

LEVEL 4 ASSESSMENT SPECIFICATION

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Module	Engineering Applications and Study Skills		
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Lecturer:	Calvin Williams	Internal Verifier:	Rabya Kadhim
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Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.
Academic honesty/ referencing:	Academic honesty is required. In the main body of your <u>submission</u> you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted <u>in order to</u> complete this assessment.

Module Learning Outcomes (from module syllabus)

Demonstrate transferable skills in a learning environment. Apply an academic, positive and professional approach to their studies. Identify suitable and relevant sources of information to meet a research topic of your choice

Task 1:

Once the questionnaire was completed, the results showed a multimodal learning style with a preference for kinaesthetic and visual learning. When taking into consideration the best overall methods for learning throughout my academic life, I have always believed that I learnt best with examples, trial and error, and visual aids, whereas learning only through audible cues was difficult to memorise and comprehend. Therefore, I believe the results of the questionnaire were accurate in this regard.

Preferred Learning Styles	Your Comments
Visual	Best learns through visual cues, such as: • Diagrams • Mind Maps • Creating Flowcharts • Using Coloured Highlights
Aural	Best learns through audible cues, such as: • Listening to Recording of Lectures • Listening to Relevant Podcasts • Group Study with a Partner or Group • Conversing with the Lecturer
Read/Write	Best learns through written sources, such as: • Taking Thorough Notes During Lectures • Reinforcing Memory by Summarising Notes • Reading Textbooks, Articles, and Papers • Writing Essays on the Topic
Kinaesthetic	Best learns through practical solutions, such as: • Using Practical Exercises • Drawing Representations of Written Notes • Trial and Error Using Past Papers • Finding Real World Practical Uses of the Question / Problem
Multimodal	A multimodal learning style uses the combined learning style of 2 or more of the 4 learning styles.
<i>What is identified as your preferred Learning Style</i>	As written above the table, I have a multimodal learning style with a preference for kinaesthetic and visual methods.

The VARK results explain that I am a multimodal learner with preferences for kinaesthetic and visual learning styles. The best method of studying in the moment, revising, and completing exams, would be to use the methods shown in the table below:

How can you use what you have learned to aid you in your studies?	
<i>Taking information in</i>	• Implementing Graphs • Using Diagrams Representations • Implementing Unique and Captivating Layouts • Using Flowcharts to Better Relate Ideas
<i>Studying & Revising</i>	• Past Papers • Online Examples • Videos of Examples Being Completed • Physical Exercises
<i>In exams or class test situation</i>	• Attempting to Visualise the Answer • Sketching Diagrams to Better Understand Questions • Using Scrap Paper to Create Flowcharts, Diagrams, etc. to Remember Notes Taken Prior. • Using Scrap Paper to Create Mind Maps to Organise thoughts.

Introduction

The VARK model is a system developed by Neil Flemming in 1987 to categorise people, primarily students, into 4 main categories; visual, audible, reading/ writing, and kinaesthetic learning styles. The VARK model has undergone extensive research and academic debate due to the uncertainty, reliability and effectiveness of the subject.

Review of Literature

The VARK model has been analysed extensively in educational research, often with mixed conclusions regarding its effectiveness in improving learning outcomes.

Some studies suggest that the VARK model may provide useful insights into students' learning habits, which may aid in providing the educator with a base for improving on their teaching methods. For example, Fleming and Baume (2006) argue that identifying preferred learning styles can help individuals adopt strategies that may make learning more effective and engaging for the individual. Similarly, Liew et al. (2015) found that students who are aware of their preferred learning styles can tailor their study habits to match their VARK style, potentially improving their learning experience.

However, a significant proportion of the academic literature on VARK challenges the reliability, practicality, and effectiveness of the model. Pashler et al. (2008) conducted a comprehensive review of the VARK framework and found little empirical evidence to support the idea that matching personal VARK learning methods will or can enhance educational outcomes. The study concluded that while VARK learning styles may improve student engagement, they do not translate to an actual increase in academic performance as a whole.

Newton (2015) further emphasises the lack of empirical evidence in support of the VARK model, describing it as a “neuromyth” that can thrive in educational environments despite the lack of evidence to support the framework. The review highlights that while learning preferences are in fact real, strictly teaching in one method does not enhance academic performance.

Husmann and O’Loughlin (2018) also conducted a study with undergraduate medical students, finding no significant relationship between VARK learning styles, and academic performance. In fact, the study suggests that the students in question performed similarly regardless of their learning styles.

Cuevas (2015) reinforce this view by arguing that the concept of learning styles oversimplifies the complexity of learning. They assert that students benefit from varied instructional methods, which engage different cognitive thought processes, rather than adhering to a single learning style.

Overall, while the VARK model may help individuals become more reflective about their learning preferences, its practical application in improving academic outcomes is questionable. Current research suggests that adopting a multimodal approach to teaching by incorporating a variety of methods may be more effective than sticking strictly to individual learning styles.

Personal Perspective and Conclusion

The VARK model, while popular for promoting awareness of individual learning preferences, has limitations in its application to enhancing educational outcomes. Evidence supporting the idea that teaching methods with learning styles improves learning remains surprising sparse, considering how seemingly widespread the framework is. Research by Pashler et al. (2008), Newton (2015), and Cuevas (2015) highlights the lack of empirical evidence for the VARK model, challenging the notion that matching instruction to VARK preferences leads to better academic performance.

However, VARK can still play a role in helping learners become more self-aware and reflective about their personal study habits, potentially helping them to adopt better suited strategies for learning. However, educators and learners are better served by using a wide variety of teaching and learning methods, embracing a multimodal approach that engages multiple senses and thought processes.

In conclusion, while VARK offers a useful framework for understanding how preferences may influence study habits, its impact on academic success is limited. Educators should leverage a range of instructional techniques to create inclusive and effective learning environments that use a range of teaching methods.

