IRENA
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COMMUNITY-OWNERSHIP MODELS

INNOVATION LANDSCAPE BRIEF

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ABOUT IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. **www.irena.org**

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DISCLAIMER

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1 BENEFITS

Community projects can provide flexibility and, when connected to the main power system, increase the reliability and resilience of the whole system. They provide many socio-economic benefits in addition to low-cost renewable energy to the local community.

Community ownership models

Main grid benefits
- Greater grid flexibility
- Increased grid resilience

Power sector transformation in the community
- Increased deployment of distributed renewable generation
- Improved renewable energy access
- Lower energy cost for the community

2 KEY ENABLING FACTORS

- Enabling policy and regulatory frameworks
- Simplification of administrative processes
- Access to finance
- Capacity building within community

3 SNAPSHOT

- ➜ More than 4 000 community-owned projects provide power, mainly in Australia, Europe and the United States
- ➜ Innovations emerging with community ownership include aggregators, demand response, mini-grids, energy storage, electric vehicles
- ➜ Eigg Electric – a community-owned company – provides 95% renewable power to all residents of a Scottish (UK) island.

What does community ownership mean for renewable energy?

Energy-related assets, such as energy generation systems, energy storage systems, energy efficiency systems, and district cooling and heating systems, can be collectively owned and managed by their users.

COMMUNITY-OWNERSHIP MODELS

Through cost-sharing, community-ownership models enable participants to own **key local energy assets**, contribute to community energy development and help to scale up renewables.

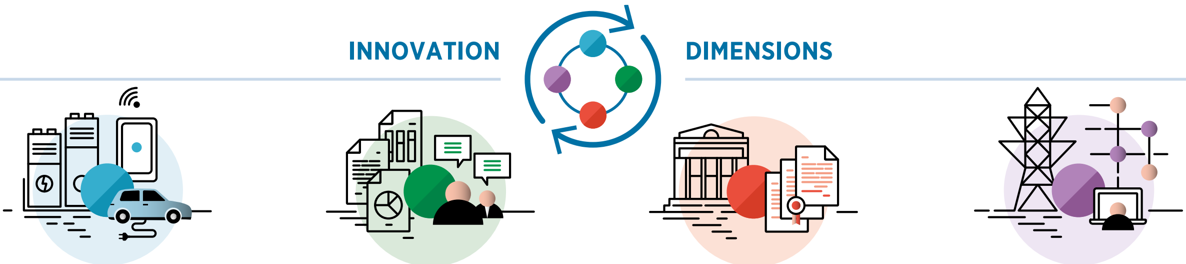
ABOUT THIS BRIEF

This brief forms part of the IRENA project "Innovation landscape for a renewable-powered future", which maps the relevant innovations, identifies the synergies and formulates solutions for integrating high shares of variable renewable energy (VRE) into power systems.

The synthesis report, "*Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables*" (IRENA, 2019a), illustrates the need for synergies between different innovations to create actual solutions. Solutions to drive the uptake of solar and wind power span four broad dimensions of innovation: enabling technologies, business models, market design and system operation.

Along with the synthesis report, the project includes a series of briefs, each covering one of 30 key innovations identified across those four dimensions. The 30 innovations are listed in the figure below.

INNOVATION DIMENSIONS



ENABLING TECHNOLOGIES

1 Utility scale batteries
2 Behind-the-meter batteries

3 Electric-vehicle smart charging
4 Renewable power-to-heat
5 Renewable power-to-hydrogen

6 Internet of Things
7 Artificial intelligence and big data
8 Blockchain

9 Renewable mini-grids
10 Supergrids

11 Flexibility in conventional power plants

BUSINESS MODELS

12 Aggregators
13 Peer-to-peer electricity trading
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15 Community-ownership models
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MARKET DESIGN

17 Increasing time granularity in electricity markets
18 Increasing space granularity in electricity markets
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20 Re-designing capacity markets
21 Regional markets

22 Time-of-use tariffs
23 Market integration of distributed energy resources
24 Net billing schemes

SYSTEM OPERATION

25 Future role of distribution system operators
26 Co-operation between transmission and distribution system operators

27 Advanced forecasting of variable renewable power generation
28 Innovative operation of pumped hydropower storage

29 Virtual power lines
30 Dynamic line rating

This brief provides an overview of community-ownership models, which allow actors, including households, individuals and businesses, to unite in investing in, developing and operating renewable energy assets. Through cost-sharing, community-ownership models enable individual participants to own parts of the asset with lower levels of investment, which is especially beneficial for the deployment of renewable energy assets.

The brief is structured as follows:

I. DESCRIPTION

Community-ownership structures, in the context of the global energy transition and the decentralisation of power systems, refer to the collective ownership and management of energy-related assets, usually distributed energy resources (DERs). Through cost-sharing, community-ownership models enable individual participants to own assets with lower levels of investment. Community-ownership projects vary in size but are often between 5 kilowatts (kW) and 5 megawatts (MW) in size, depending on where they are being implemented (Gall, 2018). While energy generation is their most common purpose, community-ownership initiatives can also deploy energy storage, energy efficiency, distribution network, and district heating and cooling systems.

A community-ownership project is characterised by local stakeholders owning most of the project and voting rights and by control resting with a community-based organisation. Most of the project's socio-economic benefits are therefore distributed at the local community level (IRENA Coalition for Action, 2018).

The innovative aspect of community-ownership business models lies in the role of the community and its participants, which goes beyond renewable energy generation. Nowadays, community-ownership models cover the entire energy value chain: they can provide localised generation for power, heat and energy-related services (*e.g.* storage, charging electric vehicles, energy trade with surrounding communities); enable efficient energy use; and provide flexibility to the entire power system. For example, the local solar community of Casalecchio di Reno in Italy expanded the model from providing electricity from solar photovoltaic (PV) power plants to encompassing shared services for charging electric cars (Bisello *et al.*, 2017).

