

When

ENERGY RESILIENCE

Meets

ENERGY TRANSITION

Challenges and opportunities

ESA COMMERCIALISATION GATEWAY

SPACE FOR BUSINESS BUSINESS FOR SPACE

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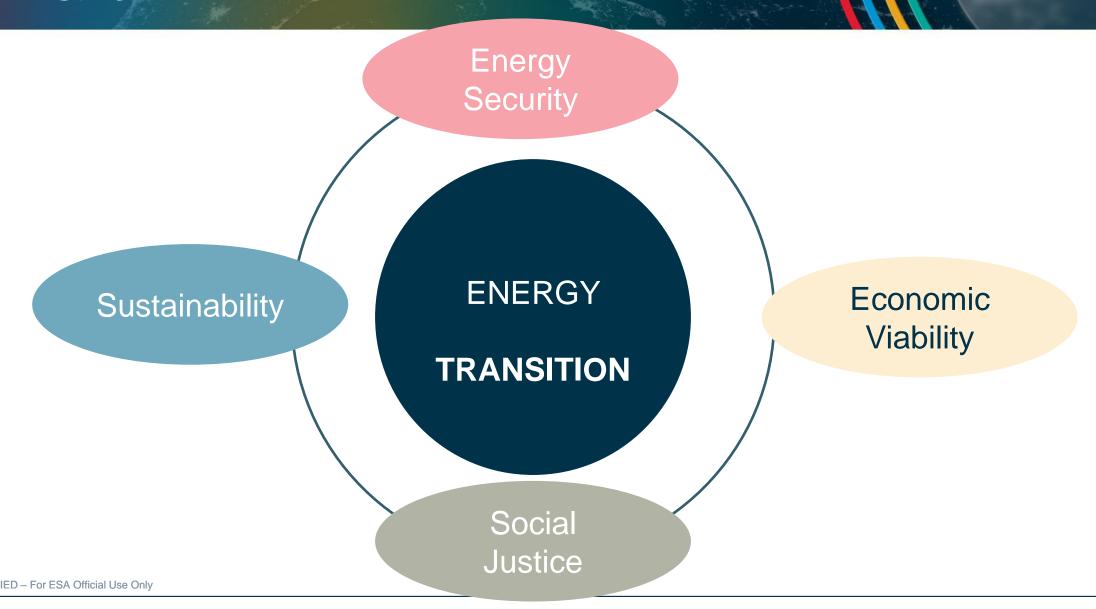






The Energy Quadrilemma







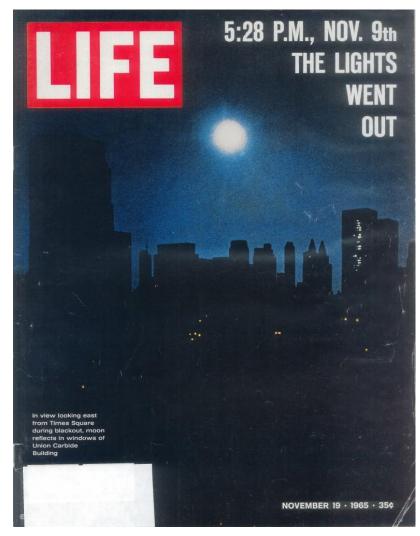
What is energy resilience?





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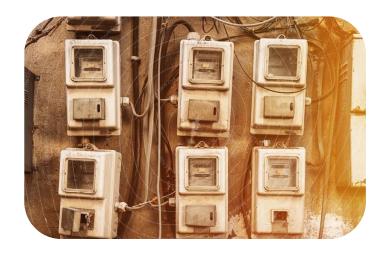


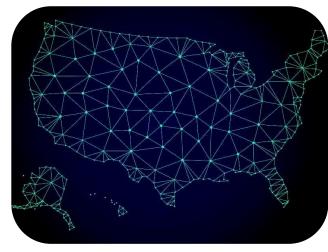
What is energy resilience?



