Defence Operational Energy Strategy

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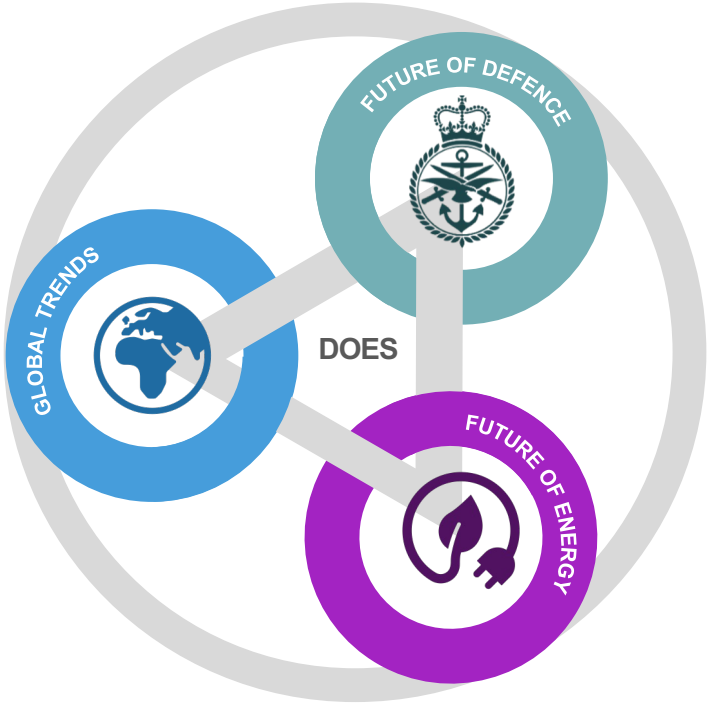
DOES sits at the heart of geopolitical, energy and Defence changes

- Increasing disruption and cost of climate change
- Expanded and unregulated information space
- Technological changes and impacts on society
- Artificial intelligence and machine-learning algorithms
- Increasing proliferation of weapons of mass effect
- Shifts in the balance of power and expanding competitive space
- Urbanisation, migrations and wider demographic changes
- Increasing demand and competition for resources
- Rising inequalities, reducing social cohesion and fragmented societies

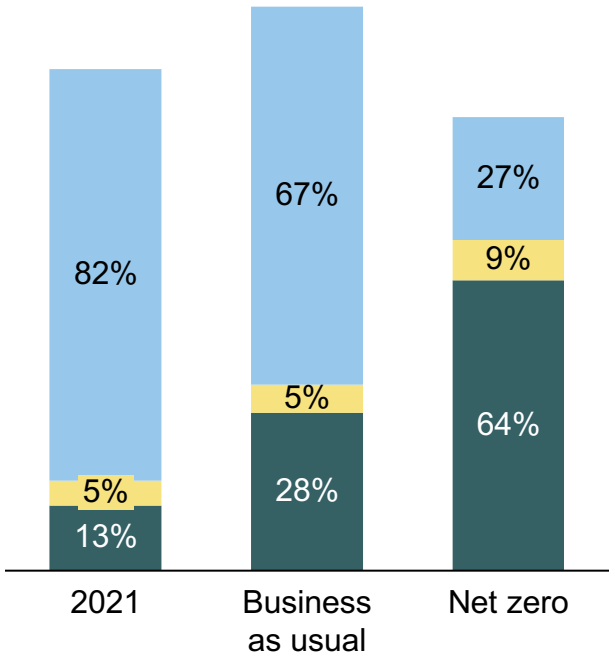


- Greater integration with allies and across domains
- Smaller and faster capabilities to avoid detection
- Reduced physical protection and increased mobility
- Greater use of low-observable/stealth technologies
- Increased dependence on electronic warfare and passive deception measures
- Mix of crewed, uncrewed and autonomous platforms
- Greater network integration through a combat cloud

