IRENA coalition FOR ACTION

COMMUNITY ENERGY BENEFITS

POWERING UNIVERSAL WELLBEING

ISBN: 978-92-9260-638-1

Citation: IRENA Coalition for Action (2024), *Community energy benefits: Powering universal wellbeing*, International Renewable Energy Agency, Abu Dhabi.

About the Coalition

The IRENA Coalition for Action brings together leading renewable energy players from around the world with the common goal of advancing the uptake of renewable energy. The Coalition facilitates global dialogues between public and private sectors to develop actions to increase the share of renewables in the global energy mix and accelerate the energy transition.

About this publication

This white paper has been developed jointly by members of the Coalition's Working Group on Community Energy. The Community Energy Working Group brings together a diverse range of stakeholders united by the goal of empowering communities and citizens to participate in the energy transition. This white paper details how community-led renewable energy projects can unlock multiple benefits across economic, social and environmental dimensions.

Acknowledgements

Contributing authors: Ayu Abdullah, Sonia Luhong Wan (COMET); Sebastian Helgenberger (former IASS); Kanak Gokarn, David Jacome-Polit (ICLEI); Namiz Musafer (Integrated Development Association Kandy); Shota Furuya (Institute for Sustainable Energy Policies); Kelly Trumbull, Igor Vejnovic (The Nature Conservancy); Eman Adel, Akram Almohamadi, Maged Mahmoud (RCREEE); Alexandros Fakas Kakouris (RGI); Namrata Ginoya, Vandita Sahay (WRI); Stefan Gsänger (World Wind Energy Association); and Giedre Viskantaite under the guidance of Raúl Alfaro-Pelico (IRENA)

Further acknowledgements: Valuable review and feedback were provided by Janet Milongo (CAN International), Monica Oliphant (ISES), Andrea Wainer (REN21), Ira Shefer, Andrzej Ceglarz (RGI), Ute Collier, Celia García-Baños, Jarred McCarthy, Ilina Radoslavova Stefanova, Mirjam Reiner, Michael Renner, Ntsebo Sephelane, and Kamran Siddiqui (IRENA)

The report was edited by Justin French-Brooks. Publications and editorial support were provided by Francis Field and Stephanie Clarke. Design was provided by Myrto Petrou.

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Abbreviations

DRE	decentralised renewable energy
DSO	distribution system operator
SDG	Sustainable Development Goals
TSO	transmission system operator
WWEA	World Wind Energy Association

Executive summary

As the world grapples with the interrelated challenges of climate change, inequality and geopolitical tensions, it is imperative to rethink the way our societal and economic structures work. Complex problems demand holistic solutions. Future energy systems must not only be renewables-based, but also inclusive and resilient. This requires active citizen participation in addition to universal access to affordable and reliable energy services (IRENA, 2023a). Community energy, defined as the economic and operational participation in and/or ownership of energy projects by citizens, emerges as a vital component of future energy systems designed to tackle these challenges.

This paper highlights why countries should pursue community energy to achieve their goals of tripling renewable energy capacity by 2030 in a just and inclusive manner. Community ownership and involvement from project inception to operation can deliver multiple benefits across social, economic and environmental dimensions. In addition, citizen ownership ensures that these benefits are shared more widely and equitably. Active measures and policies are essential to ensure that these benefits are fully realised.

Widespread citizen support is central to a rapid energy transition.

Community energy based upon the participation of local stakeholders is not only inherently more accepted, but also fosters active citizenship and social cohesion. Such initiatives are well placed to ensure fair representation in ownership and decision-making. Fairness, transparency and equitable distribution of costs and benefits must guide decision-making processes to gain stakeholders' trust and engagement. This requires tailored strategies developed with consideration for gender, low-income households and marginalised communities.

National energy plans and policies should prioritise community ownership and citizen involvement.

Supportive regulatory frameworks are necessary to remove barriers to community energy initiatives. Auction schemes that tend to exclude smaller investors should incorporate non-financial criteria to create a level playing field for community energy initiatives. Simplified and flexible regulations for ownership, permitting, licensing, tariff setting and selling excess electricity are essential. Additionally, communities should be able to benefit from local projects, such as by owning a stake in them.

It should become standard practice for energy projects to prioritise advancing community well-being and maximise socio-economic benefits.

The energy project assessment should go beyond technical and financial parameters, taking into account local social performance, and community needs and preferences. This includes fostering local economic value creation and employment, promoting community cohesion, and maintaining a healthy natural environment. Facilitating community ownership of energy projects and associated infrastructure is crucial. It not only fosters public support, but also creates optimal incentives for integrating renewable energy generation, energy efficiency and affordability objectives.

A secure and affordable energy supply is a precondition for development and well-being.

Decentralised renewable energy projects owned by communities can deliver affordable and reliable energy services in remote areas. Community energy can contribute to achieving universal energy access and increase local energy security by reducing reliance on imported energy with fluctuating costs. Given their decentralised nature and local management, community energy initiatives can also reach those most in need in conflict-affected areas.

The energy system's resilience and capacity to adapt to climate change is increasingly important.

With ever-increasing climate change pressures, involving communities more actively in the energy system early on ensures that adaptation measures function effectively and are better suited to local needs. Decentralised renewable solutions that can be operated independently from the central system strengthen resilience and facilitate a more rapid recovery in the face of any such shocks.

Renewable energy developments must prioritise the protection of nature, biodiversity and local culture to achieve true long-term sustainability and climate goals.

By siting renewable energy in a manner that supports ecosystem conservation and aligns with local values and preferences, negative environmental impacts can be minimised and land conflicts mitigated. Local communities are the most effective stewards of the environment because they possess a knowledge of their ecosystems and the motivation to preserve them for themselves and future generations. Community-owned renewable energy projects are well placed to incorporate this local knowledge, leading to the identification of sustainable approaches.

Recognising the social value of community energy, it is crucial to facilitate access to finance.

Innovative financing options can derisk projects and allow marginalised communities to participate. Leveraging digital tools can streamline the pooling of citizen funds, while risk-sharing mechanisms and public–private partnerships can increase funding and lower the cost of capital. Aggregating smaller projects can reduce overall costs and make them more attractive to larger investors.

Introduction

While the effects of climate change are increasingly evident, the world is not on track to achieve global climate goals and deliveran energy transition that ensures affordable, reliable, sustainable and modern energy for all in line with Sustainable Development Goal 7. Bold action is needed not only to tackle the climate crisis, but also to address widespread injustices within the world's energy systems. Over a quarter of the global population lacks access to clean cooking and 8% still live without electricity (IEA *et al.*, 2024). Numerous households in both developed and developing economies are struggling with their energy bills. Community energy can play an important role in accelerating the deployment of renewables while generating local socio-economic benefits, giving more decision-making power to citizens and thus increasing public support for local energy transitions.

Climate-resilient development is achieved when governments, civil society and the private sector make inclusive decisions prioritising risk reduction, equity and justice (IPCC, 2022). This requires building partnerships with traditionally marginalised groups, including women, youth, indigenous peoples, local communities and ethnic minorities. For the successful deployment of renewable energy, it is necessary to give due consideration to its interconnections with socio-economic and environmental systems.

Community energy is defined as the economic and operational participation in and/or ownership of an energy project by citizens or members of a defined community, in other words as a locally owned and/or controlled project (IRENA Coalition for Action, 2018). A community energy initiative incorporates at least two of the elements in Figure 1.

Figure 1 **Elements of community energy initiative**

Source: (IRENA Coalition for Action, 2018).

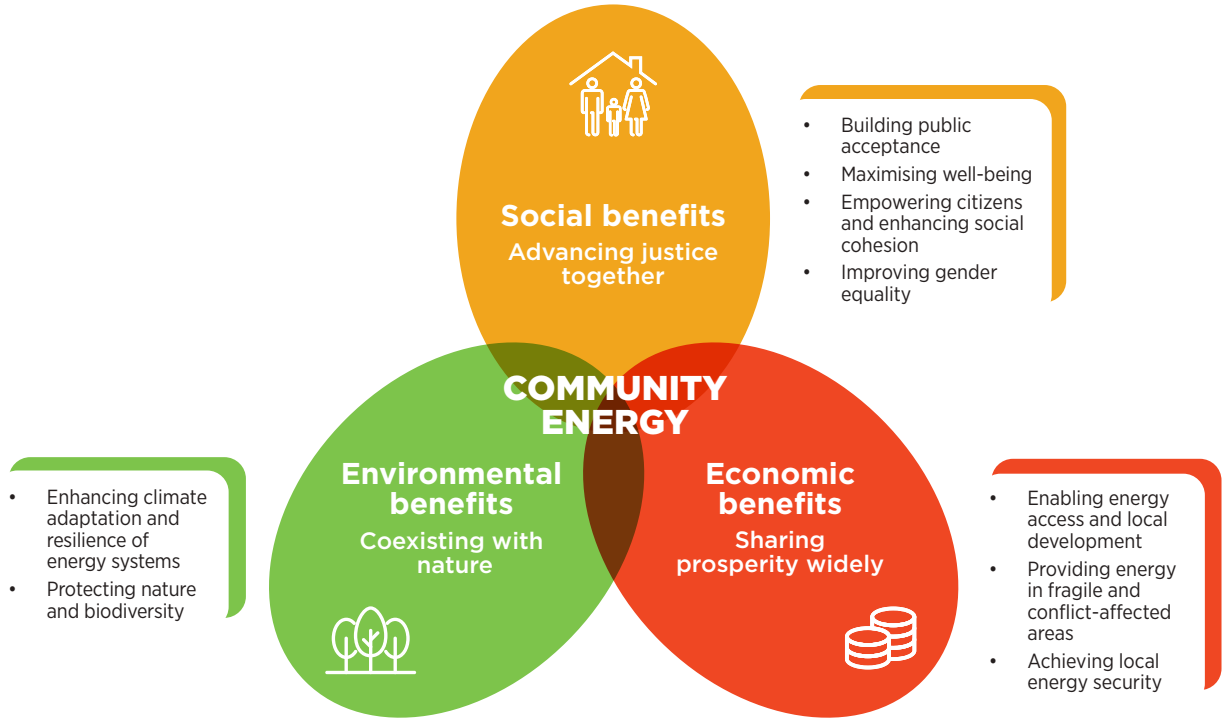
Community energy provides an alternative or a supportive model to the traditionally dominant state-owned or private energy utilities. It can play a substantial role in the energy system by allowing citizens to own a considerable share of renewable energy projects and supporting infrastructure. Beyond increasing renewable energy supply, it can provide multiple social, economic and environmental benefits and ensure that these benefits are shared more widely. As described in this paper, these potential benefits range from broader public support and the inclusion of traditionally marginalised groups, to revitalised economies, improved energy security and increased resilience.

