Paper information

Paper number	1114
Paper title	Creating a JUST energy transition for embedded generation via customer empowerment in South Africa
Study Committee	SC C5 – Electricity markets and regulation
Paper Stream	3. Towards a sustainable power system
Authors	Aradhna Pandarum, Vuyo Mbam
Affiliations (optional)	Council for Scientific and Industrial Research (CSIR) South Africa
Email address	apandarum@csir.co.za

Summary

South Africa (SA) is the 12th largest greenhouse gas (GHG) emitter in the world. Furthermore, the country has pledged to transition away from a carbon insensitive economy within the Conference of Parties (COP) thus highlighting the need to reduce emissions. Following various policy decisions regarding large scale generation, the country is further promoting the installation of embedded generation with no need to obtain a generation licence for any size of plant. There has been a significant increasing trend of small-scale rooftop solar photovoltaic (PV) installations in the past decade due to decreasing technology costs, increasing electricity tariffs, energy security during loadshedding and climate change concerns. Other enabling factors for increasing embedded generation on distribution networks include the development of distribution markets and distribution system operators in the country are being pursued. An opportunity therefore presents itself within the JUST energy transition to create social and distributive justice for customers using these embedded generation opportunities and enablers. The theme of this paper specifically focusses on the community shares model as a customer empowerment mechanism and its impact on a JUST transition in South Africa. The community shares business model involves installation and community ownership of solar PV systems that may or may not be located away from the customers in the community who make use of the power generated. The customers can purchase rights to a segment of the PV plant and its revenues or can even purchase equity or shares from the revenue generated from the plant.

The paper will provide insight into how this business model could possibly be achieved, enabling factors and barriers, technical and operational considerations, and its role in the future of the South African energy transition. Lastly, policy recommendations for interventions within this landscape will further be made.

Keywords

Just transition, Community shared business model, Solar PV, Battery storage

Introduction

Globally, South Africa is the world's 12th largest emitter of greenhouse gasses and is heavily reliant on ageing coal-fired power stations for its electricity [1]. The transition from a carbon-based economy to a low-carbon one is driven by the global need to reduce greenhouse gas emissions and carry out the pledges made at the Conference of Parties (COP) to reach net-zero before 2050. However, this transition needs to be a "just" one aligning with the South African National Development Plan (NDP) which states that the country will move towards a 'low-carbon, climate resilient economy and just society'. This is especially required since the country is grappling with the triple challenge of inequality, poverty, and unemployment with the highest unemployment rate and the highest gini coefficient[1]. Proper planning is therefore mandatory to ensure that substantial economic losses (with further potential to trigger social unrest and violence) are not incurred by the South African economy and society at large.

Significant investment is expected to be injected into the country's economy and this is predominantly for large infrastructure projects required to decarbonise the energy sector. The draft Just Energy Transition Investment Plan (JET-IP) indicates that $82.2bn will be required from 2023 to 2027 for decarbonisation, new energy vehicles and green hydrogen [2]. For a just transition to be a success, it must have left no-one behind, however, it is already argued that the recent decommissioning of Komati Power Station has left the community behind. Decisions should be all encompassing of not only technical feasibility and prospects for environmental impacts and benefits but also social and economic imperatives of the implementation. All aspects that should be considered within these various dimensions are summarized in Figure 1 below.

Very little to no thought is being given to the creation of shared value within large infrastructure projects and community involvement and/or participation. The most significant portion of technology implementation required for net-zero targets is expected to emanate from renewable technologies coupled with battery storage. Macro-economic impact analyses of implementation of such technology in South Africa shows that the direct job creation over the lifespan of the technology is not sufficient to make up for all the jobs lost in the coal sector and this does not take into account the pay disparity for coal vs renewable jobs nor the reskilling/upskilling required. Given this and the socio-economic challenges mentioned above, creative ways of embedding unemployed and poor communities into large infrastructure projects is required to ensure a just transition and achieve sustainable development.

[1] Gini coefficient refers to the income inequality or the wealth inequality within a nation.

Figure 1: Dimensions and associated aspects considered for selection of technologies for a Just Transition (CSIR Analysis)

At present, the situation in the country is worsened by the energy crisis and increasing power cuts experienced due to ageing power stations, lack of proper maintenance and untimely implementation of the Integrated Resource Plan (IRP). Many incentives and deregulatory decisions have been made to enable embedded generation and behind-the-meter generation. An example of such is the relaxation on the generation licence requirement as part of the Schedule 2 of the Electricity Regulation Act (ERA) for the installation of any plant with any capacity as long as the installer has an offtake agreement for energy generated.

