A NET ZERO FUTURE FOR MANITOBA THROUGH BIGGER, CLEANER, SMARTER ELECTRICITY

By Bill Hamlin and Arthur Zhang

SUMMARY

Manitoba is at an important point in its transition to a net zero economy. With a new government elected in the fall of 2023, the province is increasingly committed to powering much of its economy with clean electricity to reach its climate and clean economy goals. And while Manitoba's current electricity grid is almost entirely renewables, it will need to significantly expand the scope of its network—making it bigger, cleaner, and smarter—in order to get firmly on a pathway to net zero.

This scoping paper takes a deeper dive into new and existing modelling and analysis of Manitoba's electricity system to get a better picture of the current opportunities and challenges facing the province in the energy transition. It provides recommendations to help guide Manitoba's system expansion, electrification plans, and governance reforms as the province develops its energy roadmaps.

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Manitoba is at a pivotal point in the transition to clean electricity. A new government was elected in fall 2023 and the mandate letter for the Minister for Environment and Climate Change states an intent to "make Manitoba a leader in clean energy and help our government take bold action when it comes to fighting the climate crisis." The mandate letter further directs the Minister to work with others in government to "create a roadmap to meet net zero targets by 2050" and "work toward making our energy grid net-zero by 2035". In recent months there have been changes to Manitoba Hydro's board and a search is currently underway for a new CEO.

All of this is taking place as the federal government prepares its forthcoming Clean Electricity Regulations, aimed at driving Canada's progress towards a cleaner grid. Given these factors, it is an opportune time to take stock of what we know about decarbonization and electrification to offer insights and recommendations on developing a net zero pathway for Manitoba.

Electrification will be critical to meeting Manitoba's climate goals and involves replacing technologies that rely on fossil fuels with ones that use clean electricity. This is core to every conceivable pathway to the province's emissions reduction targets, and will be required across all sectors of the economy.

The aim of this scoping paper is to help guide Manitoba's system expansion and provide recommendations to electrification plans and governance reforms that should be considered in the province's energy roadmaps. The province is already in the process of developing long-term energy roadmaps set to be presented before the end of September to guide the work of Manitoba Hydro, the Manitoba Public Utilities Board, Efficiency Manitoba and other actors, with an emphasis on identifying near-term actions taken today to maintain a clean, affordable, reliable electricity system.

We explore a range of pathways for Manitoba towards reaching net zero electricity by 2035 and demonstrate that this progress is achievable. We also explore what reaching net zero by 2050 will mean for the longer-term development of Manitoba's electricity system.

Our analysis is grounded in comparisons across recent analytical studies of the province. It explores the following questions before making targeted policy recommendations:

1. What is an achievable scope and pace of electrification that meets Manitoba's climate goals?
2. What electricity system resource mixes can best serve growing demand?
3. What level of investment will be required to expand the grid and meet these goals?

EXPLORING MANITOBA'S PATHWAYS TO NET ZERO ELECTRICITY

To meet net zero, electricity will have to grow to become the dominant form of energy consumed in Manitoba, which will require expansion of the provincial electricity system. Electricity currently supplies about 24 per cent of Manitoba's total energy needs, while fossil fuels serve about 72 per cent. In addition to new generation requirements, transmission and distribution systems will also have to grow and become more flexible to respond to fluctuations in supply and demand.

In order to meet Manitoba's climate and clean economy goals, this grid expansion needs to be clean. The good news is that clean electricity is already a strategic advantage for Manitoba. The province has among the lowest utility rates and the cleanest electricity in North America, thanks to legacy investments in hydropower. In an average year, Manitoba generates up to 30 terawatt hours of electricity, with 99 per cent from non-emitting sources. This helps make Manitoba attractive to commercial and industrial activities, but maintaining this advantage will require strategic policy, planning, and investment.

> Clean electricity is already a strategic advantage for Manitoba.

To get a better picture of the range of pathways to net zero electricity in Manitoba, we compare two modelling studies: Manitoba Hydro's 2023 Integrated Resource Plan (referred herein as Hydro's plan or the plan) and new modelling data from Navius Research[1]. Both studies are comprehensive, relevant to Manitoba's electricity system, and consider a range of electrification assumptions that will be discussed below.

Hydro's plan represents an important first step in the development of a long-term energy roadmap for the province. It is rich in analysis and represents a key input to any net zero or electrification plan for Manitoba.

