



Cooperatives as bottom-up energy system actors for increasing renewables adoption

Sumit Kothari and Neil Strachan

March 2023



UK Research
and Innovation

Authors

- **Sumit Kothari** | University College London
- **Neil Strachan** | University College London

This report should be referenced as:

Kothari, S. and Strachan, N. 2023. Cooperatives as bottom-up energy system actors for increasing renewables adoption. EnergyREV, University of Strathclyde Publishing: Glasgow, UK.
ISBN 978-1-914241-39-0

Acknowledgements

The analysis presented in this Briefing Note was undertaken in the EnergyREV project, specifically in Work Package 5.3. EnergyREV aims to drive forward research and innovation in SLES. Work Package 5.3, “Next Wave of Local Energy Systems in a Whole Systems Context”, aims to understand how the development of SLES will relate to the national energy system as a whole and the extent to which the future investment in national electricity and gas grids may be altered by widespread deployment of SLES.

Contents

Summary	3
Introduction	5
Diffusion intermediaries, their functions and the role of cooperatives	7
Modern cooperatives	9
How cooperatives are organised	9
Socioeconomic benefits	11
Longevity and efficiency	12
Cooperative evolution	13
Cooperative actors in future energy systems	17
Cooperatives as diffusion intermediaries	17
Sustained market success	18
Public policy support	19
References	22

Summary

This report highlights the potential role of energy cooperatives as intermediaries for renewable energy adoption and as prominent actors in future renewable energy systems. Energy cooperatives can channel the sizable resources of communities to support the low-carbon energy transition and perform critical intermediation functions to increase renewable technology penetration in society. These include activities like configuring renewable energy solutions, brokering technology acquisition, matchmaking with technical and financial partners, and coordinating with government agencies. In this way they link potential adopters with a wide range of actors. Energy cooperatives can also be instrumental in enabling “social learning” for renewables by utilising their social linkages with communities and forming industry and peer networks. They can thus transform the technological, social, cultural, and political spaces around renewables and enable a socio-technical transition in the energy sector. With growing scale, they can establish a national presence and become regime-level intermediaries that facilitate the spread of low-carbon technologies that are critical to the energy transition in societies.

The distributed nature of renewable energy technologies can allow communities to adopt them at a local level and generate beneficial outcomes across social, economic, and environmental dimensions. These range from financial returns to clean energy provision and local economic development. Cooperatives have proven to be competitive, efficient, scalable, and adaptable organisations in numerous sectors of the economy across the world while creating both social and economic value. Energy cooperatives can similarly help to overcome barriers created by market and institutional imperfections, create a procompetitive effect, improve market efficiency and generate broader economic welfare.

Renewable energy cooperatives have emerged around the world, driven by policy incentives and market protections as well as the desire of communities to achieve energy self-sufficiency and pursue an eco-social agenda. They are typically organised as traditional cooperatives with open membership, democratic control, collective ownership, and member financing. Advances in renewable technologies and policy changes, however, have exposed them to greater competition, higher costs, financial risks, and bureaucratic hurdles, thus challenging their growth prospects. Adaptation to changing conditions and generating economies of scale through product or regional diversification requires cooperatives to evolve their organisational structure to generate efficiency and access larger amounts of capital. The changes that energy cooperatives may undergo to achieve this include:

- Improving governance structures by incorporating formal authority, administrative controls, better coordination mechanisms, professional management and technical expertise.
- Inducing dynamism and reducing decision making costs through separation of responsibilities and multi-level decision making.
- Aligning incentive structures across the organisation with long-term growth-oriented goals, for example through equity redemption/transfers and returns distribution that are linked to the success of the cooperative.
- Modifying the organisational and capital structure by incorporating elements from investor-owned corporations to raise non-member capital and create a larger asset base.

Energy cooperatives need a supportive policy environment that empowers them to effectively organise, grow, diversify, and evolve. Policy actions that would enable this include:

- Lowering the institutional requirements and costs associated with the legal organisation, project development and initial operations of energy cooperatives.
- Improving access to finance across different stages of a cooperative's growth by creating dedicated financing channels, improving access to bank debt financing and providing investment incentives for external investors such as tax credits.
- Integrating cooperative actors into the energy system by redesigning policies, incentives, requirements and constraints to ensure that cooperatives can access energy markets and networks at a low cost.
- Reducing technical barriers to setting up and managing energy assets by improving access to technology networks, developing local technical capacity and integrating cooperatives in the renewables innovation ecosystem.
- Growing the social capital of cooperatives by increasing the awareness of the many benefits of renewable energy and of producing it through participation in energy cooperatives.

With adequate support, energy cooperatives can attain their full potential, build large scale renewables portfolio and become significant actors in future low-carbon energy systems.

Introduction

This report examines the potential of energy cooperatives to act as intermediaries for channelling community investment into renewable energy and to become successful long-term players in the energy markets. Their participation in the energy markets would give an impetus to the low-carbon energy transition and contribute to both climate and energy security goals.

The adoption of renewable technologies at scale is an important element in designing future energy systems that are carbon-free, distributed, smart and local. Incumbent actors in the energy sector such as utility companies have not displayed the capacity to invest in renewable projects at the required pace. The power sector needs to fully decarbonise by 2050 while meeting increased future demand as more end-use sectors get electrified (IEA, 2021). As renewable technologies such as solar photovoltaics, onshore wind and offshore wind have become cost competitive with fossil-fuel based technologies (IRENA, 2021), the focus has shifted to identify and encourage actors that have the capacity to invest in them. Past experiences with technology adoption, particularly those that create both economic and social value, have shown that intermediary organisations play a critical role in diffusing technologies to end users (Aspeteg and Bergek, 2020). They can perform vital technology selection and configuration functions, address barriers to investment and identify willing adopters to stimulate the process of technology diffusion.

With growing acceptance of renewable energy in society and the demand for climate action among populations, private citizens have emerged as potential actors that can drive the adoption of renewable technologies within their homes and communities. Evidence of their involvement with renewable energy technologies as innovators and early adopters spans the last two decades. However, their engagement with renewable energy technologies beyond their personal sphere of choice is restricted due to their individual limits on capacity, influence, and organisation (Pons-Seres de Brauwer and Cohen, 2020). Community energy initiatives act as intermediary organisations and unite the efforts of citizens, allowing them to pool their resources and pursue collective returns by setting up decentralised energy assets.

Energy cooperatives are a popular legal and organisational form for pursuing such decentralised community energy actions, bringing with them social and economic benefits to their member communities (Tarhan, 2015). These are organisations that adopt the cooperative legal form with joint ownership and democratic management. They are active throughout the energy industry value chain spanning generation, transmission, distribution and trading of energy (Yildiz et al., 2015). Historically these organisations have used fossil-fuel based technologies to pursue social goals such as community electrification. However, cooperatives are increasingly adopting renewable energy technologies, both as a response to policy incentives and motivated by the prospect of exacting greater social value through lower local and global pollution (Yildiz, 2014).

Although energy cooperatives are created by local communities and have a local or regional focus at inception, they are capable of growth through widening membership and resource pooling, earnings retention, and access to debt markets. Growing their capital base and technical experience can enable them to achieve a scale beyond their local region through the pursuit of large profitable renewable energy projects that meet the demands of their increasing membership base and utilise available government incentives (Li, Barazza and Strachan, 2022). In addition to being the collective channel for citizen investments, cooperatives can also act as ‘diffusion intermediaries’ for renewable technologies by providing a range of services to their members that includes knowledge dissemination, brokering and facilitation, technology validation and commercialisation. They can become important actors for renewable technology penetration in energy systems and attain a significant market position even at a national level with appropriate policy support.

This report seeks to highlight this potential role of energy cooperatives — as diffusion intermediaries for renewable technologies and prominent actors in future energy systems. The upcoming section describes the role of diffusion intermediaries and the functions that energy cooperatives may perform, and the following section looks at the nature of modern cooperative organisations and their organisational evolution. The report concludes with a discussion of the role that cooperatives can play in future energy systems, highlighting the ways in which they can be successful in the long-run and where enabling public policy is required.

Diffusion intermediaries, their functions and the role of cooperatives

Energy cooperatives are a collective channel for the adoption of renewable energy technologies by individual members of society and this makes them a valuable actor in their innovation ecosystem. Systems perspectives of innovation activity have highlighted the important role of actors and their linkages in driving technical change. This understanding has resulted in the identification of a broad class of actors spread across public, private, and non-profit sectors that perform a variety of supporting functions. Generically referred to as consultants, third parties, brokers or bridgers, these have been labelled innovation intermediaries, and defined as “an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties” (Howells, 2006). Their activities span the innovation cycle covering multiple roles in the innovation process across different stages. Their role though has been long acknowledged in technology diffusion where such organisations act as agents of change and speed up the adoption of technology in society (Rogers, 2003).

