SOLAR POWER ENERGY AND ITS PRODUCTIVE USE IN ISLAND COMMUNITIES' SERIES

THE CASE OF TIKINA TAI VUGALEI, TAILEVU FIJI ISLANDS

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BEYOND THE BILIBILI INC

ISBN 978-982-101-818-0

This is the first publication in a series of looking at the productive use of solar power energy in Small Island Developing States (SIDS). The use of off-grid solar can contribute towards the achievement of Fiji's Sustainable Development Goals (SDGs) particularly SDG 4 Quality Education, SDG 5 Gender Equality, SDG 7 Affordable and Clean Energy, SDG 8 Decent work and economic growth, SDG 9 Industry innovation and infrastructure, SDG 11 Sustainable cities and communities, SDG 13 Climate action, and SDG 17 Partnerships for the Goals.

Contents

Introduction and Background

The Pacific Small Island Developing States[1] (PSIDS) comprise of 13 United Nations listed countries and are amongst the world's smallest independent nation states except for Papua New Guinea which has a much larger land mass. The countries are the Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu and are bound together by the Pacific Ocean and have similar characteristics such as 'traditional forms of governance, geographical distance from markets, natural hazards, expensive and unreliable transportation, and high levels of development assistance' (Dornan, 2015).

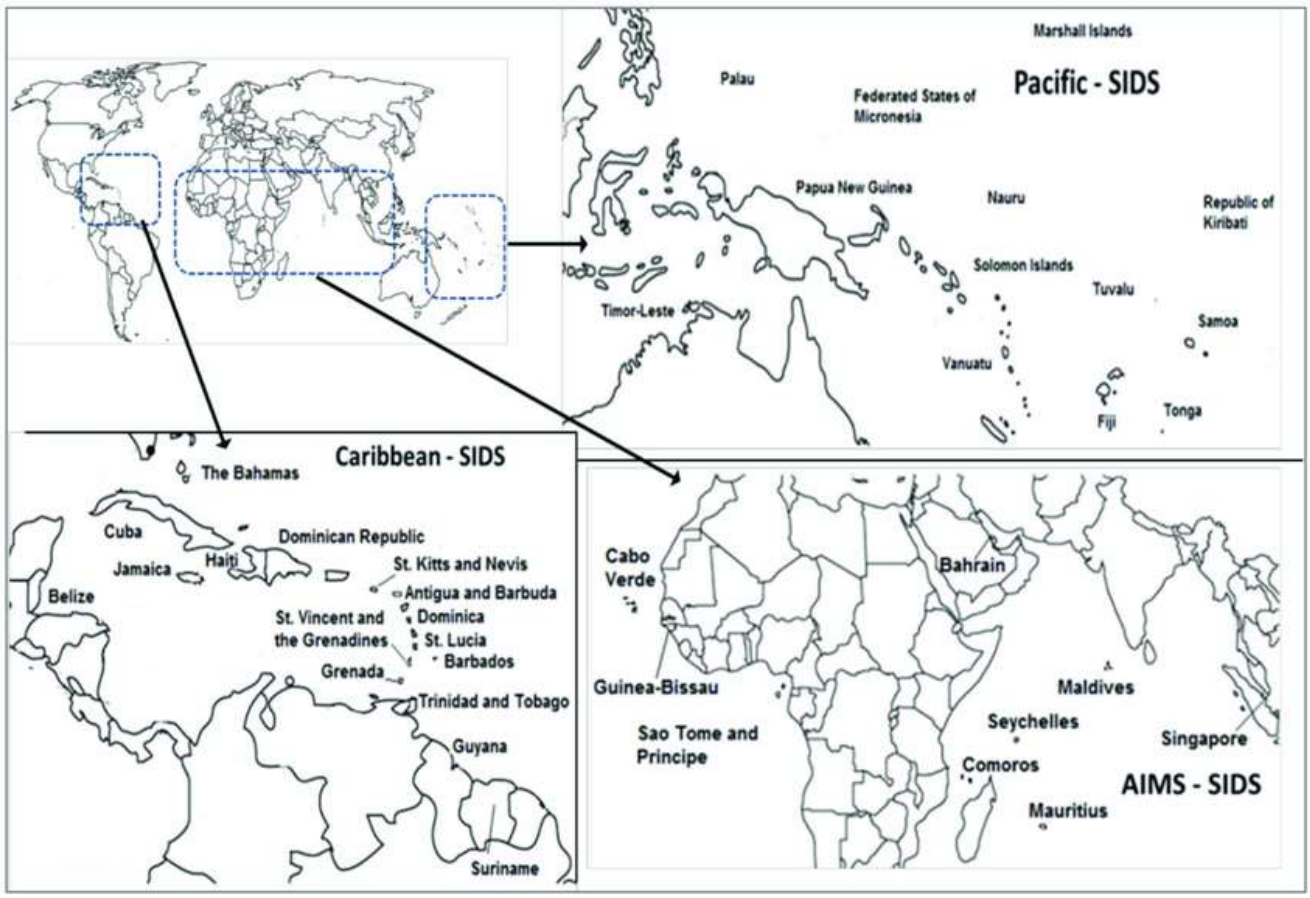
What is Off – Grid Solar

The "term off–grid solar" system relates to electricity that is not provided through main grids. (IRENA, 2018). The application and implementation of "off-grid systems" is highly diverse ranging from small-scale solar lanterns to larger-scale mini-grids serving hundreds of households (IRENA, 2018). Off-grid electricity technologies and infrastructure have increasingly become a part