MAY, 2020

An Integrated Energy System Pathway:

A Better Way Forward to Net-Zero in Nova Scotia

eastward energy

eastwardenergy.com

Executive Summary

To mitigate the impacts of climate change, the world must significantly reduce global GHG emissions over the next thirty years. Canada signed the Paris Climate Accord in 2015 and pledged to implement actions to drastically reduce GHG emissions. In support of Canada's commitments to fight climate change, Nova Scotia passed the Sustainable Development Goals Act (SDGA) in October 2019 and established new provincial greenhouse gas (GHG) emission reduction targets to:

- reduce GHG emissions to at least 53% below 2005 levels by 2030; and,
- achieve net-zero emissions by 2050[1].

challenge of climate change. Eastward Energy is optimistic about the challenge ahead and we believe the gas distribution system has an important role to play to help Nova Scotia transition to a low-carbon economy by delivering cleaner energy where and when we'll need it.

While there is a viable pathway to achieve Nova Scotia's 2030 emissions target, reducing emissions to net-zero by 2050 will be significantly more challenging. Studies from around the world have concluded that energy efficiency measures, combined with the decarbonization of electricity generation will be important, yet insufficient to achieve net-zero emissions by 2050.

Our Vision is a resilient province with an abundance of clean, affordable energy.

To achieve these targets, Nova Scotia must fundamentally transform how energy is produced, stored, distributed, and consumed. This transformation to a resilient net-zero energy system will require a significant improvement in energy efficiency and conservation, the decarbonization of electricity generation, and a transition to low-carbon fuels for buildings, industrial processes, and transportation.

Nova Scotia relies on energy to move us forward, and the decades ahead will be defined by how we meet the

The future energy system that Nova Scotia needs to achieve net-zero emissions should be built on two foundational principles:

1. **Energy efficiency and conservation.** The government of Canada's Generation Energy Council reported that Canada can achieve at least one-third of our emissions targets by improving energy efficiency and conservation[2]. The energy we don't use saves money and reduces the cost of doing business in Nova Scotia.

1 An Act to Achieve Environmental Goals and Sustainable Prosperity, 2019.

2 The Generation Energy Council, Canada's Energy Transition, 2018.

2. **Cleaner electricity and gas grids.** Nova Scotia's net-zero energy system will need to be fueled by low-carbon energy. We can decarbonize our energy system by transitioning to renewable electricity, renewable natural gas (RNG), and low-carbon hydrogen. Nova Scotia has made significant progress in reducing the emissions intensity of electricity generation, and further reductions are possible by replacing coal-fired generation with additional hydro, wind energy, or natural gas. The emissions intensity of the gas grid can also be reduced by displacing fossil natural gas with RNG, by blending low-carbon hydrogen with natural gas and, over the longer term, by converting the natural gas grid to a 100% clean hydrogen, so we can leverage the gas infrastructure we have today to deliver the cleaner energy we'll need tomorrow.

Increasingly, governments are concluding that the large-scale production of **hydrogen will be needed to deliver the clean energy that Nova Scotia will need to achieve net-zero emissions by 2050.** The European Union's Hydrogen Roadmap Report, for example, concluded that *"achieving the energy transition in the EU will require hydrogen at large scale. Without it, the EU will miss its decarbonization objective"*[3]. Hydrogen will play an important role in the decarbonization of key energy sectors:

Buildings: Hydrogen can play a valuable role in the decarbonization of building heat by delivering a low-carbon fuel for gas boilers, integrated with electric heat pumps in hybrid heating systems.

Industry: Hydrogen can produce the high-grade heat required in many industrial processes that cannot be produced by electricity.

Heavy Transportation: Hydrogen is the most promising fuel to decarbonize heavy trucks, buses, ships, trains, large cars, and commercial vehicles, where the lower energy density, high initial costs, and slow recharging performance of batteries are major disadvantages[4].

Power Generation: The surplus electricity generated by variable renewable energy (i.e. wind, solar) can be used to produce 'green' hydrogen through electrolysis to support the deployment of more renewable electricity generation and for the storage of renewable power.

"hydrogen will be needed to deliver the clean energy that Nova Scotia will need to achieve net-zero emissions by 2050."

