Energy Technology Perspectives 2014: a look at Energy Systems Integration

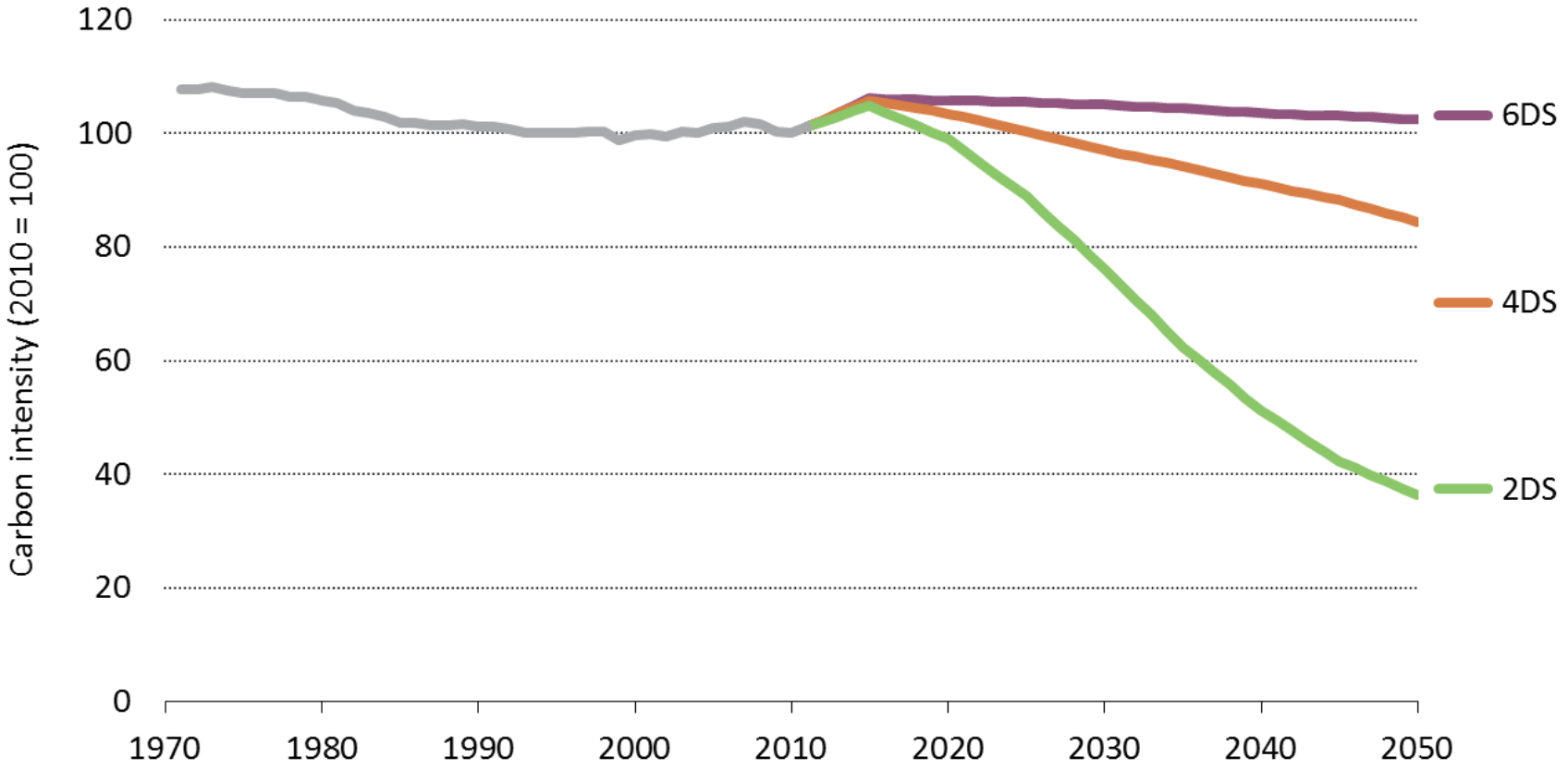
iiESI European Workshop, DTU

27 May, 2014

International Energy Agency

Understanding various potential futures

ETP 2014



Carbon Intensity of supply is stuck *- The political will to make meaningful progress at a global scale has yet to be demonstrated*

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A transformation is needed…

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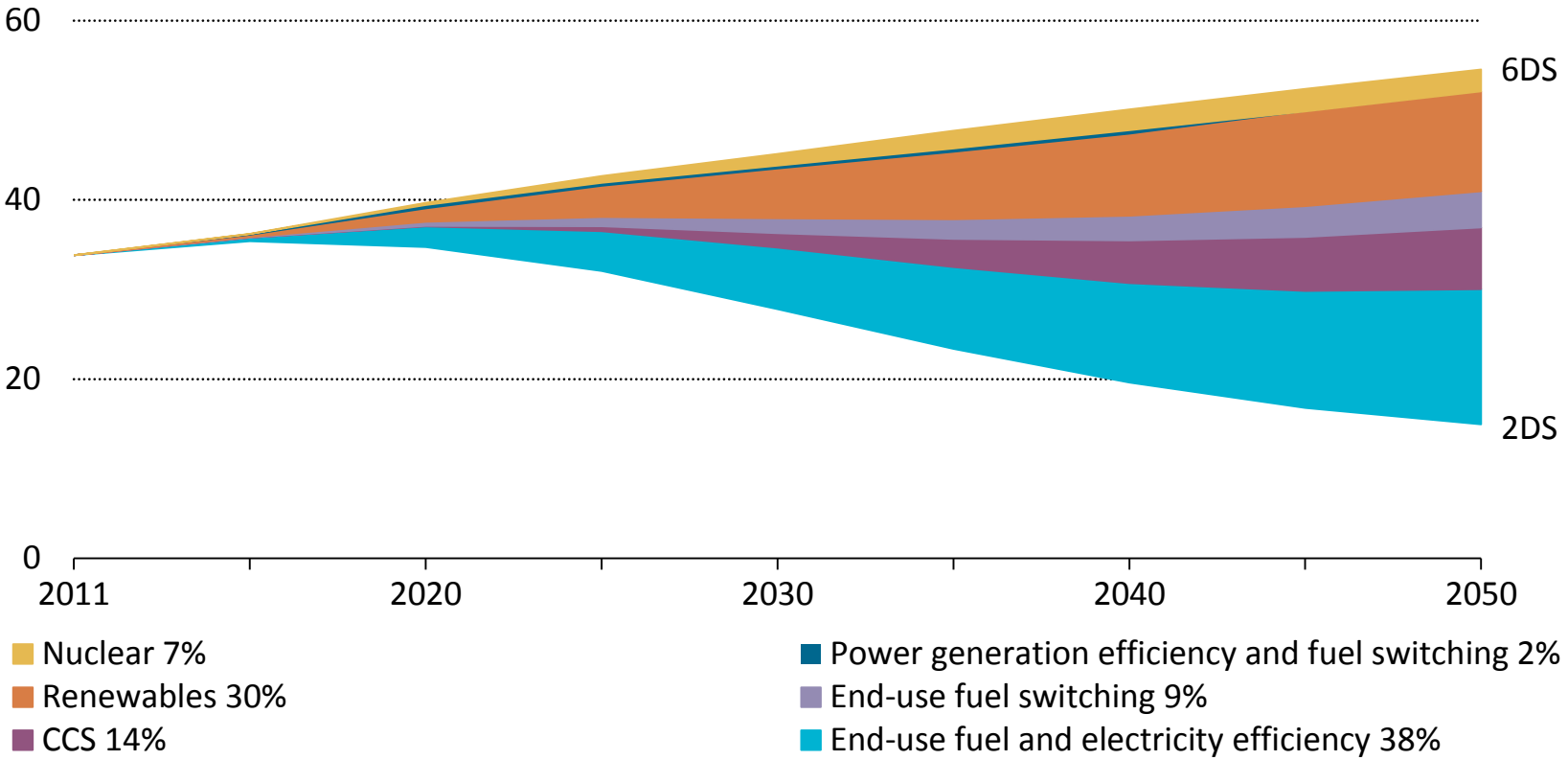

..and we to have the tools to develop a strategy and be proactive.

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Investment in our future pays off…

