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Small-scale solar power plant system design for wharf lighting and public facilities in coastal areas

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ABSTRACT

Purpose: designing a small-scale solar power plant system that suits the solar potential in coastal areas to meet the lighting needs of docks and public facilities.
Method: this research uses descriptive-quantitative methods through field measurements, engineering calculations, and system design to produce a small-scale solar power plant design that meets the lighting needs of docks and public facilities in coastal areas.
Findings: research has found that Kuala Tungkal has significant solar energy potential for solar power plants. A 200 Wp panel produces 730–970 Wh per day, and for a typical home, 16 solar panels and 13 batteries are required. However, weather and cost are significant constraints.
Implications: solar power plants have significant development potential in coastal areas and can increase community energy independence. However, they require appropriate design, sufficient batteries, and financial and technological support to address weather and initial investment challenges.
Originality: providing field data on solar radiation in Kuala Tungkal, modeling the design of a small-scale solar power plant based on real conditions, and producing practical calculations of panel and battery requirements specifically intended for piers and coastal public facilities, which has not been widely studied before.

Introduction

Solar energy is energy in the form of heat and light emitted by the sun. Solar energy is one of the most important renewable energy sources (Kannan & Vakeesan, 2016). Indonesia has abundant solar energy potential. However, Indonesia's abundant solar energy resources have not been fully utilized. One way to harvest heat and light radiation is to convert solar radiation into electricity using thermal or photovoltaic (solar cell) technology (Pandey, R., et al., 2022). Thermal technology is typically used for drying agricultural and fishery products, cooking (solar stoves), and heating water (Yudonago et al., 2025). Solar cells, on the other hand, convert sunlight into electrical energy via the photoelectric effect. With solar cell (photovoltaic) technology, solar energy is converted into electrical energy for various purposes (Rathore et al., 2021).

With its enormous potential, solar energy is believed to be the primary energy source of the future (Li et al., 2022). This is especially true given its advantages, such as its nearly unlimited availability and environmental friendliness. However, current challenges include the high cost and limited capacity of solar cells and storage technology. For Indonesia, solar energy is one of the best energy alternatives. With its vast potential, it will be able to unleash Indonesia's potential from dependence on conventional energy sources. Solar energy is well-suited for use in remote areas and on small islands in Indonesia (Pandey, Kalidasan, et al., 2022; Silalahi et al., 2021). The use of solar energy is one of the alternative energy sources. This can be done by building a solar power plant and a solar home system, namely home-scale utilization (Rahmatullah et al., 2022).

As a country in the equatorial region, Indonesia has a significant solar energy potential. Indonesia has around 4.8 kWh/m2, which is equivalent to 112,000 GWp of solar energy (Joewono et al., 2023). Unfortunately, solar energy has not received its due share in this country of this total solar energy potential, Indonesia has only utilized around 10 MWp (Silalahi et al., 2023). Meanwhile, energy demand, particularly for electricity, in coastal and island areas, remains largely unmet. To address this issue, it is necessary to develop new, renewable energy power plants, particularly solar energy, for coastal and island areas, both independently and centrally. This is one area of Indonesia currently experiencing significant shortages. This experience deficit energy electricity, and his position is at the coast, Kuala Tungkal, West Tanjung Jabung regency, Jambi.

Several previous studies have discussed the use of solar energy in remote and coastal areas. A study by Wiryadinata et al. examined the implementation of solar power plants (PLTS) on small islands in Indonesia but did not detail household energy requirements or simulate actual load. A study by Purwanto et al. (2019) examined the potential of solar energy in coastal areas of Java and concluded that solar power plants could be an alternative to generators. However, the study used only radiation data from the Meteorology, Climatology, and Geophysics Agency, without field measurements. Meanwhile, a study by Putra et al. (2025) designed a household solar power plant system but focused solely on the technical design, without accounting for daily radiation variations and weather effects. In general, previous studies have focused more on the theoretical potential of solar energy, general feasibility analysis, or household-scale solar power plant designs without considering coastal environmental characteristics or actual radiation data at the measurement points.

