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Keeping the Lights On

Ensuring energy affordability, equity, and access in the transition to clean electricity in Canada

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EXECUTIVE SUMMARY

PHOTO David Dodge

Canada is facing a major energy transition. As part of the federal government's overall emissions reduction plans, Canada has committed to introducing clean electricity regulations, aimed at achieving a net-zero emissions electricity system by 2035. Replacing fossil fuels with clean electricity can help to mitigate climate change and promote greater energy security within Canada. It can also help to address challenges linked to fossil fuels, such as environmental degradation, poor air quality and inequality. This report has a particular focus on energy poverty in the context of a people-centred transition in Canada.

Calls have been made for energy transitions to be equitable so that they do not cause unnecessary burden or enforce pre-existing notions of "winners and losers." Some people and households are particularly vulnerable in the current energy system. Many live in energy poverty, struggling to have a sufficient level of energy services. This means being either too cold in winter or too hot in summer at home, and having to limit use of lighting and appliances on the basis of cost. This in turn can have damaging effects on health, resiliency, social relationships and, in extreme cases, loss of life.

There is renewed interest in energy poverty in Canada due to volatile energy costs as well as concerns over affordability. Almost one in ten Canadian households spends more than 10 per cent of their income on energy bills. The main reasons for energy poverty are low incomes, geographical location, housing conditions (including energy efficiency and fuel source) and housing costs. Considerable regional differences exist throughout Canada. Almost 19 per cent of households living in energy poverty are in the Atlantic provinces (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador), despite having only eight per cent of the population. Canadian households that are in energy poverty spend a greater share of their budgets on energy services (almost five times more) than households not in energy

poverty. For many households in energy poverty, spending on energy services increases as their household income increases. This strongly suggests that some households in Canada are struggling, and their increased energy spending suggests they may not have adequate levels of energy services. That is, they are not using enough energy to meet their needs.

Phasing out fossil fuel electricity generation and switching from fossil fuel end uses to clean electricity will be far-reaching and will require modernizing the electricity system, as well as transitioning to technologies compatible with clean electricity. Such changes will increase the demand for electricity as well as present potential upfront costs, which may be especially challenging for households that are already struggling to afford their energy needs. Importantly, although overall energy cost savings are likely, shifting to clean electricity does not automatically translate to addressing energy poverty.

Households that currently face energy poverty may continue to do so if the distribution of costs and benefits in the electricity transition are not properly addressed. Moreover, if these are not addressed, there is also a risk that more households could be pushed into energy poverty, with detrimental impacts.

To mitigate energy poverty in the context of a clean energy transition, this report makes policy recommendations on the following four areas:

Policy topic	Key recommendations
1. National energy poverty strategy	R1.1 Energy justice as a guiding approach R1.2 Energy poverty advisory group R1.3 Household energy data R1.4 Energy poverty definition, indicators and targets
2. Universal clean energy service	R2.1 All-season energy disconnection ban R2.2 Access to cooling services
3. Affordable energy	R3.1 Lifeline rate R3.2 On-bill credits/discounts R3.3 Seasonal programs R3.4 Emergency assistance
4. Decarbonizing and efficiency for the residential sector	R4.1 Utility targets R4.2 Building sector targets R4.3 Low-income energy efficiency funding R4.4 Multi-residential and landlord-owned building programs R4.5 Free heat pump program R4.6 Free electric hot water heater program R4.7 Community outreach and education programs R4.8 Diverse and inclusive stakeholder engagement

The phenomenon of energy poverty extends to those not connected to the electricity grid; however, it is beyond the scope of this report to undertake that particular investigation. In Canada, those living in off-grid communities as well as northern communities face several challenges. These include reliance on fuel types such as wood, oil, kerosene, propane and diesel. Many Indigenous communities face additional challenges, such as displacement due to energy developments. That these communities are not connected to the main grid, or connected at all, is a clear energy justice issue that warrants focused attention and study in and of itself.

Energy poverty affects people's quality of life. The introduction of clean electricity regulations and the transition to electrification provide an opportunity to decarbonize homes while addressing energy poverty. It is essential that no one is left behind, or lacks energy services, in the transition to net-zero.

GLOSSARY OF ACRONYMS

B.C.	British Columbia
BEIS	Department for Business, Energy and Industrial Strategy (United Kingdom)
BIPOC	Black, Indigenous, and People of Colour
CRA	Canada Revenue Agency
CARE	California Alternative Rates for Energy
COP	Conference of the Parties
CREDS	Centre for Research into Energy Demand Solutions (United Kingdom)
CUSP	Canadian Urban Sustainability Practitioners network
DOE	Department of Energy (United States)
EFB	Emergency Fuel Benefit (New Brunswick)
EFS	Electric Fuel Supplement (New Brunswick)
ECO	Energy Company Obligation (United Kingdom)
EEWG	Energy Efficiency Working Group (Canada)
EERS	Energy Efficiency Resources Standard
ESST	Energy Sector Sustainability Table (Canada)
EU	European Union
FERA	Family Electric Rate Assistance (California)
G7	Group of Seven countries
GHG	Greenhouse gas
HARP	Heating Assistance Rebate Program (Nova Scotia)
IEA	International Energy Agency
LEAP	Low-Income Energy Assistance Program (Ontario)
LICO	Low-income cut-offs
LIEN	Low-Income Energy Network
LIHC	Low income, high cost (United Kingdom)
LIHEAP	Low-Income Home Energy Assistance Program (United States)
LILEE	Low Income, Low Energy Efficiency (United Kingdom)
LIM	Low-income measure
NZ2035	Net Zero 2035
OEB	Ontario Energy Board
OESP	Ontario Electricity Support Program
PIPP	Percentage of income payment plans (United States)
P.E.I.	Prince Edward Island

PUMFS	Public-use microdata files
SDGs	Sustainable Development Goals (United Nations)
SHS	Survey of Household Spending
SULPU	Suomen lämpöpumppuyhdistys (Finnish Heat Pump Association)
SSHRC	Social Sciences and Humanities Research Council of Canada
UN	United Nations
U.K.	United Kingdom
UKERC	U.K. Energy Research Centre (United Kingdom)
UNFCCC	United Nations Framework Convention on Climate Change
U.S.	United States
WAP	Weatherization Assistance Program (United States)
WHEJAC	White House Environmental Justice Council (United States)

KEY CONCEPTS

Concepts	Definition
Net-zero energy transition	A net-zero energy transition means moving to an energy system that has a balance between emissions produced into the atmosphere and those removed from it.
Energy service	An energy service is a service provided by electricity or heat, such as the use of heating, cooling or appliances.
Energy poverty	A household, or person, is in energy poverty when they do not have an adequate level of home energy services such as space and water heating, cooling, lighting and use of appliances. Energy poverty means households have to budget and limit the energy services they use.
Energy justice	Energy justice focuses on unveiling justice issues related to energy systems, including resource, use and waste implications along the supply chain.
Vulnerability	In the context of this report, vulnerability is defined as the exposure and sensitivity to potentially harmful effects of energy systems. Vulnerability varies depending on country context, but often relates to age, disability, ethnicity, health and tenancy. People can also be vulnerable due to large-scale factors such as energy pricing policies and poor energy infrastructure.

1. INTRODUCTION

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Canada is facing a challenge to decarbonize its energy system and address the impacts of climate change. To avoid the very worst of the climate crisis, the Paris Agreement establishes a goal of keeping global temperature rise to below 1.5 C. Burning fossil fuels for energy is the key contributor to greenhouse gas emissions. Moving away from our collective dependence on fossil fuels requires a major overhaul in the way energy is produced and used in Canada and around the world.

Prime Minister Justin Trudeau committed Canada to moving toward a net-zero emissions electricity system by 2035 in his remarks at the 26th United Nations Framework Convention on Climate Change's Conference of the Parties (COP26) in November 2021. This goal is further affirmed in the mandate letters for the ministers of environment and climate change and natural resources in December 2021. As clearly stated in the International Energy Agency's landmark "Net-Zero by 2050" report[1], the importance of a net-zero emissions electricity sector by 2035 for all advanced economies is a foundational goal for meeting the Paris Agreement target of 1.5 C. It is encouraging to see this commitment develop also in the United Kingdom,[2] the United States[3] and, as of May 2022, all G7 countries.[4]

The energy transition will help address climate change and promote greater energy security, but it will also bring the benefits of addressing interrelated challenges and vulnerabilities linked to fossil fuels, such as environmental degradation, poor air quality and poverty.[5,6] Increasingly, calls have been made for the net-zero transition to be equitable so that it benefits everyone.[7] A clean and affordable energy transition could be used to help those who experience challenges in the current energy system, particularly people who face "energy poverty." Those

affected by energy poverty struggle to have critical needs met through adequate energy services such as being able to heat or cool a home, use appliances for essentials such as cooking and refrigeration or even connecting to the internet. Energy poverty is a unique form of deprivation that is entangled with infrastructure issues such as housing quality and energy systems and therefore requires unique policy approaches.

A successful and equitable energy transition — in which costs and benefits are distributed fairly and the needs of everyone are recognized and included — requires regulatory certainty and consistent policies.[8] Acknowledging the social and distributional impacts of such policies is key so that energy transitions do not cause further vulnerabilities.[9,10] Importantly, an equitable approach requires *directed efforts* to reach those households that are vulnerable to energy poverty since they already face barriers in accessing energy benefits. For example, increased electrification could lead to higher energy bills, which could exacerbate energy poverty. Electrification measures such as rooftop solar panels, electric vehicles and heat pumps can be costly and will be difficult for some households to acquire. These barriers will only be exacerbated through the clean energy transition unless programs and policies focus directly on removing these barriers. Ultimately, energy and the services it provides are vital in society and careful consideration — planning, policy and implementation — is needed so that future energy systems are equitable and beneficial for *everyone*.

2. KEY POLICY OBJECTIVES FOR A CLEAN, AFFORDABLE AND EQUITABLE ENERGY TRANSITION IN CANADA

PHOTO Elena Elisseeva, Adobe Stock

Canada has a clear mandate to deliver a net-zero electricity grid by 2035 with its clean electricity regulations. The timing of the regulations is critical. We cannot further delay widespread decarbonization. Big actions are necessary to clean up our electricity system. However, policy attention to distributional consequences and protecting vulnerable households from potential downstream effects has been lacking.

To ensure accountability and transparency, Canada enshrined into law the *Canadian Net-Zero Emissions Accountability Act* in 2021.[11] Canada's first Emissions Reduction Plan under the act — *2030 Emissions Reduction Plan: Clean Air, Strong Economy* — provides new measures and strategies to achieve the new targets, building on the previous *Pan-Canadian Framework* and the strengthened climate plan, *A Healthy Environment and a Healthy Economy*.[12,13] The Emissions Reduction Plan puts forward mitigation plans for many sectors in Canada and includes a commitment to create a net-zero electricity system across Canada by 2035.[14]

To create the net-zero electricity grid, Canada is developing federal clean electricity regulations,[8,15] which will support reducing emissions from electricity generation to achieve a net-zero electricity supply by 2035, as well as contribute to net-zero emissions economy-wide by 2050.[i,8] Currently, 82 per cent of Canada's electricity comes from non-emitting sources such as hydro, nuclear

i "Economy-wide net-zero by 2050 refers to Canada's stated goal of having the Canadian economy achieve either no greenhouse gas emissions by 2050, or compensating for emissions by removing carbon from the atmosphere (negative emissions) through other actions; for example, planting trees or carbon capture, utilization and storage deployment. In realizing this goal, it is expected that some economic sectors, facilities, institutions and other sources of GHG emissions that are difficult to eliminate entirely would continue to emit some GHGs, but at levels much lower than current rates and thus could be balanced by negative emissions elsewhere in the economy." [8, p.3]

power, wind and solar.[16] Despite previous reductions, electricity generation is Canada's fourth-largest source of emissions and accounted for approximately eight per cent of Canada's total emissions in 2019.[8] Electricity demand is predicted to increase throughout the country as various parts of the economy switch from carbon-based fuels to electricity, which could see electricity generation more than double over the next few decades.[17] This will affect energy use throughout society, particularly in the residential sector, which is also expected to have increased cooling demand. Figures 1 and 2 show residential electricity consumption for each province and territory in Canada as well as per capita consumption, all of which are likely to increase.

Current energy systems are well-established but leave households facing challenges that influence their potential to be vulnerable to energy poverty. Broad and macro factors that influence vulnerability include energy pricing policies and poor energy infrastructure, whereas others go beyond these to social practices, energy needs and socio-economics and demographics. These include, for example, gender, income, education, employment, tenancy, (dis) ability and/or race/ethnicity (though not exclusively).[18-22] "Vulnerability" can be probabilistic and thus changing circumstances can influence the probability of people being faced with (or lifting out of) energy poverty,[23] with the extent and/or severity of it being worsened if those who may be vulnerable are not adequately protected.[24] Policy responses and initiatives that mitigate energy-related vulnerabilities and help end energy poverty are therefore critical.