of the energy configuration across the Pacific. It helps to address issues of electricity access, energy security and/or energy resilience. Access to this source of power has been continuously facilitated by governments' agencies, community organizations, non-government organizations, the private sector, as well as a range of various bilateral and multilateral aid initiatives (Pacific Community, 2021).

[1] Pacific Small Island Developing States (PSIDS) | Department of Economic and Social Affairs (un.org)

Figure 1 Small Islands Developing States(SIDS)

Source: Map of small island developing states (SIDS)-geographical distribution... | Download Scientific Diagram (researchgate.net)



Energy Challenges on Islands

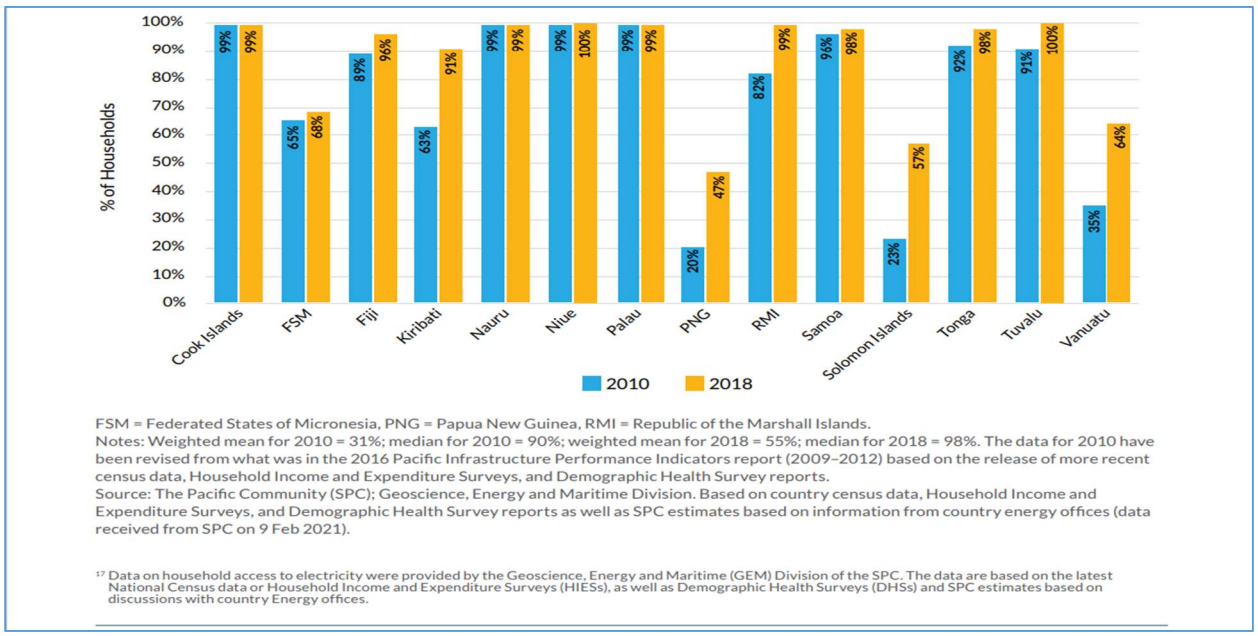
Small Islands Developing States (SIDS) have garnered two opposing descriptions during the past 30 years: vulnerability and resilience. According to Easter (1999), many of the world's vulnerable nations are SIDS. A different interpretation of the discourse surrounding SIDS vulnerability has, however, more recently surfaced. This discourse on resilience focuses on the adaptability of SIDS to deal with the difficulties (Armstrong & Read, 2006).Vulnerability is evident in the areas of energy supply and security, with 40% of the GDP of PSIDS typically accounted for by their imports of fossil fuels. This dependence drains the economy, a barrier to expansion, and a source of vulnerability. The transport sector uses the greatest fossil fuels in PSIDS, accounting for roughly 70% of all consumption (Asia Development Bank, 2013). There are many environmental issues that PSIDS must deal with, including desertification, inadequate waste management, degradation of marine ecosystems, population growth on finite resources, climate change, and others (Kumar, 2020).