References

Fleming, N.D., and Baume, D. (2006). Learning Styles Again: VARKing Up the Right Tree! Neil. [online] Available at: <https://www.scribd.com/document/12539301/Learning-Styles-Again-VARKing-Up-the-Right-Tree-Neil>.

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Pashler, H., Mcdaniel, M.A., Rohrer, D. and Bjork, R.A. (2008). Learning Styles: Concepts and Evidence. [online] ResearchGate. Available at: https://www.researchgate.net/publication/233600402_Learning_Styles_Concepts_and_Evidence

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Cuevas, J. (2015). (PDF) Is learning styles-based instruction effective? A comprehensive analysis of recent research on learning styles. [online] Available at: https://www.researchgate.net/publication/282900224_Is_learning_styles-based_instruction_effective_A_comprehensive_analysis_of_recent_research_on_learning_styles.

Task 2:

LinkedIn Profile: Bailey Armin

Header: Home, My Network, Jobs, Messaging, Notifications (25), Me, For Business, Try Premium for £0

Profile Language: English

Public profile & URL: www.linkedin.com/in/bailey-armin

Profile Information:

- Profile picture:** Bailey Armin
- Cover photo:** #OENTOWORK
- Name:** Bailey Armin
- Current position:** Sales Associate at Screwfix
- Location:** Swansea, Wales, United Kingdom
- Contact info:** Contact info
- Connections:** 1 connection
- Buttons:** Open to, Add profile section, Enhance profile, Resources
- Open to work:** Electrical Engineer roles (Show details)
- Tell non-profits:** you're interested in getting involved with your time and skills (Get started)

Analytics:

Right Sidebar: Your viewers also viewed

- Mark White** - 3rd+
Connect
- Larisa P.** - 3rd+
Audit Queen | Card Payment Solutions Saving 48...
+ Follow
- Unlock the full list:** See who else is often viewed alongside you (Try Premium for £0)

Bottom Section: Bailey Armin - Sales Associate at Screwfix

About:

I am a dedicated university student with years of experience spanning retail, customer service, and technical support roles. My passion for problem-solving and strategic thinking has driven me to excel in various positions, from assisting customers and handling sales in high-paced environments to volunteering and technical repair work. With a strong foundation in teamwork, communication, and organizational skills, I thrive in both collaborative and independent...see more

Top skills: Engineering • Electrical Safety • Electrical Industry • Communication • Teamwork

Activity: 1 followers
You haven't posted yet
Posts you share will be displayed here.
Show all activity →

Experience:

- Sales Associate**
Screwfix • Part-time

Right Sidebar: Profiles you may know

- Iwan Jones** - Developer at BTS
Connect
- Trafford Harvey Declan** - Business Management BAI(Hons) Graduate
Connect
- Kirsty Dance** - Sales & admin assistant @ Truck & Plant Asset...
Connect
- Ryan Banks** - Sales Assistant at Screwfix
Connect
- Morgan H.** - Student at University
Messaging

The image shows a LinkedIn profile for Bailey Armin, a Sales Associate at Screwfix. The profile is divided into two main sections: Work Experience and Education. The top section lists three roles: Sales Associate at Screwfix (Sep 2021 - Present), Kitchen Food Server at McDonald's (Mar 2019 - Sep 2019), and Assistant at Advanced Heating Wales (Jun 2016 - Jul 2016). The bottom section lists two educational institutions: University of Wales Trinity Saint David (Oct 2024 - May 2026) and Gower College Swansea (Sep 2023 - May 2024). The profile also includes a 'You might like' section with recommendations for Kingfisher plc and B&Q.

Work Experience:

- Sales Associate**
Screwfix · Part-time
Sep 2021 - Present · 3 yrs 5 mos
Swansea, Wales, United Kingdom · On-site
As a Sales Assistant at Screwfix, I have gained significant experience in customer service, cash handling, and team collaboration in a dynamic retail environment. My key responsibilities include assisting customers with...see more
♥ Warehouse Control, Public Speaking and +18 skills
- Kitchen Food Server**
McDonald's · Full-time
Mar 2019 - Sep 2019 · 7 mos
Swansea, Wales, United Kingdom · On-site
Provided excellent customer service, handled transactions, and maintained hygiene standards.
♥ Cash Handling, Customer Satisfaction and +4 skills
- Assistant**
Advanced Heating Wales · Contract
Jun 2016 - Jul 2016 · 2 mos
Wales, United Kingdom · On-site
Engaged in customer service and technical support, ensuring high client satisfaction and tool care.
♥ Customer Loyalty, Maintenance and Repair and +7 skills

Education:

- University of Wales Trinity Saint David**
Higher National Diploma, Electrical and Electronics Engineering
Oct 2024 - May 2026
Activities and societies: A member of the IET.
Being taught and trained as a highly skilled Electrical and Electronic Engineering with an HND with hands-on experience in circuit design, microcontroller programming, and PLC systems. Proficient in analysing ar...see more
♥ Written Communication, Time Management and +16 skills
- Gower College Swansea**
Diploma, Access of Higher Education (Engineering and Physical Science)
Sep 2023 - May 2024
Grade: DDM
Activities and societies: Chess Club
Following my qualifications in Electrical Installation, I pursued an Access to Engineering program, where I achieved a DDM. This course expanded my knowledge to encompass broader engineering principles, ...see more
♥ Written Communication, Time Management and +14 skills

Recommendations:

- Kingfisher plc**
Retail
88,168 followers
+ Follow
- B&Q**
Retail
113,858 followers
+ Follow

Profile Summary:

Bailey Armin
Sales Associate at Screwfix

Navigation: Home, My Network, Jobs, Messaging, Notifications (25), Me, For Business, Try Premium for £0

Buttons: Resources, Add profile section, Open to

Footer: Show all 3 educations →

The image shows two screenshots of a LinkedIn profile for Bailey Armin, a Sales Associate at Screwfix. The profile is displayed on a desktop view.