The scope of the necessary energy transformation and the knowledge of inequalities embedded in current energy systems are driving increasing recognition that the energy transition must be equitable. The development of clean electricity regulations coincides with emphasis by the global community to address the United Nations Sustainable Development Goals, and specifically Goal 7 of Affordable and Clean Energy: "Ensure access to affordable, reliable, sustainable and modern energy for all".[25, p.n/a] This relates to the concept of a "right to energy" that considers access to affordable, reliable and sustainable energy as a key component for human development. [26, 27] Affordable and clean energy is not only a concern in the Global South but also for Global North countries, including Canada, where energy poverty exists. Canada is developing its own strategy for implementing the SDGs, including SDG7.[28] The clean electricity regulations could complement and have impacts across the policy areas of climate, energy and sustainable development goals, helping move Canada to a clean, equitable and just energy transition that the Government of Canada has highlighted "leaves no one behind".[29]

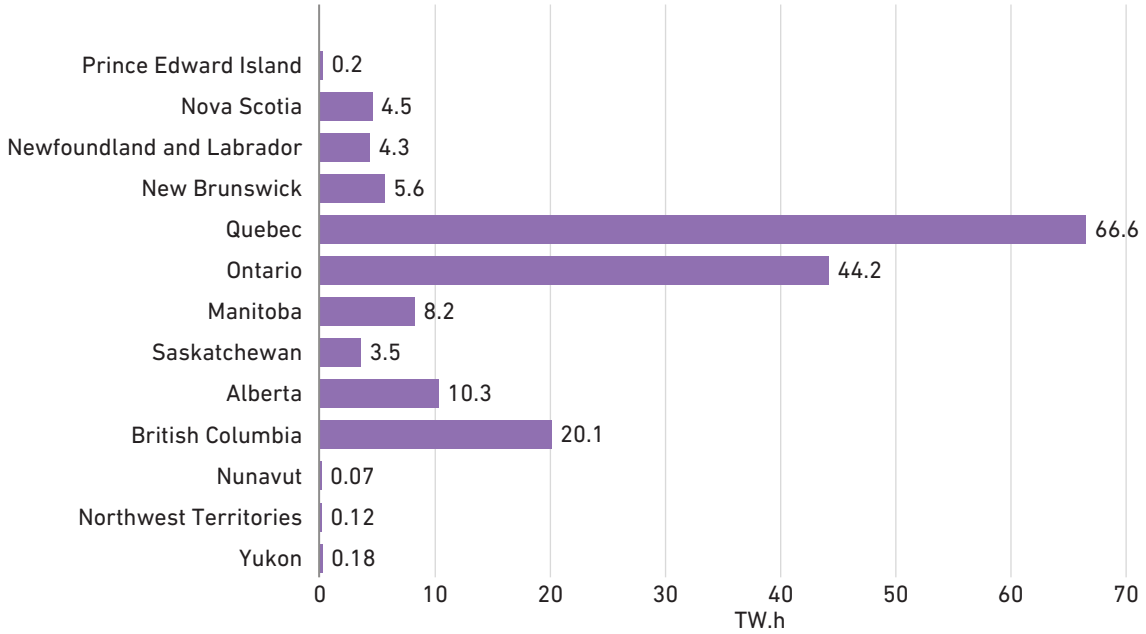

Figure 1. Residential electricity consumption in 2017

Source: Canada Energy Regulator, 2021.[30]

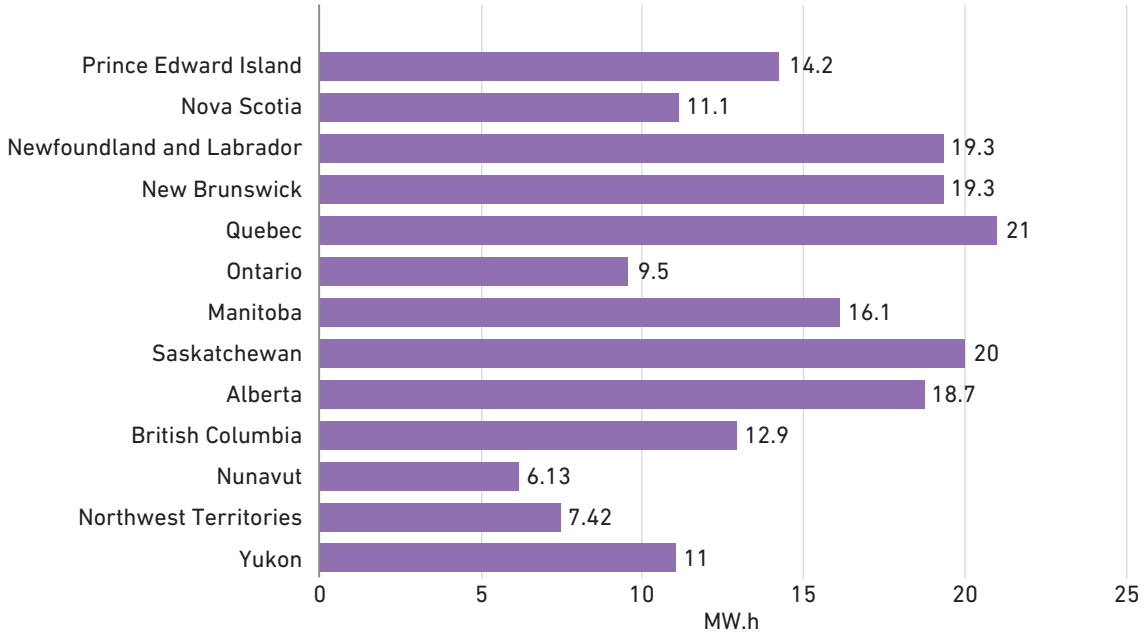

Figure 2. Electricity consumption per capita in 2017

Source: Canada Energy Regulator, 2021.[30]

3. ENERGY POVERTY

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WHAT IS ENERGY POVERTY

Energy poverty[ii] occurs when households have difficulty or cannot attain necessary and adequate home energy services such as space and water heating, cooling, lighting and use of appliances.[19] It is officially recognized as a form of deprivation worldwide[31] and is estimated to affect more than one billion households.[32, 33] Many countries use the original U.K. definition of household energy poverty as having to spend more than 10 per cent of household income to maintain comfortable home temperatures.[34] This is also known as an energy burden.[35, 36] High energy burdens are usually due to a combination of high energy prices, low household income and poor home energy efficiency. These have often been considered as the main issues related to energy poverty. However, energy expenditure indicators have been challenged, as energy poverty is now understood as a multidimensional and complex issue, caused by various factors. These can include housing and tenancy arrangements, family situations, ethnicity, culture, customs, shared conventions and geography (e.g.[20, 33, 37-41]). For example, in Hong Kong, there is a widespread housing practice of illegally subdividing apartments to meet affordable housing demands, which can result in overheating from overcrowding.[42] Residents in these homes are further affected by ambiguities that allow landlords to set energy prices at much higher rates than those set by utility companies.[42] There has been much focus in energy poverty

ii This report uses the term "energy poverty" but there is interchangeability in the use of this terminology. Historically, "energy poverty" has been used in reference to energy access, mainly in the Global South or less industrialized countries. The term "fuel poverty," which is mainly used in the U.K., has been more focused on the combination of high energy costs, low household income and inefficient housing stock.[34] Increasingly, "energy poverty" is understood to also refer to fuel poverty.

research and policy on keeping homes warm and avoiding "excess winter deaths" (e.g., [43]), but increasing evidence is showing it's important to also consider home cooling (e.g., [44]), particularly in a changing climate with more frequent heat waves. In the U.S., energy poverty has largely been conceptualized as "energy insecurity" and draws on indicators such as the inability to pay energy bills and disconnection from energy services.[45-47] Overall, energy burdens are often thought to affect a household's ability to be energy secure, which can then lead to conditions of energy poverty.[48]

Table 1. Summary of main energy poverty concepts

Concepts	Definition
Energy poverty	Lack of necessary and adequate home energy services
Energy security	Uninterrupted energy service availability
Energy burden	Percentage of household income spent on energy service costs

Many countries, like Canada, still lack a formal definition of energy poverty but recognize it in some way.[49] While several energy poverty indicators are used across the EU where energy poverty is widely acknowledged,[50] definitions of "energy poverty" and "vulnerable consumers" differ across the 27 EU member states. Those considered to be "vulnerable" consumers might not be considered "energy vulnerable" per se. They may, however, be considered at risk of facing energy poverty, with many countries identifying such groups through their social services systems.[51] Definitions of vulnerability across these nations consider factors that are known to affect people's quality of life and life chances more generally, such as age, ethnicity, health, housing tenure and income.

THE IMPACTS OF ENERGY POVERTY

Exposure to energy poverty can have damaging effects, affecting people's mental and physical health, stress levels, emotional resiliency and social relationships.[52-54] A Canadian study found that exposure to energy poverty increases the odds of adults reporting poorer general health and mental health.[55] Some of these effects arise from inadequate energy services while some arise from a household being forced to choose between paying energy bills and buying food or medicine or paying the rent or buying clothing. Living without essential energy services can make chronic health conditions, such as arthritis and rheumatism, worse and increase the risk for respiratory and cardiovascular diseases and mortality from these diseases.[36, 56-60] Experiencing energy poverty can change over time,[23] and people can experience differing degrees and types of vulnerability throughout life, such as moving in and out of energy poverty, coping with health conditions, housing insecurity, aging, etc. Hence, it is important to identify and understand the factors that cause people to be vulnerable to energy poverty, and the conditions that transform someone from being *at risk* of experiencing energy poverty, to *fully being* in

energy poverty.[61, 62] This has implications regarding *when* energy vulnerability increases the chances of entering energy poverty, *what* the sensitivity of that household is to the impacts of energy poverty and *how* that household can cope with experiences of energy poverty.[62]

HOW TO ADDRESS ENERGY POVERTY

Energy poverty mitigation has become an international priority area. The United States instituted its Weatherization Assistance Program in 1976 to address energy poverty arising from the 1973 oil crisis. More recently, following U.K.-based research, this challenge is on the agendas of many countries such as Austria, Australia, France, Germany, Greece, Hungary, Italy, New Zealand, Ukraine, the UK and, again, the U.S. (e.g.,[9, 43, 63-71]). Many of these countries have sought to conceptualize and define energy poverty, provide evidence on its impacts and identify what initiatives and policies can address it.

Along with being the first country to *define* energy poverty, the U.K. is also one of the first to *address* energy poverty via specific energy poverty programs that have provided home energy efficiency measures or additional payments to certain vulnerable groups (see Section 5.1 for a case study on the U.K.). While Northern Ireland, Wales and Scotland still use the 10 per cent energy poverty indicator, the central U.K. government updated this in its Fuel Poverty Strategy in 2015 to a "low income, high cost" metric (given the 10 per cent indicator can be sensitive to changes in domestic prices, making it difficult to track the impact of energy efficiency measures). The LIHC identifies a household to be in fuel poverty if it has an income lower and fuel costs higher than average.[72] The LIHC has nevertheless been criticized for underplaying the impact of changing energy prices and focusing mostly on energy efficiency.[73] More recently, the "low income, low energy efficiency" metric has been proposed to resolve the issues of both cost and energy efficiency, so that low-income households that experience high costs and live in inefficient homes are considered to be in energy poverty.[72] The U.K. also provides a "winter fuel payment" to help households with their heating bills.[74] Despite efforts to develop indicators and subsequent measures, an estimated 6.5 million U.K. households were in energy poverty in April 2022,[75] partly following an energy price cap lift in April 2022 (with a further lift coming in October 2022) but also partly due to lack of continued policy support.

Throughout the European Union, responses to energy poverty have been guided by the principle of subsidiarity, with the European Commission focusing on "vulnerable consumers" in regulated markets.[24, 51, 76] Half of the EU member states provide financial assistance as part of their general welfare support, while the remainder target energy or heating payments.[77] In some countries, overlap exists, such as in Denmark and the Netherlands.[76] Social tariffs provide a special pricing, often below the market price, to certain consumers to ensure energy prices are affordable, covering electricity, gas or both. These are being phased out due to market liberalization, but remain important in Belgium, Cyprus, Greece, Portugal, Romania and Spain.[77] Although most member states have some type of prohibition in place as per EU legislation, such as not permitting disconnections during the winter, almost a third do not provide specific protection for vulnerable consumers.[76]

In the U.S., responses to energy poverty include the long-time federal Low-Income Home Energy Assistance Program and Weatherization Assistance Program, as well as other state-level low-income energy assistance and energy efficiency programs.[72] LIHEAP provides low-income households assistance with their heating and cooling energy costs, bill payments, energy crises, weatherization and energy-related home repairs, with eligibility depending on annual household income and household size. Households with members who participate in other benefit programs may also be eligible.[78] WAP is the largest and longest-running energy efficiency program in the U.S. Households at or below 200 per cent of the U.S. poverty income guidelines are considered eligible, as well as those receiving supplemental security income or aid for families with dependent children.[79] After decades of energy efficiency programs and targeted policies, the average low-income household in the U.S. still spends a disproportionately large percentage of its income on energy bills.[80] In addition to energy assistance programs, several U.S. jurisdictions are adapting to climate change and considering cooling protections. Dallas requires cooling equipment in rental units[81] and Oregon passed a bill that limits the restrictions landlords can place on portable cooling devices.[82] In California, a bill is currently in the state legislature that would require landlords to maintain a safe indoor temperature.[83]

In Canada most low-income energy efficiency programs are administered by utilities or government departments at the provincial level, with almost all provinces participating.[84] These vary in their delivery strategies, energy savings measures and target markets. Kantamneni and Haley[84] estimate 55,000 Canadian households participate in these programs in a given year. Efficiency Canada notes two strengths with these programs: several low-income programs successfully engage a large number of low-income households with energy efficiency, and program administrators have amassed "deep institutional knowledge" through years of experience with program design, outreach and delivery. However, Efficiency Canada notes several gaps. Few programs target households that are experiencing high energy burdens, people living in the least efficient homes and/or households that face the additional challenges of language barriers or needing additional assistance to navigate available supports. Problematically, depth of savings achieved per household needs to increase to meet net-zero targets and, related, energy efficient heating and/or cooling systems are not widespread features of these programs. Importantly, households that require structural or remedial upgrades (such as mould removal) face barriers to energy efficiency programs because program administrators usually do not have mandates to address non-energy health and safety measures.[84] In their study of 40 energy poverty initiatives in Ontario, Das et al.[85] found that several of these are geared toward energy efficiency and savings; however, most do not appear to target households that could benefit the most from such measures. Additionally, decision-makers in this jurisdiction took several actions that are of concern for vulnerable populations, such as bringing the SHAIP retrofit program geared to social housing to a premature end due to loss of funding.[85]

It is worth highlighting that federal governments in other jurisdictions are taking on greater leadership roles in mitigating and addressing energy poverty, such as through development of energy poverty indicators, measures and strategies, but in Canada, similar efforts are lacking. Measuring energy poverty can be challenging given that the experience of energy poverty can

be "hidden" and highly variable. "This is compounded by the limited availability of appropriate data and indicators, and lack of consensus on how energy poverty should be conceptualized and measured. Statistical indicators of energy poverty are important and necessary part of the research and policy landscape."[86, p.21] These are prevailing issues in Canada. There is significant lack of energy data, generally, and energy data at the household level is even more problematic. This gap needs to be tackled to mitigate and address energy poverty as well as further understanding of equitable household energy transitions in Canada.

