Rolls-Royce SMR

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Future energy systems will look very different as industrial sectors decarbonise

- Cummins is forecasting **2,500GW of electrolyser capacity** for their addressable market – **equivalent to 5,000 SMRs**
- ITM is building a **1GW p.a. electrolyser factory** – that would require **two SMRs p.a. to power the product**
- A single data centre can require between **0.5-1.0GW constant electrical power**, equivalent to **2 SMRs per centre**
- Data centres need **c.23GW p.a**
- Bitcoin requires **c.13GW p.a.**
- The Netherlands necessitates **c.13GW p.a.**

Hydrogen & Synthetic Fuel Production

Produce 170 tonnes of H2 or 280 tonnes of net-zero synthetic fuel per day.

District Heating / Cooling

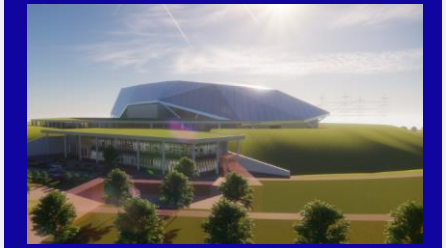
Heat or cool a city the size of Sheffield.

Annual global requirement over 10,000 TWh by 2040.

Desalination

Produce 500 million cubic metres of potable water per year.

Global demand for potable water to rise beyond 1 trillion cubic metres per year by 2040.



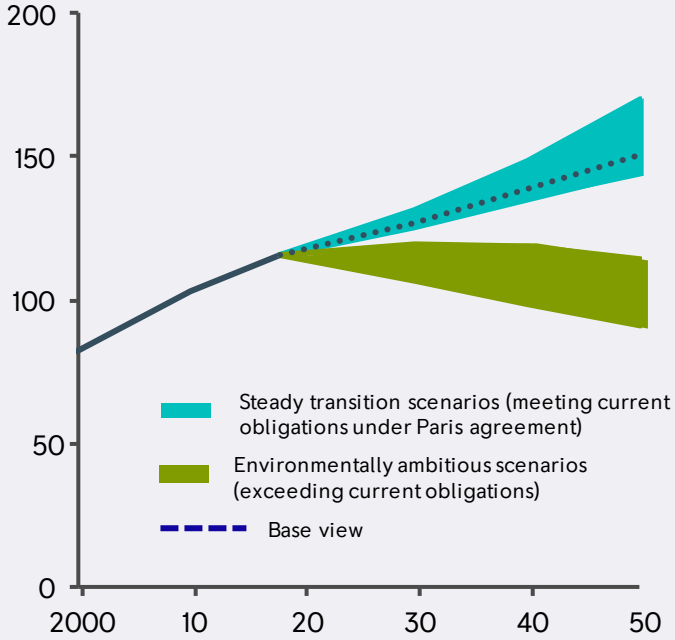
One Rolls-Royce SMR and associated plant can....

Electricity

Can power a city the size of Leeds.
Global grid capacity demand projected to double by 2040

Whilst energy forecasts vary, electricity growth is substantial in any future energy system scenario

Consensus* outlook on final energy consumption (2000-2050F)
000' TWh (*equivalent*)