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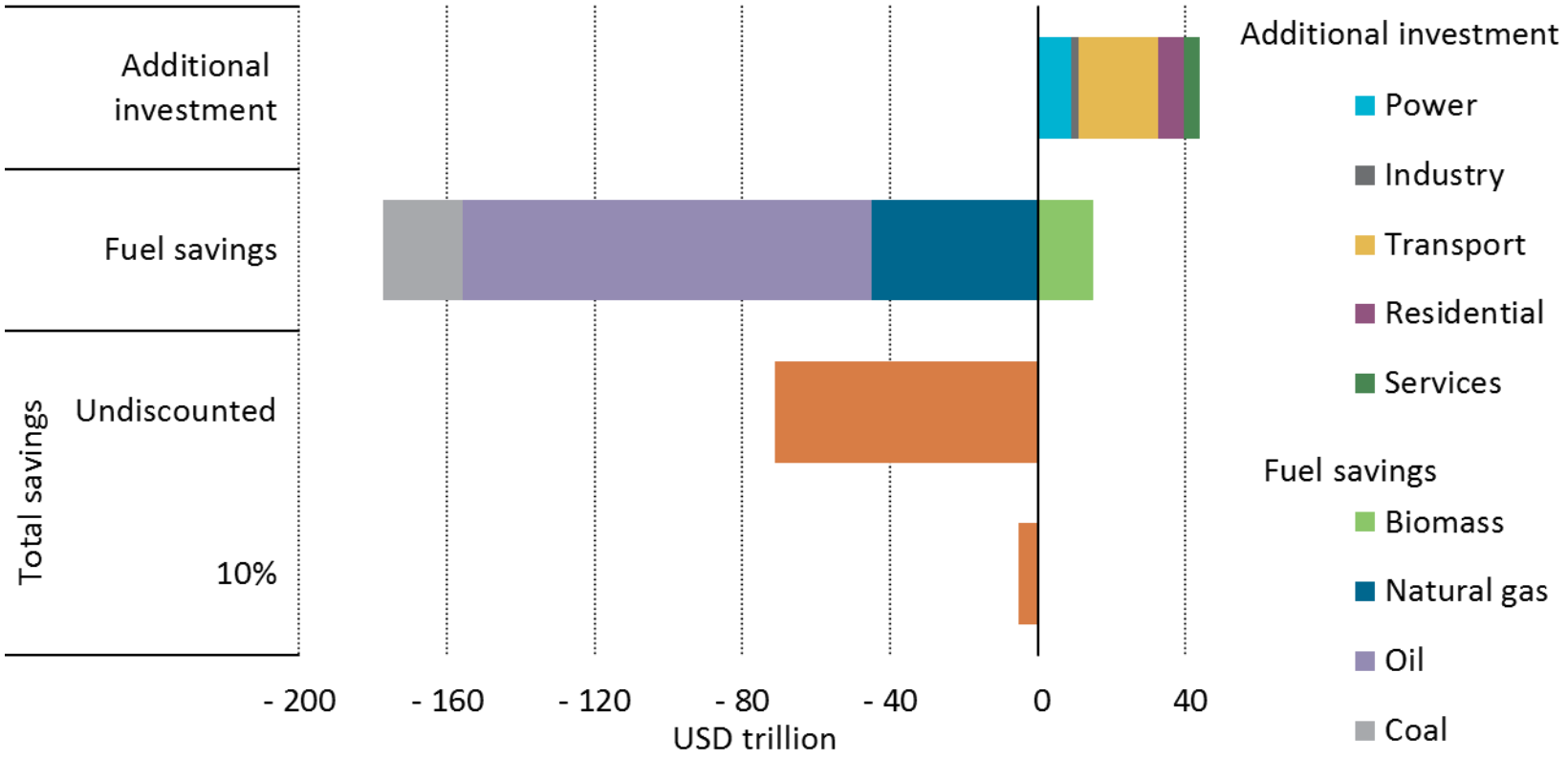

…and it is cost effective to make the transition

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Scale of the challenge

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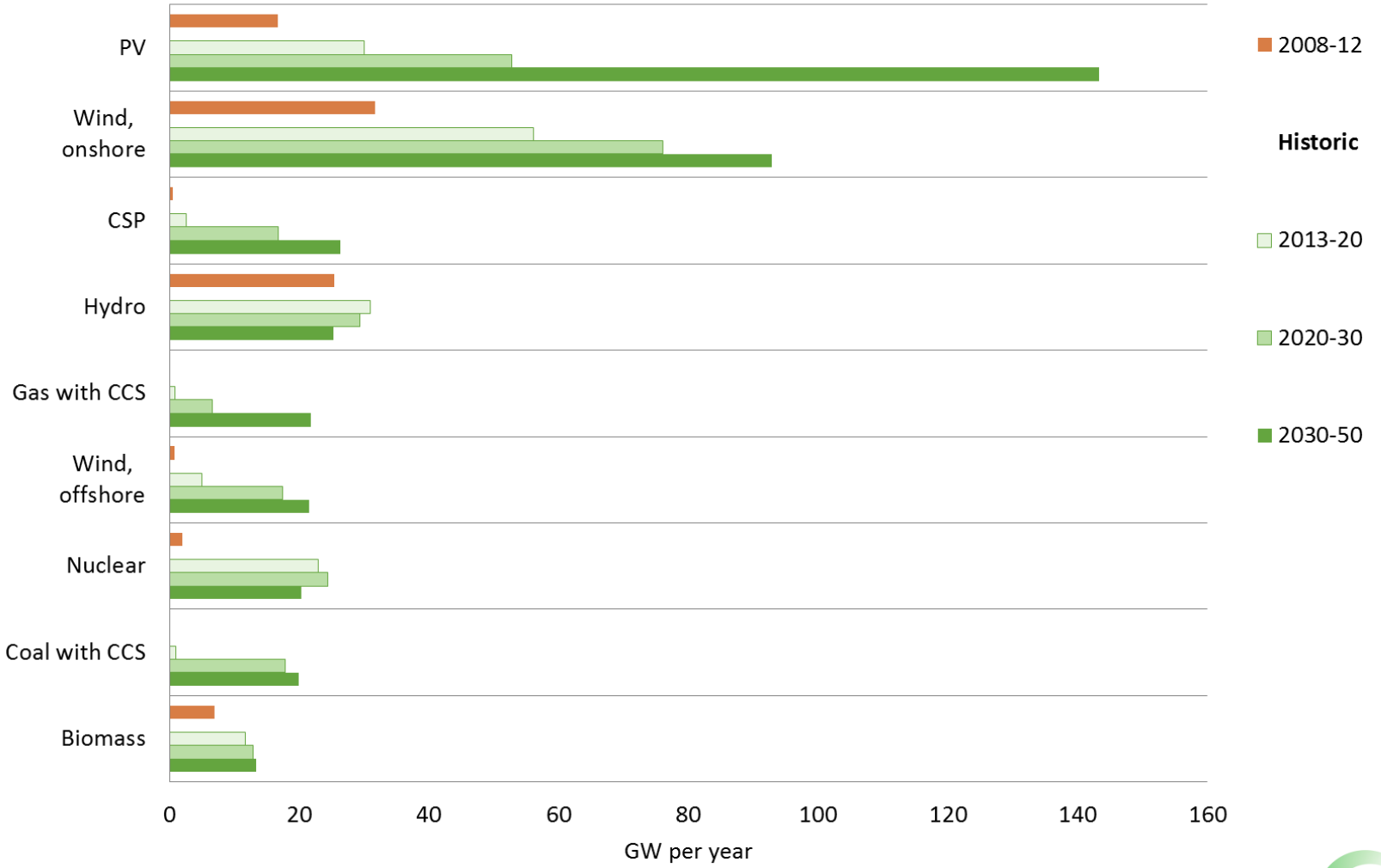

Massive acceleration of deployment of low-carbon power technologies is needed over the next four decades.

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Electricity grows regardless of the drivers

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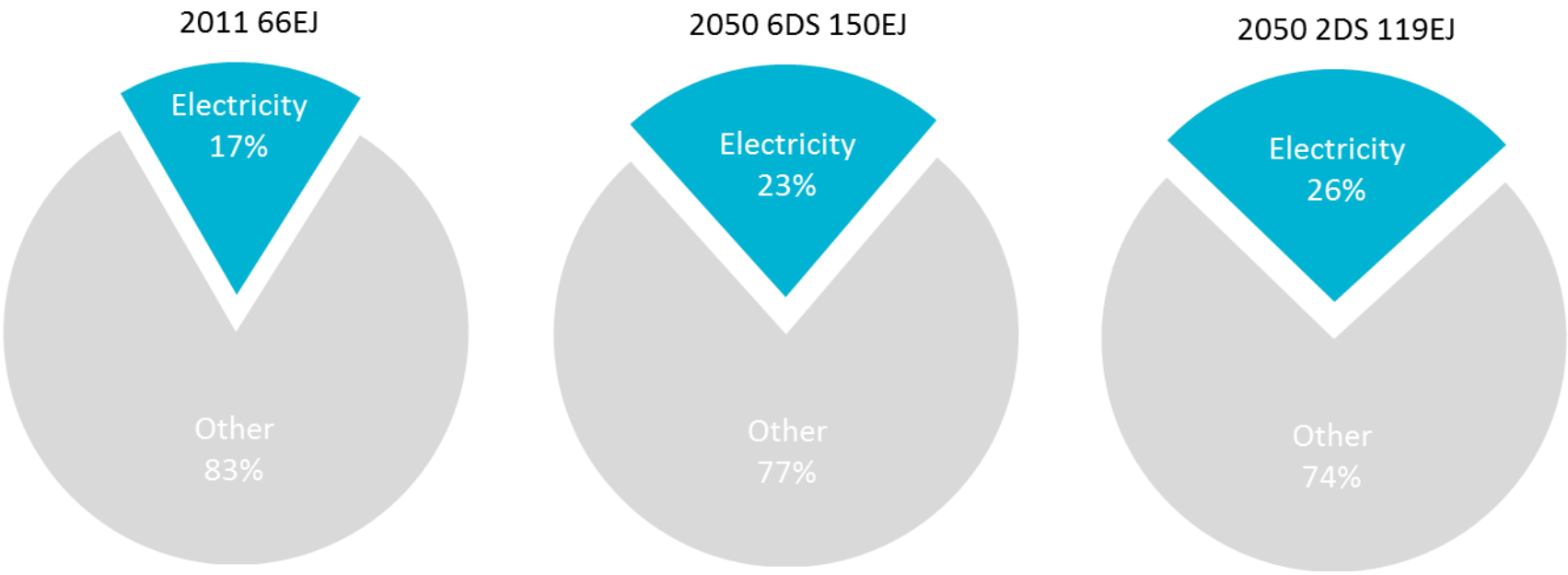
Global Electricity demand



*Increasing electricity consumption and share of overall energy usage demands our attention – for **ALL** forward looking scenarios*

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Electricity can power sustainable growth