This paper details these benefits and how they can be achieved by pooling the IRENA Coalition for Action Community Energy Working Group's knowledge and on-the-ground expertise. The list of benefits presented is by no means exhaustive. The benefits of community ownership and engagement highlighted in this paper were selected to address current key challenges, set against the backdrop of the climate emergency, energy crisis and political instability. Each section can be read as a standalone article, articulating how community involvement and ownership can serve as foundational pillars for achieving just and inclusive energy transitions. Numerous case studies in this paper illustrate that the benefits are often interrelated, creating positive feedback loops.

The tools, insights and examples build the case for a more prominent role for community energy in energy systems. This paper provides recommendations for policy makers on how to pursue these benefits while choosing energy transition pathways that meet the specific needs of citizens and communities.

The first section delves more deeply into the social aspects of community energy, including public acceptance and support, well-being, citizen empowerment and gender aspects. Following this, the second section examines the economic benefits of community energy, such as providing energy access, including in conflict-affected areas, enabling local development and enhancing local energy security. The third section analyses the intricate connection between community energy and the environment, highlighting how the capacity for adaptation and resilience can be enhanced while developing renewable energy in line with environmental and biodiversity protection goals. The fourth section outlines approaches to increasing financing for community energy, while the fifth section examines community support for the energy transition infrastructure. The sixth section enumerates barriers to and enablers of community energy and a participatory and inclusive approach. Figure 2 summarises the selected benefits across social, economic and environmental dimensions.

Figure 2 **Community energy benefits across social, economic and environmental dimensions**



01

Social benefits: Advancing justice together

This section underscores the transformative potential of community energy initiatives to empower citizens by giving them a voice and a stake in the energy transition. The first part details how active community involvement builds acceptance and support. Section 1.2 builds the case for energy projects to prioritise holistic well-being in addition to financial and technological objectives. Section 1.3 elaborates on how community energy empowers individuals and improves social cohesion. Finally, the importance of gender equality is highlighted, outlining barriers and potential solutions in Section 1.4. Together, these aspects underscore the vital role of community energy in creating a more sustainable and inclusive energy future.

1.1 Building public acceptance

Public acceptance refers to the level of approval or support that a community demonstrates towards a particular project or policy. Without public acceptance, renewable energy projects face opposition and resistance, which can hinder their progress and successful deployment. For instance, public opposition to nuclear energy in Germany has played a significant role in shaping national energy policy, while community opposition is considered one of the leading causes of large-scale wind or solar project cancellations in the United States (Berkeley Lab, 2024).

In understanding public acceptance, three dimensions have often been referred to: socio-political acceptance, market acceptance and community acceptance (Rolf Wüstenhagen *et al*., 2007). While socio-political acceptance refers to broad approval for energy technologies and policies, community acceptance is concerned with the direct impacts of energy developments. Although these three dimensions are interconnected, community acceptance of a particular energy project emphasises the importance of **procedural justice, distributional justice** and **trust** as fundamental elements for garnering support.

Procedural justice implies fairness and impartiality in the planning and decision-making processes (Suboticki *et al*., 2023). People are more likely to accept the outcome of a process when they feel that they have been treated fairly and with respect and that decisions were made in a transparent, inclusive and unbiased manner. Conversely, when people feel that planning and decision-making procedures were unfair and they were not able to influence the formation of the project, they may not support the outcome, or even oppose the project actively.

Distributional justice refers to the idea that resources, opportunities, risks, costs and benefits should be distributed equitably among stakeholders. While successful community energy projects can generate a variety of social and economic benefits, it is important to discuss, define and implement distribution arrangements proactively so that stakeholders can take the risk and enjoy the benefits as appropriate to the local context (Karytsas and Theodoropoulou, 2022).

Community dialogue in Hokkaido, Japan

An essential prerequisite for the realisation of these two types of justice in a concrete project is the establishment of **trust** among stakeholders (Goedkoop and Devine-Wright, 2016). Trust influences public acceptance across all aspects, and requires communicating with a wide range of local stakeholders from the initial planning stages of the project, giving due consideration to the unique local context when selecting technology, location and scale, and emphasising financing by local stakeholders and/or local financial institutions.

Community energy projects formed with the active participation of local stakeholders create the conditions to achieve just procedural and distributional outcomes, thereby building trust and achieving high levels of public acceptance. When people have a stake in a project, they are more likely to support and promote it to others and invest their time and resources.

There are many examples of community energy that are actively supported by broader stakeholders. Case studies in previous reports published by the IRENA Coalition for Action Community Energy Working Group (for example, IRENA, 2021) have shown that the combination of local problem-solving efforts and community energy initiatives has resulted in active support from local people for renewable energy projects. These projects have been continuously supported with contributions from people who seek to foster climate solutions, or by those who value being involved in decentralised and democratic decision-making processes to achieve the energy transition by participating in energy co-operatives. A survey in Scotland that compared different ownership structures suggests that community energy achieves greater public acceptance than privately owned projects because participants have more opportunities for fair involvement (Hogan, 2024). Community energy is therefore more than acceptance: it is also about ownership, control and sharing benefits.

1.2 Maximising well-being and social benefits

Beyond ensuring broad public acceptance, governments should aim for a more systematic approach to assessing how an energy project can maximise value to the community in which it operates. A participatory approach and local ownership can address the unique needs, values and aspirations of diverse social groups, and incorporate their views in decision-making. This can help to tap into the social opportunities of switching to renewable energy and accelerating the decarbonisation of the energy sector.

The Paris Climate Agreement and the 2030 Agenda for Sustainable Development, with its Sustainable Development Goals (SDGs), are important global frameworks for improving livelihoods and increasing opportunities for current and future generations. However, they lack the community ownership and inclusivity elements that are essential to achieve a just energy transition and prevent global climate breakdown.

Transition in the energy sector is still mostly seen through a technological lens, focusing on innovation and a shift in supply sources (Renn *et al*., 2020; Setton, 2020). Often, the social dimension of the energy transition is limited to the question of whether communities would accept renewable energy developments. This perspective overlooks the need to generate broad agency – the ability to act and influence decisions. For instance, Denmark has accelerated the development of wind power, meeting over half of its electricity demand through policies that enable citizens to have a financial stake in these projects. The Promotion of Renewable Energy Act, which entered into force in 2009, requires that renewable projects must offer at least 20% ownership to local residents (Danish Ministry of Climate, Energy and Supply, 2008).

A social performance approach refers to social impacts on the well-being of communities during the development and implementation of energy projects and the usage of locally generated energy, in both monetary and non-monetary ways. Broad political and economic ownership maximises social opportunities and prevents conflicts and community unrest. This social sustainability approach requires co-operation and public support for an intervention (Setton, 2020), preserving specific values, such as intra- and inter-generational equity and human rights (Widok, 2009).

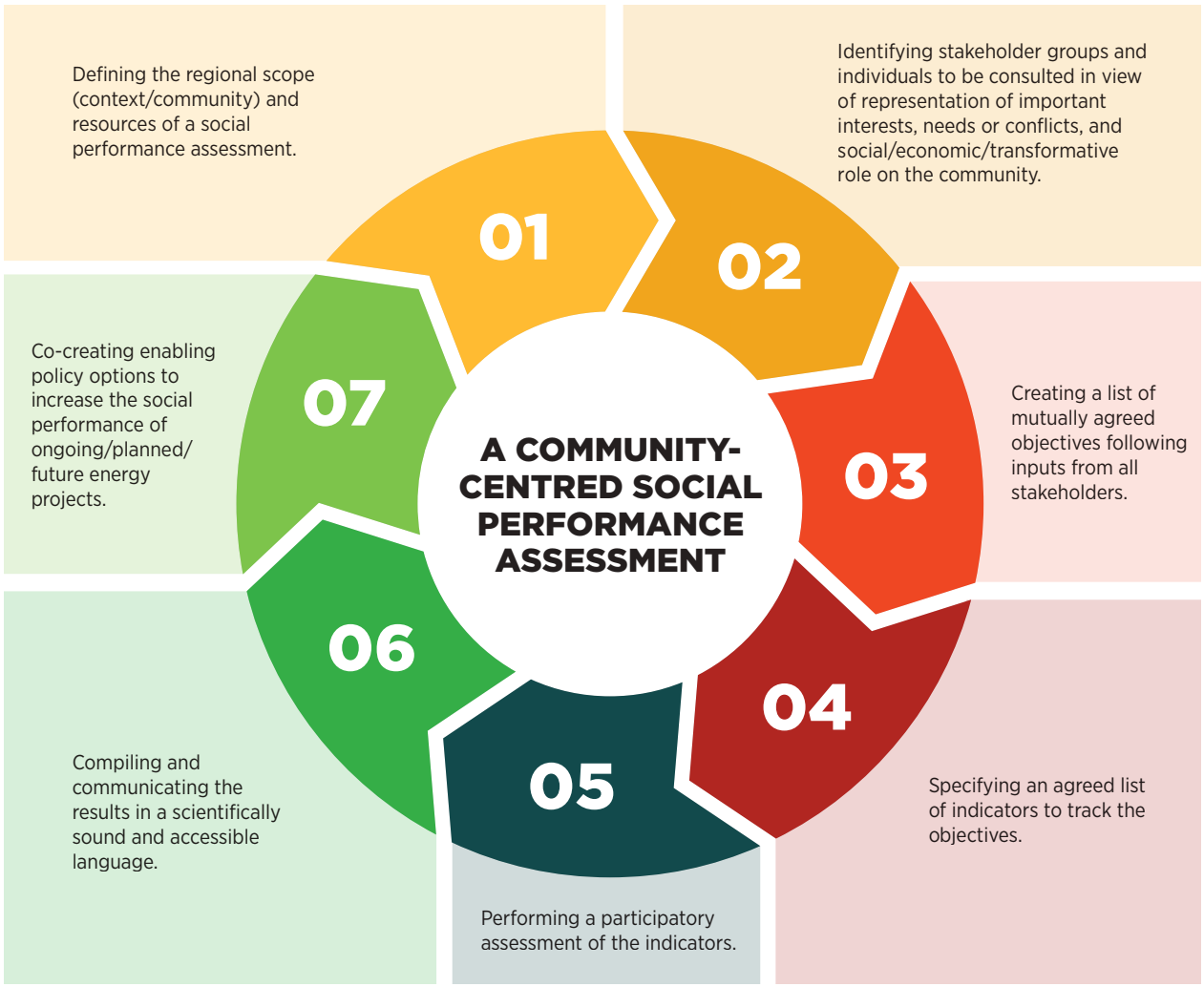
Understanding the social performance of climate action highlights the opportunity for socio-economic co-benefits, allowing policy makers to simultaneously meet several objectives such as creating employment and achieving health cost savings while reducing greenhouse gas emissions (Helgenberger *et al*., 2019). While climate debates have centred discussion on fairly distributing socio-economic costs within and across generations and regions, the co-benefits discourse changes the narrative "from burden-sharing to opportunity-sharing" (Helgenberger and Jänicke, 2017).