Generally, community-ownership models revolve around the following options:

- **Community-owned electricity generation plants, such as solar PV plants, wind power plants and biomass plants**, can be developed to fulfil the electricity needs of the local community. Consumers, bundled in communities, self-consume the electricity produced and thereby become collective "prosumers". Any additional electricity generation from such plants can be exported to the main grid, sold to third parties and businesses, or supplied back later to the members of the community, if storage is available.

- **Community-owned district heating systems**, such as biomass, wood pellet, solar, geothermal, and combined heat and power plants, can be implemented to serve the heating needs of the local community.

- **Community energy storage systems** involve the deployment and operation of batteries by communities to store the electricity generated locally or consumed from the grid to meet the peak demand of the community.

- **Community energy efficiency programmes**, either as a core or complementary activity, encourage members to take measures to reduce their consumption or invest in building retrofits. They may encourage such actions through direct investments, education and outreach, provision of technical and financial advice, or partnerships with local authorities.

- **Community electricity retailers** buy wholesale electricity produced by community-owned electricity generation plants and sell energy services to local communities and other third-party supporters.

Usually, the community owns, manages and takes the benefits of the project, while the main power grid operator and other parties have a secondary role. Figure 1 depicts an energy system based on the community-ownership business model.

The main purpose of the organisation varies. However, community-ownership projects are typically focused on generating benefits to the community (economic, social, environmental) in addition to financial profits. The main purpose of a community-ownership project influences its implementation, as different models may be better suited to different objectives.

Implementation of community-ownership models for energy-related assets can be structured differently, based on a variety of legal frameworks, forms of ownership, distribution of benefits and level of democratic governance. A community model includes a combination of at least two of the following elements (IRENA Coalition for Action, 2018):

- **Ownership structure:** Local stakeholders may own part or all of a renewable energy project. Usually, community-ownership models involve **full ownership** by the community, although in such cases other stakeholders – such as conventional energy companies (utilities, retailers, etc.), non-profit organisations and (local) authorities – can participate as individual members of the community. In other cases, the local community may own a **majority stake**, while other stakeholders can be a part of the ownership arrangement as partners. In many cases, renewable energy projects are developer led, and communities are given the option to take partial ownership of the project.

- **Level of democratic governance:** Voting control of the business around the renewable asset rests with a community-based organisation, meaning that local stakeholders have the majority of the voting rights concerning the decisions taken on the project.

- **Local distribution of profits:** The majority of social and economic benefits are distributed locally (*e.g.* jobs created locally, power supplied to the community, profits shared among individual participants to the community scheme).

Figure 1 Schematic of energy system based on the community-ownership business model

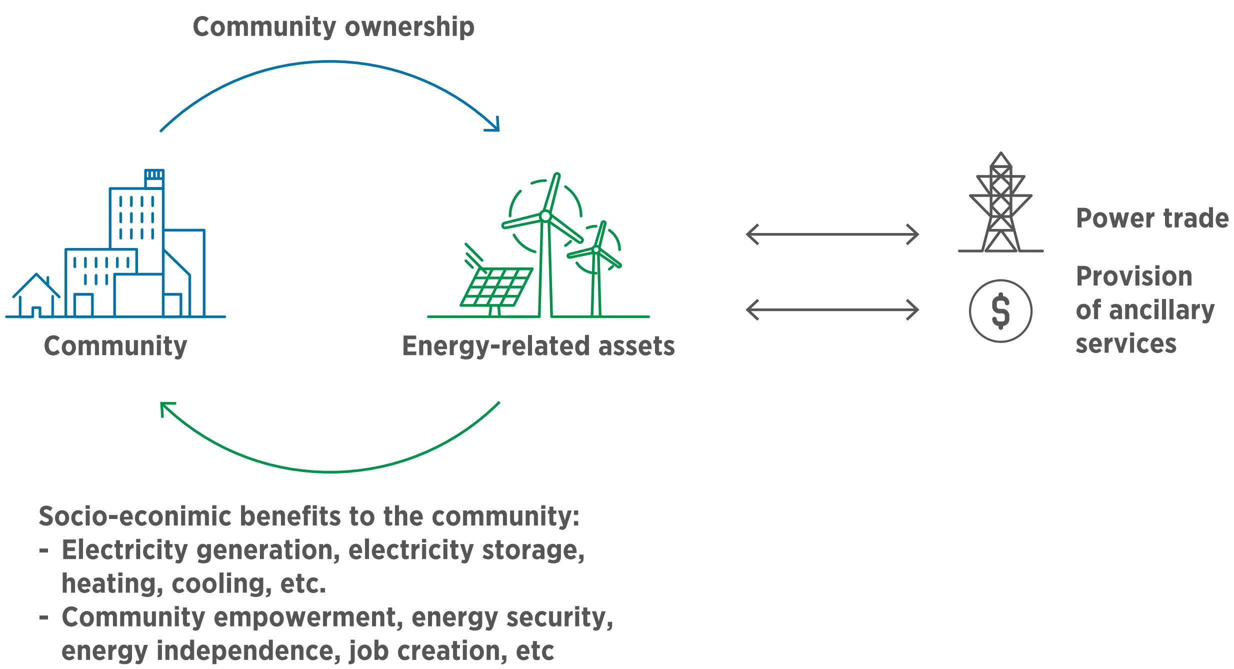


Figure 2 highlights some of the common community-ownership models. Table 1 further describes these frameworks and provides relevant examples.