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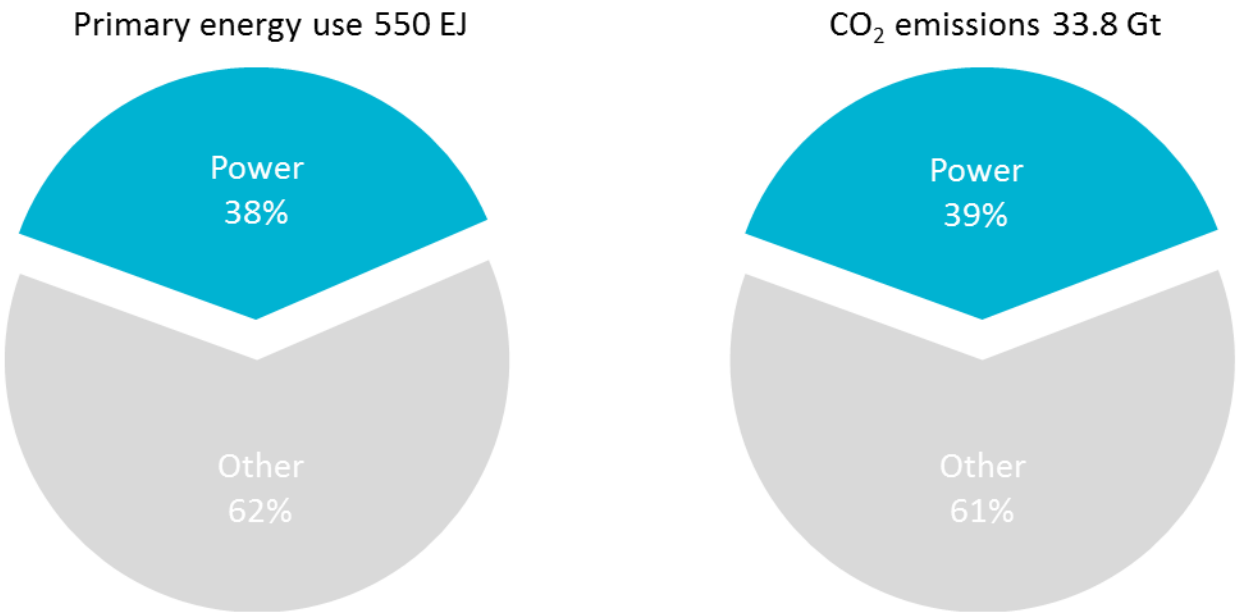
2011



But the source of electricity is of utmost importance

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Electricity can power sustainable growth

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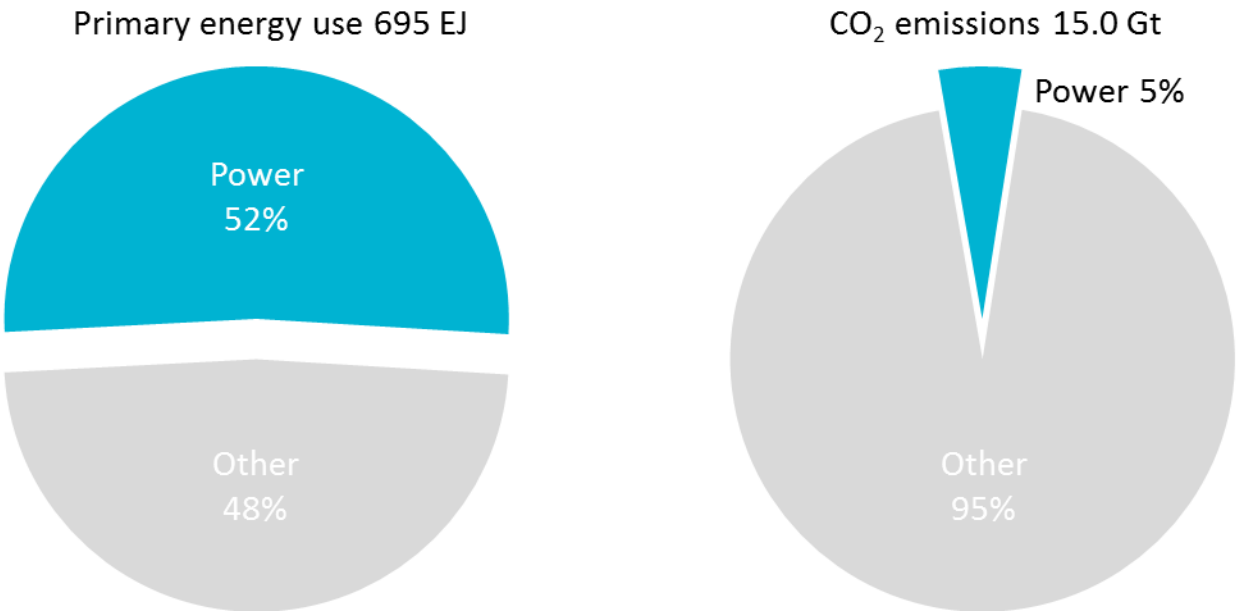
2050 2DS



The 2DS pathway disconnects primary energy used in generation from emissions

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Transformation through new loads

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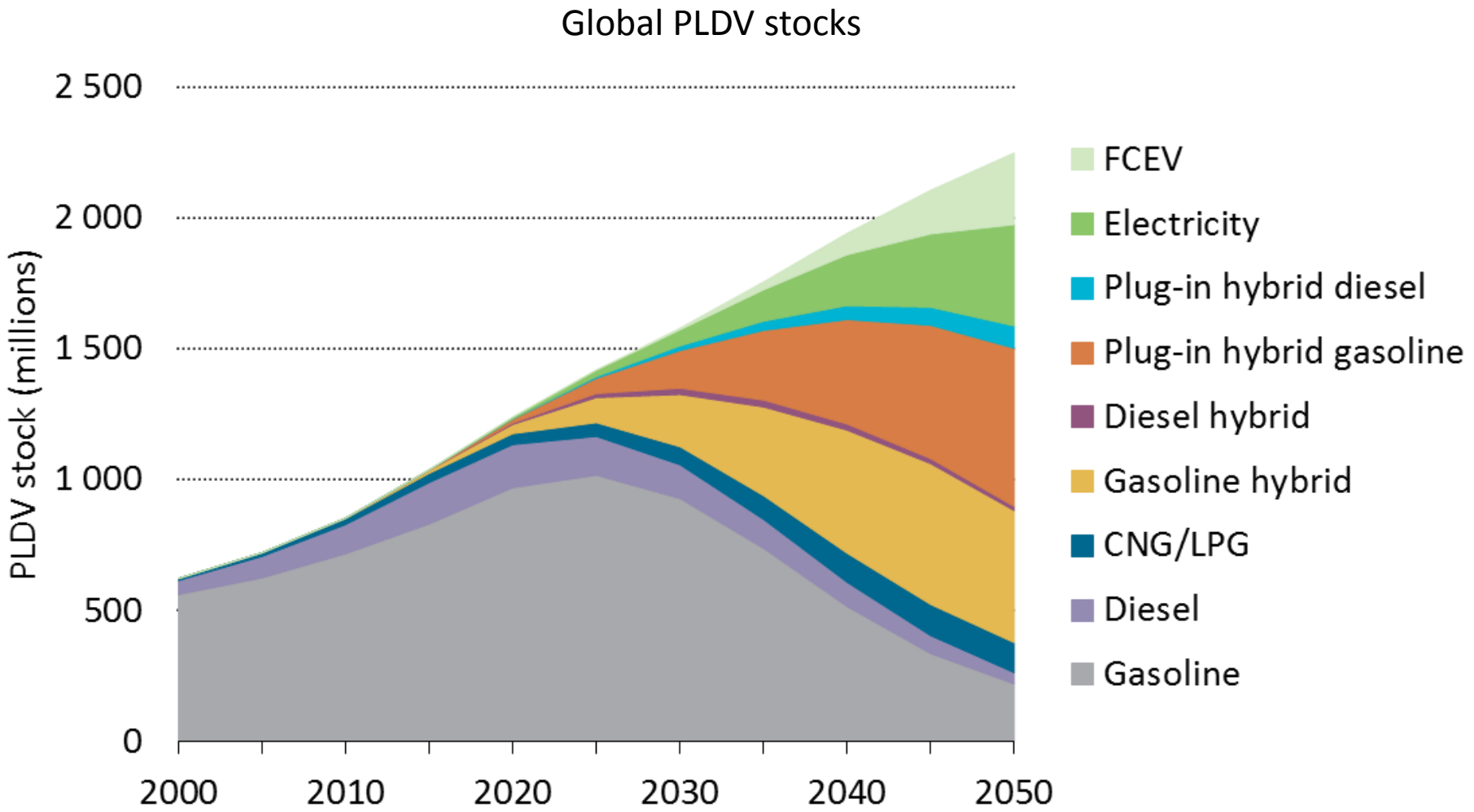

60% of LDV sales are EVs or PHEVs in 2050

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Electricity Generation: a share reversal