Header: The header includes the LinkedIn logo, a search bar, and navigation links: Home, My Network, Jobs, Messaging, Notifications (25), Me, For Business, and Try Premium for £0. The profile name is Bailey Armin, Sales Associate at Screwfix. Action buttons include Resources, Add profile section, and Open to.

Volunteering: A section titled "Volunteering" with a plus icon and an edit icon. It lists a volunteer role at the British Heart Foundation from Jan 2019 to Jul 2019 (7 months) for Poverty Alleviation. A description states: "As a volunteer at the British Heart Foundation, I took on the role of a floor labourer, where I developed practical skills in assembling furniture and maintaining a safe, organized workspace. My responsibilities include ...see more".

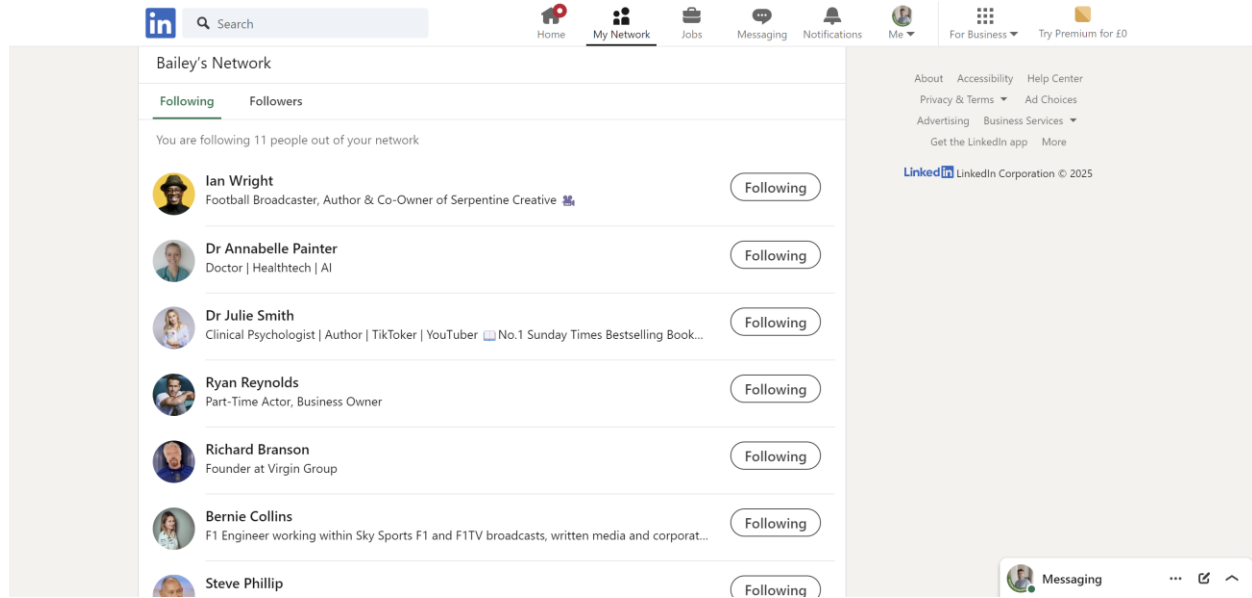
Skills: A section titled "Skills" with a plus icon and an edit icon. It lists "Office 365" as a skill from "Sales Associate at Screwfix". It also mentions "3 educational experiences at University of Wales Trinity Saint David and 1 other school". Under "Interpersonal Communication", it lists "2 experiences across Screwfix and 1 other company" and "2 educational experiences at University of Wales Trinity Saint David and 1 other school". A link "Show all 56 skills →" is at the bottom.

Languages: A section titled "Languages" with a plus icon and an edit icon. It lists "English" as "Native or bilingual proficiency" and "Welsh" as "Limited working proficiency".

Organizations: A section titled "Organizations" with a plus icon and an edit icon. It lists "IET - Institution of Engineering and Technology" as a member from Sep 2024 to Present. It also mentions "Associated with University of Wales Trinity Saint David". A description states: "As a Student Member of the Institution of Engineering and Technology, I am part of a global professional network dedicated to advancing innovation and excellence in engineering and technology. This membership provides n ...see more".

Interests: A section titled "Interests" with a plus icon and an edit icon. It lists "Top Voices", "Companies", "Groups", "Newsletters", and "Schools".

Footer: The footer includes the LinkedIn logo, a search bar, and navigation links: Home, My Network, Jobs, Messaging, Notifications (25), Me, For Business, and Try Premium for £0. The profile name is Bailey Armin, Sales Associate at Screwfix. Action buttons include Resources, Add profile section, and Open to. A "Messaging" button is also visible.



Task 3:

Goal Number	Short and medium term	Action required	Constraints	Resources – who or what can help me?	Target dates for action
1	Have a good paying, stable job.	To complete my HE education in electrical and electronic engineering and find an entry level job in my proffered area.	Finishing with a first or at least an upper degree grade. Competition in the job market for entry level jobs.	Networking events and job sites such as LinkedIn and Indeed can open opportunities for jobs relevant to me.	5 - 10 Years
2	Gain expertise and additional specialisation.	Gain an IET EngTech membership and other additional professional certifications and qualifications, such as a bachelor's degree.	Time management between work, financial investments, and additional studies.	Online learning sites such as class central courses (https://shorturl.at/9wTRk). mentors in relevant industry.	5 – 7 Years
3	Sound mental health and a healthy body.	Regular physical activity routine with a healthy and balanced diet. Maintain a good	Time management between work, financial investments, and additional studies.	Gyms and mental health programs such as therapists. The IET also give aid in this regard.	5 Years