Job numbers or health cost savings have been examined in numerous studies, which facilitates their connection to specific political agendas and socio-economic interests (IASS and TERI, 2019; IASS *et al*., 2020; IRENA and ILO, 2023). In line with the co-benefits narrative, the social performance approach entails making quantifiable and policy-directed assessments to reconcile socio-economic priorities with climate action, thereby requiring active community participation (Mbungu and Helgenberger, 2021).

1.2.1 Operationalising the social performance of energy projects

The social performance approach provides tools to compare how different energy options (*e.g*. a wind farm, decentralised energy services, such as solar mini-grids or a coal mining site) perform for local communities, allowing the identification of the option that maximises positive outcomes and reflects their aspirations for a good life. Figure 3 outlines steps for a community-centred social performance assessment. These steps facilitate the integration of other considerations outlined in this paper, such as acceptance and support, fair representation, and integration of local knowledge.

Figure 3 **Process of performing a community-centred social performance assessment**



Source: Adapted from (Mbungu *et al*., 2021).

The social performance approach helps to evaluate local energy projects in terms of social progress and ensures that investments perform for the people and the planet. Specific interventions and enablers can also be identified so that the positive contributions to well-being are maximised, for example local economic value creation and employment, community cohesion and social inclusion, a healthy environment, dignity and pride.

1.3 Empowering citizens and enhancing social cohesion

Viewing the energy transition from a decentralised perspective of the citizens can strengthen local democratisation processes (WWEA and LEE North Rhine-Westphalia, 2022). Decentralised community energy initiatives led by diverse members allow individuals to participate directly in energy generation, ownership and decision-making, thus empowering them. It can enhance social cohesion by bringing together diverse stakeholders and generating community funds that can be dedicated to issues that matter to them. With the right measures, this model can improve equity by enabling the participation of low-income households.

The benefits can only be realised by adopting enabling policy frameworks and measures that actively seek diverse stakeholders' participation, providing capacity building and addressing financial barriers to low-income households. These elements can be embedded in the business model that the community adopts to realise the project.

1.3.1 Mobilising people as active citizens

Often a community energy initiative starts with individuals who see the potential of renewable energy and have a strong commitment to do something about it. However, as they begin to plan their projects, they soon realise that specialised knowledge and experience are required in a variety of areas, including management, finance, policy and technology. As a result, community energy efforts will involve a variety of people with interests and skills from within the community, and in some cases, they will need to acquire new professional knowledge and skills.

A renewable energy project needs to meet a series of prerequisites before moving on to construction and operations. Such steps include conducting feasibility studies, assessing environmental and social impacts, the acquisition of land and potentially gaining access to the electricity grid, gaining clearance and permission from many agencies such as energy authorities, local governments, and forest, wildlife and environmental bodies. Engaging and mobilising the community is also required.

Empowerment is crucial in this process. Information-sharing practices within energy communities enable participants to acquire technical and non-technical skills, such as managing renewable energy installations, optimising energy use, estimating costs, securing permits and improving communication within the community (Medved *et al*., 2022). They also need to learn how to generate a certain level of profit, comply with legal requirements, assess technical options and operate sustainably. Although some skills are transferrable, training and external support will most likely be required. One-stop shops have been implemented in several countries and regions as policy support for such community needs, and their effectiveness has been reported (IRENA Coalition for Action, 2018). Capacity-building programmes and peer-to-peer learning through networks of energy communities are also effective in helping new actors.

Ownership of renewable energy generation provides greater local control over energy production and costs, also contributing to a sense of empowerment and improved energy literacy, encouraging more sustainable behaviours. Such citizen empowerment strengthens local institutions. By providing opportunities for communities to organise and lead, renewable energy projects enable collective decision-making and development of community organising and leadership skills. Often those involved in leading and managing community systems can become local leaders in other spheres of community life.

1.3.2 Supporting broader community goals

The community energy entity allows collective decision-making and as such may become a hub of the community. The entity can serve as a point of contact for the people in the community. The connection of a community energy entity to a variety of other local communities in the vicinity of the project, such as farmers, fisheries, food producers and cultural and educational institutions, opens the possibility of the project's business model leading to solutions to local issues, as well as the distribution of revenues from the project contributing to the community's well-being and solidarity. One such case is Hepburn Energy in the Australian state of Victoria, as described in Box 1 (Hepburn Energy, 2022).

Box 1 Hepburn Energy community grants programme in Australia

The first community owned wind power co operative in Australia distributes part of its profit to the community, initially through the Community Grants programme, which funded 60 local projects. Responding to the voices of the community, in 2019, Hepburn Energy renewed the programme as the Impact Fund and set the goals of contributing to the community's net zero emissions target by 2030 and enabling a thriving, resilient community and ecosystem that can regenerate in the face of climate change impacts.

In 2022 the Impact Fund contributed to the Community Power Hub programme, which supports other communities to start energy projects. This programme is an initiative of the Victoria State Government aimed at supporting community-driven renewable energy projects by providing funding, expertise and resources to help communities develop and implement their own renewable energy solutions. The Impact Fund also contributed to the Trentham Carbon Forestry Project, which works with local landholders to increase sustainable woodlot management by building carbon sinks and enhancing biodiversity, and Wattwatchers to install demand management packages to help local schools monitor and save energy.

Photo credit: ISEP

Hepburn Wind farm in Australia

Shonan Power in Japan provides an example of how local ownership enables stakeholders to choose how to distribute part of the profit to meaningful purposes for the community, improving social cohesion (IRENA, 2021) as described in Box 3.

Box 2 Shonan Power initiatives enhancing social cohesion in Japan

A community-based electricity retailer in Odawara, Shonan Power actively developed electricity menus that contribute 1% of electricity bill revenues to various community support activities (Table 1). The menu was developed through close communication between Odawara city and Shonan Power and is officially recognised as one of the practices in realising a Regional Circular Symbiosis Zone. This is a concept advocated by Japan's Ministry of Environment that incorporates an integrated policy approach for a low-carbon society, resource circulation and living in harmony with nature. For example, if a customer selects "Odawara Support Plan", 1% of the electricity bill is allocated to providing operational support for a Kodomo-Shokudo ("Children's Cafeteria"), which provides free or reduced-price meals to children from families in economically difficult situations.

Community Solar in Odawara

Table 1 Options for consumers to support community goals in Japan

Plan	Content
Community Development Support	Support the revitalisation of local industries, the effective use of local resources, and the promotion of festivals and traditional events in the region
Shonan Lifestyle Support	Support environmental activities and disaster prevention efforts, especially in the Shonan area
Shonan Bellmare Support	Support a professional soccer club in the Shonan area, Shonan Bellmare
Shonan Bellmare Futsal Support	Support a professional futsal club based in Odawara, Shonan Bellmare Futsal Club
Odawara Support Plan	As part of Odawara City's efforts to realise a "Regional Circular Symbiosis Zone" Shonan Power and Odawara City support a Kodomo-Shokudo in the city as a joint project
Kanagawa Prefecture Moms' Volleyball Support	Support local sports promotion and health promotion activities through the Kanagawa Prefecture moms' volleyball
Yokohama Living-Lab Support	Support local activities in Yokohama by supporting the activities of the Yokohama Living Lab Support Office
Art de Vivre Support	Support the culture and art of the community by supporting the creative activities of people with disabilities, especially in art
Pink Ribbon Fujisawa Support	Support the activities of Pink Ribbon Fujisawa, which is engaged in breast cancer screening awareness activities and support for those affected by breast cancer, mainly in Fujisawa City, Kanagawa Prefecture

Source: (Shonan Power, 2022).

1.4 Improving gender equality

Increased representation of women in community power, and the renewable energy sector in general, is essential for achieving social equity and developing energy systems that address their unique needs effectively while leveraging their talents and perspectives.

Women have an important role to play as multipliers of the energy transition as responsible citizens, consumers, business owners and policy makers. A World Wind Energy Association (WWEA) survey from 2021 showed that community energy projects led by women also have a higher overall proportion of female members (WWEA, 2021). Diverse teams not only demonstrate a higher level of satisfaction in their collaboration, but also serve as a powerful signal to society that every citizen can actively engage in the energy transition. Community energy can empower women, as demonstrated by the Sosai Renewable Energies initiative in Nigeria in Box 3 (IRENA, 2021) and women-led solar community in Yemen in Box 7.

Box 3 Sosai Renewable Energies empowering women in Nigeria

In 2017, two 10 kW mini-grids were installed in the Baawa and Kadabo communities in Nigeria, providing renewable energy supply to 79 households and 12 businesses. Communities buy energy from the mini-grids through a pay-as-you-go model. Mini-grids and energy bill payments are monitored by local employees.
Women in the communities benefited from the mini grids in several ways. Each community was assigned an 18 metre solar tunnel dryer and a solar kiosk. Local women manage the equipment and earn income by renting out the dryer to farmers, charging mobile phones and selling products through the kiosk. The solar dryers allow local farmers, many of whom are also women, to dry their products quickly and efficiently. As a result, women improved their financial independence and social status and can support their families.

Photo credit: Sosai Renewable Energies

Drying mango with solar

1.4.1 Barriers to gender equality in community energy projects

The current reality often falls short of the potential. While the renewable sector out-performs fossil fuels in gender representation, with women comprising 32% of the workforce, significant progress is still needed to achieve equitable representation (Gill-Wiehl *et al*., 2022). Although global data are not available, according to a study conducted by WWEA, the proportion of women as shareholders in community energy in parts of Germany stands at 29%, while in Japan the share is only 20.5%. The share has risen slightly in recent years, but parity is still a long way off (WWEA, 2021). A survey of community energy projects showed that young people, people with a migration background and those with a lower level of education are also underrepresented in community power (WWEA, 2021). A number of barriers persist for women to participate in community energy (WWEA *et al*., 2022):

- **Social and cultural norms**, which describe societal attitudes towards women in different spheres, including work, care and family responsibilities and balance, financial control, and decision-making.
- **Lack of access to capital,** as women are more likely to own fewer assets, receive a lower income and work in the informal sector with restricted access to formal lenders.
- **The perception of gender roles and capabilities,** both by community and individuals themselves, such as entrepreneurship and technical roles being perceived as male domains.
- The lack of **equal representation** of women in decision-making roles.
- **Inertia,** as community energy projects are often initiated by already strongly male-dominated networks in the energy sector.
- **Work conditions** not adjusted to women's needs, for example, lack of flexibility and childcare facilities.
- **Lack of training** and mentorship opportunities designed for women.