This paper discusses the implementation of a community shared business model for embedded generation, specifically solar PV with battery storage, as part of the solution to enable a just transition in communities that are economically vulnerable to the loss from coal related activities.

Community Shared Business Model

This model involves the installation of large-scale solar PV systems that may be located away from the customers in the community who make use of the power generated. The customers can purchase rights to a segment of the PV plant and its revenues or can even purchase equity or shares from the revenue generated from the plant [3]. This model can be categorised in three ways distinguishing between the following community solar business providers who capitalise on the plant [4]:

- Utility Model – where the utility owns and/or operates the plant, which is then open to voluntary ratepayers for participation,
- Special Purpose Entity (SPE) Model – where individuals join or form a business enterprise to create and manage a community shared plant and
- Non-profit Model – where a charitable non-profit corporation manages a community shared plant on behalf of its donors or members.

The framework for this business model is illustrated in Figure 2 below. This figure shows the monetary, information and electricity interactions/flows between the relevant parties.

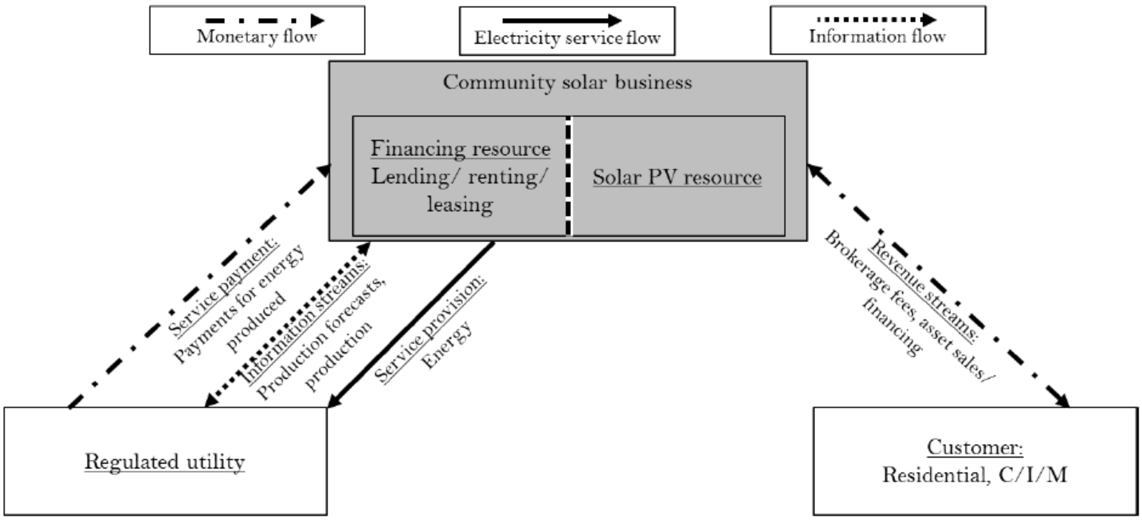

Figure 2: Community shares business model framework for solar PV [3]

The community solar business provider can earn revenues by selling the generated output to the utility, typically via a Power Purchase Agreement (PPA) and can further charge the customer/s a fixed fee for the shares they own (brokerage fees). This model can also be adopted for a community who wishes to use the energy generated for themselves or even to be distributed amongst other customers who can then be charged a discounted rate via a PPA. The community shares business model canvas (linear) is detailed in Table *1* below.

Table 1: Community shares linear business model for PV [5]

Customer side	
Value propositions	• Use of green energy without hosting the PV system • Reduced electricity bill • Decreased financial barriers and costs • Flexibility
Customer relationships	• Personal relationships • Online contact forms
Customer segments	• Residential customers • Businesses • Commercial companies who lease their buildings • Non-profit organizations • Institutional consumers (e.g. universities, military)
Channels	• Conferences, meetings • Educational programmes • House parties, community events • Websites • Sales representatives
Revenue streams	• Sale of solar bonds • Upfront payments • State incentives • Tax incentives incl. renewable energy investment tax credit and accelerated depreciation
Infrastructure side	
Key partners	• Utilities • Subcontractors (e.g. construction company) • Producers and wholesalers
Key activities	• Subscriber management • Program management incl. customer protection, data reporting, regulatory compliance • Installation • System purchase • System operation and maintenance
Key resources	• Existing customer base • IT infrastructure • Workforce (incl. sales representatives)
Cost structure	• Initial infrastructure development • Operation and maintenance • Labour and IT costs

