LAYING THE FOUNDATION

6 Priorities for supporting the decarbonization of Canada's grid with energy storage

Canadian Renewable Energy Association | Association canadienne de l'énergie renouvelable

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For information on joining CanREA's National Energy Storage Caucus, please visit the [Caucuses and Committees] webpage, and contact member services at members@renewablesassociation.ca or 1-800-922-6932.

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Canadian Renewable Energy Association

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The Canadian Renewable Energy Association (CanREA) is the voice for wind energy, solar energy and energy-storage solutions that will power Canada's energy future. We work to create the conditions for a modern energy system through stakeholder advocacy and public engagement. Our diverse members are uniquely positioned to deliver clean, low-cost, reliable, flexible and scalable solutions for Canada's energy needs. Our vision is to ensure wind energy, solar energy and energy storage play a central role in transforming Canada's energy mix.

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LAYING THE FOUNDATION

6 PRIORITIES FOR SUPPORTING THE DECARBONIZATION OF CANADA'S GRID WITH ENERGY STORAGE

This CanREA whitepaper focuses on six priorities for advancing energy storage in Canada:

- Education
- Regulation
- Markets
- Grid optimization
- Communities
- Sustainability

> **"Affordable, dynamic and versatile, energy storage will be a cornerstone of Canada's energy transition."**

EXECUTIVE SUMMARY

This whitepaper, "Laying the Foundation: Six priorities for supporting the decarbonization of Canada's electricity grid with energy storage," outlines CanREA's perspective on what is required to advance energy storage in Canada.

As CanREA has argued in "Powering Canada's Journey to Next-Zero: CanREA's 2050 Vision," Canada will need to expand its wind and solar energy capacity ten-fold in the next 30 years to meet its commitment to move a net-zero greenhouse gas (GHG) emissions electricity grid by 2035, and to a net-zero GHG emissions economy by 2050.

It is CanREA's position that affordable, dynamic and versatile energy storage will be a cornerstone of Canada's energy transition, as it will provide flexibility services to match Canada's abundant and untapped wind and solar energy resources and support electricity system reliability.

The Canadian electricity sector has not begun to realize the enormous potential of energy-storage technologies. To build an expanded and decarbonized electricity grid in Canada on a solid foundation, we need to advance energy-storage technologies.

We can do this by taking actions in six priority areas: education, regulation, markets, grid optimization, communities and sustainability.

PRIORITY 1. EDUCATION

The challenge: Energy-storage technologies can provide many services but, to date, only a few of these services are being leveraged in a meaningful way in Canada.

The solution: Key stakeholders need an increased understanding of energy storage and greater familiarity with the application of its many services. This education is fundamental and will enable actions on each of the remaining five priorities noted in this paper.

Priority action: Through educational presentations to policymakers, utilities, system operators and other key stakeholders, CanREA will increase decision-makers' understanding of energy storage and its many possibilities.

PRIORITY 2. REGULATION

The challenge: Most jurisdictions lack a clearly defined legislative and regulatory framework for the participation of energy storage in the electricity system.

The solution: Policymakers, regulatory agencies and the energy storage industry can address these barriers to enable the solutions that energy storage can contribute to the energy transition.

Priority action: CanREA will continue to advocate for the changes that need to be made within regulatory frameworks to enable energy storage more broadly.

PRIORITY 3. MARKETS

The challenge: Current market structures and valuation methods do not offer investors sufficient revenue opportunities to justify making the significant investment required.

The solution: New market rules, structures and valuation methods for revenue stacking can encourage investment in energy storage.

Priority action: CanREA will continue to advocate for new policies, regulations and market rules that expand market structures and valuation methods and enable viable business models for energy storage technologies.

PRIORITY 4. GRID OPTIMIZATION

The challenge: On average, Canada's transmission and distribution lines are used at a fraction of their capacity.

The solution: Using energy storage as a grid-optimization technology will provide low-carbon grid flexibility, while also reducing costs to consumers.

Priority action: CanREA will continue to advance a modern paradigm for grid reliability that uses energy storage as a grid-optimization technology.

PRIORITY 5. COMMUNITIES

The challenge: Canada has many off-grid, Indigenous and remote communities that burn costly, polluting diesel fuel to generate electricity.

The solution: Energy-storage technologies are versatile enough to be installed locally at reasonable scales in these communities.

Priority action: CanREA will continue to engage with policymakers on issues related to community generation and community-scale energy storage.

PRIORITY 6. SUSTAINABILITY

The challenge: With the exponential growth in energy-storage deployment that is required to support decarbonization and expansion of the grid, sustainable development, recycling and reuse practices need to advance simultaneously.

The solution: Produce, and dispose of, energy-storage technologies using environmentally responsible processes.

Priority action: CanREA will engage with industry participants to develop best-practices in sustainable development and end-of-life practices for energy-storage technologies.

Through ongoing advocacy work, CanREA and its members are actively involved in relevant discussions with governments and other electricity system decision-makers, to encourage action on all these six priorities. The following chapters provide details and context on energy storage in this regard.

INTRODUCTION: WHAT IS ENERGY STORAGE?

Interest in energy-storage technologies has intensified over the past decade as nations have worked to decarbonize their sources of electricity as part of the global effort to mitigate climate change. Characterized by diversity, versatility, and affordability, energy storage should be a cornerstone of the energy transition required to achieve net-zero GHG emissions by 2050 in Canada—and the world over.

PHOTO CREDIT: EDF RENEWABLES

DIVERSITY

Energy storage is characterized by its diversity—many different technologies provide energy-storage services. For the purposes of this paper, "Energy Storage" is defined as: a technology that uses electricity as an input, stores energy in some form for a period of time, and returns electricity as an output.

Current technologies that meet the definition include:

- Electrochemical storage (batteries)
- Mechanical storage (pumped hydro, compressed air, flywheels)
- Thermal storage (heating a material)
- Chemical storage (hydrogen)

CanREA recognizes the value of having a diversity of technology options for energy-storage solutions which enables each technology to provide the services to which it is best suited.

VERSATILITY

A hallmark of energy storage is its versatility—storage offers modular installations, flexible configurations and a wide range of services.

- **Modular Installations:** Energy-storage technologies can be deployed at multiple scales: just a few kW for residential installations, or hundreds of MW for utility-scale projects.
- **Flexible Configurations:** In addition to stand-alone situations, storage can be deployed at load-customer sites or at the same location as generation, often resulting in a "hybrid" facility. (For more on how wind, solar and energy storage can work together, visit "Natural Allies" [1] on the CanREA website.)
- **Wide-Ranging Services:** Energy storage also provides a wide range of different services to the electricity grid, from congestion management to regulating reserve and backup power.

AFFORDABILITY

One reason for the growing interest in energy storage is its increasing affordability.

For example, the cost of lithium-ion batteries, one effective technology for storing energy, has plummeted by 90% over the past decade, as reported by Bloomberg NEF, including another 6% in the past year[2].