1.4.2 Opportunities for action

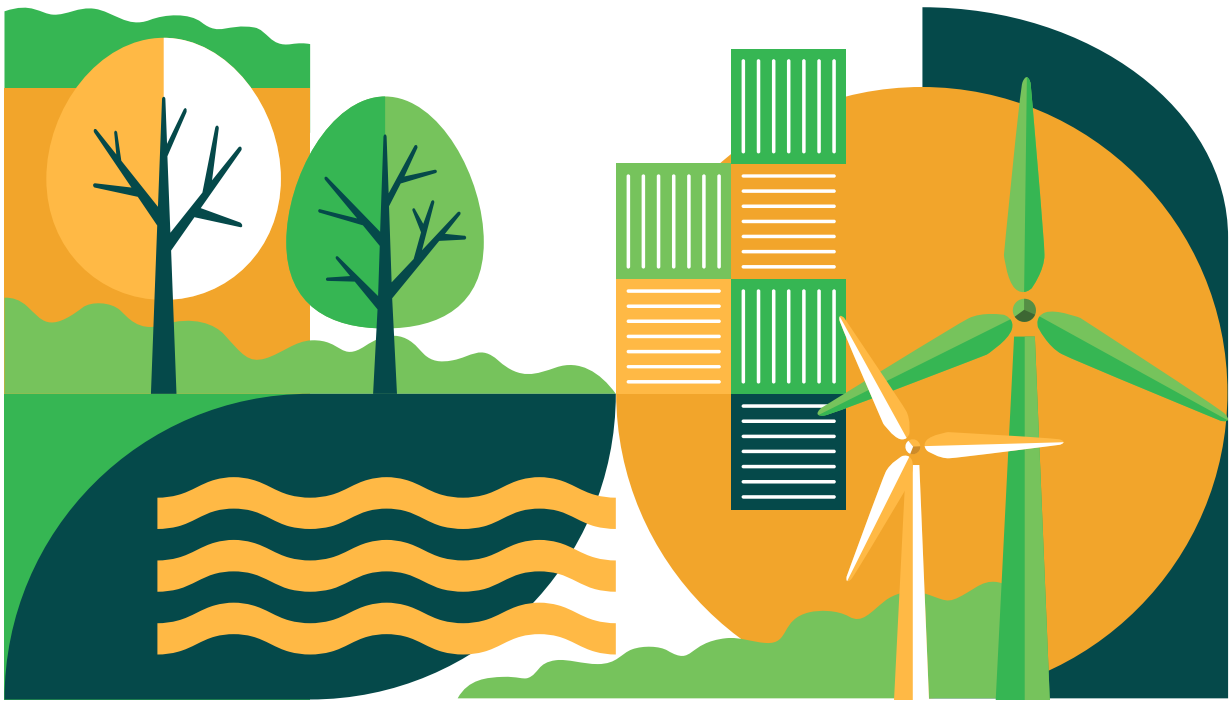
A number of actions can be taken to address the barriers set out in the previous section and open up community power to a broader section of society.

Governments should:

- Address gender imbalances with energy, economic and employment policies. Public procurement procedures, auctions and tenders can include criteria for achieving gender balance.
- Seek to shift social norms for more equitable sharing of domestic and caregiving responsibilities.
- Address social and cultural barriers towards women's enrolment in STEM (science, technology, engineering and mathematics) fields, considering gender quotas, especially for STEM jobs.
- Facilitate women's access to training and skills development with programmes designed to meet their needs.
- Improve access to finance for women entrepreneurs in the energy sector.

Local government should:

- Collaborate with community energy entities to improve understanding of community energy initiatives, highlighting women participation.
- Develop innovative forms of communication, including strengthening direct personal contact and social media presence and using adequate communication channels about community energy initiatives to reach women.
- Encourage communities to form networking and action alliances with other local stakeholders and organise open and gender-specific events.
- Encourage the creation of dynamic action groups and other forms of participation, offering flexibility and low-threshold financial entry points. Flexible participation options could act as a catalyst to enable people to approach a new subject area on a trial basis for the first time. This is important not only for the participation of women, but also youth and minorities.



02

Economic benefits: Sharing prosperity widely

The economic benefits of community energy, especially in less developed and fragile regions, go beyond financial gains, encompassing a vision of universal energy access and more equitable sharing of benefits. Ownership of renewable energy assets gives the local community the greatest economic benefits (Thapar *et al.*, 2017). Community energy projects direct their revenue towards local needs and provide an alternative source of income from generating and selling energy and new job opportunities, thereby contributing to socio-economic development, especially in remote areas (Slee, 2015). Locally generated renewable energy reduces reliance on centralised, often fossil fuel-based energy systems or imported fossil fuels. It cuts down on transmission losses and relieves the pressure on electricity grids. With the focus on long-term sustainability and resilience, the case for decentralised renewable energy (DRE) solutions becomes eminent.

2.1 Enabling energy access and local development

Over 685 million people worldwide are currently living without access to modern energy services (IEA *et al.*, 2024). Most live in rural and remote areas that do not have access to the national grid. These communities typically have low population densities and incomes, and limited access to connective infrastructure, modern services and amenities. In these settings, DRE systems can provide a number of advantages over the national grid, including the ability to generate electricity cost-effectively through renewable energy sources and flexibility in system design. These advantages do not happen on their own; they are the result of careful, deliberate planning and execution of specific strategies.

One factor that is widely acknowledged to contribute to the success of DRE projects for sustainable energy access is substantive community involvement and governance in all phases of the project life cycle (Gill-Wiehl *et al.*, 2022). When energy access DRE projects are developed and implemented with community participation, systems align better with local needs and priorities, amplifying many socio-economic benefits. Additionally, involving communities in the operation and management of DRE systems can help reduce costs and build support, thereby increasing the project's long-term viability.

2.1.1 Defining ownership and decision-making in remote areas

There are many ways that communities can participate in DRE projects; this is encapsulated in the concept of community energy that links to ownership and operational participation (IRENA Coalition for Action, 2018). Depending on local regulations and requirements for asset ownership and project structures, community ownership and involvement in energy access projects can take a wide range of forms: from partial to full ownership over assets, and from informal to formal forms of ownership.

Full project ownership might not always be desirable, or even possible. While it gives the community more control than partial ownership, it can also imply a more comprehensive financial and technical responsibility for the operation and maintenance of the DRE systems. Moreover, a lack of supportive policy frameworks can limit the ability of communities to own energy systems and to participate in the project's development and implementation.

In the absence of regulations, community energy schemes can resort to informal community mechanisms for decision-making. Often they will use existing community institutions and governance structures, such as local leaders (*e.g.* village head), committees (*e.g.* Village Electrification Committee or VEC), and/or community-wide assemblies for discussion and voting.

These informal institutions can be as resilient and effective as formalised institutions, in great part because they rely heavily on shared values and cultural identity (Wirth, 2014) In rural areas, communities are generally reliant on their natural environment for livelihoods, and have a long history of sharing natural resources as well as mobilising community-based resource management (Dietz *et al*., 2003). DRE systems, especially mini-grids, are sometimes also viewed as a shared community resource. In these situations, communities can use their institutions to distribute costs and benefits based on local norms and values, as they do in the governance of other shared resources.

2.1.2 Benefits of community energy in low energy access settings

In its various forms, community energy allows energy access initiatives to deliver the manifold benefits outlined in this paper and deepen their socio-economic impacts. In addition, it brings reliable and sustainable power to underserved regions, thereby improving living conditions and enabling better health services, education and economic opportunities. With meaningful community involvement and ownership, projects are more likely to be accepted by communities, have fewer associated risks and bolster communities' confidence in renewable energy (Haggett and Aitken, 2015). Studies have identified additional benefits specific to energy access, with examples from the field (Energy Action Partners, 2021):

- **Community energy instils a sense of ownership and belonging to the territory.** When communities have an active stake in a project, it becomes easier to achieve their buy-in and retention. Additionally, community members are encouraged to remain engaged and actively contribute to local community development. This sense of ownership is especially important in remote, rural communities to discourage migration, particularly that of younger generations (see Box 4).

Box 4 Youth engagement in micro-hydro in Malaysia

In the village of Kampung Terian, Malaysia, the micro-hydro system is managed and maintained by local communities. The Village Energy Committee (VEC) is also the village youth committee. Entrusting the youth committee with this important responsibility to manage energy decisions gives them an added sense of ownership and belonging, encouraging them to stay in the community and build skills for the development of socio-economic opportunities created by the DRE system.

- **Economies of isolated areas are revitalised.** Local, equitable distribution of revenue and profits from DRE projects generates an invaluable economic surplus that can serve as contingency funds for families in cases of emergency (Madriz-Vargas *et al*., 2018). Furthermore, when community members have control over the cash flows of the DRE system, they are able to reinvest the generated profits to develop new economic activities, as well as bring technological innovations to the region (IRENA Coalition for Action, 2021). Productive use of energy and local management of the energy system can also open up opportunities for job creation, providing important sources of income and stimulating the local economy, as outlined in Box 5.

Box 5 Solar mini-grid strengthening the local economy in Mata Redi, Indonesia

The rural community of Mata Redi is a recent beneficiary of the MENTARI Demonstration Project, initiated by the Indonesian and British governments. It included the establishment of a Village-Owned Enterprise (known locally as BUMDes), and technical and enterprise development-related capacity building, as well as the provision of a solar mini-grid. Revenues generated by the BUMDes from entrepreneurial activities and energy fees will be used to fund community development, creating livelihood opportunities within this remote community.

- **Long-term viability and community support is created in hard-to-reach areas.** When developers and external operators actively and meaningfully involve communities, it contributes towards a strong working relationship between both parties. A high level of trust supports feedback loops to ensure that issues related to the energy system are resolved in a timely manner. This also reduces demand-side conflicts related to system operations, such as non-payments and electricity theft, and fosters long-term support from the community that is essential for the project success and sustainability. Training community members ensures that maintenance and repairs can be performed locally. Box 6 provides a case study illustrating positive community involvement (ARE, 2022).

Box 6 Solar power improving livelihoods in a rural community in Mozambique

The rural community of Mangunze in Mozambique had identified a lack of energy access as a major challenge in achieving sustainable development. After discussions with the community, the Carlos Morgado Foundation – which has been working with the community for more than 10 years – determined that a solar-powered cell phone charging station would bring a significant positive impact to community members' lives. Community youth provided valuable support in terms of labour, knowledge-sharing on the use of the cell phone charging station, and advocacy for the energy transition. Two women were trained with the assistance of Mozambique Women of Energy to maintain the space and guide users on how to use the service. Since then, these women have also become advocates for the benefit of renewable energy to fellow community members.

Although community engagement and participation are widely acknowledged as contributing factors to project success and sustainability, in practice the role that communities play in energy access projects – which are typically top-down – tends to be limited to demand estimation during project planning, operation and maintenance activities upon commissioning, and using the energy for various applications. This is primarily due to a lack of understanding of how to effectively engage remote communities in different stages of project implementation (Gill-Wiehl *et al*., 2022).

Stakeholders can contribute to this goal by ensuring that community involvement and governance are part of energy access projects, as detailed in Section 5. At the country level, enabling regulation and stable policies to provide energy access, capacity building and community-based financing are also key.

2.2 Providing energy in fragile and conflict-affected areas

State fragility or a fragile state has several definitions, but in general it refers "to the weakness in the state's functional capacity to provide basic security within its territory, institutional capacity to provide for the basic social needs of its population, or political legitimacy to represent its citizens effectively at home and abroad" (Asian Development Bank, 2012). Fragility and energy poverty are interrelated. It is more challenging to provide energy access in a fragile context, while energy access is crucial to development, which in turn is a precondition for stability (State Fragility Council, 2020).

