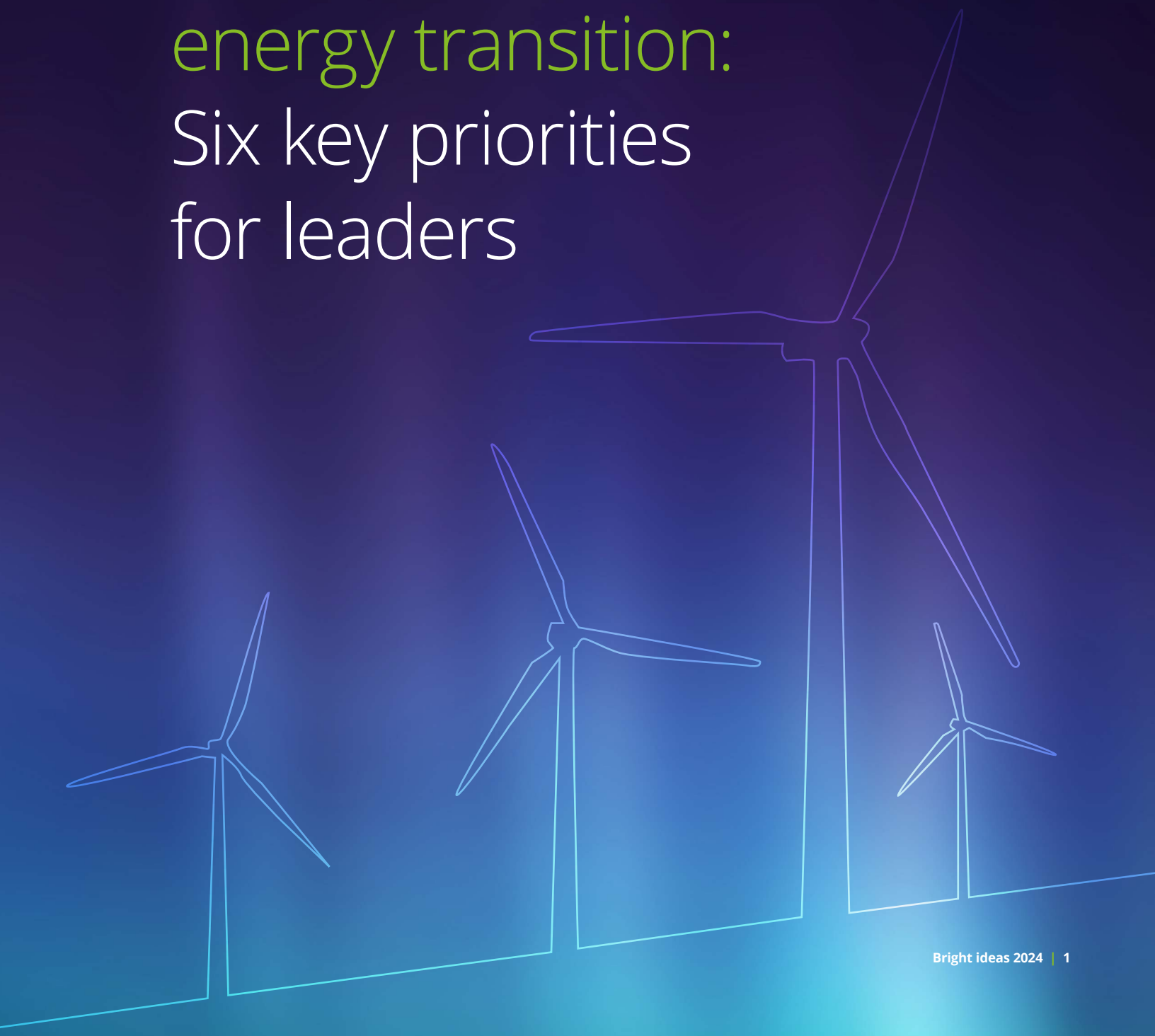
Deloitte.

Bright ideas 2024

Driving Canada's energy transition: Six key priorities for leaders

Contents

Driving Canada's energy transition: Six key priorities for leaders



If Canada is to achieve its decarbonization goals, electricity generation will need to increase significantly.[1] Current assessments suggest that by 2050, provincial peak loads may be 1.3 to 3.6 times higher than those of 2021.

Precisely how much electricity will be needed, and by when, is difficult to predict with accuracy—even harder is making it happen in the right places at the right times.

Accordingly, estimates for the total investment required in Canada between now and 2050 vary considerably. The CD Howe Institute's estimate of up to $2 trillion is on the lower end; on average, estimates suggest that annual capital spending will need to ramp up by about $100 billion per year.[2] Canada will need integrated energy systems to ensure that each utility can drive the climate impacts expected with this additional spending.

Coordinated action is clearly required—and quickly—if the power, utilities, and renewables (PU&R) sector is to adequately boost production in support of electrification. The good news is that such action is under way; however, important questions remain. Will Canada's political, regulatory, and free-market systems be able to get the 2050 job done? And can enough be done to bring the entire population along in a fair and equitable energy transition?

In addition, the energy transition requires coordination across industries and economies, prioritizing collaboration and risk mitigation to achieve net-zero goals. Learn more in our Global report *Energy transition: The road to scale*.

Looking back at 2023

Extreme weather events persisted in 2023. Wildfires, floods, a dramatic cold snap, and several intense heat waves damaged infrastructure, disrupted operations, and increased the demand for electricity. This probably won't change any time soon. While Canada's utilities work hard to maintain the grid, that job is getting harder.

The PU&R sector continued to invest heavily. According to Statistics Canada, utilities' capital construction spending rose by 7% between 2022 and 2023, up to about $33.8 billion.[3] This reflects its investments in infrastructure renewal, expansion, and modernization—and the growing demand for clean, reliable electricity.

The sector also continued getting to grips with new technologies, including electric vehicles, smart grids, energy storage, and hydrogen, which is creating new opportunities and challenges. This has meant adapting to changing customer expectations, preferences, and behaviours, as well as to new competitors and entrants, such as large technology businesses, startups, and prosumers (those who both produce and consume). Many PU&R organizations are already boosting their collaboration efforts, taking advantage of digitalization, automation, and data analytics, and working to address their cybersecurity and privacy issues.

Organizations throughout the sector also continued to navigate evolving, ambitious regulatory and policy environments, both federally and provincially, which affect their operations and profitability. They also had to balance the trade-offs between their environmental, social, and economic objectives. Another critical area of focus was building alignment and coordination on the energy transition by working with governments, regulators, customers, communities, and Indigenous groups, among others. However, such engagement is still in its infancy in many ways.

The current state

Across the country, the PU&R sector is driving progress on the energy transition.

British Columbia

THE PROVINCE CONTINUES TO PURSUE ITS CleanBC PLAN, WHICH INCLUDES INCREASING THE RENEWABLE ELECTRICITY SHARE TO

96%

BY 2030 AND ELECTRIFYING KEY SECTORS SUCH AS TRANSPORTATION AND INDUSTRY.

To improve grid reliability and resilience, BC Hydro completed several transmission and distribution projects last year, and continues to support the development of small-scale hydro, wind, solar, and biomass projects.[4]

Alberta

Alberta's power system continues to change rapidly, evidenced by its evolving supply mix, including a decrease in traditional coal-fired power generation from 38% in 2016 to 7% in 2022. An anticipated phase-out of all coal-fired generation in 2024 has been propped up by a significant rise in renewables, with Alberta adding 1,391 megawatts of installed wind and solar capacity in 2022, as well as the conversion of coal-to-gas generation units.