		work life balance.			
4	Develop better interpersonal and leadership skills for job advancements.	Apply and enrol in leadership programs and participate in group projects.	Limited opportunities for leadership practice between work, education, and life.	Leadership programs, mentors, and professional organisations / workshops	5 - 7 Years
5	Own a house in a healthy and clean area.	Save money for an initial mortgage payment, improve my credit score, and research housing options.	Financial constraints, rising property prices.	Financial advisors, real estate agents, mortgage brokers.	10 Years
6	Travel to east and south Asia.	Plan trips, save for travel expenses, and arrange work leave.	Cost of travel, time management with work commitments.	Travel agencies, online trip planners, and savings plans.	5 – 10 Years
7	Get a good work life balance.	Set clear boundaries, prioritize tasks, and schedule regular breaks and leisure time.	Work demands, potential lack of support from colleagues.	Time management tools, supportive colleagues, and HR policies.	5 Years
8	Have a good social life.	Set clear boundaries, prioritize tasks, and schedule	Balancing social life with work and personal	Community groups, social media platforms, and	5 – 7 Years

		regular breaks and leisure time.	commitments.	networking events.	
9	I will relearn Welsh and then learn Mandarin.	Enrol in language courses and practice regularly with full Welsh speakers.	Time required for consistent practice, access to resources.	Language apps (e.g., Duolingo, Rosetta Stone), tutors, language exchange programs.	5 – 8 Years
10	Acquire a breadth of knowledge.	Read widely, take diverse courses, and attend seminars or workshops.	Availability of time to dedicate to learning new topics.	Libraries, online courses (e.g., Coursera, Khan Academy), conferences.	Ongoing
11	Support my local community in endeavours such as community events.	Volunteer for local projects, organize events, and join local committees.	Balancing community work with personal and professional responsibilities.	Community organizations, local government, and volunteer groups.	5 – 10 Years
12	Learn how to drive motorbikes.	Enrol in a certified motorbike driving course and practice regularly.	Access to practice areas, cost of lessons and licensing.	Driving schools, licensing authorities, and experienced riders.	5 Years

Solar Energy from Space for use on Earth

Bailey Armin

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Aims and Objectives

- Determine the efficiency of solar panels in orbit compared to the efficiency of solar panels on the surface:
 - This will be done from gathering data from reports to compare the overall effectiveness of solar panels in both positions.

- Determine the financial cost and the resources required for such an endeavour:
 - Review the findings from accredited financial sources.

- Investigate the potential socio-economic impacts of committing to this technology:
 - Review the research for and against the proposal for the potential impacts and compare to give an interpreted view.

Abstract

This report explores the feasibility and potential of Space-Based Solar Power (SBSP) as a solution to current global energy challenges. Addressing the need for reliable, renewable energy sources, SBSP offers continuous power generation by harnessing solar energy in orbit, overcoming limitations such as weather dependence and day cycles faced by terrestrial systems. Through a review of technological advancements, cost analyses, and socio-economic implications, this study identifies key barriers to SBSP implementation, including cost demands, environmental risks, and equity concerns.

The findings highlight that while SBSP remains expensive due to satellite manufacturing, launch, and maintenance costs, innovations such as reusable rockets and scalable production could significantly lower expenses. Environmental challenges, such as rocket emissions and space debris, underscore the need for carbon-neutral technologies and robust international regulation frameworks. Moreover, equitable access must be ensured through global collaboration and shared investment to prevent disparities in energy distribution.

The findings suggest that SBSP holds great promise as a complementary energy source to terrestrial solar power, particularly in addressing energy security and decarbonisation goals. Future research should focus on improving wireless power transmission, reducing deployment costs, and mitigating environmental impacts. By addressing these challenges, SBSP could play a crucial role in transitioning to a sustainable and reliable global energy future.

Introduction

With energy demands expected to double by 2050, renewable and more efficient means of producing energy have become a focal point of innovation. All types of terrestrial solar energy, including thermal or photovoltaic energy especially, are reliant on favourable weather patterns, precise placement, seasonal changes, the day and night cycle. and are susceptible to disruptions caused by interferences in the atmosphere.

SBSP offers a potential solution by placing solar collectors in orbit, where they can receive uninterrupted sunlight, free from atmospheric interference and the rotation of the Earth. By using advanced wireless power transmission technologies, SBSP can deliver consistent and clean energy to the Earth, overcoming many shortcomings of terrestrial-based solar energy systems.

This report aims to establish whether SBSP is an efficient alternative to traditional terrestrial solar power. The report will evaluate and compare the efficiency, financial feasibility, and environmental impacts of SBSP while examining the technological challenges associated with its implementation by analysing data from credible sources and incorporating diverse perspectives.

Dabate

A Brief History of SBSP

The concept of SBSP was introduced in 1969 by Dr Peter Glaser, an aerospace engineer and scientist, who proposed using geostationary satellites equipped with solar panels to collect energy and beam it to Earth via microwaves (Glaser, 1968). The viability of this technology was explored in NASA's 1975 report on the feasibility of SBSP but highlighted the significant financial and technological hurdles involved (NASA, 1975).

In recent years, advancements in wireless power transfer (WPT), reusable launch systems, and lightweight materials have renewed interest in SBSP. For instance, the European Space Agency's Solaris initiative aims to test large-scale SBSP concepts by 2030 (ESA, 2023). However, the debate around its viability is still present, with supporters emphasising its benefits and critics pointing to its challenges.

Efficiency Analysis

SBSP and ground-based panels have unique advantages. SBSP panels, benefiting from advanced materials and uninterrupted sunlight in orbit, achieve average photovoltaic efficiencies up to 40% (IAA, 2011). However, their end-to-end efficiency drops to 5–10% due to significant losses during wireless power transmission to Earth (Abiri et al, 2022). In contrast, ground-based solar panels, while limited by weather and day-night cycles, maintain efficiencies of 20–22% for commercial monocrystalline silicon panels and up to 47.1% under peak laboratory conditions for multi-junction cells (Smith et al, 2021; NREL, 2024). Ground-based systems also avoid transmission losses, retaining an end-to-end efficiency of around 20%. Ultimately, SBSP offers continuous energy potential but requires technological advancements to overcome transmission challenges, while ground-based panels remain more efficient for direct energy utilisation.