We are also seeing considerable research and development efforts in other chemistries and technologies with the potential to offer energy-storage services at ever lower costs.

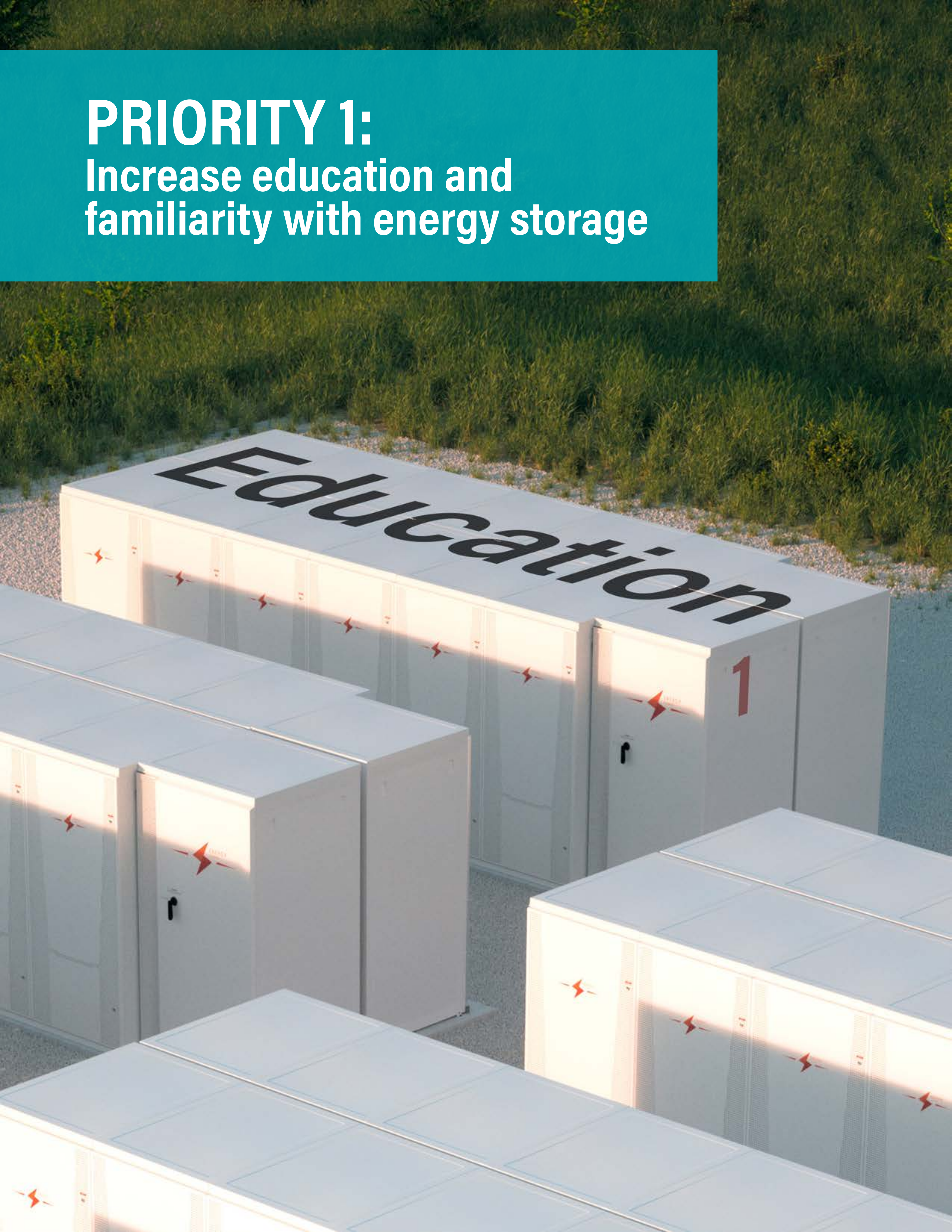
Bloomberg reports exponential growth in energy-storage investment in many regions of the world, growing from zero in 2004 to $0.7B in 2014, and reaching $3.6B in 2020[3]. In Canada, the current level of investment is not nearly enough to enable energy storage's potential to fully facilitate Canada's energy transition.

As costs continue to decline in multiple storage technologies, we will soon be able to better quantify the potential for energy storage as Canada moves toward a fully decarbonized and expanded grid. In the meantime, the need to address the six priorities identified in this paper remains CanREA's focus.

KEY TAKEAWAYS

- Energy storage is a technology that uses electricity as an input, stores energy in some form for a period of time, then returns electricity as an output.
- CanREA recognizes the value of having a diversity of options for energy-storage solutions which enables each technology to provide the services to which it is best suited.
- There is exponential growth in energy-storage investment globally, driven by plummeting costs and heightened awareness of the value that energy storage can provide as a flexibility solution to accelerate decarbonization.

PRIORITY 1:
Increase education and familiarity with energy storage



PRIORITY 1: INCREASE EDUCATION AND FAMILIARITY WITH ENERGY STORAGE

DECISION-MAKERS ACROSS THE ELECTRICITY SECTOR NEED TO UNDERSTAND THE FULL RANGE OF CAPABILITIES OFFERED BY ENERGY STORAGE TECHNOLOGIES.

STORAGE FUNDAMENTALS

Affordable, dynamic and versatile, energy storage must be a cornerstone of Canada's energy transition, providing a solid foundation upon which to build a decarbonized and expanded grid by 2035. CanREA's innovative plan of action for advancing energy storage in Canada focuses on six priority areas, starting with education.

Education is fundamental for facilitating the participation of energy storage in the energy transition. Before the other priorities of CanREA's plan can be effectively addressed, decision-makers across the electricity sector need to understand the full range of capabilities offered by energy storage technologies.

The challenge:

Energy-storage technologies can provide many services to the electricity system but to date, enablers—policymakers, regulators, system operators, project developers and on-site operators—have evaluated energy storage in a limited capacity and have not taken full advantage of the suite of solutions available. Only a few of these services are being leveraged in a meaningful way.

The solution:

Key stakeholders, who make legislative, regulatory and market decisions that will impact the uptake of energy storage, need more information and experience with energy storage to increase their understanding and familiarity with the application of its many services. This education is fundamental, as it will enable positive action on each of the remaining five priorities noted in this paper.

PHOTO CREDIT: PETR MALINAK/SHUTTERSTOCK

ENERGY STORAGE PROVIDES MANY SERVICES

Energy-storage technologies can provide 13 key services, as identified by the Rocky Mountain Institute[4]: Capacity Value, Peak Shaving, Voltage Support, Frequency Regulation, Transmission & Distribution Deferral, Transmission & Distribution Congestion Management, Regulating Reserve, Spinning Reserve, Black Start, Time Shift/Arbitrage, Demand Charge Reduction and Backup Power.