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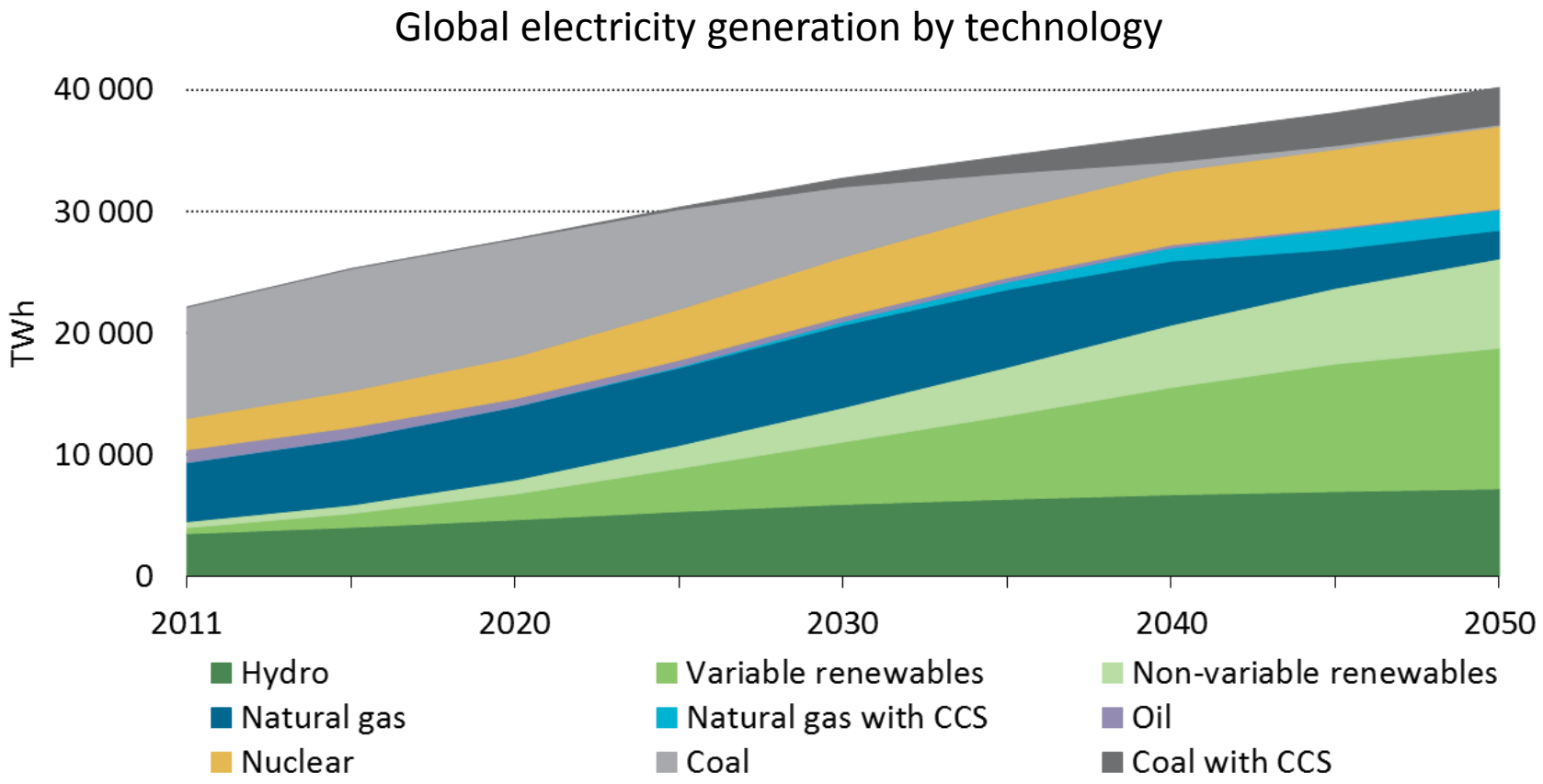

- Generation today:
  - Fossil fuels: 68%
  - Renewables: 20%
- Generation 2DS 2050:
  - Renewables: 65%
  - Fossil fuels: 20%

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Understanding the regional context in the 2DS

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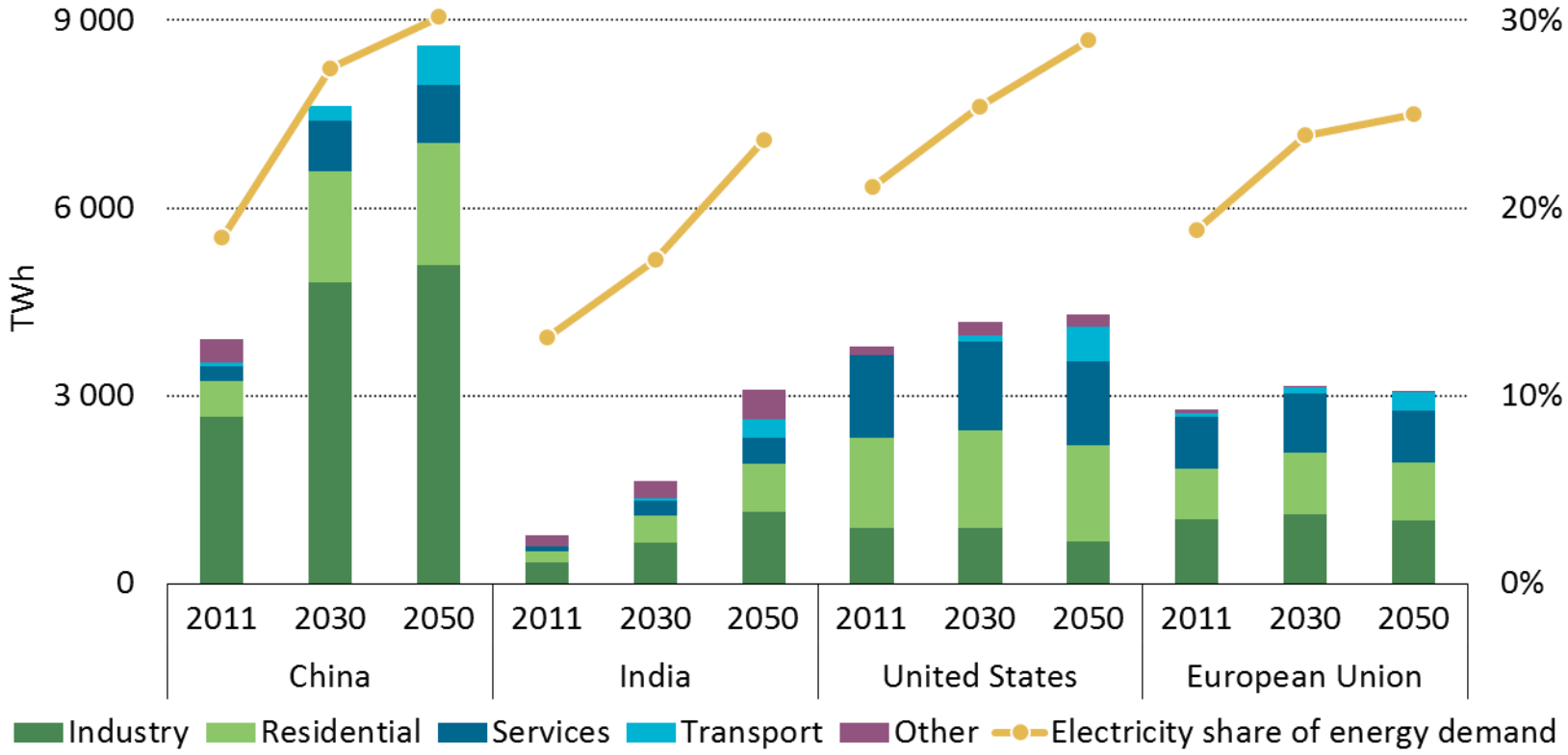

Differences in growth of *electricity* demand and sectoral distribution require targeted systems development plans. All regions show high growth in VRE deployment

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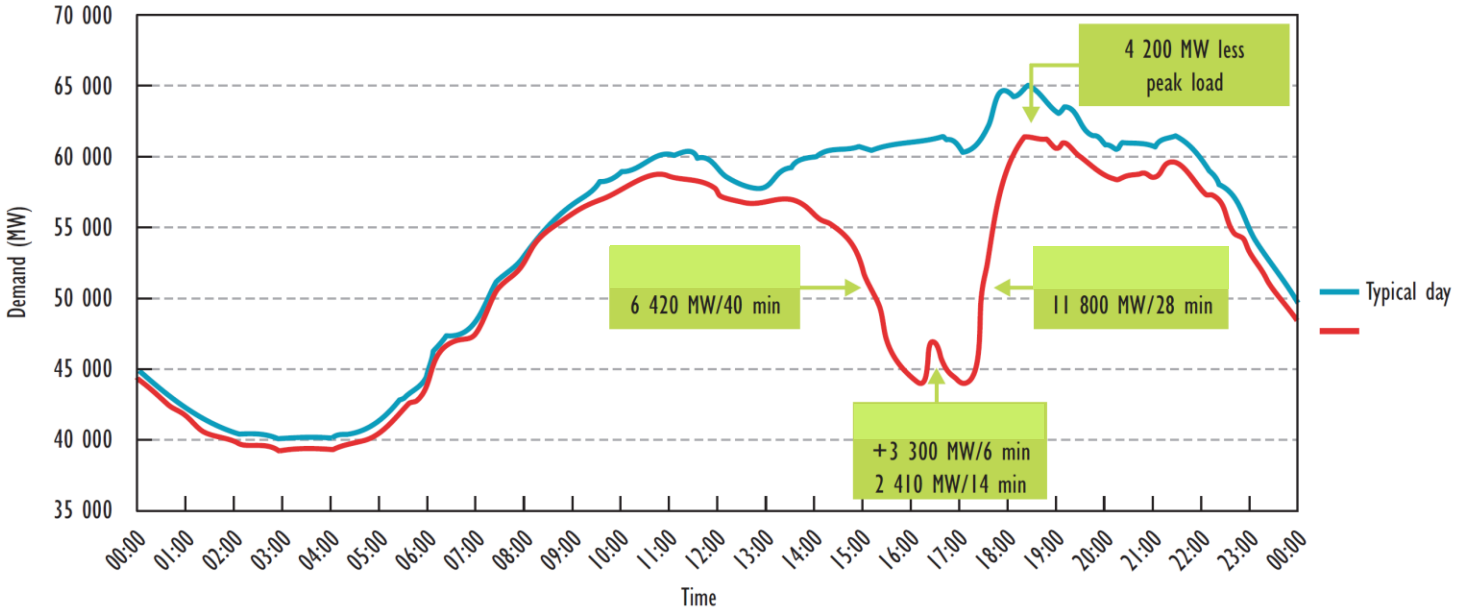
VRE: no problem at 5% - 10%, if …

