Community, batteries

A discussion paper on the impacts of “community batteries” on equity, sustainability and the decarbonisation transition

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Executive Summary

This paper discusses the potential impacts of “community batteries”, or more generally medium-scale batteries, on the equity and ecological sustainability of the energy system. The discussion is situated within the context of an energy system in the throes of sweeping changes, driven by climate change and decarbonisation, that are guaranteed to continue and accelerate.

While many of the conversations surrounding “community batteries” revolve around questions of ownership and operations, I believe that there is a more fundamental question. This is: **why should we deploy medium-scale batteries – what objectives do they address?**

I address this question by disentangling “community” and “batteries” considerations and explicitly focusing on the values of social equity and ecological sustainability. This leads to conclusions that:

- Medium-scale batteries are:
    - **Very well suited to managing local network conditions**, enabling greater hosting capacities of solar, electric vehicles and electrified appliances.
    - Less well suited to providing system wide services such as supply-demand balancing and frequency support services because these can be more efficiently sourced – in terms of labour, capital and resources – from utility-scale energy storage assets.
- Ineffective or inefficient uses could have unnecessarily large environmental impacts.
- Ownership and operation models should align with the purpose of network management.
- Medium-scale batteries could exacerbate inequality through focussing their benefits on exclusive communities, such as customers with solar or residents of wealthy suburbs.
- Equity improvements are best pursued in broad and diverse communities, such as all residents of a local/state government or all customers of a distribution network.
- Communities have many avenues by which to pursue improved affordability, accelerated decarbonisation, and greater participation in shaping their energy supply. Advocacy for, or ownership of, medium-scale batteries is unlikely to be the most effective avenue in general.

My most important conclusion is that **deploying medium-scale batteries is no substitute for developing clear plans and deliberative processes for transforming communities’ electricity systems to be decarbonised and resilient**. Such plans and processes are what communities ultimately wish to see and be a part of.

For a deeper dive into the various aspects of medium-scale batteries please see the Knowledge Hub and Impact Framework developed by colleagues within the Battery Storage and Grid Integration Program at ANU at https://bsgip.com/neighbourhood-battery-knowledge-hub/ This discussion paper is not affiliated with this initiative but draws on previous shared projects and insightful discussions with these colleagues.

Background

The Federal government has committed to supporting the roll out of 400 "community batteries" with promises of more affordable electricity and lower greenhouse gas emissions. The Victorian government has subsequently committed to supporting 100 such batteries (which may or may not be additional to the federal batteries). These represent government investments of $224m and $42m respectively.

The Victorian Government has also funded colleagues within the Battery Storage and Grid Integration Program at ANU to develop a Knowledge Hub that serves as the best starting point for further reading: https://bsgip.com/neighbourhood-battery-knowledge-hub/

While there is broad agreement that decarbonised electricity systems would benefit from the connection of medium-scale batteries to distribution networks, there remains significant uncertainty and contention about precisely what services such batteries ought to provide, how they should be deployed and operated, and who the best party(s) is for owning and operating them. Furthermore, it is unclear what, if any, involvement communities will have with such batteries, and what therefore is to be understood by the term "community batteries".

In this paper I therefore use the term "medium-scale battery" as a generic title for batteries with capacities in the range of hundreds to thousands of kilowatt hours.

The uncertainty surrounding these batteries is part of broader uncertainties regarding how the decarbonisation transition will affect peoples' immediate surroundings – their homes, workplaces, streetscapes and distribution network. These uncertainties have the potential to obstruct and misguide individual and community actions. It presents systemic risks to the social acceptance of actions from energy sector organisations, including the deployment of medium-scale batteries.

Within this context, the deployment of medium-scale batteries – under the label of "community batteries" or otherwise – may be a step towards a better future (pending how they're deployed) but is no substitute for the comprehensive and coherent plan and process required for defining and delivering such a better future.

Purpose

The intent of this paper is to call particular attention the potential impacts of medium-scale batteries on the equity and ecological sustainability of the energy system – and to the evolution of this system in response to worsening climate change and accelerating decarbonisation. For discussions of the broader impacts of these batteries see the Knowledge Hub.