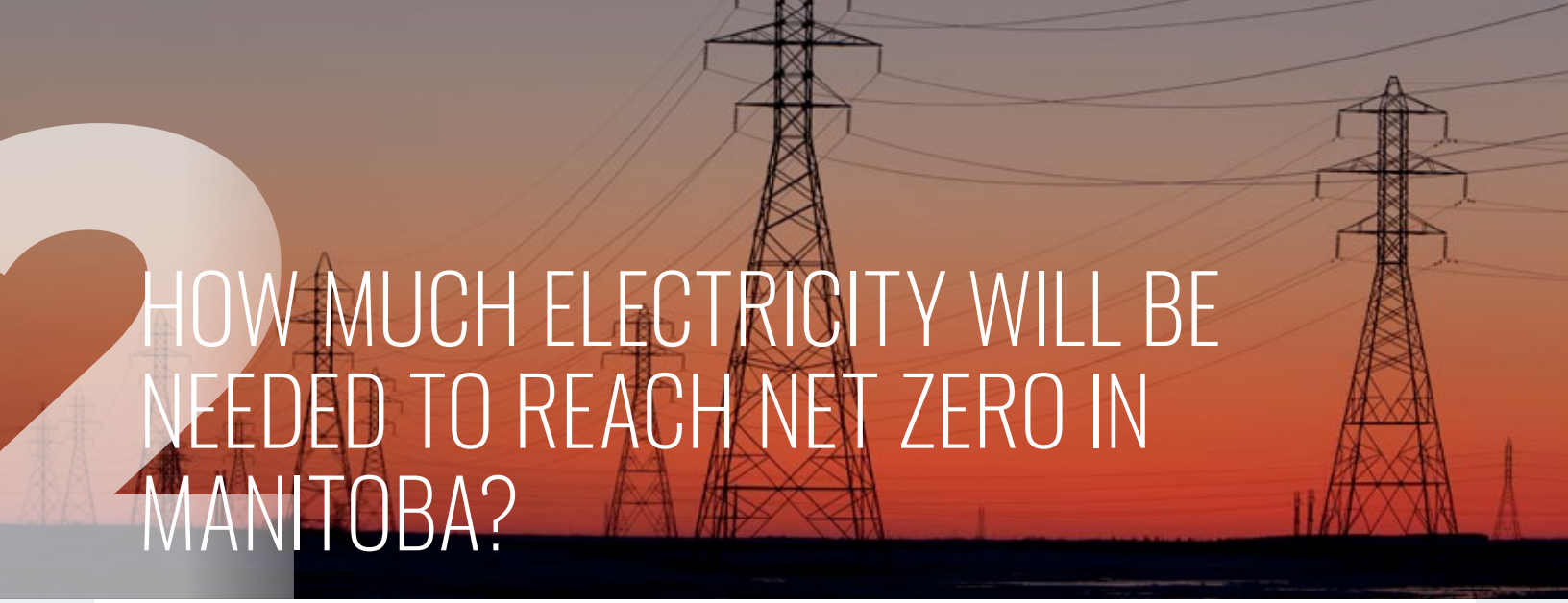
1 Navius' analysis net zero is met on the national level (not provincial level) and that use of offsets from Direct Air Capture (DAC) and land use, land-use change, and forestry (LULUCF)—amounting to 105 Mt CO_2e by 2050—within Canada count towards net zero. A net zero study where Manitoba reaches net zero, not Canada as a whole, or different assumptions around DAC and LULUCF could change results.

One of the key benefits of the plan is that it considers a wide range of Manitoba-specific assumptions and system constraints. For instance, it considers operating constraints, transmission interconnections, export sales, reliability considerations, and market conditions that are all detailed and specific to Manitoba. It also considers the implications of water flow variability on electricity generation, which is particularly important for hydropower systems designed to meet loads at their lowest energy production during severe drought.

That said, it still lacks the specificity relevant to meeting Manitoba's climate targets. While we consider the full range of scenarios and sensitivities in Hydro's plan to draw conclusions, our analysis focuses primarily on the fourth scenario (MH S4), as it is the scenario with significant electrification that is reasonably consistent with a pathway to net zero in the broader economy, (albeit not explicitly consistent with net zero electricity system by 2035 or net zero economy by 2050). It highlights important potential problems to consider in the transition to net zero electricity, but is limited in its ability to inform policymakers on the appropriate scope and pace of electrification.

The second set of results used in this paper are drawn from the analysis of Navius Research that examines national electricity pathways to net zero by 2050 under currently announced policies with the federal government's 2030 Emissions Reduction Plan and the Clean Electricity Regulations. While the results lack some of the Manitoba-specific assumptions and system constraints of Hydro's plan (ie. water flow variability), they have other attributes that provide some important insights as a comparison.

Lastly, we also consider the findings of other recent studies that provide perspective on Manitoba's electricity system pathways, including Dunsky Energy + Climate's Electricity Roadmap for Manitoba, the Canada Energy Regulator's Canada's Energy Future 2023, Efficiency Manitoba's 2020/23 Efficiency Plan, and the Climate Action Team's Manitoba's Road To Resilience.