There is an “ecology of actors” between innovation seekers or adopters and innovation providers and solvers (Stewart and Hyysalo, 2008). They can be engaged by actors on either end of the diffusion process. They might assist technology providers in pushing the technology to potential adopters or seek the appropriate technology on behalf of potential adopters, which has historically been the more prominent setting (Bergek, 2020). In this role they may simply act in a matchmaking capacity by linking technology providers and adopters or become a more involved partner in facilitating technology transfer. In the latter case, they may run a systematic selection process, take ownership of the relevant technology, manage the end-to-end technology transfer process, create customized solutions by combining technologies or deliver a complete turnkey project. In doing so, they link adopters with a wide range of actors in a “many to one relationship”. For example, linking adopters with technology providers, government agencies, financial institutions and infrastructure companies to deliver a complete technological solution to them. In addition, they perform coordination functions where intermediaries act as a link between parties without creating a direct relationship among them. For instance, they act as consultants or agents and help in coordinating with permitting authorities or environmental agencies.

By linking user communities with innovation providers, intermediaries also perform functions beyond brokering and coordination. One such function is configuration, which involves tailoring innovations for different groups of users or providing reinventions that make the technology more appealing to them. Another is facilitation, where intermediaries provide information and skills, educate communities, create cultural and physical spaces or influence regulations and local rules (Stewart and Hyysalo, 2008). By linking innovation and user networks they also circulate information between these communities. This can be particularly valuable when the market for a technology is relatively nascent or when new technologies need to be developed based on experiences of use over time. Intermediaries can also function as intermediate or proxy users, thereby making adoption decisions on behalf of the end users of the technology. Broadly speaking, they are instrumental in “social learning” by transforming the technological, social, cultural, and political spaces around an innovation. In the context of a socio-technical transition in the energy sector, such intermediaries can therefore be crucial actors by playing an important role in the wider diffusion of low-carbon technologies.

Diffusion stage



Figure 1: Functions of Diffusion Intermediaries and Suitability of Cooperatives

Figure 1 illustrates the functions that diffusion intermediaries have been broadly observed to perform (Howells, 2006; Stewart and Hyysalo, 2008; Bergek, 2020) and identifies those that cooperatives may be well-suited to execute. The unique organisational structure of cooperatives - member ownership and decision-making and strong links with local communities - places them close to technology users and therefore in a natural position to perform certain diffusion functions. Like other innovation intermediaries they may be expected to perform a range of functions – intermediaries rarely perform all functions or single functions. But in doing so cooperatives can become important players in the innovation ecology and can fulfil existing gaps in intermediation.

Modern cooperatives

Cooperatives are generally defined as “an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise” (International Cooperative Alliance, no date). Modern cooperatives can thus have a huge breadth of objectives that they try to achieve on behalf of their members, although typically they will try to balance economic and social objectives rather than being purely profit-seeking entities. Even the economic objectives of cooperatives may be quite different from investor-owned firms. For instance, they may seek to maximise member returns or minimize operating costs, over profit maximisation (Royer, 2014a).

Cooperatives typically exist because markets are perceived as unable to adequately bundle the relevant resources and capabilities to create new firms and where it is not optimal for existing firms in adjacent markets to expand upstream or downstream along the product hierarchy. They are also found in highly competitive markets where they pool resources to deal with significant uncertainties and ensure survival. In such situations, cooperatives combine contractual arrangements and administrative units to coordinate member activities for generating economic rents through coproduction and control opportunistic behaviour (Ménard, 2004). However, informal mechanisms play an important role in cooperative governance. Trust and reputation are built over time and combine with formal mechanisms to minimize agency and collective decision-making costs and make them efficient organisational forms.

Cooperatives are active worldwide across a diverse range of sectors such as agriculture, financial services, insurance, retail, healthcare, industrials, utilities, housing, and education. There were 2.6 million cooperatives across 145 countries in 2014, with \$19.6 trillion in total assets and over a billion people involved as members and clients (Dave Grace & Associates, 2014). With annual revenues of almost \$3 trillion, they formed an important part of the global economy contributing 4.3% to the world's GDP and employing approximately 9.5% of the employed workforce (Dave Grace & Associates, 2014; Eum, 2017). In addition, being member-owned and member-focused, they can empower their members to pursue economic opportunities, create social capital through collective enterprise, and contribute to human development in communities. Surveying the vast number of cooperative experiences across economic sectors can provide an indication of how cooperatives may function in the renewable energy sector.

How cooperatives are organised

Cooperatives are a highly varied organisational form. They can be characterised based on a system of key attributes that define their governance and operational structures (Chaddad, 2012) and may therefore acquire distinct configurations (Table 1). Different cooperative organisations such as bargaining associations, marketing cooperatives, credit cooperatives or multi-purpose cooperatives, occupy a spectrum of feasible economic entities that vary across these attributes and co-exist in competition with market-based organisations or other hybrid/cooperative entities. The type of transactions conducted by the cooperative may also determine the hybrid arrangement, contractual provisions, incentives rules and dispute resolution mechanisms in place (Ménard, 2004). The relative costs and advantages of alternative modes of governance in a specific market context define their competitive position in markets.

Table 1: Governance attributes of cooperative organisations. Adapted from Chaddad (2012).

Attribute	Description
Ownership/Property rights	The nature of claims on the residual assets of the cooperatives – equal amongst members, proportionate to patronage rights or as per equity contributions
Formal authority structures	The level of formal structure in the organisation for coordination and control – administrative controls, presence of distinct authorities and central staff that affect the level of autonomy of member decisions
Intensity of Incentives	The level of incentives in decision-making at both the organisation and member levels – low level of incentives at the organisation level leads to principal agent problems and low levels at the member level leads to a lack of loyalty
Administrative controls for coordination and information sharing	The level of administrative controls for coordinating the activities within the organisation including overall planning, information processing and transaction governance
Central staffing	The number of staff that is directly employed for performing the different governance functions within the cooperative organisation
Partner selection	Mechanisms in place to define the membership in the cooperative organisation – lack of any criteria leads to an open cooperative with free membership but there may be well defined criteria in place to make it a closed cooperative
Level of autonomous adaptation	Adaptation to changes in market conditions or any shocks directly by members of the cooperative that may be considered unplanned and uncoordinated, for example, a response to sudden price changes
Level of coordinated adaptation	The level of centralisation and coordination as a collective response to changes in market conditions or adverse events – requires consensus-based and planned decision making
Strength of contract laws	The formality of contract mechanisms in place to govern the transactions of the cooperative, the behaviour of members, co-dependence of member decisions and the interaction of members and the cooperative
Formalization of horizontal and vertical links, and centralisation	The extent to which the association between members, their commitments to the cooperative, the transfer of central functions, production decisions and transaction decisions are formalised through agreements, contracts, incorporation statutes or bylaws

Energy cooperatives can be organised in a range of configurations defined by these attributes and by the prevalent market and institutional context. These configurations will adapt and evolve due to changing market conditions or in response to policy actions as cooperatives search for efficient operating structures that can ensure survival and the achievement of member objectives. Over time changes may also be needed to achieve a greater scale or to improve the competitive position of the cooperative in the market.

Socioeconomic benefits

Cooperative organisations commonly emerge as a collective action response to imperfect market conditions; that is a market with the existence of incomplete information, externalities or monopoly/ monopsony conditions (Cook and Plunkett, 2006). In uncertain environments where individual investments are risky, cooperatives are formed as collective risk sharing arrangements (Sadowski, 2017). However, their presence provides broader benefits that extend beyond its member community by improving the overall efficiency of markets and yielding macro advantages (Liang and Hendrikse, 2016; ILO, 2020). These include:

- **Bargaining and countervailing power:** Cooperatives can provide an institutional mechanism to individual actors to correct any imbalance in market power caused due to the presence of a monopoly (single seller) or a monopsony (single buyer). Cooperatives improve the bargaining position of individuals in the market by aggregating their activities and help to reduce costs (Galbraith, 2017).
- **Procompetitive and yardstick competition effect:** The presence of cooperatives can act as a competitive yardstick in the overall market (Nourse, 1922). Strong cooperatives manage to provide higher rewards for their members and in the long run lead to greater transparency and lower prices, particularly in imperfect markets (Sagebiel, Müller and Rommel, 2014; Liang and Hendrikse, 2016; Sadowski, 2017).
- **Market creation and public good provision:** Cooperatives can create new markets and invest in the provision of goods and services that investor-owned enterprises find to be not profitable enough or high risk ventures, but which may be beneficial for consumers or the society in general (Périlleux, Vanroose and D’Espallier, 2016).
- **Technological innovation:** Cooperatives can serve as a channel for the diffusion of technologies through members’ participation in coproduction activities, collective acquisition of inputs, provision of finance and professional services, and information sharing between cooperative members. This helps members to overcome technical and institutional barriers and reduces risks for new technologies through shared experiences, resulting in faster technology uptake and greater technical efficiency (Manda et al., 2020; Zhang et al., 2020).
- **Economic stability:** The presence of cooperatives can lead to broader economic resilience during recessions, price transparency and reduced volatility in markets, better coordination between demand and supply, and employment stability during economic shocks. Cooperatives enable this through risk-averse decision making, lack of predatory rent extraction and broader social responsibility to the community (Birchall, 2013b, 2013a; Delbono and Reggiani, 2013; Müller et al., 2018).
- **Wealth accumulation:** Cooperatives can help their members to accumulate wealth in the long-term by enabling them to become entrepreneurs and business owners, aggregating limited capital to create scale and provide a means to develop local capability (Nembhard, 2002, 2014). This is particularly relevant for marginalised communities that have a low initial endowment of wealth.
- **Human and social capital development:** Cooperatives can bring direct developmental benefits to the community by creating employment and increasing incomes. They also improve access to markets and financial capital, catalyse skill development, develop local expertise, improve social cohesion and contribute to the sustainable development of the community (Markelova et al., 2009; Lang and Novy, 2014; Wanyama, 2014; Herbel, Rocchigiani and Ferrier, 2015; Verhofstadt and Maertens, 2015; Zimnoch and Mazur, 2018).

The significant economic and social benefits generated by the existence of cooperatives serve as the motivation for providing a beneficial policy environment to these organisations. They are considered procompetitive forces that improve market efficiency and economic welfare (Royer, 2014b) and provide broader economic resilience (Rousselière, 2019).

As a result, cooperatives have been supported historically in various sectors by public policy measures such as preferential tax environment, access to credit, technical assistance, relaxed anti-competition restrictions, low start-up costs and simpler bureaucratic procedures. A similar case can be made for supporting energy cooperatives who can provide multiple socio-economic benefits through their functioning. They aggregate the resources of individuals and enable them to create a producer organisation that supplies renewable energy to communities. By doing this they increase the dissemination of renewable energy technologies, create decentralised energy markets, contribute to environmental goals, generate local economic development and enrich communities.

Longevity and efficiency

Cooperatives in general are found to have low failure rates and are longer lasting organisations than investor-owned corporations and small businesses (Monteiro and Stewart, 2015). They are attracted to industries that have low entry cost requirements and high volatility, where their prudence and risk pooling emerge as strengths. For instance, in the United States the failure rate of cooperatives after the first year of operation stands at about 10% compared to 60%-80% for investor-owned corporations; more than 90% of cooperatives survive beyond five years compared to just 3%-5% of corporations (Williams, 2007). The initial survival of the cooperative can be attributed to the fact that a cooperative is embedded in a community. It enjoys the support of community members who are invested in collective action and contribute voluntarily to ensure the continued functioning of the cooperative. They are therefore resilient to initial challenges and unlikely to change their organisational form in the short run. Even in the longer-term cooperatives rely on the social capital built through linkages between members, customers, community actors and other organisations, in the pursuit of member and community interests. This enables them to survive market shocks and inefficiencies (Herbel, Rocchigiani and Ferrier, 2015).

Beyond the “bridging” of social capital, cooperative success is linked to:

- Economic benefits of collective organisation such as scale economics, market power and transaction cost minimisation
- Support from the institutional environment
- Accumulation of capital and cash reserves
- Ability to align heterogeneous member interests
- Organic growth across geographical, product and value chain markets
- Capacity to tinker with operational models to maintain efficiency and effectiveness in decision making
- Capacity to adapt to market shocks through a focus on both the economic and social interests of members (Iliopoulos and Valentinov, 2018)

Evidence spread across different economic sectors shows that cooperatives are capable of enduring in the long run through a combination of organisational strengths and inherent resilience, as well as prudent adaptation to market conditions (Monteiro and Stewart, 2015; Iliopoulos and Valentinov, 2018).

The long-term survival of cooperative firms is also linked to the efficiency of their organisational structures. The evidence of their enduring nature in the long-term contrasts with the historically held view of cooperatives as weak organisational structures compared to investor-owned firms. Clear evidence of their efficiency or lack thereof, however, has been lacking (Sexton and Iskow, 1993).

Measuring the performance of cooperatives itself is tricky because of multiple objectives that they pursue in contrast to investor-owned firms where revenues and profits serve as adequate performance parameters (Soboh, Oude Lansink and Van Dijk, 2012). They indeed face challenges, especially as they become larger (Hendrikse, 1998; Hendrikse and Feng, 2013). These include:

- A potential preference for short-term investments and returns over long-term investments particularly in infrastructure to support growth and diversification.
- Hesitation from members to invest beyond their local geography and hence continuing to make uneconomic investments locally
- Risk aversion to diversification beyond current products and known technologies or to more ambitious market opportunities
- Increasingly heterogeneous membership and corresponding attempts to influence decisions based on diverse preferences may lead to high decision-making costs, coordination challenges and difficulties in arriving at consensus decisions
- Oversupply situations may emerge in specific markets as production and consumption in individual regions might not match
- General inertia to changes in bylaws, information processing mechanisms and adaptation to changing market conditions

Overall though, the coexistence of cooperatives alongside investor-owned firms has been found to be a stable industry structure with the relative market power of the cooperative depending on the structure of the market (Liang and Hendrikse, 2016). Cooperatives can enter and survive in existing markets with pure for-profit players or even in markets with strong incumbents that deter other pure for-profit players (Sexton and Sexton, 1987). Cooperatives can therefore be successful in a wide range of market conditions. For instance, it has been found that the top 300 cooperative organisations measured by generated revenues spanned multiple countries and sectors and generated a combined \$1.6 trillion in 2008 (ICA, 2011). Additionally, as cooperatives are designed to generate benefits beyond pure economic results, their existence is preferred both by the communities in which they operate and by policy makers.

Community energy initiatives such as energy cooperatives have high social capital acquired through the participation of community members in energy production and through the realisation of direct and indirect benefits by the community. While these help the cooperative in the initial stages of its operations, longer term survival and success will depend on expanding the scale of operations, the capability to accumulate capital and a supportive institutional environment that reduces barriers to market participation. At the same time, energy cooperatives will need to adapt their organisation to changing market conditions and evolve to deal with the challenges that afflict cooperative organisations over time such as a heterogeneous member base, decision-making problems and expansion and diversification. Prudent management, efficient functioning and member-supported growth are thus crucial for cooperatives to become serious long-term players in the energy markets.

Cooperative evolution

The generic lifecycle of cooperatives can be mapped to distinct phases (Figure 2) (Cook, 2018). A cooperative emerges out of the desire of a group of individuals or firms to improve their socio-economic position in the context of a non-functioning market. Additionally, they recognize the possibility to benefit from scale economics through coordinated economic action.

Once the economic justification for collective action is determined, the next phase involves designing the organisation to achieve their goals. This involves establishing the business model, the organisational structure and legal form, as well as the “rules of the game” comprising the objectives, responsibilities, rules, benefits, and governance procedures for the cooperative.

Once established, the following phase is one of growth in the activities of the cooperative and the realisation of collective benefits. This is also accompanied over time with a growing heterogeneity amongst preferences of member groups about the activities and future direction of the cooperative. The varying performance of the cooperative across the multiple objectives that it seeks to achieve results in friction and disruption of its activities. Survival of the cooperative therefore depends on the resolution of differences, corresponding adjustments, and a return to efficient functioning.

The next phase is one of introspection. It must identify the underlying causes of growing decision-making costs, as well as potential solutions such as modifying the incentive structure, making investments to retain members, improving transparency in governance, or making changes to the capital structure. Based on these evaluations, the cooperative firm may choose to undertake one of four courses of action:

- Exit through liquidation or merge with a better functioning cooperative
- Maintain the status quo with minimal changes, but which over time may lead to spiralling costs and an uneconomic business model
- Spawn into new organisations either as a cooperative or a corporation with different objectives and structure
- Reinvent the existing cooperative with significant changes for a new cycle of growth. The reinvention typically involves drastic change to the residual claim rights, organisation control rights, purpose of the cooperative or the operating culture of the cooperative.

