Plan an outline of your community energy project

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It is crucial for communities to determine the type and size of the Community Energy Project (CEP) they need to ensure it meets their requirements and goals. Building a CEP solely based on budget or available space without considering the community's needs can lead to an inadequate system and negative impacts on economics and satisfaction. Performing an energy audit and taking an inventory of your current energy assets and system are two essential steps in planning an energy project.

Energy audit

To conduct an energy audit effectively, here are some practical approaches and considerations:

Determine maximum power demand: Identify the maximum power demand your community or facility may require at any given moment. This involves adding up the power ratings of all devices that could be connected and running simultaneously. This information helps determine the capacity and size requirements for your energy generation and distribution systems.

Analyse energy usage: Obtain data on your energy usage over a 24-hour period and throughout the year. Electricity invoices from the previous 12 months can provide valuable insights into your consumption patterns. Request a spreadsheet of your energy use, ideally in 30-minute increments, from your retailer. Analysing this data helps identify peak demand periods, daily fluctuations, and seasonal variations.

Assess load pProfiles: Create load profiles to visualise and understand your energy consumption patterns. Plotting energy usage over time allows you to identify high-demand periods, such as morning and evening peaks. This information helps you optimise energy generation and storage systems to align with your community's specific needs.

Explore energy efficiency measures: Look for opportunities to reduce energy consumption through energy efficiency improvements. Identify inefficient appliances, lighting systems, or heating/cooling equipment that could be upgraded to more energy-efficient alternatives. This not only helps reduce overall energy usage but also informs the sizing and capacity requirements for your energy generation system.

Identify controllable loads: Determine which energy loads are controllable or flexible within your community or facility. This includes loads that can be adjusted or scheduled to align with periods of higher energy generation or lower electricity rates. By identifying controllable loads, you can optimise energy usage and potentially integrate demand response strategies.

Consider future energy needs: Estimate your future energy usage by considering any planned additions of new appliances, equipment, or loads. Assess their expected power requirements, usage patterns, and duration of operation. This forward-looking analysis helps ensure that your energy generation system can accommodate future growth and changes in energy demand.

Energy inventory of your current system

Developing an inventory of your current energy assets and system is crucial when planning a Community Energy Project. Here are the key questions to consider during the inventory process:

What energy assets do you have today? Identify the existing energy assets in your community, such as generators, solar installations, and energy storage systems. Assess their capacity, condition, and functionality.

What space and buildings do you have? Evaluate the available space and buildings in your community that can be utilised for energy purposes. This includes both for accommodating energy loads and for installing renewable energy systems. Consider roof space, ground space, and other suitable locations for solar panels or wind turbines.

What natural resources do you have? Identify the natural resources available in your community that can be harnessed for energy generation. These resources may include sunlight for solar energy, rivers for hydropower, elevated land for wind energy, geothermal potential, or other local renewable resources. Assess the feasibility and potential capacity of utilising these resources.

How to decide what to include? Start with a broad list of potential energy assets and then prioritise based on feasibility, economic viability, community needs, and available resources. Consider factors such as technical feasibility, financial viability, environmental impact, and community benefits when determining which assets to include in your CEP.

How many phases do you have, and why does it matter? Understand the electrical phase configuration of your property and how it affects your energy system. Determine if your property has a single-phase or three-phase electrical connection. Assess the implications of the phase configuration on load balancing, solar generation, and storage integration. Note that single-phase systems are simpler to balance, while three-phase systems offer higher capacity but require more expertise for optimal configuration.

Where do you interconnect to the distribution network? Trace the power cable from your property to the nearest power pole to identify your connection point to the distribution grid. If you have a metal box resembling a medium-sized microwave oven, it indicates that you are connected to the grid through your own distribution transformer. If not, you might be sharing a transformer. Obtain a network map from your local lines company or refer to their Distribution Asset Management Plan to understand your grid connection and identify potential partnering opportunities with neighbouring properties.

What other energy assets are on your power line? Identify if there are other properties on the same power line that are interested in implementing CEPs. Collaborating with neighbours who share the same power line can increase your collective influence on the network and facilitate negotiations with the lines company.

What is the capacity of distribution transformers, feeders, and network transformers? Consult with the lines company or review their asset management plan to determine the spare capacity of distribution transformers, feeders, and network transformers (substation) relative to existing load. Understanding the available capacity helps you plan your energy project in a way that aligns with the grid's capability and potentially allows for lower connection costs or revenue generation through flexibility or ancillary services.

How to choose generation and storage options

Consider the specific priorities and goals of your community when choosing generation and storage options. These could include factors such as environmental sustainability, energy independence, resilience during power outages, or community engagement and participation. When choosing generation and storage options for your Community Energy Project (CEP), consider the following factors:

Solar PV as the foundation: Start by establishing a solar photovoltaic (PV) system as the foundation of your CEP. Solar PV is a widely adopted and cost-effective renewable energy technology. Analyse the solar potential in your area and install a system that can meet a significant portion of your community's energy needs.