In 2022, the Alberta Electric System Operator (AESO) published a future outlook report outlining its analysis of the potential pathways for the province to achieve a net-zero electric system by 2035. The report modelled three scenarios for decarbonization and their respective projected annual greenhouse gas emissions. It also outlined the addressable risks to achieving the capacity required to support growing electricity demand. AESO's ongoing review of the system while in transition confirms that continued and significant investment in renewables generation and energy storage projects are playing a critical role in the energy transition.[5]

Saskatchewan

The province has committed to reducing emissions from the electricity sector by 50% below 2005 levels by 2030 and achieving net-zero emissions by 2050. It also set a target of increasing the renewable electricity share to 50% by 2030. Saskatchewan Power Corporation has implemented several initiatives to diversify its generation mix, including natural gas, wind, solar, and carbon capture and storage projects.[6]

Manitoba

Manitoba's 15 hydro stations make up 30,732 gigawatt hours, or 97% of its total electricity production. In 2023, wind energy accounted for 873 gigawatt hours, or 2.8% of total energy production. The province is also trying to land what would be North America's largest solar panel production facility. It's also home to a handful of small hydrogen production facilities that have yet to begin operations.

Ontario

The province has revised its long-term energy plan, which focuses on ensuring the reliability, affordability, and sustainability of the electricity system. The plan includes expanding nuclear power, increasing renewable energy integration, enhancing grid modernization and resilience, and promoting innovation and conservation.

In late 2022, the Independent Electricity System Operator (IESO) released its Pathways to Decarbonization, defining several long-term demand scenarios for achieving decarbonization outcomes and the investments in Ontario's electricity system they would require. The analysis was designed to illustrate a system of the future that could meet system peaks double those of today, requiring an additional 69,000 megawatts of non-emitting supply, expansion of conservation and demand management programs, a six-fold increase in the

workforce, and $400 billion in investment in the bulk system. The Ontario government responded to this work with its Clean Energy Future: Powering Ontario's Growth plan, committing to acquiring the electricity resources needed to power economic growth and increase electrification. Actions include moving forward with major projects and procurements, including a new nuclear station on the shores of Lake Huron, the country's first grid-scale small modular nuclear reactor (SMR), three additional small modular reactors at Darlington, a $342-million expansion of energy-efficiency programs, the largest energy storage procurement in Canada's history, and new investments in transmission systems to meet increasing demand for electricity. The aim is to ensure that Ontario can maintain and build on its clean electricity advantage and help meet the needs for economic growth and electrification that businesses are looking for over the next 30 years.

Quebec

THE PROVINCE MAINTAINS ITS POSITION AS A LEADER IN RENEWABLE ENERGY, WITH APPROXIMATELY

99.8%

OF ITS ELECTRICITY COMING FROM HYDROELECTRICITY AND OTHER CLEAN SOURCES.

It has increased its electricity exports to neighbouring markets and supported the development of the Appalachian Clean Energy Corridor, which aims to connect Quebec with New England and New York. Hydro-Québec is invested in several transmission and distribution projects, as well as research and development initiatives in areas such as smart grids, energy storage, and green hydrogen.[7]

Atlantic Canada

Atlantic Canada (New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island) plans to transition toward a more sustainable and low-carbon future. The goals are to reduce greenhouse gas emissions, improve energy efficiency, and develop renewable energy sources to achieve a more resilient energy system.

Each province has set its own renewable energy targets, with Nova Scotia and Newfoundland and Labrador aiming to generate 80% of their electricity from renewable sources by 2030. The Atlantic provinces collaborate closely and share best practices, research, and resources to accelerate the energy transition. Several initiatives and projects are under way, including the Muskrat Falls hydroelectric project in Newfoundland and Labrador, which is expected to significantly contribute to the region's renewable energy goals.

In our view, electrification across end-use sectors is set to accelerate in 2024 and beyond, impacting longer-term electricity forecasts and strategies. The sector will also likely sharpen its focus on resource adequacy concerns amid grid transformation. Finally, power and utilities companies will likely continue to seek new ways to address rising costs and to explore how AI, including Generative AI, could be part of their approach to addressing several of these challenges.

Top priorities for PU&R leaders

In our 2023 annual review of the PU&R sector, we asked 75 key executives for their unprompted thoughts on their top priorities. They identified six that are capturing their attention. We've listed them briefly here, along with the percentage of respondents who identified each priority. PU&R specialists throughout Deloitte have provided their brightest ideas for tackling these priorities, which are detailed in the six articles below that make up our *Bright ideas* series for 2024.

System and process optimization

TOP PRIORITY FOR

43%

For the transition to a clean energy future, Canada needs a grid with a strong backbone, that's decentralized and operating within an interconnected energy landscape. To achieve that, it needs to be physically reinforced and made more intelligent, adaptable, and able to operate without full central control. It will also need to integrate energy efficiency and optimization across sectors like transportation, buildings, and smart city infrastructure. In *Reimagining the energy grid: The path to a sustainable, net-zero future*, our system and process optimization specialists outline some bright ideas:

- Focusing on the digital thread that runs through the asset management life cycle
- Planning for integrated energy management
- Running operations using artificial intelligence
- Managing life cycle using data

Talent

TOP PRIORITY FOR

33%

Talented people are in short supply and high demand in the sector. With massive energy infrastructure projects under way in every corner of the country, finding enough people with the right skills to push them forward is a massive challenge. How can the sector attract the best and brightest, and grow the talent pool to meet its needs? The specialists on our Talent team identified several ways to make this happen. Check out *Meeting demand: Talent strategies for the Power, Utilities, and Renewables sector* for their bright ideas about:

- Innovating to attract and retain skilled talent
- Rethinking how work gets delivered
- Embracing the power of emerging technologies

Strategic direction

TOP PRIORITY FOR

33%

With so many uncertainties at play, it can be hard to develop a strategic direction. One thing is clear, however. All energy players *must* work together. The time for working in silos has passed. Our strategy specialists identified several critical opportunities where collective action is rapidly becoming a force for a successful energy transition. The sector, including regulators and system operators, need to work closely together on short and longer time horizons to realize solutions as quickly and efficiently as possible. A critical factor in successful collaboration is sharing information and data across channels and between those that don't normally share it. In *The rise of collective action: Unlocking value in the Power, Utilities, and Renewables sector* our Strategy team outlines several bright ideas for collective action on:

- Using common, shared data sets in system planning
- Establishing more public-private partnerships, innovative business models, and broader ecosystem engagement to execute capital infrastructure build-out
- Embracing open innovation models to increase the pace of technology innovation

Growth

TOP PRIORITY FOR

26%

Around the world, national and regional analysis illustrates the unique and expanding role that the PU&R sector must play to meet the evolving energy and decarbonization goals of the next 25 years. Climate action plans universally call for significant growth in electrified technologies like EVs and air-source heat pumps, clean fuels like hydrogen, and technologies like small modular reactors and carbon capture and storage. It's time to move from imagining the system of the future to executing and delivering on it. We asked the specialists on our Growth team to share their thoughts on enabling this huge endeavour. In *Growing energy-efficient electric infrastructure: A massive undertaking and opportunity*, they share some of their bright ideas about:

- Working together to ensure affordability, reliability, and sustainability
- Making room for non-traditional players to enter utilities markets
- Casting a wider net in seeking funding sources