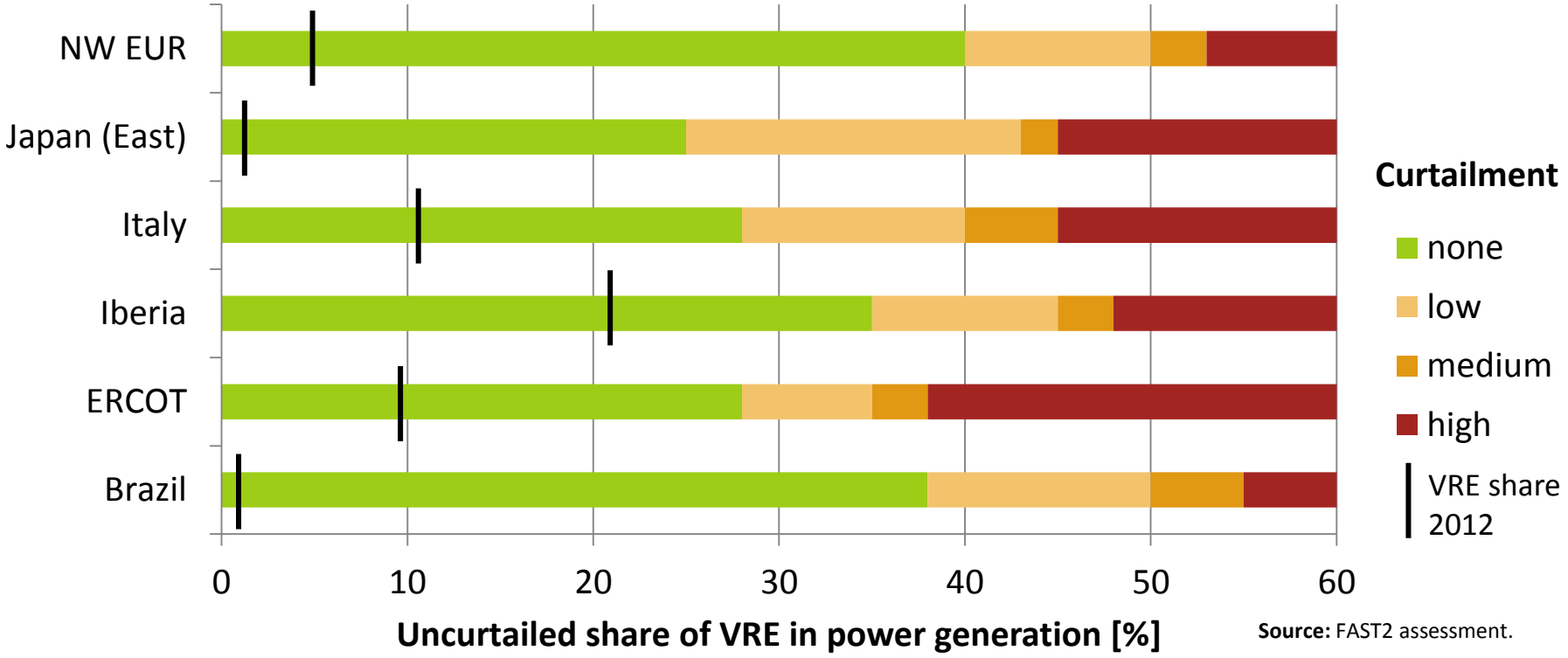
- **Power systems already deal with a vast demand variability**
  - **Can use existing flexibility for VRE integration**

Exceptionally high variability in Brazil, 28 June 2010



- **No technical or economic challenges at low shares, if basic rules are followed:**
  - **Avoid uncontrolled, local 'hot spots' of deployment**
  - **Adapt basic system operation strategies, such as forecasts**
  - **Ensure that VRE power plants are state-of-the art and can stabilise the grid**

Much higher shares technically feasible



Source: FAST2 assessment.

- **IEA assessment: All power systems can take 25% in annual generation already today.**
- **There is no technical limit on how much variable generation a power system can absorb**
  - **But system transformation increased flexibility required for higher shares**

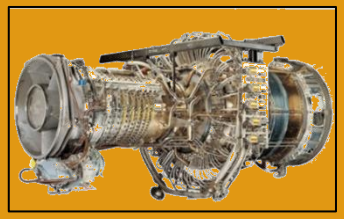
Reaching high VRE shares: three pillars of system transformation

Technology spread

Geographic spread

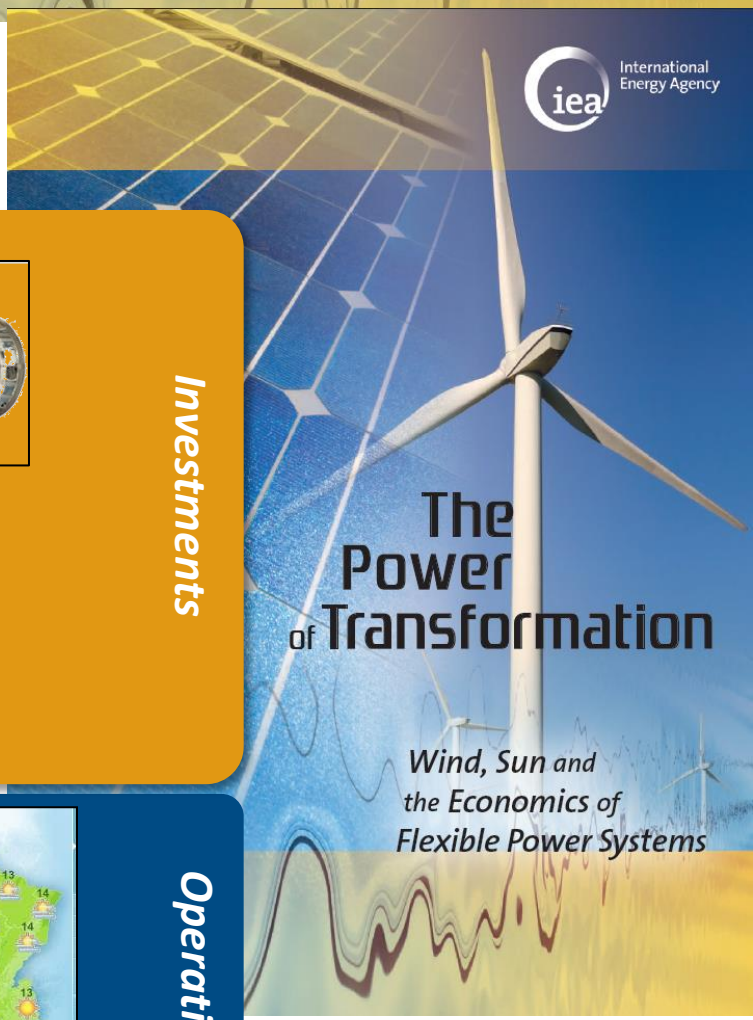
Design of power plants

System friendly VRE



Investments

Operations



Systems Integration: Key Questions

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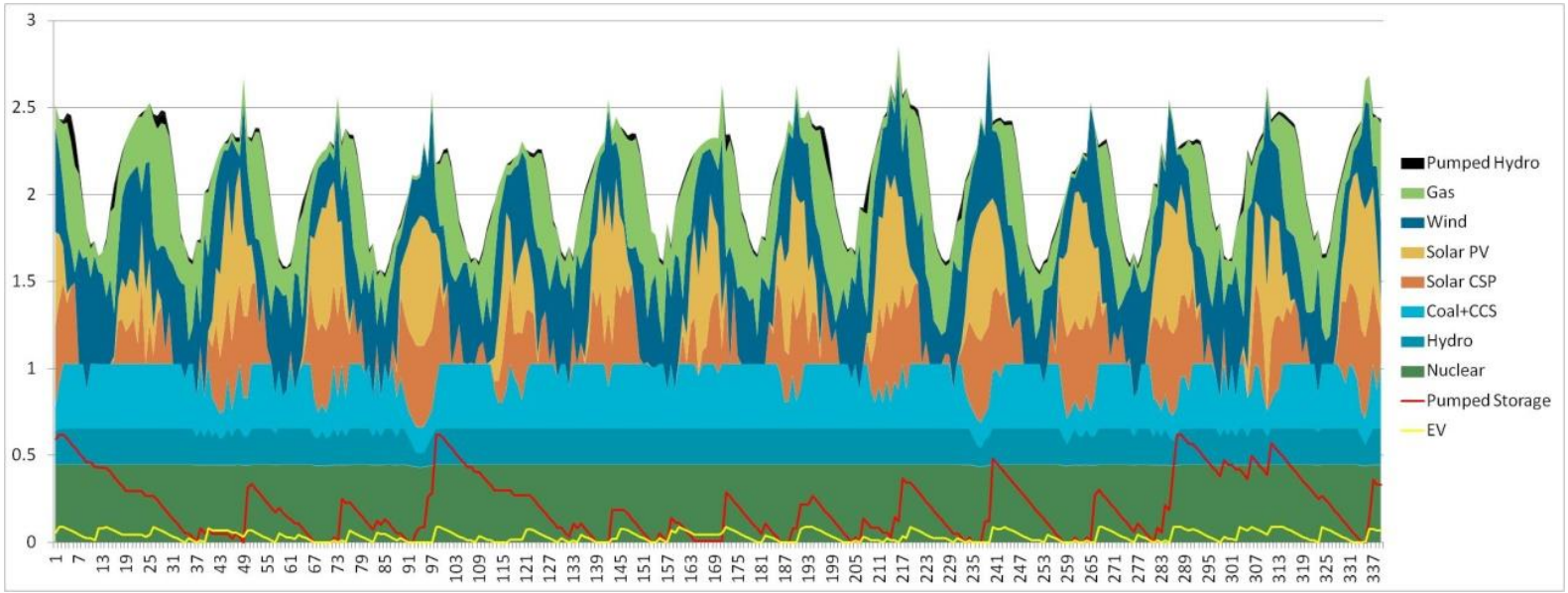
- How to model capacity expansion + system integration?
- Sectoral penetration and costs of DSI?
- Flexible power plant designs (e.g. flexibility of CCS?)
- System-friendly design of VRE plant



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Evaluating the right amount of storage: The value is in the application

