Digitalization & Energy

George Kamiya, Energy Environment Division

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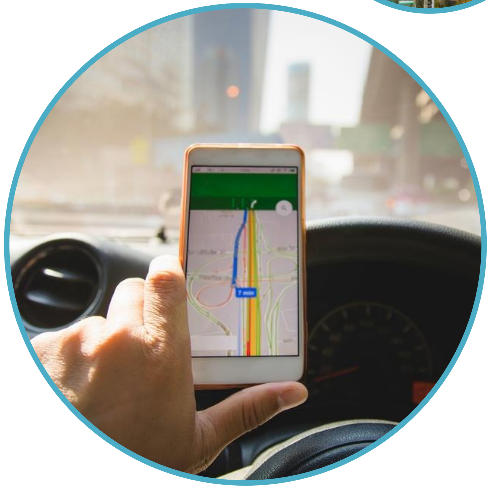
IEA

Digital technologies are everywhere….



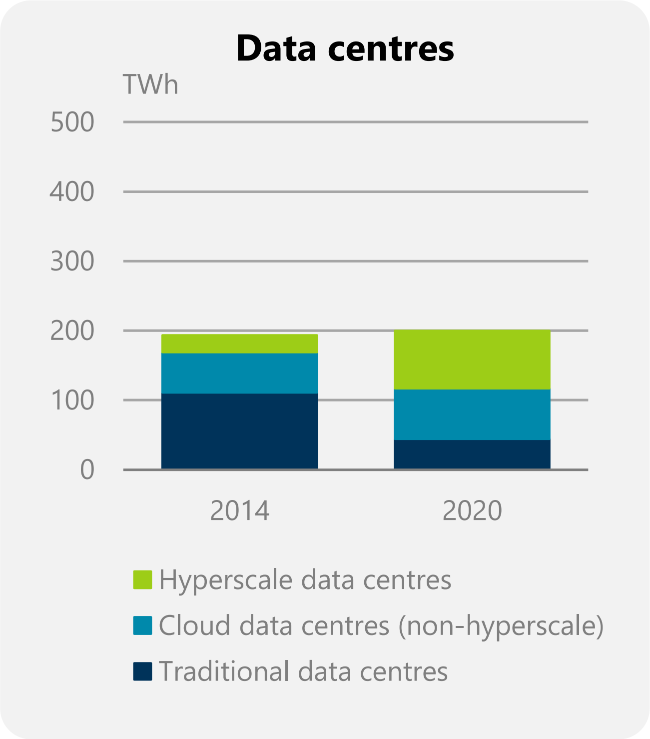
Connectivity trends

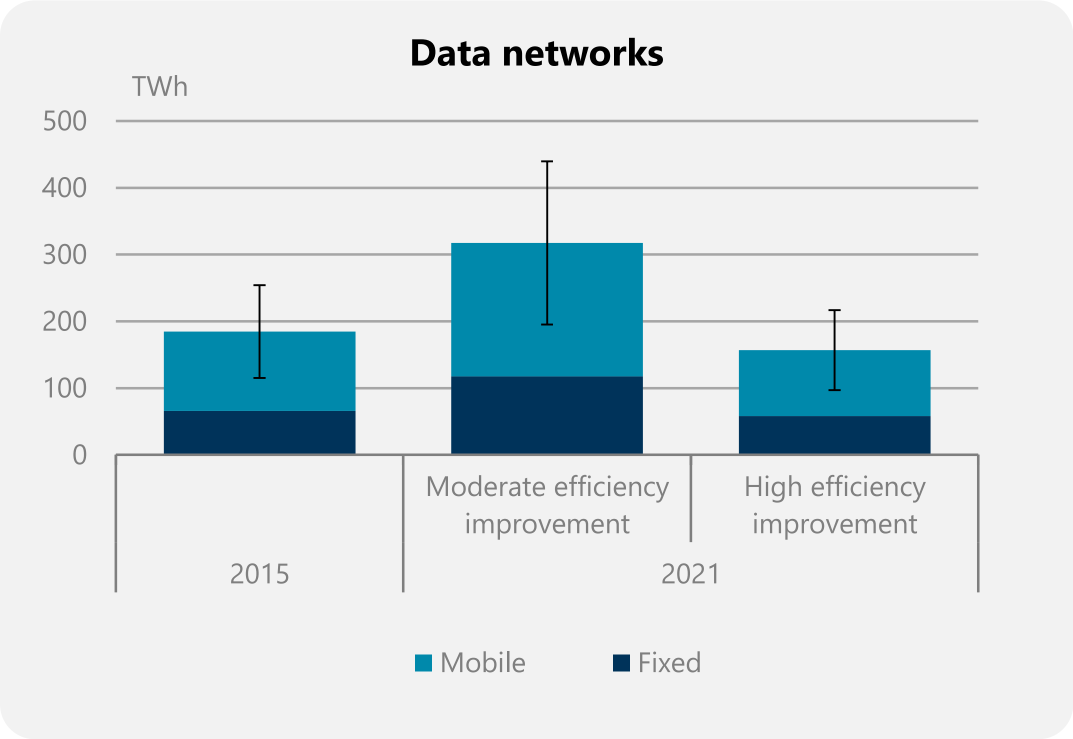
KB	kilobyte	10^3 bytes
MB	megabyte	10^6 bytes
GB	gigabyte	10^9 bytes
TB	terabyte	10^{12} bytes
PB	petabyte	10^{15} bytes
EB	exabyte	10^{18} bytes
ZB	zettabyte	10^{21} bytes
YB	yottabyte	10^{24} bytes