Supply chains

TOP PRIORITY FOR

16%

Governments and private players are making substantial investments to construct new power plants and upgrade existing ones as part of the push to increase electricity generation capacity. Several important trends are helping drive the growth needed, including efforts to modernize and digitalize existing plants, build supply chain resilience, increase focus on environmental, social, and governance (ESG) issues, and evolve strategic risk management processes. In *Mitigating supply chain disruptions in preparation for increased electricity demand*, our supply chain specialists outline several bright ideas that can truly disrupt the PU&R sector for the better, including:

- Embracing a multi-year planning approach and digital supply chain management solutions
- Collaborating and building strategic partnerships with governments and other key players
- Rethinking the skills required in the evolving PU&R workplace, redesigning training programs, and employing new strategies and AI technologies to address skills gaps

Regulation, risk, and security

TOP PRIORITY FOR

14%

One of the biggest challenges in realizing Canada's energy goals is regulation. The regulatory process complicated—just keeping up to date with the rules and regulations is a full-time job for many organizations. The energy transition also brings health and safety concerns for workers, as the grid itself will become much more complex and distributed. Cyber risks are also growing as the sector rapidly digitalizes systems that were historically either mechanical or isolated. Our team of risk specialists outlines several bright ideas to help alleviate these concerns in *Compliance and regulatory risk: Building an energy transition road map*, including:

- Adopting an integrated corporate compliance framework
- Developing a robust enterprise technology compliance strategy
- Prioritizing training, change management, and organizational awareness
- Addressing cybersecurity vulnerabilities at the enterprise level

There's a long way to go, but collaboration will get us there

The energy transition is the biggest challenge the PU&R sector has ever faced. It's encouraging to see leaders focused on these priorities, even with widespread concern about the complexities involved.

1 System and process optimization

Reimagining the energy grid: The path to a sustainable, net-zero future

A modernized grid is essential for Canada's transition to a clean energy future.

Attempting to predict load profiles or make changes using the methods that are currently in place will not get us there. Without a transformation to ensure the effective management of increasingly unpredictable and heavy loads, the energy transition will be significantly more costly, slow, and uncertain than it needs to be.

The energy sector needs to embrace new ways of operating and maintaining systems to support the energy transition. Today's methods of managing the grid will not be able to handle the increasingly spatial and temporal impacts on variable demand and model it in a way that allows for optimization. The system needs to not only balance supply and demand based on local requirements but be primed to respond to the peak loads of the future.

What needs to change?

Ultimately, there needs to be a more resilient grid, with a high degree of decentralized control that can operate effectively within an interconnected energy landscape, including gas and thermal energy resources. Having an integrated cross-sectoral energy system would be ideal, but that won't be easy to achieve, given current regulatory arrangements. The grid also needs a stronger backbone that can be reinforced physically so that it can handle higher, more variable loads. It needs to be hardened against key risks, including extreme weather conditions, global warming, and cyberattacks. Given the technology that will need to be deployed, it's important to note that the system will be more vulnerable to corona mass ejections (CME) and electromagnetic pulse (EMP) attacks.

An optimally managed grid will operate more like the internet as it integrates distributed energy sources and mobile loads and balances its performance. It will need to be more intelligent, adaptable, and able to operate without exclusive central control. In response to the increasing adoption of electric vehicles that's expected, for example, selected utilities should begin testing edge-processing deployment at scale to avoid potentially significant disruptions to grid stability.

A need for greater integration of energy efficiency and optimization is also needed in transportation, buildings, and smart city infrastructure.

What will enable a smooth and successful transition?

Capital—and lots of it. Most estimates for Canada's transition to clean energy are in the trillions of dollars. This funding will need to be obtained and approved by governments and regulators and then pushed through the system, with upgrades and changes being made by real people using parts and materials supplied by well-managed, strong supply chains.

Talent—the talent profile needed to support the transition is changing, and competition with banks, technology companies and others makes finding and retaining the right people even harder.

Technology—the right tools for the right jobs are needed, from smart planning through to smart operations and smart maintenance. Data must be used in the most efficient and progressive ways possible to drive business value.

Innovative business models—with today's risk-averse cultures, siloed organizational structures, and dynamic market conditions, there are plenty of challenges in the business environment. It's time to reinvent the energy company model and move to more sustainable, flexible, and consumer-centric models.

Policymakers, companies, and consumers have critical roles to play as key architects of grid modernization. Collaborative action will be needed to develop new regulatory approaches, create integrated inter-sectoral policy, embrace adaptive and dynamic policy frameworks, foster collaborative open ecosystems, and facilitate private sector finance, to name a few. There's a real need to align efforts and prioritize strategic investments to overcome current bottlenecks and clear the way to a sustainable, net-zero energy future.

Utility companies will need to reimagine, rework, and relaunch many of their systems and processes to lay the groundwork for the more transformative actions they'll need to take in the future.

The key to a successful transition is the deployment of technology that can help optimize planning, operation, and maintenance, as these processes will continue to make up the foundation of the electricity system.

Bright idea

Focus on the digital thread that runs through the asset management life cycle

Planning

Making changes to the grid at the right times and in the right places will be critical as less predictable demand, by location and time, grows year over year. Traditional approaches to planning and upgrades will no longer work, given the shifts that will continue to unfold. A new approach is needed, one that models many scenarios and helps utilities to optimize their buildout using the minimum amount of capital possible.

The good news is that integrated energy modelling and system planning models are already being deployed in Canada. Deloitte's Electrified Grid platform, for example, uses geospatially specific technology adoption modelling and load impact assessments, which are then overlaid onto a digital representation of the grid system. This enables assessment of the potential impacts of emerging electro-technology loads on distribution, which can then be cascaded into plans for bulk generation and transmission infrastructure. When integrated with economic analysis models and capabilities so that the economic costs, benefits, and risks can be well understood, decision-makers can navigate uncertainty with a lot more transparency and confidence. Improved planning is definitely a strong "no-regret bet" that will pay dividends throughout the energy transition.

Delivery

From the energy planning tools, all data and analysis can be passed seamlessly to the delivery phase, where assets go from ideas to the built environment, commissioning, and operation. The data moves to detailed engineering design software such as AutoCAD and to as-builts, with data outputs eventually migrating back into systems of record, such as bills of materials and enterprise asset management systems. Such linking of systems would drive immediate benefits for PU&R businesses.

Operations

The digital thread picks back up as the expanded system and various inputs make their way into operational technology platforms. An accurate digital representation of the system will be key for decision-making, particularly as the automation of the grid continues to accelerate. Thoughtful use of artificial intelligence will support more objective, data-based decisions than human users would be able to take on their own. AI technology can be used to analyze data from meters, sensors, weather forecasts, and other sources to forecast demand, manage loads, and help balance the grid. It also offers opportunities to improve energy efficiency and conservation by providing personalized recommendations and incentives to customers, and to support vegetation and wildfire management by enabling demand response or drone technology. As AI matures and utilities hone their data management strategies, AI is set to make an ever-increasing contribution to the energy transition.

Maintenance

Using the digital representation of the system, data from multiple internal and external sources can be brought together to optimize the maintenance stage of the life cycle. AI can be used to predict and respond to maintenance

issues—for example, alerting or positioning crews based on peak loads or incoming weather. The play here will be in detecting and diagnosing anomalies and managing the resolution of these issues before they lead to impactful faults or outages. Properly linking subcontractors and the utilities with real-time planning, management, execution, and GIS system updating software will radically improve the effectiveness of construction efforts. The detection of maintenance challenges and root cause analysis can feed directly back into system planning and design to boost resilience and grid hardening.

