



Circular Economy for offshore wind

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The Offshore Renewable Energy Catapult

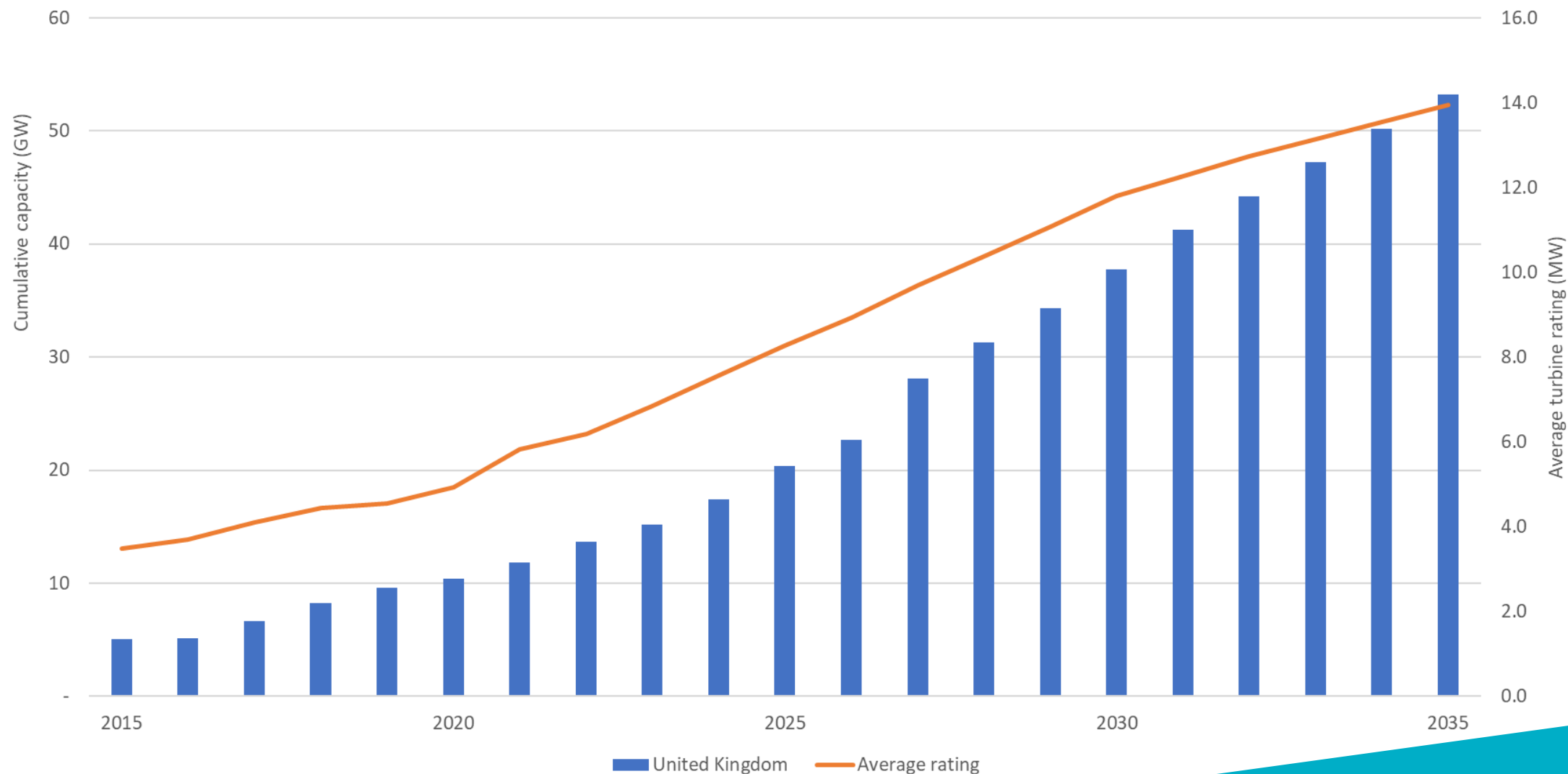
The UK's leading technology innovation and research centre for offshore renewable energy

Mission: to accelerate the creation & growth of UK companies in the offshore renewable energy sector.