Sources: Cisco (2017). The Zettabyte Era: Trends and Analysis June 2017; Cisco (2015). The History and Future of Internet Traffic.

Internet data traffic is growing exponentially, <u>tripling</u> over the past five years

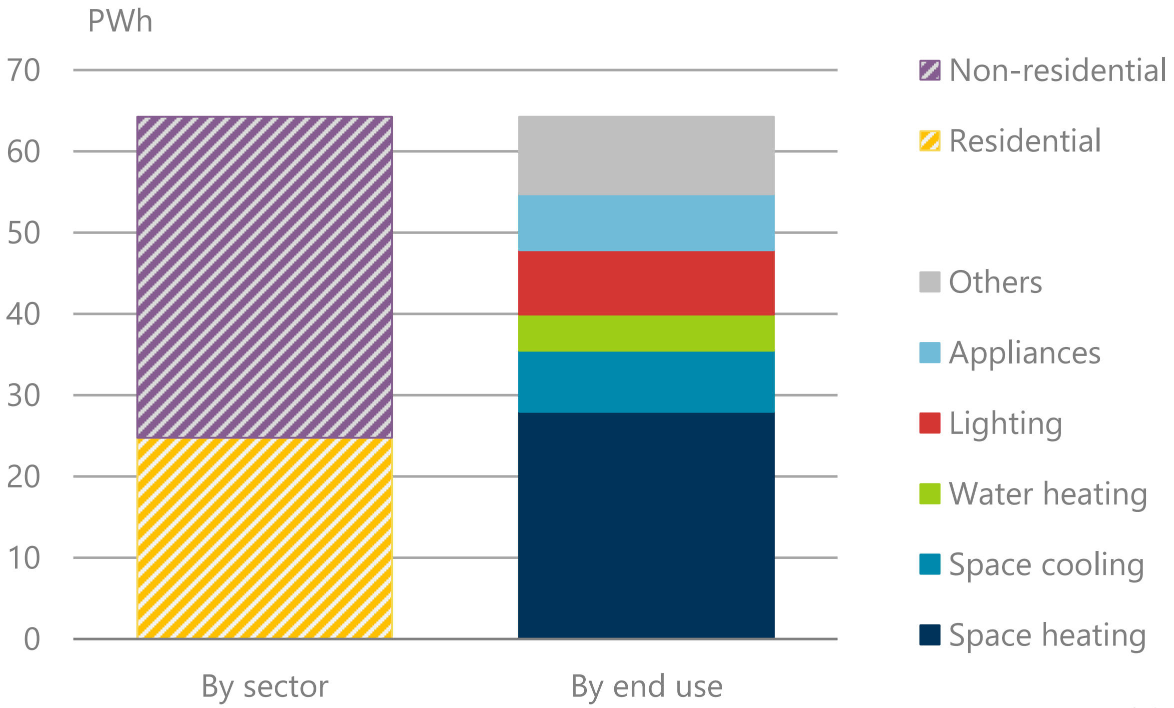
Electricity use by data centres and networks





Sustained efficiency gains could keep energy demand largely in check over the next five years, despite exponential growth in demand for data centre and network services

Buildings



IEA analysis

Widespread deployment of smart building controls could reduce energy use by 10% to 2040

Transport

Road freight

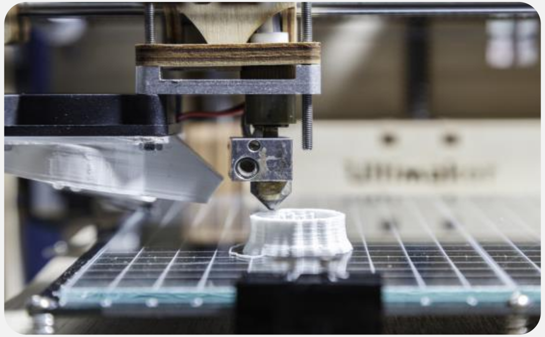
- Digital solutions for trucks and logistics could reduce energy use for road freight by 20-25%.
- Digital solutions include platooning, route optimisation, and data sharing across the supply chain