While the conversations surrounding "community batteries" tend to revolve around questions (and contestations) of ownership and operations, I believe the key question is: **why should we deploy medium-scale batteries – what objectives do they address?**

Resolution to this question will be instructive to the issues of operating and ownership models and helps lay the foundations for the public acceptance and support for these batteries and the decarbonisation transition broadly.

Premise

My analysis is focused on two core values: equity, between and within communities and ecological sustainability, particularly regarding decarbonisation and resource consumption.

My approach throughout the paper is to disentangle the term "community battery" by considering the "community" and "battery" aspects in their own right. Doing so reveals that many of the stated objectives for "community batteries" could alternatively be pursued through other means. Such alternatives ought to be given due consideration before deploying batteries.

The second point to emphasise is that **batteries and solar are decisively different** in their environmental and economic functions and value propositions. Furthermore, **batteries are not an inevitable sequel to solar**.

Batteries do not produce electricity but rather add to total electricity demand through their internal losses. They are incredibly flexible in when they charge and discharge. It is the timing of charging/discharging that determines whether they decrease or increase carbon emissions by facilitating more/less energy to be provided by zero emissions generators. Batteries are also much more resource intensive to produce than solar panels, which further heightens the care that must be taken to identify their optimal uses. (Care should also be taken when deploying solar, but solar benefits from directly offsetting its embodied emissions by generating zero carbon electricity.)

The economics of batteries are also very different (for the same reason that they consume rather than generate energy.) Currently, business cases for batteries outside of solar/wind farms often struggle to produce favourable financial returns due to the high price of batteries and the relatively modest unserved need for further energy storage in the current electricity system.

Thirdly, energy assets connected directly to the grid incur very different treatment than those connected "behind the meter (BTM)" in customers' premises. This is because BTM energy flows are a private matter of the property owner/occupier and lie outside of the purview of the national market, whereas all actions on the grid relate to the shared infrastructure that is paid for by all customers and regulated accordingly.

I outline these differences in the interest of expectation setting. Specifically, to clarify that **the deployment of medium-scale batteries will not necessarily reduce electricity costs nor produce environmental benefits – it will only do so in certain contexts**.

Battery Objectives

In this section I consider medium-scale batteries as batteries – i.e. as energy assets – and explore the reasons for why such assets may be connected directly to the distribution network. My appraisals in this section generally relate to the value of ecological sustainability, as measured by the efficacy and efficiency in allocating our finite human and material resources to address climate change.

Batteries

Batteries provide a way to store electricity for later use. There are broadly two reasons for needing to store electricity.

1. Balancing electricity supply and demand across a wide range of timespans:
   - on a sub-second basis, which is achieved via mandatory and market services responding to variations in the frequency of the grid's Alternating Current (AC) waveform,
   - across a period of a few hours or a day or few, for which the electricity market is an important mechanism for scheduling dispatch, and
   - over a horizon of months, which is the domain of government and electricity sector planning departments and long-term financial contracts.
2. Managing the flow of power around the electricity network, within the constraints of:
   - maximum/minimum voltages that appliances and network components can handle, and
   - limits on the amount of power flowing through the wires, transformers and other components of the network.

Amongst the various technologies we use to store electricity, batteries are particularly well suited to balancing supply and demand over short periods of time (sub-second to hours) and managing the flow of power around the network. This is due to the exceptional speed with which they can respond to control signals – being able to produce or consume a lot of power more quickly than hydropower stations and other technologies. Demand for these services is increasing, being driven in part by increasing adoption of variable generation/ renewables and electric vehicles.

In contrast, batteries are less well suited to storing electricity over long time periods because other technologies, such as pumped hydropower, can more cost effectively increase their energy capacity (in MWh) without increasing their power rating (MW).

When considering whether batteries – or any other energy storage technology for that matter – are the best solution for providing balancing or network management services, we should compare them to alternative solutions, such as reducing demand, shifting demand, increasing electricity generation, or increasing the capacity of the electricity network.

Because energy storage systems, including batteries, do not generate clean electricity but act as a net load on the power system, their contribution to reducing carbon emissions can be both positive and negative. Their positive contributions come through two means: by absorbing clean electricity that would otherwise have been curtailed and assisting with the management of the power system to facilitate a higher instantaneous percentage of renewable energy. Alternatively, batteries can also increase carbon emissions, for example when a home battery stores electrons from a rooftop solar system – at a time when these electrons would otherwise have flowed to a neighbouring property and displaced electrons from a fossil generation – and discharges the stored electrons at a later moment when a wind turbine in being constrained due to insufficient load.