Most of these services can also be supplied from storage that is co-located with load or generation.

Figure 1 itemizes these services, grouping them into three "Industry Segments" (Wires Services, Reliability Services and Market Services) and three "Storage Configurations" (Stand-Alone, Load Co-Located, Generation Co-Located).

Each of these terms is defined in the Appendix.

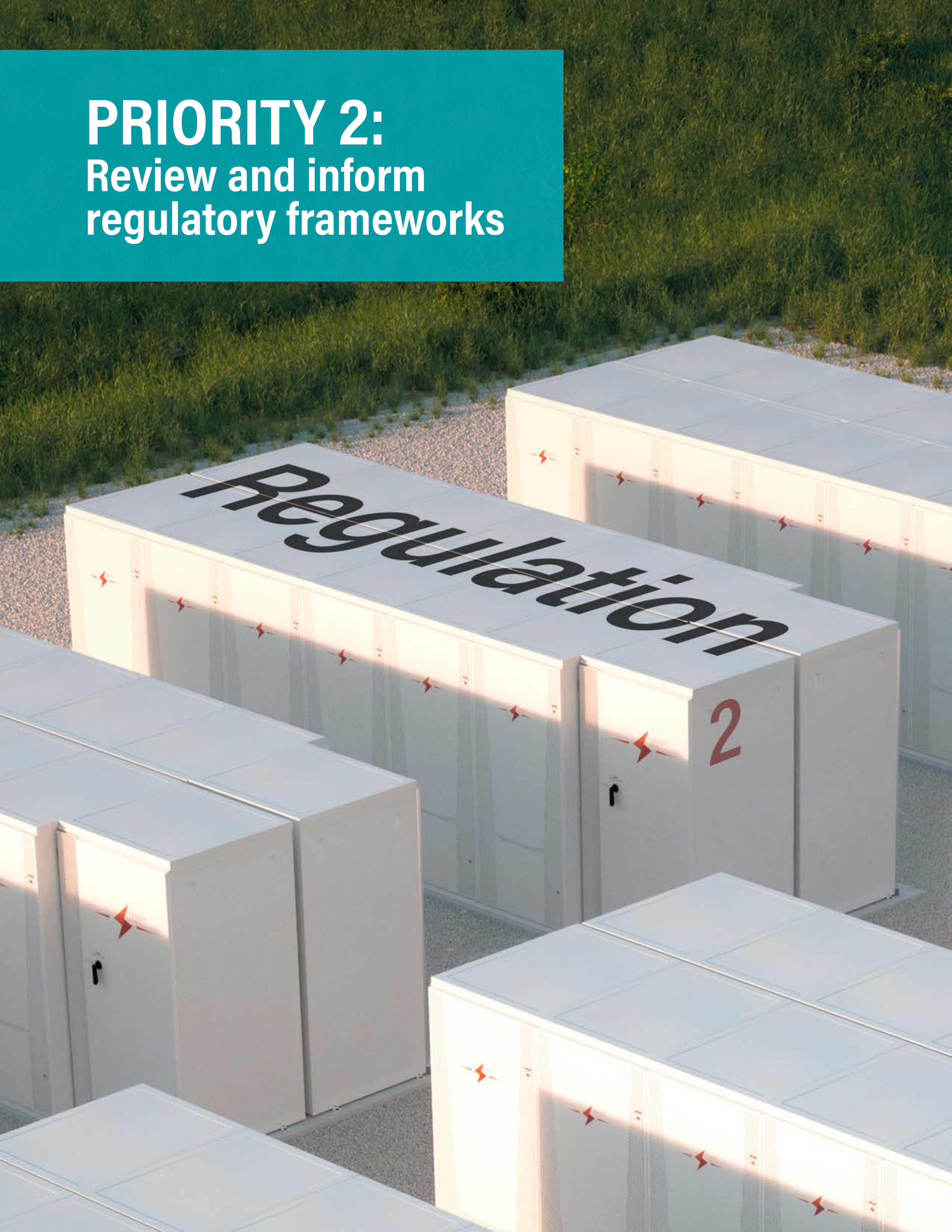
Figure 1: Energy-storage services, sorted by industry segment and installation configuration.

Service Type	Energy Storage Service	Stand-Alone	Load Co-Located	Generation Co-Located
Wires	Capacity/Peak Shaving	•	•	•
(System Services)	Voltage Support	•	•	•
	Frequency Regulation	•	•	•
	T&D Deferral	•	•	•
	T&D Congestion Management	•	•	•
	Renewable Smoothing			•
Reliability	Regulating Reserve	•	•	•
(Ancillary Services)	Spinning Reserve	•	•	•
	Supplemental Reserve (Non-Spinning)	•	•	•
	Black Start	•	•	•
Market	Time Shift/Arbitrage	•	•	•
(Market Services)	Demand Charge Reduction		•	
	Backup Power		•	

PRIORITY ACTIONS

CanREA will collaborate with its members to develop new educational resources explaining the affordability and range of services and solutions provided by energy-storage technologies. CanREA will use these resources in presentations to policymakers, utilities, system operators and other key stakeholders, to increase decision-makers' understanding of energy storage and familiarity with the solutions that storage can enable through the application of its many services.

PRIORITY 2:
Review and inform regulatory frameworks



PRIORITY 2: REVIEW AND INFORM REGULATORY FRAMEWORKS

ALL JURISDICTIONS NEED A CLEARLY DEFINED FRAMEWORK FOR THE PARTICIPATION OF ENERGY STORAGE IN THE ELECTRICITY SYSTEM.

STORAGE REGULATIONS

As the key stakeholders of Canada's electricity system acquire an increased understanding of energy storage through education, CanREA will also advocate for changes to current regulatory frameworks to more fully enable the advantages that energy storage can contribute to the energy transition.

The challenge:

Most jurisdictions in Canada lack a clearly defined legislative and regulatory context to guide the participation of energy storage in the electricity system. This barrier can prevent these jurisdictions from taking full advantage of energy-storage solutions in a timely manner to advance the energy transition.

The solution:

Policymakers, regulatory agencies and the energy storage industry can address these barriers to enable the solutions that energy storage can contribute to the energy transition. The legislation and regulations governing energy storage need to be reviewed. This will help to identify actions to remove barriers to increase uptake of energy-storage technologies.

Specifically:

1. Review legislation and regulations

It is common for electricity system enabling legislation to define generation, transmission infrastructure and, sometimes, various classes of load customers. Enshrining definitions in legislation and regulations serves to provide clarity to all electricity-system stakeholders and those agencies tasked with the administration of the electricity system.

A legislative definition of energy storage may not be necessary in all jurisdictions to enable storage technologies to be integrated, as demonstrated by the installation of some energy-storage facilities even in the absence of a specific definition. As such, it will be important to determine, for each jurisdiction, whether existing legislation and regulations are sufficient enablers, or if amendments are required to advance the uptake of energy storage further[5].