Not surprisingly, countries facing fragility and conflict have the lowest rates of electrification, with 421 million people in 2021 deprived of electricity services (IEA *et al*., 2023). Innovative approaches need to be developed to fit different contexts, taking into account significant challenges such as limited resources, accessibility, security issues and high investment risks.

Providing food to the affected communities remains a serious challenge in fragile or crisis settings. Health and nutrition are compromised in the absence of access to clean cooking fuels. Several options exist for the supply of renewable energy for clean cooking in fragile or crisis settings, offering the added advantages of local availability, improved health outcomes and enhanced safety compared to alternative solutions. The entire cooking system, including the combination of stove and fuel, whether for individual or community cooking, must be holistically considered in any design of a cooking intervention. A number of aspects have to be regarded in parallel while choosing the best technology, such as safety, cost, local preferences, sustainable supply and adaptability. The next section highlights the potential of community renewable energy to fill the energy gap in fragile and conflict-affected areas.

2.2.1 Community energy potential in crisis settings

Community energy initiatives facilitate the prioritisation of local needs, voluntary and democratic ownership, and local capacity building. Such models play a positive role in fragile and conflict-affected countries in meeting community energy needs in sustainable manner when public institutions fail to deliver. In conflict situations, community control over energy resources and collective decision-making can enable communities and citizens to engage in local strategies for development, facilitating communities' development-related activities, and supporting basic service provision. Box 7 provides an example of how a women-led solar project provides affordable energy and economic opportunities to vulnerable population in Yemen (United Nations, 2023).

Box 7 Women-led solar community in Yemen

Continuous conflict in Yemen, coupled with extreme weather events, have severely affected the livelihoods and opportunities of its population. In response to unreliable public energy services, displaced women in the Abs region self-organised to establish a solar energy project. They received from UNDP an initial solar micro-grid and training in business management and operations.

By 2022 the project was delivering clean energy to 53 households at a fraction of the cost of diesel-generated electricity. Additionally, the income generated is used to provide microloans to community members for productive activities, further enhancing local economic resilience.

Under fragile or crisis settings, the active participation and involvement of the concerned communities is even more important. The community energy approach is instrumental in implementing renewable energy options for energy generation and clean cooking for several reasons:

- Community initiatives present viable options for **self-organisation** and can spur livelihood opportunities and economic activity. For example, they help rebuild local societal structures, create jobs and improve the life of the vulnerable groups.
- **Longevity and resilience** are achieved as communities can manage and maintain renewable energy projects locally. Due consideration of their perspectives can build ownership and trust during the introductory, implementation and operational phases.
- The community approach can also leverage **collective knowledge** and address shared concerns, leading to improved outcomes. This refers to identifying locally available materials, minimising environmental impacts, and organising resource collection to ensure safety for individuals, especially women and girls. For solid biomass, the community approach can facilitate sustainable harvesting practices and reduce health, security and environmental risks. The community approach to biogas generation can facilitate responsible waste management.
- Community self-organisation can lead to other collective **initiatives to improve livelihoods**, such as basic services provision and organising community kitchens.
- The community approach facilitates **collective production and use**, which increases efficiency, reduces costs and creates economic opportunities.

As outlined in other sections, community energy based on renewable solutions can improve energy security (2.3), resilience (3.1) and social cohesion (1.3), which are particularly relevant when centralised services are disrupted. Community energy projects can be facilitated in fragile and conflicted regions by providing targeted financing and capacity development. The engagement and co operation of women are key to effective intervention that addresses their needs and safety concerns. It is necessary to pilot projects in vulnerable communities and scale up successful initiatives.

2.3 Achieving local energy security

Energy security refers to the availability of reliable, uninterrupted and affordable energy sources (Cox *et al*., 2019). It is an integral part of providing access to essential services such as health, education, water and sanitation, and providing livelihoods through agriculture, productive industry and the service sectors. As a result, energy security supports the development and sustainability of multiple SDGs.

Fluctuating energy prices, energy import dependency, disruptions due to climate impacts and conflicts, lack of grid access and poor response mechanisms to breakdowns are major reasons driving energy security discussions. The transition to renewables will strengthen local resilience, as every country and region has some form of renewable resource that can be harnessed (IRENA, 2024).

There are several differences between energy security discussions in developed and developing countries. In developing countries, the goal of poverty alleviation lies at the forefront of development (Obadia *et al*., 2019). These countries also suffer from low per-capita energy availability (Mendu *et al*., 2012). Such countries are adopting various measures to integrate renewable energy into existing systems and building community energy systems to improve energy access and achieve the dual goal of improving socio-economic conditions and reducing carbon emissions.

Conversely, developed countries focus on resilient energy systems and securing the amount of energy required for economic and social activities and other purposes at acceptable prices (Dulal and Shakya, 2018). Developed countries have widely adopted energy initiatives to facilitate the distributed generation of electricity from renewable energy sources, while developing countries should improve institutional design to facilitate community-shared systems (Mukisa *et al*., 2022).

2.3.1 Community approaches increasing security

Community energy projects enhance energy security by diversifying energy sources and increasing local resilience. Energy security is enhanced and robust when DRE generation technology and storage converge with community energy schemes (UKERC, 2018).

Community energy can reduce energy costs and energy poverty (Adelaida Parreño-Rodriguez *et al*., 2023). Locally generated renewable electricity prices can be significantly lower than those for imported fossil fuels. Reliability can be improved where the centralised grid supply is erratic. Community projects can maximise economic returns by combining energy generation and energy efficiency. Energy efficiency interventions such as smokeless cooking stoves, improved insulation of housing and more efficient appliances lead to a reduction in energy costs, indirectly increasing the disposable income of the community. Additional income may result from selling excess energy, for example from rural communities to cities or companies.

As further expanded in Section 3.1, the impact of climate change through weather distortions is resulting in extreme rainfall, flooding, cyclones, heatwaves and cold waves, all in turn affecting the reliability of energy sources from generation to distribution. Building renewable energy generation and distribution capacity at a community level can add diversity to the electricity generation portfolio, reduce down-time after natural disasters and support building a resilient energy security system.

In India the prominence of off-grid micro-renewables, mini-grid and micro-grid projects, and stand-alone solar systems (*e.g*. solar lamps/lanterns, solar home lighting systems, solar water purification systems and streetlights) has gained importance and are considered as community energy security projects. Box 8 outlines an example of a community energy project in India that is improving security and self-sufficiency (Joshi and Yenneti, 2020).

Box 8 Community energy security in India

A small district of Rajasthan boasts India's first community-owned solar module manufacturing company, called DURGA, which is wholly owned and operated by indigenous women in the area. This organisation provides the training and skills development needed to produce technology solutions like solar lamps, solar home systems and solar streetlights, and to carry out quality checks, repairs and maintenance. Employees help customers with installation and service.

This initiative has developed entrepreneurship spirit at the local level. The manufacturing unit helped create employment opportunities for 200 women in different roles such as assemblers, managers and data entry personnel. Installations have supported the community by improving livelihoods and quality of life. The localisation of value chains has facilitated the provision of solar energy in one of the most marginalised and isolated regions of the country, thereby diminishing the reliance on imported energy or energy technologies.

03

Environmental benefits: Co-existing with nature

Community projects based on renewable energy reduce energy-related emissions, thereby contributing to global carbon mitigation efforts. Beyond this advantage, community-owned initiatives are also likely to prioritise more responsible and sustainable practices preserving local ecosystems. This is due to their connection with the territory, and a vested interest in maintaining the ecological balance, given the direct exposure to any harm.

Community energy approaches can enhance climate adaptation, resilience and recovery abilities. Active community engagement and DRE solutions increase energy system resilience in the face of disruptions and extreme weather events. Furthermore, active community participation is instrumental in ensuring that energy projects are developed in alignment with local priorities for preserving nature and biodiversity, and minimising negative impacts.

3.1 Enhancing climate adaptation and energy system resilience

While closely interrelated, it is important to differentiate between the concepts of adaptation and resilience. Adaptation refers to "adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects"(UNFCCC, n.d.). This encompasses changes in processes, practices and structures to mitigate potential damage or benefit from emerging opportunities due to climate change. Resilience can be understood as the capacity of a system to "maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity" (Meerow *et al*., 2016). Community energy approaches can be particularly effective in both regards due to their context-sensitive, decentralised and flexible nature.

3.1.1 Self-organisation and adaptability of communities to climate shocks

Communities will have to navigate a transition to sustainable sources of energy, while simultaneously facing shocks magnified by climate change. Research suggests that in complex adaptive systems, communities can self-organise in response to a crisis by creating new systems to meet their needs even if a government fails (Martin-Breen and Anderies, 2011). Involving communities more actively in the energy system early on not only ensures that adaptation measures function effectively and are better suited to local needs, but also can enable a more rapid recovery.

Governance has been identified as a critical factor in enhancing community resilience, especially when authority, decision-making processes and accountability are clear to stakeholders (Dvorakova *et al.*, 2020). Instead of unilateral state- or corporate-led top-down approaches, a more inclusive approach can be key to

implementing effective solutions for adaptation and resilience. Community participation can help uncover the relationships and interactions that may not be obvious at first glance. The communal experiences of vulnerable populations can be better included across various intersections such as class, gender, disability, ethnicity and age. Such an approach can also help in identifying potential local champions to take ownership of resilience and adaptation efforts, as well as identifying effective communication and awareness-raising strategies for key stakeholders in the roles they must play. Box 9 details successful community initiatives in response to extreme weather events (Avery, 2023; FEMA, 2019).

Box 9 Community energy initiatives: Enhancing climate resilience

In 2017 hurricane Maria hit Puerto Rico, destroying entire neighbourhoods and paralysing the island's power grid. It catalysed a wave of community-driven solar projects aimed at improving energy affordability, enhancing the climate-resilience of energy systems, and eliminating pollution. The initiative Resilient Power Puerto Rico initially focused on community public buildings, later expanding to microgrids and residential buildings. Freestanding and autonomous but interconnected solar energy generation sources were set up after the extreme weather event. The interconnected subsystems could cover and support failing nodes in a modular fashion when needed, permitting at least partial functioning of the system.

The initiative operated through race, class and gender lenses, leveraging community knowledge to make sure that underrepresented and marginalised groups were not discriminated against in the recovery efforts. Such a robust participatory process based on transparency and responsiveness strengthened social capital and formed the basis for a successful decentralised governance system. Taking the different priorities into account was vital for adaptation and resilience efforts.

In the town of Galena, Alaska, the community was able to pinpoint its reliance on expensive imports of fossil fuels as a critical vulnerability when faced with recurring natural disasters such as floods. This led them to explore the possibility of setting up a community biomass plant, reliant on local and sustainable sources of energy. Energy efficiency improvements were also undertaken to improve resilience and the success of future renewable energy projects.