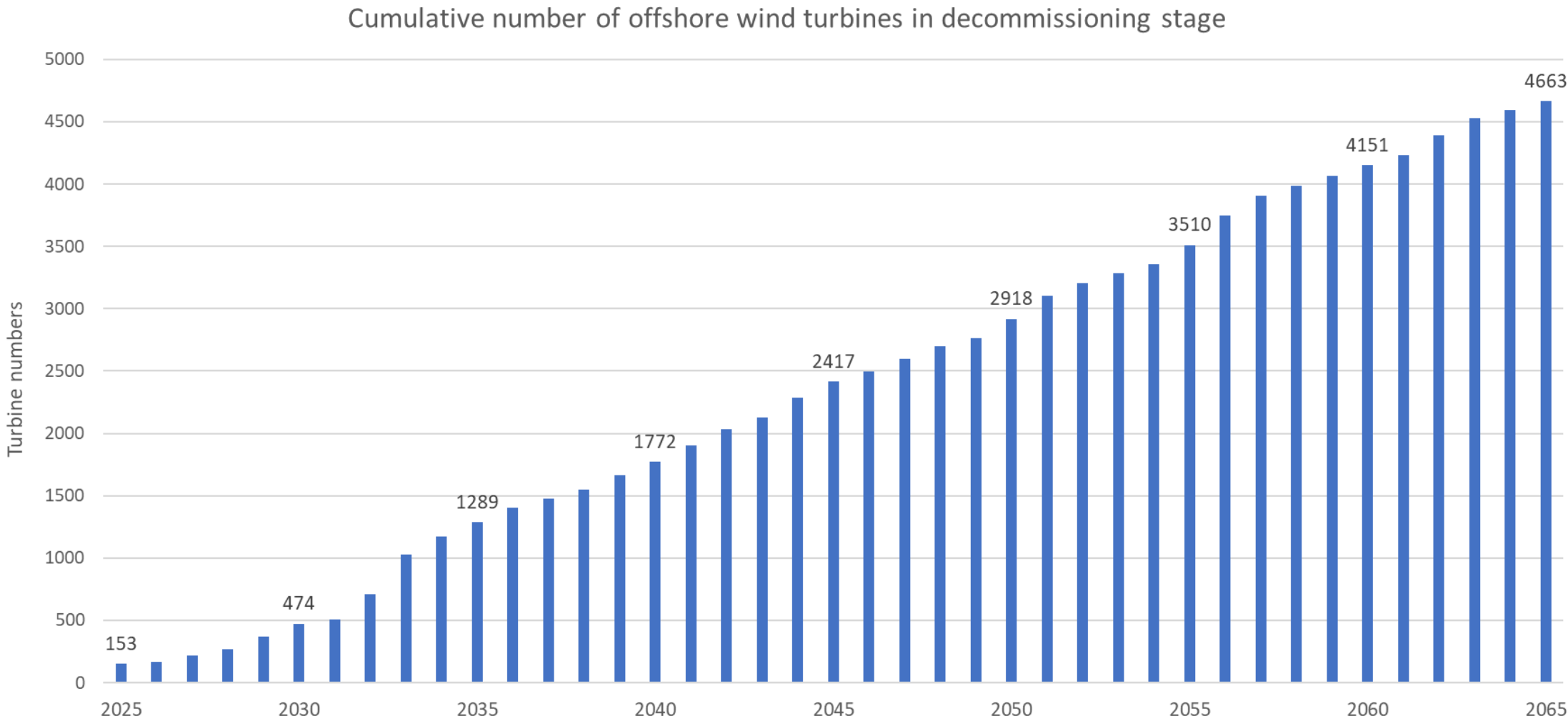
- Unique facilities, research & engineering capabilities
- Bringing together innovators, industry and academia
- Accelerating creation and growth of UK companies
- Reducing cost and risk in renewable technologies
- Growing UK economic value
- Enabling the transition to a low carbon economy



UK Offshore wind capacity



UK Decommissioning Projections



Average operational life assumption
2015: 25 years -> 2035: 31 years

Economic Drivers

- Contracts For Difference (CfD): guarantees income for 15 years – concerns for affordability once CfD ends.
- Geopolitical
War, trade tensions, global market uncertainties, access to resources.
- Cost of Energy
Can we afford to decommission wind farms when energy prices are so high?
- Cost of maintenance
What are the operational costs vs income from generation?
- Drive for Net Zero / Energy Transition
Government policy and incentives: EU Green Deal, American Inflation Reduction Act.
- Social
Creating jobs, “local content” in contracts, Just Transition
- Environmental
Carbon accounting, Biodiversity, resource productivity, Company core values



**~23 kt
COPPER
in cables**

X2

**2,555
turbines**



**152 kt
blades**

**Materials in
UK offshore
wind in 2019**

**550 kt
nacelles:
steel,
aluminium,
copper, REEs
& cast iron**

45,825



**1.7M tonnes
STEEL**

**in monopiles &
foundations**



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Jensen et al. (2020) Highlighting the need to embed circular economy in low carbon infrastructure decommissioning: the case of offshore wind

Lifetime Extension



Continuous operation beyond design life.



