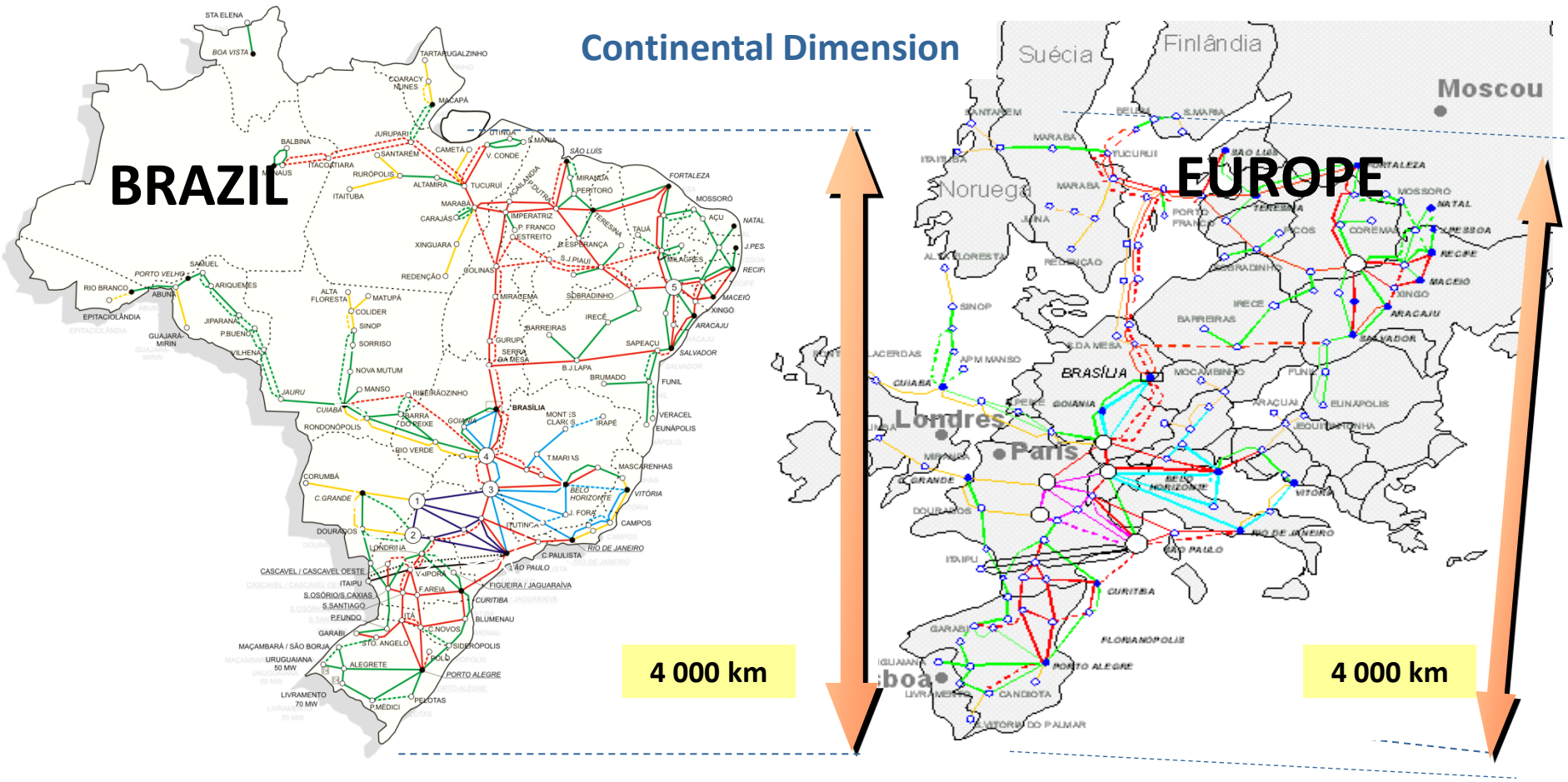


Demand Side



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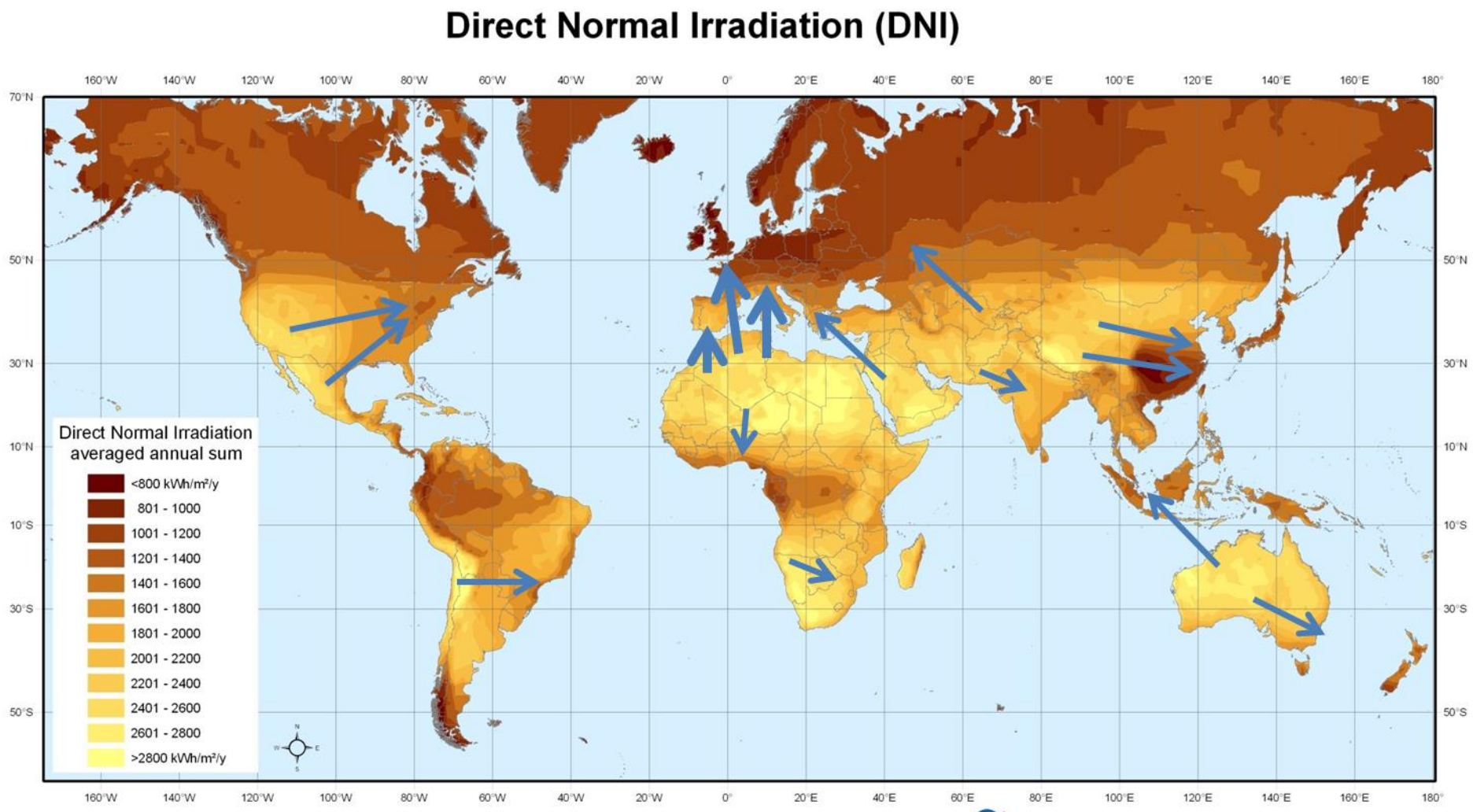
Importance of grids



- **Interconnected continental-scale balancing areas smoothen out variability and allow to exploit seasonal complementarities**

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Future possible interconnections – Solar Thermal Electricity



Source: Adapted from STE Roadmap 2014

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Policy implications: Enabling environment is crucial

before 2013

Main Policy

2014-2020

Providing financial support

Enabling policy and market framework which allows low cost financing and generation

Cost reduction

Cost reduction through
- Technology development
- Scale up
- Learning

Cost reduction through
- Technology **innovation**
- Financial **innovation**
- New markets with best resources

Key Characteristics

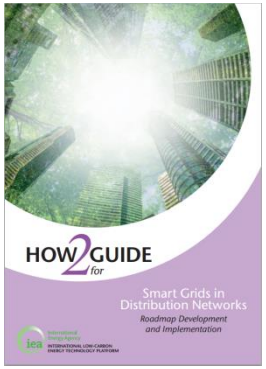
