FINANCING STRATEGY FOR PHASE 1 OF THE SPG ARCHITECTURE

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AGENDA

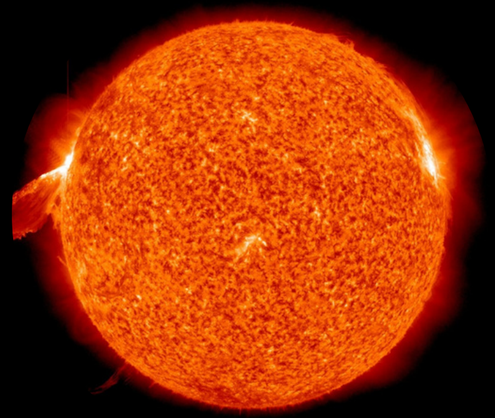
SPG ARCHITECTURE

FINANCIAL VIABILITY ASSESSMENT

FINANCIAL STRATEGY

LOOKING FORWARD

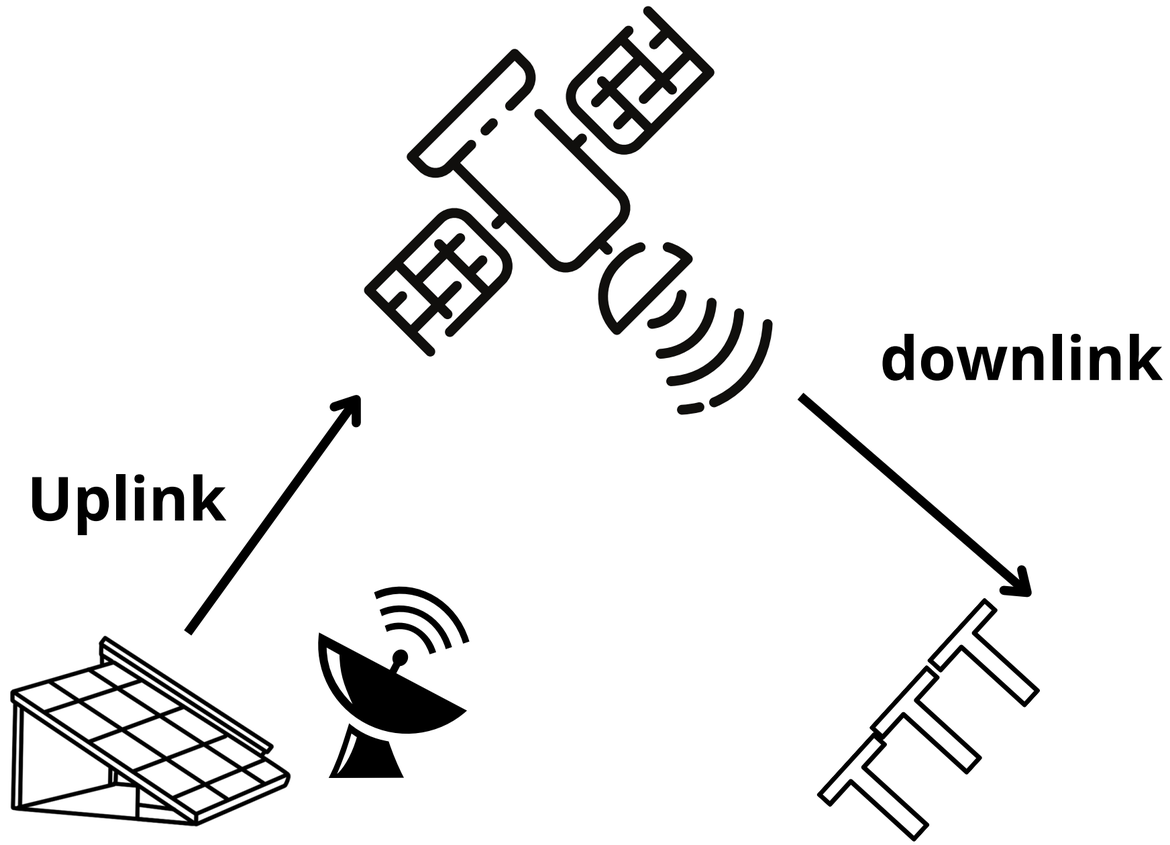
FINANCIAL VIABILITY



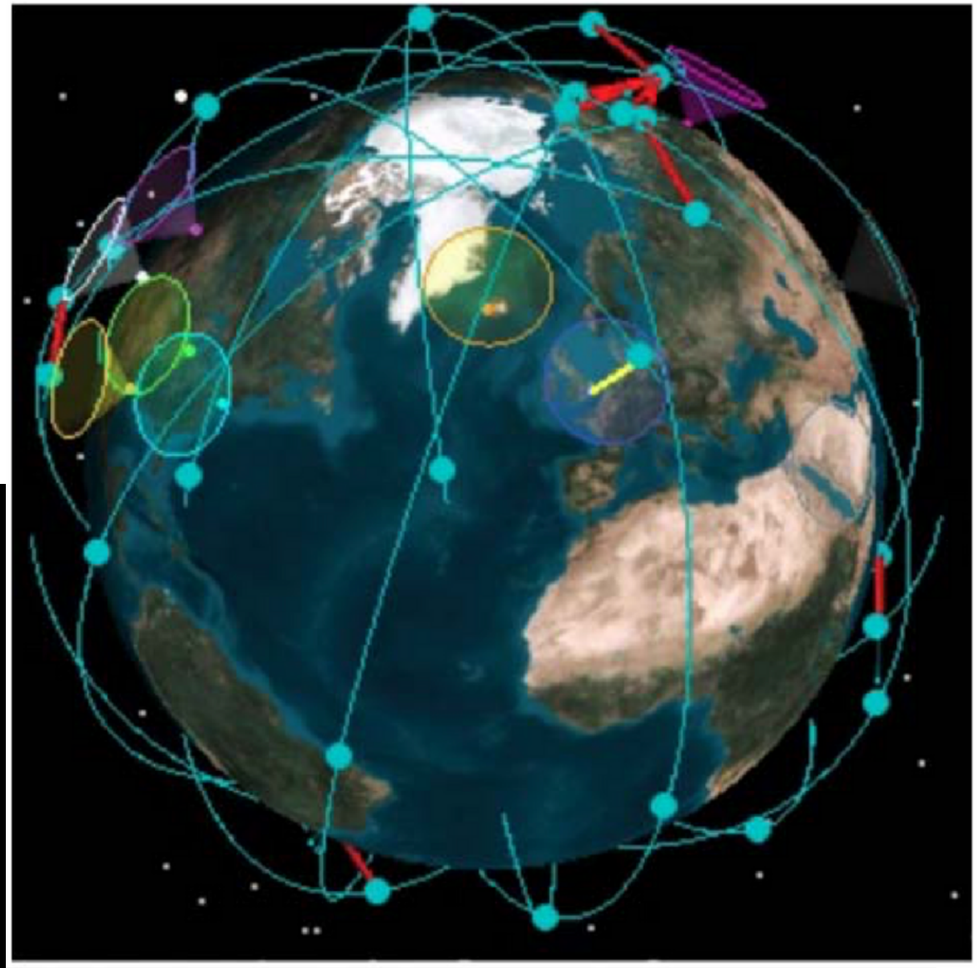
(Dessanti et al., 2021)

SPG ARCHITECTURE

- Space power grid is a constellation of relay satellites in LEO
- There is no power generation in space in phase 1
- Power is transmitted from one terrestrial station to another
- Similar to communication sats
- Aims to stabilise the RE grid



(Dessanti et al., 2021)



ADVANTAGES OF SPG

- Scalable and profitable
- Flexible operations
- Investor friendly
- Smaller due to lower orbit (2000 km) and high frequency (200 GHz)
- Installed cost per watt : moderate (4 cents/ KWH)
- Provides grid stabilisation

SIGNIFICANCE OF THIS STUDY

Frazer Nash

- Govt consultancy report
- Policy proposal
- Public spending throughout all phases of development

LBST consortium

- GEO and MEO architecture
- Large investment spending
- $10529M for 5GW power generation