Further considerations for implementation of this business model is the element of direct incentives being implemented to result in energy efficiency, energy savings, optimisation and effectively lower cost of supply. Some of these models include [6] time of use (TOU) tariffs to incentivise power reduction during peak periods thus reducing the energy required from the battery and charging capacity, distribution of costs and benefits based on specific usage for each customer e.g. the customer will be charged a higher tariff based on their monthly or yearly consumption, enabling peer-to-peer and peer-to-grid trading and shared distribution of costs and benefits. Implementation of such models can result in low electricity costs, reasonable NPV's, lower on-peak penalties, and maximum income via cost improvements [7].

International experiences

Community shared solar projects have experienced exponential growth in the past decade in the USA with the cumulative installed capacity increased by approximately 121% since 2010 [8]. Statistics released by the National Renewable Energy Laboratory (NREL) indicate that by the end of 2020 there were approximately 1600 community shared solar projects spread across 39 US states and Washington D.C. with a combined total installed capacity of about 3253 MW [8]. In 2020, ten states accounted for approximately 91% of the cumulative community solar capacity, of which, Minnesota, Florida, Massachusetts, and New York had the largest installed capacities. Out of the USA's 50 states, only 22 states and Washington DC have policies that support such projects; however, this did not hinder progression in states that didn't have these policies, such as Florida, Arkansas, Georgia and Texas. The US Solar Energy Industries Association estimates that a total of 5.6GW has been installed by the end of 2022 and the next 5 years will see this increase by an additional 6GW.

Community shared solar projects in the EU have also become quite popular with the government promoting it due to the direct link to the EU Green Energy deal and net-zero greenhouse gas emission targets. These types of projects have been implemented in Italy, Germany, Switzerland, Denmark and France to name a few [9, 10]. It was estimated that there were 9000 community shared plants in operation by 2022. The European commission has established 2 initiatives to disseminate information on best practices relating to these projects as well as provide technical assistance for the development of such projects i.e. Energy Communities Repository and Rural Energy Community Advisory Hub.

Enablers

The presence of supporting policy has been an enabler for the development of community shared solar projects throughout the states. Such policies include tax policies such as the business energy investment tax credit which grants a one-time tax credit of a certain percentage of the solar PV installed costs to commercial, industrial, and non-public utility owners of PV systems; the production tax credit which is a tax credit for electricity generated by solar or other qualifying renewable energy technologies for the first ten years of the system's operation [11]. Other than tax policies there are other incentives such as the modified accelerated cost recovery system which allows business to accelerate the depreciation of their investments in solar projects, this is a five year cost recovery systems accounting for the depreciation of solar PV assets over time [4]; and virtual net metering which is a bill crediting system that allows the benefits (net metering credit) of energy generation from community solar projects to be distributed to subscribers, in this scheme the energy generated by a subscriber's share of a community solar installation is sold to them at a discount and they receive credits on their electric bills when there is excess generation [4, 12].

Besides the tax credits and other financial incentives, there are other factors that encourage different stakeholders to engage in community shared solar projects including social incentives such as social cohesion, giving communities a sense of duty, and showing that alternatives to existing energy systems are feasible. Goedkoop and Devine-Wright [13] indicate that such social incentives contribute towards increasing citizen mobilization and participation and reinforce positive behavioural changes.

Barriers

A study conducted by Michaud [14] in which they interviewed multiple stakeholders from electric utility companies, government, environmental groups, and the USA solar industry found that the biggest barriers to the further implementation of community solar projects were "electric utilities, lobbying / money power, disproportionate attention, regulations, and bounded reality" in that order. It was indicated that electric utilities were the biggest barrier because these companies believe that such projects disrupt their business models and undercut their profits due to a reduction in revenue received from customers. A respondent from utility company further stated that these projects were a logistical nightmare; such a sentiment may be attributed to the complex project economics of community shared solar as Augustine and McGavisk point out that in states with low retail electricity rates and low or no incentives for solar, community shared solar projects are hard to justify unless customers are willing to pay a premium or utilities are willing to provide a sufficient subsidy [15]. Another key reason why utilities were viewed as a roadblock was their concern about cross-subsidization in which community shared solar projects might subsidize those customers who can afford to buy shares in the projects and penalize those who can't.