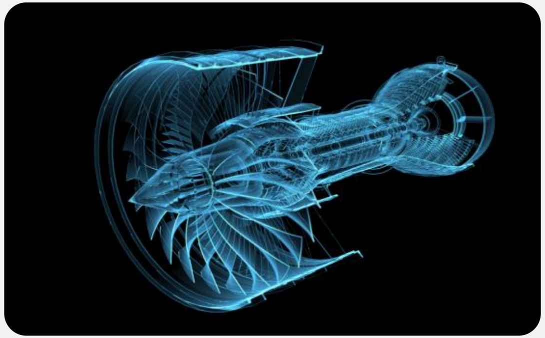
Road passenger

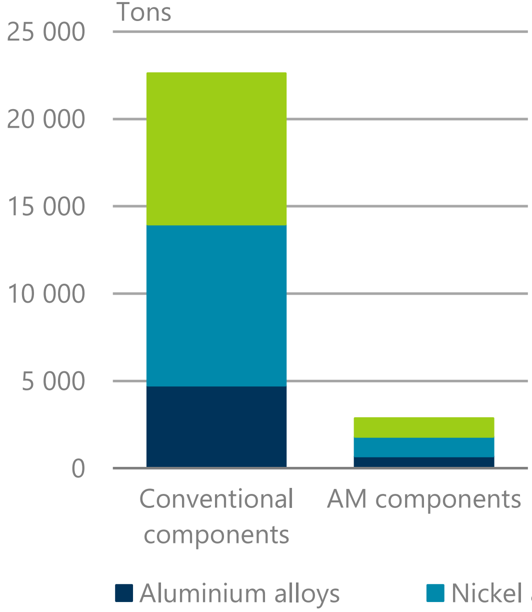
- Automation, connectivity, sharing, and electrification (ACES) to dramatically reshape road transport
- Impacts on energy demand difficult to predict
- Automation and connectivity could halve or double energy demand, depending on how technology, behavior, and policy evolve

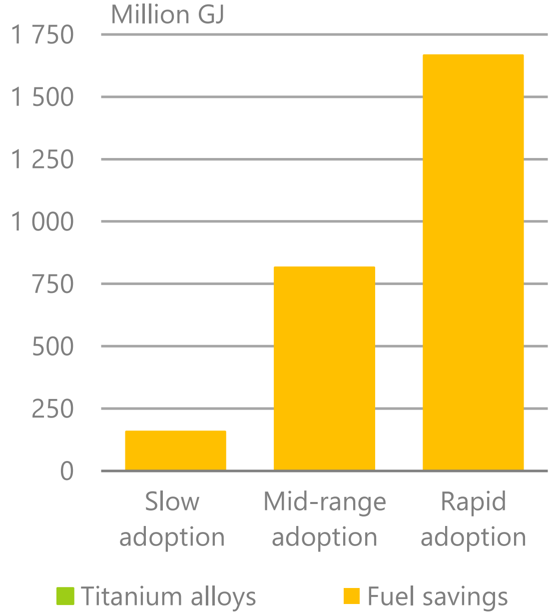
Intelligent transport systems are improving safety and efficiency of all modes, with the most transformative impacts expected in road transport

Industry





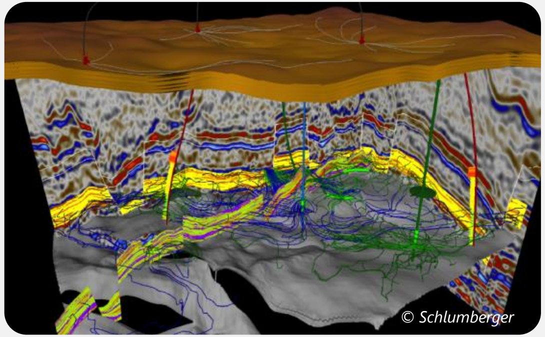




Source: Huang et al. (2016)

Energy use can be incrementally reduced at the plant level
but widespread use of 3D printing, AI and robotics could herald transformative changes

Supply: oil and gas, coal, and power



Oil and gas

- Increased productivity, improved safety and environmental performance
- Could decrease production costs by 10-20%; recovery could be enhanced by 5%.