ENERGY POVERTY IN THE CANADIAN CONTEXT

Home energy in Canada is mostly used for space heating (64%), water heating (18%), appliances (13%), lighting (3%) and space cooling (2%).[87] Space and water heating are mainly provided by fossil gas (though not everywhere), whereas electricity is the energy source for many other household activities.[88] Space heating and cooling are important for sufficient and comfortable indoor temperatures given the cold winters and hot summers in many parts of Canada. As Tardy and Lee[89, p.47] have highlighted, "beyond mere comfort, home heating in Canada is literally a matter of life and death." The 2021 summer heat dome in British Columbia, during which 619 people died[90] and the heat wave that hit Quebec in 2018 contributing to 86 deaths[91] show that cooling is also becoming increasingly important. People living in urban centres in old high-rise buildings with no air conditioning are especially vulnerable in the face of extreme heat.[92] For example, in the City of Toronto, approximately 500,000 people (about 15 per cent of the population) live in apartments without air conditioning.[93] In the Montreal heatwave, 78 per cent of fatalities occurred in homes and apartments that had no air conditioning.[91] In addition to energy transition, decarbonization and a shifting electricity landscape, the changing climate will make using electricity for cooling more important and, in many cases, necessary. Building practices can "insulate" householders from excessive heat and cold, while improving comfort. Moreover, building codes that lead to better insulated and sealed homes are key to ensuring that less energy will be used overall for space heating and cooling.

The challenge of energy poverty has been raised previously in Canada among various stakeholders, including various levels of government; legal aid; frontline emergency service providers; and environmental, anti-poverty and affordable housing advocacy groups. The term was applied early on in government documents, such as in a 2008 federal document of the now defunct Energy Efficiency Working Group, which was established through the former Energy Sector Sustainability Table created by the Government of Canada.[94] The ESST consisted of industry, government and civil society experts to advise on ways to improve the environmental and economic sustainability of Canadian energy systems, and energy efficiency was key.[94] Similarly, early investigations at Canadian research institutes emphasized the prevalence of health issues linked to energy poverty and the benefits of energy efficiency programming for low-income households.[95, 96] Consumer protections, such as equal payment plans, arrears payment agreements and legislated processes for disconnection notices have made some advancements, with most notable developments in Ontario due to the Low-Income Energy Network.[97] However,

there is no federal strategy for Canada's 1.6 million low-income homeowners and 2.2 million low-income renters in private market housing that could benefit from support for energy efficiency.[98] Reports from 2007 and 2009[99-101] also provide insights on energy poverty through the lens of residential energy security and Nova Scotia's vulnerability, specifically, to the availability of regular energy supply at an affordable price. Hughes[100] also presents recommendations on responses for heating emergencies across Canadian jurisdictions.

There is renewed interest in energy poverty in Canada, as evidenced by increasing media coverage (e.g., [102-107]), as well as attention from notable stakeholders focused on Canadian environmental and energy issues: the Canada Energy Regulator,[108] Natural Resources Canada,[87] the Environmental Commissioner of Ontario,[109, 110] the Canadian Urban Sustainability Practitioners network[111] and Efficiency Canada.[112]

The limited energy poverty–related research in Canada has mostly focused on the built environment;[89] energy planning and access in two First Nations in B.C.;[113, 114] electricity infrastructure and demand in remote communities;[115] energy transitions;[116, 117] and research and knowledge mobilization for more public audiences.[95, 96, 118] Additionally, research has found that increases in household heating prices have previously contributed to food insecurity in Canada and consequently to the phenomenon of "heat or eat".[119] Ecotrust Canada notes that "utility shut-off policies represent the essence of energy poverty".[120, p.12] The Canada Energy Regulator — a governmental body that advises on energy markets, supply and technologies and regulates pipelines, electricity transmission across provincial borders and energy trade with other countries — has adapted the following definition for energy poverty: "a household may be described as experiencing fuel poverty[iii] when it spends more than 10% of its income on utilities".[30] Using data from 2015, the Canada Energy Regulator estimates eight per cent of Canadian households experienced energy poverty in 2015.[30]

Since the Canada Energy Regulator's reporting, we have analyzed data from Canada's 2016 Survey of Household Spending to look more closely at energy burdens experienced by households in Canada as reported in Das et al.[121] Our proxy measure of energy poverty is based on an expenditures approach that takes into account household energy costs against a threshold to provide an estimate of an energy burden. We used a threshold of 10 per cent so that those spending more than 10 per cent of their income on home energy expenditures are considered to be in energy poverty. We also adjusted for housing costs. Details on our methodology can be found in Appendix 1.

We found approximately seven per cent of Canadian households (close to 900,000) spent more than 10 per cent of their incomes on energy expenditures in 2016, with low income, geography and dwelling conditions being the main predictors of energy poverty. When accounting for housing costs, energy poverty in each province increased, bringing national energy poverty to nine per

iii We use the term "energy poverty" throughout (unless referring to specific works), and as it is generally used in Canada. The Canada Energy Regulator first published its "Market Snapshot: Fuel poverty across Canada — lower energy efficiency in lower income households" in 2017. Since then, the term has become more widely used in Canadian discourse and research.

cent (1.2 million households). As shown in Figure 3, energy poverty varied across the country, ranging from three per cent in Alberta to an average of 19 per cent in the Atlantic provinces (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador). When adjusting for housing costs, the number of households in energy poverty increased in all provinces.

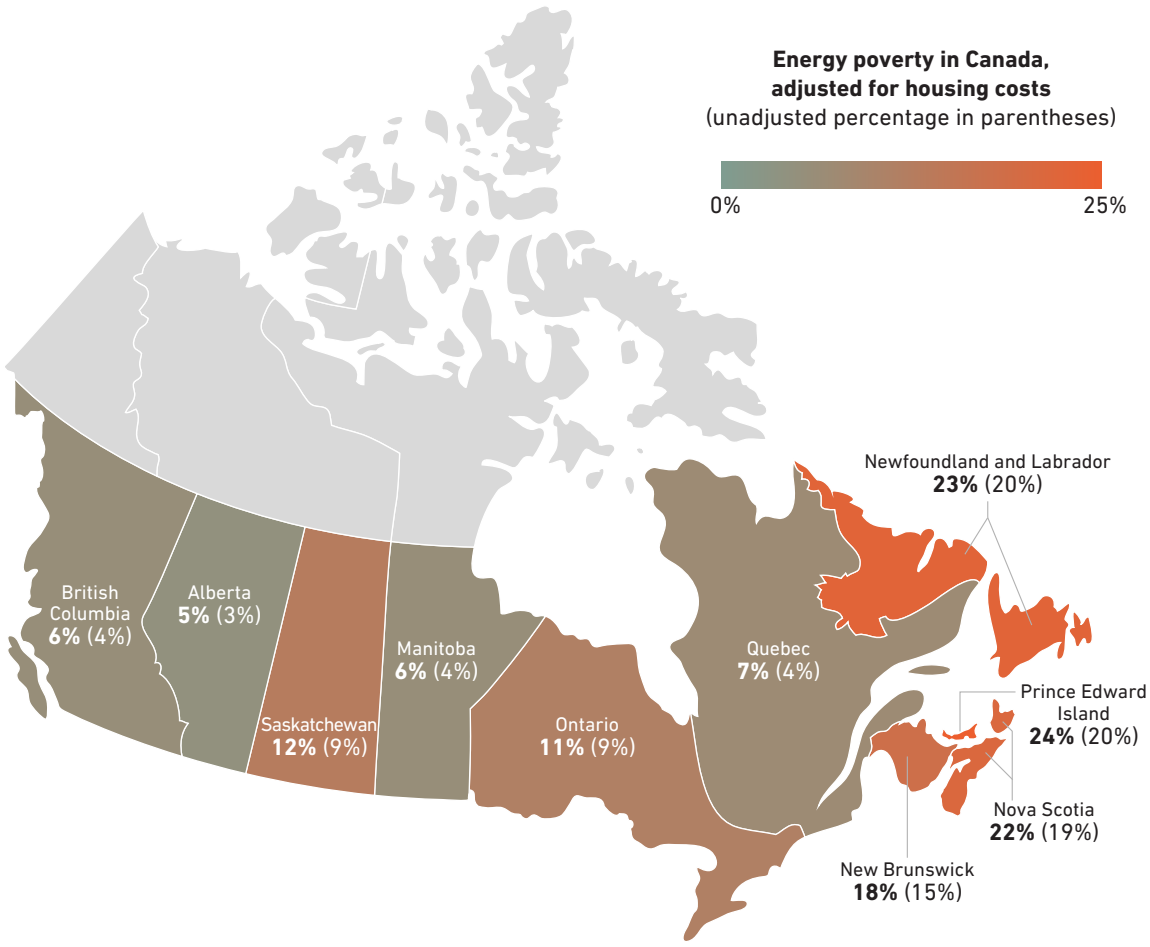

Figure 3. Rates of energy poverty in Canada's provinces.

Source: Adapted from Das, Martiskainen and Li, 2022.[121]

As noted, income-related variables were the most significant predictors of energy poverty, with households in energy poverty having lower levels of income. Median annual household income in Canada for those not in energy poverty was estimated to be $68,989, whereas for those in energy poverty it was $22,407. The major source of income for all Canadians was employment, while the majority of households in energy poverty received government transfer payments. The majority of Canadian households own rather than rent their homes. However, the split is wider among households in energy poverty with even more of households in energy poverty owning their homes. Notably, households in energy poverty spent nearly double the Canadian average on major health care equipment, and spent less on private vehicle and public transit costs compared to households not in energy poverty.

Our estimates indicate households in energy poverty spend roughly $3,600 annually on home energy. In contrast, households not in energy poverty spend roughly $1,800 per year. Higher costs can be related to higher home maintenance costs.[122, 123] As shown in other research, dwelling conditions and energy inefficiency — gauged via dwelling age and repair requirements — are associated with higher levels of energy poverty (e.g., [89]). Of the households in energy poverty, 66 per cent reported homes constructed prior to 1980 (compared to 55 per cent of those not in energy poverty), and 39 per cent reported that their homes needed major or minor repairs (average for those not in energy poverty was 30 per cent).

We also found that geography matters. Those living in the Atlantic provinces, where spending on energy is higher, are substantially at higher risk of being in energy poverty than households in other provinces. Notably, on average, home energy expenditures were highest in the Atlantic provinces where electricity, oil and wood are often used for heating, and single detached dwellings are the dominant form of housing. Further, of those considered to be in energy poverty, 24 per cent reported living in a rural area compared to 10 per cent of all Canadians who live in rural areas. Household energy poverty appears to be more likely among those who own homes, but the homes are often older, single detached and in more need of repair. These types of homes are also likely to be in more rural areas. More detailed figures on these findings are in Tables 3 and 4 in Appendix 1.

We note that similar trends have been observed by Riva et al.[124] for the 10 per cent indicator using data from the 2017 SHS. In addition to using the 10 per cent indicator, Riva et al. estimated energy poverty using the 2M measure in which households spending more than twice the national median share on energy costs are considered to be in energy poverty (the national median share is three per cent; therefore, households spending greater than six per cent are considered to be in energy poverty) and found energy poverty estimates to be much higher (18 and 19 per cent, before and after housing costs, respectively) in comparison to estimates using the 10 per cent measure. In the U.S., energy poverty is generally considered to mean spending more than six per cent of income on energy bills,[35] although the 10 per cent threshold is also used (e.g., [125]). Additionally, several practitioner organizations in Canada use the six per cent measure (e.g., Affordable Energy Coalition).