Based on this study, several research gaps remain unfilled. First, few studies have directly measured solar radiation at coastal locations, even though light intensity varies significantly due to clouds, water vapour, and typical coastal meteorological conditions. Second, previous research has not combined actual radiation measurements with detailed calculations of household energy needs, resulting in solar power plant designs that often do not reflect real-world conditions. Third, very few studies have specifically examined the application of solar power plants to coastal facilities such as piers, which have different energy usage patterns than residential homes. Fourth, no research has integrated battery and panel capacity requirements for nighttime operation and adverse weather in volatile coastal environments. This gap underlies the importance of this research.

The novelty of this research lies in three main aspects. First, it presents direct field measurements of solar radiation over several days in the coastal area of Kuala Tungkal, yielding more accurate data than secondary data alone. Second, it combines detailed calculations of a simple home's energy needs, from lighting, air conditioning, refrigerators, and water pumps, down to their respective operating durations, with calculations of the required solar panel and battery capacities. Third, it provides a design for a small-scale solar power plant that is applicable and specific to the lighting needs of docks and coastal public facilities, a context rarely studied but highly relevant for energy-deficient areas like Kuala Tungkal. The combination of technical aspects, the coastal environment, and the needs of the local community makes this research novel and a significant scientific contribution.

The purpose of this research is to design a small-scale solar power generation system that is suitable for the solar potential in coastal areas to meet the lighting needs of docks and public facilities. The research also examines the potential for solar power generation in Kuala Tungkal, located on the coast of West Tanjung Jabung regency. Furthermore, the amount of solar radiation received at various points in the area is investigated, as is the average solar radiation that can be converted into electrical energy in the area. Solar power plants have great potential for development in coastal areas and can increase community energy independence. However, solar power plants require proper design, adequate batteries, and financial and technological support to overcome weather challenges and initial investment. This research is expected to enable communities in coastal and island areas, particularly in Kuala Tungkal, to build their own power plants to meet their electricity needs. Once they own these solar power plants, they are also expected to maintain the systems and equipment.

The sun is a source of energy that radiates enormous amounts of energy to the Earth's surface. Each square meter of the Earth's surface receives up to 1,000 watts of solar energy (Stevanović & Stevanović, 2021). Approximately 30% of this energy is reflected into space, and clouds, oceans, and land absorb the remainder. The amount of energy absorbed by the atmosphere, the ocean, and the mainland Earth is around 3,850,000 exajoules (EJ) per year. To illustrate the magnitude of the solar energy received by the Earth in just one hour, it is equivalent to the energy the world uses for more than a year. The sun is the star closest to Earth. The sun is currently star-sized, with a size around 110 times that of Earth. The sun formed around 4.6 billion years ago, originating from dust space, whose particles attract each other to form a large mass. Its influence on life on Earth is far-reaching. Each second, every square meter of atmosphere outside Earth accepts an average of 1,324 watts, enough to light 10 light bulbs. The number of light bulbs falling per second is equal to the energy produced by burning 6.4 million tons of coal per second. Its energy powers the circulation of air, weather, and water, as well as all life on Earth.

A solar cell, or photovoltaic cell, is a device that converts solar radiation directly into electrical energy. These cells are essentially diodes composed of P-N junctions. Photovoltaic solar cells are made from semiconductor materials that are processed to produce direct current (DC). In use, these solar cells are connected in parallel or series, depending on their purpose, to produce power with the desired combination of voltage and current (Rathore et al., 2021; Vodapally & Ali, 2022). Sunlight consists of photons, or particles of solar energy, which are converted into electrical energy. Photons have energy that varies with their wavelength. The photon energy absorbed by a solar cell is transferred, in part or in full, to the electrons within the cell. This new energy allows electrons to escape their normal positions relative to the atoms, creating an electric current in an electrical circuit.

Method

This research used a descriptive-quantitative method to systematically describe the solar radiation conditions and the potential electrical energy generated by a solar power plant (PLTS) system in a coastal area, specifically in Kuala Tungkal, West Tanjung Jabung Regency, Jambi. This method utilized direct measurements to obtain quantitative data on solar panel sunlight intensity, current, voltage, and generated electrical power. Field measurements were conducted at the dock area using measuring instruments such as a lux meter or pyranometer to measure irradiance, a multimeter to record panel voltage and current, and a test solar panel to generate energy performance data. Weather conditions, such as sunny or cloudy skies, were also observed, as they significantly affect the amount of energy generated. Data from the lux meter were recorded, along with the voltage and current generated by the 200-watt solar panel installed there. Data were collected hourly and daily for six days. This data was directly converted into electrical energy in the form of direct current (DC).