Consensus[1] outlook on final electricity consumption (2000-2050F)
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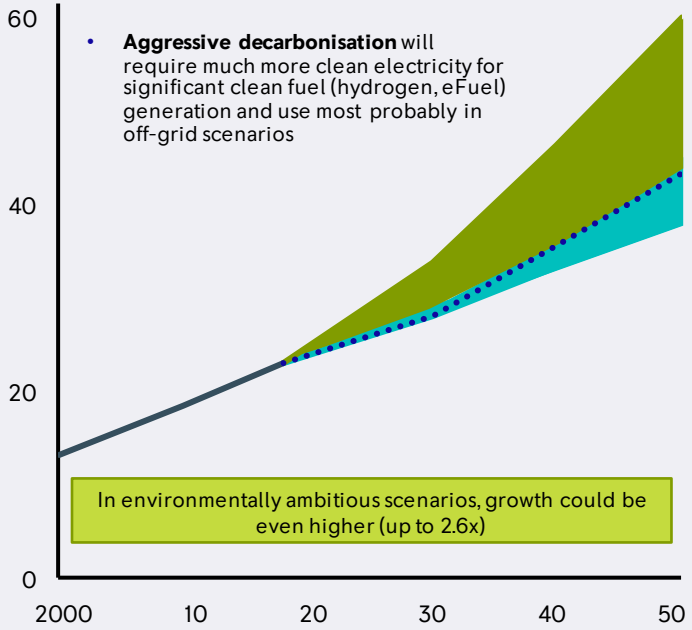
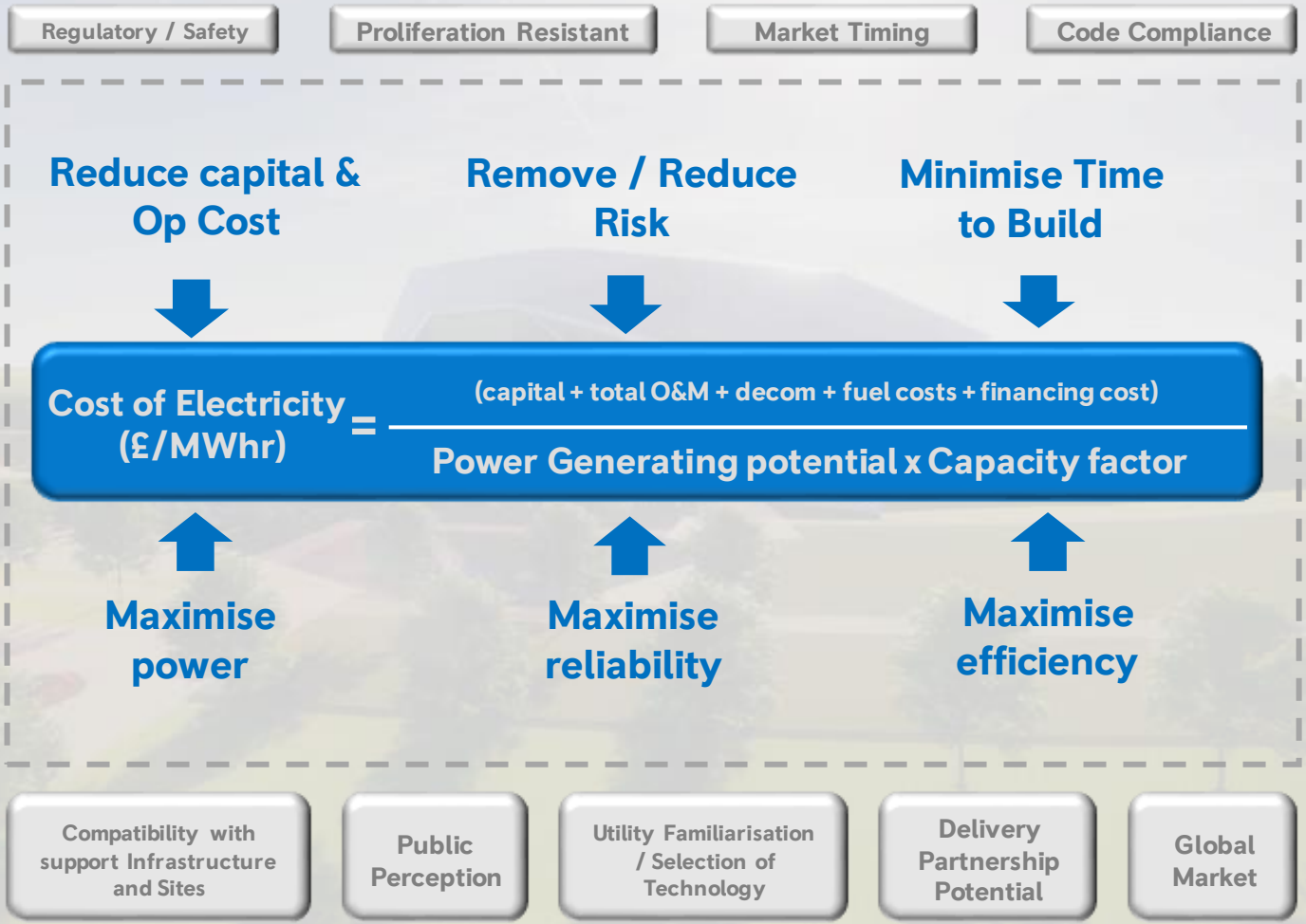
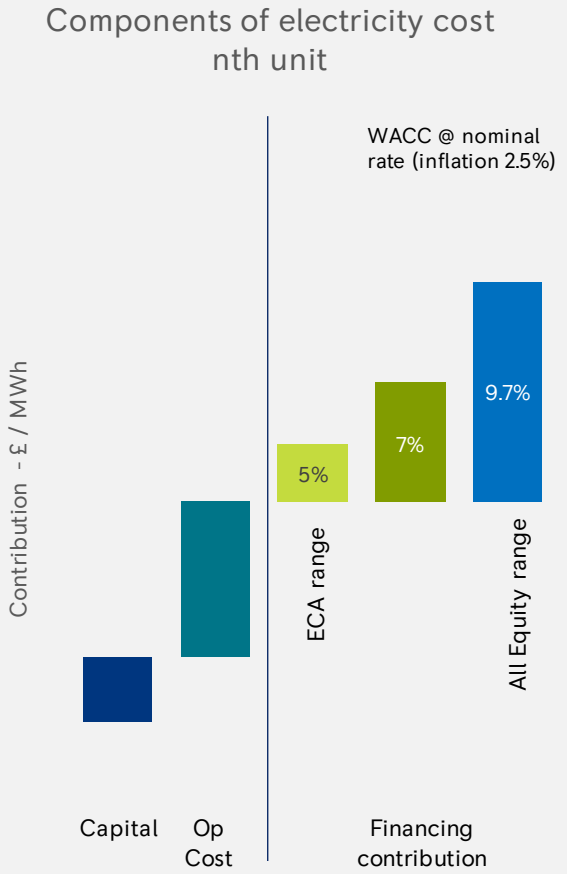


