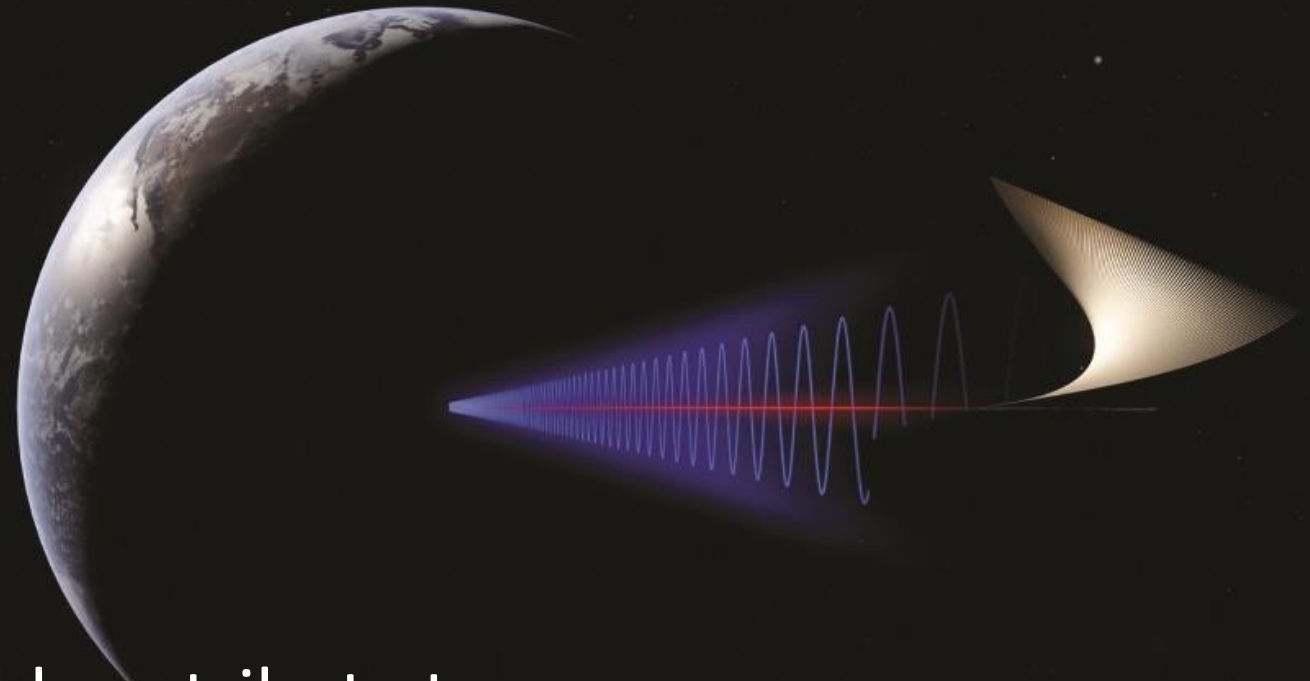
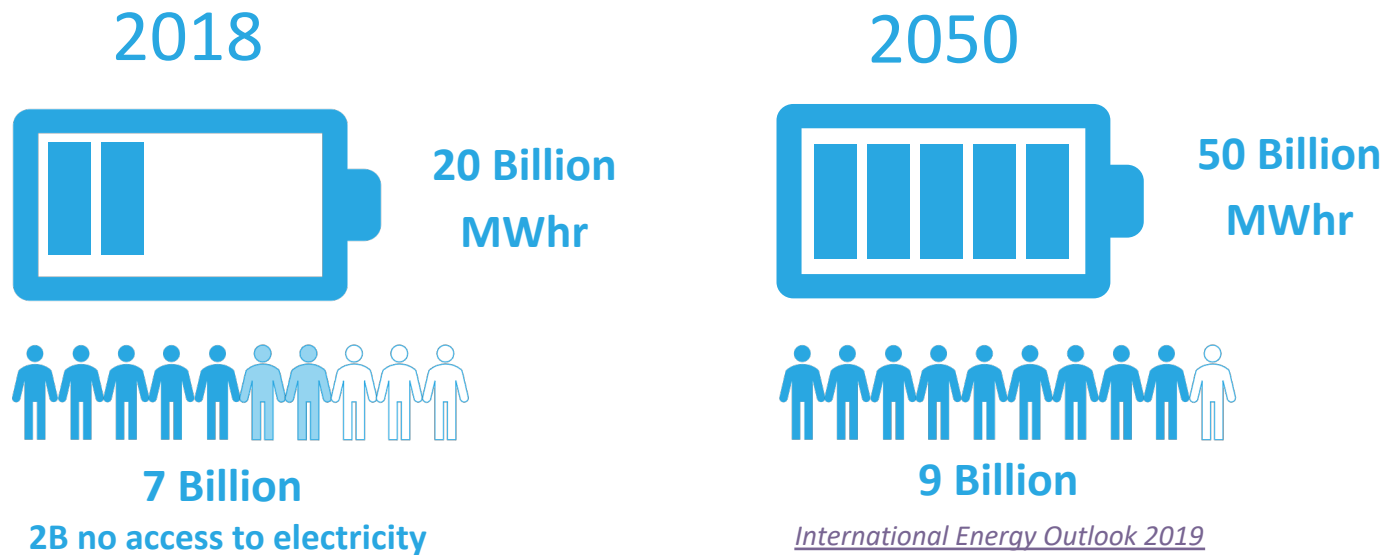