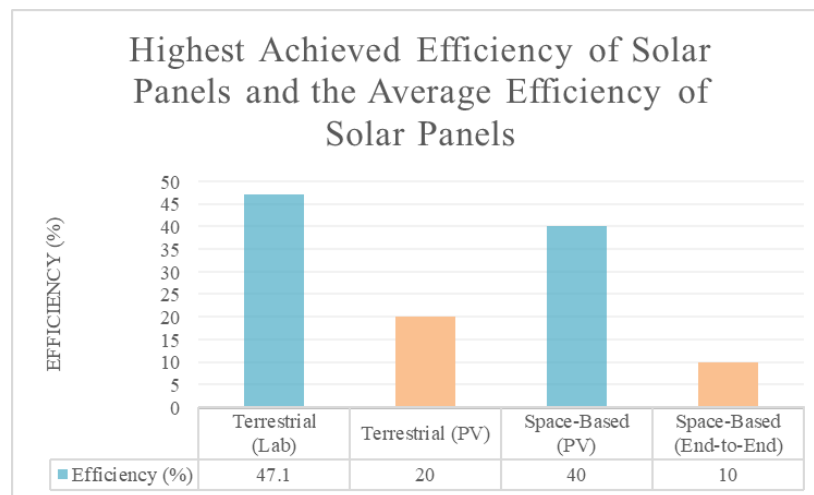


Figure 1: Efficiencies of solar panels on ground and in orbit

The data presented in Figure 1 highlights the comparative efficiencies of SBSP and traditional terrestrial solar panels, providing a perspective into their potential peak and average operational potentials shown in blue and then orange respectively. Terrestrial panels, while limited by environmental factors such as weather and diurnal cycles, demonstrate robust performance with commercial efficiencies reaching 20-22% and isolated laboratory efficiencies up to 47.1%. On the other hand, SBSP panels achieve impressive photovoltaic efficiencies of around 40% under optimal conditions in orbit, benefiting from uninterrupted sunlight. However, this advantage is significantly countered by the end-to-end transmission losses, reducing overall efficiency to around 5-10%.

Author: Bailey Armin

From a technological viewpoint, SBSP represents an ambitious step forward in renewable energy innovation. It addresses and overcomes many of the limitations of terrestrial solar systems, such as sporadic energy generation and location dependency. However, the significant transmission losses indicate a pressing need for advancements in wireless power transfer technology to make SBSP viable on a large scale.

The issue of the highest achieved efficiency of terrestrial panels is that it is in peak optimal laboratory conditions, meaning that it is not really applicable to the real world, and we are comparing those conditions to the average efficiency of solar panels in space, while it may not seem a fair comparison, it highlights the positives of SBSP, as the average efficiency of SBSP is comparable to the best laboratory conditions of terrestrial solar panels

Personally, I find the concept of SBSP extremely promising but still in a relatively early stage. The trade-offs between efficiency, cost, and practicality suggest that it may serve as a complementary solution rather than a replacement for terrestrial systems as a whole. With further technological breakthroughs in wireless power transmission technology however, SBSP could play a critical role in meeting global energy demands sustainably, especially in regions where terrestrial solar infrastructure is less feasible.

Cost Analysis

The implementation of SBSP requires significant financial investment across various stages. According to the European Space Agency (ESA), development and manufacturing costs for an SBSP satellite range from €8.1 billion (£6.7 billion) to €33.4 billion (£27.7 billion), reflecting the need for advanced materials and cutting-edge technologies (ESA, 2023). Launch expenses, while reduced by reusable rockets like SpaceX's Falcon 9, still average \$70 million (£55 million) per payload (SpaceX, 2024). Operational and maintenance costs over 30 years are estimated at €7.5 billion (£5.9 billion) to €31.1 billion (£25.8 billion), largely due to the challenges of maintaining orbital systems (IAA, 2011).

In comparison, terrestrial solar systems are far more economical. Installation costs are approximately €1 billion (£830 million) per gigawatt, with minimal ongoing maintenance expenses (Ramasamy et al., 2023). However, SBSP's ability to provide consistent, weather-

independent energy offers a distinct advantage over terrestrial systems, particularly in areas where uninterrupted energy is critical.