Life cycle management

The very same digital representation allows a utility to track the effective remaining life of its assets using reliable asset condition, performance, and reliability information and guide its investments in existing infrastructure. Using data versus shifting risk profiles can help to redirect investment based on true needs. Making targeted investments based on data-informed insights can increase utilities' ability to meet service commitments at the lowest cost possible.

The digital thread running through this life cycle, including the capabilities and use cases outlined above, all rely on solving the most basic challenges in core asset management. Utilities, now more than ever, need to reliably know about their assets—what they are, where they are both geospatially and within the network, what condition they are in, what stress they are being put under, and their criticality. The challenge is doing this consistently and accurately over time so the proper actions can be taken at the optimal times.

We don't pretend that the transition will be easy. Utility companies face many challenges, particularly the need to update core operational systems, which often haven't been upgraded for years, and to collect, store, manage, and provide access to data quickly and effectively. Many are already making the necessary progress on their core systems and their data management. Those who get it right will reap the most benefits. The energy transition is a call to action that also comes with abundant opportunities to optimize the systems and processes required for a reliable, resilient, and sustainable grid.

2 Talent

Meeting demand: Talent strategies for the Power, Utilities, and Renewables sector

In the push to meet rising energy demand and ambitious decarbonization goals, significant investments in infrastructure are being made throughout Canada.

Beyond funding, one of the biggest challenges is finding the right people with the right skills to deliver on a long list of projects and shifting priorities. But talented people are in both short supply and high demand—and they're being pulled into different industries and lured to other countries.

The good news is that there are promising potential solutions to the talent squeeze. Most successful talent strategies centre on:

- Innovatively attracting and retaining skilled talent
- Rethinking how, when, and where work gets delivered
- Embracing the power of emerging technologies

Innovatively attracting and retaining skilled talent

Utilities throughout Canada are in fierce competition to attract and retain great talent. A recent survey by HR firm Manpower found that 71% of energy and utilities employers around the world struggle to find staff.[8] People with IT and data skills are in particularly short supply, as are those with operations and engineering skills.

Three challenges stand out as making it hard for power, utilities, and renewables (PU&R) organizations to react effectively:

1 Quality data and insights on the required skills, shape, and size of the workforce

Organizations often take a short-term view of workforce analytics and planning in terms of both headcount and skills. The changing nature of work, due to technology advancements as well as the energy transition, isn't always given enough consideration when thinking about skills requirements. This limits an organization's ability to make targeted investment decisions for training, hiring, and technology.

Human resources and business units should work together to develop an enterprise-wide view of the gaps in the organization's technical, professional, and leadership capabilities. This would allow HR to recommend which skills the organization should build (train), buy (hire), borrow (contract out), or bot (automate)—and invest in targeted talent programs accordingly.

2 Ability to attract young people to the sector

PU&R organizations are already playing an outsized role in helping Canada reach its decarbonization goals. But many young Canadians' first thoughts about a career in PU&R are the downsides, such as remote locations, shift schedules, and potentially dangerous work.

To address this, sector players must take an ecosystem-wide approach to building their talent pools. Actors from across the ecosystem—utility organizations, governments, educational institutions, industry associations, economic development groups, etc.—can come together to reshape how the sector is perceived by clarifying its purpose, the opportunities it offers, and the benefits to working within it. Organizations should expand their collaborative efforts to attract and grow PU&R talent pools while also competing to recruit workers based on their unique employee value propositions.

3 Flexible talent management practices

As work evolves, the traditional approach of managing the workforce based mostly on roles is becoming outdated. Anchoring management strategies on skills is more practical in today's talent landscape. Yet many organizations still tend to focus their roles and recruitment efforts on technical requirements, with less emphasis on the human skills that are critical for innovation, operational excellence, and safety.

An integrated, skills-based approach to recruiting, work assignments, and compensation is needed. Collaboration with unions can support the evolution toward becoming a skills-based organization, which would be a win-win for the organization and its workers.

For example, leadership development is key for front-line supervisors. In the utilities sector, many leaders are grown from within, so testing for potential leadership skills in the recruitment process would allow for the cultivation of a promising pool of leaders from the start, which would in turn make any leadership skills gaps less likely to appear and easier to close as workers are promoted.

Bright ideas

To attract and retain great talent, top organizations can:

- Upgrade workforce analytics to properly anticipate and plug skills gaps
- Anchor their talent strategy on their purpose
- Collaborate to build sector-wide talent pools
- Transition from role-based to skills-based talent management

Rethinking how, when, and where work gets delivered

Between the significant infrastructure investments required to support decarbonization and the rapid inflation that's created cost-of-living pressures across Canada, energy affordability remains a critical focus for PU&R organizations. In the context of the talent shortage, this means continually examining how and where employees are focused. Beyond overall management discipline, this includes making informed decisions about what work should be done by the organization itself and where technology solutions and the sector ecosystem can help by providing capacity and cost relief.

Rigid, hierarchical organizational structures are an obstacle to organizational agility. Taking a skills-based perspective on the workforce and deploying teams based on where they will have the highest impact can help organizations make the most of what they have while also offering employees a broader set of experiences.

Strategic use of outside partners and providers is an important consideration. Beyond one-off contracts, many PU&R organizations are taking a skills-based view of where service providers should be delivering certain capabilities and processes. This can help organizations to not only navigate talent shortages, but also drive better operational outcomes by accessing external expertise and proactively managing performance using service level agreements.

Reimagining service delivery isn't an easy, straightforward process. It requires engagement across the ecosystem, with organizations, regulators, governments, and workforce representatives working together to develop strategies and tactics that consider the needs of all players.

Bright idea

Be strategic about where to compete for talent—and where to borrow capabilities from the market

Embracing the power of emerging technologies

While technology alone will not solve the talent crunch, emerging technologies hold immense potential to reshape work. A technology strategy and road map that are explicitly connected with a skills-based talent strategy can accelerate and augment work delivery, help PU&R organizations manage their workforces more effectively, and improve the overall employee experience.

More and more, artificial intelligence (AI) is being used to optimize workforce management by analyzing historical data, predicting future demands, and identifying skills gaps. AI-powered workforce management systems, for example, can support efficient resource allocation by scheduling and assigning tasks based on employee availability, skills, and location.

Another trend in the PU&R sector is the increasing use of connected devices and sensors. By improving asset infrastructure and equipping field workers with these devices, utilities can remotely monitor equipment performance, detect faults, and proactively schedule maintenance—reducing downtime and improving worker productivity and safety.

Additionally, virtual reality (VR) and augmented reality (AR) technologies are transforming training and safety procedures. PU&R organizations can use these technologies to simulate high-risk scenarios for training purposes and to provide real-time guidance and data overlays to field workers, improving safety and efficiency.

While the technology universe is growing every day, utilities still need to determine which investments will be most beneficial to their businesses. "Quick wins" can often be found by tapping into data using existing technology to drive insights that can make work better and more efficient within the organization.

Capitalizing on emerging technologies not only enables PU&R organizations to manage their workforces more effectively, but also enhances the work experience for their employees, making their tasks safer, more efficient, and more engaging. Utilities can then redeploy their talent on tasks that require distinctly human skills and are linked to the purpose that fuels their workforce.

Bright idea

Zero in on what to prioritize by connecting talent and technology strategies

Getting talent back on track

PU&R organizations are playing a huge role in helping Canada reach its decarbonization goals. Yet talent challenges are a real threat to progress. The sector will need to look to innovative solutions—increasingly outside of the four walls of the organizations—to stay on track.