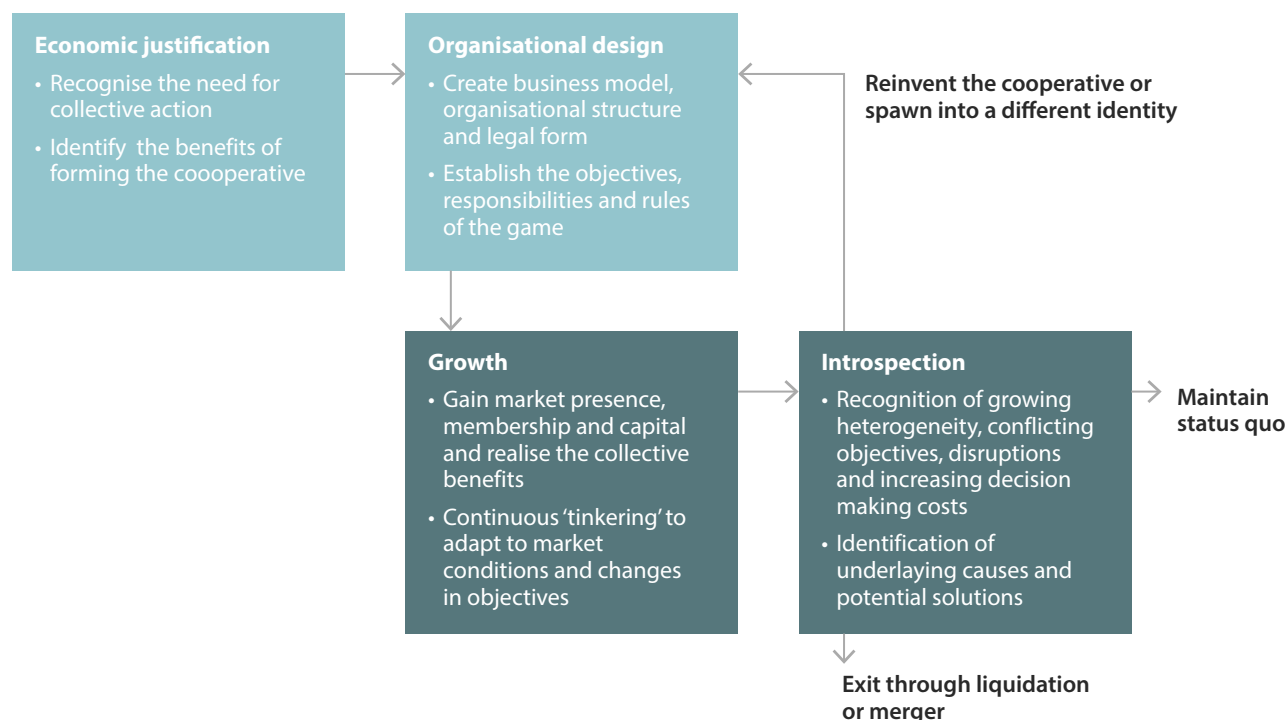


Figure 2: Life cycle of cooperative organisations. Adapted from Cook (2018)

The cooperative form itself has undergone changes since traditional cooperatives emerged in several sectors, particularly agriculture. A “defensive model” has typically involved open membership, democratic control, redeemable ownership rights, member rights over all assets and capital contributions in proportion to the patronage availed (Cook and Plunkett, 2006). This organisational structure was designed to protect the economic interests of members from opportunistic upstream or downstream market players in imperfect markets. With increasing competition, growing decision-making costs due to member heterogeneity and other inherent organisational limitations, the defensive model can become unsuited to the objective of increasing the asset base of the cooperative. As a result, new organisational models have been explored to adapt to these challenges, as well as that of evolving market environments, technologies and membership demands.

Facing competitive pressures and the need to raise capital to adopt technological innovations and pursue growth strategies, cooperatives have had to evolve their organisational structure. New cooperative models involve restricted memberships and defined selection procedures, patronage rights in response to initial capital investment and strong contractual agreements on sharing and transfer of membership benefits (Chaddad and Cook, 2004b). These new cooperative organisational forms fall between the traditional cooperative structure and pure investor-owned firms with regards to ownership rights and control over residual assets of the organisation (Figure 3).

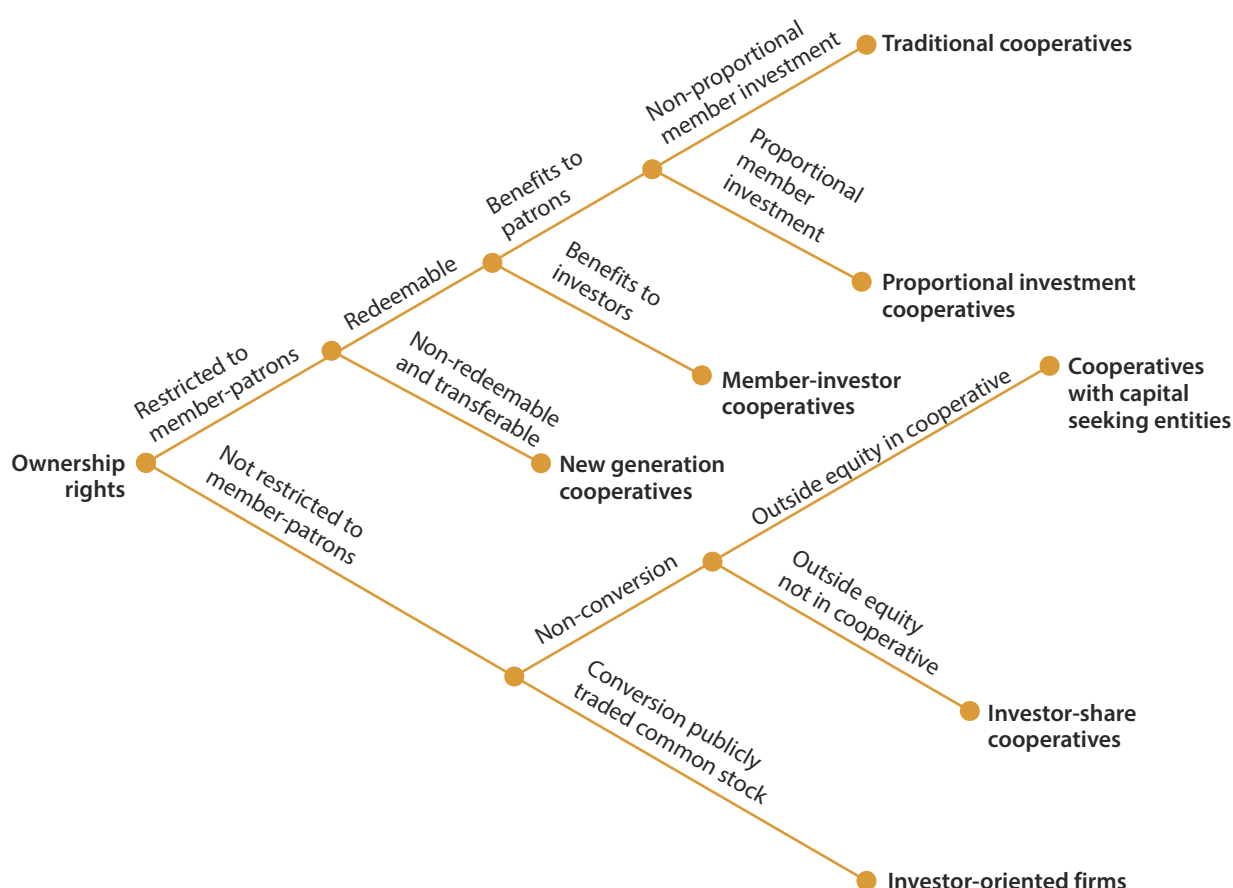


Figure 3: Ownership-Control rights typology of new cooperative organisations. Source: Chaddad and Cook (2004).

These new models enable the cooperative to go beyond a defensive position of minimising member losses due to market vulnerabilities to one where it extracts rents through vertical integration and long-term investments. They can realise further value through economies of scale and greater business diversity, and acquire new organisational capabilities, competitive strength, strong market positions and greater control over productive factors. This transformation from defensive to offensive organisations also involves their evolution to more market-oriented structures. Cooperatives thus become more hybrid in nature, incorporating elements from investor-owned firms and becoming more suitable for capital formation such as through external investments, closed membership and redeemability of invested capital at market value. Building societies in the UK, for example, saw a wave of demutualisation in the 1990s and conversion to publicly traded investor-owned banks. This enabled them to scale their capital base through access to wider financial markets; in turn enabling them to rapidly expand their business operations in open markets, grow inorganically through mergers and acquisitions and better react to structural and institutional changes in the mortgage industry that favoured business diversification (Stephens, 2001).