Das et al.[121] note critical findings by specifically examining the relationship between a household's budget share on energy expenditures and household income. First, households in energy poverty spent a greater share of their household budget on energy services (almost five times more) than households not in energy poverty. Second, for those in energy poverty, spending on energy services as a proportion of total spending increased proportionally with increases in household income. In contrast, for those not in energy poverty, the budget share on energy expenses is relatively stable across all levels of income. These findings strongly suggest that some households in Canada are struggling and doing without adequate energy. That is, given that some households increase their spending on energy services when they do experience an increase in their disposable income points to households doing without adequate levels of energy services before the income increase. Even more, it is possible that our analysis did not capture hidden energy poverty. That is, households that struggle and limit their energy expenditures to

the degree that they cannot or do not spend more than 10 per cent of their income on energy expenditures. Details of this analysis can be found in Appendix 1 Engel Curve Figure 7.

With the introduction of clean electricity regulations and the transition to electrification, many households will increase their electricity use as they decarbonize and adapt to climate change. We therefore used data from the 2017 cycle of the SHS using Statistics Canada's Public Use Microdata Files Collection focusing on household spending on electricity; more on the data and methodology is described in Appendix 2.

Our findings, based on analysis of the Statistics Canada 2017 PUMF file,[iv] show annual household median spending on home electricity in Canada was approximately $1,164. Spending was highest in the Atlantic provinces ($1,668) and lowest in B.C. ($828) and Manitoba ($960). These figures reflect a combination of (interrelated) factors that vary by province or territory and/or household: the energy mix of provinces and territories; electricity prices; climate; heating equipment type; dwelling energy efficiency levels; dwelling size and insulation levels. These factors along with projected increased demand are important to consider in the clean electricity transition.

As shown in Figure 4, there was considerable variation in spending by income quintile, and this was consistent across provinces and territories (Figure 5). Households in the higher income quintiles spent more than households in the lower quintiles, and this is consistent across provinces.

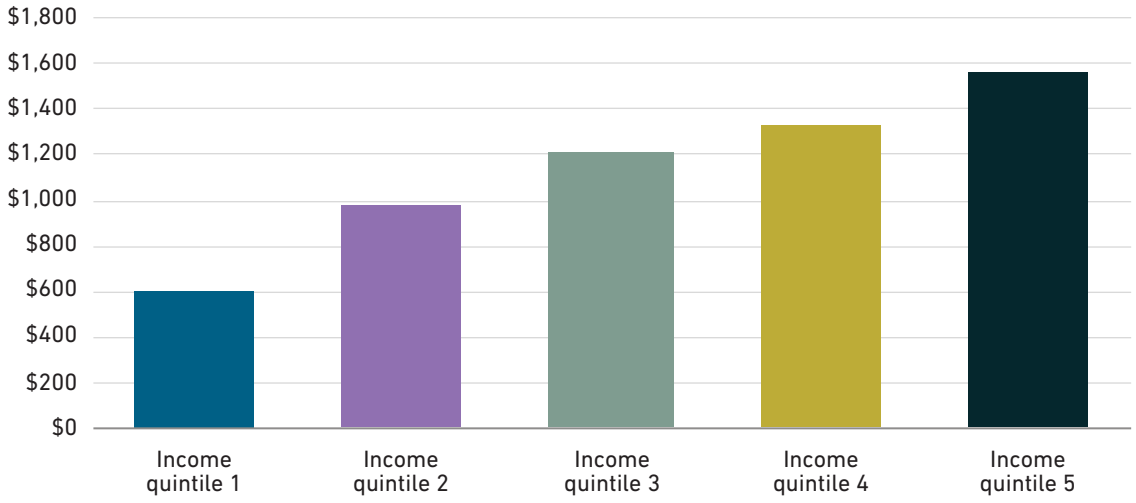

Figure 4. Annual median household spending on electricity by income quintile in Canada

Source: 2017 Survey of Household Spending PUMF.

iv These are preliminary results and have not undergone academic peer review.

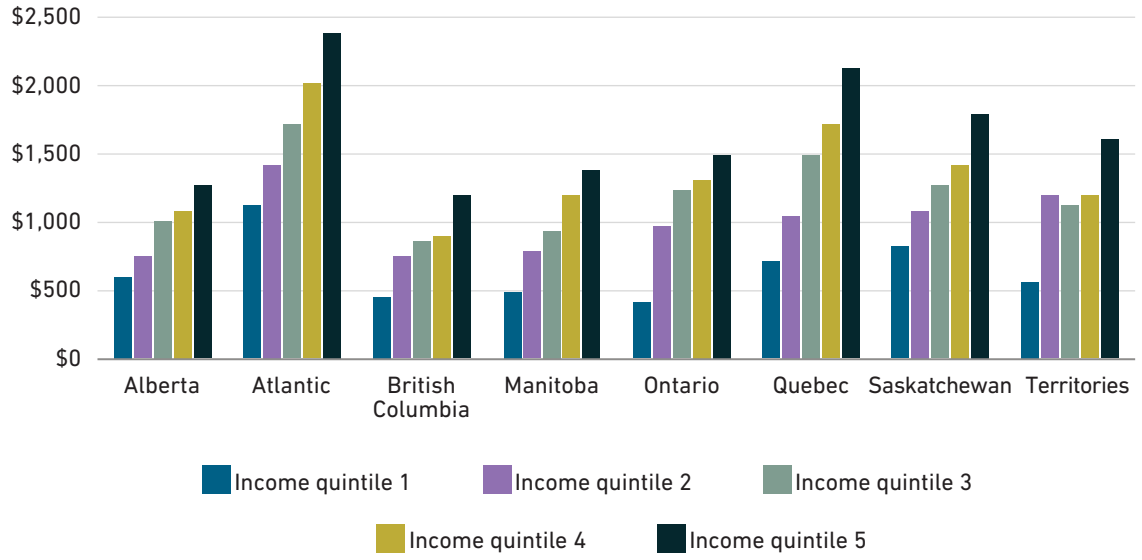

Figure 5. Annual median household spending on electricity by income quintile by province

Source: 2017 Survey of Household Spending PUMF.

The data show that in 2017 annual median spending on energy (which included electricity *and* other fuels) was approximately $1,900 in Canada, and was highest in Atlantic Canada, which is similar to what we found in Das et al. 2022[121] using a different survey cycle. Spending also varied by income quintile as shown in Figure 6, with households in the bottom quintile spending a larger share of their household income on annual energy expenditures, on average, compared to those in the highest quintile. Additional figures can be found in Appendix 2. Based on income alone, households in the bottom income quintile are spending just over twice as much of their household income on their energy compared to households in the top quintile. We note this "appears" to contrast with our finding that households in energy poverty spent almost five times more of their household budget on energy services than households not in energy poverty.[121] This is because energy poverty is predicted by factors such as energy efficiency and geography (in addition to income) and therefore households that may have to spend more than 10 per cent of income on energy services ***may be affected by factors other than*** low income. Therefore both findings hold.

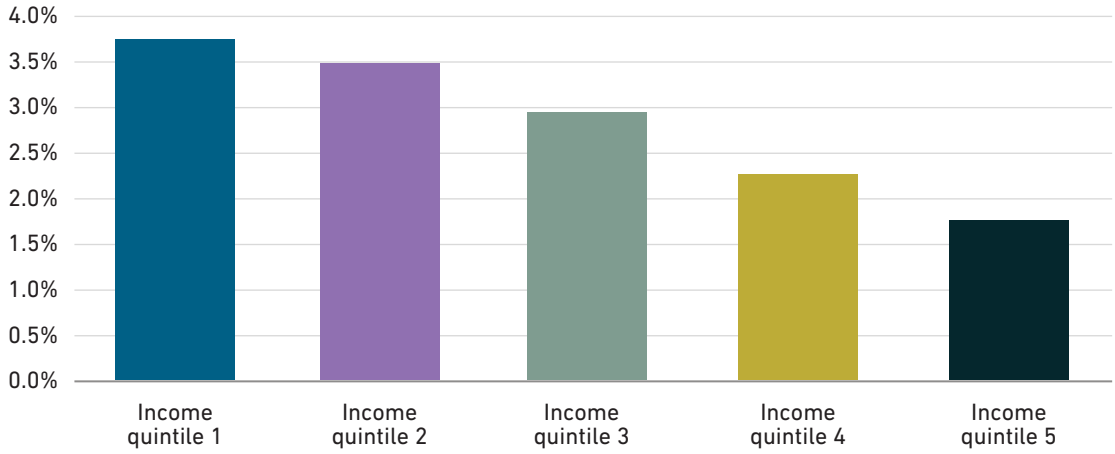

Figure 6. Proportion of household income spent on energy expenditures by income quintile

Source: 2017 Survey of Household Spending PUMF.

LIVED EXPERIENCES OF ENERGY POVERTY

In Canada, many households are struggling with accessing and affording energy and the services it provides. Some are reluctant to open their energy bills for fear of what is inside; others huddle under comforters to stay warm in the wintertime cold. Tenants who do not have to pay for utilities are nevertheless vulnerable. They may lack control over their apartment temperature settings, suffering from excessive heat or cold. They may feel trapped by the high energy prices they would encounter were they to move: to remain in rental contracts in which utilities are included, they put up with tenancy situations that are otherwise undesirable or even abusive. Human beings cannot survive — let alone participate in society — without the services energy provides. Chasing after those services, or coping with their inadequacy, puts an enormous strain on the mental and physical health of people in Canada and on their ability to create meaningful lives for themselves. One of the authors has spent time with some of the households experiencing energy poverty in Canada. Using pseudonyms, we share some of their experiences through their voices.

> We use the gas 'cos it's part of our strata fees and we just kind of like stay in one room, we'll heat one room where the fireplace is. We'll stay in that room and we won't really use the bedrooms if it's cold. We just make sure we dress warm and just have lots of blankets and things like that. This'll be our third winter, coming up here in there, and we used to have two air conditioners too, one for each bedroom, but we got rid of one, because it was costing us way too much electricity, so we just put one in the kids' room. So the kids are fine and sometimes if it's like a really hot night or something, we'll just go sleep... all sleep in the kids' room. So we literally have to section off areas of our house where there's no heat.
> *– Mohammed*

> …I don't like bringing my friends over here, it's very rare that I bring anybody over here. I'm really like embarrassed, unless it's evening and it's like kinda dark and then they can't see anything really, and then they're like, oh it's so nice in here, we should come more often. It's like, no. So. But yeah, no, it… you know, it'd be nice to have like movie night and stuff, but I worry because there is mould and I've had, like I've had like some lung issues before.
> – *Sarah*

> I read it, I just to look at what it's, like $200, you know, a month. And then more, 'cos actually really I don't pay very close attention. I'm afraid to, you know that's like, you know when you're afraid to look at your bills, you're just, no okay… paycheque has come in, and okay, this this this, paid, and then go.
> – *Matthew*

> Winter you always, you know, I'm trying to manage with blankets, you know? When it's very cold. For sure the most problem comes when we are going to sleep, because it's very cold, it's very hard so just trying to wear socks on your feet, get more blankets for covering, and managing in a way, you know?
> – *Shruti*

4. ENERGY JUSTICE AS AN APPROACH FOR DELIVERING A PEOPLE-FOCUSED ENERGY TRANSITION

PHOTO Anatoliy Gleb, Adobe Stock

ENERGY JUSTICE

Calls have been made for energy transitions to be equitable, so that they do not cause unnecessary burden or enforce pre-existing inequalities with "winners and losers".[7, 126] A "just transition" approach was initially developed to ensure that workers' rights and livelihoods were protected in energy transitions, when, for example, old energy infrastructure such as coal mines were being phased out. However, a just transition is increasingly understood as a concept that also helps ensure the move to new net-zero systems does not cause further inequalities, or worsen the situation of those who may be currently vulnerable (e.g., [127]), whatever their role or position in the energy system.

Energy justice has been discussed since the 1980s and is increasingly being used in academic inquiries, with calls for its application in policy as an approach to not only examining the justice outcomes of energy transitions, but also for designing energy transitions that benefit everyone.[128, 129] Energy justice is a concept that has close connections to climate justice and environmental justice, though its particular focus is on energy systems, which often have complex resource, use and waste implications along the whole supply chain that go beyond their immediate local communities.[130] Energy justice is usually defined by the following five main areas of justice: 1) *distributive justice* addresses how social "goods" and "bads" are allocated and distributed across society and its members; 2) *procedural justice* deals with due process, participation and representativeness; 3) *recognition justice* helps to identify, support and guarantee representation for those who are the most vulnerable in society, and

whose situation could be made worse by developments such as low-carbon transitions; 4) *cosmopolitan justice* sees all humans as equals and being protected by moral values no matter what their origin, ethnicity, social status, gender, ability, etc.; and 5) *restorative justice* calls for the need to "make things right" for those people and communities that have been victims of harm, such as those that have been displaced by energy developments.[129, 131-134]

Given the importance of energy services in societies, the systems that provide these vital services ought to be ones that do not violate human rights, or increase pollution and emissions and subsequently worsen climate change.[129] Energy justice is now a core theme of the leading international scientific journal *Nature Energy* and of leading international research centres such as the U.K.-wide Centre for Research into Energy Demand Solutions[v]. Energy justice is also featured in the projects of the U.K. Energy Research Centre, which produces policy reports to inform on the challenges and opportunities with transition to net-zero.