The sector can lean into purpose-driven employee value propositions and take a skills-based approach to talent and work management to overcome its challenges. Opportunities can also be found in uniting ecosystem players to share strategies and costs, reimagining how work gets delivered, and using technology in more thoughtful ways. Adopting such an approach will also help PU&R organizations to build strong, resilient workforces with the capabilities to carry the sector into the future.

3 **Strategic direction**

The rise of collective action: Unlocking value in the Power, Utilities, and Renewables sector

The value of working together

Achieving Canada's decarbonization and electrification targets is a massive challenge and the power, utilities, and renewables (PU&R) sector has a leading role to play. If the country's climate commitments are to be met, one thing is clear: no individual party can make it happen alone. It requires the collective action of a multitude of players throughout the PU&R value chain.

Research shows that one of the most important conditions for enabling collective action among diverse players is the propagation of information beyond traditional boundaries.[9] The better the PU&R sector's ability to share information in multiple channels and across groups that typically work in silos, the better it will be able to facilitate the extensive collaboration needed.

The good news is that we're already seeing new models of collaboration and information-sharing being adopted in the PU&R sector. Three key opportunities where we see a major role for collective action in the sector moving forward—and where information-sharing is becoming increasingly critical—are:

- System planning
- Infrastructure development
- Technology innovation

System planning

Historically, resource planning has been performed in silos, with each utility developing its own plans for how best to deliver service to its customers. A shift is under way, however, with increasing efforts to develop integrated system plans that incorporate the perspectives of multiple players and energy types in a region—bringing together utilities, governments, communities, regulators, and consumers to plan for the future in a more holistic way.

Meeting decarbonization targets while also optimizing the associated technical, social, and economic benefits will be difficult, but getting discrete energy ecosystem participants to collaborate on analyzing and planning a path forward will be even more so. The established means of driving this type of collaboration—setting up working groups and panels chaired by experts—will not work on its own, given the complexity associated with the changes required. To drive aligned decision-making and synchronized execution to create the desired energy system, these collaborative working bodies will need common frameworks, principles, and, most importantly, analytical models based on common data sets and assumptions. Without this type of digital enablement, progress will stall, opportunities will be missed, risks will actualize, costs will escalate, and a timely and economically viable energy transition will be in jeopardy.

Players should draw on common, shared data sets to obtain a broader view of a region's needs and challenges and then work together to address them. They should also collaborate on the development of innovative, system-wide energy plans to guide infrastructure development and resource allocation.

In regions already experiencing the impacts of flawed energy system planning and design, leaders have learned this the hard way and are finding ways to work together differently.[10] There's an opportunity to apply their lessons to Canada's efforts on the energy transition.

Aligning all players, establishing transparent data models, and charting a path forward that harnesses computing power to analyze multiple future scenarios and identify the best outcomes for all parties, including those who would be the most impacted by an unjust transition, will be key to collective success.

Infrastructure development

While holistic planning efforts will help to optimize the where, when, and how for energy system development, the magnitude of the infrastructure development needed is staggering. Recent reports peg the price tag of the transition at close to $1.7 trillion.[11] Expanding transmission networks—across borders in many cases—and installing new generation capacity, charging stations, non-wire alternatives, and more, at the pace required, will require significant collaboration across the capital project's life cycle.

The sheer number of projects required over the next 10 to 15 years, and the resultant labour, materials, and regulatory requirements, present both opportunities and risks for project and infrastructure developers. Training and development of skilled trades, permitting, procurement of materials, and technology enablement are just a few aspects where coordinated development between public and private sector players would support a more efficient and effective buildout of the energy system.

An example of where this type of collaboration is beginning to occur is in the effort to drive the decarbonization of medium- and heavy-duty vehicle transport in Western Canada. Rather than working in silos, over 40 participants, including original equipment manufacturers (OEMs), charge-point operators, fuel providers, utilities, and Indigenous communities, are working together to define how a multilateral ecosystem approach can accelerate the required infrastructure buildout.[12] This initiative identified new collaborations that should help to lower adoption barriers, support policy alignment, scale low- and zero-emissions energies and vehicles, and innovate on commercial models throughout the value chain. As a result, several participating organizations have launched new interfaces and projects in the ecosystem in support of decarbonization.

The Pathways Alliance of Alberta's oil sands companies is another great example of players coming together on infrastructure development in support of climate change initiatives.[13] Its initial goal is to build a 400-kilometre CO_2 transportation line that could eventually link over 20 carbon capture facilities to a carbon storage hub in northeast Alberta—clearly a far more efficient solution than if each player sought to build their own.

There's a real need to establish more public-private partnerships, innovative business models, and extensive ecosystem engagement to execute the capital infrastructure buildout needed for Canada's future energy system.

For PU&R organizations, these examples show how capabilities can be bolstered through collective action to enable more affordable infrastructure development at pace and scale.

Technology innovation

Fostering innovation in the PU&R sector will be critical to both driving down the levelized cost of energy for existing technologies, including rooftop solar, wind, and geothermal, and accelerating the time to commercialization for technologies that are still in earlier stages, such as hydrogen, small modular reactors (SMRs), and utility-scale batteries.

The development of COVID-19 vaccines is a great example of the role collaboration can play in accelerating innovation. During the pandemic, the collective action taken by governments, pharma, and supply chain and manufacturing organizations enabled the development of vaccines in 12 to 18 months, rather than the 10 to 15 years that it typically takes.

There's tremendous opportunity for collaboration on technology innovation in Canada's PU&R sector. A powerful example can be seen in the development and commercialization of SMRs. Emerging as one of the critical technologies for achieving decarbonization targets, SMRs have yet to be proven—but they'll be needed before 2030. So, accelerating the development timeline is top of mind for many ecosystem players. The Small Modular Reactor Acton Plan has identified and begun actioning more than 50 recommendations to position Canada as a world leader and desired partner in this high-tech innovation.[14]

This type of collective action is intended to bolster decarbonization efforts and, especially in Indigenous and northern communities where energy challenges already exist, to drive economic development by positioning Canada as a first mover in the global SMR market, which is estimated to be valued at over $150 billion by 2040.[15]

There's a real need to embrace open innovation models to increase the pace of technology innovation in the PU&R sector.