The measurement data were then analyzed using engineering calculation methods. At this stage, calculations are made regarding the daily energy requirements for lighting the pier and public facilities, the number of solar panels required, the appropriate battery capacity, and the appropriate system configuration, both in series and parallel. This analysis provides a technical overview of the optimal design of solar power plant capacity. The next stage is the system design method, which involves designing the entire solar power plant system structure, including creating a system flow diagram, selecting component specifications (e.g., PV panels, charge controllers, batteries, and inverters), and designing the solar panel installation layout. In addition, a system operational plan is prepared to ensure the solar power plant functions optimally to meet lighting needs in coastal areas.

Results and discussion

Daily energy variation of 200 Wp solar panel

Testing was conducted over six consecutive days to determine the energy that could be harvested from a 200 Wp solar panel under various weather conditions. The results showed that solar radiation intensity directly affected the amount of energy collected each day. On the first four days, the weather was generally sunny, resulting in energy production ranging from 941–970 Wh/day. However, on the fifth and sixth days, thick clouds began to obscure the sun before noon, causing a significant decrease in energy output. The daily energy summary is as follows: day 1: 948 Wh; day 2: 965 Wh; day 3: 970 Wh; day 4: 941 Wh; day 5: 730 Wh; and day 6: 730 Wh. The average daily energy output was 897 Wh, with a production range of 730–970 Wh. These findings confirm that solar panel capacity is significantly affected by weather fluctuations, especially in coastal areas with the potential for marine clouds.

Daily energy requirements for a sample home

The energy requirements calculation was performed for a simple home inhabited by a family of six. The house has a total of 8 rooms with 12 lighting points, as well as additional electrical loads including a refrigerator, a water pump, two televisions, and three 1/2 HP air conditioners. The energy consumption of each load is calculated based on its power and daily operating hours. The load requirements breakdown is as follows: lights: 1,170 Wh; 100 W refrigerator (8 hours): 800 Wh; 125 W water pump (0.5 hour): 62.5 Wh; two LCD TVs (2 x 100 W x 6 hours): 1,200 Wh; three 1/2 HP air conditioners (3 x 500 W x 7 hours): 10,500 Wh; the total daily energy requirements of the house are: 12,741 Wh ≈ 12.7 kWh. By including the system efficiency factor (20% for inverter, cables, and controller), the requirement becomes: 15,289 Wh ≈ 15.3 kWh/day.

Determining battery capacity

Energy storage requirements are calculated based on the system's daily requirements. With a 12V storage system, the total current capacity required is: Capacity = 15,289 / 12 = 1,274 Ah. If using 12V batteries with a capacity of 100 Ah, the number of batteries required is: 1,274 / 100 = 12.74 ≈ 13 batteries with a capacity of 100 Ah. This number is sufficient to provide energy for an entire night and maintain the household's load continuity.

Solar power system integration

Based on the calculations, the recommended system design includes: Solar panels: 16 units @ 200 Wp; Batteries: 13 units @ 12 V, 100 Ah; Solar charge controller: minimum rating 80–100 A; and Inverter: minimum capacity 3,000–5,000 W. Installation configuration: series–parallel combination to achieve optimal system voltage and current capacity. Solar panel energy production is sensitive to weather; output can drop by as much as 25% on cloudy days. A simple home with high energy consumption (predominantly air conditioning) requires a medium-scale solar power system of approximately 3.2 kWp. The large number of solar panels and the required battery capacity mean that a standalone renewable energy system requires careful design to ensure reliability. A solar power system with 16 panels and 13 batteries can meet a home's needs for 24 hours without support from the state electricity company.

Discussion

The research results show that small-scale solar power generation systems are significantly affected by environmental conditions, particularly solar radiation intensity in coastal areas. Weather variations during the test period caused significant fluctuations in daily energy production. The energy output of a 200 Wp solar panel ranged from 730 to 970 Wh/day. On sunny days, the panel produced energy close to optimal capacity, while on cloudy days production dropped by up to 25%. This finding is consistent with the basic concept of photovoltaic energy conversion, where solar radiation is the primary factor determining system efficiency (Eze et al., 2024).