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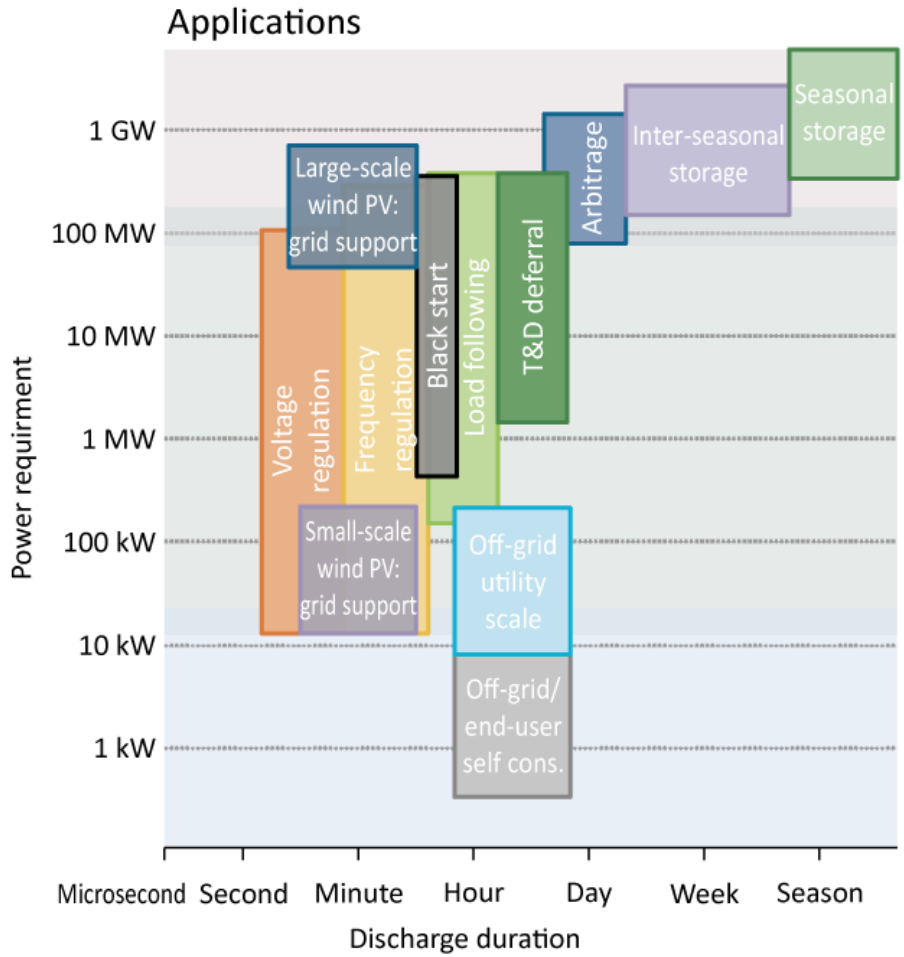

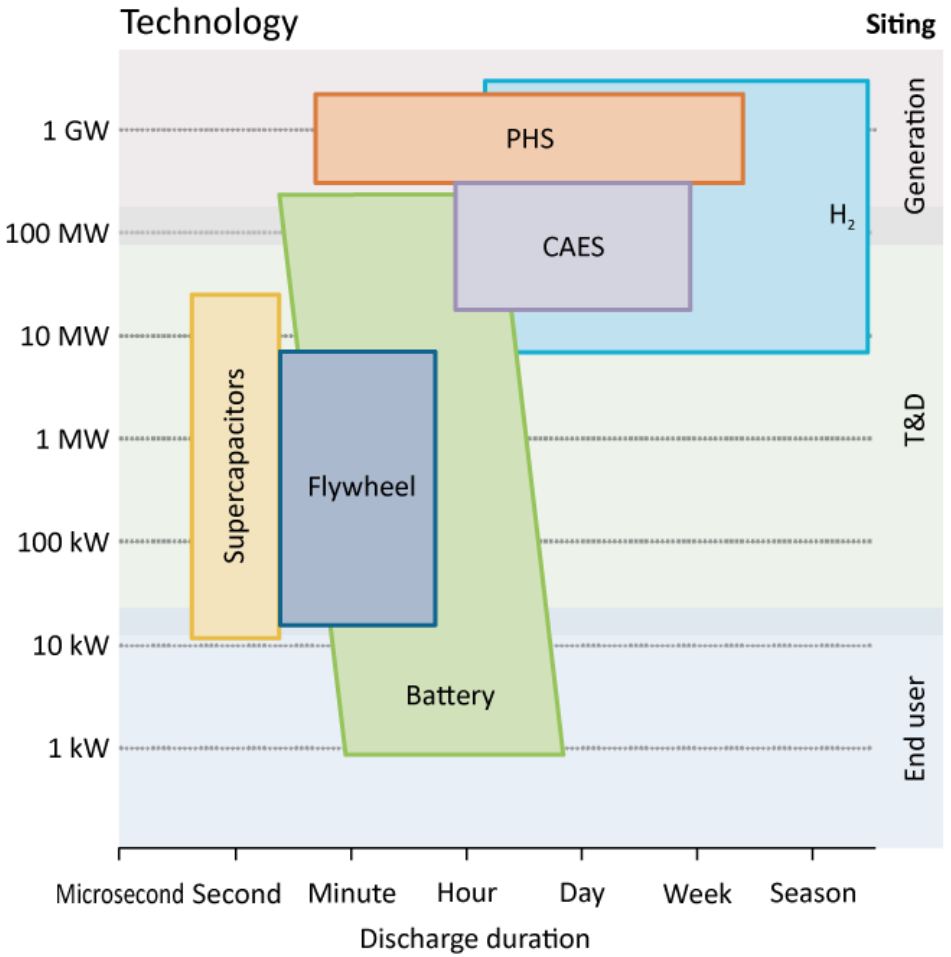

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Storage is but one of a suite of options for providing flexibility

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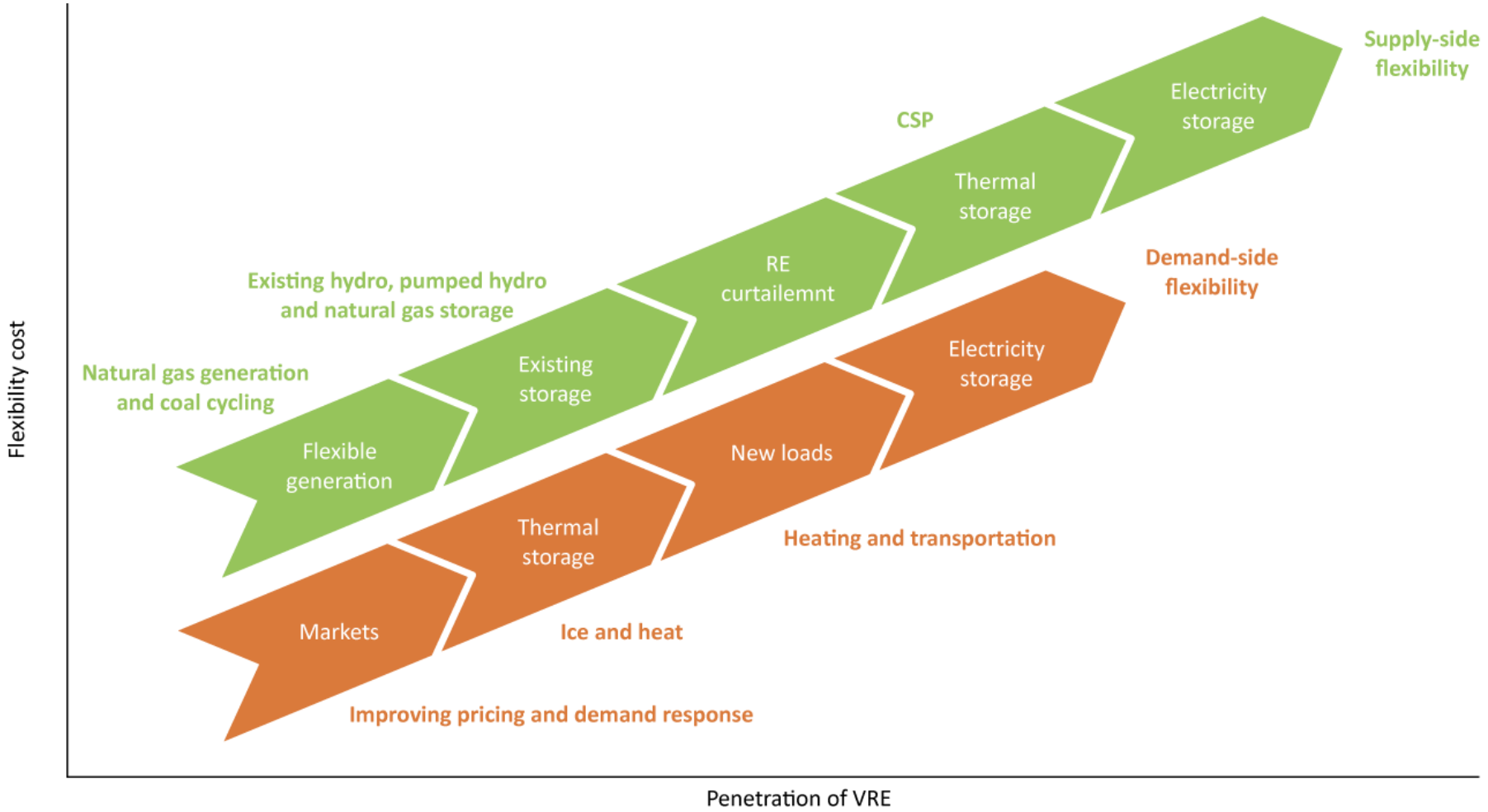