Medium-scale batteries

Batteries are a very modular technology. The batteries used in medium-scale batteries (as well as in homes and electric vehicles) are simply an integrated package of a great many identical battery cells (imagine a somewhat larger version of the ubiquitous AA battery). This structure gives rise to efficiencies of scale in terms of the labour, capital and materials required for larger conglomerations of battery packs. This makes home batteries less efficient than medium-scaled batteries, which in turn are less efficient than utility-scale batteries.

Another important consideration is that, like solar, quality and capabilities tend to improve with scale, both of hardware components and of the systems and processes of operations. Solar farm owners, for instance, may perform photoluminescent quality control on solar modules before installation, usually utilise inverters capable of providing advanced grid services such as providing reactive power even during the night, and provide the grid operator AEMO with visibility and forecasts for constant monitoring. Rooftop solar systems meanwhile are more likely to have lower quality hardware with fewer features and higher rates of hardware or installation faults and poor maintenance that see them fall short of providing their (lesser) regulated grid support functions.

These consequences of scale define the terrain on which medium-scale batteries must demonstrate their unique advantages – in terms of their impact on equity and ecological sustainability. I now consider what these may be for the tasks of balancing supply and demand, and distribution network management respectively.

Balancing supply and demand

Balancing supply and demand is a system-wide task that can be contributed to (roughly) equally from any connection to the interconnected electricity grid. This holds across all time scales, from sub-second frequency control services through to balancing through and across days. For example, the provision of a unit of energy from a battery on a solar farm in Western NSW is basically equivalent to the provision of a unit of energy from a battery in a suburb of Brisbane.

The advantages that come from locating energy supply and storage assets in close proximity to demand are that it reduces the modest amount of energy lost in transporting electrons across the grid, and that it could reduce the capacity requirements of the upstream grid. This latter point may be difficult to realise because grid capacity requirements are conservatively designed to handle moments of peak demand, in which the availability and contributions of small- and medium-scale batteries may not be sufficiently guaranteed to alter planning constraints.

Balancing services are therefore likely better provided from large utility storage assets that benefit from efficiency and quality advantages of scale. Our future 100% renewable energy system will include sufficient “deep” storage (such as hydro) to provide power for extended (multi-day) periods of low renewable generation. This will dramatically diminish the need for “shallow” (short term) storage as long-term storage covers short-term needs. Medium-scale batteries may still contribute to the provision of these services, but efforts directed primarily at these goals – including efforts to transition to 100% renewables – would be better directed towards utility-scale assets.

The same effects of scale give medium-scale batteries advantages over smaller BTM batteries. The deployment of medium-scale batteries may therefore be (partially) justified on the grounds of suppress to deployments of BTM batteries.

Network management services

In contrast to balancing services, services managing the flow of power through the network are inextricably linked with the location of assets. A battery in Western NSW cannot (generally) assist with regulating the voltage or power flows through a power line in suburban Brisbane.

Medium-scale batteries are therefore well suited to the management of local network conditions. Their role(s) could include assisting with:

- Day-to-day network management – facilitating a higher presence of rooftop solar and large loads like air-conditioning and electric vehicles by controlling voltage and power flows.
- Reliability – providing power to cover what would otherwise be short duration outages due to maintenance and moderately low impact, high probability events.
- Resilience – providing power over extended periods of time, such as a day or longer at reduced power levels, in response to major high impact low probability events like fires and floods.

The identification of these applications raises three pertinent points. Firstly, these roles are all currently the responsibility of Distribution Network Service Providers (DNSPs). DNSPs have well established regulatory frameworks for delivering these services with a balance of customer cost against level of service (avoiding massive over-builds of infrastructure to counteract rare events). Two caveats to this are:

1. As mentioned above, regulatory arrangement tend to limit the ambition and scope of DNSPs' activities in facilitating the decarbonisation transition beyond their traditional network infrastructure. Consequently, DNSPs are at times responding reactively to changes in customer assets and behaviours rather than proactively collaborating with customers and policy setters on shaping and driving this evolution.
2. Resilience is not explicitly dealt with in DNSP frameworks (or other energy sector regulations for that matter). Planning around infrequent extreme events – that are becoming more frequent as a result of climate change – presents regulators and DNSPs with very difficult challenges in balancing extreme impacts with unpredictable frequency.