Against the backdrop of these challenges, sustainable energy production and use continue to compound the challenges such as a limited range of indigenous resources, high cost of energy resources for the populations, poor data quality and trends, limited expertise and weak bargaining positions. The Pacific region has developed the Framework for Energy Security and Resilience in the Pacific (FESRIP). The 2021-2030 framework focuses on actions to assist PSIDS in addressing their own energy sector priorities, with a strong emphasis on improved energy sector robustness and resilience to adverse climate change and natural hazards, and long-term goals of sustainable and affordable clean energy supply with 100 percent electricity access and low-carbon transport energy for all their island communities (Pacific Community, 2021).

Access to Energy to Build Resilient Community

The four Melanesian countries[2], which are home to approximately 5.1 million women (Population.Net, n.d.) have the lowest overall rate of energy access[3], with only 10-15% of Papua New Guineans having access to electricity. Gender inequality is prevalent in PSIDS when it comes to access to renewable energy, energy efficiency, and related technologies (Pacific Community, 2021). Pacific women are energy poor; national energy policy frameworks are gender blind; Pacific culture and values prevent women from entering traditionally male-dominated university programs and working fields; and the few existing initiatives have had limited impact in including women in the clean energy value chain, that is, in planning and procurement, sales and distribution, installation, operation and maintenance (O&M), and decommissioning (Pacific Community, 2021).

Figure 2 HOUSEHOLD WITH ACCESS TO THE ELECTRICITY SOURCE: (PRIF, 2021)



FSM = Federated States of Micronesia, PNG = Papua New Guinea, RMI = Republic of the Marshall Islands.
Notes: Weighted mean for 2010 = 31%; median for 2010 = 90%; weighted mean for 2018 = 55%; median for 2018 = 98%. The data for 2010 have been revised from what was in the 2016 Pacific Infrastructure Performance Indicators report (2009–2012) based on the release of more recent census data, Household Income and Expenditure Surveys, and Demographic Health Survey reports.
Source: The Pacific Community (SPC); Geoscience, Energy and Maritime Division. Based on country census data, Household Income and Expenditure Surveys, and Demographic Health Survey reports as well as SPC estimates based on information from country energy offices (data received from SPC on 9 Feb 2021).

[17] Data on household access to electricity were provided by the Geoscience, Energy and Maritime (GEM) Division of the SPC. The data are based on the latest National Census data or Household Income and Expenditure Surveys (HIESs), as well as Demographic Health Surveys (DHSs) and SPC estimates based on discussions with country Energy offices.

[2] Fiji, Solomon Islands, Papua New Guinea, Vanuatu

[3] Fiji is an exception. Vanuatu is improving rapidly.