Coal

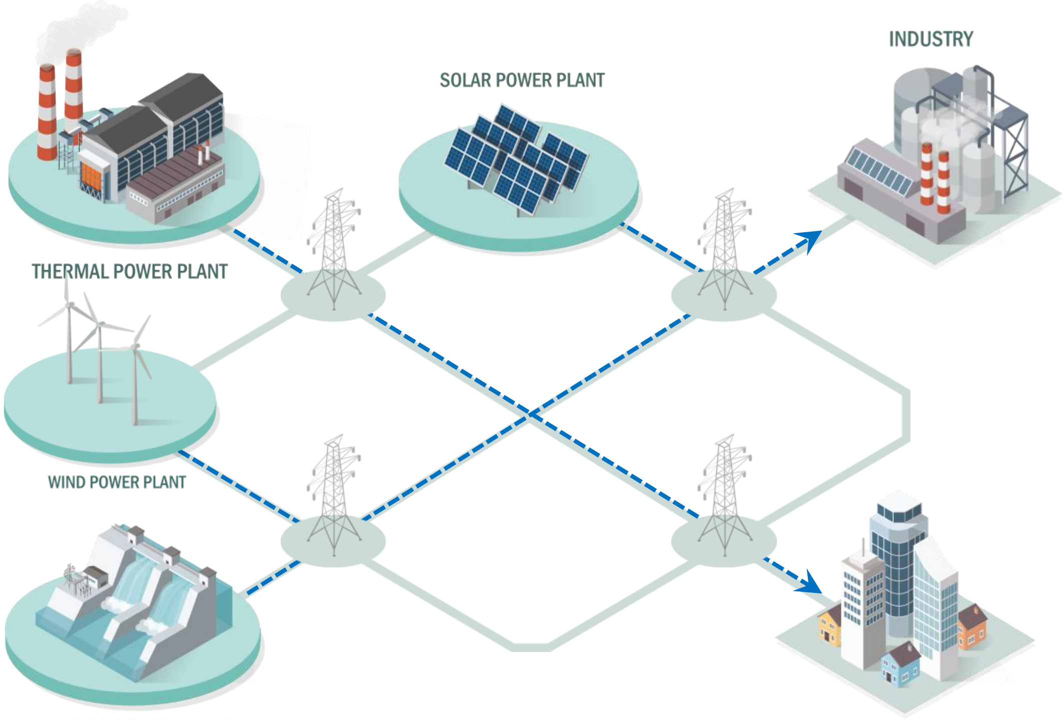
- Coal mining can expect to see improved processes and reduced costs as well as improved environmental performance

Power

- Power plants and electricity networks could see reduced O&M costs, extended life time, improved efficiencies and enhanced stability
- Savings of USD 80 billion per year

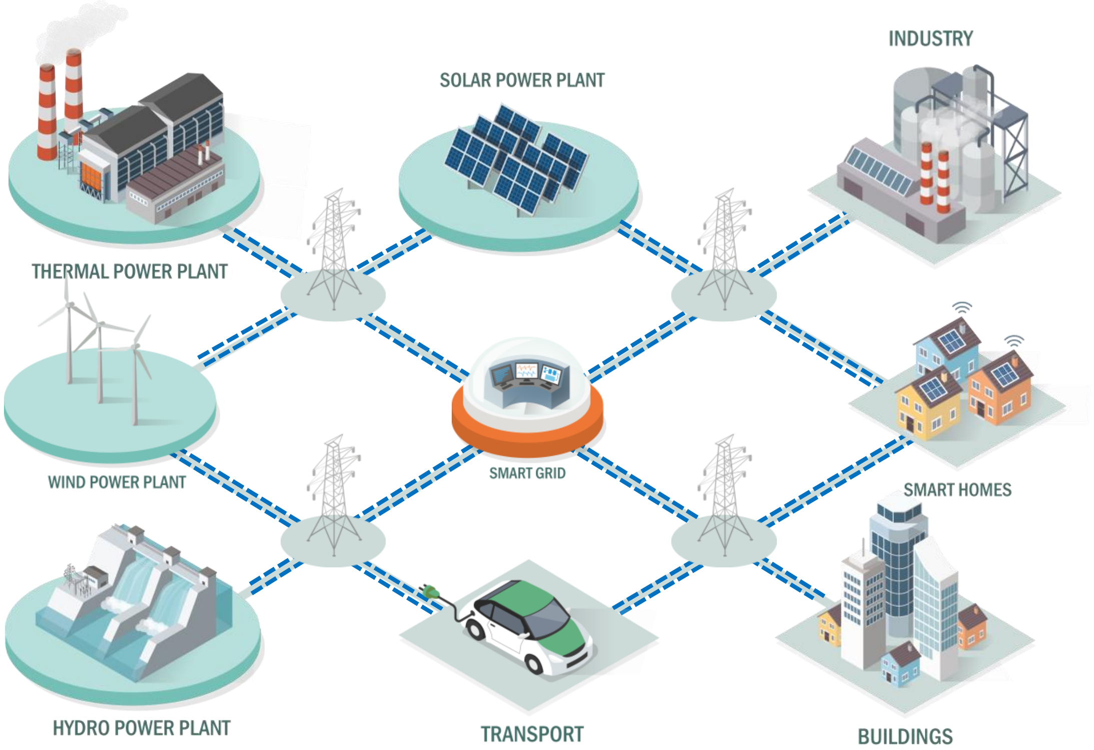
Energy companies have been adopting digital technologies for years, to increase productivity, reduce costs, improve safety and environmental performance