These caveats would ideally be addressed in unison with one another, and in unison with commitments to deploy medium-scale batteries. Deployments of "community batteries" are no substitute for such regulatory updates and, critically, are not in and of themselves what communities are seeking: **communities are seeking clarity on the evolution of their electricity supply in a decarbonised and climate change affected future**.

Secondly, these roles for medium-scale batteries can all be achieved through alternative approaches, such as upgrading equipment or adopting smarter network management systems. These present pertinent reference points against which an investment in a battery should be assessed.

Thirdly, using a battery to provide power when there is a blackout upstream in the grid (reliability and resilience services) requires a higher tier of battery control system, as well as additional hardware (as the battery takes over the responsibility for managing the energy security of the islanded grid/community, for which it requires a capability called "grid-forming" mode). These components and capabilities have not been included in most existing "community batteries" and are not stipulated in planned projects. This is despite the provision of backup power to prevent local blackouts being a common expectation and assumption from customers.

Community Objectives

Mirroring the previous section, I now consider the objectives of "community batteries" from the perspective of communities. While my appraisals continue to consider both efficacy and ecological sustainability, in this section the primary focus is on equity.

Communities, and their individual constituents, may be motivated to engage with "community batteries", community energy projects broadly, and the energy system in general for a very wide range of motivations. In the following sections I explore a few of these, taking a similar comparative lens to alternative ways by which goals could be pursued.

Defining community

Before discussing any specific community objective, we need to consider how to define a community? Specifically, how is a community bounded: who is "in" the community and who is "out"? The attractiveness of "community benefits" sounds distinctly different depending on if one assumes one is "in" the community or "out" of the community that is benefitting. It may be wise to take a Rawlsian approach and **judge the ethical attractiveness of a community initiative from the perspective of someone excluded from the community**.

The choice of how to define a community has major equity implications. In relation to medium-scale batteries, I consider the following to be potential choices of "communities":

- All customers connected to the same grid, be that the National Electricity Market that spans from Port Douglas in Queensland to Port Augusta in South Australia to Port Arthur in Tasmania, or the smaller grids in WA and NT.
- All customers of a particular DNSP – spanning some fraction of a state – who all pay the same "postage stamp prices" for the maintenance of their network, despite the cost of servicing regional customers being many times greater than the cost of servicing urban centres. Research generally finds there to be strong support for this arrangement from customers and it is absolutely critical to delivering on the social contract of electricity as an essential service that is provided to all in an affordable and reliable manner.
- Geographically dispersed community members who invest in a battery.
- Geographically concentrated citizens in a region, town, suburb, or street who are actively advocating for changes in the energy system and/or are seeking to invest in a battery.

Leaving aside the unavoidable politics of drawing a boundary around a community, there are inherent tensions and trade-offs in the choice of community size. Larger communities tend to have greater diversity and subsequent ability to support equity through internal redistributions, while smaller communities may be able to leverage their closer relations and potentially financial or social privileges to drive disproportionate impacts. This tends to place localised initiatives in tension with broader social equity – which we observe when "communities" are defined by subgroups such as customers in close proximity to batteries, customers with rooftop solar, or individuals with access to capital to invest.

Having selected these potential communities, I now explore three aspects of their energy supply which communities may feel dissatisfied about and wish to improve through deploying "community batteries": affordability, environmental impacts, and the community's role in decision making regarding the evolution of their energy supply.

Affordability

I begin by considering the "community" of all customers connected to a shared grid (e.g. NEM).

Based on the preceding discussion, the optimal affordability outcome for this community of customers collectively would be for medium-scale batteries to be selectively deployed to meet local network needs, and not to be deployed on the grounds of balancing services.

Next, I consider communities comprised of subsets of customers connected to a shared grid.