DEFINITION: The ability of an energy system to recover from adversity









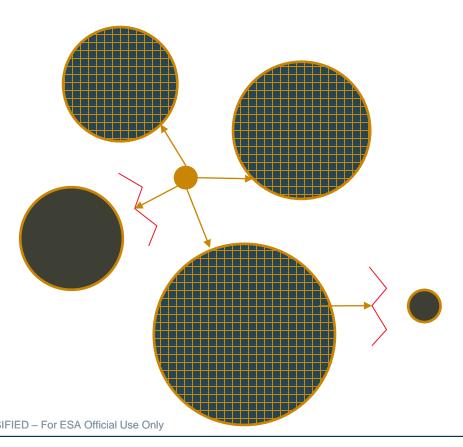




Solutions in energy centralised systems



AIM: Non-negotiable systems must remain operational 24/7 with a "critical load" – or the energy load that must be always available



TRADITIONAL SOLUTIONS:

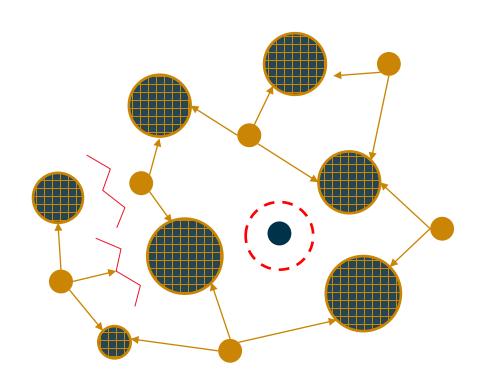
Backup generators, typically operate on diesel fuel. Technically and economically feasible.

Microgrids, on-site generation technology (solar/wind/backup generators) energy storage, and energy resilience hardware and controls.

Renewable energies: energy supply delocalisation



DELOCALISATION: Energy sourced from multiple locations and times



DIVERSIFICATION: Energy sourced from different "secondary" sources



Wind



Biomass



Solar



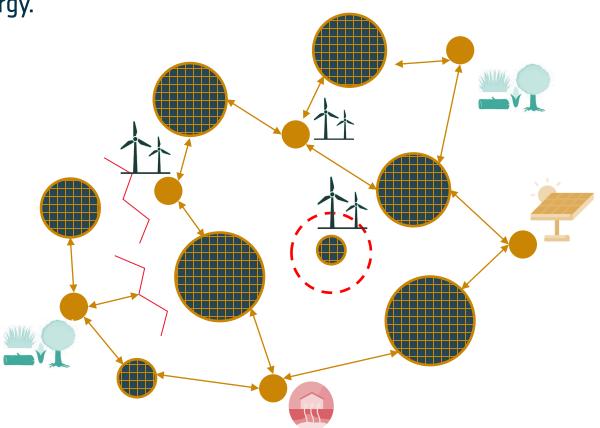


Renewable energies: prosumers



PROSUMERS: Producers + Consumers of energy

through PV panels, wind energy.



























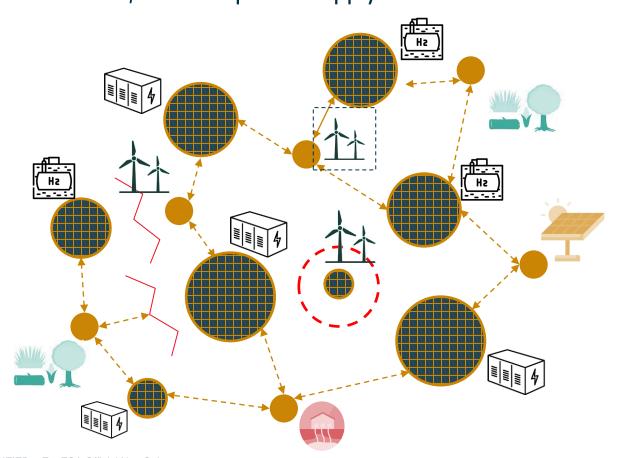


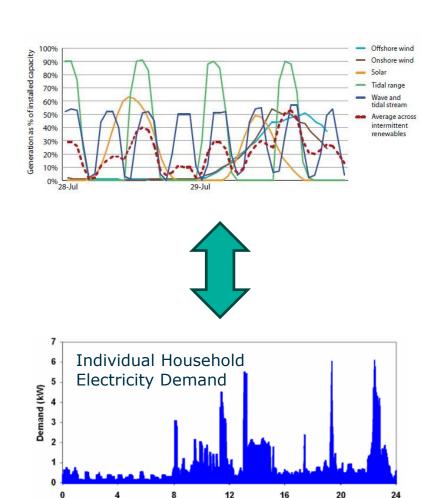


Renewable energies: storage



STORAGE: A strategy to overcome variability of renewable sources, but also power supply