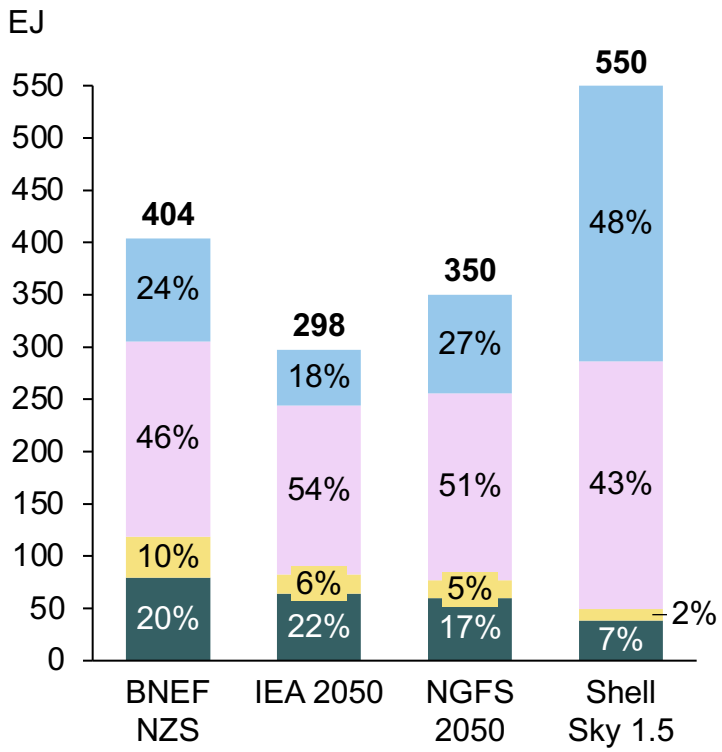
- Increased renewable energy generation and greater electrification of end-uses
- More distributed energy system
- Reduced reliance on fossil fuels
- Uptake of alternative low carbon fuels and hydrogen
- Increased energy efficiency

Future of energy: the global transition

Energy demand and mix



Energy demand and mix in different outlooks



Renewables | Hydrogen / Nuclear | Fossil fuels | Electricity

The future energy landscape looks very uncertain

Key agreements between outlooks

Diverse mix of primary energy sources. Renewable energy will increasingly replace current fossil fuels demand

Fossil fuels will still be used in 2050 and likely beyond, disproportionately in certain regions of the world

Carbon capture and storage will therefore need to scale up to achieve net zero emissions

Greater electrification of end-uses across the economy

Future of energy: energy sources

North America

	Current	Potential (2050)
Fossil fuels	81%	18%
Renewables	15%	79%

Europe

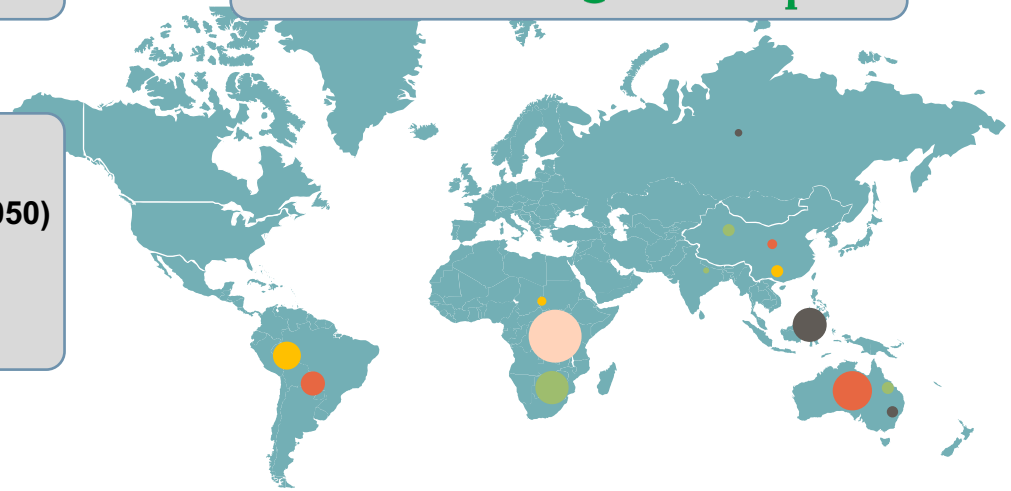
	Current	Potential (2050)
Fossil fuels	71%	3%
Renewables	25%	95%