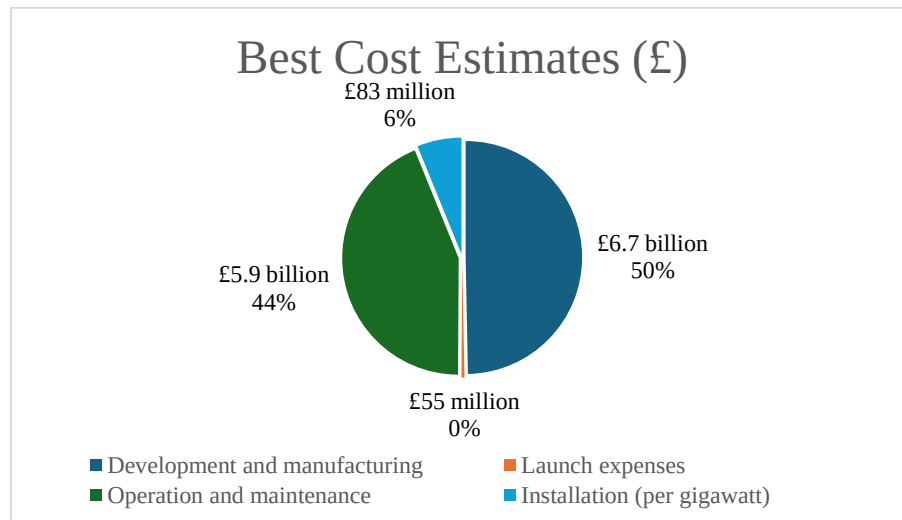


Figure 2: Best Cost Estimates for SBSP

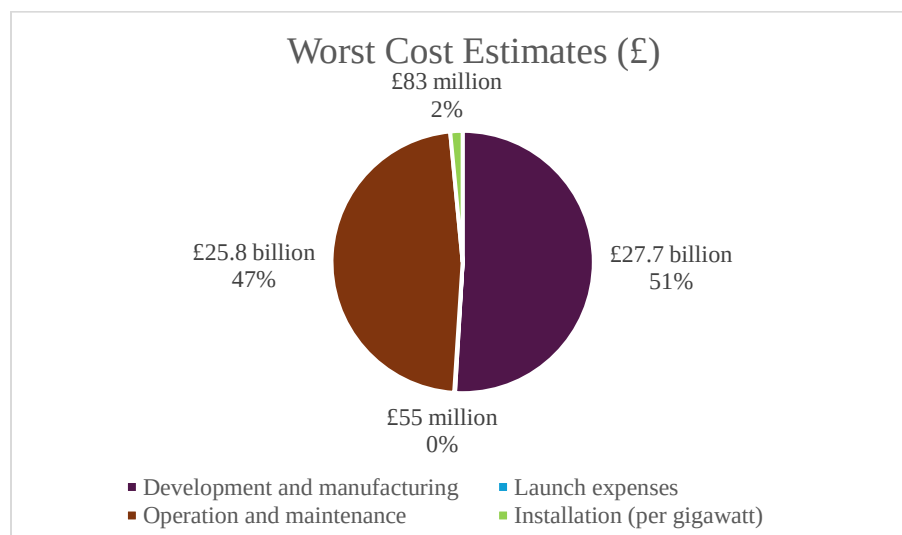


Figure 3: Worst Cost Estimates for SBSP

Figures 2 and 3 show the best and worst cost estimates for the installation of SBSP per gigawatt, shaped by the high demands of space operations and advanced technology requirements. While reusable rockets have reduced launch costs, repeated launches for SBSP infrastructure remain a significant financial challenge. Maintenance, often reliant on advanced robotics, further adds to the expense. On average, creating and implementing SBSP on a usable scale is estimated at £33.9 billion.

By contrast, terrestrial solar installations benefit from decades of optimisation, offering scalability, simplicity, and affordability. These features make terrestrial systems the preferred choice in most scenarios. Yet, SBSP's ability to deliver continuous, sustainable energy regardless of weather or time remains unparalleled.

In summary, while SBSP is costly, it holds transformative potential for energy generation. Investments are substantial, but its capacity to provide uninterrupted, global energy justifies its development. Advancements in launch technologies and international collaboration could reduce costs, allowing SBSP to complement terrestrial systems and play a crucial role in future energy security and sustainability.

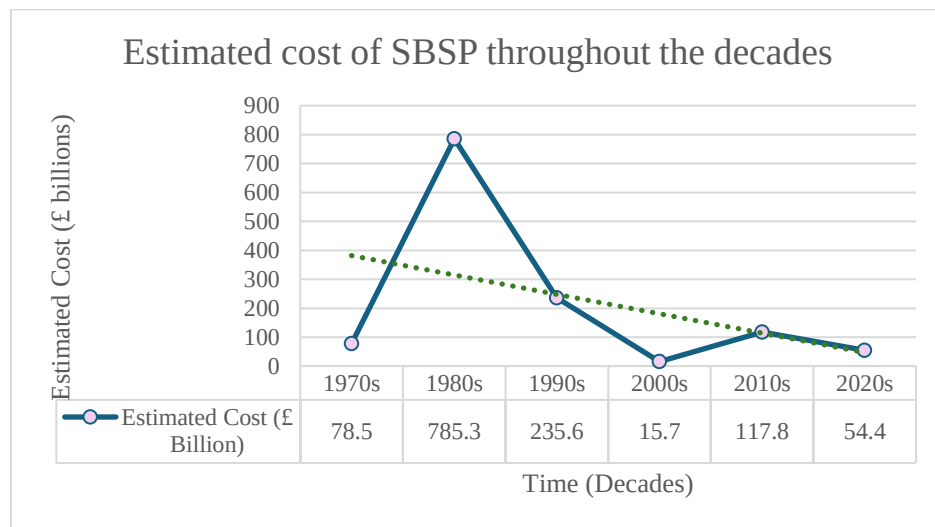


Figure 4: Estimated cost of implementing SBSP throughout the decades

The cost of implementing SBSP has evolved significantly over time, reflecting advancements in technology, economics, and investment levels. In the 1970s, NASA estimated the cost of a full SBSP system at \$100 billion (£78.9 billion), highlighting the financial and technological challenges of the early conceptual stage (NASA, 1975). By the late 1970s, joint studies by NASA and the Department of Energy projected costs rising to \$1 trillion (£788.9 billion), driven by the high cost of launching heavy payloads and the infancy of wireless power transfer technologies (NASA & DOE, 1979).

In the 1990s, NASA's "Fresh Look" study updated the estimates downward to \$100 billion (£78.9 billion) to \$500 billion (£394.4 billion), reflecting improvements in solar cell efficiency and materials science (NASA, 1995, as cited in Berger, 2007). By the early 2000s, the National

Security Space Office suggested that a demonstrator system might cost \$10 billion (£7.9 billion) to \$30 billion (£23.7 billion) (NSSO, 2007). In the 2010s, the International Academy of Astronautics estimated a large-scale SBSP system could cost \$150 billion (£120 billion), while recent European Space Agency studies in the 2020s estimate costs for a single satellite at €8.1 billion (£6.7 billion) to €33.4 billion (£27.7 billion), reflecting advancements in wireless power transfer and reduced launch expenses (IAA, 2011; ESA, 2022).

The trend shows SBSP implementation costs decreasing over time due to technological improvements, process refinements, and reduced research, manufacturing, and launch expenses. This suggests continued research and development are essential to lower costs to levels comparable with terrestrial solar power systems.