Energy cooperatives will similarly encounter challenges during their lifecycle that inhibit their growth, precipitated by either internal organisational constraints or through adverse external conditions in the market and policy environment. This may require a change in the organisational structure, operational strategy or business plans of the cooperative to engineer a new phase of growth that enables it to become a strong market player and achieve the objectives of the growing member base. Some of these changes to the fundamental elements of the cooperative will alter its existential form and may involve the amalgamation or disintegration of the organisation. Closely related to this transformation is the necessity to raise greater amounts of capital to finance the upfront investment required to undertake larger energy projects and pursue regional or product diversification. This will require the organisation to become more return-oriented and conducive to external investment. Progressive adaptation and a gradual hybridisation of the cooperative will thus be necessary for long-term success and becoming a strong actor in future energy systems.

Cooperative actors in future energy systems

Cooperatives as diffusion intermediaries

Cooperatives have the potential to be important actors in the transition to decarbonised energy systems with significant presence across a host of European countries. For instance, it is estimated that European citizens can potentially finance up to €176 billion in community administered wind energy projects offering market rates of return (Pons-Seres de Brauwer and Cohen, 2020). Key renewable energy technologies are highly distributed in nature, which allows individuals and communities to adopt them at a local level and thereby find collective solutions and benefits as well as contribute to global climate action (Heras-Saizarbitoria et al., 2018). They can generate beneficial outcomes across social, economic, and environmental dimensions. These can range from energy savings and financial benefits for participating members to collective entrepreneurship, local economic development and clean energy provision for the community (Tarhan, 2015). Additionally, they can bring a behavioural change in populations and increase the social acceptance of renewable energy technologies (Coenen, Benneworth and Truffer, 2012; Brummer, 2018).

With direct and collective involvement in renewable energy projects, energy cooperatives can act as diffusion agents for renewable energy technologies. They can overcome many of the barriers to renewable energy adoption by improving the social perception of usability and usefulness. By aggregating micro investments from individuals, they can create scale economics and help to lower technology costs. They can also provide consulting services to other adopters in areas of land acquisition, planning, feasibility and technical services (Viardot, 2013). In Germany and Italy, for instance, they have been responsible for adding 0.85 GW of solar capacity up to 2020. They have matched investor-owned organisations in performance and displayed a trend of expanding their activities and financing larger installations (Wierling et al., 2021).

Energy cooperatives effectively perform the key functions that are identified with diffusion intermediaries (Aspeteg and Bergek, 2020). As a collective organisation they perform brokering activities for members such as technology search and configuration selection, acquisition of technological solutions and end-to-end project development. They also perform coordination functions on their behalf by acquiring regulatory approvals, making grant applications, and raising external financing from financial institutions. As they expand and recruit members, they utilise their growing social capital to disseminate information and create community learning about renewables. At a macro level they form networks with upstream and downstream actors, generate contextual knowledge and facilitate learning through peer networks of other cooperatives (Yang, Klerkx and Leeuwis, 2014). They can become an important part of the ecosystem of innovation intermediaries. Finally with growing scale, they may even expand their role to become regime-level intermediaries that facilitate the diffusion of low-carbon technologies that are critical to the energy transition (Kivimaa et al., 2019).

Public policy needs to enable the transformation of the potential for community adoption of renewables into functioning cooperative organisations. Firstly, it needs to create an awareness among communities of the benefits of local cooperative entrepreneurship from the generation of renewable energy such as financial returns, energy security and local employment. Information campaigns can also reduce social barriers to renewable energy projects. Secondly, it needs to foster networks of technology providers and cooperative organisations so that new cooperatives can gain an understanding of technological products and the experience of other cooperatives to identify and configure their own solutions. Such networks can create bi-directional information flows that enrich the innovation system for renewable technologies. Finally, energy cooperatives need to be integrated into the broader innovation ecosystem by linking them with other intermediaries that can support them in establishing and expanding their operations, accessing incentive schemes and obtaining finance, especially from public institutions.

Sustained market success

Community initiatives for the coproduction and consumption of renewable energy have emerged in countries around the world. In Europe particularly, these efforts have been driven by:

- Policy incentives in the form of fixed long-term feed-in tariffs to promote small-scale renewable energy generation
- The desire of individuals and communities to achieve energy self-sufficiency and pursue an eco-social agenda
- Discontent with monopolistic/oligopolistic (only one or just a few) utility companies
- A favourable regulatory environment for cooperatives comprising tax incentives and market protection

These conditions have led to the emergence of many local cooperatives that largely follow the traditional model of open membership, democratic control, capital contributions by members and member rights over all assets (Seyfang, Park and Smith, 2013; Heras-Saizarbitoria et al., 2018; Klagge and Meister, 2018; Mey and Diesendorf, 2018). Government subsidies and open market conditions gave cooperatives the initial space to recruit community members, build technical capacity around renewable technologies and undertake project planning without significant pressures to be cost efficient.

Ongoing growth and stability are impacted, however, from changes in both the technological and institutional landscape (Bauwens, Gotchev and Holstenkamp, 2016; Mey and Diesendorf, 2018). Advances in renewable technology, particularly wind and solar, requires a corresponding technological learning for cooperatives, as well as access to a larger capital base in order to plan bigger projects and achieve lower costs. Policy changes have similarly affected their prospects. The introduction of auction-based capacity markets, for instance, has exposed cooperatives to greater competitive pressures and introduced transaction costs, greater financial risks, and bureaucratic hurdles. Many cooperatives have, as a result, stayed confined to their primary locales and struggled to expand their presence. This in turn puts them at risk of dissolution or acquisition in the long term (Wierling et al., 2018). In addition, other hurdles such as varying social acceptance of renewable technologies and administrative bottlenecks with planning permissions indicate an erosion of social capital. Energy cooperatives have had to adapt by pursuing product diversification (electricity/heat or production/grid services/distribution) and regional diversification strategies to reduce dependence on services impacted by regulatory changes or to gain further economies of scale (Klagge and Meister, 2018). However, the capacity to adapt is restricted by the size and the capital base of the cooperative.

Energy cooperatives need to change their organisational structure to become more efficient, attract wider sources of capital beyond their members, and broadly evolve towards a more 'offensive' return-oriented cooperative organisation (Cook and Chaddad, 2004). A new governance structure that incorporates formal authority, professional management and technical expertise, administrative controls and improved coordination can lead to efficiency gains. Decision making costs can similarly be reduced through separation of responsibilities and multi-level decision making that makes it easier to respond to market changes. Incentive structures across the organisation can be realigned with long-term growth-oriented goals of the cooperative, for example through equity redemption/transfers and returns distribution that are linked to the success of the cooperative.

Energy cooperatives can choose between multiple organisational structures to expand their avenues for gaining financial capital (see Figure 3). The optimal structure for the future cooperative will depend on both external factors such as the institutional environment and internal factors such as heterogeneity of members, short vs long-term investment horizons and portfolio problems within the current structure. An alternative might even be for local or regional cooperatives to consolidate under a broader cooperative or corporatized structure that gives the entity a much larger size and capital base, similar to the German cooperative banking sector (Greve, 2009). A strong asset base created in this fashion can provide long term stability to the organisation as well as enable it to gain further debt capital from the banking system.

The viability of the cooperative is also improved by the strength of the community linkages that it develops; these provide a loyal membership/customer base and social support for the projects of the cooperative. Being an organisation that achieves social value with economic gains, the socio-cultural dimension of a cooperative's existence is an important contributor to its long-term health. As a result, increasing social capital should be as much a part of its growth recipe as financial capital (Bauwens, Gotchev and Holstenkamp, 2016). Successful cooperative organisations can act as networks of proponents for renewable energy in the society that leads to collective technology entrepreneurship and increased penetration of renewables.

Public policy support

The increasing numbers of renewable energy cooperatives in Europe over the last two decades shows that these are viable and competitive actors in the energy system, rooted in local organisation and pursuit of both economic and social goals. They have however been dependent on financial support from the government in the form of favourable feed-in tariffs and have been adversely impacted when these have been withdrawn (Wierling et al., 2018). Cooperatives have responded by pursuing diversification strategies, scaling up their numbers, and modifying their capital structure to seek non-member investments. However, these organisations have so far remained largely local in nature. On one hand, this ensures that they continue to build on their social capital but on the other hand they face challenges as energy policies favour larger private actors and induce system level transitions. Cooperatives thus need a supportive policy environment that enables them to effectively organise, grow, diversify, and evolve, similarly to cooperative organisations across other sectors such as agriculture, banking, insurance, and retail, where they have evolved and managed to capture significant share of their respective markets.