Other barriers to community shared solar growth highlighted by Augustine and McGavisk were a lack of access to tax credit and incentives such as the investment tax credit and modified accelerated cost recovery system because to take advantage of these requires the system owners to have a large tax basis and enough passive income which SPEs and non-profit organisations might not have, thus further incentivising utilities who might have such resources; and providing operating and mechanical barriers such as bill crediting systems for subscribers and mechanisms for transferring solar shares when subscribers move out of the vicinity of the utility which owns the community solar project [15].

Other barriers include the lack of time and resources required to develop, implement, operate, and expand their energy projects due to the fact that they are generally financed, operated and maintained by local authorities, small businesses or citizens [16]. These issues lead to a variety of barriers, such as onerous and difficult administrative processes, permitting issues, grid access and licensing issues [16].

Project examples

This section highlights some examples of community solar projects across the three major models: utility, special purpose entity, and non-profit.

1. Utility model (investor-owned) example: Bright Tucson Community Solar

Bright Tucson Community Solar is a program launched in 2011 by Tucson Electric Power, it was the first community solar project to be developed and financed by an investor-owned utility in the USA [17]. The program started out with a 1.6 MW solar array installed at the University of Arizona Science and Technology Park. The project sought to provide access to solar energy to customers who could not afford to invest in rooftop solar PV, those who were inhibited by not owning their own properties (i.e., those living in condominiums, multi-family housing, businesses renting commercial space, etc.), and those whose roofs were not appropriate for the installation of solar PV. The scheme allowed customers to purchase as a basis solar energy “blocks” of 150 kWh per month but allowed discretion to purchase more depending on their monthly energy consumption. Upon purchase of a “block” customers would the receive an offsetting discount to the power purchase and fuel charge as well as renewable surcharge on their monthly bill. This provided a much cheaper way of accessing renewable energy compared to investing in rooftop solar PV as there were no capital costs and the subscription model allowed customers the flexibility to opt out at any point; the program’s solar tariff only added two cents per kWh to a customer’s average rate.

Besides exempting customers from surcharges that are otherwise levied on other electricity usage and offering a more affordable way to invest in renewable energy, other value propositions of the project were (1) providing protection against future energy cost increase because the solar block rate was locked for 20 years; (2) no long-term contracts, and (3) contribution towards decarbonisation of energy generation.

Between 2011 and the first half of 2014, the number of customers had grown by 132.7% from 532 to 1238 customers, and the amount of energy that had been purchased grew from 334 MWh to 3340 MWh, a ten-fold increase [17]. By 2016 program had a total installed capacity of 23 MW servicing different types of customers as follows:

- 5 MW for subscribed to by 1238 residential customers,
- 3 MW subscribed to by 10 commercial customers, and
- 15 MW subscribed to by a city and county customer.

When the program was launched in 2011, power purchase agreements for solar energy in Arizona were between 12 cents/kWh to 14 cents/kWh [18]. During this period Tucson Electric Power had to invest in solar energy to comply with the renewable energy standard which their customers were paying towards. Through financing their first 1.6 MW PV solar installation, Tucson Electric Power were able to use a levelized investment tax credit which would have been approximately US$1.92 million[2]. Furthermore, they secured the renewable energy credits from the projects under the Bright Tucson Community Solar program.

2. *Utility model (municipality-owned) example: SolarShares*

The SolarShares program was launched in 2008 by the Sacramento Municipal Utility District, a public power utility and was the first to offer a subscription-based model [18]. The districts business model was to purchase solar power output from local, community-scale PV systems under 20-year PPAs and then resell the solar power to the program's subscribers. The value proposition to customers were providing access affordable to renewable energy generation, providing virtual net metering benefits like those of rooftop solar PV systems in the form of bill credits, and hedging against future rate increases by locking the rate upon subscription to the program.

The program's first installation was a 1 MW system which produced 1745 MWh per year and, in the first year, 86% of this energy was sold to the program's participants. The program's is reported to have had a enrolment of about 600 subscribers from 2008 to 2011 [4].

Subscribers had to pay a fixed monthly fee based on their average monthly consumption and the capacity of solar they required (between 0.5 to 4 kW), the premium rate of the program was 14.9 cents/kWh which was 4.4 cents/kWh more than the district's retail rate of 10.5 cents/kWh at the time [18]. For their monthly fee, participants would receive energy credits for the estimated output of their solar PV subscription [4].