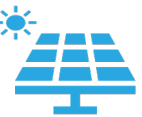



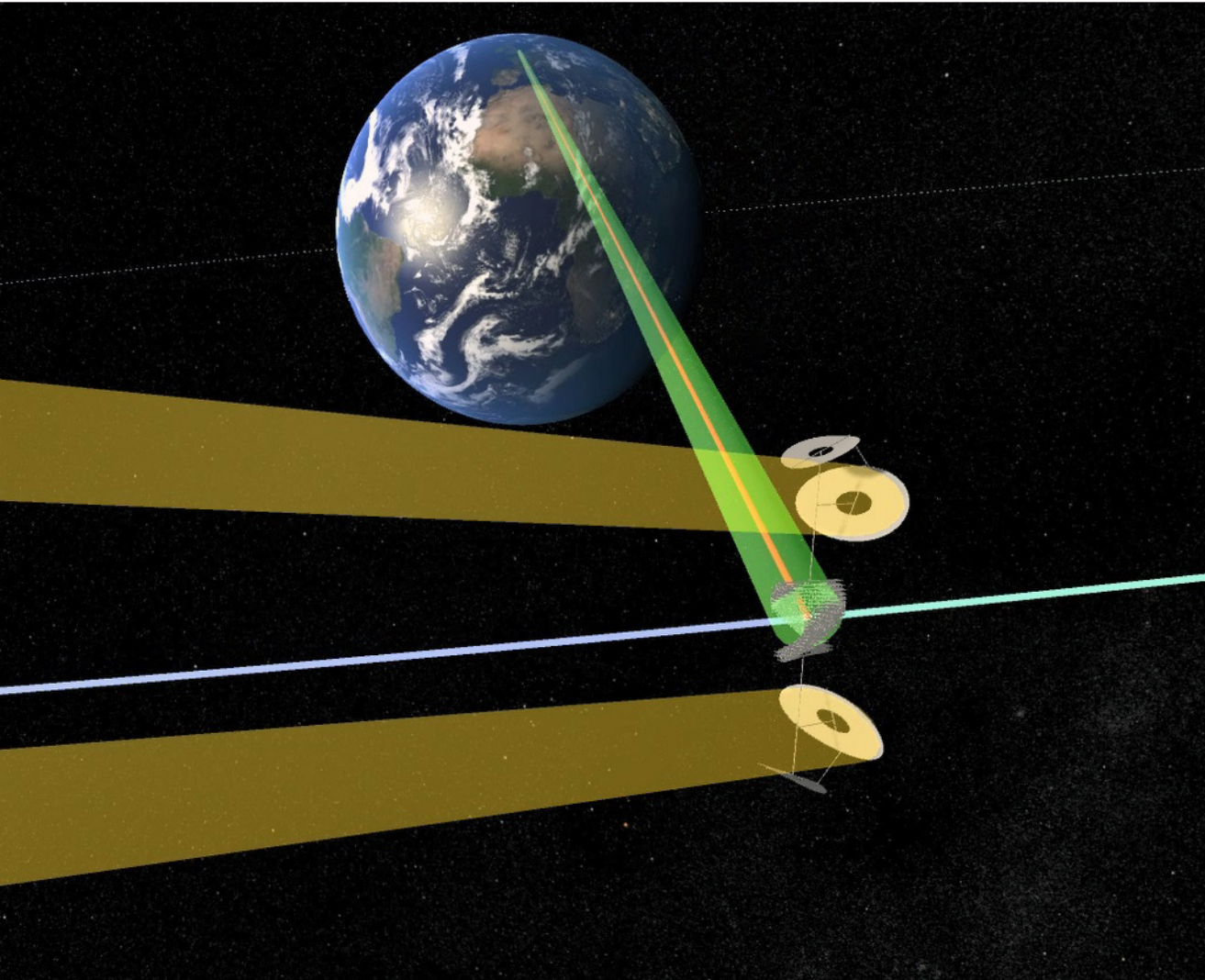
Space Energy
Initiative



How space-based solar power could contribute to
UK Net Zero and Energy Security targets



Type	How many for 40Bn MWhr?	How quick?	Current speed	Issues
	2000 x Hinkley Point C (0.02B MWhr each)	0.2/day	5-20 years	Not mass produced, politics, not all countries nuclear, high cost, burn once
	1,200,000 km ² (35000 MWhr/km ²)	100km ² /day	5km ² /day	Geopolitical cooperation, only suited to certain areas, intermittent, needs global infrastructure, storage
	7,000,000 (6M MWhr for 3MW onshore)	650/day	28 days	Concrete, geopolitical cooperation, only suited to certain areas, intermittent, needs global infrastructure, storage



There is 100 times more solar energy available from a narrow strip around the earth at GEO, than the forecast global energy demands of humanity in 2050.

- Independent studies confirm it is technically and economically viable
- Potential to provide fully renewable, baseload generation at scale: provide resilience to Net Zero pathways.
- Supports the UK's space strategy