Figure 2 Characteristics and common community-ownership models

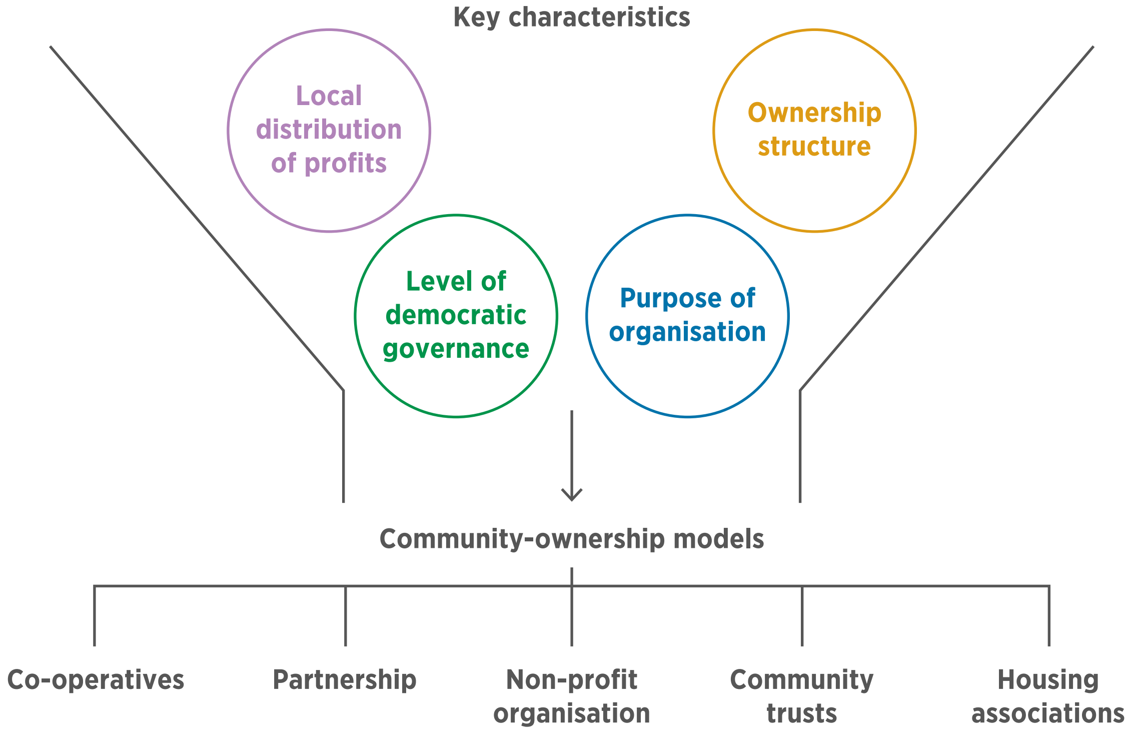


Table 1 Legal forms of community-ownership business model

Community-ownership model	Description
Co-operatives	Co-operatives are jointly owned by their members to achieve common economic, social or cultural goals based on the democratic principle of "one member, one vote". Co-operatives rely largely on volunteers but can have paid staff.
Partnerships	In partnerships, individual partners own shares in the community-ownership model. The key objective of a partnership is to generate profits for the shareholders, in addition to any other benefits of the project. Unlike co-operatives, partnerships may not operate on the basis of "one member, one vote". Nor do partnership firms rely largely on volunteers, as co-operatives do. They may employ full-time staff to provide expertise needed for specific projects.
Non-profit organisations	A non-profit organisation is formed by investments from its members, who are responsible for financing the organisation but do not take back any profits. Profits are re-invested in projects focused on community development.
Community trusts	Trusts use the returns from investments in community projects for specific local purposes. These benefits are also shared with people who are not able to invest directly in projects.
Housing associations	A form of non-profit, such associations offer housing to low-income families and individuals.

Social benefits of community-ownership models

While community-owned projects have various purposes, they typically focus on creating social benefits. One major benefit of community-ownership models is that communities are less reluctant for larger devices such as wind turbines to be installed. Opposition is strongly reduced, and the "not in my backyard" effect is diminished as communities become part of and actively involved in the project.

This creates a sense of ownership that in turn can **empower a community** greatly: members are more prone to do other (non-energy-related) projects as a community and feel a bigger sense of attachment to the place because of their active involvement.

Especially in rural areas, this attachment – together with job creation (from technical to managerial jobs) – can play a crucial role in (particularly young) people's decision to stay or return to places with otherwise declining and ageing populations. This can have huge effects on the future of rural settlements.

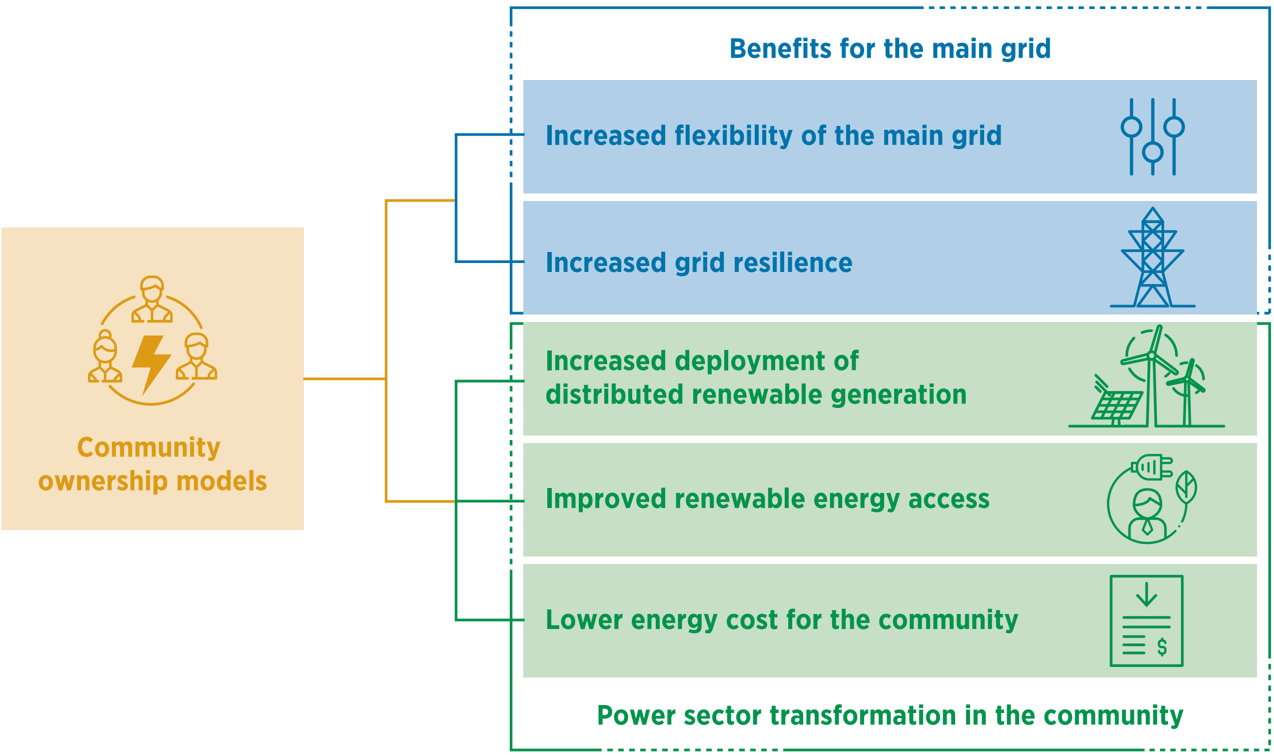
Another important social benefit of community ownership is the **energy and environmental consciousness** that is created among a community, which can go beyond energy consumption. For example, on Eigg Island in Scotland (UK), Eigg Electric is a community-owned, managed and operated renewable-based system that provides electricity to all residents. Households there have an electricity demand cap of 5 kW, and they have a traffic light system at the pier, where everyone can see if available electricity is becoming scarce, so there is great participation and consciousness about the availability of electricity resources. In addition, people are starting to drive electric vehicles, do beach clean-ups, plant trees, and other similar activities (Green Eigg, *n.d.*)