This study

- LEO architecture
- Private spending strategy
- Phase 1 target
- Power relay

FINANCIAL VIABILITY

- Useful revenue with min 36 satellites and 12 plants.
- **200GHz** transmission, and with a **30% end-to-end** transmission of the power
- **Break even** at **year 17**, R&D first 6 years
- With 36 sats **2.16 GW** power transmitted
- Total non recurring cost: **$2719M**
- Economies of scale will reduce costs

Parameter	Value
Satellite power level	60MW
Satellite mass	4510 kg
Launch cost to 2000 km high circular orbit	$19.8M
Development cost for system	$330M
Production cost for 1st 36 sats	$1370M
Ground facilities development cost	$1000M
Per sat annual mission operations and data analysis cost	$2.75M
Ground station power level	55MW
Cost of production of power	4 cents per KWH
End to end efficiency of beaming power grid	30%
Sales price at delivery point	30 cents per KWH
Gross margin	5 cents per KWH
SPG share of gross margin	4.5 cents per KWH

(Komerath, 2009)

SPG LIFE CYCLE

- High capital cost but investment payback
- Communication satellite has a lifespan of 15 years
- Net positive financial return for 4 years after the deployment of the constellation.
- Enough revenue to begin phase 2 which are power generation satellites
- De orbit of Satellites of phase 1 satellites

FINANCIAL STRATEGY

COMPARISON WITH OTHER MARKETS

Nuclear energy

- High capital cost & long term rate of return
- Scalable model and flexible model (able to either act as relay satellite or transmit through power generation)
- Global energy market
- Linked to terrestrial RE market

Terrestrial renewable energy storage

- High cost of transportation
- Both industries are linked to terrestrial RE providers
- So look for parallels in financing strategy

Premium energy markets

- Disaster prone regions
- Remote regions
- military bases
- Countries willing to collaborate

(Financing Nuclear Energy - World Nuclear Association, 2020)

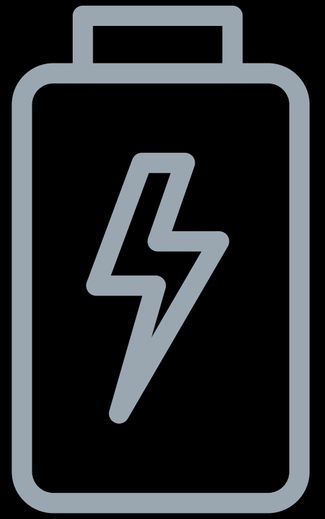
NUCLEAR ENERGY VS SPS

- Cooperative corporate finance
- Mankala principle – A cooperative model for large scale energy investments in Finland
- **Mankala companies** (limited liability companies): each owner proportional to their share of equity has to purchase energy from the company on a cost-price basis instead of dividends.
- Shareholders sell their share of electricity further or use it in their own processes
- The economic result of generating electricity is part of shareholder’s own profit/loss
- Applicable because in **global market multiple energy producers and investors**
- Consumers benefit as electricity prices stabilise
- Nascent tech financed with **greater equity than debt**

(Miller and Carriveau, 2018)

TERRESTRIAL ENERGY STORAGE

- The global energy storage market was valued at **USD 10.37 billion in 2020**, and it is expected to reach **USD 37.06 billion** by 2027, registering a CAGR of 19.9% during the forecast period of 2022-2027.
- SPG provides profit through power export stabilising both electric grids
- Partner with terrestrial RE providers
- **Hybrid bond model** - pools projects together in order to reduce market and credit risks faced by investors.
- **CPPA's -** long-term contract under which a business agrees to purchase electricity directly from an energy generator.



(National Security Space Office, 2007)

PREMIUM ENERGY MARKETS

- The national space security office: #1 requirement for generating industry interest and investment in developing the initial operational SBSP systems is **acquiring an anchor tenant customer**, or customers, willing to sign contracts for high-value/premium SBSP services.
- Thus premium energy markets: disaster prone regions, remote regions, remote military bases
- Additionally: collaborating nations (industrial energy supply)
- Conducive global political and regulatory framework

LOOKING FORWARD

- Financial viability and financing strategy have been suggested
- Focused only on private investments, need to focus on the role of govts and customer end of the spectrum
- The role of govts in aiding the project through incentives and conducive policies
- Limitations of this architecture and the recommended financing strategy

THANK YOU

Q&A

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