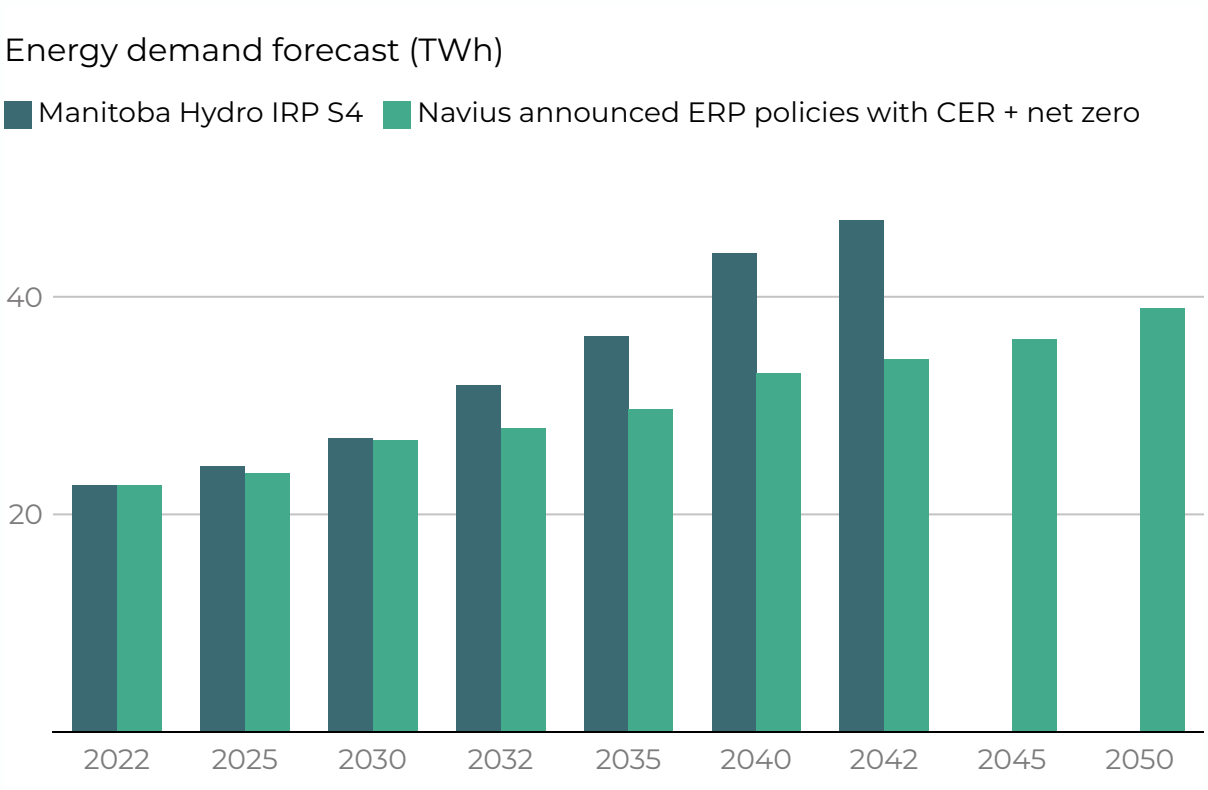
2 HOW MUCH ELECTRICITY WILL BE NEEDED TO REACH NET ZERO IN MANITOBA?

Each of the studies considered anticipate demand increases. However, the exact rate and degree of growth varies. By 2050, studies anticipate that electricity demand will grow by up to two times today's levels, as Manitoba's economy grows and continues on a path towards electrification.

Figure 1 compares energy load forecasts for Manitoba between MH S4 and Navius Research's modelling.

Figure 1:

Studies point to higer electricity demand on the path to net zero



All scenarios indexed to reflect actual system Manitoba load in 2022

Load growth under MH S4 is the highest, reflecting aggressive assumptions of accelerated electrification towards net zero. In this scenario, customers require about double the electrical energy consumed today by the end of their 20-year study in 2042. While the Navius analysis also anticipates an increase in load growth, its projections are lower than MH S4, resulting in energy load growth by 2040 that is about one and a half times the 2022 levels. This is more consistent with other scenarios examined in Hydro's plan that assume less aggressive electrification pathways. To draw conclusions from the plan related to the level or timing of electrification, results need to be compared between scenarios.

Navius' model estimates load growth and electrification internally by computing pathways for building heat decarbonization and a range of technologies and possible interventions (e.g., heat pumps and electric resistance heating, biomethane or hydrogen, and energy efficiency retrofits) to strive for an optimal mix.

Some of the main drivers of load growth in any net zero scenario for Manitoba include:

- **ELECTRIFICATION OF SPACE HEATING.** All scenarios considered here include some level of increased demand from the electrification of space heating, and the growth in grid capacity it requires. Navius' modelling projected lower initial levels of electric space heating relative to MH S4. MH S4 anticipates significant capacity requirements in order to meet growing winter peak demand due to electrification in space heating. By contrast, Navius' model anticipates less electrification of space heating than MH S4 in early years and a less dramatic capacity build-out.
- **GREATER ADOPTION OF ELECTRIC VEHICLES (EVs).** All scenarios evaluated in this paper model all new car and light-duty truck sales to be zero emissions by 2035 (as required under the legislated federal ZEV mandate). Medium- and heavy-duty truck sales under Navius were modelled using assumptions of adopting policies similar to California's Advanced Clean Trucks regulations, as well as reaching 75 per cent of on-road medium-duty trucks and 40 per cent of on-road heavy-duty trucks to be ZEVs by 2035.
- **INDUSTRIAL ELECTRICITY DEMAND.** MH S4 anticipates increased industrial demand for electricity. By contrast, Navius' results show industrial electricity demand to be relatively constant. In this instance, we assume that MH S4 is better informed on Manitoba-specific data related to industrial activity.