Public policy can seek to address the barriers that inhibit the formation and growth of energy cooperatives (Brummer, 2018). These include:

- Cooperatives face organisational and institutional barriers particularly in the early stages as they start small and rely on voluntary effort to build up their organisations. They face high transaction costs, hurdles in establishing their legal form, barriers to access state and private funding, and inhibiting planning rules for setting up renewable energy projects.
- Market structures and regulations often favour big energy companies and large centralised projects. This means that smaller generators face high grid connection costs, as well as exclusion from grant and subsidy schemes.
- Energy regulators may not view cooperatives as important players in the energy system and thus exclude them from energy security mechanisms such as capacity markets by setting tough qualifying rules. Additionally, complex energy regulations, frequent policy changes and high regulatory costs due to licensing requirements further impede the capacity of cooperatives to grow.
- Cooperatives face resource constraints on multiple fronts. These include a lack of knowledge and expertise across technical, financial, and regulatory matters; absence of networks with industry players and policy makers; lack of finance in the initial stages, as well as the lack of long-term finance because of low levels of capital accumulation and long-term investment.
- Behavioural barriers exist within societies, including their views on renewable energy. As a result, cooperatives may struggle to recruit members, develop projects, build social capital, and scale the organisation.

Therefore, long-term emergence of cooperatives as key actors in future energy systems can be achieved with policy actions that include:

- Reducing the procedures and costs associated with the initial set-up of a renewable cooperative organisation: This can be achieved by simplifying the institutional requirements for activities involved during the start-up phase of an energy cooperative, such as to register a cooperative, raise funds from community members, obtain planning permissions for projects, supply generated energy, invest in existing renewable energy projects and access existing state incentives.
- Improving access to finance across different stages of a cooperative's growth: Constraints on finance directly impact the scale of activities and the pace of growth for an energy cooperative. Dedicated financing channels for energy cooperatives can provide critical capital at the initial stages, prioritized lending by public banks for renewable energy projects can generate project finance and investment incentives such as tax credits can make it easier to attract external investors.
- Integrating cooperative actors into the energy system: There needs to be a recognition of energy cooperatives as important actors in energy systems and a conscious decision to support their emergence with a stable policy environment. This can be achieved by redesigning policies, incentives, requirements and constraints that currently favour larger actors and ensure that cooperatives can access energy markets and networks at a low cost. This will enable them to generate revenue from the initial stage as well as make it easier to diversify across regions and products.
- Reducing technical barriers to setting up and managing energy assets: At different stages of its growth the cooperative requires technical assistance, from an initial understanding of technological products and configurations to developing large-scale projects and optimising energy asset portfolios to achieve efficient operations. They can be supported by improving access to technology networks, developing local technical capacity and integrating them in the renewables innovation ecosystem.

- Growing the social capital of cooperatives: Increasing the social capital alongside financial and technological capital is key for the long-term prospects of an energy cooperative. Public policy can support this by increasing the awareness of both the economic and environmental benefits provided by renewable energy technologies and the social and economic benefits of participating in renewable energy cooperatives. This will enable the cooperative to attract members and resources as well as make it easier to obtain planning permissions from local authorities.

Cooperatives have shown to be competitive, efficient, scalable, and adaptable organisations in numerous sectors of the economy across the world, while creating both social and economic value. They can involve substantial populations in their organisations and acquire strong market positions. The characteristics and capabilities of these organisations make them crucial players in the energy transition where they can channel significant financial resources and perform important functions as diffusion intermediaries to increase the scale of renewable energy in the society (Kivimaa et al., 2019). Energy cooperatives can create social acceptance for renewables and ensure that their economic benefits are spread across society. However, public policy needs to recognise the importance of these actors and incorporate them in their energy transition visions and plans at different scales from national to local levels (Busch et al., 2021; Martens, 2022). Adequate support is necessary for these actors to attain their full potential, build social capital, and contribute to the emergence of future low-carbon energy systems.