The digital transformation of the energy system



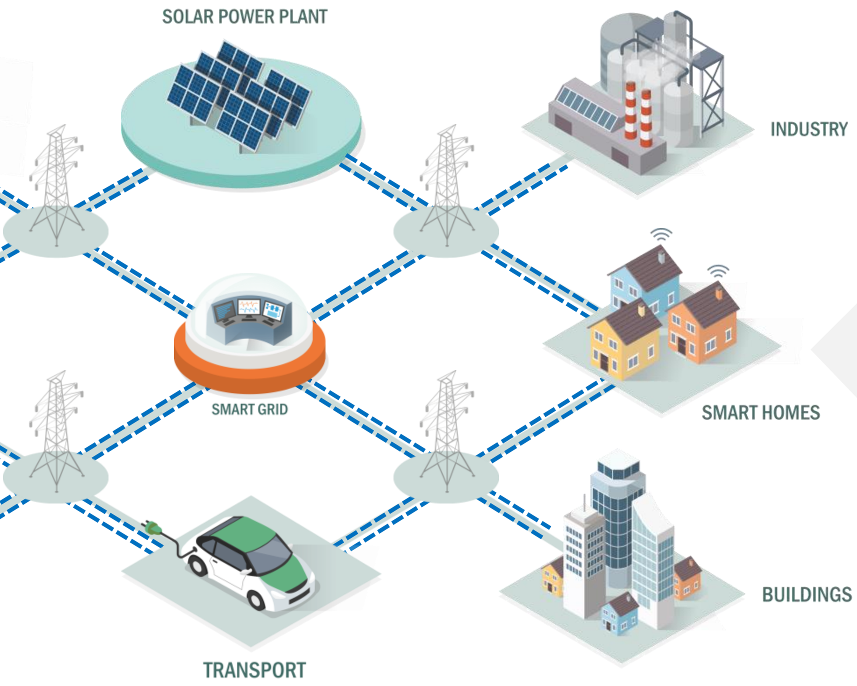
Pre-digital energy systems are defined by unidirectional flows and distinct roles

The digital transformation of the energy system



Pre-digital energy systems are defined by unidirectional flows and distinct roles, digital technologies enable a multi-directional and highly integrated energy system