Each study varies in terms of the timing of electrification, both in terms of the pace of adoption, as well as the types of decarbonization solutions adopted. Taken together, the results of these studies provide a range of possible pathways for load growth in Manitoba.

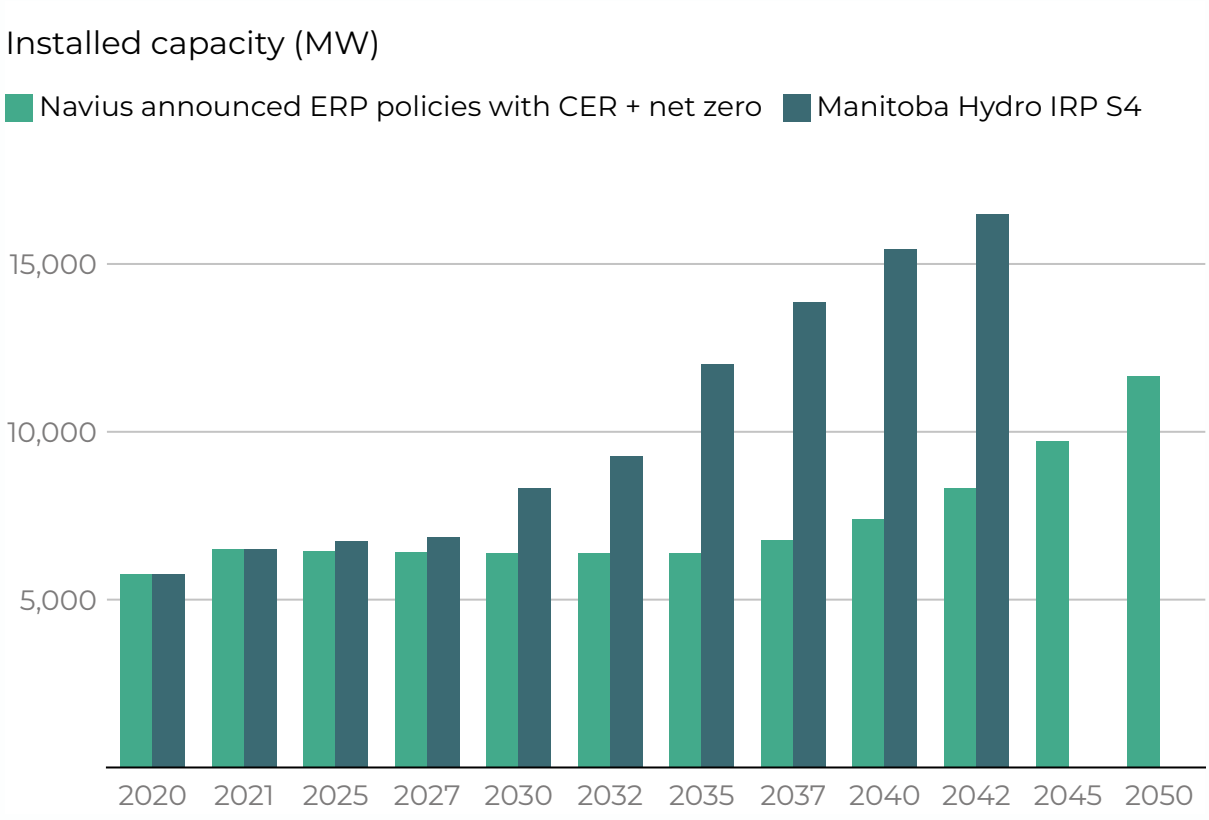
HOW MUCH NEW GRID CAPACITY IS NEEDED FOR NET ZERO AND WHAT WILL IT LOOK LIKE?

As the above suggests, it's clear that Manitoba's grid capacity will need to grow. In fact, Manitoba Hydro is already planning to at least double existing grid capacity by the 2040s.

Figure 2 summarizes different estimates of installed capacity growth across the models.

Figure 2:

Studies differ on how much grid capacity will need to increase



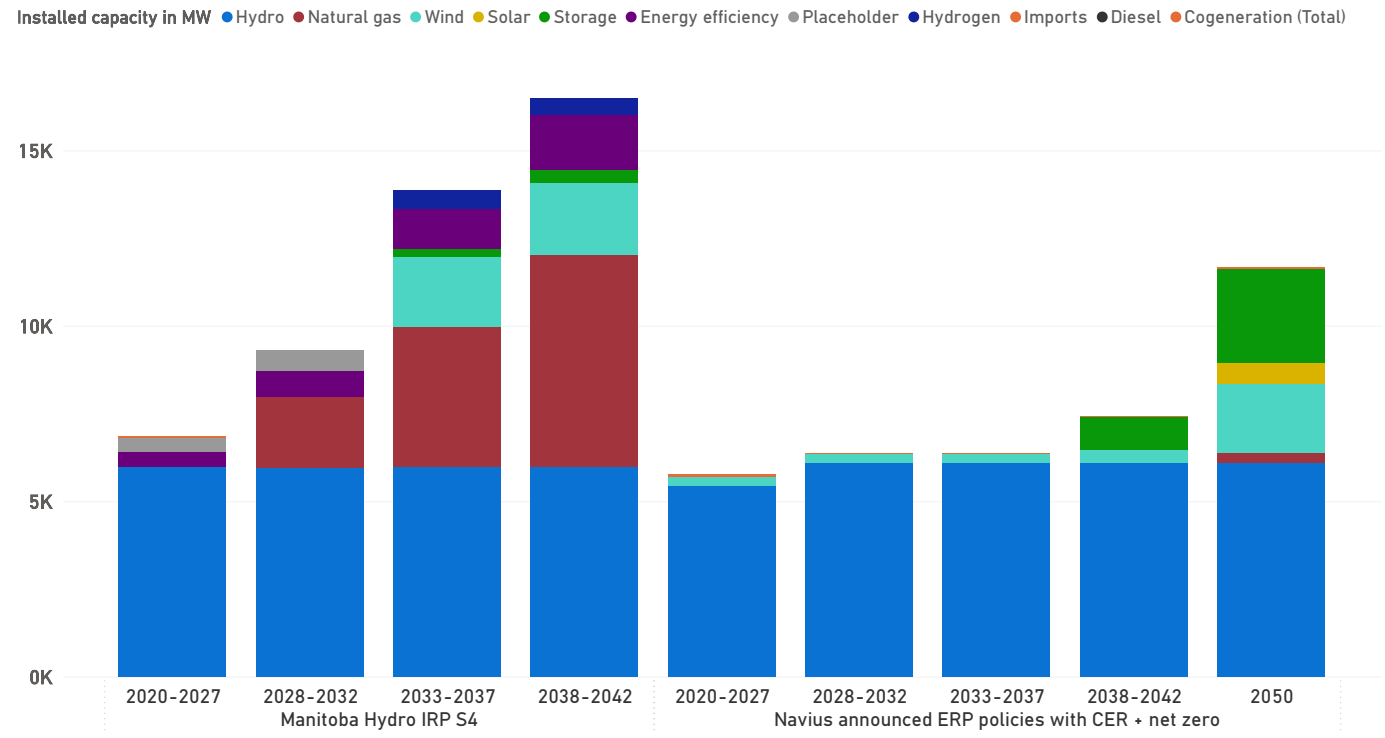
Both MH S4 and the Navius analysis project that installed capacity in Manitoba will need to double by mid-century. Navius sees total installed capacity staying relatively flat at around 7,000 MW until 2035, while MH S4 anticipates additional capacity will need to be installed much faster. MH S4 models a much more aggressive and early electrification of space heating, which is an important contributing factor for the difference.

The capacity mix estimated by each model can be seen in Figure 3. MH S4 is much more reliant on gas generation compared to Navius. MH S4 projects a significant amount of gas to meet capacity requirements (5,500 MW by 2042). By contrast, the Navius analysis projects a much more limited role for gas, increasing at most to 300 MW by 2050.

The divergence in the role that gas generation plays is partly explained by how the studies model the Clean Electricity Regulations (CER). Navius' modelling corresponds with the design that was proposed for the CER in Canada Gazette 1 in August 2023[2], while MH S4 does not model the CER at all. The differences are also driven by the rapid growth in winter peak requirements associated with the accelerated space heating electrification associated with MH S4.

Figure 3:

A range of technologies can help Manitoba's electricity generation align with net zero by 2035



2 As of February 16, 2024, Environment and Climate Change Canada released an update with new design options for the Clean Electricity Regulations.

Increased reliance on intermittent renewables is common to both studies. This is also consistent with previous statements from Manitoba Hydro, calling for the need to rely on wind as it doubles or triples the province's electricity capacity by 2040.

Despite their similarities, Hydro's plan's reliance on intermittent renewables differs from Navius' modelling in a couple of ways. First, Navius' model assumes a larger role for intermittent renewables such as solar and wind power. In Hydro's plan, a comparable level of intermittent renewables was only explored under certain sensitivity analyses that put further constraints on gas generation or emissions. Second, MH S4 does not include a role for utility-scale solar, whereas Navius projects a modest amount being built by 2050. This difference may warrant further consideration of solar by Manitoba Hydro in subsequent studies.

Hydro's plan also includes demand-side management (DSM) opportunities such as programs to incentivize electric vehicle charging at off-peak times, interruptible load rates and, perhaps most importantly, better energy efficiency measures in the building sector. Demand-side management (DSM) approaches are often among the lowest-cost solutions to reduce emissions in the electricity sector. DSM opportunities, such as utility-controlled charging, were not included in this Navius analysis but could be investigated in future analyses. Nevertheless, DSM is likely to play a very significant role in any cost-effective pathway because of its ability to reduce and manage both energy and peak capacity demands for electricity.

The IRP also considered variation in annual precipitation patterns. Under conditions with average or higher water flows, the use of gas turbines and imports is projected to be relatively modest. However, under persistent drought conditions, gas generation would be used much more. This level of reliance on gas is likely inconsistent with the proposed federal Clean Electricity Regulations and with Manitoba's objective for the electricity grid to be net zero by 2035.