Economics and viability: Evaluate the economics of the chosen generation and storage technologies. If solar PV and battery storage prove to be economically viable, it's likely that other renewable technologies will also be feasible. Explore additional technologies that can further enhance the economic return, supply resilience, or address other specific needs of your community.

Complementary generation sources: Identify generation sources that complement solar PV when its production is lower than your community's load. For example, if your region has consistent wind resources, wind turbines could be considered alongside solar PV. This ensures a more reliable and balanced energy supply throughout different weather conditions and times of day.

Cost-effective storage option: Lithium-Ion Phosphate batteries, such as those commonly used in residential and community-scale energy storage systems, are often a cost-effective storage option to model. These batteries provide efficient energy storage and can be integrated with solar PV systems to store excess energy for use during periods of low solar production or high demand.

Minimise network export: In Aotearoa New Zealand, exporting energy to the network typically has lower economic merit compared to self-consumption. Therefore, prioritise maximising self-consumption and minimise network export to maximise the economic value of your CEP. Design the system to meet the community's energy demand as much as possible.

Is it better to have solar PV on multiple house roofs, on one big community roof, or ground mounted?

Larger solar arrays tend to have a lower overall cost per kilowatt-hour (kWh) produced. If you have a significant energy demand and the available space allows for a larger solar array, a centralised installation, such as on a big community roof or ground-mounted system, may be more cost-effective in the long run.

For small-scale systems, such as individual house roofs, rooftop installations are generally more cost-effective per kWh than ground-mounted systems. Ground-mounted arrays involve additional costs for design, civil works, and building the structure to support the panels. Ground-mounted solar becomes more economically viable at a larger scale

What type of energy system is best for you?

When deciding on the type of energy system for your community project, there are a number of choices to consider: on-grid or off-grid, independent or inter-dependent, integrated or microgrid, private networks and virtual power plants (VPPs). Let's break down each choice:

On-Grid or Off-Grid

Choosing between an on-grid or off-grid system for a community project is indeed an important decision. While the specific circumstances of each project may vary, there are certain factors to consider that can help guide this decision-making process.

Proximity to the main grid: If the community is located far away from the main grid, such as on a small island or in a remote village, it might be more practical to opt for an off-grid system. In such cases, it can be challenging and expensive to connect to the main grid, making off-grid solutions a viable alternative.

Economic considerations: If the community is already connected to the main grid or is in close proximity to it, an on-grid system might be more economically advantageous. The main grid typically provides a cost-effective way to supply power to many people, and it is unlikely that an off-grid system would significantly reduce costs.

Reliability and backup: The main grid acts as a reliable backup for communities connected to it. If there are any issues with the community's power system, the grid can serve as a backup source. This reliability factor can be beneficial, especially in areas where power outages are common or in critical situations where uninterrupted power supply is necessary.

Grid as a battery: The main grid can function as a large-scale battery system. It can absorb excess electricity generated by the community's system when there is surplus power and return it when the community's system cannot meet the demand. This feature provides flexibility and reduces the need for individual energy storage systems.

Future possibilities: Being connected to the main grid opens up potential future opportunities. As the energy market evolves, there may be changes in the value of exported power, and communities connected to the grid may benefit from this. Additionally, there might be incentives or compensation for offering flexibility in delivering electricity or capacity, which being on-grid facilitates.

Hybrid model: Some projects may choose a hybrid approach, where certain parts of the property are connected to the grid while more remote areas remain off-grid. This setup can provide the benefits of both systems, ensuring reliable power supply from the grid while enjoying the independence and sustainability of off-grid solutions in specific areas.

Integrated or microgrid

The main distinction between an integrated system and a microgrid lies in their ability to disconnect from and reconnect to the main grid. A microgrid is often a more versatile system that can operate both connected to and disconnected from the main grid, providing resilience, support during grid outages, and localised power supply. However, it requires more complex control systems and ongoing maintenance. Integrated systems, while simpler and cheaper to maintain, lack the ability to disconnect and operate autonomously. The choice between the two depends on the specific needs and requirements of the project, considering factors such as reliability, resilience, and the ability to provide backup power during grid disruptions. Here are key points to consider:

Microgrid:

- A microgrid is a collection of interconnected loads and distributed energy resources (DERs) within defined electrical boundaries.
- It acts as a single controllable entity with respect to the grid.
- A microgrid has the capability to disconnect from the main grid and operate in island mode, where it can function autonomously.
- It can automatically reconnect to the main grid when it becomes available again, with seamless synchronisation of voltage, frequency, and phase.
- Microgrids offer supply resilience, as they can continue to operate even if the main grid experiences an outage.
- In situations where there is insufficient power on the grid, microgrids can help support the grid's recovery.
- Microgrids can provide electricity to individuals who have lost power, offering essential services like charging phones, cooking, or providing hot water.
- Operating and maintaining a microgrid requires expertise in managing its control system and ensuring its reliable operation, often with ongoing support from a knowledgeable team.