II. CONTRIBUTION TO POWER SECTOR TRANSFORMATION

Community-ownership models allow costs to be shared, which lowers upfront investments and therefore enables larger deployment of decentralised renewable power plants at the local level. They also encourage people to unite and act on energy and other socio-economic challenges specific to their communities, while encouraging solidarity and co-operation.

While community-owned projects have various purposes, they typically focus on creating benefits for the community. In addition, projects developed under community ownership can provide flexibility to the main transmission grid, if connection is in place. Figure 3 summarises the key contribution of community-ownership models to power sector transformation.

Figure 3 Key contributions of community-ownership models to power sector transformation



Increased flexibility of the main grid

Community-owned projects, either individual projects or projects bundled around a mini-grid, are primarily used for community applications. However, if these projects are connected to the main grid, as with any DER, they can provide power and other ancillary services to the main grid. For the electricity injected into the main grid, the community-owned projects would be remunerated in accordance with the regulation in place, either through direct trade on the wholesale market, feed-in tariffs, net metering or net billing (for more information, see *Innovation landscape brief: Net billing schemes* [IRENA, 2019b]). This could increase flexibility in the main grid while providing additional income for the community members.

Through demand-side management, the community can unlock demand-side flexibility in the system through load shifting and peak shaving. Community energy storage systems, for example, can also reduce peak demand in the grid by supplying stored energy to local communities, as well as to the grid, during peak hours (for more information on storage systems please see *Innovation landscape brief: Utility-scale batteries* [IRENA, 2019c]).

Community-owned projects can help balance power grids, providing different services such as frequency control, voltage stability congestion management, system restoration and enhanced power quality, as with any DER or mini-grid. For example, a solar PV system connected to a battery storage system deployed by communities can quickly ramp the power output up or down to provide frequency and voltage regulation services (for more information, see the *Innovation landscape briefs: Renewable mini-grids* [IRENA, 2019d], *Market integration of distributed energy resources* [IRENA, 2019e], and *Innovative ancillary services* [IRENA, 2019f]).

Increased grid resilience

The main system of large, centralised power plants is vulnerable to massive outages from natural disasters and acts of terrorism. Incorporating smaller, decentralised local renewables and other DERs diversifies the energy supply and reduces the risk of widespread power outages, especially in power systems with a history of outages. Distributed generators and micro-grids could enable islanded operation, thus improving resiliency against extreme events. However, the co-ordinated operation of heterogeneous distributed generators introduces different operational and control requirements (Singh, Kekatos and Liu, 2018).

Increased self-consumption inside a community, by installing generation plants coupled or not with battery systems, leads to enhanced resilience and energy security in the community and can keep a community functioning during a blackout. Because of its local scale, a micro-grid does not need a vast system of overhead lines to deliver power and could therefore keep safely functioning when a central grid turns off owing to hazards (Chrobak, 2019). Community-owned projects can allow a community to get a more powerful, resilient energy system. For example, in Scotland some households have a 3–10 kW wind turbine in the backyard, but as a community they can get a bigger (900 kW) turbine project.

Increased deployment of distributed renewable generation

When decentralised energy systems are implemented by a local community, the size of the project is larger than when implemented by an individual, benefiting from economies of scale. Community-ownership models can enable aggregation of demand for energy-related assets and negotiation of better prices with installers, project developers and equipment suppliers, thus lowering the upfront investments needed from community members. Community battery storage provides economic advantages over household storage as costs per kilowatt-hour (kWh) decrease with increasing battery size (Fraunhofer IWES, 2014). For instance, Cooperative Community Energy, a solar co-operative based in California, United States, gets discounts on equipment because of bulk procurement, which are passed on to the members (Cooperative Community Energy, *n.d.*). In Vermont, United States, Acorn Renewable Energy Co-op is a co-operative organisation that provides discounts to members for the purchase of solar heaters, residential solar PV systems and wood pellets for heating. This is enabled through bulk procurement by the co-operative on behalf of its members (Acorn Energy Co-op, 2017).

For example, St. Gorran Community in Cornwall, United Kingdom, established in 2008 the co-operative Community Power Cornwall Limited to enable community ownership of energy assets, to generate capital to be re-invested locally in renewable energy and to nurture the spread of community-owned renewable energy generation. The first project developed was a 160 kW wind power plant in 2011, followed by a second 10 kW wind turbine in 2014. In 2015 and 2016, solar PV projects totalling 90 kW were developed, followed by other solar PV projects totalling 220 kW in 2018 and 2019 (Community Power Cornwall, 2020).

Owing to better economic viability, the use of community-ownership models can lead to a higher and more rapid deployment of distributed renewable generation assets than is possible with individually owned systems.

Improved renewable energy access

Increased deployment of decentralised energy resources contributes to local decarbonisation goals and provides socio-economic benefits, such as creating new jobs and energy access.