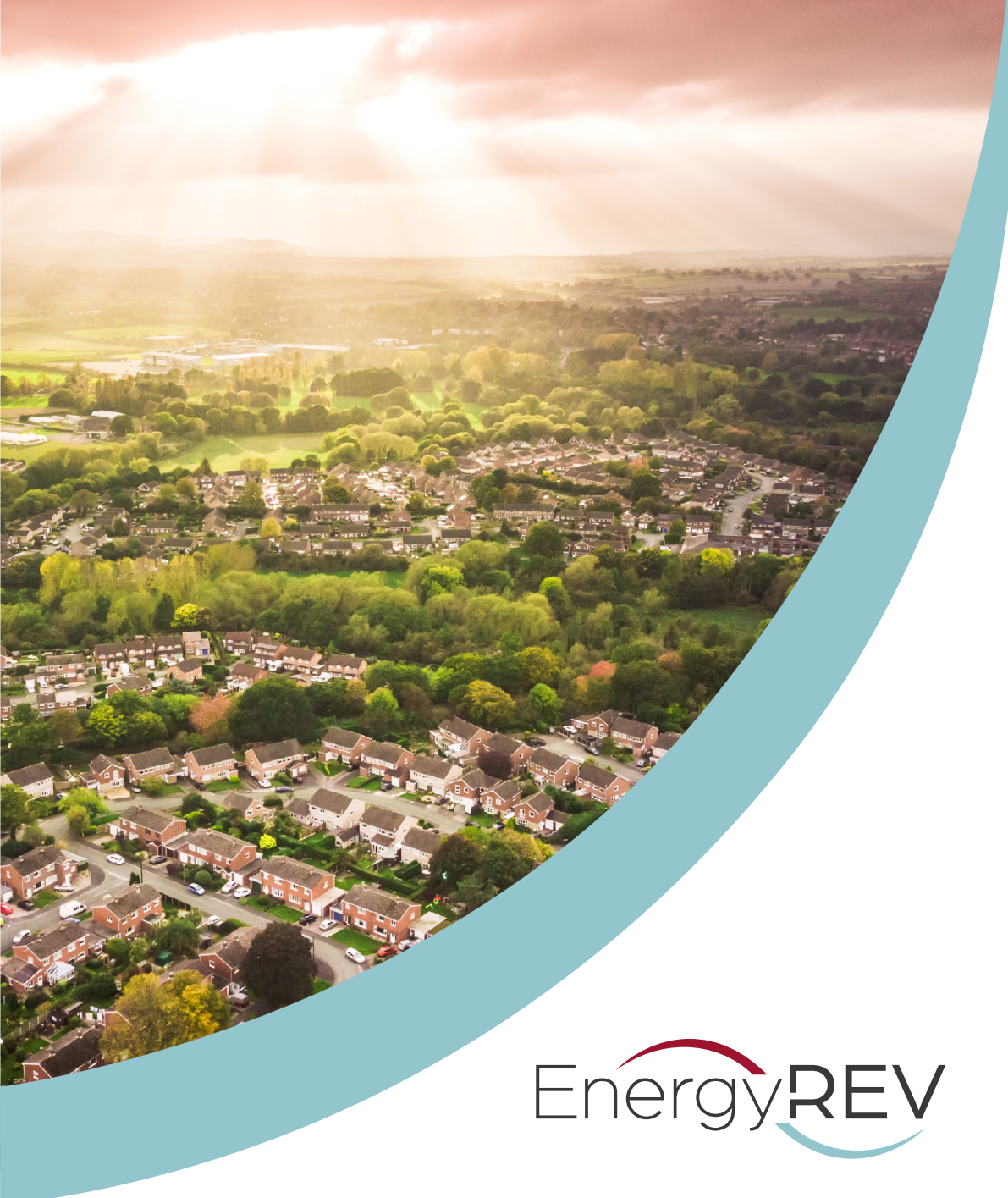
References

- Aspeteg, J. and Bergek, A. 2020. The value creation of diffusion intermediaries: Brokering mechanisms and trade-offs in solar and wind power in Sweden. *Journal of Cleaner Production*, **251**: 119640. doi: [10.1016/j.jclepro.2019.119640](https://doi.org/10.1016/j.jclepro.2019.119640)
- Bauwens, T., Gotchev, B. and Holstenkamp, L. 2016. What drives the development of community energy in Europe? The case of wind power cooperatives. *Energy Research & Social Science*, **13**: 136–147. doi: [10.1016/j.erss.2015.12.016](https://doi.org/10.1016/j.erss.2015.12.016)
- Bergek, A. 2020. Diffusion intermediaries: A taxonomy based on renewable electricity technology in Sweden. *Environmental Innovation and Societal Transitions*, **36**: 378–392. doi: [10.1016/j.eist.2019.11.004](https://doi.org/10.1016/j.eist.2019.11.004)
- Birchall, J. 2013a. [Resilience in a downturn: the power of financial cooperatives](#). Geneva: International Labour Organisation.
- Birchall, J. 2013b. The potential of co-operatives during the current recession; theorizing comparative advantage. *Journal of Entrepreneurial and Organizational Diversity* [Preprint]. doi: [10.5947/jeod.2013.001](https://doi.org/10.5947/jeod.2013.001) (preprint)
- Brummer, V. 2018. Community energy – benefits and barriers: A comparative literature review of Community Energy in the UK, Germany and the USA, the benefits it provides for society and the barriers it faces. *Renewable and Sustainable Energy Reviews*, **94**: 187–196. doi: [10.1016/j.rser.2018.06.013](https://doi.org/10.1016/j.rser.2018.06.013)
- Busch, H., Ruggiero, S., Isakovic, A. and Hansen, T. 2021. Policy challenges to community energy in the EU: A systematic review of the scientific literature. *Renewable and Sustainable Energy Reviews*, **151**: 111535. doi: [10.1016/j.rser.2021.111535](https://doi.org/10.1016/j.rser.2021.111535)
- Chaddad, F. 2012. Advancing the theory of the cooperative organization: The cooperative as a true hybrid. *Annals of Public and Cooperative Economics*, **83**(4): 445–461. doi: [10.1111/j.1467-8292.2012.00472.x](https://doi.org/10.1111/j.1467-8292.2012.00472.x)
- Chaddad, F.R. and Cook, M.L. 2004a. The economics of organization structure changes: a US perspective on demutualization. *Annals of Public and Cooperative Economics*, **75**(4): 575–594. doi: [10.1111/j.1467-8292.2004.00263.x](https://doi.org/10.1111/j.1467-8292.2004.00263.x)
- Chaddad, F.R. and Cook, M.L. 2004b. Understanding new cooperative models: An ownership-control rights typology. *Review of Agricultural Economics*, **26**(3): 348–360. doi: [10.1111/j.1467-9353.2004.00184.x](https://doi.org/10.1111/j.1467-9353.2004.00184.x)
- Coenen, L., Benneworth, P. and Truffer, B. 2012. Toward a spatial perspective on sustainability transitions. *Research Policy*, **41**(6): 968–979. doi: [10.1016/j.respol.2012.02.014](https://doi.org/10.1016/j.respol.2012.02.014)
- Cook, M. 2018. A life cycle explanation of cooperative longevity. *Sustainability*, **10**(5): 1586. doi: [10.3390/su10051586](https://doi.org/10.3390/su10051586)
- Cook, M.L. and Chaddad, F.R. 2004. [Redesigning cooperative boundaries: The emergence of new models](#). *American Journal of Agricultural Economics*, **86**(5): 1249–1253.
- Cook, M.L. and Plunkett, B. 2006. Collective entrepreneurship: An emerging phenomenon in producer-owned organizations. *Journal of Agricultural and Applied Economics*, **38**(2): 421–428. doi: [10.1017/S1074070800022458](https://doi.org/10.1017/S1074070800022458)
- Dave Grace & Associates, 2014. [Measuring the size and scope of the cooperative economy: Results of the 2014 Global Census on Co-operatives](#). United Nation's Secretariat, Department of Economic and Social Affairs.
- Delbono, F. and Reggiani, C. 2013. Cooperative firms and the crisis: Evidence from some Italian mixed oligopolies. *Annals of Public and Cooperative Economics*, **84**(4): 383–397. doi: [10.1111/apce.12020](https://doi.org/10.1111/apce.12020)

- Eum, H. 2017. [Cooperatives and employment: Second Global Report, Contribution of cooperatives to decent work in the changing world of work](#). D/2017/13.486/1. International Organization of Industrial, Artisanal and Service Producer Cooperatives (CICOPA).
- Galbraith, J.K. 2017. American capitalism: The concept of countervailing power. 1st edn. New York, NY, USA.: Routledge. doi: [10.4324/9781315082691](#)
- Greve, R. 2009. The German Cooperative Banking Group as a strategic network. *Canadian Journal of Development Studies / Revue canadienne d'études du développement*, **29**(1–2): 65–100. doi: [10.1080/02255189.2009.9669248](#)
- Hendrikse, G. and Feng, L. 2013. 26 Interfirm cooperatives, in A. Grandori (ed.) Handbook of economic organization: integrating economic and organization theory. Cheltenham, UK: Edward Elgar. ISBN: 978 1 78254 025 0
- Hendrikse, G.W.J. 1998. Screening, competition and the choice of the cooperative as an organisational form. *Journal of Agricultural Economics*, **49**(2): 202–217. doi: [10.1111/j.1477-9552.1998.tb01264.x](#)
- Heras-Saizarbitoria, I., Sáez, L., Allur, E. and Morandeira, J. 2018. The emergence of renewable energy cooperatives in Spain: A review. *Renewable and Sustainable Energy Reviews*, **94**: 1036–1043. doi: [10.1016/j.rser.2018.06.049](#)
- Herbel, D., Rocchigiani, M. and Ferrier, C. 2015. The role of the social and organisational capital in agricultural co-operatives' development Practical lessons from the CUMA movement. *Journal of Co-operative Organization and Management*, **3**(1): 24–31. doi: [10.1016/j.jcom.2015.02.003](#)
- Howells, J. 2006. Intermediation and the role of intermediaries in innovation. *Research Policy*, **35**(5): 715–728. doi: [10.1016/j.respol.2006.03.005](#)
- ICA, 2011. [Global300 Report 2010: The world's major co-operatives and mutual businesses](#). Geneva, Switzerland: International Co-operative Alliance.
- IEA, 2021. [World Energy Investment 2021](#). Paris, France: International Energy Agency, p. 64.
- Iliopoulos, C. and Valentinov, V. 2018. Cooperative longevity: Why are so many cooperatives so successful? *Sustainability*, **10**(10): 3449. doi: [10.3390/su10103449](#)
- ILO, 2020. [Statistics on Cooperatives: Concepts, classification, work and economic contribution measurement](#). Geneva: International Labour Organization.
- International Cooperative Alliance (no date) [Cooperative identity, values & principles](#) | ICA.
- IRENA. 2021. [Renewable power generation costs in 2020](#). Abu Dhabi: International Renewable Energy Agency.
- Kivimaa, P., Boon, W., Hyysalo, S. and Klerkx, L. 2019. Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*, **48**(4): 1062–1075. doi: [10.1016/j.respol.2018.10.006](#)
- Klagge, B. and Meister, T. 2018. Energy cooperatives in Germany – an example of successful alternative economies? *Local Environment*, **23**(7): 697–716. doi: [10.1080/13549839.2018.1436045](#)
- Lang, R. and Novy, A. 2014. Cooperative housing and social cohesion: The role of linking social capital. *European Planning Studies*, **22**(8): 1744–1764. doi: [10.1080/09654313.2013.800025](#)
- Li, P.-H., Barazza, E. and Strachan, N. 2022. [Incorporating novel renewable energy cooperatives to scale-up smart local energy systems for UK's net zero future](#). Glasgow, UK: University of Strathclyde Publishing.
- Liang, Q. and Hendrikse, G. 2016. Pooling and the yardstick effect of cooperatives. *Agricultural Systems*, **143**: 97–105. doi: [10.1016/j.agsy.2015.12.004](#)
- Manda, J., Khonje, M.G., Alene, A.D., Tufa, A.H., Abdoulaye, T., Mutenje, M., Setimela, P. and Manyong, V. 2020. Does cooperative membership increase and accelerate agricultural technology adoption? Empirical evidence from Zambia. *Technological Forecasting and Social Change*, **158**: 120160. doi: [10.1016/j.techfore.2020.120160](#)
- Markelova, H., Markelova, H., Meinzen-Dick, R., Hellin, J. and Dohrn, S. 2009. Collective action for smallholder market access. *Food Policy*, **34**(1): 1–7. doi: [10.1016/j.foodpol.2008.10.001](#)
- Martens, K. 2022. Investigating subnational success conditions to foster renewable energy community co-operatives. *Energy Policy*, **162**: 112796. doi: [10.1016/j.enpol.2022.112796](#)