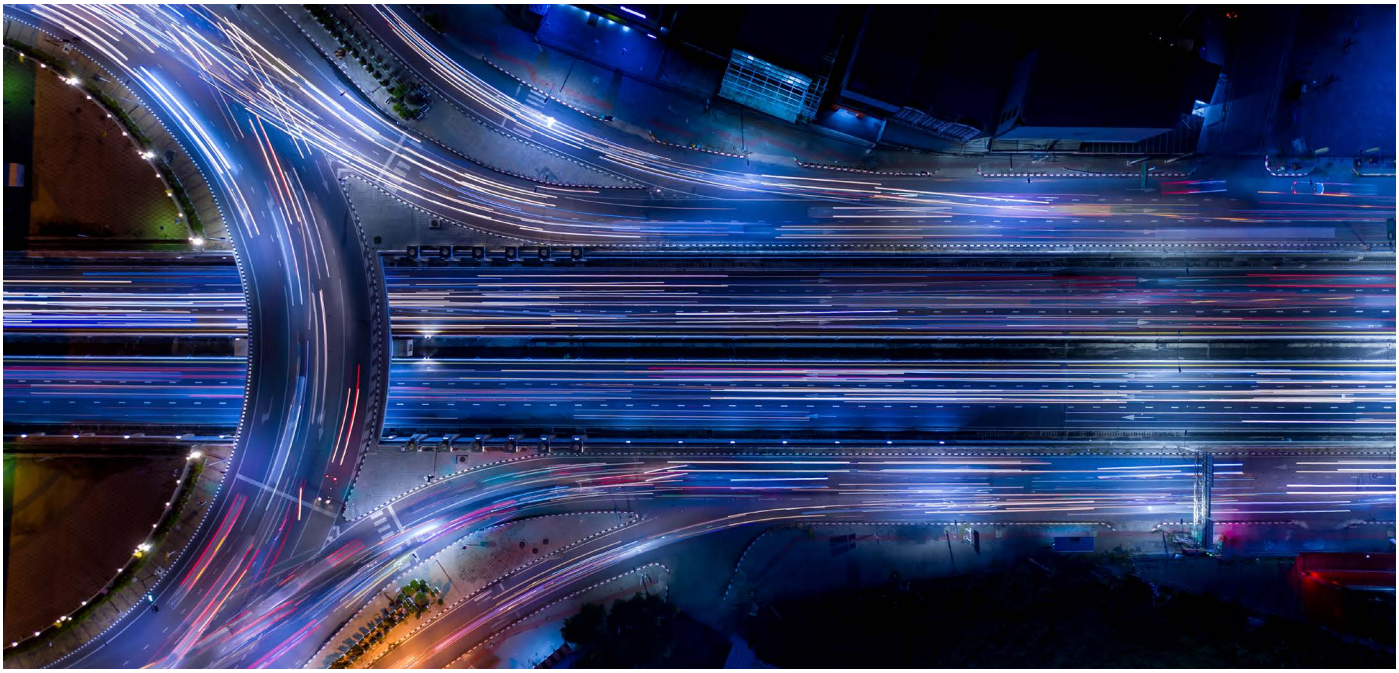
Supporting collective action

The critical enabler of collective action is the establishment of a common fact base and extensive information-sharing. It's very difficult for groups to collaborate if they can't align on a problem statement and talk about it in the same terms. For this reason, technology and data will continue to have an elevated role in enabling collaboration, cooperation, and coordination in the PU&R sector.

Achieving Canada's ambitions for decarbonization and the energy transition will require unprecedented levels of collective action—at Deloitte, we're excited by the opportunities this presents and committed to being part of the solution.

4 Growth

Growing energy-efficient electric infrastructure: A massive opportunity and undertaking



For the last 25 years, despite a growing and energy-intensive economy, demand for energy has remained broadly flat in Canada.[16] Unfortunately, greenhouse gas (GHG) emissions have also remained relatively unchanged, despite growing public concern, ambitious targets, declarations of a climate emergency at all levels of government, a complex array of federal and provincial regulations and incentives, and industry commitments for 2030 and 2050.

Around the world, national and regional analysis illustrates the unique and expanded role that the power, utilities, and renewables (PU&R) sector has to play in meeting the urgent and evolving energy and decarbonization goals of the next 25 years.

Drivers of change

Climate action plans universally call for significant growth in electrified technologies like electric vehicles (EVs) and air-source heat pumps, clean fuels like hydrogen, and technologies like small modular reactors and carbon capture and storage. The good news is that evolving policies, consumer expectations, and technologies are finally creating the necessary impetus, certainty, and economic returns needed to drive the PU&R sector to expand and transform its energy infrastructure. This also supports the sector's investments in new sources of supply and end-use technology in pursuit of economy-wide decarbonization.

Drivers of the sector's transformation include:

- The decarbonization ambitions of governments, the private sector, and society
- Increased demand for electric energy and non-emitting forms of generation—locally, nationally, and globally
- Precedents and ambitions related to nuclear generation and opportunities to expand hydroelectric, wind, and solar power generation
- Improvements in energy-efficient technologies, from electric vehicles to air and ground-source heat pumps, and industrial innovations such as induction and radiative heating technologies
- The decreasing costs and improved performance of renewable, distributed energy sources such as rooftop solar
- Advancements in the ability to manage massive amounts of data, via improved computing power and artificial intelligence (AI), to predict system needs at the sub-hourly level and control millions of distributed resources—EVs, storage equipment, thermostats, lighting, etc.—to optimize the balance of supply and demand
- The need to ensure reliable preparation for potentially frequent extreme weather events

Needs and expectations will continue to change

The drivers of change will impact the relative contributions of oil, natural gas, and electricity in Canada's energy system. The scale and speed of the transition will vary by region, and the effects it will have on affordability and reliability of supply are, for the most part, poorly understood. And needs and expectations will continue to evolve, both throughout and beyond the PU&R sector.

Nevertheless, it's time to move from imagining the system of the future to executing and delivering on it. Natural gas and electric systems need to coordinate their plans and work in unison. Energy commissions, regulators, system operators, governments of all levels, all classes of customers, and others need to work together toward an affordable, reliable, and sustainable energy system in Canada—and there's no time to waste.

This is one of the most complicated endeavours society has ever faced. It will require targeted action along many lines—analytic, strategic, planning, financial, policy, technical, etc.—and by a staggering number of system players.

Roles for old and new players alike

As all parties work together to solve the issues, each energy utility can seize the opportunities presented to deploy the infrastructure and capital needed to transform Canada's energy system. These opportunities include increasing supply, growing revenue, expanding generation and transmission, developing and deploying clean fuels like hydrogen and renewable natural gas, and designing and delivering programs for energy efficiency, electrification, storage, distributed generation, renewables, and more. Ultimately, each energy utility will be able to play a broader role in creating value for the customer and providing new, non-energy benefits such as GHG emissions reductions and social equity.

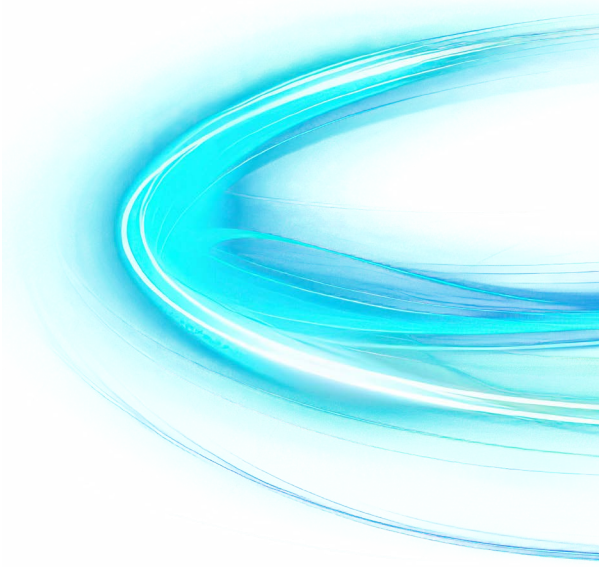
The resources required will differ by region, and each utility must manage and maintain the hardware to ensure adequate energy, capacity, and reliability.

Beyond this, the role of the traditional utility as the energy system transformer is far from a foregone conclusion. New, more agile, and aggressive companies expect to compete for and play a significant role in the transition. Well-capitalized companies such as Tesla, Google, Apple, and Amazon, along with smaller entities like BlocPower, SparkPower, Sunverge, and Swtch, are often much less risk averse, and unencumbered by the regulations and constraints imposed on the energy utilities. However, these emerging players will need to rely on public transmission and distribution systems to create value, they will need to meet the requirements of commissions and regulators, and they will face penalties if they can't deliver.