Firstly, there is the "community" of customers who live close to the battery. The physical proximity of these customers makes them the primary recipients of the physical benefits of the battery, including increased hosting capacities, network management, and potentially reliability and resilience. The open question is whether these local customers also receive affordability benefits, such as through modified network tariffs or through bespoke retail offerings including subscription models. Such a localisation of benefits inherently introduces inequities. A useful analogy may be to consider a public pool. This unavoidably provides a higher level of amenity to residents who live within walking distance, but we do not exacerbate this by charging them discounted entry. In the case of network tariffs, local differences run counter to the social contract of postage stamp network pricing. In the case of retail offerings, it's unclear where any retail cost reductions would arise as the battery would experience the same market arbitrage opportunities as all batteries (and customers and generators).

One way to potential ameliorate these problems is to consider the community of all customers connected to the same DNSP. This is the community who currently distribute the costs of their network through postage stamp prices that heavily subsidise more rural community members who are more expensive to serve. Were the DNSP to deploy a medium-scale battery – in a context where it is deemed the most effective solution to a substantial problem – the cost savings derived from the battery would be equitably shared by all of the DNSP's customers through a reduction of the postage stamp network tariff.

Another community that is frequently called out in relation to "community batteries" are customers with rooftop solar systems, who would like to receive higher prices for their exported solar power and/or avoid losses from curtailment. Batteries providing services specifically for this "community" would likely exacerbate the inequality between the "solar haves" and the "solar have-nots", especially as increases to solar feed-in-tariffs are ultimately paid by the customers consuming this solar energy, who are generally customers who have not, or cannot, install their own solar systems. This aside, ownership of (medium-scale) batteries doesn't alter a retailer's primary reference point for setting feed-in-tariffs: it remains the NEM value during hours of solar generation.

Another "community" could be constituted by those (wishing to) invest in a medium-scale battery. In this case the pertinent point of comparison is a battery owned by a DNSP, which would be generating profits at a relatively modest rate enforced by the regulator. If a "community" owned battery generates returns in excess of the DNSP rate of return, customers would have been better off with a DNSP owned battery. Alternatively, if the community owned battery generates lower returns, community investors are foregoing returns they could be making from alternatives, including from decarbonisation aligned energy investments such as in utility batteries, solar farms or ASX listed energy companies. Such philanthropy – as in the case of the Hepburn Energy cooperative – may be in service of bolstering local resilience or economic development, or environmental benefits.

Environmental impacts of batteries

As discussed, batteries' environmental impacts hinge on how they facilitate other changes in the energy mix towards decarbonisation. Given medium-scale batteries' unique size and location in the distribution network, the changes they can best effect are to increase the local network's hosting capacity of solar and electric appliances and vehicles.

In considering batteries' environmental benefits we must consider the impacts of their production. The rush to produce batteries has seen mining and processing of lithium and cobalt dispossess local populations from their land, deplete water sources and endanger human health. With battery recycling infrastructure not yet in place, additional batteries are likely to place further pressure on these activities. This points not only for the need for responsible mining and manufacturing practices, but for batteries to be deployed judiciously with regard to alternatives.

Alternatives do not necessarily need to be storage technologies, as hosting capacity can be increased through alternative network investments, and environmental (as well as energy affordability) benefits can be realised through energy efficiency, demand shifting, and other methods. Communities can facilitate high-impact activities on this front, as I describe in the next section.

Community power in the energy system

Another potential community objective may be to gain (a sense of) control of the evolution of their energy supply. Such a sentiment has been part of the dynamics driving Australia's phenomenal uptake in rooftop solar, and batteries may be viewed by community members (and their influencers) as the inevitable next step in this process of decarbonising – without awareness of the issues discussed above.

While community ownership of an energy asset – be it a medium-scale battery or a solar farm – brings with it a degree of power, this power may not be shared throughout the community, and may even exacerbate inequitable power dynamics. The structures through which communities manage assets are therefore all important.

I believe it is worth considering alternative avenues through which communities and individuals can participate in steering the decarbonisation transition. These could focus on strengthening social contracts within communities and between communities and the energy sector actors – rather than adding new financial contracts within the framework of a privatised energy market. Such initiatives could do much to rebuild trust in energy system as a whole.

As an example, consider the scenario in which a DNSP has identified that a medium-scale battery (or an alternative program of works) was required to address a shortcoming in reliability/resilience or in their ability to accommodate an increase in solar or electrified loads. How could the DNSP involve the local community in this process?