SMRs can play a significant role, but not at any cost.

Market driven requirements must drive the design approach



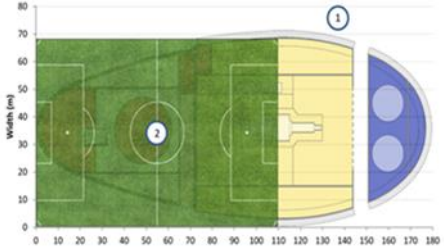
Components of LCOE

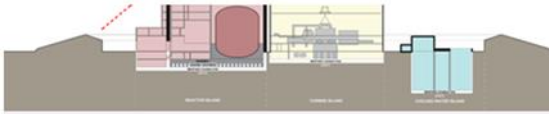


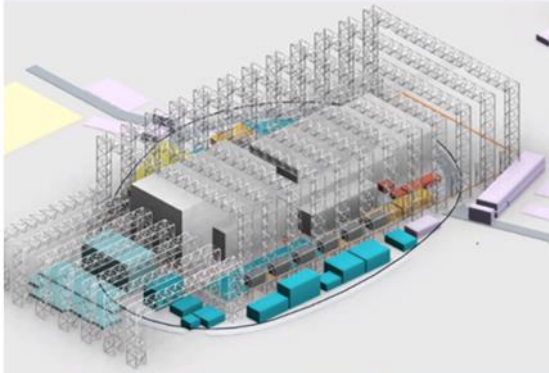
- Capital cost alone is not a measure of market competitiveness
- Cost of electricity is heavily dependent on financing cost:
  - Absolute capital
  - Time to build
  - Risk (or perceived risk)

