

Mitigation Research Director Senior Research Associate



Defining the Big Switch

To support net zero, household energy use will shift away from natural gas and gasoline toward electricity

Average household share of energy consumption by type





All roads to net zero pass through electricity

Studies consistently show that **electricity underpins economy-wide emissions reductions** Failing to set up electricity systems to support broader net zero **undermines the achievement of that goal**

Making electricity non-emitting is an important **source of GHG reductions itself** Fuel switching away from fossil fuels to electricity (e.g., by adopting EVs for transportation) is **one of the most impactful solutions available** Aligning electricity systems with net zero can help mitigate climate change, create jobs and drive economic opportunities for Canada



Transforming electricity systems will enable clean growth opportunities

Samson et al. (2021)

Canada's non-emitting electricity sector is well-positioned to profit in the global low-carbon transition



Difference in profitability versus baseline scenario

4

Transforming electricity systems will enable clean growth opportunities

On the path to net zero, renewables, storage, and nuclear* see the most jobs growth

Labour required (number of full time equivalent jobs averaged across studies)





5

A focus on the <mark>supply-side</mark> of Canada's big switch

Demand-side implications

Increasing use of technologies like electric vehicles and heat pumps

Supply-side implications

Increased production of clean electricity to:

1) replace unabated **coal** and **natural gas power plants**

2) meet growing need for clean electricity

Our scope: A focus on systems



Our Approach: The **what** and the **how** of electricity system transformation







Ul

Introduction

OBJECTIVES

Describe the key ways electricity systems in Canada must transform from a technological perspective, to support economy-wide net zero by 2050

METHODS

Summarize existing findings and knowledge by synthesizing recent major studies, in consultation with experts and thought leaders





TO ALIGN WITH NET ZERO, ELECTRICITY SYSTEMS MUST BECOME:

BIGGER, CLEANER, SMARTER



BIGGER

MEETING THE DEMAND CREATED BY WIDESPREAD ELECTRIFICATION

BIGGER Boosting *capacity* to meet growing demand

On the path to net zero, installed capacity must grow substantially

Studies show capacity will be 2.2 to 3.4 times larger by 2050 relative to today







CLEANER

GROWING CLEAN ELECTRICITY SOURCES, PHASING OUT POLLUTING SOURCES, AND MAINTAINING EXISTING NON-EMITTING SOURCES

CLEANER Phasing out unabated fossil fuel generation

On the path to net zero, unabated fossil fuel generation must be phased out

Studies show that unabated fossil fuel generation will reach at most 14 TWh in 2050, or 1% of total generation





CLEANER Boosting supply from variable renewable energy

On the path to net zero, most new capacity to 2030 must be wind and solar

Studies show that by 2030, 63-96% of new capacity additions will come from solar, wind, and storage





CLEANER

Hydro and nuclear play a steady role, otherwise other non-emitting sources must grow faster

On the path to net zero, multiple sources of clean electricity displace fossil fuels



Studies illustrate a range of possible generation mixes

Hydro | Wind | Solar | Nuclear | Natural gas & coal | Natural gas with CCUS | Biomass





SMARTER

ENHANCING SYSTEM FLEXIBILITY TO SUPPORT VARIABLE SUPPLY AND BOOST RESILIENCE

SMARTER Importance of system flexibility

Smarter electricity systems can support more variable renewables and improve climate resilience

A flexible electricity system is one that can manage variability in supply and demand in a reliable, costeffective manner





CONCLUSIONS What aligning electricity systems with net zero means for Canada



Meeting net zero goals requires electricity systems to become **bigger**, **cleaner and smarter** (i.e., more flexible) 2

Transforming electricity systems to support net zero **is complex but achievable** 3

Governments in partnership with Indigenous Peoples have driving roles in these transformations













The stakes in transforming Canada's electricity system



Acting early with smart policies

can significantly reduce overall costs and make achieving net zero easier

Strategic action today can enable clean growth opportunities

If pursued with justice and equity in mind, electricity system transformations can **contribute to a fairer society** Catalyzing Indigenous participation and leadership can support **Indigenous self**determination and reconciliation