- Potential for international leadership from a position of moral strength.
- Main barrier to date (cost of launch) is rapidly shrinking.

Wireless Power Transmission

High frequency radio wave transmission from satellite to receiver on ground (ground station)

- Specific frequency (e.g. 2.45 GHz)
- Locked onto pilot beam from ground station

Solar Power Satellite

Collecting solar power and transmitting down to Earth

- 2,000 tonnes
- 1,700 m diameter
- Geosynchronous Orbit - 35,786 km

CASSIOPeiA Solar Power Satellite concept (International Electric)

Ground Station (Rectenna)

- ~5 km (diameter) scale rectenna
- Receiving 245 W/m² high frequency radio wave power
- Generating 2 GW into grid

Solar Power Satellite - Overview

Solar Reflectors

Orientation of satellite with respect to the sun controlled to constantly reflect sunlight onto the solar panel array below.

Sunlight

Radio Waves

Solar Panels & Transmitters

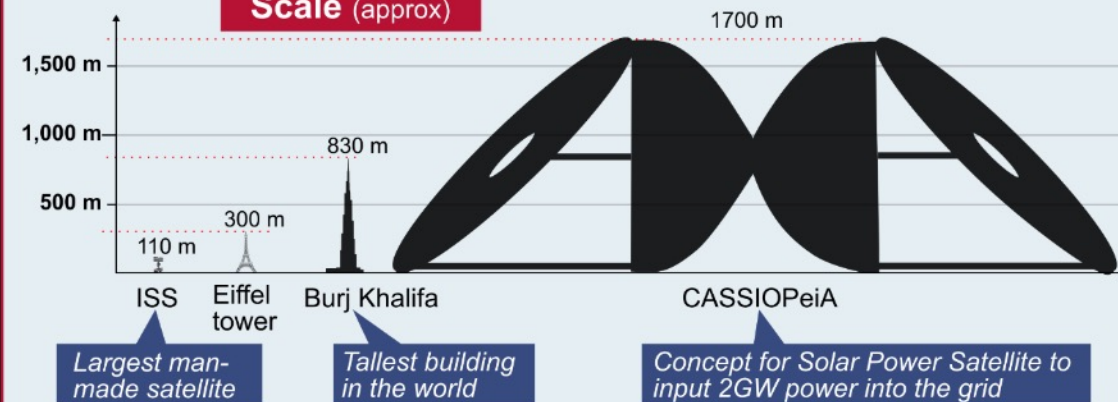
~60,000 layers of solar panels that collect the sunlight from the reflectors, and convert this to transmit high frequency radio waves.