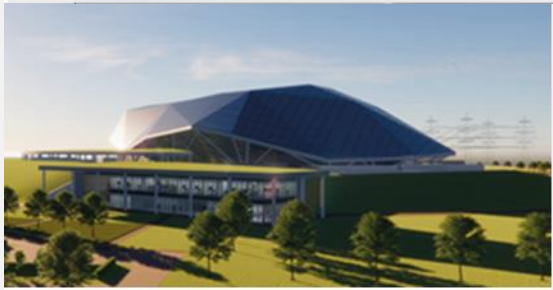
The design philosophy is of paramount importance

- **Small** power doesn't necessarily mean small footprint / lower capital
  - Maximising power for physical size
- **Modular** – at total power station level
  - Modularisation is about manufacturability and deliverability
- ~~**Reactor**~~ - **Power station** design NOT just the reactor
  - The reactor is only a modest proportion of the cost / schedule / risk









What problems are we trying to solve?

Innovations must solve problems NOT create them

Time to Market is critical

1. Reduce cost

- Proven Technology – innovation for benefit
- Compatibility with existing infrastructure (fuel, waste, etc)
- Simplified and Standardised Equipment
- Minimise additional site works / infrastructure / transient loads

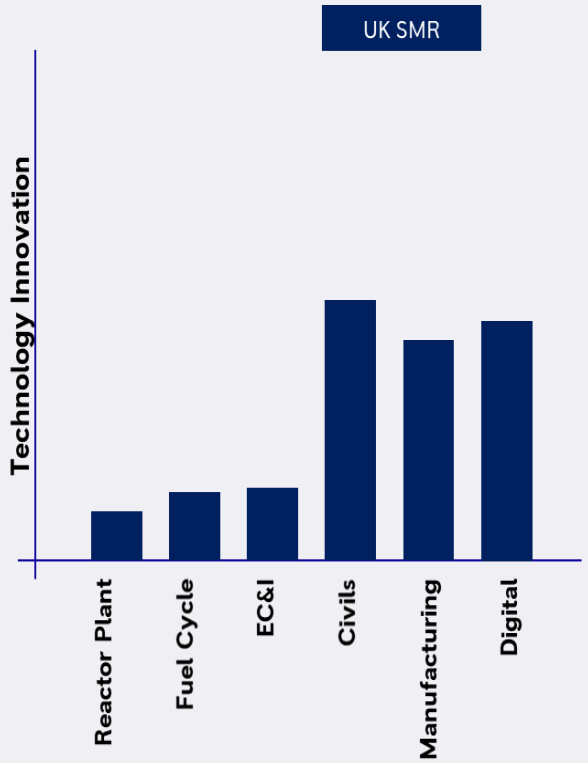
2. Improve Deliverability

- Reduce time to build
- Compatibility with licensing regimes
- Maximise Productivity and Innovation across Fleet

3. Improve investibility

- Factory Built Commodity
- Minimise Build Risk
- Predictable and Repeatable

Innovation for benefit, not for innovation sake



Modularisation is a solution to reduce capital cost, schedule and risk

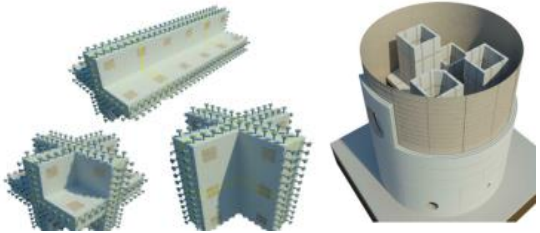
..NOT a design itself

- **Must be done across the whole plant**
- **Road transportable** without disassembly
- **Standardisation** of product, module sizes and interfaces – improve learner effect
- **Production line** approach to module manufacture
- **Use of Commercial / commodity** products
- **Use of digital twin** – design for maintenance

Nuclear Island

BOP & systems

Civil construction



Benefits or learner of amplified through a shift from site construction to factory module construction