2. Develop technical requirements for connecting and operating energy storage

CanREA will engage system operators and regulators to develop and implement technical requirements to connect and operate an energy-storage resource on the electricity system.

For some technologies, such as pumped hydro and compressed air energy storage, the technology components are similar to the pumps and turbines that already have defined connection requirements.

Batteries, on the other hand, may need unique technical rules for connection and operations. This has been done by the Alberta Electricity System Operator[6] as part of the Independent System Operator rules.

In many jurisdictions, the technical details may be included in the operating documents of the crown-owned utility. However, there are other elements, such as the scope of safety and environmental reviews, that will need legislated descriptions or will need to be included in the regulatory documents of the relevant ministry or government department.

3. Enhance the mandate of the regulating authority to evaluate energy storage

In most jurisdictions, the mandate and/or rules of the regulating authority (for example the Alberta Utilities Commission) may need to be enhanced[7]. Regulatory authorities will need sufficient expertise to fairly evaluate proposed energy-storage installations.

Some details of the mandate modifications may need to be included in legislation while other changes could be made in the rules and procedures of the regulatory authority themselves.

4. Oversee transactions in deregulated markets involving energy storage

For the deregulated markets in Alberta and Ontario, regulations will be required to oversee transactions between regulated entities, such as local utilities, and non-regulated entities such as private developers.

The ability for a regulated entity to contract for services (such as congestion management) from a private developer should be clearly established in the regulations, and the regulated entity should be required by the approving authority to investigate and then present the potential cost savings compared to a traditional wires solution.

5. Enable contracts between utilities and private energy-storage developers that ensure fair compensation for services

The potential for the cost of contracts for services between utilities and private storage developers to be included in the utility rate base also needs to be addressed.

In general, if the contract is treated as an operating expense, then the utility will only be eligible to recover the costs of the contract with no return. However, the competing solution, namely an investment in new wires infrastructure, would be considered a capital expense and would be eligible to earn a rate of return. Therefore, the comparison between the two solutions is not balanced.

To ensure a fair comparison, regulated utilities should be able to include the cost of a contract for grid services as part of their rate base and earn a return on those costs.

PRIORITY ACTIONS

CanREA will continue to advocate for the changes that need to be made within regulatory frameworks to enable energy storage more broadly. This includes reviewing legislation and regulations currently in place, identifying barriers to the integration of energy-storage technologies, and engaging with policymakers and regulatory agencies to present clear solutions to address these barriers.

PHOTO CREDIT: PETR MALINAK/SHUTTERSTOCK

PRIORITY 3:
Expand market structures and valuation models

PRIORITY 3: EXPAND MARKET STRUCTURES AND VALUATION MODELS

CANREA WILL ADVOCATE FOR NEW MARKET STRUCTURES AND VALUATION METHODS TO ENCOURAGE INVESTMENT IN ENERGY-STORAGE TECHNOLOGIES.

STORAGE AND THE MARKET

As CanREA continues to engage with key stakeholders, promoting the benefits and possibilities of energy storage and addressing the barriers for increased uptake, there will also be a need to ensure that revenue opportunities are sufficient to justify investment in energy-storage projects, to encourage the level of investment that will be needed for Canada to successfully meet its net-zero targets.

The challenge:

Significant investment will be required for energy storage to play a more meaningful role in decarbonizing and expanding the electricity grid, but the current market structures and valuation methods do not offer investors sufficient revenue opportunities for the services that could be provided by energy storage across Canada

The solution:

To encourage investment in energy storage, new market rules, structures, procurement methods and valuation methods, including the potential for revenue stacking, need to be developed or expanded in most jurisdictions.

Figure 2: Illustrative example of revenue stacking

	Winter	Spring	Summer	Fall
Overnight	RR	RR	RR	RR
Evening	CM	ARB	CM	ARB
Afternoon	ARB	ARB	CM	ARB
Morning	ARB	ARB	ARB	ARB

Revenue sources

RR	Regulating Reserve (Ancillary Services Market)
ARB	Price Arbitrage (Energy Market)
CM	Congestion Management (Utility Contract)

REVENUE STACKING

Revenue stacking means the ability to earn revenue from different grid services at different times.

CanREA recommends that consideration of revenue stacking include utilities contracting with private developers to minimize costs for consumers. One example of revenue stacking is illustrated in Figure 2 and includes revenue from ancillary services, power price arbitrage and contracting with a utility.

In this example, a private energy-storage-resource owner has contracted to provide Congestion Management services (CM in Figure 2) to a regulated utility during the hours when it is most likely needed.

We assume that is evening hours in the winter and afternoon and evening hours in the summer. During hours when the storage resource is not contractually obligated to the utility, the owner has determined that it is most profitable to sell Regulating Reserves (RR in Figure 2) in the Ancillary Services market during the overnight hours and perform Price Arbitrage (ARB in Figure 2) in the energy market in the remaining hours.

If the utility purchased and installed the battery, it would be unused in many hours of the year since regulated utilities cannot participate in the de-regulated ancillary services and energy markets.

Therefore, the contracted arrangement with a private energy-storage-resource owner should be lower cost to the utility, and the utility customers, compared to owning the storage resource itself.

Meanwhile the private storage owner benefits from the arrangement by earning some amount of lower risk revenue from the utility contract.

For regulated entities to justify the deployment of an energy-storage resource, there must be a methodology to value the services that the resource will provide.

Jurisdictions that do not currently have such methodologies are missing opportunities to provide services to electricity customers at lower costs[8].

As mentioned above, storage will not always be the best solution, but customers deserve to have storage options considered and properly valued.