Eurasia

	Current	Potential (2050)
Fossil fuels	90%	Not available
Renewables	9%	

Central and South America

	Current	Potential (2050)
Fossil fuels	63%	6%
Renewables	34%	89%



Asia Pacific

	Current	Potential (2050)
Fossil fuels	83%	16%
Renewables	11%	85%

Africa

	Current	Potential (2050)
Fossil fuels	50%	26%
Renewables	47%	69%

Middle East

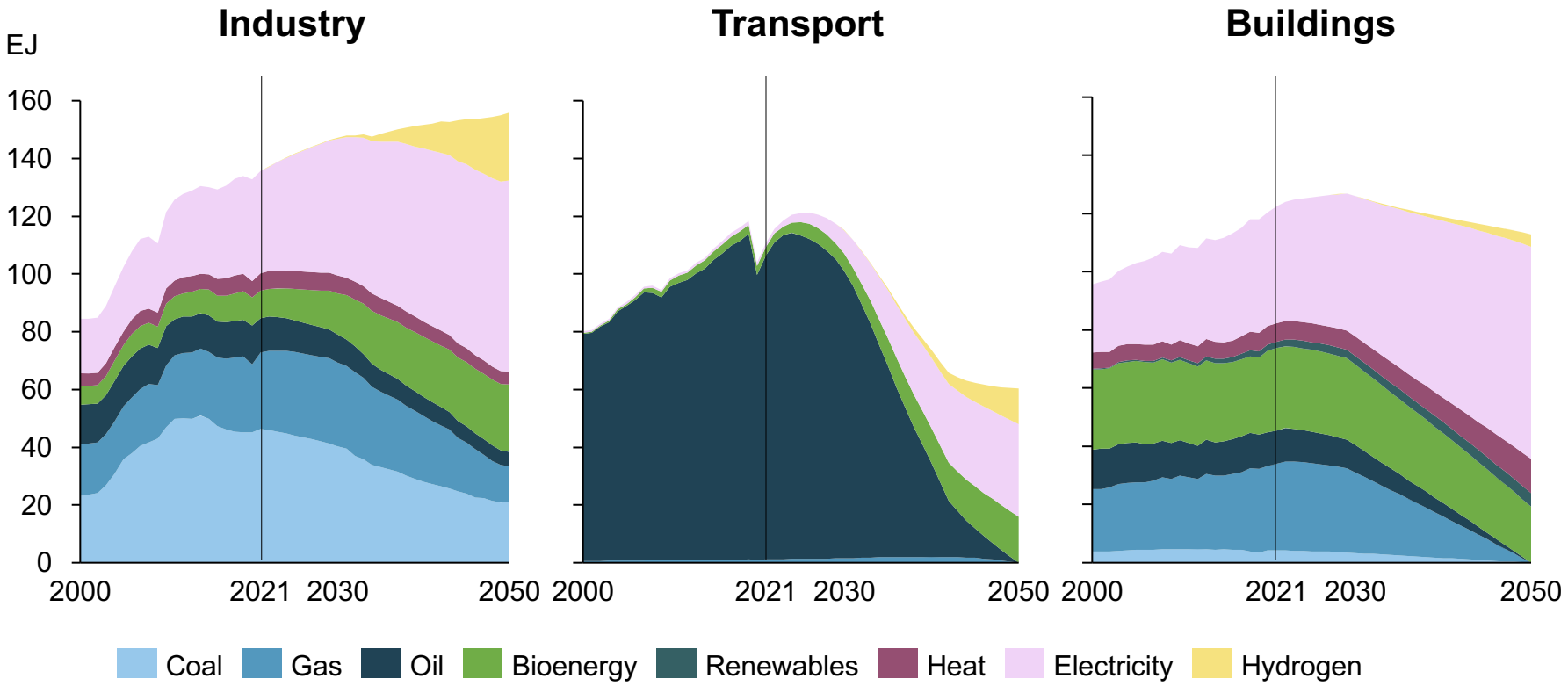
	Current	Potential (2050)
Fossil fuels	99%	34%
Renewables	0%	73%