3. *Non-utility model example: Edinburgh Community Solar Cooperative (ECSC)*

ECSC is a UK Community Benefit Society that was established in 2013 with the aim of installing solar PV panels on 25 buildings owned by City of Edinburgh Council (CEC) and Edinburgh Leisure; it also aims to provide local residents with an opportunity to invest in renewable energy generation. ECSC is currently the largest community-owned solar rooftop project in Scotland [19]. Thus far the co-op has had two project phases: phase 1 (2015) in which £1.46 million was raised to install 1.38MW of solar panels across 24 buildings and phase 2 (2019) in which £660,000 was raised to install 0.9MW of solar panels on six buildings. For both phases, the co-op raised funds via a public share offering of £1 per share. In the share offerings, Edinburgh locals were prioritised and in phase 1 over 70% of the shares were purchased by locals [20].

The installations generate about 1.5GWh of renewable electricity per annum [21]. The energy generated is sold for own consumption by the buildings on which they are installed under a fixed rate (power purchase agreement) for 20 years, income is earned from the feed-in tariff (FiT) scheme with 20% of total generation in excess being sold through the wholesale market [19]. Profits were repaid to shareholders/members at an interest rate of 5% for phase 1 and 4.5% for phase 2. Table 1 shows an example of returns for a £1,000 investment in phase 2. The rest of the profits are allocated to the Community Benefit Fund which seeks to promote environmental/sustainability education, environmental improvements to buildings, support initiatives that address fuel poverty, etc. [22]. In 2018, the net surplus from the scheme was £10,000, down from £23,000 in the previous year. At the end of each phases' 20-year PPA agreement with the Council and once shareholders have been paid off, the solar panels will be handed over to the Council for free. This project is indeed a flagship example of the distributional benefits that arise from community solar projects.

[2] ITC value = ITC rate (%) x Installed capacity (W) x Installed cost (US$/W)

Table 2: Example of shareholder returns throughout phase 2 for a for a £1,00 investment. Source: ECSC Phase 2 offer [19]

	Year 1*	Year 2	Year 3	Years 4 – 16	Years 17 – 20	Total Return
Share Interest (£)	30	45	43	342	29	**448**
Capital Returned (£)	0	52	52	676	221	**1,000**
Capital Balance (£)	1,000	948	896	221	0	
Annual Share Interest Rate (%)	4.5	4.5	4.5	4.5	4.5	

* Year 1 annual share interest is for 1 January 2021 to 30 September 2021.

Financial analysis of community shared solar and LMI subscriber participation

In 2018, NREL conducted a study to assess the cost of low-and-moderate-income (LMI) customer participation in community solar projects [23]. The study was done for six states - Connecticut, Minnesota, New Mexico, Oregon, Rhode Island, and the District of Columbia - using the *Community Solar Business Case Tool* [24]. The assumption was that the community solar projects would be owned by a third-party developer and the subscribers would pay a monthly panel lease fee and would receive monthly bill credits for the generation of their share (similar to the Bright Tucson Community Solar project mentioned above). The study developed three scenarios for the subscriber composition as shown in Table 1. In these scenarios, the subscribers would receive a 10% discount on the panel lease fee. The goal of the developer would be to attain a modified internal rate of return (MIRR)[3] of at least 10%.

Table 3: Community solar project customer composition across the three modelled scenarios. Adapted from NREL [23].

Scenario	LMI	Anchor Subscriber**	Non-LMI
1 – with an anchor subscriber	20%	40%	40%
2 – without an anchor subscriber	20%	-	80%
3 – without an anchor subscriber, subscriber breakeven	20%	-	80%

**An anchor subscriber is a large-scale off-taker such as business, commercial park, local government building etc.

As an illustration, the results for setting up a community solar project in Albuquerque, New Mexico were produced. The model assumptions and inputs used are tabulated in Table 2.

Table 4: Model inputs and assumptions for Albuquerque, New Mexico. Adapted from NREL [23].

Parameter	Value
System size – DC (kW)	1,000
Panel size (W)	300
Panels per subscriber	10
Installation type	Ground mount
System life (years)	25
Total installed cost ($/W)	1.58
Annual site lease ($/year)	7,500

[3] The MIRR assumes that positive cash flows are reinvested at the firms cost of capital **Invalid source specified.**. Compared to the traditional IRR, it more accurately reflects the financial attractiveness of an investment/project.