OPPORTUNITIES FOR A CLEAN, JUST AND EQUITABLE ENERGY TRANSITION

As our previous sections have shown, people do not currently benefit in equal measures from energy systems. A good example in the Canadian context is that some energy users, such as private businesses, are being offered low-carbon services and products more than other users such as low-income households and renters, thus perpetuating inequities.[135] Many Indigenous communities have been displaced for large-scale hydroelectricity developments; others are still not connected to the main power grids — a clear energy justice issue.[136] In addition, Canada has made a lot of money from fossil fuel investments and exports, with most going to resource industry shareholders. Meanwhile, many workers in the industry need to rely on short-term work, and many could be displaced in the energy transition. Increasingly, policy-makers are recognizing that a successful net-zero transition needs to have everyone on board, and must in particular secure opportunities for those who are not benefitting equally in today's energy system. As in many other countries, Canada is working toward a just transition[vi] and the Government of Canada launched a just transition engagement in July 2021 to ensure that "the low-carbon transition is just and equitable so that equity-deserving groups — such as women, Indigenous Peoples, racialized individuals, people with disabilities and youth — are able to benefit from new jobs and opportunities".[136] Canada has committed to developing legislation that enables a "people-centred just transition".[29] Energy justice approaches can help inform key questions about what type of energy systems will be used in the net-zero society, and on which moral values those systems will be based. Energy justice as a policy approach could help ensure that Canada's transition is indeed people-centred, where the new net-zero energy system and the services it provides not only meet climate goals, but also protect rights, and create opportunities for everyone.

v See https://www.creds.ac.uk/fair/ for more on developing energy poverty projects using equity and justice.

vi For more information, see: https://www.rncanengagenrcan.ca/en/collections/just-transition

5. CASE STUDIES: CHALLENGES AND LESSONS LEARNED FROM EXAMPLES OF DECARBONIZATION

PHOTO David Dodge

We provide below some case studies that have energy justice implications, acting as illustrative examples of some of the challenges linked to addressing energy poverty and developing just and equitable energy transitions.

ADDRESSING ENERGY POVERTY VIA THE WARM FRONT PROGRAMME, U.K.

Summary: The Warm Front scheme was one the largest programs addressing energy poverty, running between 2000 and 2013 in the U.K. It provided 2.85 million different measures at an expenditure of £3.23 billion.[137, 138] The program helped 2.36 million vulnerable households — at the time the U.K. government targeted support for those in receipt of certain welfare benefits such as income support, unemployment benefits, pension credits, childcare support or disability support — including those who were in energy poverty.[137, 138] Both those who privately owned or rented their homes were eligible for grants up to £1,500 to £2,500 in 2001.[137] The scheme was later adjusted in 2010 following a review on government spending, and "from 2011 to 2012 households had to be in receipt of income-related benefits *and* be living in a thermally inefficient home *and/or* not have a working central heating system".[137, p.363] While the level of grants increased to up to £3,500, or £6,000 for oil central heating replacements, the funding level for the program over time dropped.[137] The scheme provided energy efficiency measures, such as insulation and draft-proofing and improved heating installations, resulting in better thermal comfort and improved public health.[137]

Drivers: The U.K. has one of the longest established actions on tackling energy poverty. In 1999, an inter-ministerial group on fuel poverty was created to develop a fuel poverty strategy and address low incomes, cost of energy and poor energy inefficiency, identified as the main causes of fuel poverty in the U.K. at the time.[139] A year later, the *Warm Homes and Energy Conservation Act 2000* established a target to end fuel poverty within 15 years of being legislated. This included the legal commitment to produce a strategy, resulting in the Warm Front Home Energy Efficiency Scheme.[140] The aim of the scheme was to help, in particular, the energy efficiency of homes for those on the lowest of incomes and who were vulnerable, so that they would not risk ill health due to cold homes.[139]

Benefits: Measures under the program included energy efficiency improvements such as installing loft and cavity wall insulation and hot water tank jackets, and draught-proofing, as well as heating system installations such as replacing old gas boilers with more efficient ones, installing new gas central heating and undertaking other heating repairs. The Warm Front scheme reportedly helped both those in energy poverty and those who may have been at risk of energy poverty had they not been part of the scheme.[138] With increased energy efficiency measures, homes were made more comfortable as beneficiaries had, for example, better warmth and hot water at home that they were also able to control better.[139] People also reported improved physical and mental health and overall well-being.[139] Gilbertson et al.,[141, p.122] for example, found that "higher temperatures, satisfaction with the heating system, greater thermal comfort, reductions in fuel poverty and lower stress were significantly correlated with improved health" among those who benefited from the scheme.

Challenges: The Warm Front scheme did not meet all the targets set out for it,[137] and it was criticized for reduced levels of funding during the program, which then affected the number of households that benefited from the scheme (11 per cent of all households in England).[138] Despite pledges by the U.K. government to end energy poverty, the issue persists, partly due to lack of consistent policy[142] to overhaul housing stock, which is one of the oldest and most inefficient,[143] but also due to the lack of addressing systemic inequalities that cause energy poverty. For example, the Energy Company Obligation, which replaced the Warm Front in 2013, has not eradicated energy poverty. Following energy price rises during 2022,[vii] [144, 145] an estimated 6.5 million households were facing energy poverty in the U.K.[75] While the government offered one-off payments to help with bills,[142] more targeted policy is needed to reform the energy market, improve the housing stock and reduce inequality to increase resilience to energy poverty.

vii The U.K. Office of Gas and Electricity Markets (Ofgem) lifted an energy price cap — i.e., limits to how much utilities can charge customers — in April 2022, which meant a 54 per cent rise in energy prices, with the average annual energy bill increasing by almost £700.[145] A further rise to the price cap is planned for October 2022 and average U.K. annual energy bill could rise to £3,300.[144]

DECARBONIZING HOUSEHOLD HEATING, FINLAND

Summary: Finland has one of the highest numbers of heat pumps sold per capita, with the country of 5.5 million people and three million households having sold over 1.2 million heat pumps.[146] Heat pumps accounted for approximately 9.5 per cent of household energy consumption in 2020.[147] In July 2022, the European Heat Pump Association reported that 44.01 heat pumps per 1,000 households were installed in Finland during 2021[148, 149] Backed by long-term policies that have supported a move away from fossil fuel and combustion-based heating, heat pumps have become a popular choice for Finnish households and are increasingly used also for cooling during the short, yet increasingly hot, summers.

Drivers: The main motives for heat pumps have been consistent policies that have backed a move away from fossil fuel and combustion-based heating options since the early 2000s.[150] Finland also has a social policy in place that "secures the right of all citizens to basic necessities such as energy".[151, p. 78] The Finnish social support system guarantees a minimum income for everyone, and therefore it does not have separate energy poverty measures in place, but more general subsidies targeting housing expenditure (e.g., housing allowance) and basic needs (e.g., social support) are seen to aid also with energy costs.[151] Finland has had an effective heat pump association, SULPU, which has undertaken active lobbying since 1990s to get heat pumps to the Finnish market via policy support, following examples from neighbouring Sweden.[152] Phasing out oil-based domestic heating, in particular, has been supported by grants and tax breaks; for example, households have had subsidies such as tax breaks on heat pump purchase loans and installation costs.[152] One of the support mechanisms is a tax credit for general household expenses, which enables households to claim credit for up to 40 per cent of total costs of various works and services undertaken in their home.[153] Eligible services include, for example, child care costs, cleaning services, home renovations, various installations such as heat pumps and general maintenance works. For example, in 2021, the maximum claim households were able to make was a total of €2,250 per person (€100 is paid by the householder first).[153] This tax credit was first introduced in 1997 and has been widely used for home installations such as heat pumps and their maintenance costs. Previous research in Finland has shown that the rise in heat pump popularity has been partly influenced by online user communities, where people shared their early experience of heat pump use, including tips on how to "tinker" certain models for Nordic conditions, and also "police" certain installers or manufacturers for their services.[154] Ground source heat pumps have been popular particularly with those who live in detached houses and have the space for a GSHP system. They are also increasingly used in larger buildings such as apartment blocks, which are switching from municipality-owned district heating networks to owning their own GSHPs (for example, when large heating system maintenance works have been due or when district heating prices have risen).[155] Air source heat pumps are more versatile due to their smaller size and are increasingly installed also for cooling purposes; for example, in apartments that are not able to switch from district heating. They are also installed in holiday homes, such

as summer cottages, as remote-controlled ASHP systems allow households to control them remotely via mobile apps; they can also provide low-grade maintenance heating over winter months to avoid damage from freezing pipes.[156]

Benefits: Heat pumps enable a move away from fossil fuel and combustion-based heating sources, especially oil-based heating, reducing emissions and helping address climate change. They can also provide cooling in increasingly hot summers, which has an added health benefit to those who are at risk in high temperatures. When heat pumps have been installed in apartment blocks, residents have effectively taken ownership of a large part of their energy system and in some cases saved as much as 50 per cent on their heating costs.[155] This can provide better recognition and distributional justice as it enables residents to have more control over the system that supplies their energy services like heating, instead of it being tied to municipalities that have a near monopoly over district heating networks in some locations and can increase prices as they wish.

Challenges: In many homes, heat pumps have been installed alongside several other heating sources; for example, homes often have a heat pump, a fireplace and sometimes electric backup radiators. Wood burning has air quality implications, and therefore the ratio between fireplace use to heat pump use could have implications. The increasing use of heat pumps in holiday homes could lead to increased overall electricity consumption. Similarly, in a country with short summers, heat pumps have paved a way for increased electrified cooling use, potentially also increasing electricity demand. There are potential recognition justice implications regarding who can install heat pumps, as they are not always allowed to be installed for heating in certain situations (e.g., some apartment blocks connected to district heating only allow their use for cooling). This could leave some vulnerable groups locked into district heating that could become more expensive in the future. However, district heating systems have historically been much more efficient and less costly than individual heating systems. One possible approach is to decarbonize district heating plants.

IMPROVING DISADVANTAGED COMMUNITIES VIA JUSTICE40 INITIATIVE, U.S.

Summary: The Justice40 Initiative is a U.S. federal government goal to have at least 40 per cent of overall benefits from certain government investments go to communities that are disadvantaged, underserved, marginalized and over-proportionally affected by pollution.[157] Launched by the Biden-Harris administration in January 2021, the initiative has a specific focus on improving environmental justice by investment in climate-resilient infrastructure.[157]

Drivers: U.S. environmental policy has historically failed to properly account for environmental injustice, including disproportionate, disparate and cumulative effects of pollution and climate change on low-income and Black, Indigenous and People of Colour communities. The Justice40 initiative is the first national commitment to improve environmental justice at scale, with the White House stating that the program was influenced by community feedback to the Biden-

Harris administration,[157] and will include further consultation with affected disadvantaged communities on its implementation.[158] The White House Environmental Justice Council was set up alongside the Justice40 initiative to advise the U.S. government on how to address environmental injustice and strengthen environmental justice monitoring and enforcement.[159] WHEJAC's members were appointed by the U.S. president and include a wide range of people with expertise in climate change, environmental justice, racial inequity and disaster preparedness.[159]

Benefits: The initiative aims to advance environmental justice and deliver at least 40 per cent of overall benefits from federal investments in climate and clean energy to disadvantaged communities. Projects will include investment in the following categories: "climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure".[157] The initiative includes a spatial geo-mapping tool, which can be used to identify disadvantaged and marginalized communities[viii], and can be used to target Justice40 programs, such as Housing Improvement Program.[160] WHEJAC has called for the Justice40 initiative, for example, to ensure that 100 per cent of the investment undertaken under the initiative does not harm front-line communities, and that it takes bold action such as to sunset investment in fossil fuel and nuclear energy, and sets requirements for 100 per cent renewable electricity by 2030.[161]

Challenges: The challenge for a program such as Justice40 links to its deployment in federal departments that have not considered environmental justice much in the past,[162] in order to target the program effectively and ensure the right people benefit. This means taking into account recognition justice in identifying and protecting those who are marginalized, but also procedural justice, so that the process of delivering the various Justice40 programs follows due process. This will mean that those who are marginalized not only partake in the process, but also have an opportunity to design the way the process is run, and how final benefits and costs are shared. On that latter note related to distributive justice, identifying marginalised communities and determining the way the benefits of Justice40 programs are shared will have implications on who benefits and how. The White House and WHEJAC have published initial guidance in this regard, both on the importance of consultation, and which the disadvantaged communities may be,[161, 163] though there are limited details on how the program will be evaluated. In 2022, it was reported that the initiative's delivery was still in its infancy, with questions remaining over, for example, how different agencies were implementing the program and how it could be best incorporated into spending decisions.[162]

viii The tool is available at https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5

CONCLUSIONS ON CASE STUDIES

The above case studies show examples of how energy poverty and decarbonizing household heating could be addressed by different initiatives and programs. Although the Warm Front scheme did not meet all its targets, or eradicate energy poverty in the U.K., it nevertheless helped a large number of people in energy poverty, improving their homes, thermal comfort and health. In Finland, heat pumps have become widely popular. The Finnish policy approach of ensuring that citizens have basic necessities, like energy, has meant that grants aiding energy efficiency and heat pump installations have been available widely, and many for the long term. Programs such as Justice40, which is still in its infancy and has yet to produce long-term evidence, show that it is possible to design ambitious government programs on climate change that aim to protect disadvantaged communities. These case studies demonstrate potential avenues for better recognition justice in terms of identifying who may be disproportionately affected and needs support the most, distributive in terms of who benefits and how, procedural as to who has a say, and also importantly restorative in terms of improving the lives and communities of those who may have been unjustly ignored in previous energy developments.