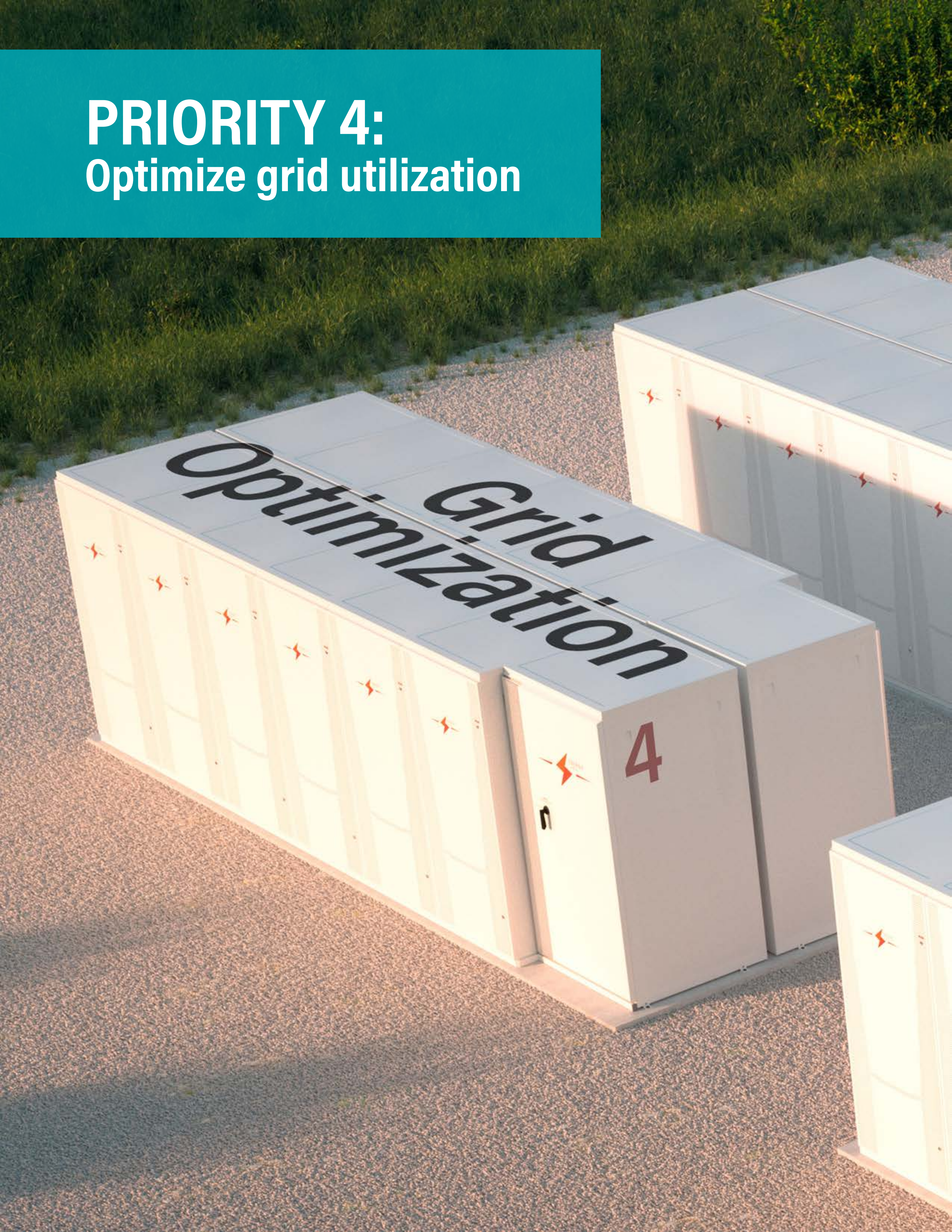
CanREA will continue to advocate for new policies, regulations and market rules that enable viable business models for energy-storage technologies in regulated and de-regulated markets.

PRIORITY ACTIONS

To enable viable business models to support investment in energy-storage technologies, CanREA will advocate for new market structures and valuation methods. CanREA also recommends that consideration of revenue stacking include utilities contracting with private developers to minimize costs for consumers.

PHOTO CREDIT: PETR MALINAK/SHUTTERSTOCK

PRIORITY 4:
Optimize grid utilization



PRIORITY 4: OPTIMIZE GRID UTILIZATION

ENERGY STORAGE WILL HELP CANADA MAKE OPTIMAL USE OF GRID INFRASTRUCTURE AND MODERNIZE OUR APPROACH TO RELIABILITY, SUCCESSFULLY INCORPORATING MORE WIND AND SOLAR GENERATION WHILE REDUCING COSTS TO CONSUMERS.

STORAGE AND THE GRID

As Canada heads down the pathway to its energy transition, it will be important to not only address the priorities of education, legislation and market structures, but also to optimize the electricity grid, and modernize our approach to grid reliability. Canada can use the physical transmission and distribution assets that comprise the grid in a more efficient manner than we do today.

The Challenge:

On average, Canada's transmission and distribution lines are used at a fraction of their capacity. The physical assets that comprise the electricity grid could be used much more efficiently with the greater deployment of energy storage technologies.

The Solution:

Using energy storage as a grid-optimization technology will provide low-carbon grid flexibility, while also reducing costs to consumers. System operators can cost-effectively use energy storage to optimize grid utilization and successfully incorporate increased amounts of wind and solar generation to decarbonize the grid.

Energy storage facilitates a paradigm shift in the way the physical grid is designed and operated[9]. The historical paradigm is based on peak load: build enough generation and transmission to serve the point in time when load is the greatest. This is essentially a static view of reliability because the focus is on a level of demand that occurs only once.

With the addition of energy storage, electricity can be delivered to customers at a different time from when it was generated[10]. Under the new paradigm, we build enough generation, transmission and *storage* to serve load on a dynamic basis. The paradigm shift is illustrated in Figure 3.

Canada needs to move toward a more modern paradigm for grid reliability, incorporating energy storage. This will allow us to make optimal use of grid infrastructure and reduce costs to consumers as we successfully incorporate more wind and solar generation into the grid, as a core part of the energy transition.