From a technology perspective, community energy can develop alongside technological innovations such as mini-grids and increasing digitalisation, to strengthen overall energy system resilience. Communities can function as "islands" in case of disruption to the larger grid. Digital technologies can enable real-time communication and facilitate demand response measures when needed for overall system stability. The result is overall better functioning, greater efficiencies and increased responsiveness, with inbuilt redundancy, which are at the core of a resilient energy system (Small *et al.*, 2020). Improving local technical capacity can also go a long way to improving resilience and adaptiveness, where communities are able to rely on themselves, even if for temporary fixes, in the face of more centralised official disaster recovery efforts.

Vertical solar panels

3.1.2 Enabling communities to achieve greater resilience

Two steps can create meaningful change and enhance adaptation and resilience efforts: identifying the purpose of the energy system, and actively involving communities in shaping these efforts. For the energy system, both are enhanced through community energy approaches, by increasing direct input and a clear identification of needs and constraints.

The first step is establishing the purpose of a system (*e.g.* solving electricity insecurity) and identifying its existing interconnections and enablers. The entry point of every resilience strategy should be the one that reduces vulnerabilities, since breaking the cycle of poverty, including energy poverty, may be the most effective way to mitigate climate-related and other risks (Hallegatte *et al.*, 2017). Areas where people lack secure energy access face greater challenges during and after a disruptive event. Furthermore, restoring services after disruptive events usually takes more time and effort. Not only are communities best placed to identify the risks they face and the possibilities for recovery, but their participation also ensures that potential solutions are implemented.

Secondly, by turning communities into active participants in the energy system, various adaptive capacities and diverse stakeholder perspectives can be incorporated into planning, resulting in improved long-term-oriented and more sustainable solutions. Direct ownership of energy projects can enhance resilience from an economic perspective, as ownership creates an alternative source of income while simultaneously improving energy access and affordability. This is a key feature of many community energy projects, *i.e.* the gains are often redistributed among the local community (IRENA Coalition for Action, 2018). Certain groups within communities can encounter overlapping vulnerabilities and therefore have different priorities regarding their energy systems.

To reach resilience and adaptation capacities at this level, empowering communities through awareness raising, capacity building and outreach are critical in the initial stages after the event and, even better, before any event occurs. This can be taken further through improved governance and accountability that incorporate different perspectives and vulnerabilities, and the economic benefits associated with improved energy access and potential alternative sources of income through ownership.

Governments can facilitate these steps by localising national adaptation and resilience strategies, relying on local governments and communities to tailor them to their specific contexts. Effective policies are key to directing resources and financing to where they are needed most, encouraging investment and the development of novel business models. In sum, community energy approaches can contribute to stronger adaptive capabilities and improve the resilience of energy systems by creating a more responsive and efficient system overall, building in the flexibility and adaptability necessary for communities to be able to face shocks when they occur, and recover more effectively in their wake.

3.2 Protecting nature and biodiversity

The world needs to triple renewable power capacity by 2030 to meet climate change mitigation targets (COP28 Presidency *et al.*, 2023). Solar and wind energy are expected to make up a large share of the new renewable energy capacity added. Without planning, renewable energy development may result in land use conflicts. Potential sources of land use conflict can include:

- Negative impacts on nature and biodiversity.
- Conversion of productive agricultural lands.
- Infringement on local and/or indigenous community lands.
- Varying social, community and cultural acceptance (Mulvaney, 2017).

Such conflicts can cause delays in deploying renewable energy (Susskind *et al*., 2022). Beyond these potential land use conflicts, renewable energy siting also needs to consider other factors such as resource potential, cost, interconnection and transmission capacity.

Renewable energy and enabling infrastructure development should align with the principles of sustainability, the circular economy and minimal environmental impact, especially regarding land use, ecologically sensitive areas and biodiversity (COP28 Presidency *et al*., 2023). Local communities are often the best stewards of their environments (Bennett *et al*., 2018). As such, active community involvement and ownership of energy projects can help effectively address environmental concerns, complementing mandated environmental and social impact assessments. Any solution must be considered through a systemic lens to offer nature the opportunity to regenerate and prosper, respecting its right to coexist, since communities ultimately depend on it and are keenly interested in safeguarding it. An example of a community energy initiative using existing infrastructure and enhancing biodiversity in an urban setting is described in Box 10 (Energy Garden, 2023).

Box 10 The Energy Garden: Improving urban biodiversity in the United Kingdom

The Energy Garden Community Benefit Society has around 500 members who have raised over GBP 1 million for solar development in London. They create "energy gardens" by locating solar panels and urban gardens on transport infrastructure. Renewable energy is sold to individuals and companies, while gardens contribute to food production and urban green spaces. One of the core elements has been a certified Youth Training Programme engaging youth to gain experience in community development. As a result, communities are empowered to take positive action, and energy and food security are enhanced while improving air quality and biodiversity.

3.2.1 Siting renewable energy to support climate, conservation and communities

Locating renewable energy projects in a way that supports goals for the climate, conservation and communities can help to avoid the previously mentioned conflicts and negative impacts, and instead promote environmental and social benefits (The Nature Conservancy *et al*., 2021).

Climate: Siting renewable energy well can avoid conflicts that hinder the development process. In turn, this will allow renewable energy to be deployed faster and greenhouse gas emissions can be reduced on a more rapid timeline (Roth, 2022). For example, there may be limited requirements for environmental assessment if a project is sited in an area with little or no potential environmental impact. Siting that avoids the conversion of natural lands, like forests, also helps maintain carbon storage (The Nature Conservancy *et al*., 2021).

Conservation: Many new renewable energy projects are being sited in intact natural areas that have not been significantly modified by human activity. For example, one study found that "over 74% of solar development In India was built on landcover types that have natural ecosystem preservation, or agricultural value" (Ortiz *et al*., 2022). Smaller-scale community energy projects can reconcile energy and nature. Siting renewable energy developments in places where they do not cause harm, such as rooftops, can minimise impacts on the natural environment or even enhance biodiversity. Locally generated renewable energy reduces the need for electricity grid expansion. This also includes nature-inclusive design of electricity infrastructure, avoiding natural lands with rich biodiversity, mitigation and restoration measures to support healthy ecosystems, and community engagement (Kiesecker *et al*., 2019).

Communities: Engaging communities in the renewable energy siting process can lead to increased community buy-in, which can help avoid community conflicts and delays in deployment, as well as bring more tangible benefits to the community (Firestone *et al*., 2017; Hindmarsh, 2010). Examples include the following:

- When wind turbines or photovoltaics are collocated well with agricultural lands, renewable energy projects can increase farmers' revenue. Agrivoltaics, a method of using land to simultaneously produce solar energy and grow crops, is a growing field of renewable energy that in some cases may even make crops more productive. One study found that solar on agricultural lands led to "reduced plant drought stress, greater food production and reduced PV panel heat stress" (Barron-Gafford *et al.*, 2019). Other projects have been explored that collocate renewable energy projects with native plants and pollinators (Kerber, 2022). There may also be positive interactions between offshore wind farms and fisheries. Smart siting on the built environment (*e.g.* rooftop solar) can also reduce the urban heat island effect (Masson *et al.*, 2014).
- Another way communities can benefit is through rural electrification opportunities. With community consultation, well-sited renewable energy can increase access to clean energy while avoiding negative impacts on natural areas.
- Community energy fosters resilience and environmental awareness. Through first-hand experience in managing their renewable energy systems, communities can further develop their shared sense of responsibility, as well as acquire new skills and practices related to conservation and environmental management. Organised communities with evolving knowledge of managing resources are often more capable of adapting and mitigating the effects of climate change within their local contexts, as Box 11 illustrates (Lopez *et al.*, 2007).

Shading crops with solar panels

Box 11 Micro-hydro: Fostering environmental awareness in the Philippines

In the evaluation study of the Sibol ng Agham at Teknolohiya (SIBAT) Renewable Energy Programme in the Philippines, four micro-hydro projects in Buneg, Katablangan, Caguyen and Adugao focused on watershed protection and management. Strategically executed in critical catchment areas, the protection plans incorporated essential steps:

- Educating the communities about agroforestry systems, sustainable agriculture and watershed management.
- Utilising resource assessment techniques like mapping and identifying existing forest wildlife and indigenous forest species.
- Conducting community workshops dedicated to watershed management planning.

These projects effectively reinforced age-old environmentally friendly indigenous practices such as controlled hunting seasons, supplemented with the enforcement of firm policies. By incorporating watershed management and conservation alongside electricity generation, these micro-hydro projects further fostered environmental awareness and stewardship among community members.

Photo credit: ISEP

Community small hydro

04

Increasing financing for community energy

Investment in renewable energy will need to be significantly scaled up to meet the Paris Agreement objectives (IRENA, 2023a). Community energy that allows mostly small-scale investments can complement large public and private investments, thus helping to bridge the investment gap and increase energy access and security (Ebers Broughel and Hampl, 2018).

Community energy financing refers to the means by which community members collect the required funds for community energy projects. A group of individuals may form a social enterprise, co operative, non-profit organisation or other form of entity and collectively commit to finding the project capital and funding to cover initial running expenses for a renewable energy project.

Developing a business plan with sound analysis and realistic projections are the bedrock of success in financing a community energy project. A renewable energy project should deliver a fair return on investment within a reasonable time. This requires detailing costs, projected revenue, cash flow and expenditure along the time scale, together with risk assessments. A variety of methods are used to calculate the return on investment, such as payback period, net present value, break-even point, internal rate of return and effective rate of return. Usually, as the amount of financing required for a project increases, more effort and stringency have to be exerted to secure the finance. However, community energy projects may be implemented not only with the expectations of financial returns but also targeting many other non-financial benefits, such as social cohesion, gender inclusion and energy access.

4.1 Community energy financing options

Some communities can rely on the private investments of their members to finance community energy projects. A fundraising strategy to raise money from the local community allows the members to build mutual trust and have visibility on the funding status and planning of ongoing projects. Box 12 illustrates the example of the pay-as-you-save service, enabling community investors to buy shares and participants to cover upfront costs with savings from reduced energy bills (Cairns *et al*., 2020).

Box 12 Pay-as-you-save model of Brighton and Hove Energy Services, United Kingdom

Brighton and Hove Energy Services (BHESCo) was established in 2013 with the goal of developing renewable energy and energy efficiency projects that ensure equal access to energy. It provides energy services that satisfy energy needs (*e.g.* ambient temperature and lighting) instead of merely selling energy. This consists of conducting energy performance studies, installing renewable energy equipment, implementing energy efficiency measures and providing free advice about how to save energy and reduce energy bills.

BHESCo operates a pay-as-you-save model, where customers avoid any upfront costs and gradually pay back over 10-12 years with the savings achieved from lower energy bills. The initial costs are covered by community investors buying shares, who later receive interest, providing a continuous revenue stream. The entity also relies on government grants and volunteer work to ensure low costs. This service-based business model has its own advantages and disadvantages. It enables a new revenue stream for communities and reduces reliance on a single technology, subsidy or revenue stream. However, it presents a more complex offering and higher operating costs.