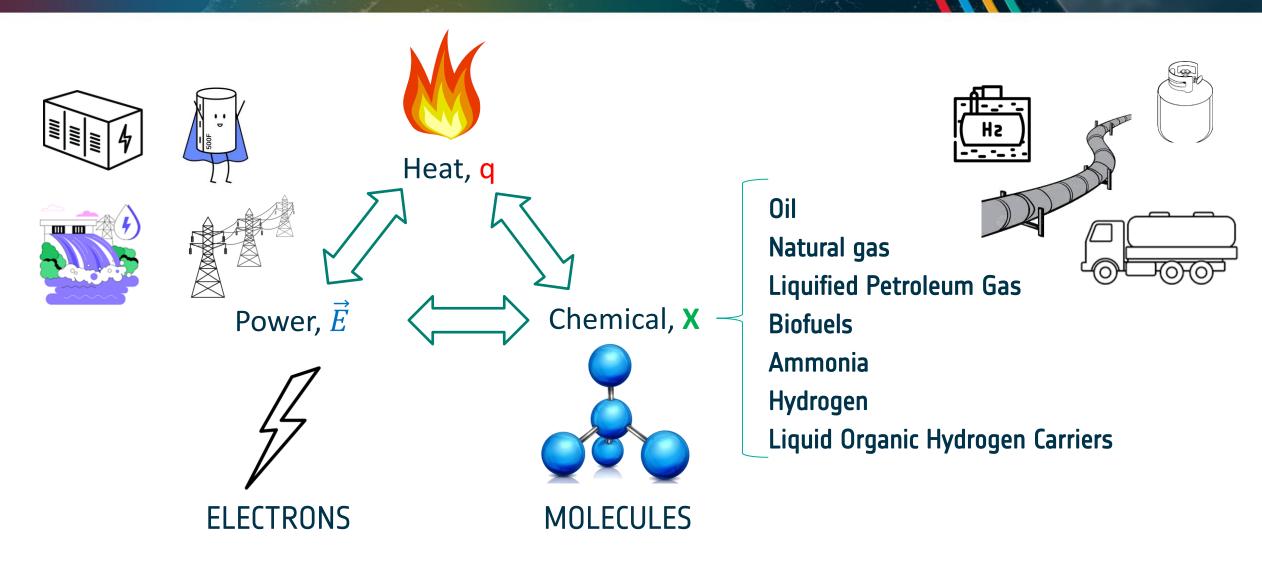




Time of Day

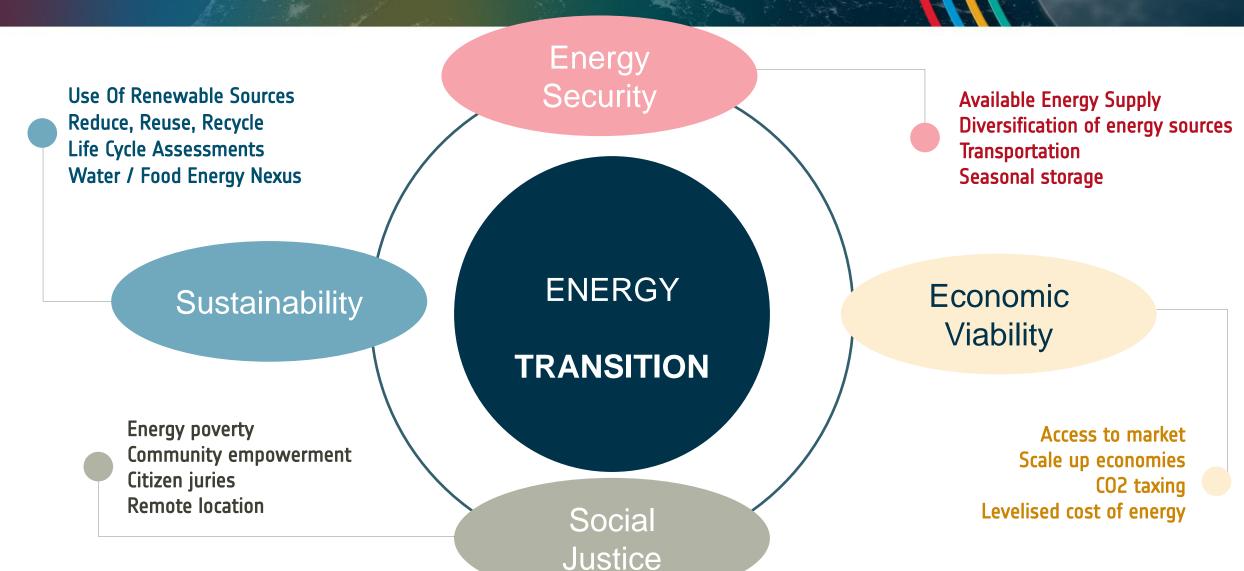
Energy vectors: electrons vs molecules





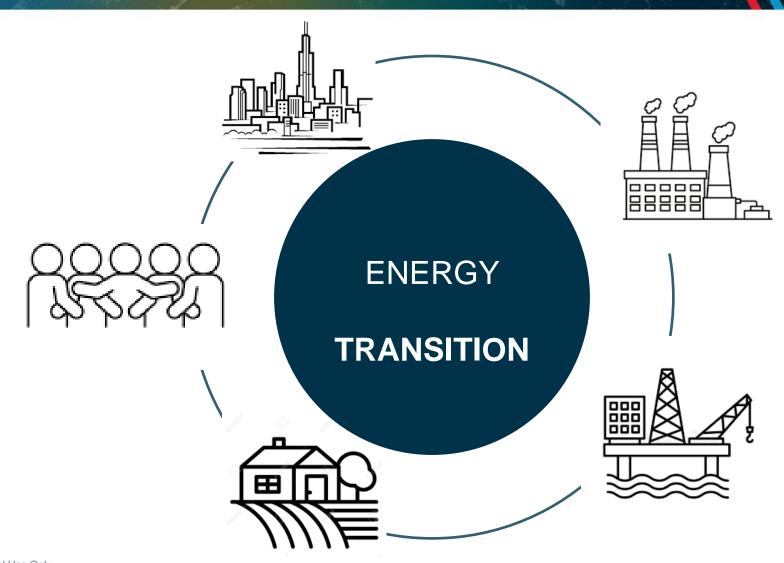
The Energy Quadrilemma: Renewable Energies