Renewables
- Nuclear
- Biofuel/Waste
- Solar
- Wind

Fossil fuels
- Natural gas
- Oil
- Coal

Critical minerals concentration
- Copper
- Nickel
- Lithium
- Cobalt
- Manganese

Future of energy: use by sectors



The energy transition is having a significant impact on various industries, and companies are **having to adapt to these changes to remain competitive**

Actions taken by companies towards the energy transition

Amazon launched electric heavy goods vehicles in its fleet

Apple invested in carbon removal technologies and designed products to improve energy efficiency

Coca-Cola installed rooftop solar panels to power their bottling plants

Google committed to using 100% renewable energy for its data centers and offices

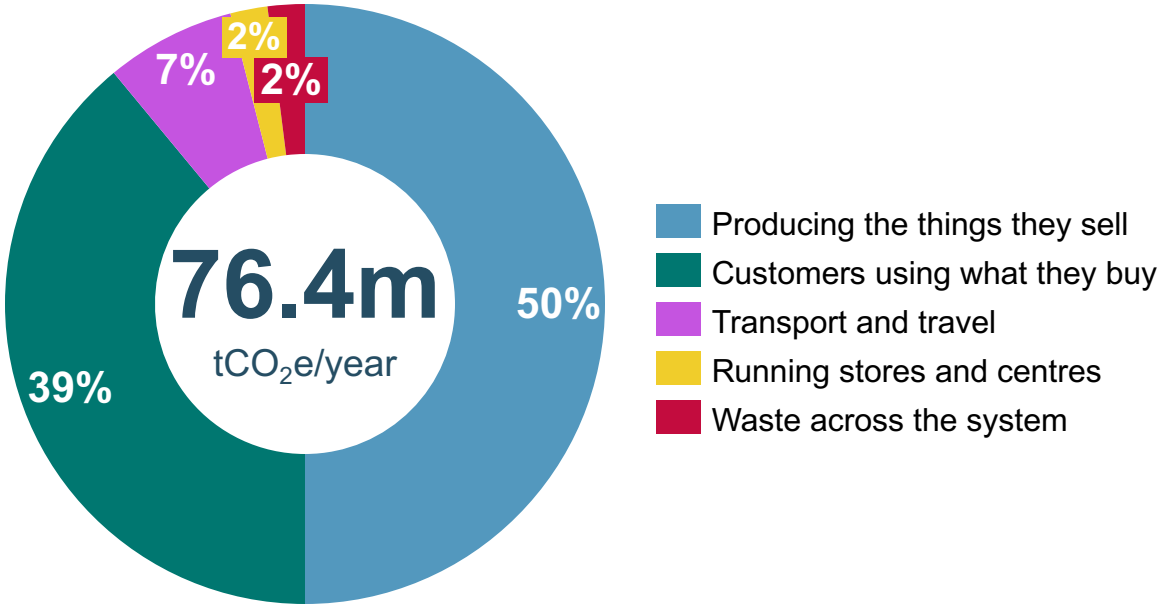
Ørsted transitioned from being a fossil fuel company to a leader in offshore wind power

Case study: Tesco

Tesco's material energy hotspots throughout their value chain:

- refrigeration
- heating
- transport

Total emissions footprint



Highlights of Tesco's energy strategy which ensures energy security and decarbonises its operations

Implemented a **energy efficiency** measures across its stores and distribution centers:

- Retrofitted with LED lighting
- Installed aerofoil technology in refrigerant systems
- Trialled heat pumps and heat reclaim systems
- Optimised transportation routes

Sourced **renewable energy** to power its operations:

- Installed solar panels on the roofs of its stores
- Invested in large-scale wind and solar projects (PPA)