6. RECOMMENDATIONS FOR POLICY TOWARD A CLEAN AND AFFORDABLE PEOPLE-CENTRED ENERGY TRANSITION

PHOTO lovelyday12, Adobe Stock

The Clean Electricity Regulations are important for Canada's clean energy transition. They will supplement carbon pricing by requiring the phase-out of all electricity generation dependent on fossil fuels by 2035.[8] Carbon pricing is a cornerstone of the federal government's plan for reducing emissions and is "designed to incent the lowest cost reductions" across the economy.[8, p.9] There is evidence that carbon pricing can reduce fossil fuel consumption and even shift behaviours. However, a focus on mitigation is *not enough*.

Addressing climate change through a tax alone fails to recognize that climate change is not only an environmental crisis, but is also a social and economic crisis. *Current energy systems have detrimental impacts across society*. Consequently, actions beyond "cost-efficient mitigation strategies" are needed to recognize, address and prevent the burdens associated with our energy systems.[164] The scope and design of the Clean Electricity Regulations will be influenced by the "full set of changes needed to transition the electricity sector to net-zero in 2035 while providing increased supply of electricity to support electrification, and the role of available technologies in the provision of clean power to Canadians".[8, p.9] Here is a critical opportunity to ensure that energy poverty in the net-zero transition is considered, and addressed, early on.

To mitigate and address energy poverty in the net-zero transition in Canada, we provide policy recommendations in the following four areas: 1) national energy poverty strategy; 2) universal clean energy service; 3) affordable energy and 4) decarbonizing and efficiency for the residential sector.

Table 2. Recommendations to mitigate and address energy poverty in Canada

Key policy topic	Sub sections	Recommendations	Key actors
Energy poverty strategy	A national energy poverty strategy for canada	• Energy justice as a guiding approach • Energy poverty advisory group • Household energy data • Energy poverty definition, indicators and targets	• Federal government • Provincial government • Civil society
Universal clean energy service	Consumer protection and access to energy services	• All-season energy disconnection ban	• Provincial government • Municipal government • Utilities • Social service agencies
	A right to cool (and heat)	• Access to cooling services	
Affordable energy	Bill-assistance programs	• Lifeline rate • On-bill credits/discounts • Seasonal programs • Emergency assistance	• Provincial government • Utilities • Social service agencies
Decarbonizing and efficiency for the residential sector	Energy efficiency resources standard	• Utility targets	• Provincial government • Utilities • Social service agencies
	Energy efficiency	• Building-sector targets • Low-income energy efficiency funding • Multi-residential and landlord-owned buildings programs	• Federal government • Provincial government • Municipal government
	Renewable energy programs	• Free heat pump programs • Free electric water heater programs	• Federal funding • Provincial government • Municipal government • Utilities • Social service agencies
	Education and collaboration	• Community outreach and education delivery • Diverse and inclusive stakeholder engagement	• Provincial government • Municipal government • Utilities • Community organizations

NATIONAL ENERGY POVERTY STRATEGY

Climate change and the necessary energy transition make it urgent to develop a National Energy Poverty Strategy for Canada. A National Energy Poverty Strategy would have the important objectives of 1) improving knowledge and awareness of energy poverty; 2) developing targets to monitor energy poverty improvements and 3) improving responses to energy poverty. Canada could look to other nations that have national level energy poverty strategies as part of domestic energy policy (e.g., England, Scotland, Northern Ireland, Wales and Spain).

R1.1 Energy justice as a guiding approach. An energy justice approach should be used to guide all aspects of the National Energy Poverty Strategy, including informing membership of the advisory group members and stakeholders within (see R1.2). An energy justice approach will 1) address the distribution of costs and benefits; 2) address due process, participation and representativeness; 3) identify support and guarantee representation for vulnerable members of society; 4) ensure all people are considered equals and 5) attempt to "make things right" for those people and communities that have experienced previous burdens.

R1.2 Energy poverty advisory group. We recommend forming a diverse energy poverty advisory group with expertise in science, building science, business, utilities, housing, energy poverty advocacy, civil society, policy-making and Indigenous governance. This is not an exhaustive list, and particular attention will need to be paid to who chooses the advisory group's membership and how it will be selected. The advisory group will set its role but its objective will be to steer development of the National Energy Poverty Strategy. The advisory group could be positioned, for example, under Canada's Net-Zero Advisory Body,[ix] given the federal government's mandate to prioritize equitable transitions, and could leverage the latter group's accountability to the federal government — and therefore to all Canadians.

R1.3 Household energy data. Energy end-use data in Canada is severely lacking, particularly for the residential sector and at the household level. Surveys and datasets,such as Statistics Canada's Survey of Household Spending, collects data on energy expenditures and the Households and Environment Survey (and Energy Use Supplement) collects data on energy consumption. However it is difficult to research and monitor expenditures as a function of usage or vice versa if data are not collected together (in addition to various other energy poverty research inquiries). Without better data and access to data, it will be difficult to advance understanding of energy poverty as well as many of the objectives in R1.4. Canada (and Statistics Canada) needs to prioritize collecting household level energy data.

R1.4 Energy poverty definition, indicators and targets. Using a multi-stakeholder engagement process, and the principles of energy justice, define and conceptualize "energy poverty" in the Canadian context. A clear definition will assist in developing indicators for measuring

ix See https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050/advisory-body.html for more information of the Net-Zero Advisory Body.

and qualifying energy poverty, as well as targets to address it. Canada's energy poverty stakeholders across various sectors can use indicators and targets to inform decision-making on energy poverty challenges; for example, qualifying criteria for participation in energy efficiency programming to remove households from energy poverty. The development of indicators and targets by group consensus will allow for a comprehensive and unified response to energy poverty.

UNIVERSAL CLEAN ENERGY SERVICE

Energy services such as heating, cooling, lighting and use of appliances and communication technologies are necessary for good quality of life. Circumstances such as heat waves, natural disasters and health emergencies show a need to rethink policies around access to energy, and therefore universal clean energy service.

R2.1 All-season energy disconnection ban. Canadian utilities prohibit disconnections in the winter season for non-payment in accordance with seasonal low temperatures, defined as temperatures below 0 C. Utilities throughout Canada extended disconnection bans and suspended collections due to non-payment in response to COVID-19 [165], but these measures do not protect consumers on an ongoing basis from climate or other emergencies. Nor do they protect vulnerable consumers who need access to energy outside the regulated seasonal disconnection times, including increased access to energy for cooling during hot summer days. We recommend a utility-wide year-round suspension on disconnections altogether, with the goal of eliminating non-payment disconnections for vulnerable households. We recommend arrears collection from those who can afford to pay, as well as any reconnection fees. As with winter bans, this recommendation will need to be legislated under the authority of provincial energy regulators who can oversee and enforce utility compliance.

R2.2 Access to cooling services. Notably, cooling policies are gaining attention. The City of Mississauga [166] is the only jurisdiction in Canada to have a maximum temperature bylaw for rental properties. In the City of Vancouver, air conditioning will be mandatory in new homes, coming into effect in January 2025 [167]. However, this will apply to homes that will have air conditioning and many households currently do not have this option. Most jurisdictions in Canada have local bylaws to ensure tenants get adequate heat, such as in the City of Toronto, [168] but renter households are currently not afforded access to cooling. If there is inadequate or no heat, it is within a tenant's rights to request access and landlords are required to resolve. Actions can include providing a space heater and paying any out-of-pocket extra expenses incurred by the tenant for not having adequate heating.[169] It is within a tenant's right to submit complaints to local government, for investigation by bylaw enforcement officers. Landlords are subject to a maximum fine of $100,000 if they are found guilty of committing an offence under the bylaw. The same protections and processes should be in place for cooling. We recommend local governments mandate landlords to provide adequate cooling to their tenants.

AFFORDABLE ENERGY

Energy poverty means households have to budget and limit using energy services. We recommend a combination of government and either tax- or ratepayer-funded programs that offer both ongoing and one-time emergency assistance to provide affordable energy. Historically utilities have been set up to provide customers with a commodity. Utilities and regulators need to instead begin to consider providing people with necessary services. This inability to transition to a service model has been a major barrier in advancing affordable energy and consumer protections in many Canadian jurisdictions.

R3.1 Lifeline rate. A lifeline rate will offer a lower rate for low-income customers. This will provide ongoing assistance to households that face barriers to their ability to pay energy bills on a continuing basis. We recommend the lifeline rate be applied to all fuel types during transition to clean electricity, given that many households facing energy poverty use oil, wood, propane and/or diesel, in addition to electricity, as their primary heating fuel source. Statistics Canada's "low Income cut-offs" (LICO) or "low income measure" (LIM) could be used for qualifying criteriax. Both indicators can be adjusted to account for household or family size and for specific demographics, such as age.

R3.2 On-bill credits and discounts. On-bill credit programs provide assistance to customers who face ongoing difficulty with their energy bills. This is another approach to making bills affordable for low-income customers. For example, the Ontario Electricity Support Program provides support, regardless of outside factors.[170] The OESP is a provincially funded program that offers a fixed monthly credit on a sliding scale based on income, with a more liberal scale for those who heat with electricity or use a pre-approved medical device that requires electricity, such as a respirator or kidney dialysis machine. The sliding-scale credit does not, however, account for discrepancies in energy needs. For example, housing in rural and Indigenous communities may need to use more energy to heat larger, older or more inefficient homes.

An alternative to on-bill credits is a percentage rebate on energy bills. For example, the California Alternative Rates for Energy, or CARE, program[172] is funded through a rate rider charge, offering 30 to 35 per cent discounts on electricity bills to low-income customers if the utility serves more than 100,000 customers. Discounts are 20 per cent if the utility serves fewer than 100,000 customers. Some larger utilities, like San Diego Gas & Electric and Pacific Gas and Electric, offer a similar program: the Family Electric Rate Assistance program (FERA).[172]

x LICO are income thresholds below which a household will devote a larger share of its income to basic necessities such as food, shelter and clothing than the average family. The LIM is a relative measure whereby a household is considered low income if its income is below 50 per cent of median household income. The LIM is comparable with other countries as it is frequently used in international contexts. For more information on Statistic Canada's low income measure, see: https://www.canada.ca/en/employment-social-development/programs/poverty-reduction/backgrounder.html

Some on-bill credit programs provide tailored credit. For example, the Percentage of Income Payment Plans in Colorado and Illinois[173] are bill-assistance programs that limit participating customer utility bills from surpassing an agreed-upon percentage of household income. In Illinois, participating and eligible customers pay six per cent of their gross income toward their utility bills, with the remaining difference being covered by a monthly credit of up to $100.[174] PIPP could be used to directly reduce energy poverty by capping the energy burden of customers to the agreed-upon threshold of energy poverty.[120] However, as this type of program requires both income and usage verification to calculate benefit amounts, it would require co-operation between program administrators, such as utilities and potentially the Canada Revenue Agency.[120]

R3.3 Seasonal programs. New Brunswick and Nova Scotia have programs designed to assist with winter heating according to income for eligible customers: the Electric Fuel Supplement and Heating Assistance Rebate Program, respectively. The Electric Fuel Supplement is a provincially funded program, offering a monthly credit of $150 to recipients of social assistance from November to April, while HARP is distributed annually to applicants based on a sliding scale of eligible incomes and is available October to March. HARP applies to all heating fuels. Similar programs could be developed in other jurisdictions. Summer programming could also be considered to accommodate the growing number of heat waves and thus increased demand during summer.

R3.4 Emergency assistance. One-time, or emergency, programs provide singular credits to help households facing short-term, extenuating circumstances affecting their ability to pay bills. Commonly considered eligible circumstances include exceptionally high bills due to winter heating or summer cooling, loss of income, disconnection or disconnection notice and needing arrears assistance. Ecotrust[120] conducted a jurisdictional scan of these programs and found the main difference between these types of programs relates to eligibility criteria. Certain programs, such as BC Hydro's Customer Crisis Fund, receive adequate funding and have a demonstrated demand but may struggle to effectively meet customers' needs, due to unclear or restrictive eligibility criteria. Until recently, BC Hydro's Customer Crisis Fund required households to receive a disconnection notice before applying for assistance, while others have household income requirements only, as is the case with Ontario's Low-Income Energy Assistance Program. New Brunswick's Emergency Fuel Benefit takes a more equitable approach and is less restrictive with respect to eligibility criteria — e.g., "having to choose between paying heating bills or feeding one's family" — and other similar circumstances are mentioned as eligible emergency situations.[175]

DECARBONIZING AND EFFICIENCY FOR THE RESIDENTIAL SECTOR

Opportunities to decarbonize and improve efficiency in the residential sector need to be developed and widely employed. Successful market solutions to assist households with electrification will depend on understanding the people for whom the solutions and technologies are being developed. A large portion of Canadian households currently lack sufficient support. We also recommend that utilities participate in energy-savings planning with specific goals.

R4.1 Utility targets. We recommend legislation that sets target goals for energy savings for utilities in every province. Provinces can develop mandatory long-term energy-savings targets and implementation plans through customer energy-efficiency programs. The targets could vary by province. Energy Efficiency Resources Standards have been used, for example, in the U.S. and the U.K., with utilities reporting savings.