Social and Economic Analysis

The implementation of SBSP presents significant socio-economic opportunities and challenges. It could enhance global energy security by providing reliable, continuous power, particularly benefiting remote and energy-insecure regions while supporting decarbonisation (ESA, 2022). Additionally, SBSP infrastructure development could drive economic growth, creating high-skilled jobs in engineering, aerospace, and renewable energy sectors. For instance, a UK government report estimates SBSP could create tens of thousands of jobs and boost GDP (UK Government, 2022).

However, challenges include high upfront costs, which may widen inequality as only wealthy nations can afford investment. Environmental risks, such as rocket emissions and space debris, remain critical concerns. Abiri et al. (2022) warn that without reusable rockets, SBSP deployment could significantly increase CO₂ emissions. Public acceptance is another hurdle, with concerns about microwave energy transmission safety and equitable access. The IEA (2023) emphasises that SBSP must align with global energy equity initiatives to benefit developing nations.

In summary, SBSP's success depends on addressing costs, environmental risks, and equitable access. By advancing carbon-neutral technologies, fostering international partnerships, and implementing shared funding models, SBSP can transform the global energy landscape.

Author: Bailey Armin

Conclusion

This report highlights the significant potential of SBSP as a transformative solution to global energy challenges. SBSP provides uninterrupted, renewable energy, overcoming limitations such as weather dependence and diurnal cycles faced by terrestrial solar systems. The findings emphasise that while SBSP can complement terrestrial energy solutions, its implementation faces substantial financial, environmental, and equity challenges. High costs of development, manufacturing, and deployment remain key barriers, though advancements in reusable launch systems and scalable production technologies could help mitigate these expenses. Environmental risks, including rocket emissions and space debris, necessitate the adoption of carbon-neutral launch technologies and global regulatory frameworks to ensure sustainable deployment. Additionally, equitable access must be prioritised to ensure that SBSP benefits are shared globally, not limited to wealthy nations.

These findings contribute to the growing body of scientific knowledge on renewable energy systems, illustrating how SBSP could complement existing technologies in achieving energy security and sustainability. However, realising its full potential will require ongoing innovation, international collaboration, and strategic planning. Future research should focus on advancing wireless power transmission efficiency, reducing per-launch costs, and addressing environmental concerns through improved materials and regulatory policies.

In conclusion, while SBSP is not yet ready to replace terrestrial solar systems, it represents a promising addition to the global energy industry. By addressing the outlined challenges and building on current technological advances, SBSP could play a pivotal role in the transition toward a more sustainable and resilient energy future.

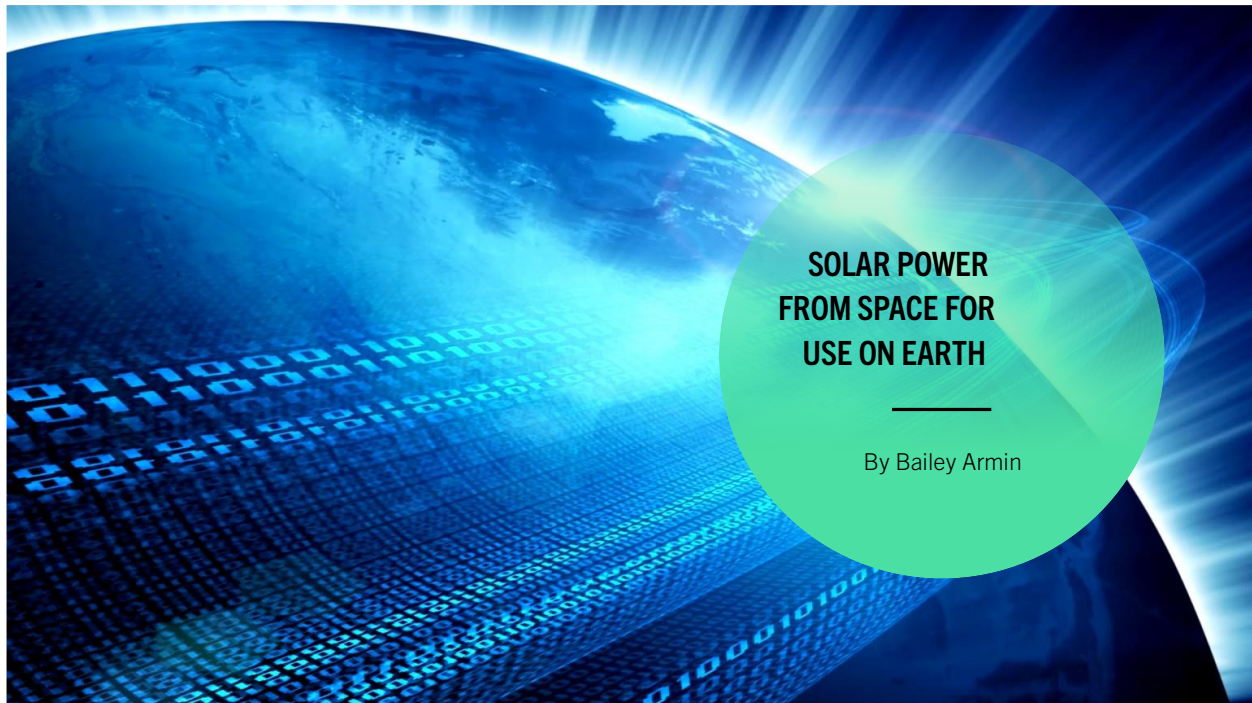
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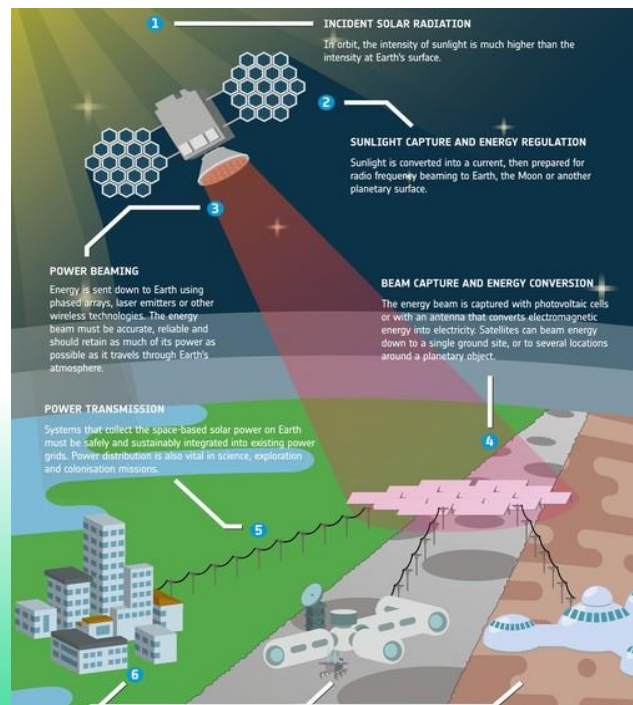
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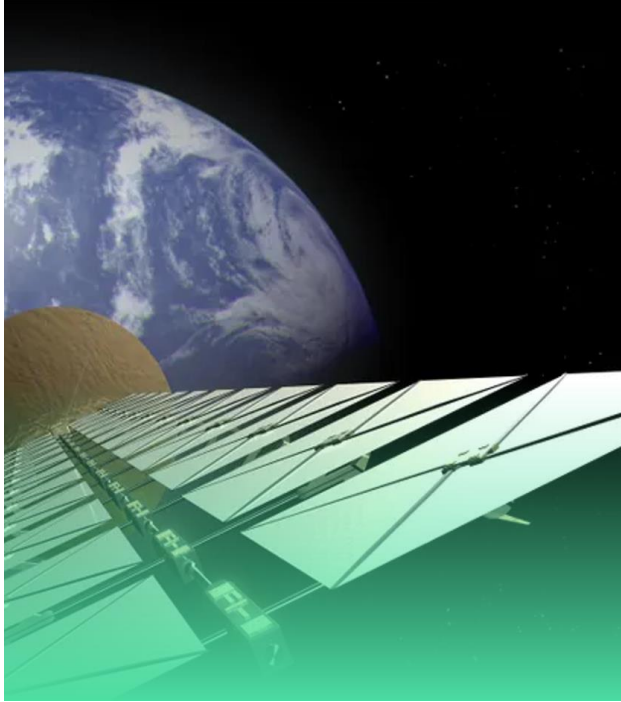
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WHAT IS SBSP?