It's time to design and deliver new processes that enable newer and more nimble companies operating at the grid edge to fully participate, contribute, and create value.

Finally, the energy transition will take about 25 years and massive amounts of capital to complete. The fossil systems and natural gas and oil products that reliably and affordably meet 80% of energy demand today will not be eliminated tomorrow. Nor will electrification be the sole route to decarbonization. The idea of imposing the entire cost of decarbonizing an economy on the system rate payer—the consumer—is untenable. Pension funds and other large institutions understand that there's an opportunity, and shareholder pressure, to invest to help fund this tremendously important endeavour. Investments should be made in both new and legacy systems—including Canada's sustainable electrical system and reliable, affordable natural gas distribution infrastructure—to maximize transition and emissions outcomes.

There's significant activity already taking place in support of the energy transition, and we're excited to see it gain momentum. With tremendous focus, collaboration, and investment, the power sector can catalyze real change toward Canada's energy and decarbonization targets and make a meaningful contribution to addressing the world's climate crisis.



5 **Supply chains**

Mitigating supply chain disruptions in preparation for increased electricity demand

For Canada to meet its decarbonization commitments, rapid growth is needed in the power, utilities, and renewables (PU&R) sector in preparation for a significant increase in demand for electricity.

This is expected to cost at least $2 trillion, and estimates suggest that annual capital spending will need to ramp up by about $100 billion per year.[17] In *Pathways to Decarbonization*, the independent Electricity System Operator (IESO) estimates a $400-billion investment in the bulk system alone. The sector has never had to handle a transformation on this scale. It's a massive challenge—and it will only intensify if current constraints in the supply chain aren't resolved.

To meet the increased demand, both governments and private players are making substantial investments to construct new power plants and other generation facilities and upgrade existing ones.

PU&R trends and challenges

Let's take a look at some of the key challenges and trends that will significantly impact the sector's ability to lead Canada's energy transformation.

Materials availability
Ensuring that the right materials are available in the right quantities at the right times is a significant challenge. Multiple players competing for more access to the same set of vendors at the same time may lead to a strain on supply and production, which could lead to shortages and increased costs. Companies need to take a longer-term view of material requirements to support both new projects and upgrades.

Aging assets
Many of Canada's power plant assets are aging and in need of upgrades and digitalization. To meet forecasted demand, these assets will need to operate at nameplate capacity, which may accelerate equipment failures. There are, however, several promising developments in this area, including:

- **Using artificial intelligence (AI)** to track assets and manage spare parts requirements
- **Standardizing metadata** to streamline communication across business units and speed up the preparation of operations and maintenance work assignments and tasks
- **Enhancing system reactiveness** so that output can be quickly adjusted based on demand and grid conditions

Dependence on other industries
The PU&R sector relies heavily on other industries to supply raw materials and support long-term sustainability goals, such as critical mineral mining for fleet electrification. There's an increasing need for greater collaboration between major players in the PU&R sector and governments to shape policy and secure long-term funding for these industries.

Workforce shortages
Canada's skilled labour gaps are expected to widen, and the PU&R sector will be particularly impacted due to its requirements for specialized skills. Upskilling the existing workforce and leveraging technologies like GenAI will be crucial in helping to meet demand.

Alternative generation
The rapid deployment of alternative power generation, such as small modular reactors (SMRs), may relieve the strain on more traditional modes of power generation. However, this shift will require reimagining end-to-end supply chains and developing manufacturing clusters to support the production of these new models.

Increased focus on environmental, social, and governance (ESG) issues
Reducing greenhouse gas emissions and environmental degradation is top of mind throughout the PU&R sector. In addition to promoting the adoption of renewable energy sources, reducing carbon emissions, and improving overall environmental performance, there's also a big push—in all industries—to focus on other important ESG topics, such as diversity, equity, inclusion, and community engagement.

Ideas for keeping supply chains powered up

To meet today's challenges head on and take advantage of positive trends in modern supply chain management, there are several actions that the sector and its supply chains can take.

Bright idea

Embrace a multi-year planning approach with digital supply chain management solutions that offer complete visibility and help forecast potential failures and ensure safety

Plan ahead, drive visibility, and reimagine the supply chain

Companies need to adopt a multi-year planning approach and maximize visibility into their supply chains so that they can predict potential failures more reliably and secure the safety of our energy supply. They should work collaboratively with vendors to investigate developing supply clusters that optimize networks to ensure material availability. PU&R organizations should also deploy technology to digitalize and enhance supply chain management.

Several developments need to take place, including:

- Suppliers expanding their production capacities
- Strategic vendors relocating to create supply chain clusters
- Partnerships and ecosystems being established with existing vendors to drive innovation and collaboration
- Infrastructure such as roads, railways, and ports being reviewed and improved as needed

Bright idea

Collaborate and build strategic partnerships with governments and other key players

Work collaboratively

It's critical for all ecosystem players to boost collaboration, form strategic partnerships, and work with governments to define collective needs, develop policies, and understand interdependencies. PU&R organizations should also work closely with policymakers to identify and secure funding for sector and supply cluster development.

Bright idea

Expand the use of digitization, sensors, data analytics, smart grids, GenAI, and other game-changing solutions

Bright idea

Rethink the skills required in the evolving PU&R workplace, redesign training programs, and employ new strategies and AI technologies to address skills gaps

Expand the use of digital tools

As part of a broader effort to modernize, PU&R organizations and their supply chains are already benefiting significantly from digitization, and these efforts need to continue to grow. Power plants and suppliers alike are implementing robust systems of sensors and data analytics to continuously monitor and analyze equipment and infrastructure, which helps to improve maintenance processes. By harnessing the power of connected sensors, AI, advanced analytics, grid infrastructure monitoring, remote monitoring of building systems, and asset health monitoring and diagnostics, they can find ways to optimize asset performance, reduce downtime, and enhance overall operational efficiency.

Plants—within the sector and throughout its supply chains—should continue to harness innovative technologies and the massive amounts of data they retain, including GenAI to support decision-making and digital twins for asset management and predictive maintenance.

Reimagine workforce planning

Given today's rapid technological advancements and shifting consumer preferences, the traditional talent pool may be ill-equipped to meet the sector's specialized talent and skills needs. PU&R organizations and their supply chains can address this by:

- Identifying common competencies across diverse sectors and launching micro-certifications and bite-sized learning modules to bridge skills gaps
- Leveraging AI for upskilling to facilitate skills analysis, create learning paths tailored to individual needs, and provide continuous assessment and feedback

An exciting array of innovative solutions and strategies

Canada has a lot of work to do in support of the energy transition, but there are also unprecedented opportunities for the PU&R sector and its supply chains. Taking advantage of these opportunities and making progress toward a sustainable future requires a thorough reevaluation of the design, construction, operation, and maintenance of the country's power plants and their supply chains. The ideas we've proposed here can help the sector do all that and more.

By adopting agile planning strategies, establishing resilient supply chains, increasing collaboration, addressing labour challenges, and deploying automation, the generation, distribution, and delivery of energy in Canada can be optimized from coast to coast to coast.

Compliance and regulatory risk: Building an energy transition road map

To bring about a more sustainable future, Canada's energy system is undergoing massive structural change.

As the greatest challenge the power, utilities, and renewables (PU&R) sector has ever faced, the energy transition brings increased risk and complexity to an already risky and complex environment. It also brings enormous opportunities to evolve.