R4.2 Building sector targets. Policies are cropping up throughout Canada to support zero-emissions buildings, including multi-unit buildings, that are highly energy efficient and use renewable energy. For example, the City of Vancouver is aiming to transition to zero-emissions buildings in all new construction by 2030 by setting limits on emissions and energy use.[176] However, Canada's existing residential building stock is a major source of domestic GHG emissions from energy use (12 per cent), and about 17 per cent of all secondary energy use.[87] Generally, the poorest performing buildings are older: approximately 86 per cent of the residential building sector was built before 2006 and is about 25 to 40 per cent less energy efficient than stock built after this time.[177, 178] Differences also vary by building type. For example, community/social housing is associated with higher levels of energy use due to the sector's aging buildings (75 per cent built prior to 1990) and widespread deferred maintenance.[179, 180] In British Columbia, per unit energy consumption in community housing is 60 per cent higher than in market housing.[181] Much of it is in need of significant repair. We recommend the federal government set ambitious deep retrofit and mass retrofit targets to *accelerate* building retrofits. To reach Canada's 2030 climate target, over half of Canada's existing homes and buildings need to be retrofitted to a 56 per cent carbon-reduction standard, or one-third of homes and buildings to an 84 per cent reduction standard. At the current pace it would take 142 years to retrofit every building in Canada.[182] GHG savings from building retrofits can be realized more quickly than reductions from other sectors, and either deliver net cost savings or are cost-effective when compared to other mitigation measures.[183]

R4.3 Low-income energy efficiency funding. The Canada Greener Homes Loan Program offers up to $40,000 in interest-free financing for home energy-efficiency improvements to homeowners, complementing existing grants of up to $5,000.[184] These loans can be beneficial for many middle- and upper-income households, but they are not suitable for lower-income households that cannot afford loan payments.[98] Public polling commissioned by Efficiency Canada shows that Canadians are more supportive of funding for low-income energy efficiency than offering zero-interest loans to homeowners.[98] We recommend the federal government

develop a dedicated stream for low-income energy efficiency as part of the Greener Homes Grant. The Atmospheric Fund recommends that the federal government commit to at least $10 billion annually to make energy efficiency improvements "achievable, affordable, and accessible." This includes greater than $2 billion per year to fund no-cost deep retrofits for low-income households and top-up for renovations for social/community housing through the National Housing Strategy.[185]

R4.4 Multi-residential and landlord-owned buildings programs. Renter households make up a substantial portion of Canada's households (31 per cent)[186] and face significant barriers to decarbonizing. Specifically, multi-residential and landlord-owned buildings are often subject to split incentives. These refer to situations where the benefits of a transaction are not accrued by the party that pays for the transaction; there are several types.[187] Research shows landlords with tenants who pay utility bills underinvest in energy efficiency measures to tackle space heating, water heating, insulation, weatherization and window-thickness, leading to higher tenant energy bills.[188]

Efficiency-related split incentives refer to situations where the end user is responsible for paying energy bills but cannot choose the technology for improving the home's energy efficiency and is limited in ability to save on energy bills and improve energy efficiency.[187] In these cases, landlords lack incentive to invest in energy efficiency measures because they may not directly see benefits. Usage-related split incentives, also referred to as "reverse" split incentives, occur when occupants are not responsible for paying energy bills and therefore lack incentive to save energy, and evidence points to tenants using more energy in these situations.[187] Multi-tenant, multi-owner split incentives occur when there are many actors involved in collective decision-making, and where energy efficiency projects can be realized if all parties reach consensus, such as in condominiums or strata housing.[187] In the situation of both multi-tenant and multi-owner buildings, benefits and costs associated with energy efficiency upgrades can vary from unit to unit. Temporal split incentives refer to situations where investments in energy efficiency measures do not pay off prior to a property getting transferred to the next occupant/owner.[187] In these situations, occupants (tenants or owner-occupied) do not know how long they will be living in the property and upfront capital costs are not appealing.

Overcoming the split incentive barrier in the residential building sector is critical for progressing to net-zero in the building sector, but minimal work has taken place to advance understanding of possible policy or program models. Some possible solutions include mandating minimum building performance standards, revisions in tenant acts, building energy labelling and individual metering;[187] however, much more understanding is needed. It is unlikely that renter household populations will decrease. We recommend effort be put into better understanding this challenge so that retrofits and electrification occurs without using mechanisms that pass costs onto tenants who may be unable to pay.

R4.5 Free heat pump program. Income constraints will prevent some households from adopting technology compatible with fuel switching, potentially leaving them behind in the energy transition. Free turnkey heat pump programs could enable eligible households to switch. The Government of Prince Edward Island, for example,[189] provides free heat pumps for households that have an annual income of up to $55,000 and property valued at up to $300,000. The eligibility criteria for free heat pumps could also be based on the LIM, for example, with consideration for geographical variability in property value.

R4.6 Free electric hot water heater program. The Government of P.E.I. introduced a free electric hot water heater program in June 2022. To be eligible, households must have an annual income of $55,000 or less and use fossil fuels to heat water. We recommend this program be modelled throughout the country to incentivize fuel switching.

R4.7 Community outreach and education programs. Energy efficiency programs are often designed with a "one-size fits all" approach,[190] which can affect who receives information. Kambo Energy Group is a B.C.-based social enterprise that designs and delivers energy efficiency, conservation and education programs on behalf of utilities and other groups. Their data show that between 2018 and 2020, 89 per cent of non-English-speaking utility customers who had participated in Empower Me programs had not previously heard of programming from either BC Hydro or Fortis BC — the province's main utilities. This is presumably the case across Canada's multicultural landscape. More tailored education programs are needed to communicate concepts and information in languages understood by community members, as well as providing education on what utilities and governments are so that trusting relationships can be built.

R4.8 Diverse and inclusive stakeholder engagement. Successful energy poverty mitigation requires engagement with diverse stakeholders across different sectors. This includes provincial and local governments, utilities and those invested in energy poverty issues in Canada, such as legal aid, front-line emergency service providers and environment, anti-poverty and affordable housing advocacy groups. In this, it is key that stakeholder engagement includes those who are affected by energy poverty. In addition, stakeholders such as building owners and landlords, realtors, contractors and service and repair companies, developers and architects and financial insurance institutions are key players in determining, for example, types of housing construction, funding structures, utility payment options and the viability of building upgrades.[80] We note that it will be important for major actors to present a unified front so as not to lose sight of the end goal: an equitable energy transition.[190]

CONCLUSIONS ON RECOMMENDATIONS

We provide several recommendations for a clean and affordable people-centred energy transition. Our focus is on equitable and just policy that is inclusive and that will pass on a wide range of benefits to households during Canada's clean energy transition. Our recommendations are therefore based on what we believe to be the priority policy areas: an Energy Poverty Strategy, universal clean energy service, affordable energy and decarbonizing and efficiency in the residential sector. We note that, for many of the recommendations, the specific levers and mechanisms for implementing the policies require further investigation. For example, funding for utility-led initiatives could occur by tax or ratepayer-funded programs. Arrears are another potential issue given their potential to increase with an all-season disconnection ban. It is beyond the scope of this report to provide comprehensive and directed guidance on the policy levers and mechanisms by which our recommendations can be implemented. These will vary according to the recommendation type. However, we urge decision- and policy-makers to turn to research where available and applicable. For example, there are numerous findings on what influences uptake of energy efficiency measures, retrofits and policy in the Canadian context.[192-194]

Energy transitions and their solutions are often technology-based and on the supply side.[195] However, energy transitions also involve markets, industries, policies, infrastructure, user practices, societal discourses and technologies.[196] Furthermore, it is important to note that sustainable energy transitions depend on human behaviours regarding investments in energy efficiency, changes in energy use and use of sustainable energy sources and energy efficient technology.[197] Despite policies and programs for assisting households with high energy burdens, they persist (e.g., Brown, 2020). Programs and policies thus need to do better, and approaches will require understanding and addressing the myriad reasons people end up in energy poverty. It is therefore important to consider the various factors that influence people's energy behaviours and engagement with energy transitions.[198]

7. CONCLUDING REMARKS

PHOTO Yi Solarisys, Adobe Stock

This report shows that many Canadian households face energy poverty. The clean energy transition, and the clean electricity regulations in particular, signal that Canada is breaking away from fossil fuels. The phase-out of fossil fuel electricity generation will be far-reaching. It will require modernizing the electricity system and grid, as well as transitioning to technologies that are compatible with clean electricity. Such changes will increase the demand for electricity as well as potential costs, especially for households that are unable to afford the clean electricity transition. Importantly, shifting to clean electricity does not automatically translate to addressing energy poverty.

Households that currently face energy poverty may continue to do so if the distribution of costs and benefits in the electricity transition are not properly addressed. This would increase the risk that more households will be pushed into energy poverty, with detrimental impacts. Urgent action is required, for example, to reduce disconnection and manage the risks from overheating to avoid worsening energy poverty impacts, including fatalities.

We need to ensure that electrification and transitioning to net-zero are equitable and fair. This can and should be addressed by paying attention particularly to households in, or at risk of, energy poverty.

Canadian federalism limits centralized authority, yet the federal government has room to take leadership and guide Canada's many jurisdictions and actors in the net-zero transition. Various actors will play different roles, and this report lays out a variety of priorities and recommendations that can be taken to mitigate and address energy poverty during the energy transition. This is not intended as a comprehensive strategy but rather shows where the focus should be to ensure an equitable energy transition. The potential for positive societal change will outweigh the efforts needed now.

We note this report is limited to the Canadian provinces and grid-connected households. It therefore excludes the territories, where many off-grid and Indigenous communities are located. Indigenous communities in Canada face unique challenges related to housing and energy use.[124] For example, many communities, including most Inuit communities in Northern Canada, are not connected to power grids and rely on diesel fuel.[115] Particular care is needed to measure and address energy poverty experienced by Indigenous communities.

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APPENDIX 1

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METHODOLOGY FOR ESTIMATING HOUSEHOLD ENERGY BURDEN

Different quantitative and qualitative approaches are used to measure energy poverty, and data availability often guides the choice of methodology. We used the expenditures approach, taking into account household energy costs against a threshold to provide an estimate of an energy burden, which was then used as a proxy measure for energy poverty. We first constructed a measure of energy poverty using the 10 per cent approach. We looked at household spending on electricity, natural gas, other fuel, heating oil, propane and wood. We used actual energy expenditures (versus *required* expenditures to maintain a certain home temperature, given the non-availability of that data). We also used Engel curves to study the relationship between household spending on energy services and household income and the budget share on energy expenditures. This analysis shows how household expenditures on particular goods or services vary with household income.

Our two indicators are:

1. Energy poverty = [(electricity + natural gas + other fuel + heating oil + propane for heating and cooking + wood and other fuel for heating and cooking)/(annual household income)] > 0.10
2. Energy poverty *adj. for housing costs* = {[(electricity + natural gas + other fuel + heating oil + propane for heating and cooking + wood and other fuel for heating and cooking)]/ [(annual household income) – (rent or mortgages)]} > 0.10

Data

We drew on confidential microdata collected from January to December 2016 for Statistics Canada's national Survey of Household Spending. This survey is conducted annually in Canada's provinces and every other year in the territories. Data collected related to household expenditures, dwelling characteristics and household demographics, among others. Income and income tax data come from personal tax return files from the Canada Revenue Agency. The SHS conducts interviews to administer a questionnaire with varying recall periods based on type of expenditure. This is combined with an expenditure diary that certain households (n = 3,809) complete for two weeks post-interview.

The SHS is a sample survey with a cross-sectional design. A stratified multi-stage sampling design was used to select the sample in stages. The first stage is a sample of geographic areas (clusters) and the second consists of sampling dwellings within each cluster. Selected dwellings constitute the sample of households within the target population — the population of Canada's provinces, excluding residents of institutions, members of the Canadian Forces living in military camps and people living on "Indian reserves"; exclusions form approximately two per cent of the population. The 2016 SHS original sample consisted of 17,590 households, and a response rate of 65.1 per cent resulted in a final sample of 11,446 households. Data are weighted to compensate for the probability of selection and to match Canadian households to census data. Statistical estimates are presented on a population scale.