Factory design is a critical part of the cost and schedule reduction

- Turnkey delivery of the entire power station changes the business model
- Factories must be designed to manufacture the product
- The product must be designed to be manufactured in the factory
- A production line approach – not a “jobbing shop”
- Avoidance of high and heavy modules
  - Factory costs increase exponentially with weight and size
- Factory acceptance testing to reduce site works
  - Modules must be transported as a single unit

Primary modules


Civil modules


MEP modules

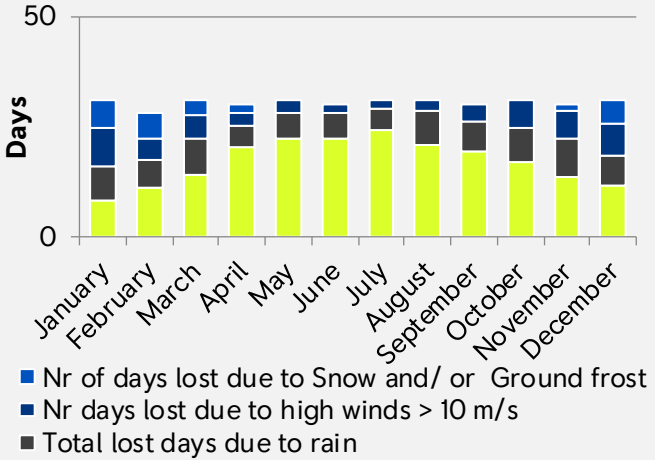
Schedule certainty

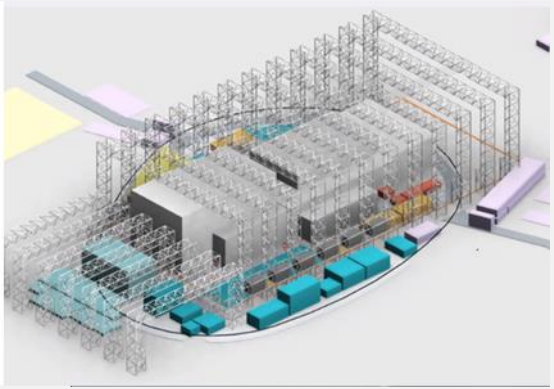
The Site Assembly Facility (4th factory) can provide major benefits in certainty of delivery schedule

- The potential impact of weather:
  - Potential lost days over 4 year construction period ~641 days
  - Avoids potential extension of programme of ~18 to 24 months
  - Avoids overspend from non-re-deployable costs

- The removal of this risk will enable:
  - **Certainty on a baseline plan with shorter schedule and lower cost**
  - **Lower premiums on financing costs**
  - **Lower LCOE**

Average weather assessment at Wylfa, UK





A completely different way of building nuclear: Factory fabricated, road transported and site assembled

A deliverable solution designed for manufacture and assembly

Groundworks and bearing

Whole plant factory fabrication

90% power station factory fabricated across 3 main factories:

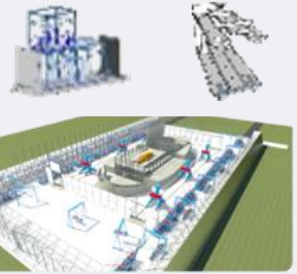
Road transportable factory products taken to site

Primary plant

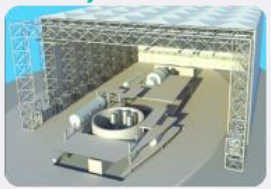
Civil modules

Systems modules

Modules designed to expedite site assembly and installation



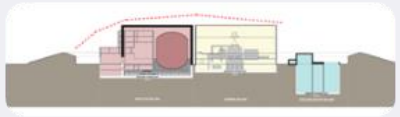
Site factory for build certainty



In a controlled environment under Site Canopy/4th factory to remove risk

Designed for a compact footprint

Assembly on an aseismic bearing to enable repeatability without cause for site specific redesign



Operation

Low cost power for a net zero world

To provide low carbon power in a flexible manner for electrical grid, hydrogen production, or synthetic fuels