Power Transmission

Direction of radio wave 'beam' controlled through changing phase of waves (beam combined from all layers).

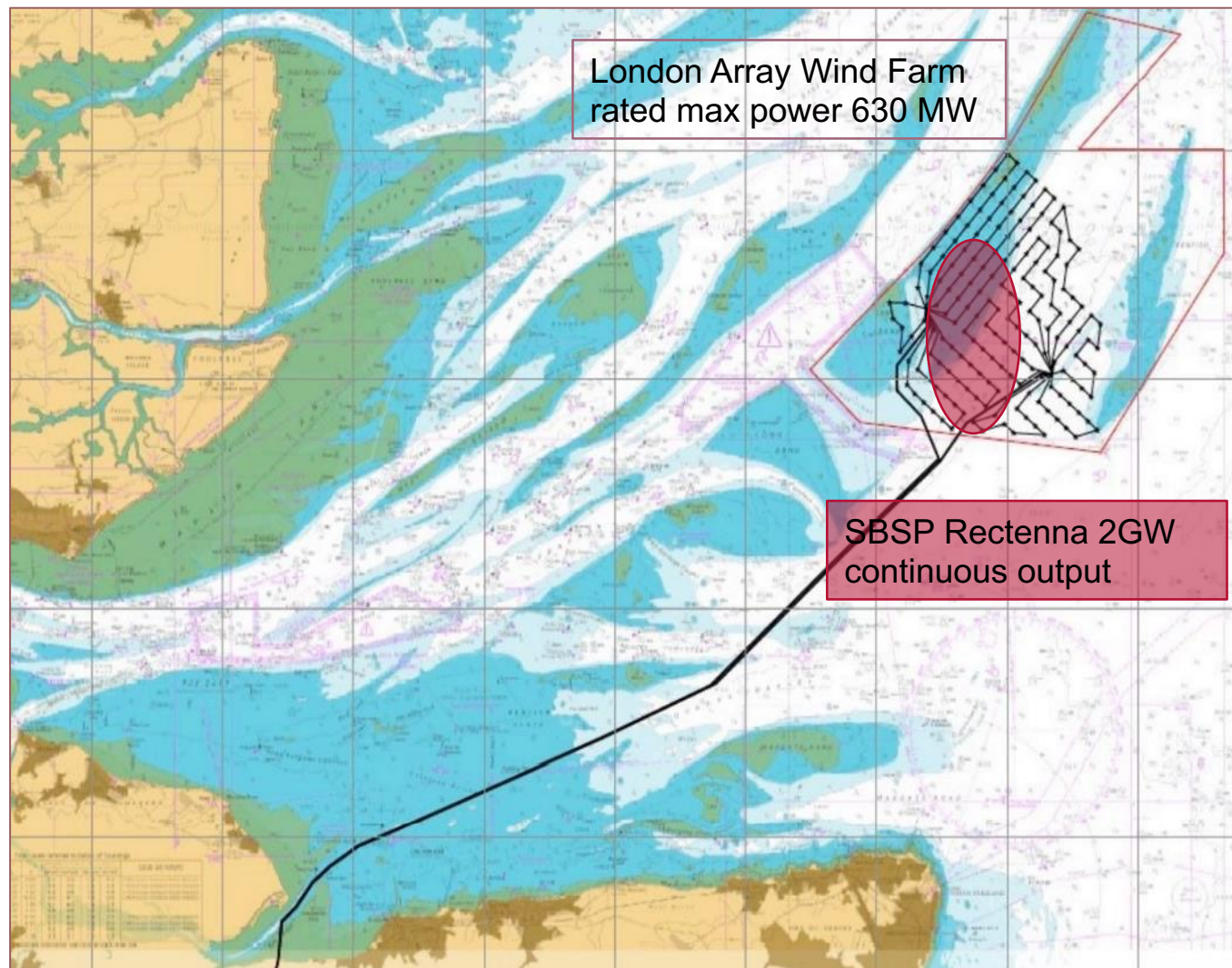
Sunlight

Scale (approx)