Catalyzing Indigenous leadership in Canada's electricity systems transformation



INDIGENOUS CLEAN ENERGY

Waves of change: Indigenous clean energy leadership for Canada's clean, electric future (ICE 222)



FOUR KEY CHALLENGES IN ALIGNING CANADIAN ELECTRICITY SYSTEMS WITH NET ZERO

Federal climate policy in the electricity sector is not currently aligned with net zero goals



Federal carbon pricing for electricity—including the current output-based approach—is not aligned with net zero targets in electricity (2035) or economy-wide (2050)

Clean electricity standard (CES) is in development, but not yet implemented



2 Creating resilient electricity systems aligned with net zero could put upward pressure on electricity rates

Þ

Electricity system transformation will require **significant investments**



Even if rising electricity rates are offset by falling energy expenditures elsewhere, **rates may increase**

Critical context

On the path to net zero, Canadians **will spend less** of their incomes **on total energy**





Energy will become cheaper for Canadians overall...

The Big Switch can make energy more affordable for Canadians



2

...but the impact on the price of electricity may vary from province to province.

Currently relies on:

hydroelectric generation

thermal electricity generation (coal, natural gas, or nuclear)





Electricity rates might modestly increase—or even decline—given the decreasing costs of renewables and storage. But in some regions, in some scenarios, rates could increase more significantly as Canada modernizes its electricity systems. Smart policy can mitigate these potential rate increases and help keep electricity affordable for Canadians.

Sources: Dion et al. (2021); Dolter, Winter, and Guertin (2022).



3 Provincial policies and institutions are not sufficiently coordinated to deliver on net zero goals



Gaps between existing policy and long-term targets are likely to persist



Institutional mandates, as they relate to climate change, are often **unstated or ambiguous**



Regulators are **not in positions to make assumptions** or decisions about governments' **future climate policy**



4 There are insufficient incentives for greater interregional coordination and integration



Despite clear benefits of integration, **provincial and territorial electricity systems remain largely siloed**

A number of **factors hinder greater interregional integration** (institutional cultures and mandates, political and public opposition, inertia)

The benefits of coordination and integration are clear, especially in the context of decarbonization





FLIPPING THE SWITCH

POLICY RECOMMENDATIONS FOR ELECTRIC FEDERALISM

The federal government should **strengthen climate policies** in the electricity sector

- Strengthen carbon pricing by doing away with output-based pricing in the electricity sector and return all revenues to ratepayers
- Employ the proposed clean electricity standard alongside carbon pricing to ensure delivery of the 2035 target





Federal, provincial, and territorial governments should **leverage public funds** to defray the costs of electricity system investments

Rationale:

- When benefits are broad, costs should be borne broadly too
- Electricity systems are 21st century energy infrastructure
- Tax systems tend to be more progressive than cost recovery from ratepayers



Provincial and territorial governments should flex their policy muscles to **transform their electricity systems**

- Set their own climate policy through equivalency agreements
- Clarify the mandates of key public institutions to deliver on climate goals
- Guide the work of these institutions with comprehensive energy plans and pathway assessments





Both orders of government should pursue greater coordination and integration using

their respective policy tools

- Provinces and territories should work
 bilaterally and multilaterally to integrate
 their electricity sectors
- The federal government can encourage integration by leveraging its spending and convening powers







Negotiated agreements as an accelerator

The federal government should explore offering sustained, predictable support to provinces and territories to accelerate electricity system transformation



Federal support could be made conditional on a number of highlevel policy actions, including:

- Changes to mandates of key institutions (e.g. regulators)
- Development of energy plans and pathway assessments
- Participation in interjurisdictional working groups

Negotiated agreements offer a practical path forward in the Canadian federation





www.climateinstitute.ca/big-switch @ClimateInstit



Scoping papers and case studies



PATHWAYS TO ALIGNING **CANADIAN ELECTRICITY SYSTEMS** WITH NET ZERO GOALS

BLAKE SHAFFER

ELECTRICITY SYSTEMS IN CANADA PIERRE-OLIVIER PINEAU

COORDINATION OF

PROVINCIALLY-MANAGED



SARA HASTINGS-SIMON

BROADER DECARBONIZATION THROUGH ENERGY SYSTEMS INTEGRATION

MADELEINE MCPHERSON