Operation and maintenance cost ($/kW/year)	15
Annual subscriber retirement/acquisition rate (%)	1.5
Panel lease escalation rate (%)	2
Annual energy cost escalation rate (%)	2.76
Federal tax credit (% ITC)	30
Tax rate for Modified Accelerated Cost Recovery System (%)	21

The annual generation output of the system modelled was found to be 1,579kWh/kW. The results for the three scenarios as summarised in Table 3 illustrate the importance of the participation of an anchor subscriber in a community solar project for other types of subscribers (LMI and non-LMI). In the presence of the anchor subscriber, the developer charges cheaper panel leasing fees and LMI and non-LMI subscribers accrue significant financial benefits as shown by the positive NPV, MIRR of 10%, positive NPV, and payback period of 8.2 years. However, this is not the best scenario for the developer, in the absence of an anchor the developer can increase the panel leasing fee as shown by the 54% increase in scenarios 2 and 3. This allows the developer to attain its financial objectives with a higher MIRR, NPV, and shorter payback period than scenario 1. However, scenario 2 is not attractive to the subscribers as it results in a negative NPV for them. Figure 3(b) shows the cumulative losses accrued by subscribers over a 25-year timeframe in the case of participating in a scenario 2 community solar project.

Table 5: Results of the three modelled scenarios.

	Scenario 1	**Scenario 2**	**Scenario 3**
Bill credit rate ($/kWh)	0.1192	0.1192	0.1453
Monthly panel lease for non-LMI ($/panel)	3.89	6	6
Annual panel lease for non-LMI ($/year)	467	720	720
Non-LMI First Year Savings ($)	98	-155	-31
Monthly panel lease for LMI, 10% discount ($/panel)	3.50	5.4	5.4
Annual panel lease for LMI ($/year)	420	648	648
LMI First Year Savings ($)	144	-83	40
Subscriber NPV ($)	1,319	-1,367	6
Developer NPV ($)	493,200	1,366,151	1,366,151
Developer MIRR (%)	10	12	12
Developer Payback Period (years)	8.2	5.5	5.5

To make the value proposition attractive to non-anchor subscribers, the developer can maintain the same panel leasing fees as in scenario 2 but their monthly bill credit rate would need to increase to $0.1453/kWh. This allows the developer to enjoy the same benefits as in scenario 2 whilst allowing the subscribers to eventually breakeven and accrue positive benefits from their participation in the project. Figure 3(c) illustrates the cumulative cash flows of the subscriber in this scenario.

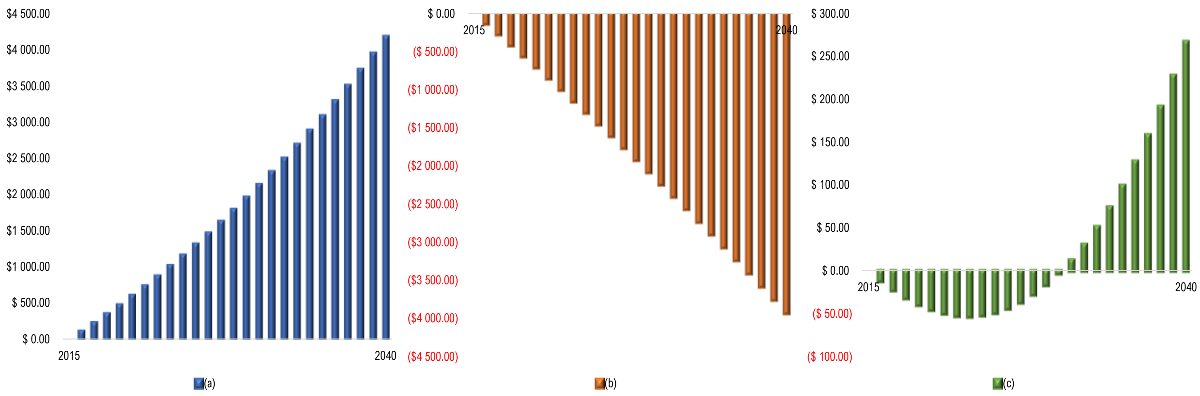

Figure 3: 25-year cumulative subscriber cash flows accross all three scenarios: (a) scenario 1, (b) scenario 2, (c) scenario 3.

Comparison of profitability of utility model community solar projects

Research conducted by NREL in 2020 to assess the financial benefit of community solar projects using the difference between credits provided to users and payments made by consumers. The net present value (NPV) was used for this comparison. The study indicated that NPVs vary by the type of utility and the state in which the projects were located [25]. Furthermore, the results showed that investor-owned utility projects had a higher value proposition by having a positive NPV compared to municipal/public and electric cooperative utility projects. These results indicate that there is financial benefit when subscribers save money throughout their subscription period compared to not subscribing.