Worked on **circular economy initiatives:**

- Committed to eliminate non-recyclable and excess packaging
- Introduced in-store recycling facilities

Reduced its reliance on fossil fuels for its fleet:

- Set a target to transition its entire delivery fleet to electric vehicles
- Introduced alternative fuels into its logistics fleet
- Invested in biomethane and CNG

Operational energy transition: sea domain

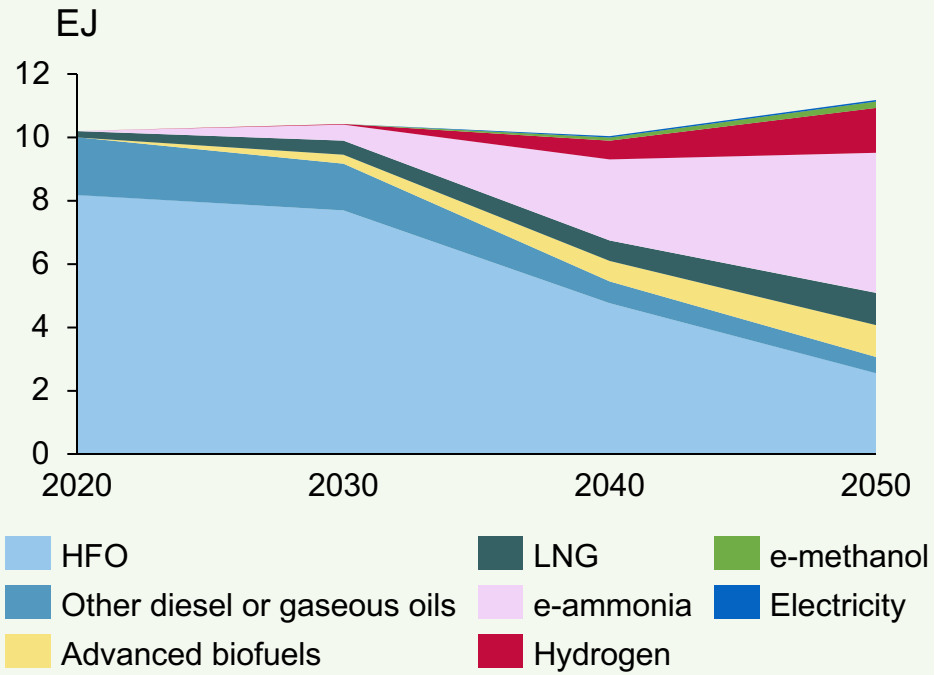
Technology assessment of alternative operational energy options

Technology	Interoperability	2025 cost	2050 cost	Sustainability & carbon emissions
Advanced biofuels	Likely drop-in	££	££	Carbon emissions lifecycle savings
Ammonia and methanol	Some engine adaptations, new refuelling infrastructure	££££	£££	High CO_2 savings but ammonia is toxic
Other diesel / gaseous oils	Likely drop-in	£	£	Limited carbon savings and potentially high sulphur content
Liquified natural gas	Some engine adaptations, new refuelling infrastructure	££	£	Fewer pollutants but low CO_2 savings and methane leakage
Hydrogen	New engines and refuelling infrastructure	£££	£	Zero emission at tailpipe, but hydrogen will need to be green
Electricity	New engines and refuelling infrastructure	£	£	Zero emission at tailpipe

Operational energy decisions for MOD

- Retrofit existing ships with new engines
- Futureproof the design of upcoming vessels
- Fuel technology
- Different approaches across the marine fleet
- Produce its own marine fuel
- Fast-follower or first-mover