Smart demand response

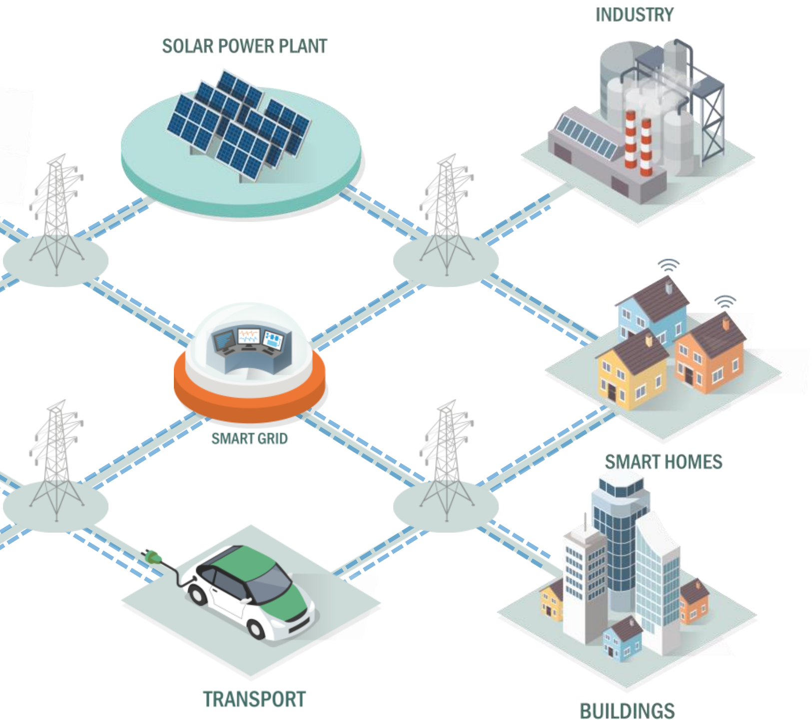


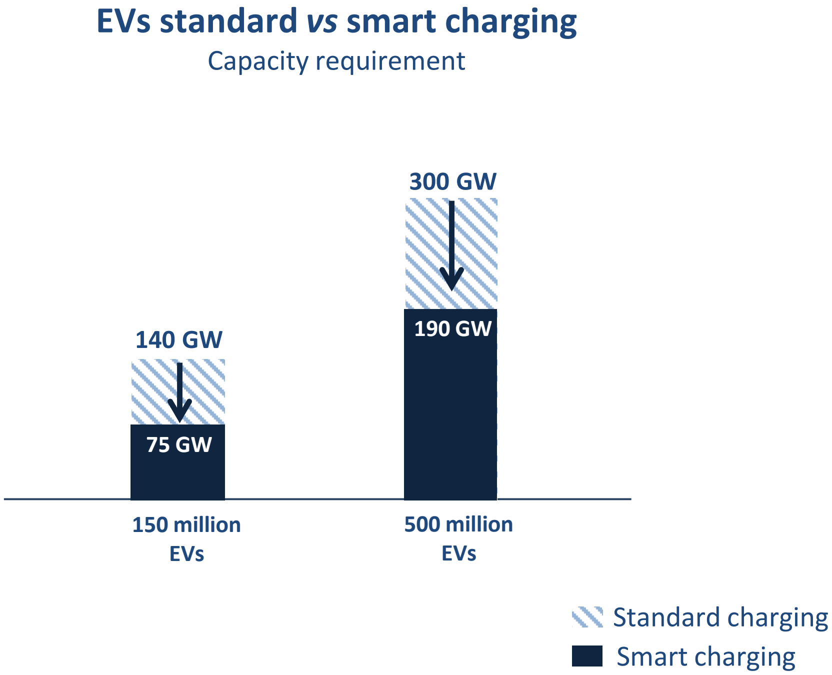
Residential sector

1 billion households and
11 billion smart appliances
could actively participate in
interconnected electricity
systems

Smart demand response could provide 185 GW of flexibility, and avoid USD 270 billion of investment in new electricity infrastructure

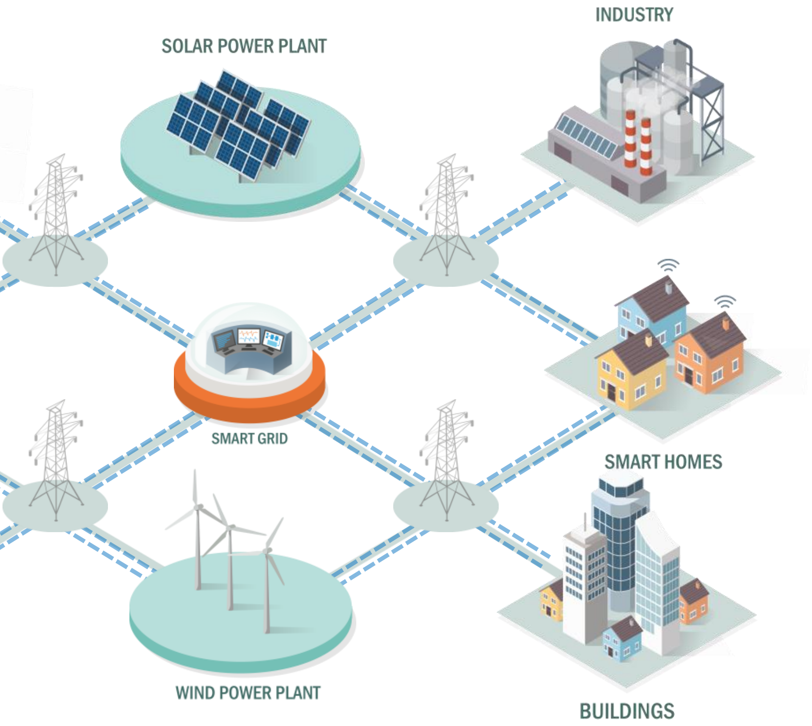
Smart charging of electric vehicles

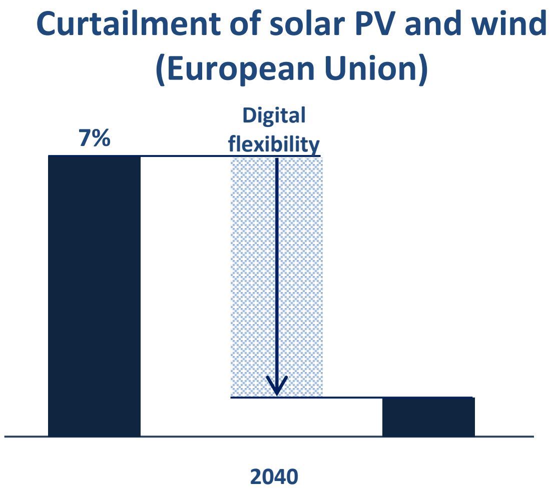




EVs smart charging would provide further flexibility to the grid saving between USD 100-280 billion investment in new electricity infrastructure