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The changing role of gas

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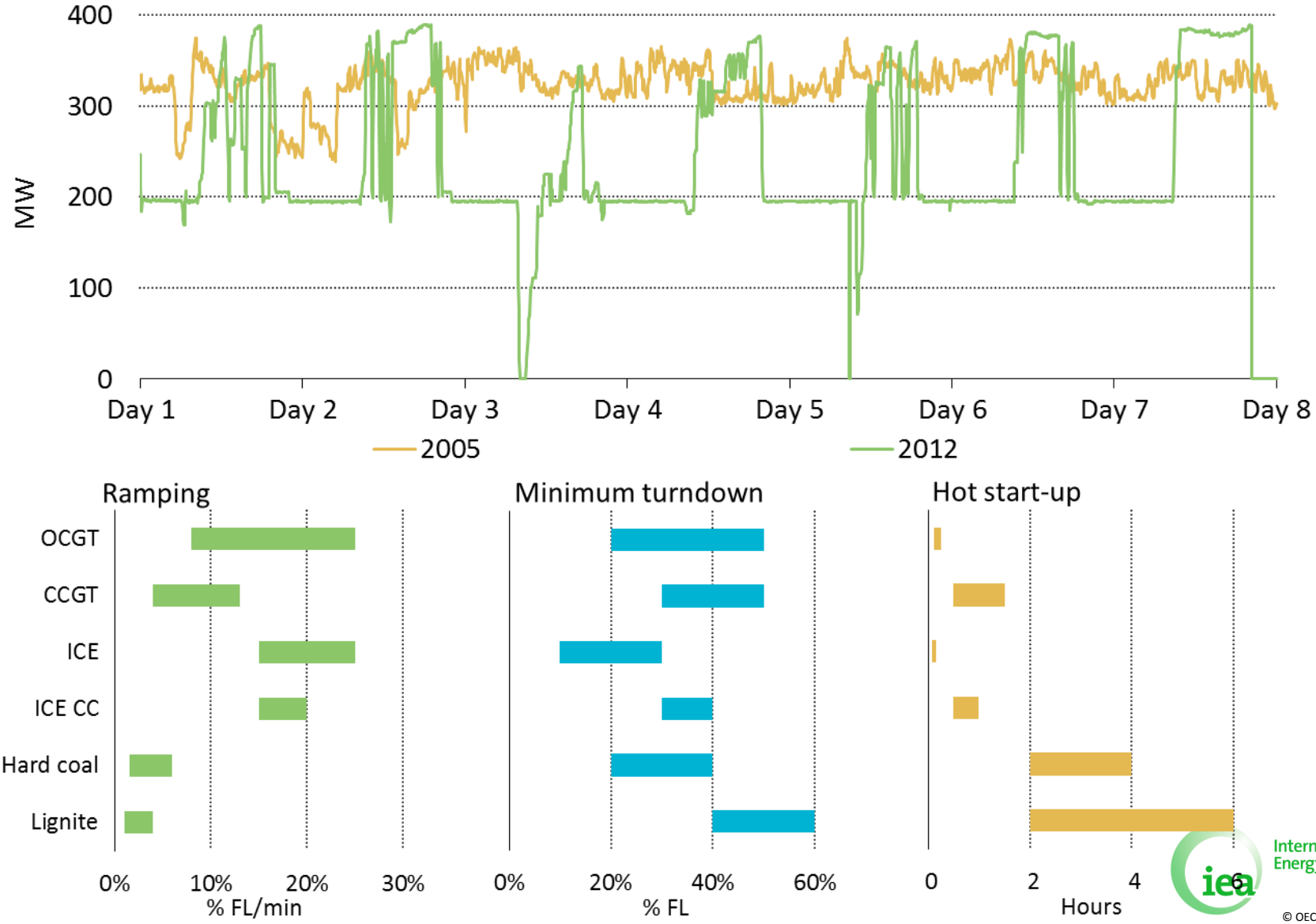

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Without CCS natural gas power generation is not carbon free

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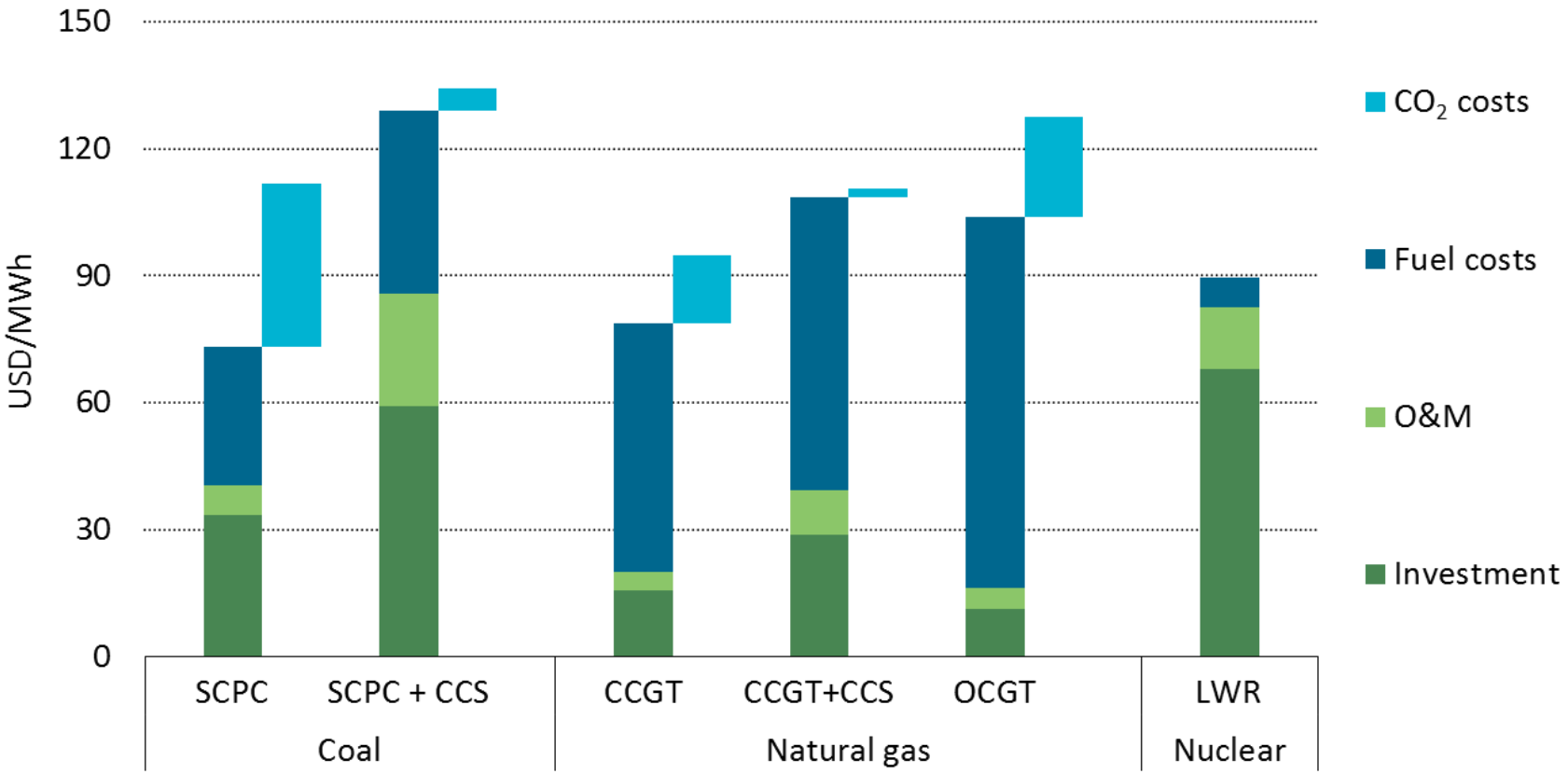
LCOE of dispatchable power generation technologies in the 2DS, 2020



CCS for natural gas power generation is less expensive than CCS for coal.

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Systems thinking and integration

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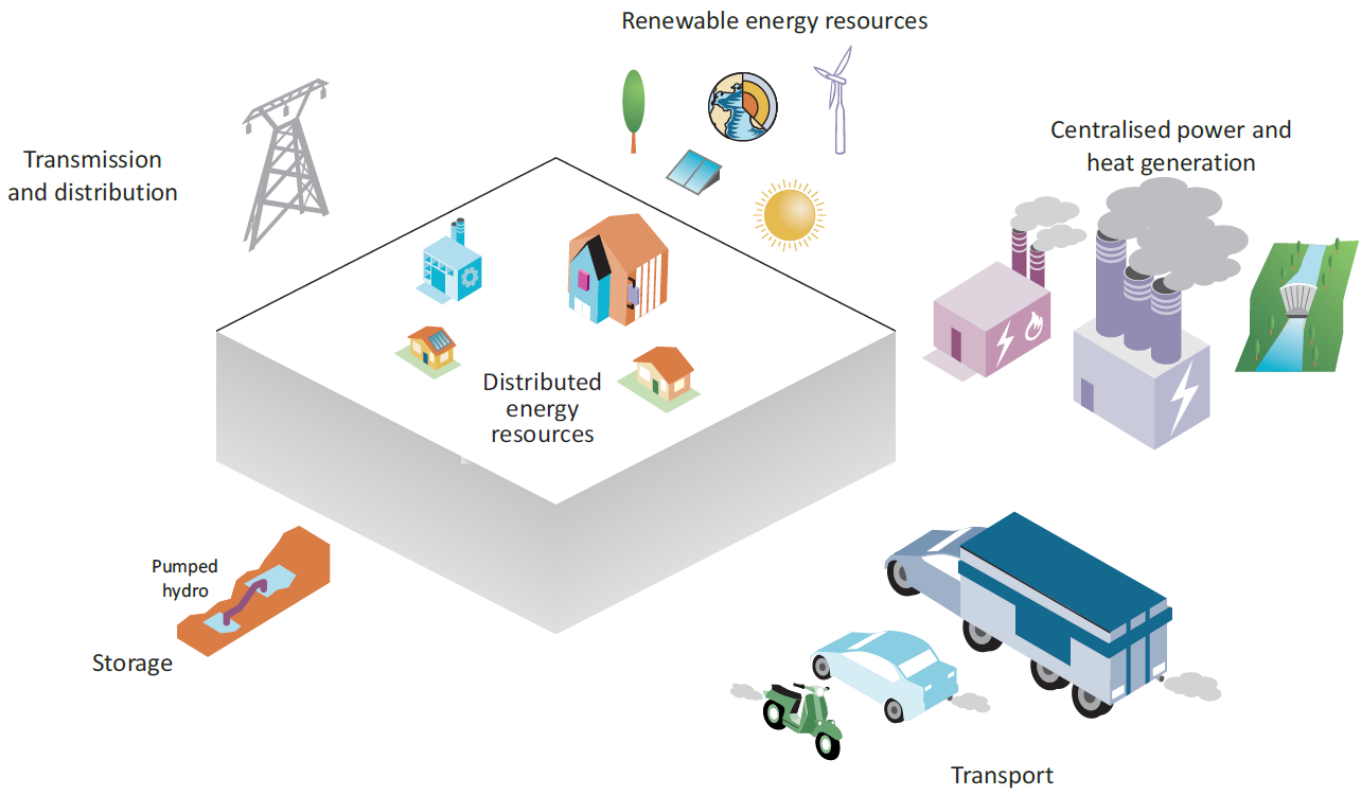