The system approach

































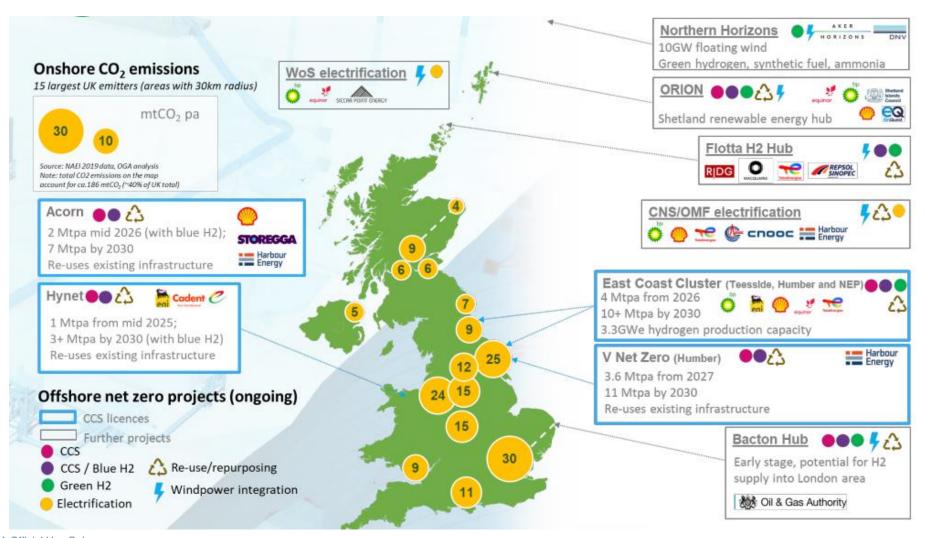






The system approach: the UK





The system approach: H2 in the UK



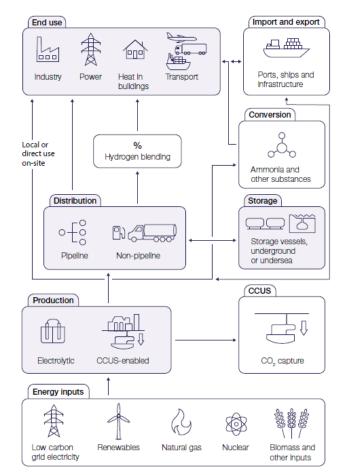
Key

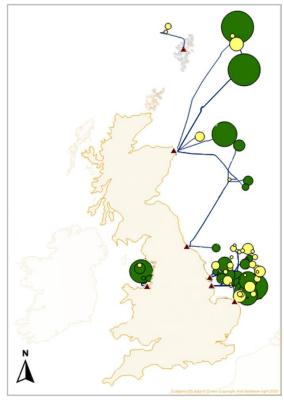
- Electrolytic production project (under 5MW)
- Electrolytic production project (over 5MW)
- CCUS enabled production project (100 MW+)
- CO, storage potential
- Offshore wind

Note: Includes plans and proposals for known projects that are in the public domain. Many more projects are under development in all parts of the UK. BEIS are continuing to gather intelligence on new projects as they emerge.