PHOTO CREDIT: PETR MALINAK/SHUTTERSTOCK

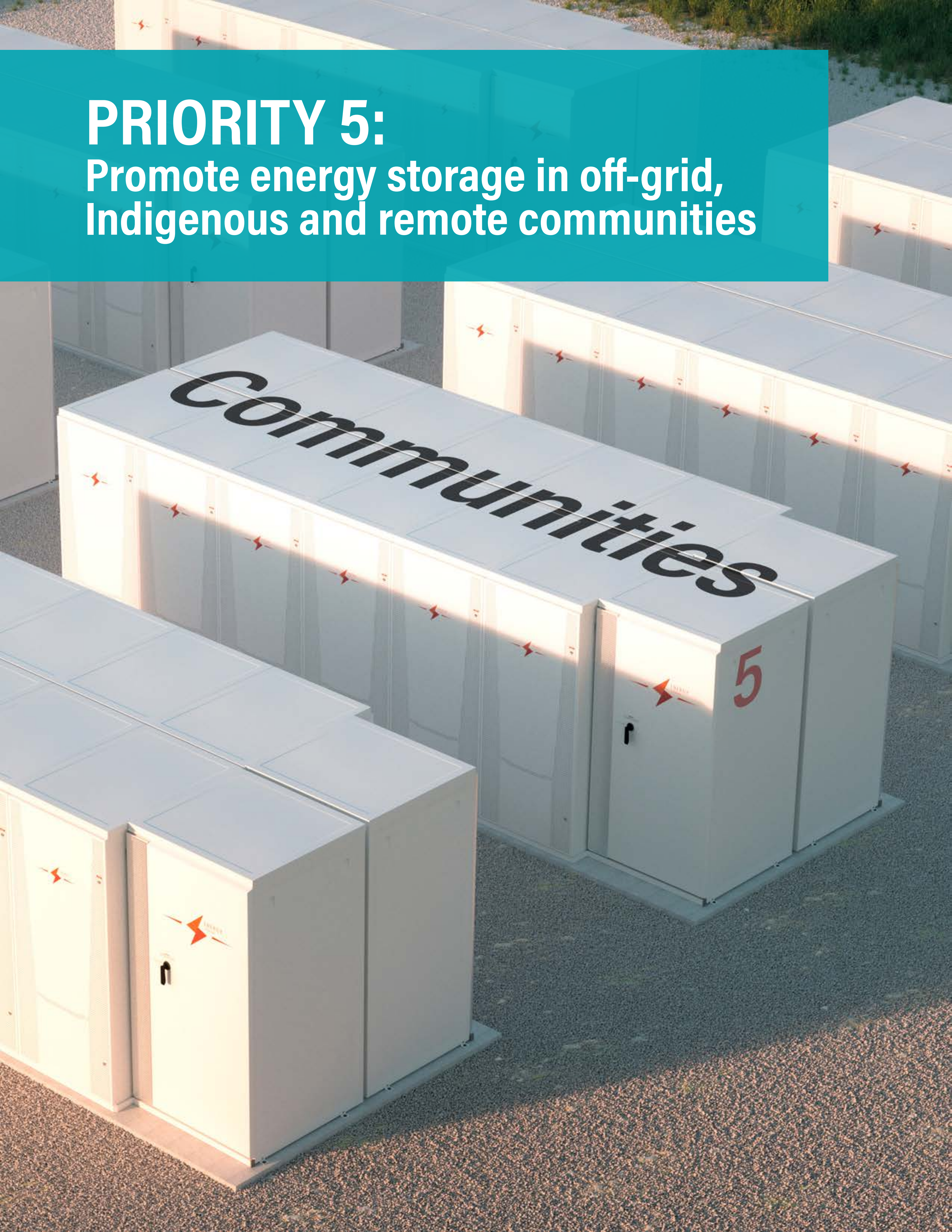
PRIORITY ACTIONS

CanREA will continue to engage with electricity system operators and researchers in every jurisdiction across Canada to advance a modern paradigm for grid reliability that uses energy storage as a grid-optimization technology.

Figure 3: A comparison of the historical and modern paradigms for grid reliability

Hallmarks	Historical paradigm, without energy storage	Modern paradigm, incorporating energy storage
Structure of electricity grid	Designed from a generator-transmission-load perspective: Large, centralized facilities generate electricity and massive transmission infrastructure send it to load customers.	Mix of centralized and distributed generation with energy storage balancing generation with load.
System components	1. Generation: converts a fuel into electricity 2. Transmission: moves the electricity to a different location 3. Load: converts electricity into something else (light, heat, widgets)	1. Generation (centralized and distributed) 2. Transmission 3. Load 4. Storage: allows for electricity to be used at a different time from when it was generated.
Peak demand	Set the standard for transmission infrastructure, which had to be large enough to serve peak load.	Will no longer set the standard for transmission infrastructure.
Grid (Transmission and distribution infrastructure)	Inefficient use created the need for larger infrastructure.	Optimal, more efficient use of infrastructure will delay and reduce the need for new investment.
Role of system planners	Static: To ensure sufficient generation and transmission assets to supply peak demand.	Dynamic: To identify the optimal combination of technologies (generation, transmission and storage) to meet customer needs over time.
Renewable energy (low-cost, non-emitting wind and solar energy)	Small reliability contribution because generation profile may not coincide with load profile.	Along with energy storage, renewable energy is a powerful tool in building a decarbonized grid.
Costs (system costs to load customers)	Higher	Lower

PRIORITY 5:
Promote energy storage in off-grid, Indigenous and remote communities



PRIORITY 5: PROMOTE ENERGY STORAGE IN OFF-GRID, INDIGENOUS AND REMOTE COMMUNITIES

IN REMOTE COMMUNITIES, ENERGY STORAGE, COMBINED WITH WIND AND SOLAR GENERATION, CAN RESULT IN A CLEANER ELECTRICITY SUPPLY WITH MANY COMMUNITY BENEFITS.

STORAGE AND COMMUNITIES

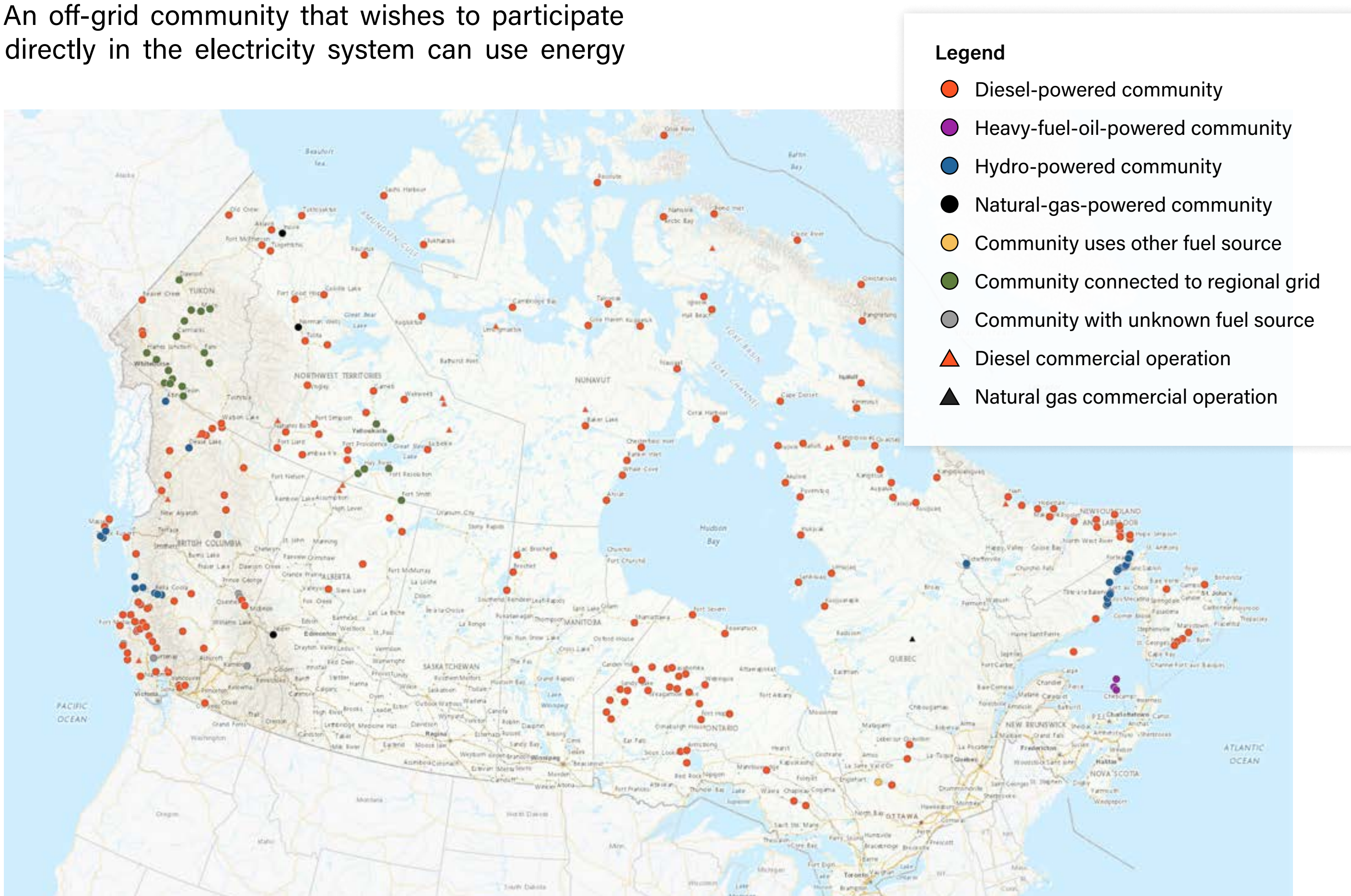
The energy transition will affect different communities in different ways. The situation is especially unique in off-grid, Indigenous and remote communities, where access to energy storage and decarbonization technologies can create local and wider-scale benefits.