Energy demand for commercial shipping



Operational energy transition: land domain

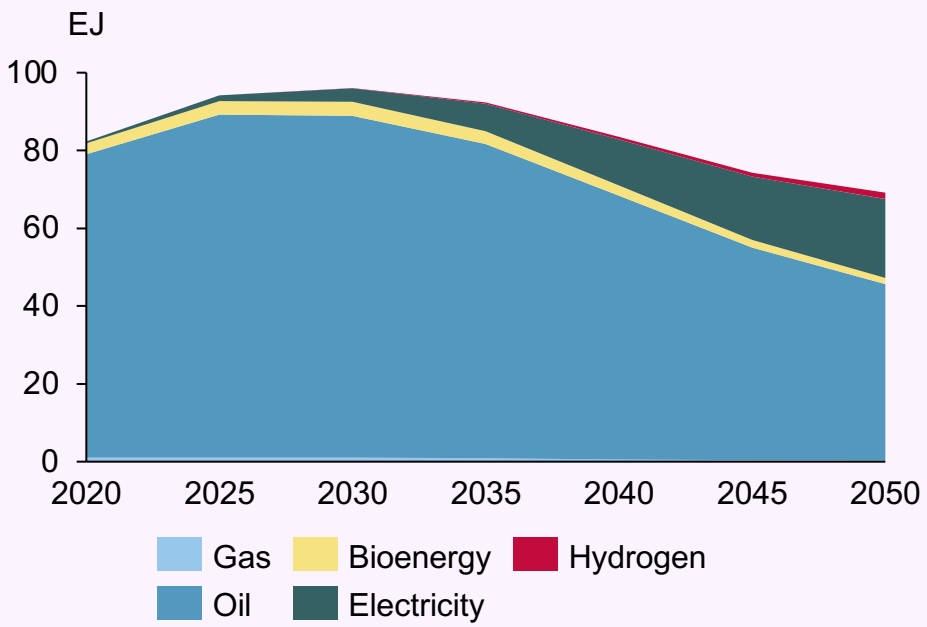
Technology assessment of alternative operational energy options

Technology	Interoperability	2025 cost	2050 cost	Sustainability & carbon emissions
Biofuels	Likely drop-in	££	££	Carbon emissions lifecycle savings
Electricity	New engines and refuelling infrastructure	£	£	Zero emission
Hydrogen	New engines and refuelling infrastructure	£££	£	Zero emission

Operational energy decisions for MOD

- Opt for hybrid technology now or wait until new vehicles develop
- Different approaches across the vehicle fleet
- Fast-follower or first-mover
- Source batteries

Energy demand for road transport



Operational energy transition: air domain

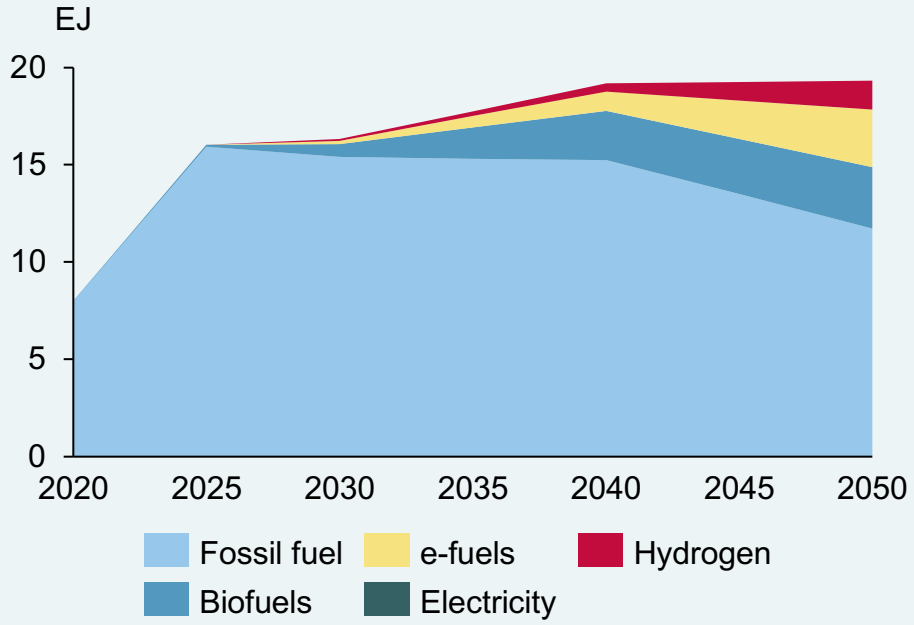
Technology assessment of alternative operational energy options