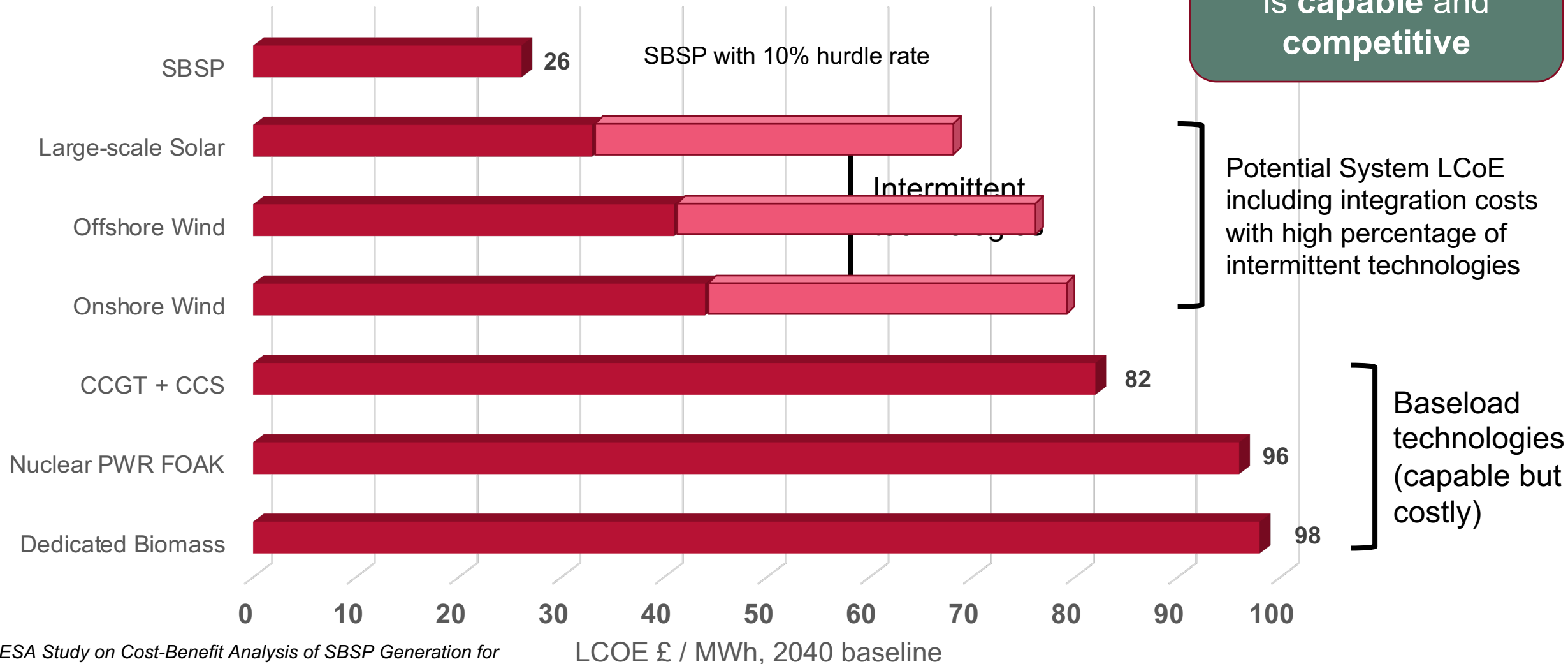
- ▶ Size about 7 km x 13 km in UK latitude
- ▶ Requires contiguous area
- ▶ Sited in remote areas or coastal regions
- ▶ 8% area of wind farm and 40% area of terrestrial solar farm of equivalent output