Communities can also seek funding from external sources, especially for larger and more complex ventures. External investors or commercial lending institutions may perceive community energy projects as high risk due to their limited track record, lack of technical expertise and small scale, leading to lower potential returns on investment. Some governments have measures to reduce the development risk or they offer special grants and support for development expenses, as with, for example, the UK Community Energy Fund for local renewable energy projects (DESNZ, 2023).

Table 2 outlines a spectrum of financing options available to finance community energy projects. When conventional financing options are not accessible, or are expensive or inappropriate, communities can resort to innovative financial solutions. All options and their combinations come with different degrees of community involvement in decision-making and ownership, and depend on the availability of the financial and other resources, and decisions relating to the distribution and retention of profits or losses. The availability of these options may vary according to the scale of the project and the accepted definitions and legality of financing community energy projects in different countries and contexts.

Table 2 **Community energy financing options**

Financing option	Description
Gifts, grants, donations	Various forms of charitable finance, including donations, grants, prizes and awards, which are provided without an expectation of repayment and can include physical and intellectual resources, and voluntary services.
In-kind contributions, 'sweat' equity*, locally sourced materials	Non-monetary resources, for instance, community members contributing their labour, skills and materials from the area for construction and project-related needs, or using part of the yields from crop harvests or livestock activities for payments.
Self-help and microfinance	Individuals form groups to collectively save and lend small amounts of money among themselves or to others in the community, which can be linked with financial institutions that provide microcredit.
Revolving fund financing	Financing schemes that use the principal and interest payments of past loans to issue fresh loans, with initial funding usually coming as a grant.
Concessions and concessionary financing	Peferential treatments such as subsidies, incentives or lower interest rates positively discriminating in favour of community energy projects.
Equity financing	Investors, typically community members, local governments, and small and medium-sized enterprises, purchasing shares in a community energy project and becoming shareholders.
Debt financing	Borrowing money for community energy projects, with an obligation to repay the principal amount and interest typically without granting the lender control or ownership in the project.
Co-financing and match financing	Financiers and/or donors pool finance to meet the total budget of the community energy projects. In match financing, the amount provided depends on the amount raised by the community.
Blended concessional finance	This combines commercial finance from the private sector, development finance, and concessional finance from public and philanthropic sources.
Renting or leasing	Landowners can rent or lease their land as their contribution to the project. Project assets such as generators and solar panels can also be rented or leased. Alternatively, such land or project assets can be issued as collateral for mortgage credits for debt financing.
Crowdfunding	Finance raised by gathering contributions from a large number of individuals, often online. This can include gifts, equity or debt financing, typically operating on more favourable terms.
Carbon credits and Renewable Energy Certificates (RECs)	Carbon credits are tradable permits representing the right to emit one tonne of carbon dioxide or equivalent greenhouse gas, while RECs represent proof that one megawatt hour of electricity was generated from a renewable energy source. Both can provide additional revenue streams for community energy.

Note: So-called 'sweat' equity refers to the work committed to a project without remuneration.

4.2 Challenges and opportunities

Financing community energy projects presents a unique set of challenges due to their smaller scale and localised nature. Outlined below are several challenges and proposed solutions, acknowledging that global and local economic circumstances also influence community energy financing.

- **Large number of owners**
  Community energy projects usually involve a large number of local owners and shareholders. Therefore, difficulties may arise when it comes to collective decision-making and reaching consensus. Furthermore, the delivery of services to and collection of cash from this many members can generate excessive administrative and transaction costs. Having a large number of people attempting to engage in operational or administrative affairs can lead to management inefficiencies. Ensuring that the right governance structures and decision-making rules are in place can help to overcome these difficulties. Additional training in conflict resolution, negotiation and project management, as well as having external advisors from outside the community, can facilitate these processes.

- **Lack of resources**
  A lack of resources within the community poses a significant challenge to their ability to fund and sustain an energy project that could greatly benefit them. This challenge can be addressed through public–private partnerships that provide initial grants and enable payment over time using a pay-as-you-save model. Additionally, using part of the energy for productive activities can generate additional income, further addressing the affordability issue.

- **Social influences**
  As many people have a stake in community energy projects, social concerns and interpersonal issues can have negative impacts on the longevity and viability of a project. Community groups can be subjected to political influence or politicisation. The decision-making or management style may not necessarily be rational or based on strong logic. While there is a higher tendency for community energy projects to attract some of their staff from the community itself, the skills of such personnel may not necessary be adequate for the jobs they are assigned. Furthermore, their labour mobility (moving to take another job) can be higher, from time to time creating a vacuum of the skills needed to effectively run the community energy project. These risks can be mitigated by establishing transparent decision-making processes and facilitating skills transfer and adequate training.

- **Lack of economies of scale**
  Compared to larger commercial investments, community energy projects are smaller in size, requiring comparatively lower capital investment. This smaller deal size can fail to attract the attention of larger investors who look for investment opportunities that are more lucrative. Smaller projects can lead to diseconomies of scale, leading to higher cost of production of a unit of energy. In addition, the professional rigour exercised on smaller projects can also be lower. The attention given to small projects by the regulatory authorities can also be less compared to larger projects. Collaboration and aggregation of smaller projects can help to increase efficiencies and attract larger investors.

- **Project soundness**
  As those engaged in community energy projects may have less knowledge of the legal, regulatory and technical considerations, the projects' financial and technical viability may not meet the stringent criteria that purely commercial projects have to meet. A lack of sound checks and balances can also lead to misappropriation of assets and finance by those handling or in control of them. Poorly designed projects may not have been planned such that they can meet their recurrent costs or have the resources to ensure smooth operations via maintenance, repairs and rehabilitation as and when necessary. Robust feasibility studies and governance structures can improve financial and technical viability and compliance.

- **Losing preferential treatment**
  Community energy projects may enjoy preferential treatment when they are in their early stages or under a certain size. However, as the projects expand and time elapses, the regulatory incentives applicable to them could cease or expire. For instance, projects that have enjoyed a preferential feed-in tariff for the energy they generate and feed into the grid may have to follow a competitive bidding process after the elapse of a gestation time period. In this instance, these community energy projects will have to compete with commercially operating companies who may offer a lower price per MWh. Diversifying revenue streams, such as by providing energy efficiency and flexibility services, can help maintain financial viability.

If the right conditions are established, community energy financing models can tap additional resources to accelerate the energy transition whilst empowering local communities. Besides the conventional financing avenues, innovative solutions and digital tools adapted to local circumstances can enable the broader participation of many stakeholders in financing community renewable energy projects. Policies to support access to finance at the end-user level can help fund projects, uphold the operation and maintenance of the system, and encourage investment in productive-use equipment. Communities can also receive capacity-building support in proposal development and pitching training, empowering them to independently seek financing for project development.

05

Gaining community support for energy transition infrastructure

The energy transition requires the deployment of a considerable amount of energy infrastructure. This encompasses power transmission and distribution lines, essential for integrating new production and demand locations (IRENA, 2023a). Locally deployed renewable energy systems and the related electricity grids can alter the local environmental and socio-economic landscape. Infrastructure expansion can cause potential negative externalities and conflicts over land use.

Opposition to electricity distribution infrastructure is less likely because its contribution to local power supply as a direct benefit to the community is more evident. Distribution networks will play an increasingly important role in the renewables-based energy system, which requires smart energy management, storage and flexibility. In some cases, distribution-related infrastructure is owned by communal enterprises or consumer co-operatives. For example, in Denmark almost all power distribution companies are owned either by citizens or municipalities. Local ownership adds bottom-up pressure regarding cost efficiency and environmental performance. The evidence in Denmark suggests that local governance can be more price-efficient than external ownership (Frede Hvelplund *et al.*, 2021). Community-owned distribution system operators (DSOs) are well placed to take decisions and facilitate smart energy solutions at a local level. The example in Box 13 illustrates the community-owned distribution grid in a rural context in Nicaragua (UNIDO and International Center on Small Hydro Power, 2019).

Box 13 Community-owned distribution grid in Nicaragua

ATDER-BL and APRODELBO, community-based not-for-profit organisations, operate two run-of-river mini-hydro power stations interconnected with a distribution grid in the municipalities of El Cuá and Bocay in Nicaragua. They started with the off-grid electrification of small and remote rural settlements and then built a regional distribution grid. It was later connected to the national grid, enabling better energy management, as they were able to sell excess hydropower during the rainy season and buy energy during the dry season. Prices for energy users were kept low, while investment continued to expand the distribution grid so that the benefits of electrification would reach more remote households and communities.

All operational profits are invested to intensify the rural electrification effort, as well as in environmental and social projects such as educational scholarships and enhancing access to drinking water. A key aspect of the work is the regeneration and conservation of the watershed and systematic soil and forest conservation surrounding the two run-of-river power stations, work that culminated in the creation of two nature reserves.

Communities are more likely to resist the development of larger supra-regional infrastructure necessary for national and international electricity transmission. Often, the location of a project, either in proximity to a community or in an environmentally sensitive area, gives rise to citizens' opposition (Ignacio Herrera Anchustegui, 2020). From an economic perspective, economic inefficiency and the burden on consumers are used by some groups as arguments against the construction of large transmission lines (Stromautobahn, 2023). While development of the infrastructure can cause negative environmental and social impacts, careful and holistic planning of transmission lines and the energy system at large can mitigate these effects, as can meaningful stakeholder engagement throughout the project's life. By contrast, delays caused by public opposition during the planning, permitting or construction of a project can slow down the integration of renewable energy sources in the energy system and increase the overall costs.

Community ownership might not be feasible in this context; however, providing benefits and engaging affected communities can help mitigate local opposition and minimise the negative externalities of infrastructure projects by addressing the uneven distribution of costs and benefits. These benefits go beyond legally enforced monetary compensation mechanisms for direct damage – they address the negative visual, auditive or environmental impacts on local societies or actors. They are, moreover, perceived to deliver on different dimensions of energy justice: not only procedural and distributional justice, as discussed in Section 1, but also restorative justice, which involves repairing damage and proactively preventing harm (McCauley and Heffron, 2018).

The approaches applied to designing community benefits related to new grid infrastructure are diverse. They span across payments to affected authorities or individuals or for selected projects, and investment-based mechanisms (RGI, 2018a). Ideally, a community benefit scheme should address citizens' concerns early in the process of infrastructure development. Therefore, proactive and meaningful public engagement and consultation are already key in the electricity grids' planning process. This, in turn, can lead to tailor-made solutions and locally relevant benefits for communities, contributing to their socio-economic welfare as well as the improvement of the local natural environment (Süsser *et al*., 2023)

Some countries in Europe - such as Germany, France and Italy - encourage project developers to share benefits with the communities hosting these assets. This holds true, for example, for some transmission system operators (TSOs), which provide benefits to communities located in the vicinity of the new grid infrastructure. These measures can increase the local acceptability of the electricity grid and provide an "appropriate benefit" to the communities hosting it. Ireland provides an interesting case where the TSO built a plan that addresses, at least partly, the needs and concerns of the affected communities so as to actively support grid projects in the country. Box 14 elaborates further on this case (RGI, 2018).