Local context

It is evident that community shared renewable projects can aid with various social, environmental and economic benefits. In the local context these benefits are as follows [26, 3, 4]:

- There are no upfront costs for the participants in the shares model as only the solar business provider will have to obtain funding for the installation and maintenance of the system. The participants will only require funds for the purchasing of shares and brokerage fees,
- Job creation and capacity building for the community can be leveraged for construction and maintenance work required,
- Reduced electricity costs,
- Reduced crime due to job creation and increased economic growth,
- Increased renewable penetration for net-zero targets and climate action. This can also assist with the current energy crisis in the country,
- Increased provision of ancillary services and demand response required (when designed for),
- The finances for the plant need not come from one individual. Furthermore, the participants are considered to be well-known to each other and have a close and trustworthy relationship,
- The utility or company that manages and develops the plant can benefit from tax credits/offsets and other tax benefits for green energy. South African Revenue Services (SARS) Income Tax Act 58 of 1962 Section 12B(1) and (2) [27] essentially decreases the companies tax liability by the same value of the capital paid to install the solar system. This results in a discount of 28% of the capital cost for installation. The recent energy crisis has resulted in

further tax benefits for companies who install renewable projects with a possibility of receiving 125% of the cost of the system back in tax relief,

- A company may write-off or fully depreciate the cost of a solar PV asset within 5 years as per SARS Income Tax Act Section 58 of 1962 Section 11E and
- Wheeling of electricity can allow customers in areas with low irradiation levels to benefit from green energy generated in a community where the solar resource is more attractive.

Some issues that can be faced when implementing this model include the allocation of tax credits and any other incentives between the participants of the community shared plant. This needs to be identified and catered for when developing the legal framework for the model. Furthermore, support from the government with respect to technical support and funding opportunities are equally important to remove barriers to project development.

Other technical issues that can occur are related to the setup of proper billing systems, installation of compliant equipment according to applicable standards, monitoring of data and cyber-security issues that can occur, grid access in areas with reduced grid availability, lack of proper wheeling frameworks and ensuring proper operating and maintaining procedures. The establishment of a distribution market operator and distribution system operators is seen as a key enabler for this model to unlock all financial capabilities for these projects. The aggregator business model which includes community shared projects can also be adopted to increase revenue streams.

Conclusion

This paper highlights findings obtained from a literature review which was aimed at understanding what benefits, enablers and barriers are experienced when pursing the installation of community shared renewable and battery storage systems. These were then evaluated for the South African context. Internationally, the US and EU have made much progress in unlocking and enabling this market. The implementation of these projects have introduced lessons learnt and highlighted the major enablers that should be considered when implementing these projects in developing countries such as South Africa.

In South Africa, it is evident that adoption of community shared projects can bring about many benefits. The notable benefits include job creation and capacity building for the community, reduced electricity costs and tariff elasticity, increased economic growth, increased renewable penetration for net-zero targets and climate action, and increased provision of ancillary services and demand response required. However, significant enablers for development include proper regulatory frameworks, technical skills and capacity, access to finance mechanisms and in some cases proper wheeling frameworks. The tax regimes and incentives that can be accessed within such a model would also need to be clearly stipulated and incorporate easy processes for access. Larger private sector institutes could consider implementation of such projects to assist with meeting corporate social responsibility requirements. Furthermore, the development of distribution system operators, development of distribution market operators, proper design and selection of business model, feed-in-tariffs, firm intent and availability of funds to ensure the project runs throughout its life, government subsidies and proper analysis to ensure that the community is benefitting from the project via just and equitable energy tariffs is critical to successful implementation of these projects that have a positive impact on the community.

In the context of the just energy transition in South Africa, such projects should be pursued and included in the Just Energy Transition Investment Plan (JET-IP) and the discussions within the Just Energy Transition Partnership (JETP). Since there will be communities that may be left behind due to lack of development in large-scale renewables but decommissioning of coal power stations and closure of coal mines, these projects can add shared value creation, assist with economic and social vulnerability and assist the country in dealing with the triple challenge of unemployment, poverty and inequality.

Bibliography

[1] "South Africa the 12th biggest source of greenhouse gases? Yes, but that's not the only measure that matters," Polity, 2021. [Online]. Available: https://www.polity.org.za/article/south-africa-the-12th-biggest-source-of-greenhouse-gases-yes-but-thats-not-the-only-measure-that-matters-2021-04-19.

[2] S. A. Presidency, "South Africa's Just Energy Transition Investment Plan," 2022.

[3] S. Burger and M. Luke, "Business models for Distributed Energy Resources," Massachusetts Institute of Technology, 2016.