It should be noted that the sensitivities in Hydro's plan also show pathways for Manitoba's future capacity mix that can avoid high levels of gas generation (e.g. consistent with progress towards a net zero grid or within what may be permitted under the CER). These pathways are accomplished by managing the pace of electrification (especially of heating loads in the near term) and enabling alternatives to new gas generation like hydropower, hydrogen and storage options.

Options like hydrogen, pumped hydro, battery and other forms of storage offer alternatives to gas to provide peak capacity. Both the Navius analysis and MH S4 project a growing role for storage (and hydrogen). While MH S4 includes these resources as early as the 2033-37 time frame, Navius' analysis projects more storage capacity added from 2040 onwards, reaching 2,700 MW by 2050.

HOW MUCH INVESTMENT WILL BE NEEDED TO BUILD A BIGGER, CLEANER, SMARTER GRID?

Supporting widespread electrification will require significant system investments. The exact size and pace of investment needed differs in the studies we examined. Results suggest that annual costs could be as much as double current levels by 2040 compared to current 2022 levels. MH S4 anticipates that total annual utility investments are expected to double by 2040, as depicted in Figure 4.

MH's IRP states that the need for additional capacity is a major driver of cost increases, followed by costs to maintain and operate the existing electrical and gas systems. Capital and fixed operating costs become the largest sources of increases incurred over the next 20 to 30 years. Because the need for capacity is a major driver of utility costs, managing capacity load growth through demand-side management offers significant potential cost savings.

While rising investment costs are likely to result in some upward pressure on electricity rates, research from the Canadian Climate Institute estimates that most households in Canada will see lower overall energy costs due to falling expenditures on fossil fuels (i.e., as they electrify) and the superior efficiency of electric end-use technologies. This finding is echoed by modelling from Canada's Electricity Advisory Council, which found that on average, 70 per cent of households are likely to see $1,500 in average annual savings by 2050 as they make the switch to electricity (Dunsky et al., 2024).

This is especially true for electric transportation where the higher capital costs are offset by the lower maintenance and fuel costs (electricity versus petroleum). Electrifying heating loads present a greater cost challenge because of the relatively low cost of gas. However, the reduction in energy requirements resulting from improved building efficiency can significantly reduce bills. Ground-source heat pump technologies offer the potential to provide the lowest cost heating options, especially if reductions in the upfront capital costs can be achieved.

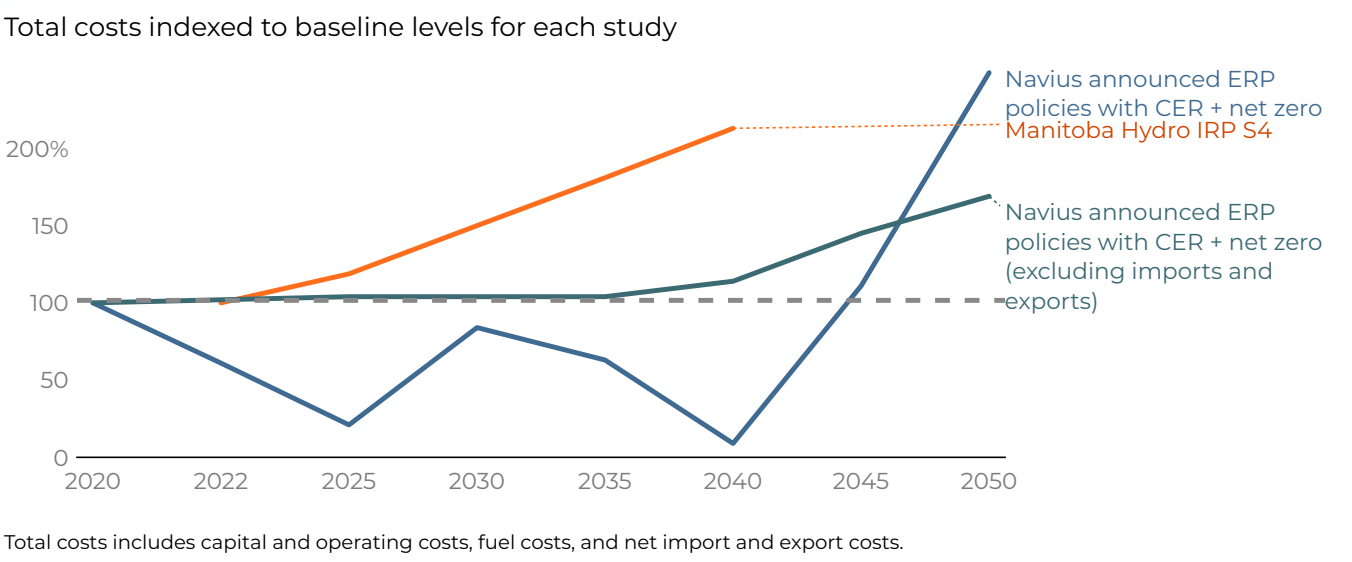
While electrification often provides the lowest societal costs to reach net zero, this rapid transition does not fit well within the traditional rate regulation frameworks. Addressing climate change is the responsibility of society as a whole, not just electricity ratepayers (Borenstein, Fowlie, and Sallee 2021; Kanduth and Dion 2022).