For example, in Scotland, on Eigg Island, Eigg Electric was established as a community-owned, managed and maintained company that provides renewable electricity for all island residents. The community-ownership system consists of three hydroelectric generators (110 kW), a group of four small wind generators (24 kW) and an array of solar electric panels (50 kW), sited at different locations around the island as determined by the optimum availability of resources. The total generating capacity of the system is approximately 184 kW, and it has provided around 95% of the electricity needed since the scheme was first switched on in 2008. The remaining 5% is generated by two 80 kW diesel generators to provide backup when renewable resources are low or during maintenance. Eigg is not connected to the mainland electricity supply, and the community-owned Eigg Electric provides the community with electricity access (The Isle of Eigg, *n.d.*).

In areas where the electricity access is poor, the lower upfront investments required by community energy projects can enable local development of renewable energy projects. Besides providing energy access to the community, such projects can improve livelihoods by enabling productive uses, such as agro-processing, cold storage, irrigation and desalination, or other micro-enterprises. In these regions, community-ownership models can be implemented together with flexible payment methods, such as pay-as-you-go models, to enable vulnerable populations to gain access to electricity (for more information, see *Innovation landscape brief: Pay-as-you-go models* [IRENA, 2020]).

Lower energy cost for the community

Community-ownership projects can also lead to significantly lower cost energy for the community. First, the costs for electricity produced from locally deployed renewable energy plants may be cheaper than electricity offered to the community by other retailers. Demand (also called "peak") charges are an important component of electricity bills and are generally based on the highest electricity usage requirement (in kW). On-site battery storage systems can be used to manage peak loads and reduce demand charges (for more information, see *Innovation landscape brief: Behind-the-meter batteries* [IRENA, 2019g]). In addition, for the electricity injected into the main grid, the community-owned projects would be remunerated in accordance with the regulation in place.

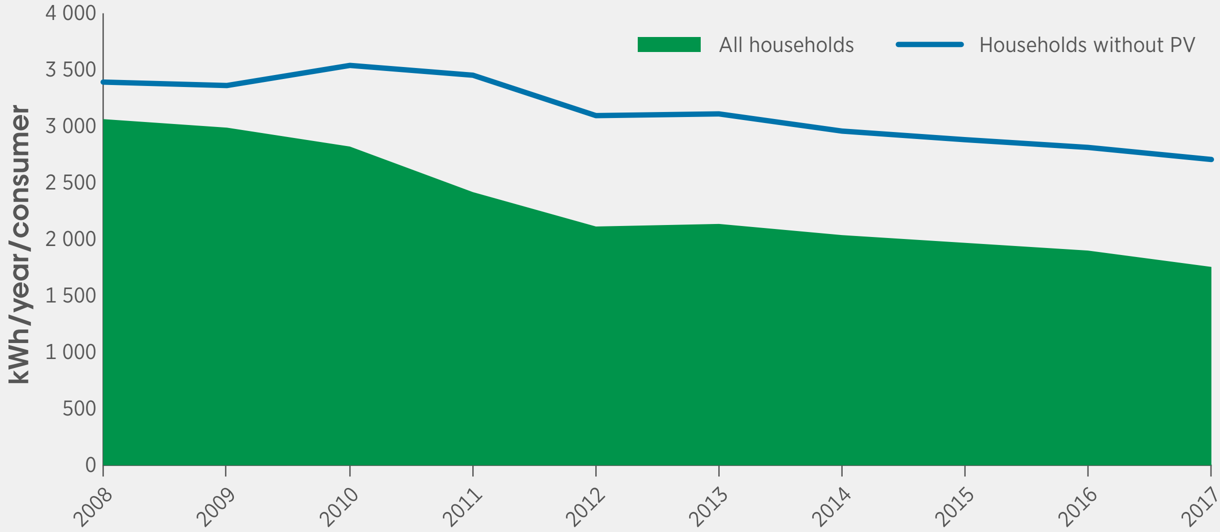
In the United States, local governmental entities called community choice aggregators (CCAs) have been established, which procure electricity on behalf of retail customers within a certain geographic area. Currently CCAs are authorised in seven states. CCAs are an attractive option for communities that want more local control over their electricity sources, more green power than is offered by the default utility and/or lower electricity prices. By aggregating demand, communities gain leverage to negotiate better rates with competitive suppliers and choose greener power sources. CCAs in California have leveraged buying power and access to low-cost financing to procure from local renewable energy projects at lower prices than from investor-owned utilities (EPA, 2020).

Potential impact on power sector transformation

Community-ownership models have a great impact on transforming the community's relationship with energy as well as providing benefits to the entire system. Examples of projects with such proven benefits are below:

- The community-owned utility in the village of Minster, Ohio, United States, has implemented a 3 MW solar project with a 7 MW, 3 megawatt-hour (MWh) battery storage system. The project has resulted in **savings of USD 1 million per year for the community**, because of which electricity tariff increase for community members has been avoided. Further, the **battery storage system is providing frequency regulation services to PJM Interconnection**,[1] leading to an additional revenue stream for the project. Minster has **saved over USD 150 000 in transmission and capacity costs** owing to the implementation of this project. The battery connected to the solar plant has further **helped defer a USD 350 000 purchase of reactive power hardware** that would have been needed to integrate the solar energy generation into its grid (Smart Electric Power Alliance, 2018; Trabish, 2016).
- In Jühnde, a small village in Germany, a 700 kW combined heat and power plant using biogas was implemented under a co-operative structure. **The plant meets 70% of the heating needs of the village** and produces double its electricity demand. **The excess electricity is fed back into the grid** (Simcock, Willis and Capener, 2016).
- In Belgium, a renewable energy co-operative, Ecopower, with about 50 000 members, supplies 1.5% of the households in the Flanders region with about 90 gigawatt-hours of renewable electricity from their own wind turbines, PV installations and small hydro. The supply is considered a service to the members and is performed at cost, without taking profits. As a result, **Ecopower offers the lowest price for electricity in the Flemish region. Members pay USD 0.22/kWh, compared with an average retail tariff of USD 0.29/kWh** (Statista, 2017). The members also get a dividend of up to 6% per annum on their holdings. More than 40% of the members have installed PV panels at home, and the average consumption from the grid of its members has almost halved over the past 10 years to 1 758 kWh/year in 2017, whereas the average household in Flanders consumes 3 468 kWh/year, as shown in Figure 4. Furthermore, Ecopower encourages its members to reduce their consumption by providing them with education and technical advice on taking efficiency measures.