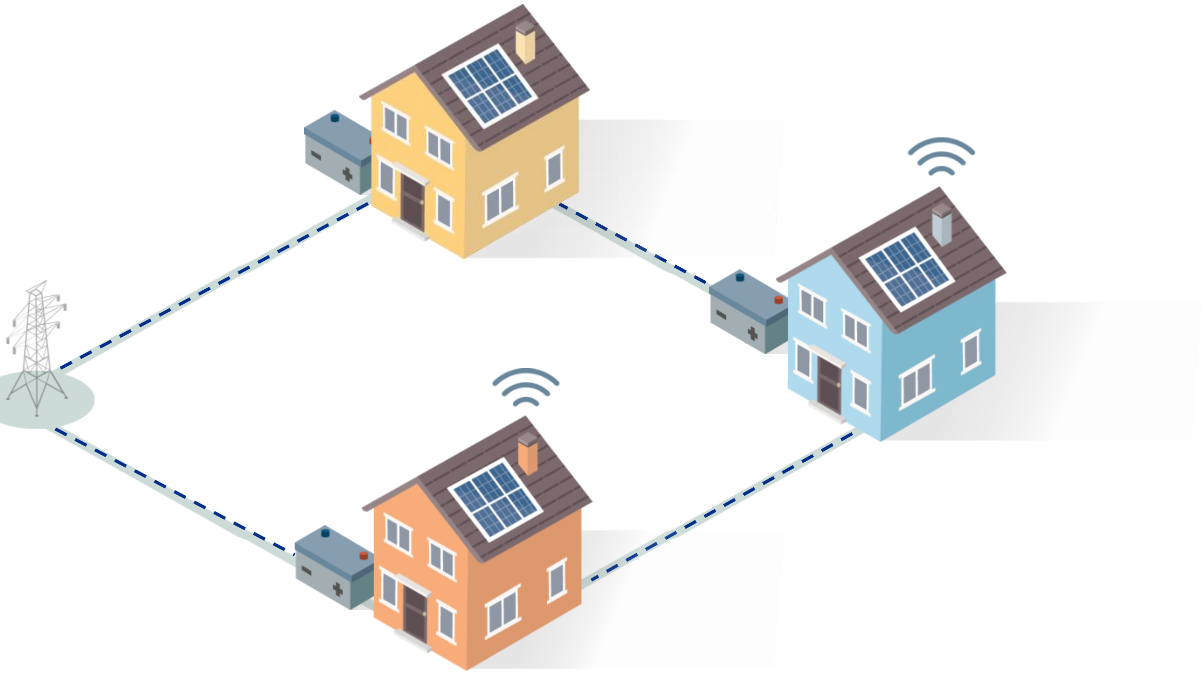
Integration of variable renewables





Digitalization can help integrate variable renewables by enabling grids to better match energy demand to times when the sun is shining and the wind is blowing.

Distributed energy resources



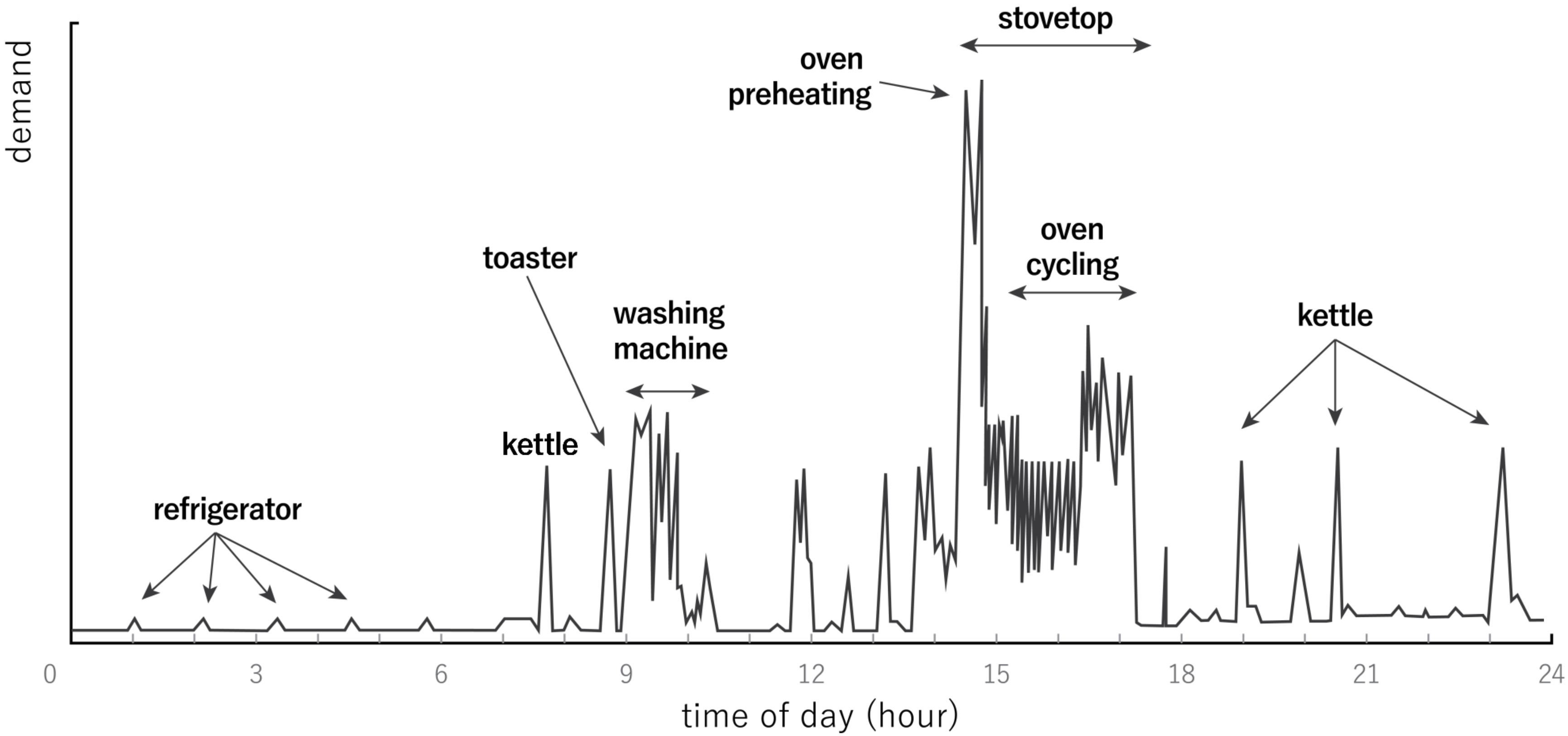
Blockchain could help to facilitate peer-to-peer electricity trade within local energy communities