Table 3. Energy poverty descriptive statistics

		Energy poverty	
Variable	**Categories**	**No**	**Yes**
		N = 12,359,051	N = 900,864
		% or Mean (S.D.)	% or Mean (S.D.)
Province of residence	Ontario	36.4%	46.3%
	Alberta	10.4%	4.7%
	British Columbia	13.7%	8.1%
	Manitoba	3.6%	2.1%
	New Brunswick	2.1%	5.2%
	Newfoundland and Labrador	1.3%	4.6%
	Nova Scotia	2.5%	8.0%
	Prince Edward Island	0.4%	1.3%
	Quebec	26.6%	15.4%
	Saskatchewan	2.9%	4.2%
Lives in a rural area (fewer than1,000 people)	Yes	9.4%	24.1%
	No	90.6%	75.9%
Tenure type	Own with mortgage	36.2%	26.6%
	Own without mortgage	27.2%	44.1%
	Rented	35.7%	27.3%
Highest level of educational attainment	High school or below	35.9%	50.4%
	Some post-secondary	36.4%	31.3%
	Bachelor's degree or above	27.5%	17.9%
Internet access	Yes	87.5%	74.5%
	No	12.5%	25.5%
Health care costs (i.e., direct costs to household and private health insurance plan premiums)		$2705.04(2692.66)	$1685.87(3578.70)
Major health care equipment costs (i.e., hearing aids, wheelchairs and scooter, hospital beds, patient lifts, and CPAP machines		$60.98(444.53)	$153.96(745.21)
Major source of income	Employment	64.8%	28.4%
	Government transfer payments	32.0%	67.8%
	Other	3.2%	3.8%
Employment insurance	Yes	16.9%	8.9%
	No	83.1%	91.1%
Full-time earners		0.79(0.81)	0.24(0.49)
Part-time earners		0.55(0.76)	0.39(0.62)
Full-time workweeks		25.53(24.52)	8.73(18.35)

Part-time workweeks		4.99(13.70)	6.93(15.99)
Private-use vehicle	Yes	83.1%	77.1%
	No	16.9%	22.9%
Private-use vehicle cost (annual)		$4580.16(12011.50)	$2446.85(8314.50)
Public transit cost (annual)		$270.82(640.62)	$110.18(382.12)
Dwelling type	Single-detached	50.4%	68.8%
	Double (semi-detached); row or terrace (townhouse); duplex	30.8%	14.2%
	Low-rise and high-rise apartments	17.2%	13.5%
Construction period	1960 or before	30.9%	37.0%
	1961-1980	23.8%	28.6%
	1981-2010	39.6%	29.5%
	2011 or after	5.7%	4.8%
Dwelling needs repair	No	70.3%	61.3%
	Minor repair	7.8%	13.1%
	Major repair	21.9%	25.6%

Table 4. Energy poverty descriptive statistics adjusted for housing

		Energy poverty adjusting for housing costs	
Variable	**Categories**	**No**	**Yes**
		N = 12,045,083	N = 1,214,832
		% or Mean (S.D.)	% or Mean (S.D.)
Province of residence	Ontario	36.4%	43.6%
	Alberta	10.5%	5.6%
	British Columbia	13.8%	8.8%
	Manitoba	3.6%	2.1%
	New Brunswick	2.1%	4.6%
	Newfoundland and Labrador	1.3%	3.8%
	Nova Scotia	2.5%	7.0%
	Prince Edward Island	0.4%	1.2%
	Quebec	26.5%	19.4%
	Saskatchewan	2.9%	4.0%
Lives in a rural area (fewer than 1,000 people)	Yes	9.4%	20.5%
	No	90.6%	79.5%
Tenure type	Own with mortgage	36.0%	31.8%
	Own without mortgage	27.9%	32.7%
	Rented	35.3%	33.9%

Highest level of educational attainment	High school or below	35.3%	51.8%
	Some post-secondary	36.5%	31.2%
	Bachelor's degree or above	27.8%	16.7%
Internet access	Yes	87.7%	75.1%
	No	12.3%	24.9%
Health care costs (i.e., direct costs to household and private health insurance plan premiums)		$2087.34(2792.54)	$1664.51(2424.32)
Major health care equipment costs (i.e., hearing aids, wheelchairs and scooter, hospital beds, patient lifts, and CPAP machines		$62.65(451.16)	$113.43(638.43)
Major source of income	Employment	64.9%	36.4%
	Government transfer payments	32.0%	58.8%
	Other	3.1%	4.8%
Employment insurance	Yes	16.8%	12.3%
	No	83.2%	87.8%
Full-time earners		0.79(0.81)	0.35(0.62)
Part-time earners		0.54(0.76)	0.45(0.68)
Full-time work weeks		25.56(24.54)	12.73(21.07)
Part-time work weeks		5.02(13.74)	6.14(15.14)
Private-use vehicle	Yes	83.6%	74.1%
	No	16.4%	25.9%
Private-use vehicle cost (annual)		$4645.93(12118.64)	$2346.08(7826.89)
Public transit cost (annual)		$272.65(644.24)	$133.56(410.47)
Dwelling type	Single-detached	50.2%	65.7%
	Double (semi-detached); row or terrace (townhouse); duplex	31.0%	16.0%
	Low-rise and high-rise apartments	17.1%	15.8%
Construction period	1960 or before	30.8%	36.8%
	1961-1980	23.5%	30.1%
	1981-2010	39.8%	30.3%
	2011 or after	5.9%	2.8%
Dwelling needs repair	No	70.8%	58.1%
	Minor repair	7.7%	12.9%
	Major repair	21.5%	29.0%

Source: Adapted from Das, Martiskainen, & Li (2022).

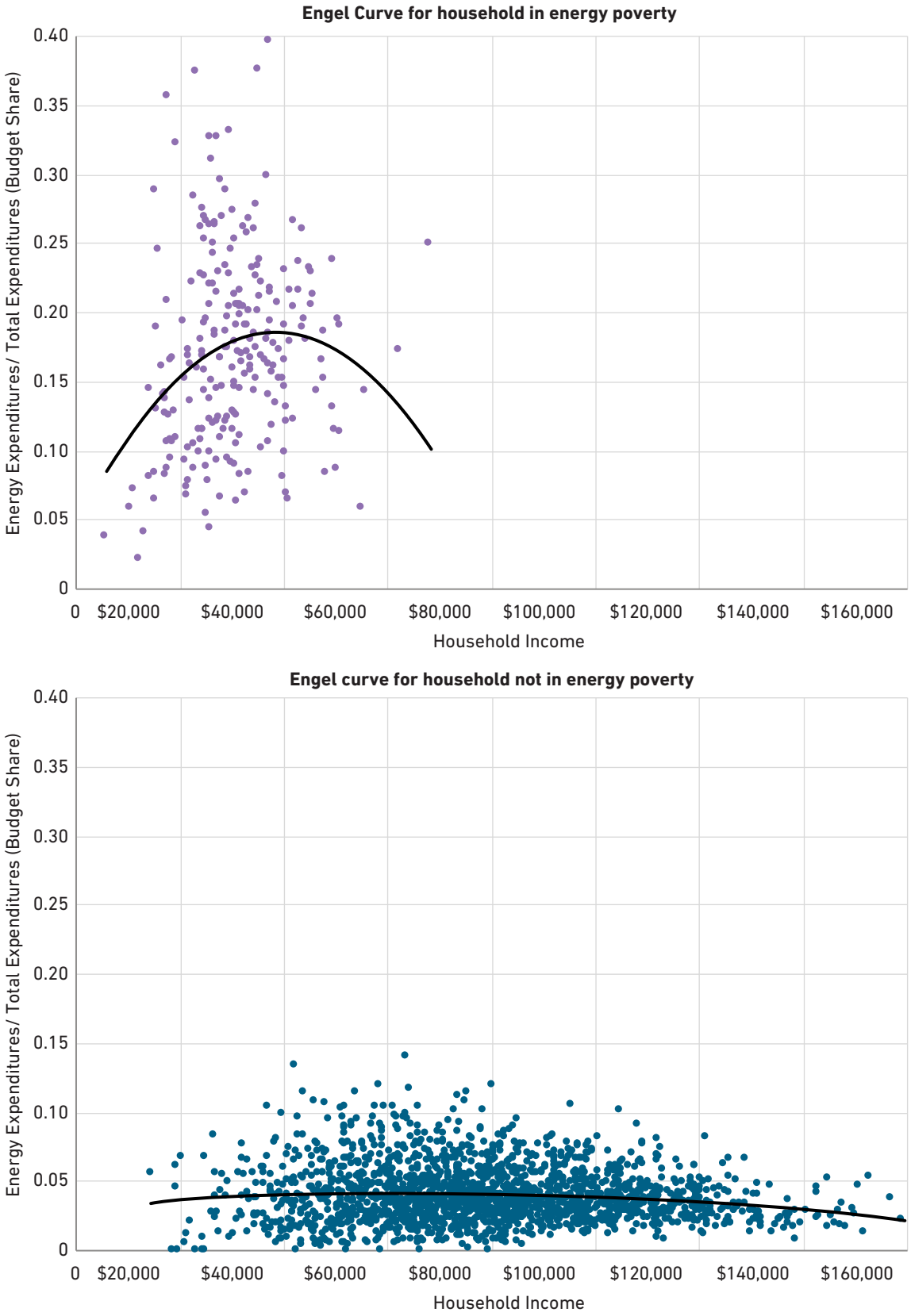
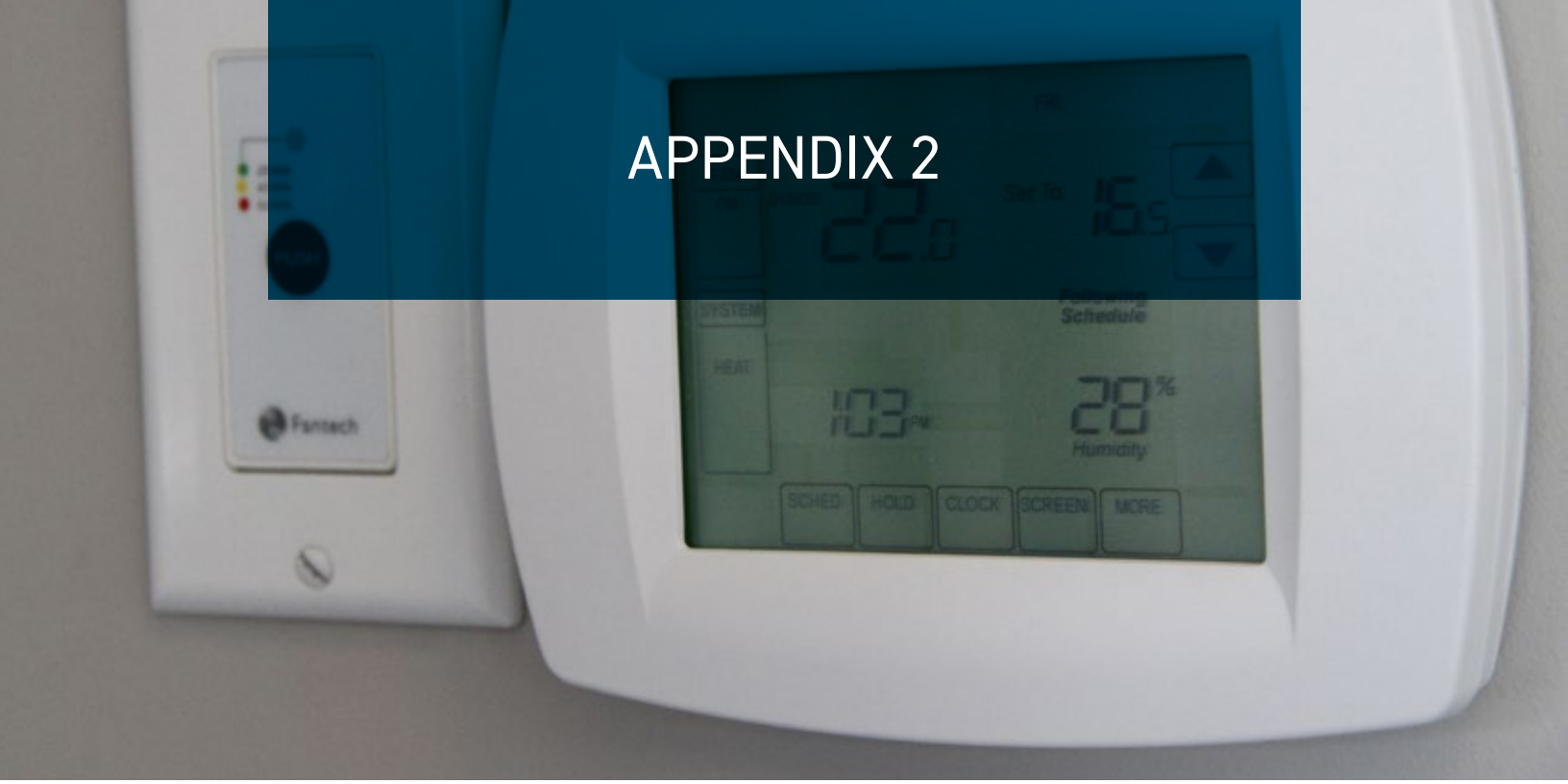


Figure 7. Engel Curves

Source: Adapted from Das, Martiskainen, & Li (2022).



APPENDIX 2

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METHODOLOGY FOR ESTIMATING HOUSEHOLD ELECTRICITY EXPENDITURES

We used data from the 2017 cycle of the Survey of Household Spending using Statistics Canada's Public Use Microdata Files (PUMFS) Collection[xi]. PUMF files are different than microdata files found at research data centres, with the latter generally being more disaggregated. Therefore, our variables differed slightly than from those used in the analyses described in Appendix 1. Household income is calculated before taxes in the year prior to the reference year of the survey. It includes income from earnings (employment income), investments, government transfer payments and other sources. Our variable of interest is that of electricity expenditures.

Data

A redesigned survey was introduced in the 2010 reference year and the 2017 SHS PUMF is the first SHS PUMF after the survey redesign. A stratified multi-stage sampling design is used to collect information on household demographic characteristics and the distribution of household expenditures across different expenditure categories. The 2017 SHS included 12,492 respondents. Respondents with total household income below $0 and over $200,000 were excluded from the sample. Thus the final sample size is 11,754 households. All results are weighted using SHS-designed weights to make them nationally representative.

xi Statistic Canada's PUMF Collection is a subscription-based service for institutions. For more information see: https://www.statcan.gc.ca/en/microdata

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