- Ménard, C. 2004. The economics of hybrid organizations. *Journal of Institutional and Theoretical Economics (JITE) / Zeitschrift für die gesamte Staatswissenschaft*, **160**(3): 345–376. doi: www.jstor.org/stable/40752467
- Mey, F. and Diesendorf, M. 2018. Who owns an energy transition? Strategic action fields and community wind energy in Denmark. *Energy Research & Social Science*, **35**: 108–117. doi: [10.1016/j.erss.2017.10.044](https://doi.org/10.1016/j.erss.2017.10.044)
- Monteiro, N.P. and Stewart, G. 2015. Scale, scope and survival: A comparison of cooperative and capitalist modes of production. *Review of Industrial Organization*, **47**(1): 91–118. doi: [10.1007/s11151-015-9464-1](https://doi.org/10.1007/s11151-015-9464-1)
- Müller, M., Hanisch, M., Malvido, A., Rommel J. and Sagebiel, J. 2018. The structural effect of cooperatives on price volatility in the European dairy sector. *Applied Economics Letters*, **25**(8): 576–579. doi: [10.1080/13504851.2017.1346358](https://doi.org/10.1080/13504851.2017.1346358)
- Nembhard, J.G. 2002. Cooperatives and wealth accumulation: Preliminary analysis. *The American Economic Review*, **92**(2): 325–329. doi: [10.1257/000282802320189483](https://doi.org/10.1257/000282802320189483)
- Nembhard, J.G. 2014. Community-based asset building and community wealth. *The Review of Black Political Economy*, **41**(2): 101–117. doi: [10.1007/s12114-014-9184-z](https://doi.org/10.1007/s12114-014-9184-z)
- Nourse, E.G. 1922. The economic philosophy of co-operation. *The American Economic Review*, **12**(4): 577–597. doi: www.jstor.org/stable/1804796
- Périlleux, A., Vanroose, A. and D’Espallier, B. 2016. Are financial cooperatives crowded out by commercial banks in the process of financial sector development? *Kyklos*, **69**(1): 108–134. doi: [10.1111/kykl.12105](https://doi.org/10.1111/kykl.12105)
- Pons-Seres de Brauwier, C. and Cohen, J.J. 2020. Analysing the potential of citizen-financed community renewable energy to drive Europe’s low-carbon energy transition. *Renewable and Sustainable Energy Reviews*, **133**: 110300. doi: [10.1016/j.rser.2020.110300](https://doi.org/10.1016/j.rser.2020.110300)
- Rogers, E.M. 2003. Diffusion of innovations. 5th ed. New York: Free Press.
- Rousselière, D. 2019. A flexible approach to age dependence in organizational mortality: Comparing the life duration for cooperative and non-cooperative enterprises using a Bayesian generalized additive discrete time survival model. *Journal of Quantitative Economics*, **17**(4): 829–855. doi: [10.1007/s40953-019-00164-0](https://doi.org/10.1007/s40953-019-00164-0)
- Royer, J.S. 2014a. The neoclassical theory of cooperatives: Part I. *Journal of Cooperatives*, **28**: 1–19. doi: [10.22004/AG.ECON.244008](https://doi.org/10.22004/AG.ECON.244008)
- Royer, J.S. 2014b. The neoclassical theory of cooperatives: Part II. *Journal of Cooperatives*, **28**: 20–35. doi: [10.22004/AG.ECON.244009](https://doi.org/10.22004/AG.ECON.244009)
- Sadowski, B.M. 2017. Consumer cooperatives as an alternative form of governance: The case of the broadband industry. *Economic Systems*, **41**(1): 86–97. doi: [10.1016/j.ecosys.2016.04.004](https://doi.org/10.1016/j.ecosys.2016.04.004)
- Sagebiel, J., Müller, J.R. and Rommel, J. 2014. Are consumers willing to pay more for electricity from cooperatives? Results from an online Choice Experiment in Germany. *Energy Research & Social Science*, **2**: 90–101. doi: [10.1016/j.erss.2014.04.003](https://doi.org/10.1016/j.erss.2014.04.003)
- Sexton, R.J. and Iskow, J. 1993. What do we know about the economic efficiency of cooperatives: An evaluative survey. *Journal of Agricultural Cooperation*, **08**: 15–27. doi: [10.22004/AG.ECON.46389](https://doi.org/10.22004/AG.ECON.46389)
- Sexton, R.J. and Sexton, T.A. 1987. Cooperatives as entrants. *The RAND Journal of Economics*, **18**(4): 581–595. JSTOR: www.jstor.org/stable/2555643
- Seyfang, G., Park, J.J. and Smith, A. 2013. A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy*, **61**: 977–989. doi: [10.1016/j.enpol.2013.06.030](https://doi.org/10.1016/j.enpol.2013.06.030)
- Soboh, R., Oude Lansink, A. and Van Dijk, G. 2012. Efficiency of cooperatives and investor owned firms revisited. *Journal of Agricultural Economics*, **63**(1): 142–157. doi: [10.1111/j.1477-9552.2011.00324.x](https://doi.org/10.1111/j.1477-9552.2011.00324.x)
- Stephens, M. 2001. Building society demutualisation in the UK. *Housing Studies*, **16**(3): 335–352. doi: [10.1080/02673030120049706](https://doi.org/10.1080/02673030120049706)
- Stewart, J. and Hyysalo, S. 2008. Intermediaries, users and social learning in technological innovation. *International Journal of Innovation Management*, **12**(03): 295–325. doi: [10.1142/S1363919608002035](https://doi.org/10.1142/S1363919608002035)

- Tarhan, M. 2015. Renewable energy cooperatives: a review of demonstrated impacts and limitations. *Journal of Entrepreneurial and Organizational Diversity*, **4**(1): 104–120. SSRN: ssrn.com/abstract=2605796
- Verhofstadt, E. and Maertens, M. 2015. Can agricultural cooperatives reduce poverty? Heterogeneous Impact of cooperative membership on farmers' welfare in Rwanda. *Applied Economic Perspectives and Policy*, **37**(1): 86–106. doi: [10.1093/aep/ppo021](https://doi.org/10.1093/aep/ppo021)
- Viardot, E. 2013. The role of cooperatives in overcoming the barriers to adoption of renewable energy. *Energy Policy*, **63**: 756–764. doi: [10.1016/j.enpol.2013.08.034](https://doi.org/10.1016/j.enpol.2013.08.034)
- Wanyama, F.O. 2014. [Cooperatives and the Sustainable Development Goals: A contribution to the post-2015 development debate. A policy brief](#). Geneva: International Co-operative Alliance / International Labour Organization.
- Wierling, A., Schwanitz, V.J., Jan Pedro Zeiss, J.P., Bout, C., Candelise C., Gilcrease, W. and Gregg, J.S. 2018. Statistical evidence on the role of energy cooperatives for the energy transition in European Countries. *Sustainability*, **10**(9): 3339. doi: [10.3390/su10093339](https://doi.org/10.3390/su10093339)
- Wierling, A., Zeiss, J.P., Lupi, V., Candelise, C., Sciallo, A. and Schwanitz, V.J. 2021. The contribution of energy communities to the upscaling of photovoltaics in Germany and Italy. *Energies*, **14**(8): 2258. doi: [10.3390/en14082258](https://doi.org/10.3390/en14082258)
- Williams, R.C. 2007. The cooperative movement: globalization from below. Aldershot, Hampshire, England ; Burlington, VT: Ashgate (Corporate social responsibility series).
- Yang, H., Klerkx, L. and Leeuwis, C. 2014. Functions and limitations of farmer cooperatives as innovation intermediaries: Findings from China. *Agricultural Systems*, **127**: 115–125. doi: [10.1016/j.agsy.2014.02.005](https://doi.org/10.1016/j.agsy.2014.02.005)
- Yildiz, Ö. 2014. Financing renewable energy infrastructures via financial citizen participation – the case of Germany. *Renewable Energy*, **68**: 677–685. doi: [10.1016/j.renene.2014.02.038](https://doi.org/10.1016/j.renene.2014.02.038)
- Yildiz, Ö. Rommel, J., Debor, S., Holstenkamp, L., Mey, F., Müller, J.R., Radtke, J. and Rognli, J. 2015. Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. *Energy Research & Social Science*, **6**: 59–73. doi: [10.1016/j.erss.2014.12.001](https://doi.org/10.1016/j.erss.2014.12.001)
- Zhang, S., Sun, Z., Ma, W. and Valentinov, V. 2020. The effect of cooperative membership on agricultural technology adoption in Sichuan, China. *China Economic Review*, **62**: 101334. doi: [10.1016/j.chieco.2019.101334](https://doi.org/10.1016/j.chieco.2019.101334)
- Zimnoch, K. and Mazur, B. 2018. Value added as a measure of social role of cooperative. *Eurasian Journal of Business and Management*, **6**(1): 42–51. doi: [10.15604/ejbm.2018.06.01.00](https://doi.org/10.15604/ejbm.2018.06.01.00)



Want to know more?

 www.energyrev.org.uk

 [@EnergyREV_UK](https://twitter.com/EnergyREV_UK)

 [EnergyREV](https://www.linkedin.com/company/energyrev)

 info@energyrev.org.uk

Sign up to receive our newsletter and keep up to date with our research, or get in touch directly by emailing info@energyrev.org.uk

About EnergyREV

EnergyREV was established in 2018 (December) under the UK's Industrial Strategy Challenge Fund Prospering from the Energy Revolution programme. It brings together a team of over 50 people across 22 UK universities to help drive forward research and innovation in Smart Local Energy Systems.

ISBN 978-1-914241-39-0

EnergyREV is funded by UK Research and Innovation, grant number EP/S031863/1