- **Competition**
- **Predictable long-term income streams**
- **Short-term market value signals**
- **Portfolio development**
- **System Integration**

Areas for innovation

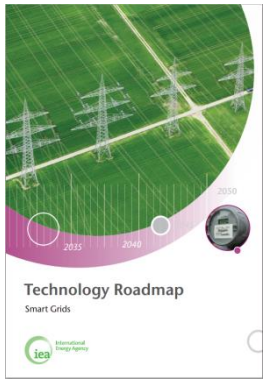
- **Electrification of end-use**
- **Interconnections**
- **Demand side response**
- **Storage**
- **System-friendly RE design**
- **Market design**
- **Smart grids**

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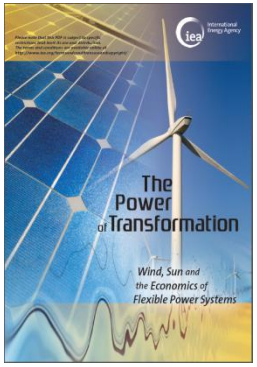
For more info on Smart Grids and RE



"Technology Roadmap How2Guide for Smart Grids in Distribution Networks: Roadmap Development and Implementation" (2015)



"Smart Grids, IEA Technology Roadmaps" (2011)



"The Power of Transformation: Wind, Sun and the Economics of Flexible Power Systems" (2014)



"Energy Technology Perspectives 2015"



"Medium-Term Renewable Energy Market Report" (2014)

Thank you for your attention!

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