Off-grid solar systems, according to the World Bank, are a smart way to address climate vulnerability and build resilience. For example, when Tropical Cyclone Pam damaged 65 kilometers of power lines in Vanuatu, leaving 12,000 customers without power, residents with solar home systems prepared ahead of time by storing equipment inside their homes. Similarly, Bangladesh is a good example, it installed solar home systems for 3.95 million customers in order to provide access to electricity while also building resilience against storm surges (World Bank, 2017).

In 2016, rural areas housed approximately 75% of Vanuatu's population (Population.Net, n.d.). From 2015 to 2017, Vanuatu saw the greatest improvement in the region in off-grid electricity access, increasing from 9 percent to 64 percent. Many remote islands and rural populations (Melanesia, Micronesia) do not have grid electricity, and the transition to modern renewable energy through the installation of off grid solar has improved electricity access (Pacific Community, 2021).

Thesis for Progress

All PSIDS are progressing with the roll-out of renewable energy. The focus on mitigation, through increased renewable energy feeding to grids, is apparent in the NDCs submitted by PSIDS to UNFCCC (Pacific NDCs, 2022). This focus, however, overlooks some of the most vulnerable aspects of PSIDS societies: off-grid rural poor communities that produce negligible GHG emissions per capita but bear the brunt of climate change impacts (Hills, Michalena, & Chalvatzis, 2018).

RE has no mitigation function in those communities because they are attempting to initiate electricity supply rather than switching to a lower carbon supply option. The innovative use of RE technologies can also create resilience for individuals, households and communities against the effects of climate change (Hills, Michalena, & Chalvatzis, 2018). RE can contribute significantly to climate change adaptation and create opportunities for innovative practices to address climate change. RE based adaptation solutions promote mitigation and intensify adaptation efforts synchronously in many sectors. As the world recognizes the role of RE in economic recovery and in continued and sustainable development post- pandemic and other threats alike, the resilience of renewable energies and their successful use cannot be overstated (To, et al., 2021).

Community Based Responses

A community is a group of individuals who reside in the same area, share similar interests, or have a similar identity. Communities may play a significant role in energy resilience, and renewable energy technology can help communities to be more resilient. Pacific communities have a strong sense of resilience that should be recognized in the energy sector. Traditional norms and practices have helped PSIDS build disaster resilience and adaptability. In response to population expansion and climate change, smallholder farmers in Papua New Guinea have embraced more flexible land access arrangements based on indigenous systems of land sharing

that traditionally operate through kinship as a risk management technique. These long-term relationship-based forms of community resilience can span geographical boundaries. Within their social network, families duplicate the adaptive behavior of others, and these networks are frequently clustered by common livelihood choices. Energy resilience efforts must support existing livelihood strategies in order to ignite revolutionary action at the local level (To, et al., 2021).

Members of communities must be empowered in particular women and vulnerable groups in the decision-making process on the use of natural resources and the implementation of RE initiatives through training for these groups. The deepening of knowledge and the disseminating of concepts, principles and practical applications of sustainable development and promoting the use of RE traditional/ community leaders/committees and members of communities will improve the sustainability of off Grid Solar PV in communities.

Modern energy access is a critical enabler of women's empowerment (Sustainable Development Goal 5). Because rural women and girls are primarily responsible for the majority of household work, having access to energy has a significant impact on their health and well-being (Barefoot college International, 2022). Pacific women lack access to energy, national energy policy frameworks do not take gender into consideration, Pacific culture and values prohibit women from enrolling in traditionally male-dominated university programs and professions, and the few initiatives that do exist have had little success in bringing about the inclusion of women in the clean energy value chain, which involves evaluating and supply chain, marketing and distribution, implementation, operation and upkeep , and decommissioning. While access to energy services does not guarantee gender equality, it does go a long way toward relieving women and girls of the drudgery associated with their daily tasks and giving them time to pursue income-generating opportunities and education (Pacific Community, 2021).

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[1] Ibid

Partnership for Impact in Localizing the Sustainable Development Goal's

The solar streetlights project is one of the priority projects identified on the village 20 year development plan and initiated at Tonia village, in Fiji. Though connected to the main electricity grid provided by Energy Fiji Limited, this electricity only provided for the domestic use in each household and other social infrastructures such as the church, community halls and schools. It did not provide for street lightings, a facility that had an increasing demand for the villagers attending meetings, church, and other social gatherings in the village. Security at night, especially for women and children also became a high priority for the villagers given the awareness on increasing abuse and prevalent crime against women.