Energy storage and linked electricity and gas grids will be important components of an **integrated energy system** – the most viable pathway to meet Nova Scotia's SDGA goals at the lowest cost while providing flexibility, diversity, and resiliency:

3 Fuel Cells and Hydrogen Joint Undertaking, Hydrogen Roadmap Europe - A Sustainable Pathway for the European Energy Transition, 2019, page 4.

4 *Ibid.*

5 European Parliamentary Research Service, Energy Storage and Sector Coupling, 2019.

Hydrogen energy storage and batteries can work together to balance short-term and seasonal energy supply and demand in Nova Scotia's winter peaking energy system. As more variable renewable energy, especially wind, is deployed on the electric grid in Nova Scotia, balancing supply and demand while ensuring grid stability will become more challenging. Energy storage will play a crucial role to bridge the imbalances between energy production and consumption[5]. **Surplus wind generation in Nova Scotia can be converted to 100% green hydrogen through the process of electrolysis to convert renewable electricity into a gas that has all the flexibility but none of the carbon emissions of natural gas.**

Linked electricity and gas grids can work together in complementary ways to build a more flexible and resilient energy system. They can support the conversion of surplus wind generation in Nova Scotia to zero-carbon 'green' hydrogen, enable the efficient on-site generation of heat & power for buildings and industrial processes, and integrate in hybrid heating systems to minimize the increase in peak electricity demand that occurs with increased penetration of electric heat pumps for space heat in buildings[6].

An **integrated energy system** has several advantages over complete electrification to meet the challenges of Nova Scotia's net-zero future:

Clean energy growth

The production of more renewable energy – wind power, green hydrogen, and renewable natural gas - here in Nova Scotia supports economic growth and energy independence. Significantly more wind energy generation can be added in Nova Scotia and the surplus electricity can be used to produce green hydrogen using Power-to-Gas facilities. The integration of wind generation, green hydrogen production, and battery storage can support further renewable energy generation in our province.

Peak demand management

A decarbonized energy system based on the electrification of building heat, industrial processes, and transportation poses significant challenges due to the need for additional flexibility in the electricity system, reinforcement of the transmission and distribution networks, and the significant increase in peak electric demand. The use of a cleaner gas grid for heavy transportation, high-temperature industrial processes, and hybrid heating systems for space heat in residential and commercial buildings can minimize the increase in peak electric demand.

Decarbonization of all energy sectors

Some energy sectors that are difficult to electrify, like high-temperature industrial processes and heavy transportation (i.e. freight, public transit, rail, marine) can be decarbonized through the use of compressed natural gas, renewable natural gas, and low-carbon hydrogen.

Improved Energy System Resiliency & Flexibility

Most of Nova Scotia's electricity transmission and distribution infrastructure is above ground, where it is exposed to increasingly frequent and more extreme weather events. Increased electrification will further increase our reliance on the electric grid in critical areas such as transportation. Conversely, gas infrastructure is located underground and is 99.996% reliable. Energy policy decisions need to consider the importance of reliable and resilient energy infrastructure.

6 European Parliament's Committee on Industry, Research and Energy, Sector coupling: how can it be enhanced in the EU to foster grid stability and decarbonise?, 2018.

Moving Forward. Together.

Now is the time for Nova Scotia to demonstrate leadership in climate action and we all have an important role to play. We must work together to reduce our energy consumption and invest in clean energy technologies so we can achieve our ambitious goal to achieve net-zero emissions by 2050. Nova Scotia is uniquely positioned to lead the clean growth and green jobs transformation in Canada. Our province has been a resource economy for generations. Moving forward, let's use our wind, biomass, tides, and green hydrogen resources as catalysts to transform Nova Scotia into a green energy economy.

Instead of depending on imported energy, we can leverage this transformation to achieve energy independence.

What's Next?

The Integrated Energy System described in this study is an important first step toward the development of a viable plan to achieve net-zero emissions in Nova Scotia by 2050. Next, Eastward Energy proposes collaborating with other energy companies, industries, academia, government, and other key stakeholders to complete a feasibility study that builds on this study and the modeling and analyses conducted by other organizations. The study should further evaluate the potential for green hydrogen production, energy storage, and linking the electricity and gas grids in Nova Scotia.

abetterwayforward.ca

eastward energy

eastwardenergy.com