$$H_2O(g) \to H_2(g) + \frac{1}{2}O_2(g)$$

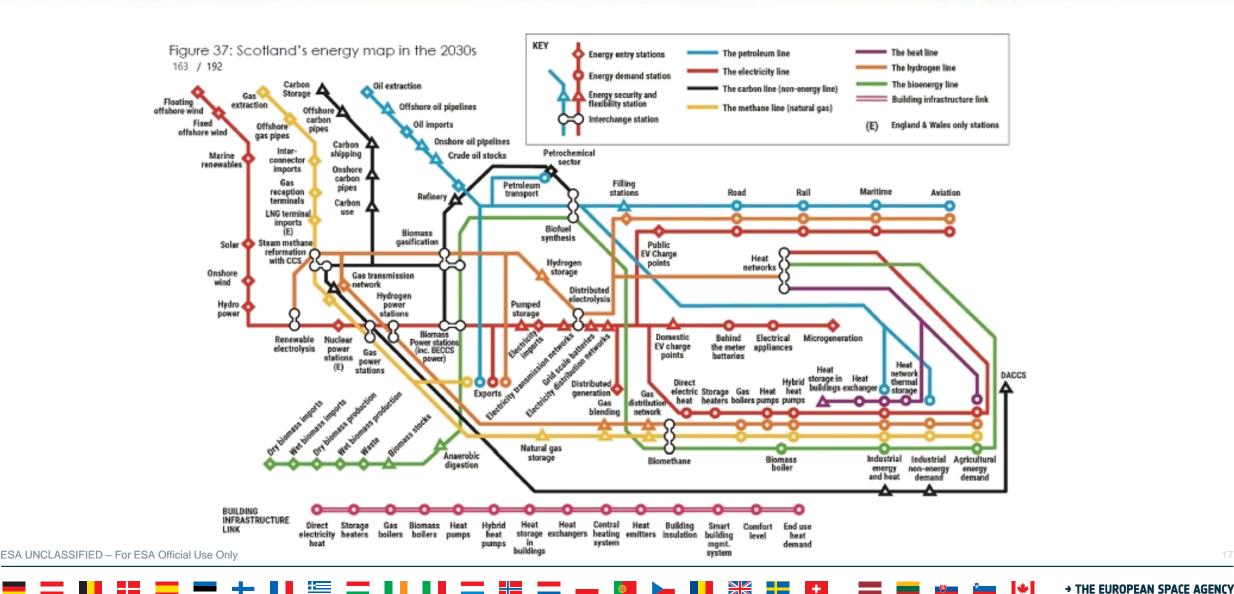




→ THE EUROPEAN SPACE AGENCY

The system approach: hydrogen in Scotland





The Aberdeen ecosystem







→ THE EUROPEAN SPACE AGENCY

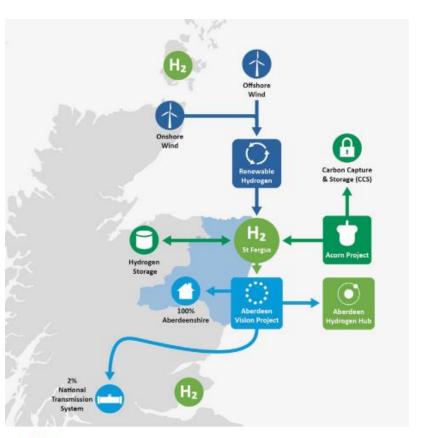
The Aberdeen ecosystem







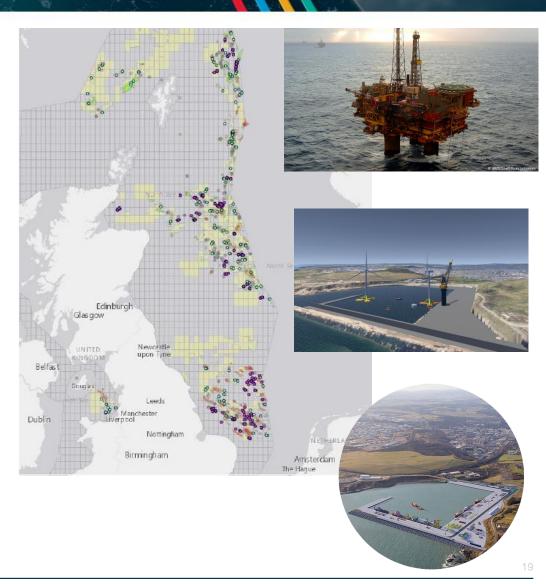






nationalgrid

Pale Blue Dot.





































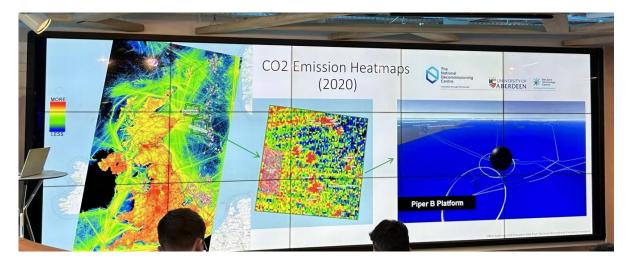




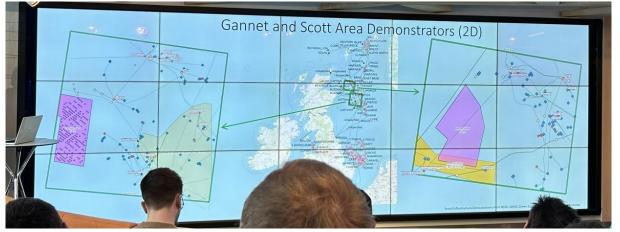


Digitalisation and energy transition











Digitalisation and energy resilience



Satellite Internet Innovation at UoA (Present & Past projects)

- ESA QUICOPTSAT: New internet transport for satellite
- SatNex: Enabling path-awareness over satcom
- ESA MTAILS: Mitigation techniques addressing satcom Latency
- EC H2020 projects: RITE, NEAT, MAMI, MONROE-PREC

Industrial Partners

 Avanti Communications, Inmarsat, Thales-Alenia Space, EADS Astrium, Mozilla

Current IETF standardisation for Satcom

- Careful Resume (draft-ietf-tsvwg-careful-resume)
- ACK frequency frame (draft-ietf-quic-ack-frequency)
- *QUIC BDP frame extension* (draft-quic-bdpframe)





