Canada has many Indigenous, remote and off-grid communities that burn diesel fuel to generate electricity. This fuel is expensive, has a high GHG emissions intensity, and causes local air quality issues.

An off-grid community that wishes to participate directly in the electricity system can use energy storage, combined with wind and solar generation, to create a micro-grid enabling them to reduce or eliminate diesel generation.

When a community replaces diesel generation with a renewables-plus-storage system, there are immediate benefits that can support their own social, environmental and economic goals.

Communities with weak connections to the provincial electricity grid also suffer lower reliability than other locations. Energy storage can provide backup power and congestion management in these communities.



SOURCE: THE ATLAS OF CANADA, REMOTE COMMUNITIES ENERGY DATABASE, NATURAL RESOURCES CANADA, 2018[11]

The Challenge:

Canada has many off-grid, Indigenous and remote communities that burn costly, polluting diesel fuel to generate electricity. This represents a significant economic and environmental cost for these communities.

The Solution:

Energy-storage technologies are versatile enough to be installed locally at reasonable scales to support the goals of these communities. When an off-grid community replaces diesel generation with a renewables-plus-storage system, there are immediate benefits to the community. Increased access to energy storage and decarbonization technologies in off-grid, Indigenous and remote communities should be promoted.

The first off-grid community solar/storage micro-grid in Canada was implemented in 2019 by Gull Bay First Nation/ Kiashke Zaaging Anishinaabek and Ontario Power Generation[12]. The technical key to successful operation is the control system that switches smoothly from solar and battery to diesel power when needed. The project will reduce community diesel usage by approximately 25% on an annual basis.

For remote communities with a weak connection to the provincial electricity grid, energy storage represents an opportunity to increase the reliability of electricity supply to residents without adding uncounted kilometers of new transmission lines. Such an approach has been used in Field, British Columbia since 2013[13] and is being deployed in Waterton, Alberta[14].

Energy storage, either at community or utility scale, represents another aspect of the electricity system in which Indigenous communities can participate.

For example, Yukon Energy is developing a battery project in Whitehorse on the Traditional Territories of the Kwanlin Dün First Nation and the Ta'an Kwäch'än Council[15]. Both First Nations collaborated on the project with Yukon Energy in a mutually beneficial partnership.

In all three cases, energy storage represents a new opportunity for communities to address their unique challenges and goals.

Clearly, the increased access to energy storage and decarbonization technologies can provide benefits in off-grid, Indigenous and remote communities.

PRIORITY ACTIONS

CanREA recognizes the importance of ongoing engagement with off-grid, Indigenous and remote communities to promote the benefits of renewable energy and energy-storage solutions that support local social, economic and environmental goals. CanREA will continue to engage with policymakers on issues related to community generation and community-scale energy storage, to increase access to and deployment of both utility-scale and smaller clean-energy projects in communities.

PRIORITY 6:
Advance sustainable development and end-of-life practices

PRIORITY 6: ADVANCE SUSTAINABLE DEVELOPMENT AND END-OF-LIFE PRACTICES

ENERGY-STORAGE TECHNOLOGIES SHOULD BE PRODUCED, AND DISPOSED OF, USING ENVIRONMENTALLY RESPONSIBLE PROCESSES.

STORAGE AND SUSTAINABILITY

It is CanREA's view that all technologies, including those that are part of the energy transition, must be part of the broader drive to sustainability which includes sustainable practices for the sourcing of raw materials and end-of-life recycling.

Energy-storage technologies need to be produced and handled, throughout all stages in their life cycle, using the most up-to-date knowledge, including state-of-the-art practices in sustainable development.

This impacts the mining, handling, transportation, manufacturing, project development, construction, operations and decommissioning processes.

The challenge:

With the exponential growth in energy-storage deployment that is required to support decarbonization and expansion of the grid, sustainable development, recycling and reuse practices need to advance simultaneously. These issues must be addressed if energy storage is to reach its full potential.

The solution:

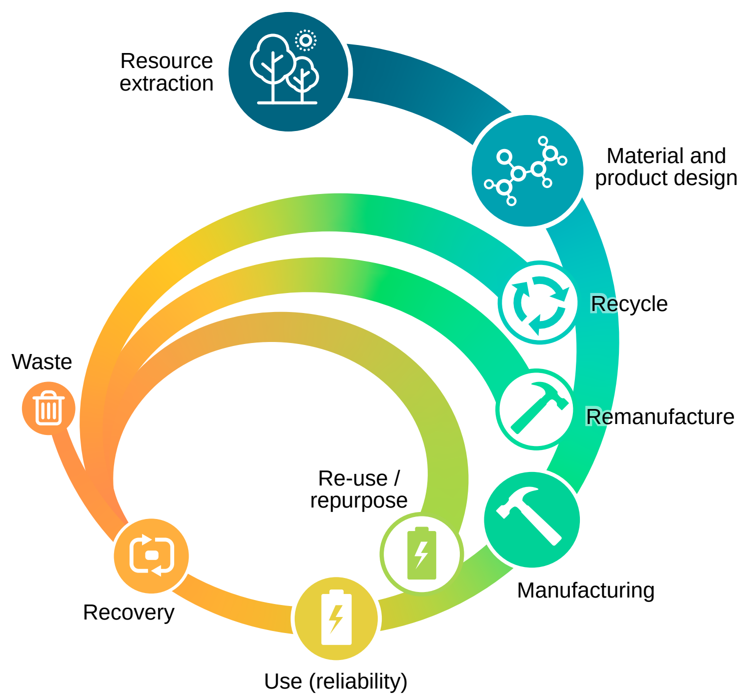
Produce, and dispose of, energy-storage technologies using environmentally responsible processes. Energy storage, like all other products, must be part of the broader drive to sustainability which includes sustainable practices for the sourcing of raw materials and end-of-life recycling.