Figure 4 Average consumption from the grid of Ecopower members



1 *PJM Interconnection is the regional transmission organisation for 13 US states, including Ohio.*

III. KEY FACTORS TO ENABLE DEPLOYMENT

Enabling policy frameworks

Creating long-term and stable policy frameworks for energy communities is key to stimulating further investment. The choice and design of these policy frameworks should be adapted to local and country-specific circumstances as well as to the broader development objectives they may seek to support. While some countries have introduced specific policy measures supporting energy communities indirectly (*e.g.* via feed-in tariffs), others have introduced support programmes directly for community energy investments (*e.g.* targeted grants) (IRENA Coalition for Action, forthcoming).

Although there are few national programmes dedicated to supporting community ownership in developing countries, several developed countries have initiated support programmes focusing on community-based planning and ownership. Such programmes typically involve energy co-operatives and local ownership of projects combined with financial support schemes. This type of structure creates a double benefit, as it enables local engagement and acceptance of projects, as well as lower energy bills for all participating consumers.

Community-ownership programmes in developed countries are usually not limited to certain resources but span a broad range of renewable technologies, such as wind, solar, bioenergy, geothermal or hydropower. For example, Germany supported participation of community-ownership projects in wind auctions by putting in place preferential rules for such projects. Under these preferential rules, community-ownership wind projects had up to two years after winning a bid to obtain a building permit.

Other bidders, in contrast, had to present the permit at the moment of bid submission. As a result of the more favourable conditions, the first three rounds before November 2017 awarded over 90% of the total auction volume of 2 890 MW to community-ownership projects. However, by June 2019, of the community-ownership wind projects that had won those bids, only a few (responsible for 167 MW of the volume) had obtained a building permit. This reflects the general permitting challenges faced (IRENA, 2019h).

Similarly, Ireland is proposing a new Renewable Electricity Support Scheme, which includes an enabling framework for community participation through the provision of pathways and supports for communities to participate in renewable energy projects. All projects looking for support under the new scheme will need to meet prequalification criteria including offering the community an opportunity to invest in and take ownership of a portion of renewable projects in their local area (DCCAE, 2020).

In 2019, the European Union institutions reached a political agreement on all the major pieces of legislation forming the Clean Energy for All Europeans package, which is set to influence the future of the energy landscape in the coming decades in Europe. One of the major breakthroughs comes from the legal recognition (with associated rights and responsibilities) granted to individual renewable energy producers and communities. Directive (EU) 2018/2001 of 11 December 2018 on the promotion of the use of energy from renewable sources now provides the right to citizens and "renewable energy communities", a recognised legal entity, to produce, store, consume and sell renewable energy without being subject to disproportionate burden and discriminatory procedures. Under this new directive, which needs to be translated into national legislation, a renewable energy community is based on "open and voluntary participation", being controlled by shareholders or members located in the proximity of the power plant, and the shareholders or members can be natural persons, small and medium enterprises, or local authorities, including municipalities (European Union, 2018).

In developing countries in general, there is a significant need to scale up energy access programmes for the hundreds of millions of people who still do not have access to electricity. A wide range of national and international programmes support schemes to provide energy access, but the capital and human resources needed are huge, and the current programmes are not sufficient. The key obstacles for rural electrification projects are (i) availability of finance at reasonable cost, (ii) mobilising and capitalising equity for rural communities, (iii) availability of technical and economic information, and (iv) availability of trained staff (IRENA, 2019i).

Clear regulatory frameworks for community-ownership projects' participation in power markets

Supply of energy to members within or outside the community may require regulatory clarity, in addition to supportive enabling policy frameworks. For instance, in most countries, the sale of surplus power to third parties outside of the community or peer-to-peer trading of energy among community members either does not have regulatory clarity or is plagued by cumbersome processes. Therefore, appropriate regulatory provisions need to be developed for community-owned projects and other DERs to enable energy supply arrangements such as third-party sale or peer-to-peer energy sharing.

The participation of community-ownership projects in the wider energy market, where applicable, is restricted in many countries owing to minimum capacity requirements. Adjusting the minimum capacity requirements or aggregation of DERs and community-ownership projects would enable the participation of these smaller projects in the wholesale markets (for more information, see the *Innovation landscape briefs: Market integration of distributed energy resources* [IRENA, 2019e] and *Aggregators* [IRENA, 2019j]).

Simplification of administrative processes

The development of renewable energy projects involves some complex administrative processes, including planning, project development and obtaining the necessary permits. Associated tasks can include environmental impact assessments, construction permits, occupational health and electric safety permissions, licences for energy generation, and grid connection authorisation. Processes for obtaining these permissions can be streamlined for community-owned projects to bring down costs and development times, thus making such projects more attractive investments. For instance, in North Rhine-Westphalia, Germany, wind installations under 10 metres in height that are not located in residential or mixed utilisation areas are exempt from certain approvals. Similarly, in the United Kingdom, the installation of solar PV on slanted roofs has been preapproved. In Wales and Scotland, projects are automatically preapproved for installation, even on flat roofs.

Access to the grid for community-owned renewable projects often involves challenges such as limited network capacity, the need for grid extension and long processes for obtaining grid connection authorisation. Simplification of these tasks can be tackled through appropriate regulatory mandates.

Access to finance for community-ownership projects

Community-ownership projects may need large upfront investments, and communities' equity contributions might prove insufficient. Access to commercial financing is often difficult owing to the lack of clarity on long-term revenues generated by community-ownership projects. Unlike other renewable projects, a community-ownership project often aims to achieve objectives in addition to maximising financial profits for its members (*e.g.* energy security, energy access, decarbonisation). This can make the business case more challenging when trying to gain the support of traditional financiers and investors. These challenges can be addressed if the community can partner with local businesses or developers to fill the funding gaps and increase the creditworthiness of the projects. In the United Kingdom, for example, the majority of community-ownership projects have been based on a partnership with developers or businesses (Murray, 2014).