Digitalization can facilitate the deployment of residential solar PV and storage, making it easier to store and sell surplus electricity to the grid or locally

Building digital resilience

- To date, cyber disruptions to energy have been small
- But cyber-attacks are become easier and cheaper – malware, ransomware, phishing / whaling, botnets
- Digitalization also increases the "cyber attack surface" of energy systems
- Full prevention is impossible, but impact can be limited:
  - Raised awareness, cyber hygiene, standard setting and staff training
  - Coordinated and proactive preparation by companies and governments
  - Design <u>digital resilience</u> in technologies and systems
- International efforts can help raise awareness and share best practices

Managing privacy concerns



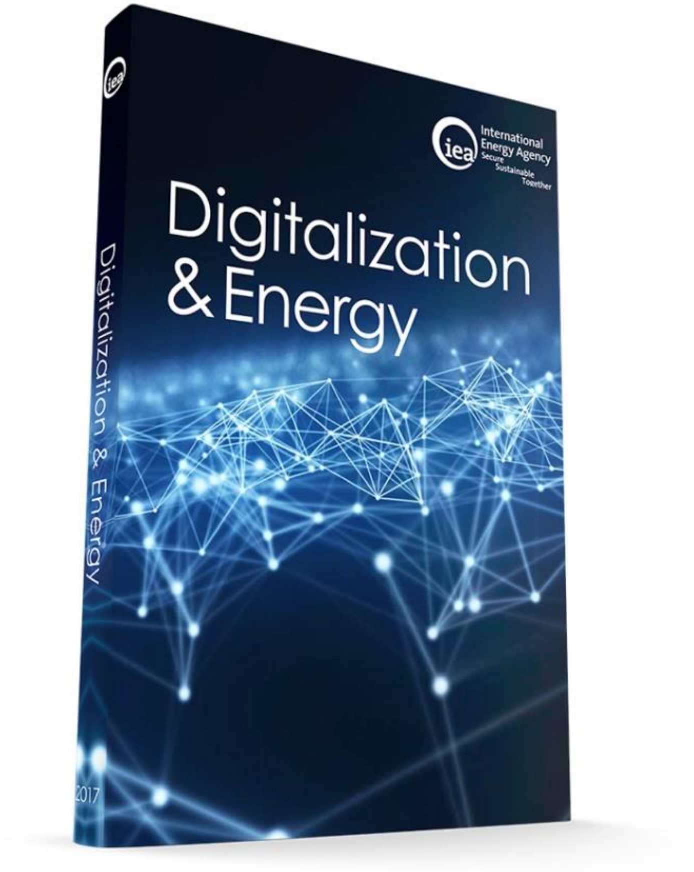
Source: Newborough and Augood (1999), "Demand-side management opportunities for the UK domestic sector" (reproduced courtesy of the Institution of Engineering and Technology).

No-regrets policy recommendations

1. Build digital expertise within their staff.
2. Ensure appropriate access to timely, robust, and verifiable data.
3. Build flexibility into policies to accommodate new technologies and developments.
4. Experiment, including through “learning by doing” pilot projects.
5. Participate in broader inter-agency discussions on digitalization.
6. Focus on the broader, overall system benefits.
7. Monitor the energy impacts of digitalization on overall energy demand.
8. Incorporate digital resilience by design into research, development and product manufacturing.
9. Provide a level playing field to allow a variety of companies to compete and serve consumers better.
10. **Learn from others, including both positive case studies as well as more cautionary tales**.

Digitalization: A New Era in Energy

- The energy system is on the cusp of a new digital era
- This first-of-its-kind “Digitalization and Energy” report will help shine a light on digitalization's enormous potential and most pressing challenges
- But impacts are difficult to predict; uncertainty in technology, policy and behaviour
- Much more work needs to be done…
- Next steps for IEA, especially to focus on high impact, high uncertainty areas:
  - Automation, connectivity, and electrification of transport
  - Electricity and smart energy systems
  - Digitalization and decarbonisation



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