- An innovative solution to energy challenges.
- Uninterrupted solar power generation in orbit.
- Overcomes limitations of terrestrial solar energy.





WHY USE IT?

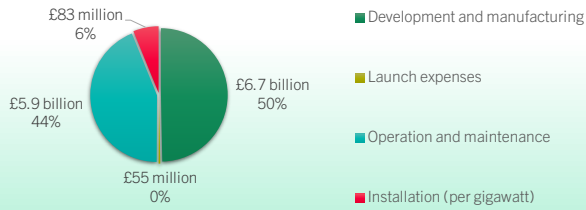
- Energy demands expected to double by 2050.
- A reliable solution, free from weather and day cycles.
- Aligns with clean sustainable energy goals.

EFFICIENCY ANALYSIS

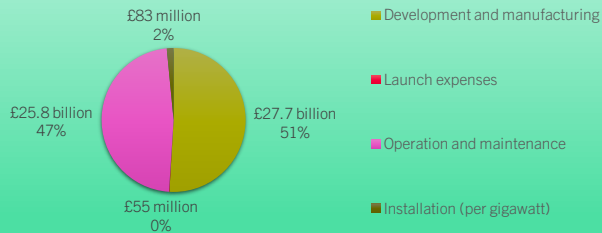
- Terrestrial panels: 20–22% commercial efficiency.
- SBSP panels: Up to 40% efficiency in orbit.
- End-to-end efficiency drops to 5–10%.



Best Cost Estimates (£)



Worst Cost Estimates (£)



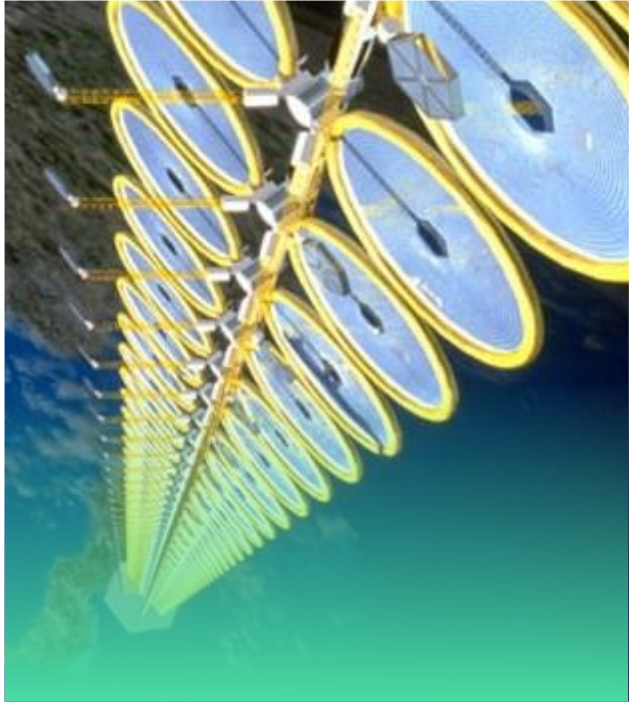
COST ANALYSIS

- High initial costs: £12.7 billion to £53.6 billion.
- Reusable rockets reducing launch expenses.
- Comparatively lower costs for terrestrial systems.

SOCIAL AND ECONOMIC ANALYSIS

- Global energy security and decarbonisation benefits.
- Environmental concerns: Emissions and debris.
- Equity challenges: Accessibility for all nations.





SUMMARY

- SBSP: A complementary renewable energy source.
- High costs and environmental challenges persist.
- Potential transformative role in global energy.