Further, small community energy projects may encounter challenges in raising funds from community members and other investors initially as the projects may be perceived as high risk. The European federation of renewable energy co-operatives (REScoop) is attempting to mitigate such development risks under its 'Renewable Energy Cooperatives Mobilizing European Citizens to Invest in Sustainable Energy' (MECISE) programme. Through this programme, REScoop MECISE will invest in community energy startups and sell its ownership to community members and other investors once the project is up and running (REScoop, 2018).

Governments and development banks can also enable growth of community-ownership projects by providing low-cost loans and grants. In Germany, around half the community-owned projects have received funding from co-operative banks, and a third of the projects have received low-cost loans from KfW, the German state-owned development bank (Murray, 2014).

The Scottish government's Community and Renewable Energy Scheme offers a range of financing options for community renewable energy projects, including different grants from USD 28 750 (GBP 25 000) up to USD 172 500 (GBP 150 000) (Local Energy Scotland, 2018).

Further, providing microcredit to communities can also be used as a mechanism to kick start community energy projects. For instance, in Latin America, Africa and South Asia, microcredit has been used to initiate community energy projects (REN21, 2016).

Capacity building and technical assistance within the community

The success of community-ownership projects depends on access to information and technical expertise within the members of the community. Therefore, capacity building of local communities as well as the availability of adequate technical expertise and assistance in implementing various community-owned projects is key. For example, to tackle this challenge, Renew Wales, an organisation in the United Kingdom led by local community experts, provides community groups with advice, training and mentoring on setting up community projects by connecting them to other groups that have implemented similar projects. The co-ordinators of the organisation spend up to three days with the community groups to help them develop action plans (Renew Wales, 2018).

Online toolkits and guidance documents can also enable local communities to set up energy projects. The German city of Freiburg, for instance, has developed an online tool called FREE SUN, which identifies available space for rooftop solar installations and provides information related to administrative procedures and regulations. The information provided by this tool has been instrumental in the massive uptake of solar PV and solar thermal energy solutions by the local communities (City of Freiburg, 2018).

In Scotland, a Community and Renewable Energy Scheme Toolkit has been developed by the government. The toolkit provides advice to communities and support in accessing grant and loan funding, in all aspects of local, renewable energy (Local Energy Scotland, 2020).

IV. CURRENT STATUS AND EXAMPLES OF ONGOING INITIATIVES

Community-based projects have gained traction in the United States and Europe, especially in countries like Denmark, Germany, the Netherlands, and the United Kingdom (particularly Scotland), where co-operative frameworks have a historical presence.

Different jurisdictions have different definitions of community-ownership models, creating challenges in comparing the status of such models across jurisdictions.

Table 2 shows some key indicators for community-ownership models.

Table 2 Key indicators on the current status of community-ownership models

Key indicators	Description
Number of community-ownership initiatives (2018)	4 000+ globally, primarily in Australia, Denmark, Germany, the Netherlands, the United Kingdom and the United States (Interreg Europe, 2018; REN21, 2016)
Countries where projects are implemented (2018)	Argentina, Australia, Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Italy, Luxemburg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States
Total installed capacity of community-ownership projects (2020)	Germany: 1 GW (1% of total installed capacity) (FSR, 2020)
Most common community-ownership models	• Co-operatives • Partnerships
Typical size of community-ownership projects	Approximately 50 kW to 10 MW (although they can be much bigger; for example, the 66 MW community-owned wind turbines in Dardesheim, Germany, and the 102 MW community-owned wind project in Krammer, Netherlands)
Technologies predominantly used in community-ownership projects	• Solar PV • Wind turbines • Energy efficiency • District heating
Other innovative technologies starting to be used in community-ownership projects	• Aggregators (virtual power plants) • Demand response • Mini-grids • Biomass power plants • Energy storage • Electric vehicles (early stages)

Table 3 Case studies

PHS scheme	Location	Description	Value added
Ærøskøbing District Heating, Ærø, Denmark	Co-operative	District heating using solar thermal and bioenergy	The co-operative owns three district heating stations in Ærø, a small community in Denmark. These plants generate heat using straw, wood pellets and a solar collector. The straw and wood pellets are used only after heat from solar capacity has been used (Ærøskøbing Fjernvarme, *n.d.*). The co-operative meets heat requirements for a community of 7 000 inhabitants. Solar produces 75–100% of the heat in summer months.
Buan Citizen Power Generation (BCPG) – South Korea	Partnership	Community solar PV project	BCPG has installed 36 kW of solar PV and a geothermal heating system in the village of Deunyong, Republic of Korea. Around 75% of the initial investment for these projects was provided by ten local people, with the rest coming from the government. The electricity generated from these projects is sold to the Korean Electric Power Company under a fixed feed-in tariff; the revenue generated is distributed to project investors (partners), and any remaining profits are allocated for further solar PV and community heating projects (Simcock, Willis and Capener, 2016).
Eigg Electric, Eigg Island, Scotland	Co--operative	Community wind, solar and hydro system	Eigg Electric is a community-owned, managed and maintained company that provides electricity for all island residents from renewable sources, comprising 110 kW hydro projects, 24 kW wind turbines and a 20 kW solar PV plant, totalling 184 kW. Renewable sources have provided around 95% of the island's electricity since the scheme was first switched on in 2008 (The Isle of Eigg, *n.d.*).
Horshader Community, Isle of Lewis, Scotland	Trust	Community wind energy project	Horshader Community constructed a 900 kW wind turbine, which earns revenues through feed-in tariffs (Simcock, Willis and Capener, 2016). The yearly revenue of approximately USD 125 000 (GBP 100 000) is used for local development. This is one of the many such projects developed in Scotland.
Hvide Sande Community, Denmark	Trust	Community wind energy project	Hvide Sande Community installed three wind turbines of 3 MW on the shoreline. The board of the foundation has members from the local community, with around 400 shareholders. (Maegaard, *n.d.*). The expected return will be invested in the modernisation and development of the harbour, which is of great importance to the region (Community Power, *n.d.*).
Hvidovrebo Section 6, Denmark	Housing association	Rooftop solar and solar thermal	In Denmark, Hvidovrebo Section 6 is a housing estate located on the outskirts of Copenhagen. Using the model of "tenants' democracy", the tenants decided through consensus to install rooftop solar and solar thermal units on roofs that were already in need of renovations. The project will span ten roofs throughout the estate and is expected to produce 120–160 MWh electricity per year. This will be financed by residents through additional rent or mortgage payments (Roberts, Bodman and Rybski, 2014).