One possibility may be that the DNSP establish a mini-public[1], comprised of representatives from the affected local community, to provide input into system design and operating model. Questions that may be considered in the design phase could include the desirability of different battery sizes or ratios of power capacity to energy capacity, factors influencing the location of hardware assets, the addition

[1] https://www.newdemocracy.com.au/2017/05/08/forms-of-mini-publics/

of non-standard features such as outlets for charging appliances directly from the battery during an emergency. Operational issues could include whether a certain battery capacity is to be held in reserve in case of an upstream outages – despite this constraining the provision of other benefits – or how the battery control system ought to trade-off competing values, such as reducing carbon emissions versus generating financial returns that would reduce community members' bills.

Alternatively, communities – such as those that have experienced repeated disasters of fires and floods – may not be seeking to actively participate in shaping infrastructure decisions but may rather be simply advocating for investments to flow to make their supply more resilient. While the desirability of such upgrades is indisputable, their desired impacts must be considered alongside their cost implications on the DNSP's total customer base and potential negative impacts such as on the environment. Assessing these trade-offs is currently the responsibility of regulatory market bodies, and to a lesser extent governments. These bodies and their processes are very attentive to the equity impacts of each investment but could perhaps do more to proactively manage the structural changes of climate change and decarbonisation.

Finally, it is worth considering the multitude of alternative ways by which communities can play an active, and leading, role in shaping and accelerating the decarbonisation transition. As just one example, community initiatives could coordinate and assist community members with energy efficiency upgrades through auditing old appliances, and helping to seal air gaps, install insulation, and replace lights with LEDs. These activities are extremely effective – financially, comfort level wise, and environmentally – and are well suited to community contributions in enthusiasm, skills, knowledge, and funding. They are also far more accessible for renters, young families and people with low incomes – contributing positively to improved equity.

Ownership and Operations

Questions surrounding who is best placed to own and/or operate medium-scale batteries are as contentious as they are consequential to many stakeholders. My view is that these questions should be treated as secondary to, and largely resolved by, the question of what objective(s) are being pursued.

There are of course important corollaries to this, particularly regarding practical considerations. These include, but are not limited to, the owner/operators': capabilities and resources to maintain a battery throughout its life to minimise serious risks such as fires, including during extreme weather events and unplanned outages; reliably meet all regulatory and customers protections standards; and their longevity to care for the battery throughout its complete life cycle, including end of life.

A further point to clarify is that financial relationships with customers are completely abstract from the physical flows of electrons. A battery subscription tariff is nothing more than an agreed pricing structure applied to the electron flows through a customers' meter. Retailers can equally well offer virtual battery subscription tariffs without owning/operating a battery – as their sole purpose is to manage/hedge the cost of sourcing electricity with what they are charging their customers. The flip side of this is that medium-scale batteries operate with respect to the wholesale market as this defines the cost to serve their collective customer base. They therefore have no impact on the costs facing customers (beyond the general impact of storage assets – of any scale and type – decreasing the variability of market prices through charging at low prices and discharging at high prices). Subscriptions or any other tariff changes merely affect the distribution of costs between the retailers and customers (the amount of profit for retailers) and between customers on different tariffs (as seen with discounts offered to new customers, effectively imposing a loyalty tax).

Without getting (further) into the weeds of the many possible ownership and operating model permutations, I briefly present four possible scenarios that illustrate the impacts of various choices.

1. *Medium-scale batteries owned and operated by a DNSP*

As discussed above, the DNSP's collective customer base could be viewed as a "community". Such batteries, situated at sites with poor reliability and/or network performance, would create two sets of benefits. Firstly, customers connected close to the battery would enjoy more reliable power supply, as well as the ability to connect more low carbon devices including solar, electric vehicles and heat pumps that contribute to mitigating climate change. Secondly, the whole "community" of DNSP customers would benefit from this reliability improvement having been achieved at a lower cost with a battery than it would have been with an alternative investment. These cost savings would be equitably distributed across the diverse customer base through the model of postage stamp pricing. The likelihood for redistribution of profits is aided by tight regulation of DNSPs, although recent analysis indicates DNSPs have extracted "supernormal profits" over the past seven years[2].