Digitalisation and energy resilience



Energy Monitoring Systems: Next-Gen challenge

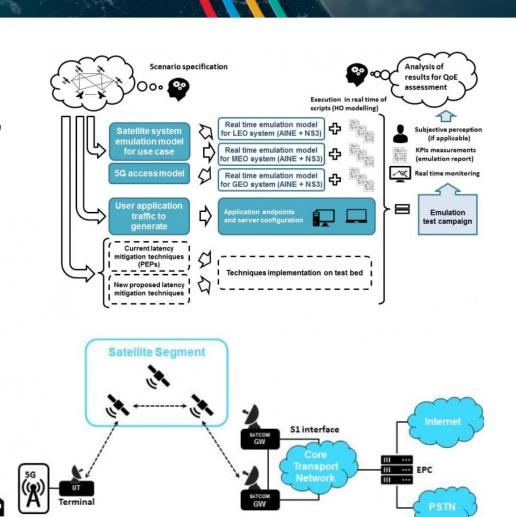
- EU action plan "Digitalising the energy system" (Oct 2022)
- 69 projects founded under EU HORIZON "Energy Systems and Grids"
- UK leading R&D with £1B allocated to Renewable Energy projects

Data Collection: Key to Efficiency

- Describe energy source/availability
- Identity energy waste
- Identify methods for sharing Energy data

Satellite Networks for Efficiency

- Satellite networks for vast territory management
- Managing dispersed networks remotely
- Efficient network management solutions





Digitalisation and natural resources

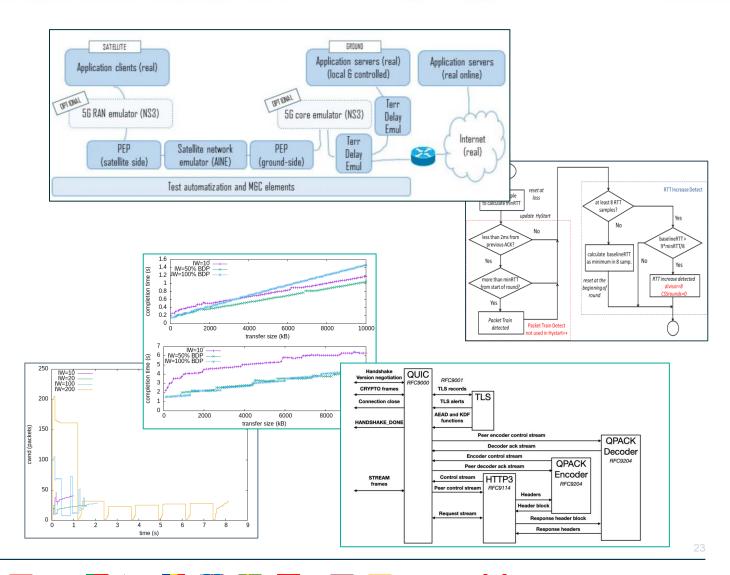


Challenges

- No standard satellite network solution
- Varied energy source descriptions
- Diverse consumption metrics
- Multiple storage usage descriptions

Goals

- Identifying reusable technologies
- *Demonstrator*: Demonstrating feasibility
- Assessing technology viability
- Exploring reusability options



Conclusions



Energy resilience is the ability of an energy system to recover from adversity and is part of energy security.

The use of **renewable energies** promotes decentralised systems and grids, and energy resilience.

The **energy transition** can benefit from resilient systems, and vice-versa.

Digitalization will help integrate energy systems, and reach resilience, but can be part of the challenges.





















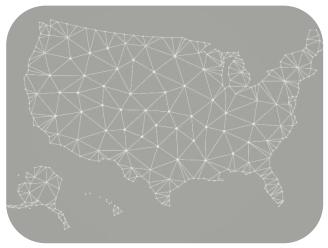




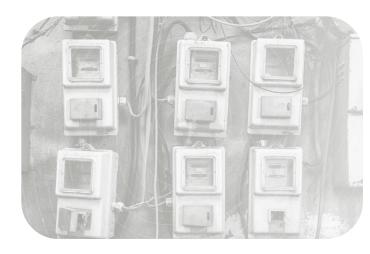
























































Acknowledgements, references



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Aberdeen Renewable Energy Group

The National Decommissioning Centre

Scottish Hydrogen and Fuel Cells Association, https://www.shfca.org.uk/