PHS scheme	Location	Description	Value added
Middlegrunden, Copenhagen, Denmark	Hybrid structure (partnership between a utility and a co-operative)	Community wind energy project	A wind farm of 20 wind turbines of 2 MW capacity each is situated offshore, near Copenhagen harbour. This wind farm is a 50:50 joint venture between Copenhagen Energy (the local utility) and Middlegrunden co-operative. It is the largest community-owned wind project in the world, and the joint venture was encouraged by Denmark's decentralisation of energy targets and flexible planning arrangements (Simcock, Willis and Capener, 2016). The project meets 3% of Copenhagen's electricity needs.
Odanthurai panchayat, Tamil Nadu, India	Co-operative	Community wind energy project	Odanthurai panchayat in the Coimbatore district of Tamil Nadu, India, implemented a 350 kW wind energy plant – the first ever community-owned power project in India. The generation from this plant is used to satisfy the electricity needs of the village; the excess is sold to the grid and used to pay the interest on the bank loans. Selling around 30% of the electricity generated to the grid brings a yearly revenue of approximately USD 27 000 (INR 2 million) to the community (Saravanan, 2016).
Ripple Energy, United Kingdom	Co-operative	Community electricity retailer	Once a customer chooses to receive their energy through Ripple, they will co-own the wind farm, or an alternative renewable source of power, through a community benefit society. Customers will be charged an upfront fee, which will be dependent on how much energy they use and the size of the project. Customers could save around USD 105 to 215 (GBP 85 to 175) each year on their electricity bill throughout the wind farm's 25 year lifespan (Gausden, 2019).
United Power, Colorado, United States	Co-operative	Community electricity retailer Community battery storage	The co-operative electricity retailer implemented a 4 MW/16 MWh battery storage system that stores energy during the night (off-peak time) and discharges it during the day (peak time) to reduce demand charges (Best, 2019).
University Park Community Solar LLC, Maryland, United States	Partnership	Community solar PV project	University Park Community Solar LLC comprises around 35 members, residents of University Park. Each member pooled in an average of USD 4 000 to develop a 27.77 kW solar power system. The power from this system is sold to the University Park Church of Brethren, and the excess is fed back into the grid. The firm also sells Solar Renewable Energy Certificates (University Park Solar, 2018).
Wiltshire Wildlife Community Energy (WWCE), Swindon, United Kingdom	Hybrid structure (co-operative set up by a trust)	Community solar PV project	WWCE is a community benefit society set up by Wiltshire Wildlife Trust for the development of community-owned renewable energy projects. WWCE has implemented two solar PV projects of 1 MW and 9.1 MW. The projects were funded by the sale of shares in WWCE, allowing people to invest anywhere between USD 670 and USD 134 000. The projects earn revenue through feed-in tariff payments, and after payment to its members, 80% of the remaining money is allocated to WWCE's community benefit fund, with 20% being directly allocated to Wiltshire Wildlife Trust (Simcock, Willis and Capener, 2016). WWCE has paid 7% dividends to its members, and the remaining profits are spent on local community development.

V. IMPLEMENTATION REQUIREMENTS: CHECKLIST

TECHNICAL REQUIREMENTS

Hardware:

- Energy assets such as renewable generation systems (solar rooftop PV, wind turbines, etc.), district heating systems (biomass-based heating), battery storage systems and mini-grids
- Grid upgrades required to connect DERs with the existing grid
- Smart meters and smart grid

Software:

- Energy accounting and management software for community projects
- Digital infrastructure that allows system operators to have real-time information on the availability of DERs that can provide flexibility, enabling them to access these ancillary services.

POLICIES NEEDED

- Long-term and stable policy frameworks, including policy measures supporting community energy and community energy investments
- Financial incentives such as tax credits, low-cost loans and grant funding for community-owned projects
- Policies to encourage public-private partnerships in setting up community-owned projects at the local level
- Promotion of energy community development and decentralisation of the power system

REGULATORY REQUIREMENTS

- Enable new energy supply and trade arrangements, such as third-party sale or peer-to-peer energy trading, for community-owned projects and other DERs (*e.g.* retailers procuring electricity from community-owned projects)
- Allow participation of community-ownership projects in the energy market by adjusting the minimum capacity requirements or allowing aggregation of DERs
- Ensure the possibility for community-owned projects to bid in national energy auctions on a level playing field with other market participants

STAKEHOLDER ROLES AND RESPONSIBILITIES

Policy makers:

- Encourage pilot programmes (*e.g.* regulatory sandboxes) to work as a test bed and disseminate results
- Support technical capacity building in local communities

Regulators:

- Simplify and increase the transparency of administrative and permitting processes for community-ownership projects

System operators:

- Engage in distribution grid planning based on collaboration with local stakeholders, and take community-ownership projects into account

Individual households and local communities:

- Search for advice, training and mentoring on setting up a community-ownership project
- Define the most suitable community-ownership structures according to desired management practices and sought distribution of profits

ABBREVIATIONS

BCPG	Buan Citizen Power Generation
CCA	community choice aggregator
DER	distributed energy resource
kW	kilowatt
kWh	kilowatt-hour
MECISE	Mobilizing European Citizens to Invest in Sustainable Energy'
MW	megawatt
MWh	megawatt-hour
PV	photovoltaic
WWCE	Wiltshire Wildlife Community Energy

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COMMUNITY-OWNERSHIP MODELS
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