Levelised Cost of Electricity (LCoE) Comparison with other technologies

Space Solar Power
is **capable** and
competitive



ESA Study on Cost-Benefit Analysis of SBSP Generation for Terrestrial Energy Needs



- ▶ Space launch costs reduced by 90%
- ▶ Space hardware costs reduced by 99%
- ▶ Latest Solar Power Satellites are lower mass
- ▶ Enabling technologies are maturing – space robotics, PV
- ▶ Urgent need to develop new energy technologies





Energy generation

Continuous baseload power
Competitive cost of electricity

Energy Security

Security of fuel supply
Resilience to hostile threats

Grid integration

Scalable and safe
Despatchable, high load factor

Environmental impact

Low carbon footprint 24 gCO₂/kWh
Low area usage (8% of equivalent wind farm)

Delivering Net Zero

Operational system by 2040
Integrates with other technologies

Flexible energy

Export opportunities
Green H₂ and water desalination

Space Based Solar Power
is **clean** and
highly **capable**



Reaction Engines SABRE powered SSTO



Blue Origin New Glenn



Rocket Lab Neutron



SpaceX Starship

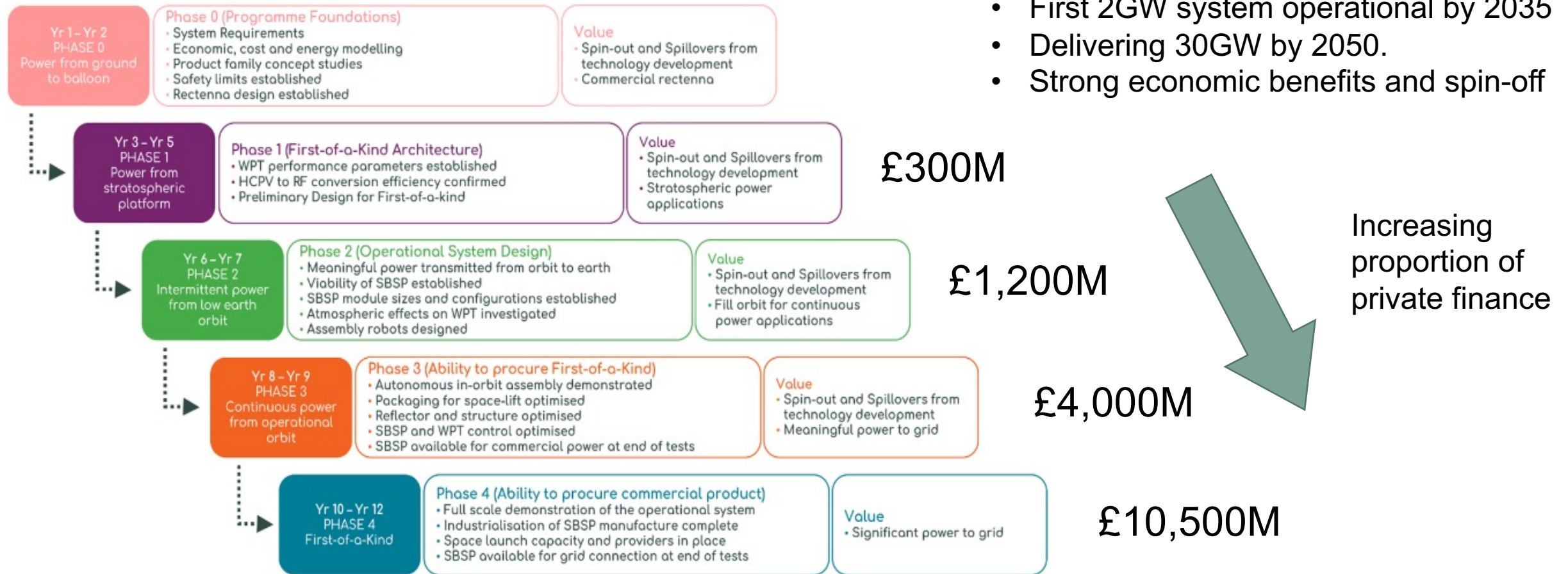
Considerations influencing launch cost

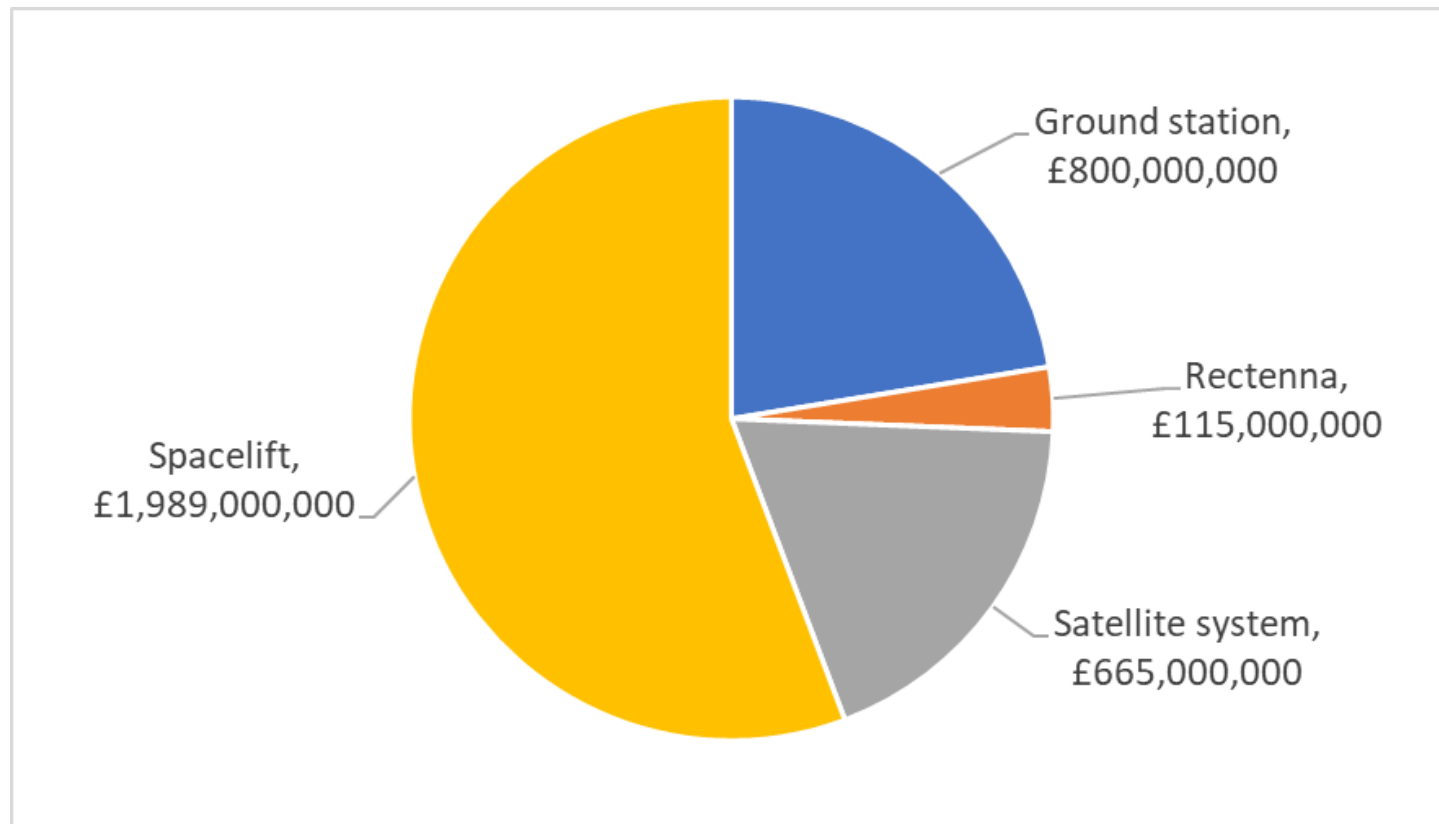
- ▶ Partial / full reusability
- ▶ Rapid turnaround & minimal refurbishment
- ▶ Service life / number of flights
- ▶ Reliability and insurance
- ▶ Cross range capability