Today's energy system paradigm is based on a unidirectional energy delivery philosophy

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Systems thinking and integration

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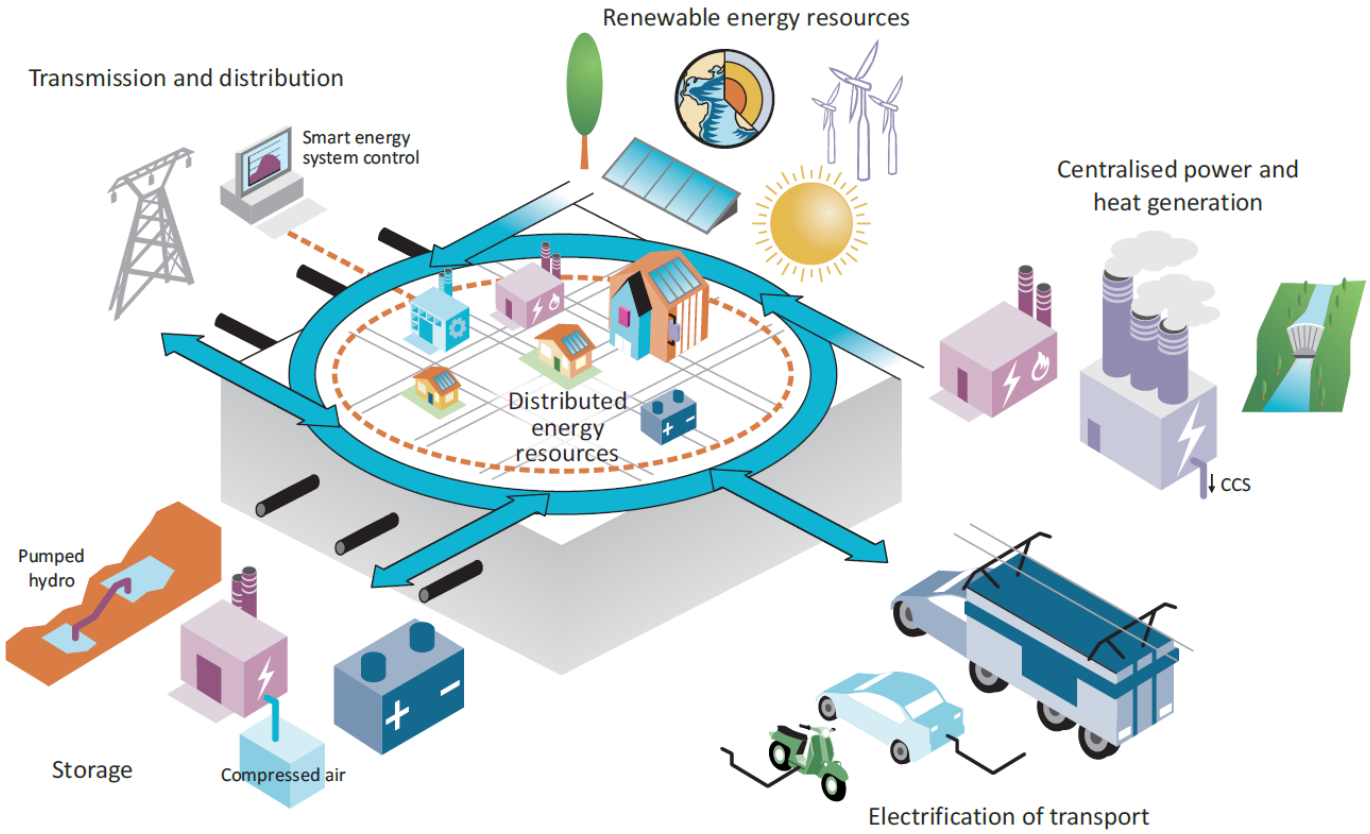

A sustainable electricity system is a smarter, multidirectional and integrated energy system that requires long-term planning for services delivery

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Ongoing work on cross-sectoral integration

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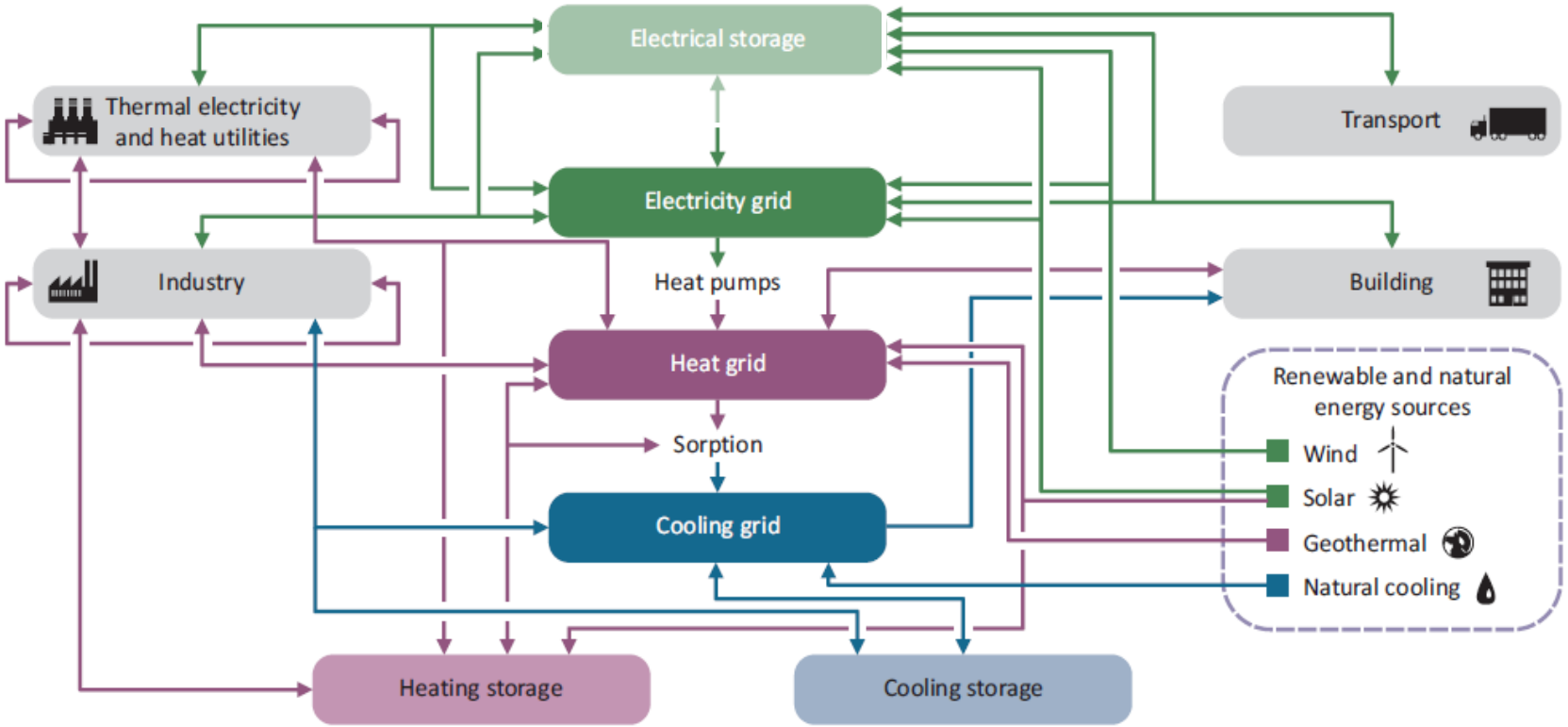
Linking heat and electricity systems: Co-generation and DHC solutions for a clean energy future. IEA, 2014.



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Harnessing Electricity's Potential

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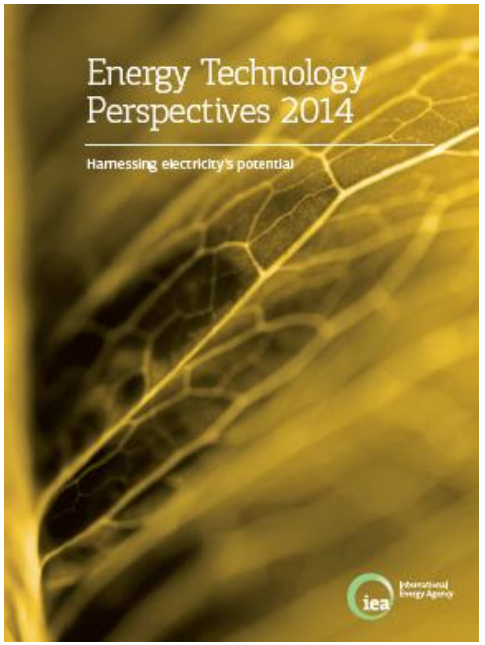
1. **Solar-The possible first resource by 2050?**
2. **The evolving role of Natural Gas in Low-C electricity systems: Flexibility vs. Base load**
3. **How Can e-mobility replace oil?**
4. **Electricity storage: Do we need a game changer?**
5. **Financing low carbon electricity generation during the transition**
6. **High efficiency power generation in India**



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Thank you

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Explore the data behind ETP