Integrated system:

- An integrated system is always connected to the main grid and does not have the capability to disconnect.
- If the main grid experiences an outage, an integrated system is designed to shut off to avoid feeding power back into the grid, which could pose risks to repair workers.
- Integrated systems cannot automatically reconnect to the main grid once it is restored.

- Integrated systems are typically cheaper and easier to maintain than microgrids, as they do not require the same level of sophisticated control systems and autonomous operation.

Private networks

Private networks, also known as secondary networks, can offer several advantages in maximising the value of a Community Energy Project (CEP). There are two primary types of private networks: **embedded networks** and **customer networks**.

Managing both embedded networks and customer networks requires expertise, and there are risks associated with network ownership. In some cases, the EDB or a private company may manage the private network on behalf of the owner, but this may reduce the overall savings.

Embedded networks and customer networks are not mutually exclusive, as a customer network can exist within an embedded network. A customer network has fewer compliance requirements and potentially delivers greater savings, but it requires more effort to manage.

Embedded network: An embedded network is a privately owned or community-owned sub-network that is connected to a larger network owned by an electricity distribution company (EDB). It has a defined boundary, known as the network supply point or network ICP, which separates the embedded network from the EDB's network. The owner of the embedded network, known as the embedded network owner (ENO), functions similarly to a mini EDB or lines company.

The ENO owns and maintains the lines within the embedded network and charges the end customers a separate lines charge. The ENO negotiates with the EDB to reduce the EDB's lines charge, which can result in significant cost savings. For example, the equivalent cost of the EDB's lines charges might decrease from 8 cents to 4 cents per kilowatt-hour (kWh), leading to savings that can be passed on to the community or used to pay off the project costs.

In some cases, a third party can be employed to manage billing and compliance for the embedded network. However, this may reduce the overall savings. At a sufficient scale, typically around 50 houses or more, there should be enough savings to make this economically viable.

Embedded networks work best for new developments where the network assets can be owned by the community. If there is existing infrastructure owned by an EDB, the embedded network can be acquired by a community electricity provider (CEP), sometimes at the depreciated value, and the CEP becomes the ENO. However, EDBs are generally hesitant to sell assets as it reduces their Regulated Asset Base (RAB), which affects their ability to recover costs through lines charges.

A typical use case for an embedded network is when there are multiple homes, buildings, businesses, or electrical loads within a single large property, such as an apartment complex, a papakainga, a rural lot with multiple dwellings, a retirement village, or a port. It is preferable for the entire network to be situated on a single private property to minimise compliance costs.

From a retail electricity trading perspective, embedded networks are still considered "on market" under the Code. Each building's individual ICPs (Installation Control Points) can be served by any retailer, allowing customers to choose their own retailer and rate plan. However, electricity can only be bought and sold between customers within the embedded network if they are with the same retailer. The CEP has the ability to negotiate reduced network charges on behalf of the customers.

With ownership of the embedded network comes accountability. The responsibility for maintaining the network and ensuring an obligation to supply people in need shifts from the EDB to the CEP.

Compliance requirements are higher for embedded networks, as the CEP needs to perform market reconciliation as a distributor and comply with regulatory maintenance needs. The CEP can choose to outsource maintenance and management to a private company, but this will reduce the overall savings. Alternatively, the embedded network can be operated by the EDB on behalf of the CEP, although this would also eat into the savings.

Customer network: In contrast to an embedded network, a customer network solution operates with a single gate ICP at the boundary between the customer network and the EDB network. All electricity flowing in and out of the network is accounted for at this single ICP. There are no other ICPs within the customer network, and the interaction with the retailer occurs only at the gate ICP. Within the customer network, billing and retailing of electricity are managed by the community entity itself, effectively acting as the retailer.

From a retail electricity trading perspective, a customer network is considered "off market" under the Code. This means that electricity retailing for each load or building can only be served by the community entity, and all consumers within the customer network deal with a single retailer.

As the owner of the network, the CEP is responsible for covering maintenance costs and administrative tasks. Commercially available billing platforms can facilitate these processes by reading meters, calculating amounts owed, and generating invoices in popular accounting software. Alternatively, manual methods such as meter reading and data entry into spreadsheets can be used. Long-term asset management may be required for the network, and this can be subcontracted to a local maintenance partner.

Customer networks are particularly advantageous for multi-unit residential properties as they allow for bulk-buying discounts on charges and energy. It enables one entity to negotiate on behalf of all units, which is appealing for individuals seeking low-cost, reliable electricity without dealing with the complexities. Retailers may offer lower bulk rates because multiple units provide load diversification, smoothing out the overall load. For example, in a 20-unit network, different occupants may have varying patterns of electricity usage, allowing the retailer to purchase electricity at a lower average rate and pass on the savings.

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