A simple calculation of a home's energy needs shows that air conditioning (AC) accounts for 82% of the total daily load. This situation suggests that AC use can be a significant determinant of the scale of the solar power system required, the higher the cooling load, the greater the need for solar panels and battery capacity. This is especially relevant in coastal areas, where high temperatures and humidity often lead to significant AC use (Hunt et al., 2022). In this context, solar power plant design must consider peak loads and the energy consumption patterns of the home's occupants, not just the number of rooms or lighting points.

The 12V system's 1,274 Ah battery capacity indicates that energy storage plays a crucial role in ensuring electricity continuity at night. With a total energy requirement of 15.3 kWh, the system requires 13 100 Ah batteries to provide a whole night's power supply without the solar power plant operating. This indicates that when daily energy consumption and load demand are both high, storage capacity must be increased proportionally. This fact also emphasizes that standalone solar systems rely heavily on batteries, unlike hybrid systems, which can partially rely on the state electricity grid (Atawi et al., 2022).

The number of solar panels required, 16,200 Wp units, indicates that the solar power system being designed is considered medium-scale, despite the concept of a simple home. This suggests that achieving energy independence requires investment in solar power systems, but that this investment cannot be minimized without considering realistic energy needs. The large number of panels and batteries also affects installation area requirements, roof structure, and installation costs (Symeonidou et al., 2021). In coastal areas, this aspect requires special attention due to the potential for corrosion due to sea air, high wind intensity, and rapidly changing weather conditions (Zi et al., 2023).

Furthermore, from a technical perspective, the research results confirm that solar PV plant design must incorporate system efficiency factors, including cable losses, inverter conversion efficiency, and controller performance. This study used an efficiency of 80% to represent field conditions realistically. The use of this efficiency factor is crucial because, in practice, the panels' power is not fully utilized. Careful input of efficiency parameters has been shown to provide more accurate calculation results that approximate field conditions (Arslan et al., 2024).

Overall, the research findings confirm that small-scale solar PV plants can be implemented to meet the electricity needs of homes in coastal areas. However, the design must consider weather variability, cooling load consumption, storage capacity, and system efficiency (Novak et al., 2023). This study also shows that modern homes with air conditioning have relatively high energy needs, so solar PV plant design must be tailored to actual consumption profiles, rather than simply adopting a minimalist approach. These findings can serve as an important reference in planning standalone solar PV systems for residential homes, public facilities, and other coastal installations.

Based on the research findings, several steps can be taken for further development. First, further technical studies are needed to optimize panel and battery capacity, including using simulation software such as Homer or PVsyst to determine whether the configuration of 16 200 Wp panels and 13 100 Ah batteries is efficient. Testing should also be extended to several months to observe seasonal variations in solar radiation, while monitoring panel degradation, battery performance, and changes in inverter efficiency. Furthermore, home energy consumption management can be improved by regulating load and using energy-efficient appliances, particularly air conditioners, which contribute the majority of consumption, thereby significantly reducing system requirements.

Furthermore, economic analysis is crucial for assessing system feasibility by calculating investment and life-cycle costs and payback periods. System evaluations also need to consider coastal environmental conditions, such as potential corrosion, humidity, and strong winds, to determine the need for more reliable protection and mounting designs (Carrera et al., 2025). To improve the accuracy of energy production predictions, collected data can be used to develop energy estimation models based on weather parameters, such as solar radiation, humidity, and cloud cover (Park et al., 2021).

The research can also be expanded to include social and policy aspects, for example, by examining user perceptions of off-grid systems, their potential application as models for energy-independent villages, and their relevance to government programs related to renewable energy. Finally, more detailed refinements to system efficiency calculations are needed to obtain more realistic results, including measurements of cable losses, charge controller performance, and inverter efficiency at various load levels. With further development, the research results can serve as a more comprehensive reference for planning independent solar power plants in coastal areas and regions with fluctuating weather.