Governments can acknowledge this by partially funding the transition. This approach spreads the burden of net zero investments—generation, transmission, distribution, and storage—among a larger group and potentially over a different period of time. Government supports could include investment tax credits, subsidies, and loan guaranties. In doing so governments will ensue electricity remains affordable and industry remains competitive.

Utilities can also improve affordability for low- and middle-income households through targeted support and innovative rate design.

Figure 4:

Significant investment will be required for a bigger, cleaner, smarter grid in Manitoba



Total costs includes capital and operating costs, fuel costs, and net import and export costs.

The size and pace of investment needed is substantially lower and more gradual under Navius' analysis for the same period of time analyzed under Hydro's plan. Costs stay relatively flat between 2025 to 2040 to maintain existing assets and when including exports, fall below 2020 levels. After 2040, costs are expected to rise as a result of added wind and storage capacity. Other scenarios within Hydro's plan with lower load growth also demonstrate costs that are lower than MH S4.

5 CONCLUSIONS

While all studies agree that there will be an increase in electricity demand as Manitoba's economy electrifies, the issue ahead for policymakers is how to best shape and influence that demand and serve it in the years ahead.

A cost-effective path should focus on steadily growing electrification to realise all opportunities by 2050. Both Hydro's plan and Navius' analysis provides important insights into the timing of electrification activities and the associated need for new electricity resources. MH S4 highlights that a rapid start to electrification could require new resources by 2025, making it extremely difficult to plan, approve, and construct new resources that quickly.

Other scenarios suggest that a more moderate approach to the pace of space heating electrification would be more affordable and could avoid the early need for additional gas generation. (Aggressive pursuit of EVs is less problematic, because charging can be managed to minimize its contribution to system peak and the need for firm capacity.)

Navius modelling suggests that the electrification of space heating and the associated load growth is modest in the early years in a cost-effective pathway to net-zero. Near-term actions such as the Manitoba government's objectives to install 5,000 ground source heat pumps and provide incentives for EV purchases represent critical first steps towards electrification without risking significant new generation requirements.

The amount of gas generation projected and used under MH S4 is likely inconsistent with the Government of Manitoba's objective to work towards a net zero electricity grid by 2035. Navius results (and MH IRP sensitivities) suggest a more significant role for intermittent renewables, batteries, and hydrogen, as an alternative to unmitigated gas generation.

Near-term pursuit of wind generation should be considered, since wind is common to all scenarios. Emission-free resources that are rich in firm capacity such as new hydropower, gas with carbon capture and sequestration, and nuclear options should also be fully considered in subsequent IRPs.

Manitoba Hydro has long understood the benefits interconnections can play in diversifying resources and loads between jurisdictions. Importing capacity and energy is another strategy to avoid or defer the need for natural gas generation.

Electrification will involve maintaining a virtually emission-free electricity system, while rapidly growing that system to meet new needs in everything from transport to buildings to industry. But it also should

involve actively influencing what gets electrified and when. Our recommendations below provide guidance as to how a net zero energy roadmap might guide the electrification activities to ensure a practical start and a sustainable path forward. The box below recommends strategies for managing heating loads.

An achievable pathway to net zero for space heating might entail something more modest in the earliest years but become increasingly more aggressive over time to ultimately ensure that electrification opportunities are all met by 2050. But to deliver this transition cost-effectively, related study, planning and policy, must begin today.

BOX 1

Strategies to manage the electrification of space heating

Following Dunsky Energy + Climate Advisors' Electricity Roadmap for Manitoba, we take the view that "heating in Manitoba can best be addressed through three options: improved energy efficiency, geothermal heating, and dual fuel systems."

While heat pump applications are the main electrification opportunities for space heating, their considerations are complex. They offer electricity load reductions in areas where gas is not available, but represent load growth where they are replacing gas heating. Electrification choices range from all resistive electric heating, air-source heat pump (ASHP) with electric resistive backup heating, ground-source heat pump (GSHP) and ASHP/gas dual-fuel systems.

Each of these choices has significant implications on the overall electrical load and the associated electricity system requirements. By their very nature, these loads are coincident with peak winter loads, which are driven by heating. As a result, the electrification of heating is a primary issue to consider in developing electrification plans and the associated requirements for new resources.

Considerations for managing the electrification of space heating loads in Manitoba could include:

- Reduce heating requirements through building codes and DSM programs to improve building efficiency. This is what the Canada Electricity Advisory Council's Final Report refers to as saving energy to lighten the load.
- Limiting use of resistive electric heating. Resistive heating is more energy intensive, which adds more demand for grid capacity in contrast to more efficient heat pump technologies. The recent Canadian Climate Institute report *Heat Exchange* found that rising energy efficiency of buildings and the switch from electric baseboards to much more efficient heat pumps can all contribute to reducing the scale of the necessary electricity system build-out.
- Prioritizing near-term heat pump applications in areas without gas availability.
- Considering dual-fuel heating as a bridging strategy to defer the need for system capacity from gas generation while gaining confidence in alternative sources of capacity (and while pursuing less expensive ways to implement ground source heat pumps).
- Targeting changes at the end of existing infrastructure and appliance lives. For instance, target the replacement of conventional central air conditioners with ASHPs when they need to be replaced.
- Pursuing GSHPs, which offer long-term potential to replace gas heating. In pursuing the commitment to convert 5,000 homes to GSHP, Manitoba should look for opportunities to build capacity in skilled trades, reduce costs, aggregate customers, and explore the potential for a centralized coordination agency or utility. A more significant pursuit of GSHP could be deferred until later in the roadmap as costs become more competitive.