CanREA has collected a summary of current knowledge and practices surrounding battery recycling in Canada. Our fact sheet, "Recycling energy-storage components in Canada[16]," is available on the CanREA website, in the "Our Technologies" section, under "Life Cycle," under "Repowering and Decommissioning."

The good news is that lithium-ion batteries are already 95% recyclable (see Figure 4). Several companies are already developing and implementing methods to recycle batteries.

Part of the challenge is that batteries are a heterogenous mix of various materials. The best practice will be a process that results in separated materials. That way, the key battery materials can be reused in new batteries and other materials can be included in the relevant circular production lifecycle.

Figure 4: A circular economy for lithium-ion batteries



Source: Recycling energy storage components in Canada, Canadian Renewable Energy Association, 2021.

Efficient recycling has the dual benefit of reducing landfill needs while also providing raw materials for manufacturing processes.

Other energy-storage technologies will also need to maintain a minimal impact from end-of-life treatment. For example, the components of pumped hydro facilities (pumps, piping, concrete) are common, and sustainable end-of-life treatment practices already exist for those types of components.

For new technologies under development, such as flow batteries, commercial deployment will need to be accompanied by appropriate end-of-life considerations.

In conclusion, energy-storage technologies require sustainable production and environmentally responsible disposal processes, which CanREA is committed to advancing.

PHOTO CREDIT: EDF RENEWABLES

PRIORITY ACTIONS

CanREA will engage with industry participants—storage-project developers, technology providers and the appropriate regulatory agencies—to develop and advance best-practices in sustainable development and end-of-life practices for energy-storage technologies.

CONCLUSION

In this paper, CanREA has identified six priorities for supporting the decarbonization of Canada's (electricity) grid with energy storage:

PRIORITY 1: EDUCATION

Increase familiarity with energy storage and the application of its many services.

PRIORITY 2: REGULATION

Review and inform regulatory frameworks.

PRIORITY 3: MARKETS

Expand market structures and valuation models.

PRIORITY 4: GRID OPTIMIZATION

Advance a modern paradigm for grid reliability that uses energy storage to optimize grid utilization.

PRIORITY 5: COMMUNITIES

Promote energy storage in off-grid, Indigenous and remote communities, who can benefit from increased access to decarbonization technologies.

PRIORITY 6: SUSTAINABILITY

Advance sustainable development and end-of-life practices for energy-storage technologies.

CanREA recognizes the importance of education, regulation, markets, grid optimization, communities and sustainability, as these factors are paramount to not only facilitate the participation of energy storage in the energy transition, but also to optimize the success of the transition itself.

Energy-storage technologies are affordable, reliable and versatile tools that can support the electrification of the broader economy through an expansion of wind and solar energy production. Energy storage is a cornerstone of the most efficient and reliable pathway to achieving net-zero GHG emissions in Canada by 2050.

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APPENDIX

GLOSSARY OF ENERGY STORAGE SERVICES

As noted in Priority 1, energy storage can provide many services. Figure 1 presents 13 services, sorted by industry segment and installation configuration. These terms are defined in this appendix.

Definitions of the 13 services provided by energy storage:

Capacity value: Capacity Value is calculated as the potential to serve a certain volume of load with a certain reliability. Although specific values vary by market, energy-storage technologies can be used as a capacity resource in all markets.

Peak shaving: When capacity value is viewed from the demand perspective, such as a load co-located energy-storage resource, then the activity is called peak shaving.

Voltage support: Responding to recover from under or over voltage events in support system reliability.

Frequency regulation: Responding to frequency deviation events to maintain system frequency within the required range determined by the system operator.

Transmission & distribution deferral: The use of non-wires alternatives to temporarily increase capacity on the transmission or distribution system to delay the need for immediate capital expenditure.

Transmission & distribution congestion management: Charging or discharging the energy storage resource to alleviate congestion on a particular portion of the transmission or distribution system.

Regulating reserve: A reserve resource that is required to respond to direction from the system operator to maintain the electricity system supply/demand balance on a real-time basis.

Spinning reserve: Reserve capacity that is required to respond with energy services to a contingency event, such as an unexpected outage, within seconds or minutes based on its high state of readiness to provide these services.

Figure 1: Energy-storage services, sorted by industry segment and installation configuration.

Service Type	Energy Storage Service	Storage Configuration: Stand-Alone	Load Co-Located	Generation Co-Located
Wires	Capacity/Peak Shaving	•	•	•
(System Services)	Voltage Support	•	•	•
	Frequency Regulation	•	•	•
	T&D Deferral	•	•	•
	T&D Congestion Management	•	•	•
	Renewable Smoothing			•
Reliability	Regulating Reserve	•	•	•
(Ancillary Services)	Spinning Reserve	•	•	•
	Supplemental Reserve (Non-Spinning)	•	•	•
	Black Start	•	•	•
Market	Time Shift/Arbitrage	•	•	•
(Market Services)	Demand Charge Reduction		•	
	Backup Power		•	

Supplemental reserve (non-spinning): A reserve resource that can respond to a contingency event after a short delay but usually within 30 minutes.

Black start: The ability of a supply resource to generate electricity and support the re-energization of the electricity grid in recovery from a black out.

Time shift/arbitrage: The purchase of electricity during hours with low energy prices to sell during hours with high prices or to avoid buying electricity during high-priced hours.

Demand charge reduction: The discharge of an energy storage resource to reduce a load customer's peak energy demand volume, where peak demand is a major determinant of non-energy electricity charges.

Backup power: The avoidance of the loss of operations during a supply interruption from the electricity grid or on-site power generation.

Definition of the three industry segments:

Wires services: Services related to actual physical electricity system infrastructure.

Reliability services: Used to maintain the stability of the electricity system on an ongoing basis. These services are provided through Ancillary Services markets where they exist or through other agreements with generators, loads, and storage facilities.

Market services: Activities that are undertaken for economic benefit, based on electricity price, system costs or the benefit of avoiding a blackout (known as Value of Lost Load).

Definition of the three storage configurations:

Most energy storage services can be provided from various configurations, including these three:

Stand-alone: A storage facility that is directly connected to the transmission or distribution system without other generation or load components.

Load co-located: A storage facility that is installed at the same location and could be behind the same utility meter as a load customer. One example of load co-located storage would be when a factory installs a battery on site to facilitate ongoing production in the event of a loss of electricity supply from the grid.

Generation co-located: A storage facility that is installed at the same location and could be behind the same utility meter as a generation facility. One example, a wind generator may install a battery on site to reduce the delivery of electricity to the grid when prices are low and increase the delivery of electricity to the grid when prices are high.

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