Case Study of Tikina Tai Vugalei: Capacity Development through the Implementation of Renewable Energy

In an annual fundraising drive, the villagers installed the first seven streetlights in Tonia village. With the intervention of Beyond the Bilibili, the streetlights project was extended to cover the entire four villages in the district. AusAID provided an additional FJD$35,667 in cash grant in May 2024, while Beyond the Bilibili provided FJD$18,400 in cash and kind. Whilst financial assistance was provided by the donors to complete the community initiative, the villagers collaborated by providing labour, meals, sand and gravel. The project also vividly extracted unusual festivity and joy amongst the villagers.

Tai-Vugalei Project Sites

The district (Tikina), Taivugalei in the northern part of Tailevu is one of the 22 districts of the of the province on Eastern Viti Levu, Fiji. Taivugalei is a remotely rural district bordering the province of Naitasiri and is not accessible by public transport. The district comprises of four villages.

Village	Latitude	Longitude
Tonia	17°48’34.40”S	178°22’39.86”E
Vatukarasa	17°49’49.33”S	178°23’8.05”E
Natuva	17°50’59.22”	178°23’43.94”E
Nameka	17°51’0.25”S	178°24’11.89”E

Unlike Tonia village, the biggest and most populated of the four and uniquely identified as the only village with the most indigenous iTaukei dairy farmers in Fiji, the villagers in Vatukarasa, Natuva and Nameka are mostly subsistence farmers whose main produce are taro, cassava and kava. Nameka village, however, has a good quantity of land leased out to the government and utilised for mahogany forest plantations. The district comprises approximately 800 people whose children attend the three local primary schools. The children of the three villages, Natuva, Nameka and Vatukarasa cross or travel upstream the Rewa River to attend Lomaivuna High School whist the children of Tonia attend Naiyala High School. There are nursing stations located in Tonia village and one in Vatukarasa village and each staffed by a nurse.

Outcomes

The intervention design focused on allowing women and vulnerable groups to participate in decision-making processes related to the use of natural resources

and the implementation of Renewable Energy projects. The project recognizes Fiji's challenges in achieving gender equality in decision-making. The project encouraged and promoted women's participation in awareness-raising and education activities, with the goal of having 40% of participants in project training activities be women and young people.

The solar streetlights were rolled out under a 60-day period from early April to end of August. The equipment and necessary material delivered on site with the partnership of the local equipment supplier and logistics provider.

Project Highlights

Tonia Village

Work in Tonia village as well as the other three was organized by the Mata ni Tikina (District Council Representative) assisted by the respective Turaga ni Koro (Village Headmen). BTB conducted bulk procurement for the project and overall project management. The works included assembling the LED Liper solar streetlights; preparing the posts, attaching the brackets, fitting the assembled LED lights on the posts, digging the post holes and installing the posts. The community provided gravel and sand, labor, meals and refreshment (Kava). The adjacent Naseva School also had four lights installed.