Lifetime Technical Evaluation (LTE)



Corrective maintenance



Upgrade of secondary components



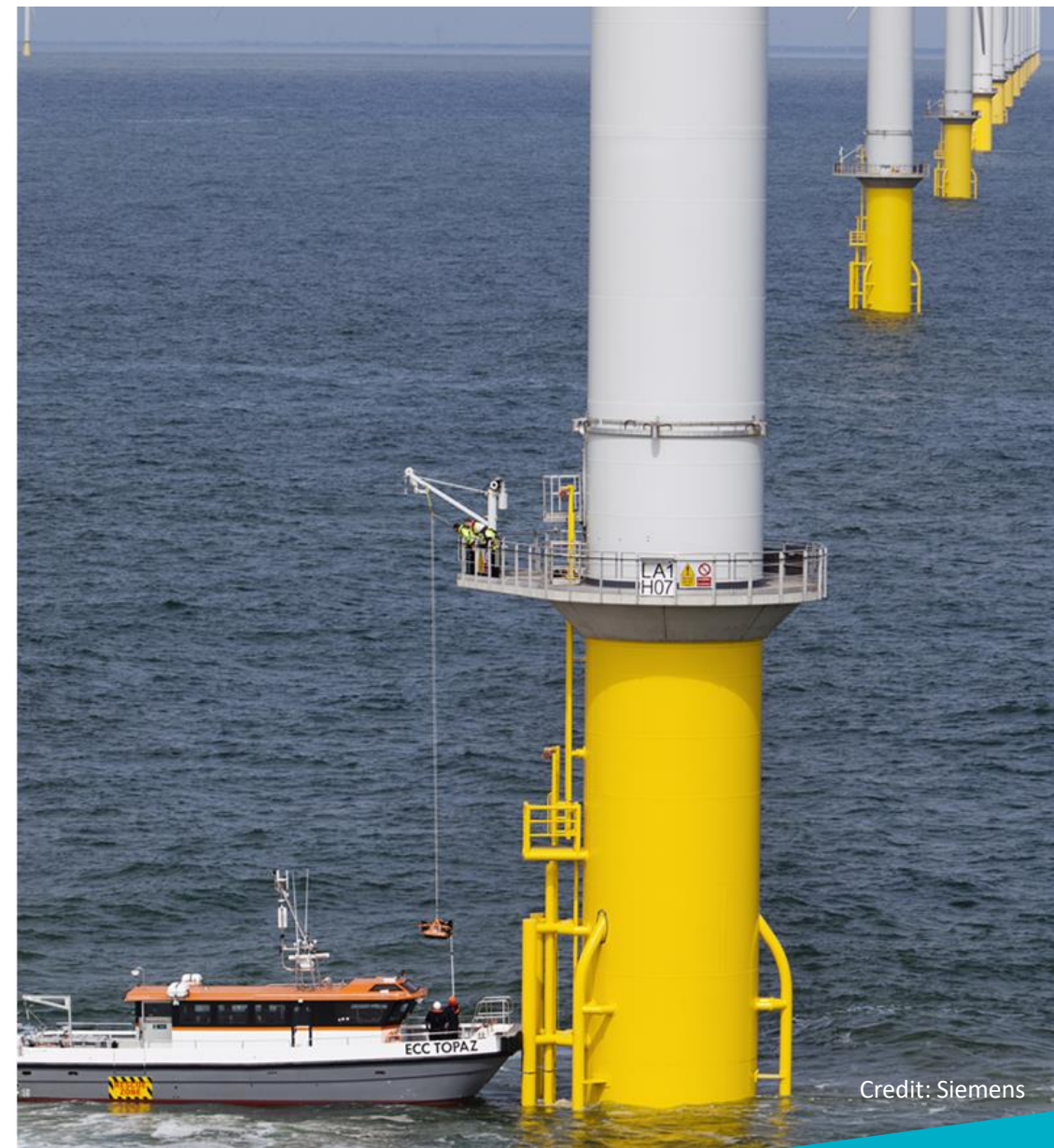
Technological improvements in O&M



OPEX increase with age



Offshore wind farm life can be extended by at least further 5 - 10 years



Credit: Siemens

Decommissioning

- Wind farm owners agree a decommissioning bond as part of the initial leasing agreement
- Full/partial removal of foundations, turbines and array cables (O&G lessons)
- No standard legislation exists
- Decision on alternative strategies affected by:
 - physical condition
 - turbine lifetime
 - process cost (£285 per kW)
 - site conditions
 - specific country legislation
 - logistical difficulties
 - environmental impact