DNSPs are uniquely positioned to understand where medium-scale batteries can create maximal benefits for network management. They are also well equipped to manage the installation and ongoing maintenance of such energy assets. Customers located close to the battery – as well as customers more broadly – could contribute to shaping the battery through a process of deep customer engagement, such as through a mini-public. Government funding contributed to the battery should

[2] https://ieefa.org/resources/regulated-electricity-network-prices-are-higher-necessary

be excluded from the DNSP's Regulated Asset Base (RAB) so that the benefits flow through to customers rather than being added to ongoing customer fees.

2. Medium-scale batteries owned and operated by a community cooperative

In the second hypothetical model, the "community" is more localised – to a neighbourhood or town. This community – or some constituency of the community – have contributed their time and/or capital to the deployment of the battery and this has been recognised in partial ownership of the battery vesting with a local co-operative that runs the grocery store and fuel station. This co-operative is managed by local residents, who gain membership status through their spending at co-operative stores. The revenue that the co-operative receives from its stake in the battery is utilised or distributed according to the democratically determined wishes of co-operative members.

This model strikes some balance between harnessing and strengthening local community spirit – which may still create inequality between other groups – with an organisational structure conducive to distributing benefits equitably. On the operational front though, it raises risks around the reliability and longevity of battery management given the likelihood of limited expertise and turn over in the community.

3. Medium-scale batteries owned and operated by a government

A third model to briefly sketch is for batteries to be owned by governments. This seems increasingly plausible given governments' renewed appetite for direct investments in the energy system. Government ownership would open many avenues through which battery revenues could be distributed to the community of the government's constituents, ranging from energy specific actions such as energy bill rebates or providing a basic amount of energy to each household for free (say enough to cover refrigeration and cooking), through to general actions such as tax reductions or improved services.

Further advantages of governments ownership include their access to low-interest financing and longevity to manage infrastructure assets throughout their life cycle. Trust in governments can be quite bifurcated; either way, battery operations would require the development of new expertise, which could be particularly challenging for local governments who are not currently empowered or resourced to take on such new roles[3].

4. Medium-scale batteries owned and operated by a market participant

The last model to mention is for batteries to be owned by private entities such as investors, community groups, or electricity retailers and operated by energy market participants, such as electricity retailers. These models are often discussed in terms of building direct relationships with customers, such as through customers paying a subscription to use a portion of the battery to store their excess solar generation to thereby retain greater value than the FiT they would receive for exporting their solar power to the market.

A challenge for such customer-connected models is that the battery has access to the electricity market as a reference price. This means the battery has no incentives for paying customers more for their solar electricity than the electricity market price or for charging customers less for exports from

[3] https://theconversation.com/beyond-roads-rates-and-rubbish-australians-now-expect-local-councils-to-act-on-bigger-issues-including-climate-change-199861

the battery than the market price. For their part, customers would be financially better off trading directly with the market than paying any additional subscription fees to the battery.

The environmental ramifications similarly flow from the alternative of exchanging energy directly with the grid/market. Once electricity has been generated it is most efficient (and least environmentally damaging in terms of emissions and material resource consumption) to use it immediately in a load, even if in another part of grid, rather than to store it in a battery (home, medium-scale or grid-scale).

Conclusion

This paper focused on the objectives that may motivate the deployment of medium-scale batteries. I believe that a clarified understanding of the (diverse) objectives is the critical first step to guiding choices of if, where, and how such batteries should be deployed, and who is best placed to own them.

My assessment of medium-scale batteries as energy assets suggests that their optimal applications relate to distribution network management, to improve reliability, resilience and hosting capacity of low carbon technologies. In contrast, they are likely a sub-optimal choice – in terms of efficacy and efficiency of decarbonisation – for providing grid scale energy balancing services.

Considering some of the potential objectives driving community interest in medium-scale batteries, I noted numerous risks for exacerbating inequality, within and between communities, and identified alternatives through which communities could be included in the decarbonisation process.

My overarching conclusion is that medium-scale batteries – under the banner of "community batteries" or otherwise **– are no substitute for communities' desire for to understand, and be a part of, the plan for transitioning their electricity system to a decarbonised and more resilient state.** Deployments of such batteries are unlikely to realise their potential in the absence of such a plan.