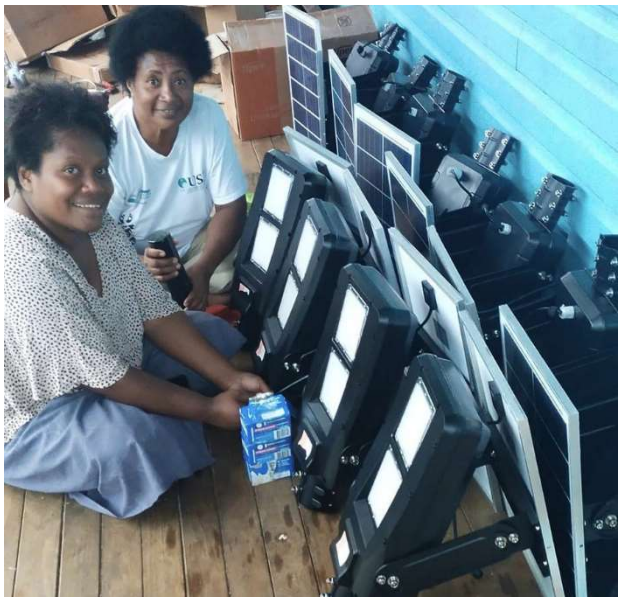

Figure 3 Women of Tonia assemble the PV Solar Lights.
Source: Authors

Vatukarasa Village

Coloi settlement lying adjacent to Vatukarasa village are people from Nataveya village in the province of Naitasiri. Because of their proximity and the relationship in the past many years through intermarriages, BTB deemed it most appropriate to include them after receiving the Vatukarasa village council proposal to do so (though not originally included in the proposal). The project provided them with two post and four lights. The gesture was received with so much admiration and appreciation by the settlers shown through their "fakawela" dressing up all the poles with cloth as usual iTaukei custom. A big thank you to the partners for the sense of inclusivity promoted and practiced by the communities.

Figure 4 Women participating in launch of the program

Natuva Village

The delivery of items to Natuva had to be delivered to the village via road and on water. It was first delivered on Nataveya a village in the Province of Naitasiri. It was then delivered via a boat downstream of the Rewa River. Despite the challenging circumstances, the project was completed on time with the communities appreciation expressed at the completion of the works.

Nameka Village

Due to the road conditions, items delivery was delayed. The Team had to liaise with road officials, Fiji Road Authority and District Officer Korovou for road repairs. All four villages engaged their church steward to conduct a short service before the laying of the foundation (vakasobu duru) of the initial posts and hence asking for the blessing to the donor and the launching of the works well. The village elders and women participated in this event, each pouring a shovel of cement to mark this memorable occasion.

Training for the Community

The program aimed to promote gender equality in Fiji's local decision-making process by involving women and vulnerable groups in renewable energy projects and awareness raising, with a target of 40% participation from women and youth. There was a marked participation of the youth and women throughout the villages in the entire course of the project and onsite focused group training. The women were very active in supporting the men preparing their meals and participating in the official launch, the "vakasobu duru" of the project. The very active participation of the communities assisted greatly in having the fifty posts and one hundred lights completed. The project also saw the development of a maintenance and operations manual for use of the community post the installation.

Project Opportunities for Scaling Up

The focus group training and consultation during the project implementation identified many areas for the productive use of Solar PV in rural economies in Fiji. The following summarizes the areas of top priority for implementation.

Aggregating Demand Solar Powered Technologies for Rural Communities

One opportunity to explore is demand aggregation and bulk sourcing in PSIDS, which will help reduce the cost of individual solar systems by 20-25% (ISA, 2020). These may include the following:

- Solarisation of schools and hospitals;
- Street lights;
- Solar pumps;
- Solar power outboard motors for inter-island transfers,
- Solar refrigerators; and
- Solar desalination plants.

The aggregation of Solar based technologies for PSIDS can be done in collaboration with best suited development partners. The program must aim to reduce the initial cost through grant support as well as enable proper maintenance and after-sales support through capacity building In the Pacific countries.

Sustainability, Operations and Maintenance

To solve community-level knowledge gaps about the operation and maintenance of solar powered systems, a training program can be provided in a hybrid or online format. A program like this may concentrate on assisting the government in improving the long-term viability of off-grid solar systems. Where needed, women in positions of leadership can be identified and targeted specifically for the opportunity to learn about sustainable development and renewable energy, acknowledging that women in traditional leadership roles, in local government senior positions or in village or island councils.

Gender mainstreaming

Gender mainstreaming will also be an important consideration of the training needs assessment when developing such programs, recognizing that different groups may have different needs and also different timing (e.g. in the morning, evening or on weekends) and methods of training may be appropriate. The program must also promote and strengthen the human rights of local communities and villages by providing them with access to information to assist and strengthen their capacity in informed decision-making on rural development and renewable energy projects. The program must recognize that local leaders and communities in the islands are often owners and major decision makers for the land, water and other natural and ecosystem resources.

Therefore, it is their human right to have information provided to allow them to make informed decision making.