Box 14 EirGrid Community Benefit Scheme for transmission infrastructure in Ireland

Based on its renewed public engagement strategy, EirGrid, the Irish TSO, has designed a comprehensive community benefit policy, with funding from the Community Benefit Fund awarded proportionate to the scale of the project. This policy aims to build a positive legacy in communities hosting electricity grid infrastructure.

EirGrid's approach encompasses three funding streams:

- Community
- Sustainability
- Biodiversity.

For each project that qualifies for an EirGrid Community Benefit Scheme at the pre-concept stage, a local Community Forum is established. Members of this forum are made up of local stakeholders who provide advice and guidance on all aspects of the Community Benefit Fund. That way, representatives of local communities are embedded at the heart of decision-making, provide relevant knowledge and build trust while ensuring transparency and effective governance on the implementation of the Community Benefit Scheme.

Each Community Forum is expected to develop a project-specific Community Benefit Strategy, with emphasis put on incorporating the SDGs. That way, the benefits are designed for the local community, by the local community. EirGrid's approach has been successfully implemented on various projects and holds particular importance for the Celtic Interconnector, a project aimed at connecting Ireland's grid with continental Europe.

Photo credit: EirGrid

Community forum in Ireland

Despite the positive contribution of different community benefit schemes towards public acceptance of energy infrastructure, the practices and legal frameworks tackling this topic are fragmented. Moreover, project developers and even public authorities often lack strategic perception of the need for, and the gains from, community benefits schemes. Existing national regulations should promote the solutions that address such an approach, and, in consequence, energy infrastructure developers should be adequately incentivised to design and implement effective community benefit schemes.

06

Community energy: Barriers and enablers

To date, many initiatives to improve and scale up renewable energy solutions have focused on the supply side, advancing technologies or business and delivery models. Important advancements have been made on the demand side through digitalisation, bridging the affordability gap and facilitating revenue collection and sharing, such as via smart metering systems, pay-as-you-go models and mobile money. More innovation is needed in participatory practices that are appropriate to the community's context and involve marginalised and underrepresented groups in order to achieve quality community participation. Figure 4 summarises the barriers faced by community energy initiatives – such as inadequate policy frameworks, financial constraints and limited capabilities – and outlines the enablers needed to overcome these challenges effectively.

Figure 4 **Barriers and enablers to community energy**

BARRIERS

- **The centralised structure of energy markets.** The top-down approach represented by state-owned or corporate power utilities still dominates energy markets. Energy systems controlled by a few players and based on long-term large-scale investments can often "lock" communities into an unsustainable status quo, limiting their ability to transition to sustainable and decentralised energy solutions.
- **Limited policy and regulatory support.** In many regions, there is a lack of a conducive policy environment, which hinders active community participation.
- **Educational and technical skill gaps and lack of capacity building.** The lack of knowledge, technical skills and managerial expertise required to manage renewable energy technologies within communities, especially in rural areas, present a substantial obstacle.
- **Financial constraints**. High upfront investment coupled with challenges related to achieving sustainable investment returns create financial barriers. Limited financing instruments are available for communities and individuals.
- **Lack of awareness.** Many remain unaware of the potential of community energy or existing community energy initiatives, and there is a lack of accessible information. There is a need for broader communication using diverse channels to reach policy makers and local communities.
- **Insufficient focus on social and environmental factors of energy projects.** The contributions of community power to society and climate protection must be made more central, a shift that has been lacking in previous approaches.

ENABLERS

- **A conducive environment and favourable policies.** There is a need to reduce complexity and bureaucracy. Literature has shown that policy support and financial and economic incentives like feed-in tariffs and net-metering have played a crucial role in the success of community renewable initiatives in Western Europe (Tingey and Webb, 2020). Community energy projects and their financing aspects should be integrated with mainstream programmes, guidelines and standards.
- **Access to finance.** The high upfront cost of installing a renewable energy system such as a solar mini-grid is often a major barrier. It is important to provide incentives, facilitate private sector investment, and ensure that the participation of low-income households and marginalised communities is enabled.
- **Comprehensive feasibility studies.** Renewable energy resource assessments, identification of hotspots for community energy projects, socio-economic factors, and sound environment and social impact assessments can facilitate community energy development.
- **Targeted assistance and training.** Measures to enhance the abilities and motivation of communities to engage in local renewable systems can be instrumental, such as one-stop clearing houses that help secure approvals from different agencies, awareness creation and advocacy, and capacity building and knowledge sharing including best practices, development of necessary vocational and managerial skills, sound financial management and technology know-how.
- **A participatory approach.** This crucial for scaling up community energy projects. The need for trust amongst community members is an important factor for the successful implementation and smooth functioning of community-led energy projects. The sense of responsibility and ownership that comes along with community asset management also supports social cohesion.

6.1 How to implement a participatory and inclusive approach in practice?

As emphasised throughout this paper, a participatory and inclusive approach is crucial – whether to achieve diverse representation from within communities or enhance the effectiveness of resilience efforts. More effective interventions for expanding energy access, energy conservation measures and any associated behavioural changes can be accomplished by following robust participatory processes that allow for greater buy-in and, therefore, more effective interventions. The solutions to gaining broad and meaningful community participation are as follows:

- It is important to identify and **include stakeholders early in the planning process**. Roles and responsibilities should be clarified at the start and throughout the project development process, leveraging existing groups and institutions such as youth or women's groups.
- **Effective communication** should be coupled with more meaningful community participation, such as public meetings, town hall discussions, workshops and training sessions with adequate publicity, inclusiveness and transparency. The goal is to create a space and fit-for-purpose formats for stakeholders to engage, ranging from information provision to co-creation, benefit sharing and ownership. These allow community members to offer feedback, build local capacity and make collective, informed decisions.
- The interests of each stakeholder group should be mapped out. This includes integrating **feedback** from stakeholders, such as citizens and civil society organisations, into the project's business model. When feedback cannot be acted upon, it is important to clearly explain the rationale behind the decision and identify and present alternative solutions.
- Providing **regular updates** on the project will also contribute to fostering the community's trust – a vital element in ensuring project success. This requires continuous project monitoring and reporting, supported by effective feedback loops.
- To facilitate **mutual understanding process** among stakeholders it may be effective to use a facilitator or a mediator. For example, in Germany, Kompetenzzentrum Naturschutz und Energiewende (KNE) has trained mediators to avoid, clarify and resolve conflicts related to renewable energy (KNE, n.d.). Such an approach should be adapted to the specific local socio-economic circumstances.

07

Policy recommendations

The following recommendations outline actions for policy makers to harness the multidimensional benefits that community energy can bring to energy systems:

Community ownership and citizen engagement should be given more prominence in national and regional development, energy plans, policy frameworks and targets. Governments must strategically prioritise gaining legitimacy and widespread public support for energy transition policies to ensure their effectiveness and long-term success. Policy frameworks must enable citizens and communities to actively participate as producers of renewable energy. More should be done to remove undue barriers to decentralised energy solutions and community ownership. An enabling regulatory environment with simplified, flexible requirements and regulations around DRE ownership, permitting, licensing, tariff setting and selling excess electricity is needed to allow for different forms of community ownership and involvement in system operations. Auction schemes that exclude smaller investors such as community energy initiatives should ensure a level playing field by including non-financial criteria. Communities should benefit from projects in their locality, *e.g.* being able to own a stake in a project.

Renewable energy projects should be designed to maximise well-being and socio-economic benefits. Energy projects should be evaluated in terms of how they perform in the communities they affect, in addition to financial and technological assessments. It is important to adhere to principles of fairness, impartiality of processes and equitable distribution of costs and benefits. This also concerns social and environmental impacts and well-being, such as local value creation, jobs and a healthy environment. Consideration should be given to which ownership models of renewable energy and associated infrastructure are the most beneficial in meeting the interconnected goals of decarbonisation, energy efficiency, affordability and fair distribution of costs and benefits.

More needs to be done to generate agency in all citizens through awareness raising, capacity building, and participatory and inclusive approaches. Supported and empowered citizens can lead community energy projects that will accelerate the energy transition and improve social cohesion. Efforts should be made to provide resources for capacity building among communities, such as one-stop shops, knowledge sharing and accessible training adapted to local needs. Communities need to be effectively included in all stages of renewable energy projects. Community energy projects should strive to identify relevant stakeholders and their interests and needs, facilitate their meaningful interaction, and create continued feedback loops throughout the project. Rethinking and enabling a paradigm shift in how community engagement is conducted can further unlock the potential of community energy.

A gender lens should be applied to enable inclusive decision-making and empower women in energy leadership roles. This requires tackling existing barriers and social norms that might limit women's participation and representation of their needs. It is necessary to strive for equitable representation, accessible finance, training and mentoring, and working conditions designed for women's needs.

Direct support, technical assistance and funding should be facilitated to enable community energy in areas with the greatest need. Decentralised energy solutions involving community participation are instrumental in delivering reliable energy to remote communities and underserved conflict-prone or fragile areas. Community ownership and control can ensure long-term viability of the project while maximising local benefits.

Recognising the social value of community energy, it is crucial to facilitate innovative financing options that de-risk projects and lower the cost of capital. Leveraging digital tools can streamline the process of pooling citizen finance. Access to finance can be facilitated by risk-sharing mechanisms and public–private partnerships. Aggregation of smaller projects can reduce overall costs and make them more attractive to larger investors.

Community energy should be an integral part of local energy security, climate adaptation and resilience strategies. As the frequency of extreme events rises, policy makers must prioritise supporting decentralised solutions and enhancing local preparedness to increase resilience and adaptation capacity. Engaging communities and implementing decentralised renewable solutions not only strengthens overall resilience, but also minimises adverse impacts during disruptions and enables faster recovery. Decentralised community energy can operate independently from the main grid, ensuring continuity of energy supply. Community energy initiatives contribute to local energy production and enable better management of demand and supply, reducing strain on infrastructure. By diversifying energy sources and promoting decentralised solutions, communities can reduce dependency on fossil fuel imports and price fluctuations. Encouraging collaboration among communities, fostering technological innovation and providing targeted support can significantly bolster energy security and energy system resilience at the local level.

Community knowledge should be leveraged to ensure that the environmental impacts of renewable energy projects are minimal. Key considerations for locating renewable energy projects and associated infrastructure should cover responsible land use, preserving biodiversity and respecting local culture and values. Community involvement in energy project siting will be beneficial in terms of long-term viability, lower environmental impacts and improved social acceptance.

Collaboration, knowledge exchange and sharing of best practices can further support community energy initiatives. International and regional co-operation can serve as catalysts for forging new partnerships, exploring diverse financing options and disseminating successful business models.

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