[4] J. Coughlin, J. Grove, L. Irvine, J. F. Jacobs, S. J. Phillips, A. Sawyer and J. Wiedman, "A Guide to Community Shared Solar: Utility, Private, and Nonprofit Project Development," Bonneville Environmental Foundation, 2012.

[5] D. Horváth and R. Z. Szabó, "Evolution of photovoltaic business models: Overcoming the main barriers of distributed energy deployment," *Renewable and Sustainable Energy Reviews,* vol. 90, p. 623–635, 2018.

[6] N. Narjabadifam, J. Fouladvand and M. Gül, "Critical Review on Community-Shared Solar—Advantages, Challenges, and Future Directions," *Energies,* vol. 16, no. 3412, 2023.

[7] N. Narjabadifam, J. Fouladvand and M. Gül, "Critical Review on Community-Shared Solar—Advantages, Challenges, and Future Directions," *Energies,* vol. 16, no. 3412, 2023.

[8] J. Heeter, K. Xu and G. Chan, *Sharing the Sun: Community Solar Deployment, Subscription Savings, and Energy Burden Reduction,* NREL, 2021.

[9] E. Commision, "Community Energy Projects: Europe's Pioneering Task," [Online]. Available: https://climatepolicyinfohub.eu/community-energy-projects-europes-pioneering-task.html.

[10] HivePower, "Community Solar Projects in Europe," [Online]. Available: https://www.hivepower.tech/blog/community-solar-projects-in-europe#:~:text=Community%20solar%20project%20in%20Europe,a%20solar%20array%20of%20energy..

[11] DOE, "Federal Solar Tax Credits for Businesses," Department of Energy - Office of Energy Efficiency & Renewable Energy, March 2023. [Online]. Available: https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses.

[12] M. Mooney, "Virtual Net Metering: What is it? How does it work?," EnergySage, 27 October 2022. [Online]. Available: https://news.energysage.com/virtual-net-metering-what-is-it-how-does-it-work/.

[13] F. Goedkoop and P. Devine-Wright, "Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects," *Energy Research & Social Science,* vol. 17, pp. 135-146, 1 July 2016.

[14] G. Michaud, "Perspectives on community solar policy adoption across the United States," *Renewable Energy Focus,* vol. 33, pp. 1-15, 1 June 2020.

[15] P. Augustine and E. McGavisk, "The next big thing in renewable energy: Shared solar," *The Electricity Journal,* vol. 29, no. 4, pp. 36-42, 1 May 2016.

[16] E. Commission, “In focus: Energy communities to transform the EU’s energy system,” [Online]. Available: https://energy.ec.europa.eu/news/focus-energy-communities-transform-eus-energy-system-2022-12-13_en.

[17] The Edison Foundation, “IEI Case Study: Bright Tucson Solar Program,” The Edison Foundation, 2014.

[18] D. Chwastyk and N. Esch, “Community Shared Solar in Real Life: A summary of interviews with utility program administrators at nine community shared solar programs and surveys of subscribers,” Dominion, 2016.

[19] Edinburgh Community Solar Co-operative, “Edinburgh Community Solar Co-operative - Phase 2 Share Offer,” Edinburgh Community Solar Co-operative (ECSC), Energy4All, Edinburgh, 2019.

[20] Local Energy Scotland, “Cares Case Study - Edinburgh Community Solar Co-operative,” Local Energy Scotland, Edinburgh, 2023.

[21] Edinburgh Community Solar Co-operative, “Edinburgh Community Solar Co-operative - History,” [Online]. Available: https://www.edinburghsolar.coop/about-us/history/.

[22] Edinburgh Community Solar Co-operative, “Community Fund,” 2023. [Online]. Available: https://www.edinburghsolar.coop/community-fund-2/.

[23] K. Kiatreungwattana, L. Bird and J. Heeter, *Modelling the Cost of LMI Community Solar Participation: Preliminary Results,* National Renewable Energy Laboratory, 2018.

[24] West Monroe Partners, Elevate Energy, *Community Solar Business Case Tool,* Cook County, Illinois, 2017.

[25] J. Heeter, E. O'Shaughnessy and G. Chan, *Sharing the Sun: Understanding Community Solar Deployment and Subscriptions,* NREL, 2020.

[26] C. Migisha, “Opportunities and Challenges for Distributed Generation with Rooftop Photovoltaic (PV) for Uganda: A case study of Crusader House, Kampala,” University of Witwatersrand, 2018.

[27] SARS, “Binding Private Ruling: BPR 311,” 2018.