Productive Use of Energy to support livelihoods for Resilience

Using innovative solutions is a critical component for connecting decentralized energy supply to rural communities. Such solutions include the selection of energy technology (e.g., solar), efficient end-use appliances (e.g., pumps, sewing machines, freezers), and the proper combination and integration of the two (SEforALL, 2019). This should revolve around delivering tailored solutions based on the local context and conditions, with end-user and community needs at the center.

Conclusion

The world is at a critical juncture. Many of the advancements in development that the international community has worked so hard for years to achieve are now in jeopardy due to the pandemic, the climate crisis, ongoing and new conflicts, economic inequality, and growing inflation. The challenges that the new technologies like off-grid solar PV are confronted with can be overcome by increasing knowledge among stakeholders and sensitizing them to on grid alternatives such as off grid Solar PV. Future deployment is anticipated to be driven by affordable prices, technological advancements, novel delivery and financing schemes, and stronger legislative backing, which is now realized in the case off-grid Solar PV solutions.

Approaches to deploying off grid renewables must integrate the need to support livelihoods. Integrating a livelihood-focused perspective in the early stages of formulating and designing off-grid renewable energy solutions can play a crucial role in maximizing socio-economic development outcomes. At the core is the need for a tailored, integrated approach to reach universal access in a timely manner and deliver electricity services necessary to maximize socio-economic outcomes (IRENA, 2016c).

References

Armstrong, H., & Read, R. (2006). Geographical ‘handicaps’ and small states: Some implications for the Pacific from a global perspective. . *Asia Pacific Viepoint*, 79-92.

Asia Development Bank. (2013). *Energy Outlook for Asia and the Pacific.* Mandaluyong City, Phillipines,: ADB.

Dornan, M. (2015). Renewable energy development in small island developing states of the Pacific. Resources,. *4*(3), 490-506. doi:https://doi.org/10.3390/resources4030490

Easter, C. (1999). Small states development: A Commonwealth vulnerability index. *The Round Table: Commonwealth Journal of International Affairs*, 403-422. doi:10.1080/003585399107947

GCEEP. (2020). *2020 Report Energy Access.* Retrieved 02 24, 2022, from https://www.endenergypoverty.org/2020-report

Hills, J. M., Michalena, & Chalvatzis, K. J. (2018). Innovative technology in the Pacific: Building resilience for vulnerable communities. *Technological Forecasting and Social Change, 129*, 16-26.

ISA. (2020). *ISA Annual Report.* New Delhi: International Solar Alliance. Retrieved 03 30, 2022, from https://www.isolaralliance.org/uploads/docs/22ea89a88f2b407da6c17d44f94cb7.pdf

Pacific Community. (2021). *Framework for Energy Security and Resilience in the Pacific 2021-2030. Final Report Volume 2.* Noumea: Pacific Community. Retrieved from spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/90/90f196c4ace4f6a0923879abc96e68ec.pdf?sv=2015-12-11&sr=b&sig=YM6IBz0n04FJfGs6BNfG5PGvAptnxoKjOY0QaQOX6qc%3D&se=2022-06-28T00%3A25%3A29Z&sp=r&rscc=public%2C%20max-age%3D864000%2C%20max-stale%3D

Pacific NDCs. (2022, 03 30). Retrieved from Regional Pacific NDC Hub: https://pacificndc.org/pacific-ndcs

Population.Net. (n.d.). *Oceania Population*. Retrieved 12 02, 2021, from Population.Net: https://www.populationof.net/oceania/

PRIF. (2021). *Pacific Infrastructure Performance Indicators 2021.* Pacific Regional Infrastructure Facility.

SEforALL. (2019). *Integrated Electrification Pathways for Universal Access to Electricity: A Primer.* Sustainable Energy for All. Retrieved 01 30, 2022, from https://www.seforall.org/publications/integrated-electrification-pathways-for-universal-access-to-electricity

To, L. S., Bruce, A., Munro, P., Santagata, E., MacGill, I., Rawali, M., & & Raturi, A. (2021). A research and innovation agenda for energy resilience in Pacific Island Countries and Territories. *Nature Energy, 6*(2), 1098-1103.

World Bank. (2017). *Energy Efficiency a key enabler for enegy access.* Washington: World Bank.

ISBN 978-982-101-818-0