Conclusions

This research demonstrates that small-scale solar power plants (PLTS) have significant potential for application in coastal areas as an alternative energy source, particularly for dock lighting and simple household needs. A 200 Wp solar panel can generate 941–970 Wh/day under sunny conditions, decreasing to 730 Wh under cloudy conditions. Therefore, the performance of a solar power plant is highly dependent on solar intensity. To meet the daily energy needs of a simple home (15,289 Wh/day), 16,200 Wp panels and 13 100 Ah batteries are required. These findings confirm that successful solar power plant implementation depends heavily on a design that accounts for local weather conditions and energy storage capacity. The research results provide an important basis for energy planning in coastal areas, particularly in encouraging the use of more sustainable renewable energy and reducing reliance on diesel. Technologically, energy storage systems are a key component in maintaining a continuous electricity supply during the night or in inclement weather. Economically and environmentally, PV systems offer long-term savings and reduced carbon emissions, while scientifically, this research serves as a baseline for developing PV plant designs based on field data.

This study still has several limitations, including a very short solar radiation measurement period, the use of load estimates without real-time testing, and assumptions about system efficiency that may differ from actual conditions. Furthermore, coastal environmental factors such as corrosion have not been analyzed, and the design calculations do not use optimization software, resulting in manual configurations. Further research is recommended to conduct annual radiation measurements, build a solar power plant prototype for testing under real-world loads, and examine the effects of the coastal environment on panel and battery degradation. The use of optimization software such as Homer or PVsyst is necessary to produce more efficient designs. Furthermore, economic feasibility analysis and the development of hybrid schemes with generators or state electricity company can improve the reliability of solar power plant systems in coastal areas.

References

Arslan, E., Küçük, F. A., Biçer, Ç., & Özsoy, B. (2024). Determining energy, exergy and enviroeconomic analysis of stand-alone photovoltaic panel under harsh environment condition: Antarctica Horseshoe-Island cases. *Renewable Energy*, *226*, 120440. https://doi.org/10.1016/j.renene.2024.120440

Atawi, I. E., Al-Shetwi, A. Q., Magableh, A. M., & Albalawi, O. H. (2022). Recent Advances in Hybrid Energy Storage System Integrated Renewable Power Generation: Configuration, Control, Applications, and Future Directions. *Batteries*, *9*(1), 29. https://doi.org/10.3390/batteries9010029

Carrera, L. A. I., Tato, L. D., Robles, C. D. C., Barajas, M. G. G., Gutiérrez, A. Z., Alvarado, J. M. Á., & Reséndiz, J. R. (2025). Advances in Mounting Structures for Photovoltaic

Systems: Sustainable Materials and Efficient Design. *Technologies*, *13*(5), 204. https://doi.org/10.3390/technologies13050204

Eze, V. H. U., Richard, K., John Ukagwu, K., & Okafor, W. (2024). Factors Influencing the Efficiency of Solar Energy Systems. *Journal of Engineering, Technology, and Applied Science (JETAS)*, *6*(3), 119–131. https://doi.org/10.36079/lamintang.jetas-0603.748

Hunt, J. D., Nascimento, A., Zakeri, B., Barbosa, P. S. F., & Costalonga, L. (2022). Seawater air-conditioning and ammonia district cooling: A solution for warm coastal regions. *Energy*, *254*, 124359. https://doi.org/10.1016/j.energy.2022.124359

Joewono, A., Angka, P. R., Sitepu*, R., & Yuliati, Y. (2023). Energy Assessment of Solar Power Plant On-Grid Bi-direction 3 KW 1 Phase. *Aceh International Journal of Science and Technology*, *12*(3), 317–326. https://doi.org/10.13170/aijst.12.3.30259

Kannan, N., & Vakeesan, D. (2016). Solar energy for future world: - A review. *Renewable and Sustainable Energy Reviews*, *62*, 1092–1105. https://doi.org/10.1016/j.rser.2016.05.022

Li, G., Li, M., Taylor, R., Hao, Y., Besagni, G., & Markides, C. N. (2022). Solar energy utilisation: Current status and roll-out potential. *Applied Thermal Engineering*, *209*, 118285. https://doi.org/10.1016/j.applthermaleng.2022.118285

Novak, M., Vohnout, R., Landkamer, L., Budik, O., Eider, M., & Mukherjee, A. (2023). Energy-efficient smart solar system cooling for real-time dynamic weather changes in mild-climate regions. *Renewable and Sustainable Energy Reviews*, *182*, 113347. https://doi.org/10.1016/j.rser.2023.113347