Technology	Interoperability	2025 cost	2050 cost	Sustainability & carbon emissions
Biofuels	Likely drop-in	££	££	High carbon emissions savings through lifecycle (with sustainable feedstocks)
Power-to-Liquid	Likely drop-in	£££££	££	High carbon emissions savings through lifecycle
Electricity	New engines and refuelling infrastructure	£	£	Zero emission at tailpipe
Hydrogen	New engines and refuelling infrastructure	£££	£	Zero emission at tailpipe, but hydrogen will need to be green

Operational energy decisions for MOD

- Efficient engines
- Electric planes
- Hydrogen planes
- Different approaches across the aircraft fleet
- Investor in SAF and/or produce its own fuel
- Fast-follower or first-mover

Energy demand for commercial aviation



Operational energy transition: operational infrastructure

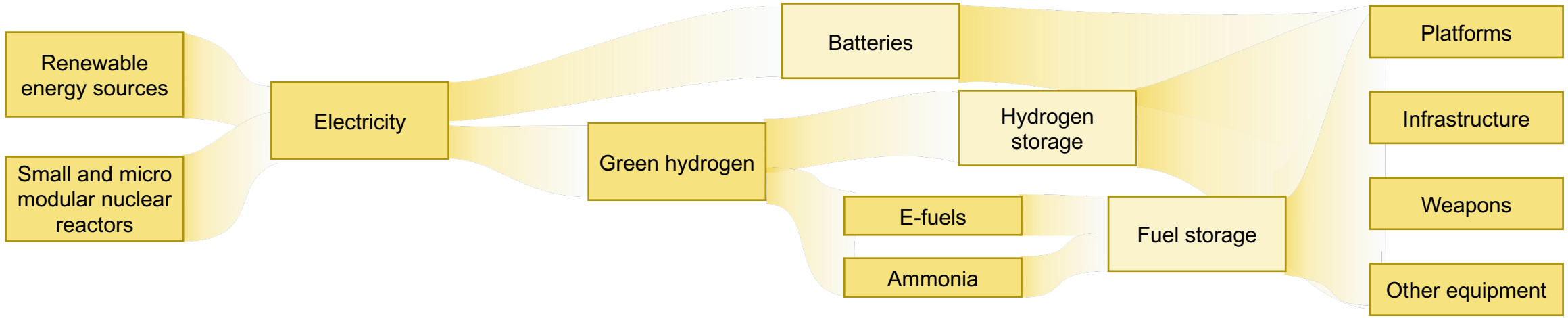
Technology assessment of alternative operational energy options

Technology	2025 cost	2050 cost	Resilience	Feasibility of deployment in the field
Renewable energy	££	£	Unpredictable and not dispatchable, unless coupled with batteries	Wind/sun will need to be available and planning permissions may be required
Nuclear energy (via small nuclear modular reactors)	Not yet commercial	££	Provides baseload generation	Country-specific policies may constrain nuclear activity, and higher vulnerability of nuclear assets may be expected

Operational energy decisions for MOD

- Generate the energy and/or the energy vectors it needs at its bases
  - Technologies and energy vectors
- Procure

Expected changes along the operational energy value chain



Defence Operational Energy Strategy

Defence Support commissioned KPMG, along with MACE, RAND and Uplift 360, to develop a **Defence Operational Energy Strategy (DOES) that enables the governance** and **direction** of the **Defence energy transition.**

It is being **developed collaboratively** with Head Office, FLCs (including StratCom) and EOs. Industry, academia and suppliers will be consulted.

DOES will:

- maintain **operational capability**
- exploit emerging **energy opportunities**
- enable the retention, or achievement, of **operational advantage** in comparison with the UK's competitors
- consider the **governance needed** to oversee the energy transition and ensure **consistent, coordinated** action

Scope → **Diagnosis** (risks and opportunities) → **Vision** → **Strategic objectives** → **Energy choices** → **Key enablers** (including governance) → **Draft strategy and governance**