12 year development roadmap Substantial generation capacity operational by 2050

- 12 year development programme
- First 2GW system operational by 2035
- Delivering 30GW by 2050.
- Strong economic benefits and spin-off





2018 economic conditions

- £3.57 Billion for 2 GW system
- Ground station includes
 - pre-development costs
 - Power station infrastructure
 - Land purchase cost
 - Satellite control station
- Satellite system includes
 - Solar Power Satellite
 - In-space autonomous assembly
- Spacelift includes
 - Earth to orbit
 - In space transportation
 - Launch insurance



Space Based Solar Power – strong alignment with Government priorities

Net Zero

- Substantial energy by 2040+
- De-risks Net Zero
- Sustainable

Economic prosperity

- Competitive affordable energy
- Wider spin-off benefits
- Export potential

Growing space capability

- Supports goal – 10% of global market
- Aligns with National Space Strategy
- Relevant industry, academia expertise

Security of CNI

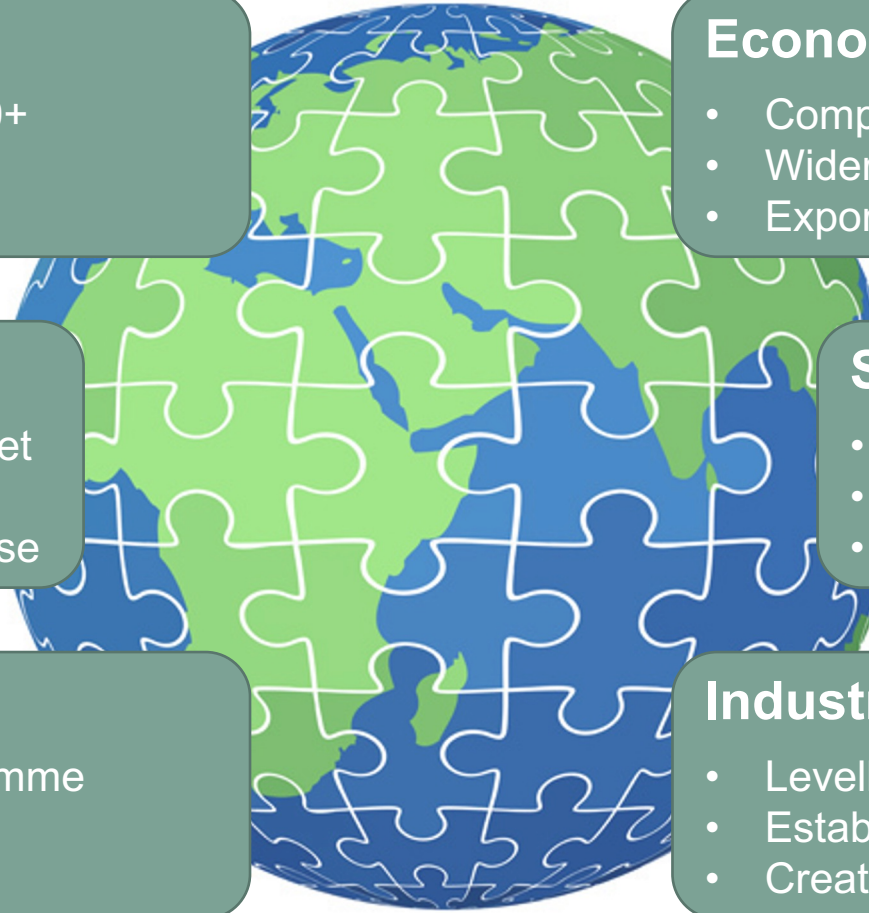
- Security of supply
- Reliability / dependability
- Resilience to disaster / terrorism

UK global position

- Major infrastructure programme
- Global societal benefit
- International collaboration

Industrial Strategy

- Levelling up and regional support
- Establish brand new industry
- Create high value skilled jobs



The Space Energy Initiative - over 70 capable organisations backing SBSP for the UK





Any Questions?

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