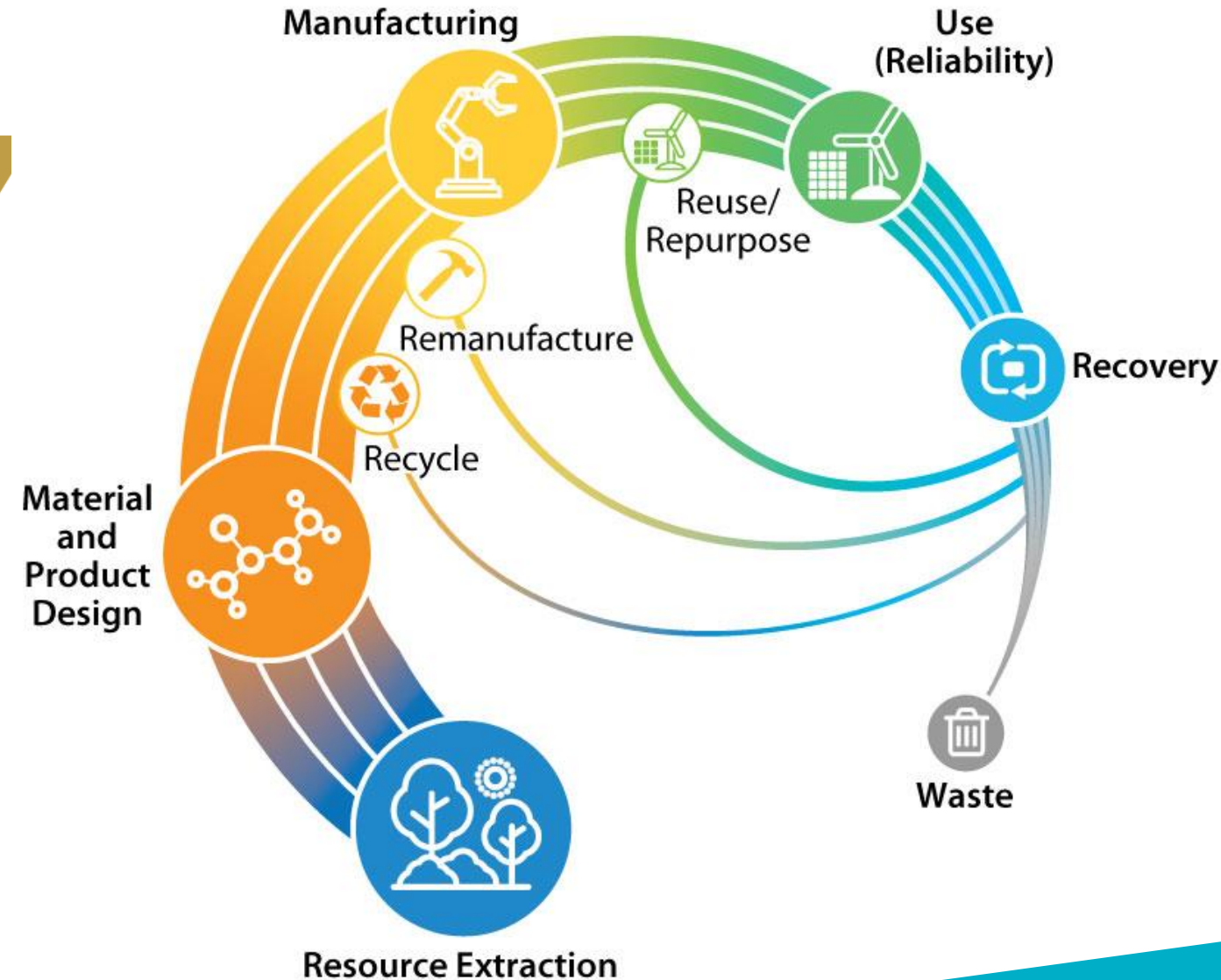
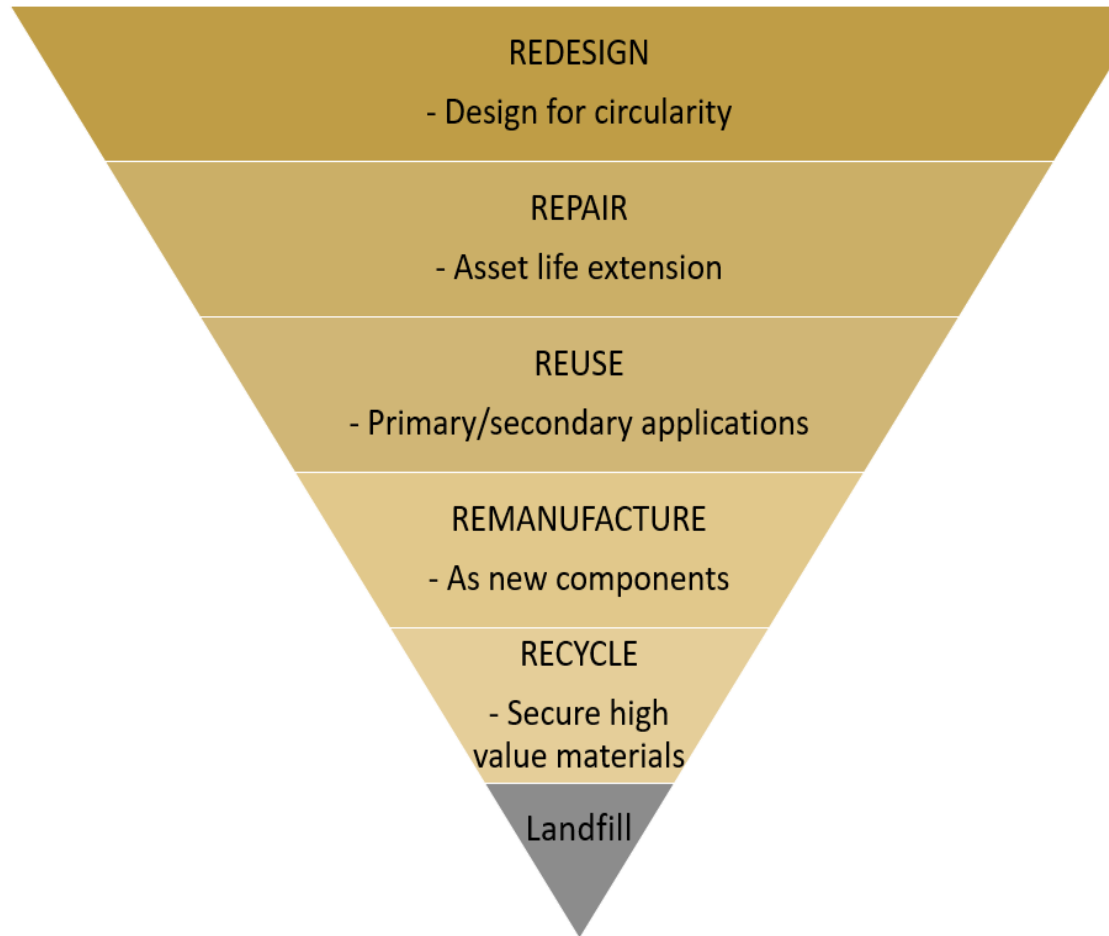
Repowering

- Replacement of old generating assets or components with next generation low cost-high output technology
- Full or partial repowering strategy depends on:
 - Site characteristics
 - Project size
 - Regulations
 - Power price
 - OPEX
 - Existing infrastructure reliability
 - Profitability of repowered project
- UK Leasing Round 4: extension of leasing terms from max 50 to 60 years.



Credit: Innogy

Circular Economy



Hierarchy of Circular Economy Principles

Courtesy of NMIS

<https://blog.yorks.ac.uk/isj/2023/03/27/the-circular-economy-at-york-st-john/>

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