Pandey, A. K., Kalidasan, B., Reji Kumar, R., Rahman, S., Tyagi, V. V., Krismadinata, Said, Z., Salam, P. A., Juanico, D. E., Ahamed, J. U., Sharma, K., Samykano, M., & Tyagi, S. K. (2022). Solar Energy Utilization Techniques, Policies, Potentials, Progresses, Challenges and Recommendations in ASEAN Countries. *Sustainability*, *14*(18), 11193. https://doi.org/10.3390/su141811193

Pandey, A. K., R., R. K., & Samykano, M. (2022). Solar energy: direct and indirect methods to harvest usable energy. In *Dye-Sensitized Solar Cells* (pp. 1–24). Elsevier. https://doi.org/10.1016/B978-0-12-818206-2.00007-4

Park, S., Kim, Y., Ferrier, N. J., Collis, S. M., Sankaran, R., & Beckman, P. H. (2021). Prediction of Solar Irradiance and Photovoltaic Solar Energy Product Based on Cloud Coverage Estimation Using Machine Learning Methods. *Atmosphere*, *12*(3), 395. https://doi.org/10.3390/atmos12030395

Purwanto, A., Nugroho, H., & Nugroho, Y. (2019). Analisis Potensi Pemanfaatan Pembangkit Listrik Tenaga Surya (PLTS) sebagai Alternatif Pengganti Genset di Wilayah Pesisir Jawa Tengah Berdasarkan Data Radiasi Matahari BMKG. *Indonesian Journal of Electrical Engineering (IJEE)*, *1*(1), 51–57. https://ejournal.undip.ac.id/index.php/ijee/article/view/23979

Putra, I. K. B. K., Yasa, I. W. S., Sutama, W., & Adrama, N. G. (2025). Perancangan Sistem Pembangkit Listrik Tenaga Surya untuk Rumah Tangga. *Jurnal Teknik Elektro Uniba (JTE UNIBA)*, *10*(1), 690–697. https://doi.org/10.36277/jteuniba.v10i1.1298

Rahmatullah, Khairul Umurani, & Lubis, S. (2022). The New Renewable Energy Hybrid Systems for Simple Home Electricity Purposes. *International Journal of Economic, Technology and Social Sciences (Injects)*, *3*(1), 99–108. https://doi.org/10.53695/injects.v3i1.715

Rathore, N., Panwar, N. L., Yettou, F., & Gama, A. (2021). A comprehensive review of different types of solar photovoltaic cells and their applications. *International Journal of Ambient Energy*, *42*(10), 1200–1217. https://doi.org/10.1080/01430750.2019.1592774

Silalahi, D. F., Blakers, A., & Cheng, C. (2023). 100% Renewable Electricity in Indonesia. *Energies*, *17*(1), 3. https://doi.org/10.3390/en17010003

Silalahi, D. F., Blakers, A., Stocks, M., Lu, B., Cheng, C., & Hayes, L. (2021). Indonesia's Vast Solar Energy Potential. *Energies*, *14*(17), 5424. https://doi.org/10.3390/en14175424

Stevanović, S., & Stevanović, S. (2021). Solar energy as a renewable energy source. *International Scientific Conference, Sustainable Agriculture and Rural Development II*, 353–363. https://www.cabidigitallibrary.org/doi/full/10.5555/20230392994

Symeonidou, M. M., Zioga, C., & Papadopoulos, A. M. (2021). Life cycle cost optimization analysis of battery storage system for residential photovoltaic panels. *Journal of Cleaner Production*, *309*, 127234. https://doi.org/10.1016/j.jclepro.2021.127234

Vodapally, S. N., & Ali, M. H. (2022). A Comprehensive Review of Solar Photovoltaic (PV) Technologies, Architecture, and Its Applications to Improved Efficiency. *Energies*, *16*(1), 319. https://doi.org/10.3390/en16010319

Yudonago, J. F. I., Valladares, O. G., Rodríguez, N. M. O., Bahena, J. I., & Luna, Y. R. G. (2025). Applications of solar thermal technologies in Mexican industries for heating processes and their contribution against global warming: An overview. *Solar Energy*, *291*, 113395. https://doi.org/10.1016/j.solener.2025.113395

Zi, Z., Ji, D., Jie, L., Di, W., & Guanghao, C. (2023). Enhancing energy–climate–economy sustainability in coastal cities through integration of seawater and solar energy. *Renewable and Sustainable Energy Reviews*, *183*, 113477. https://doi.org/10.1016/j.rser.2023.113477