6 RECOMMENDATIONS

Achieving net zero emissions by 2050 will require new and improved policies to manage the transition to a bigger, cleaner, smarter electricity system in a cost-effective and affordable manner. It may also require changes in roles, mandates and directives to provincial organizations like Manitoba Hydro, Efficiency Manitoba and the Public Utilities Board.

Based on our analysis of existing studies of Manitoba's electricity system in the energy transition, we provide four policy recommendations to the provincial government to reach its climate change goals.

RECOMMENDATION:

The government of Manitoba should establish a permanent, decision-level electricity task force to guide and inform electricity policymaking

The task force would provide policy advice and coordinate on key areas of shared or potentially competing jurisdiction (as previously recommended by Dunsky Energy + Climate Advisors). The task force could be staffed from government ministries (Ministries of Economic Development, Investment, Trade, and Natural Resources; and Environment and Climate), Manitoba Hydro and Efficiency Manitoba and report to cabinet. Several provinces have already established similar counterparts. For example, BC Hydro Task Force, Ontario's Clean Energy Task Force, as well as Quebec's Task Force on Electrification.

RECOMMENDATION:

The government of Manitoba should use its planned net zero energy roadmap to guide the work of Manitoba Hydro, Efficiency Manitoba, and the Public Utilities Board

This roadmap should provide a long-term vision, as well as five-year milestones, annual reporting requirements, near-term targets and priorities for provincial action to meet net zero emissions across sectors. It should also follow the best practices for roadmaps laid out by Canada's Electricity Advisory Council (Dunsky et al., 2024).

The government should direct Efficiency Manitoba to provide long-term plans to deliver electrification programs and activities consistent with the roadmap. It should also direct Manitoba Hydro to produce new Integrated Resource Plans that are consistent with the energy roadmap, and periodically report on cost and timing issues associated with electrification and build-out of the electricity system. Subsequent versions of the IRP and net zero energy roadmap should inform each other on an iterative basis.

The government should use the roadmap to guide all of its other activities and plans. This could include strategies to attract industry, consideration of public and active transportation infrastructure, development of building codes, and many other activities.

RECOMMENDATION:
The government of Manitoba should improve coordination and governance across the electricity sector to reach net zero

The government should provide clear direction to Manitoba Hydro and Efficiency Manitoba, clarifying that their mandate includes supporting the transition toward net zero electricity by 2035 and economy-wide net zero by 2050, and engaging with the task force described in Recommendation 1. This direction can come in the form of directives, orders in council, or changes to enabling legislation. Providing clear guidance will allow all stakeholders, including the Public Utility Board, to focus on practical, affordable and equitable outcomes that are consistent with government objectives.

The provincial government should expand Efficiency Manitoba's role to include the electrification of transportation and space heating. This would involve changes to Efficiency Manitoba's legislation, mandate, funding and targets.

RECOMMENDATION:
The government of Manitoba should ensure that clean electricity projects provide meaningful opportunities for Indigenous Peoples

Historically, some of Manitoba's energy projects were approved without the consent or inclusion of affected First Nations and Métis communities and rights-holders. The expansion of Manitoba's electricity system and the electrification of the economy both present significant opportunities for Indigenous participation, employment and ownership. Clean energy projects must proceed in ways that support reconciliation. The range of potential opportunities is very large and could include hydro, wind, solar, and transmission projects under a variety of business models. It could also include new housing, housing efficiency improvements and heat pump applications.

The government should build on Manitoba's experience of Indigenous participation as equity partners in the Wuskwatim and Keeyask generating stations, as well as the Fisher River Cree Nation's role as an Independent Power Producer, currently Manitoba's largest solar facility. Government and project developers should also include and support Indigenous-based businesses like AKI Energy, which has been successful in improving access to ground-source heat pumps for Indigenous communities, lowering energy costs, and enhancing local employment opportunities.

Governments have a constitutional obligation to consult, and Indigenous Peoples should be consulted from the outset of all major projects and policy decisions. They should have the opportunity to have equity stakes in major projects, as well as opportunities to develop their own projects. This could include providing support through mechanisms like tax credits and the loan guarantees programs like those being developed in other provinces. Mechanisms should support equity participation, training and capacity building to ensure a full range of opportunities.

7 CONCLUSION

The provincial government is at a critical juncture in the transition to a bigger, cleaner, smarter electricity system. Electrification of the economy will be a central feature of that and should be guided by a detailed and transparent energy roadmap that lays out the path ahead to ensure Manitoba remains an affordable, prosperous destination for clean business and investment.

These policy changes should be part of Manitoba's effort to reach its climate and clean economy goals in order to maximize the opportunities ahead and ensure an efficient, cost-effective and fair pathway to net zero.