The energy transition will require significant mindset shifts as PU&R companies grapple with:

- **Increasingly complex regulatory requirements**
  Even without the energy transition, PU&R is a highly regulated sector. Effectively managing regulatory requirements and expectations requires a proactive, multidisciplinary approach to management, governance, and processes. Organizations with weak regulatory management and compliance processes often only find out they have run afoul of regulation once penalties are already in play.

- **Challenging labour markets**
  Identifying, training, and retaining the specialized talent needed to sustain the energy transition is of significant concern to the PU&R sector. Organizations often overlook the need for regulatory and compliance management specialists who can bring differentiated perspectives to support this transition.

- **Heightening cyberthreats**
  Power generation is often seen as being made up of mechanical systems, largely separate from and unaffected by the digital transformation that's happening elsewhere. In reality, the energy transition involves a tremendous amount of digitalization. The threats and vulnerabilities we're working to protect against in financial and other critical systems now also apply to Canada's critical energy infrastructure. Bills C-26[18] and C-27[19] are currently making their way through parliament and could bring even more stringent cybersecurity requirements for the country's critical infrastructure.

Meeting or exceeding regulatory requirements

Establishing an effective regulatory and compliance management program requires organizations to rethink today's often disparate, siloed, and manual processes and approaches. A single organization may be required to actively monitor compliance against hundreds of regulations at a title level and thousands of the resulting regulatory obligations, spanning rate filings, health and safety, environment and sustainability, financial reporting, and Indigenous relations, to name a few. Adding complexity is the pace of change to existing regulations in response to evolving social, technological, and geopolitical situations, underscoring the importance of a robust, technology-driven approach to compliance.

Building a sustainable regulatory management and compliance program requires:

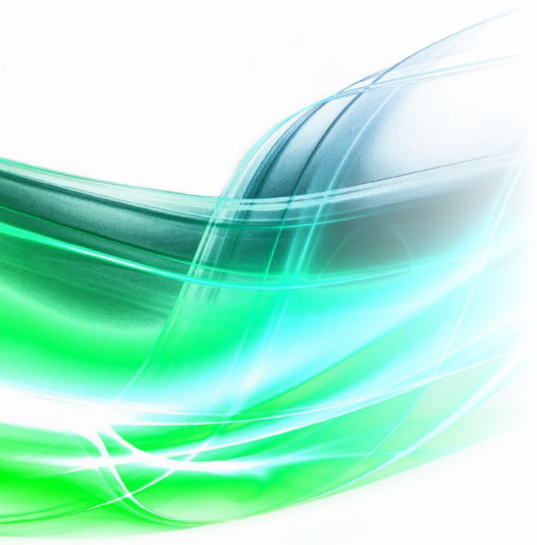
- An effective process and governance for integrating diverse departmental compliance efforts into an overall corporate compliance program

- A technology-driven approach to monitoring, assessing, and complying with all corporate regulations and obligations

- Innovative approaches to training, change management, and organizational awareness in relation to managing compliance and related incidents

Bright idea

Adopt an integrated corporate compliance framework that underpins key elements of governance, policy, and processes and integrates any siloed efforts



PU&R organizations must adopt a common framework of reference to achieve corporate compliance with internal and external regulatory obligations and a consistent process to understand, assess, evaluate, and establish monitoring programs.

There are many benefits to embracing an integrated approach, including:

- Clarity on roles and responsibilities throughout the organization using RACI (responsible, accountable, consulted, informed) charts
- An organization-wide view of risks and impacts
- Strong visibility of compliance/non-compliance across business units
- Consistent and standardized tools, templates, and techniques for compliance management
- Cost-efficiency through the deployment of scalable enterprise technology that provides an ongoing organizational view of regulatory compliance health
- Effective organizational strategies to manage compliance incidents, root cause analysis, and risk disposition

Rapid advances in the application of artificial intelligence (AI), such as Generative AI (GenAI) and machine learning, and other compliance-driven workflows and technologies can significantly simplify the organizational management of thousands of regulatory obligations across multiple departments and internal and external interest holders.

With the capabilities of AI expanding almost by the minute, technology can go a long way in helping PU&R organizations adhere to their regulatory obligations and perform their compliance functions better, faster, and more efficiently, while establishing clear and centralized ownership of compliance regulations and making sure they are well understood.

The benefits of building an effective enterprise technology compliance strategy include:

- A single source of truth that retains all organizational commitments in one repository
- An automated workflow that helps enforce compliance commitments in all groups within and outside the organization
- The identification of opportunities for achieving or exceeding compliance with diverse regulations through integrated risks, controls, and processes
- Fostering greater collaboration to reduce the need for manual intervention in rudimentary day-to-day tasks, improving the overall “compliance experience” of the organization

Bright idea

Develop a robust enterprise technology compliance strategy that uses innovative tools to simplify regulatory management and oversight, provide a holistic view of organizational compliance, and enable real-time monitoring and predictive capabilities

Bright idea

Prioritize training, change management, and organizational awareness

A sustainable regulatory compliance program requires ongoing investment in people management. Individuals with operational backgrounds are often thrust into compliance responsibilities for specific business units without formal training or awareness of the impacts of non-compliance and related reporting on the achievement of organizational objectives. The internet is awash with stories of lackadaisical attitudes toward regulatory management and compliance that resulted in spectacular failures of otherwise sustainable businesses. Regulators are introducing more stringent regulations and penalties to counter this trend, which increase the risks of non-compliance and the organizational costs of doing business.

The benefits of investing in effective people strategies as part of a regulatory compliance program include:

- Clarity and understanding of compliance obligations for all roles
- The ability to clearly articulate the risks and impacts of non-compliance, allowing for impactful, cross-functional collaboration on incident management and resolution
- The active participation of employees in de-risking business operations, resulting in fewer regulatory incidents and the protection of brand and reputation
- Physically and psychologically safe environments that improve employee health and safety and heighten employee satisfaction

Ensuring cybersecurity at the enterprise level

Most organizations aren't aware of all their cyber vulnerabilities. Threat actors have too many new and ongoing exploits to keep track of, and the frequency of attacks is increasing. For many organizations, cyber capabilities are implemented in a piecemeal fashion over time, as reactions to singular threats or attacks.

On top of all the potential unknowns, a significant amount of what used to be disconnected from the broader internet now needs to be digitalized to support advanced analytics. As the PU&R sector moves away from traditional connectivity and networks, perimeters are dissolving. Current cyber defence tactics may not be able to keep pace with the risks.

Utility organizations don't have the luxury of shutting down in response to a major breach. Up until two years ago, no major energy company in North American had ever experienced a highly impactful cyberattack or shutdown. Now it's becoming an all-too-common occurrence.

Bright idea

Transform and redesign. While many traditional techniques still have some merit, building on old foundations or doing things the same old way will not be enough to counter tomorrow's threats. To drive operational sustainability and risk mitigation, a cyber transformation throughout the PU&R ecosystem is required.

A thoughtful cyber program provides complementary capabilities unburdened by legacy issues and requirements. Coupled with a managed service or co-sourcing, it supports dedicated cybersecurity experts while enabling innovation, efficiency, and predictability. Cyberattacks, such as AI-based malware attacks, are becoming more sophisticated, and therefore harder to manage. Having experts in place who are constantly on top of the latest developments in cybercrime should be a high priority.

The PU&R sector needs a major reset.
By redesigning entire systems from the ground up, keeping effectiveness top of mind, and using defence-in-depth design and modern technology, it can reap the benefits of being future-ready as it continues to lead Canada through a successful energy transition.

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