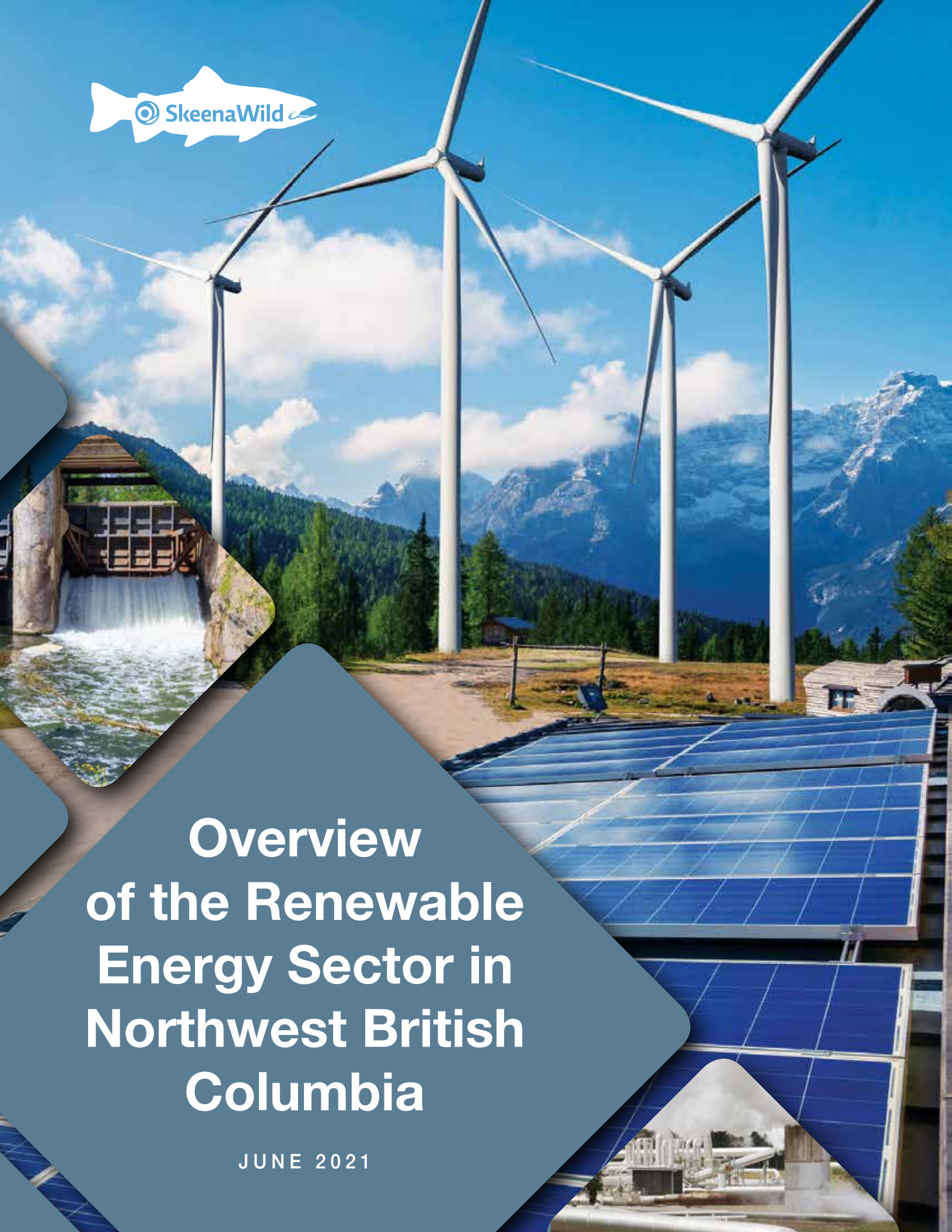

SkeenaWild

# Overview of the Renewable Energy Sector in Northwest British Columbia

JUNE 2021

# Overview of the Renewable Energy Sector in Northwest British Columbia

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# CONTENTS

# EXECUTIVE SUMMARY

Northwest British Columbia (BC) is fortunate to be endowed with renewable energy sources including biomass sources in the form of trees, earth (geothermal) energy sources, flowing rivers, rain, sun rays (solar), tides, waves, and wind. The region covers the upper left-hand corner of British Columbia, from Haida Gwaii in the west to Burns Lake in the east, and from Kitimat in the south to Dease Lake in the north, and has historically struggled with the boom and busts of an economy heavily dependent on natural resources. But changes are underway in northwest BC, and the rationale for completing this report reflects those changes.

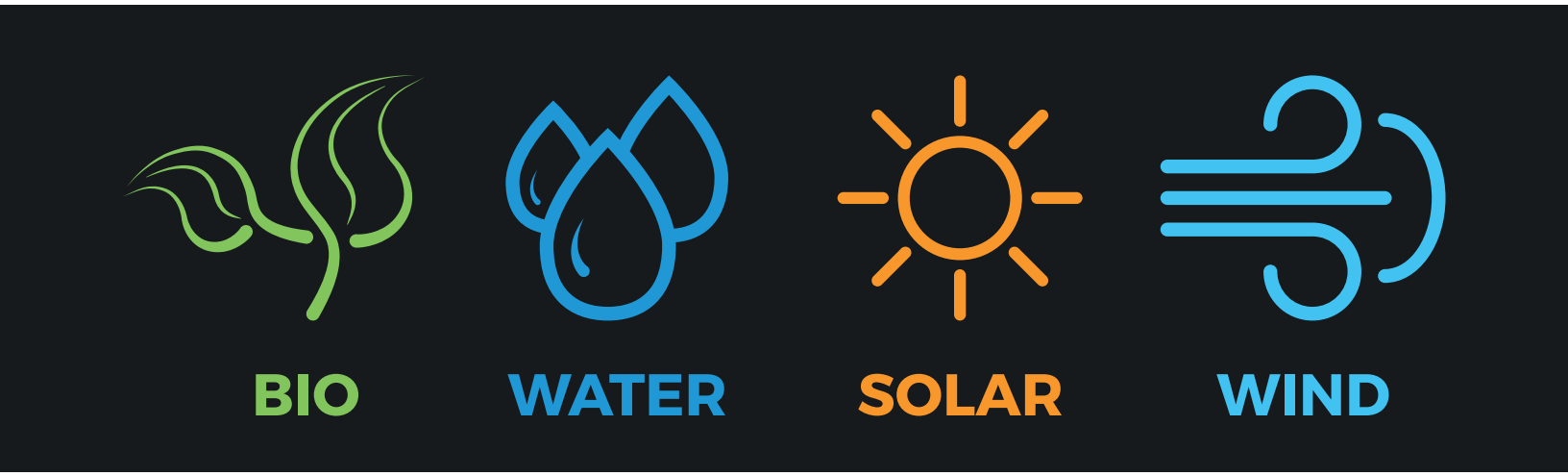
In 2013, following a significant economic slump due to a flat-lined forestry industry, $60 billion worth of industrial projects were proposed for northwest BC. This gold rush of projects resulted in conversations - some of which were confrontational - about how the region might develop. Now, with construction of a liquefied natural gas (LNG) export facility and associated pipeline underway in Kitimat, regional residents are discussing how to maintain the lifestyle and quality of life they love, while protecting the Skeena watershed's values and advancing development which promotes stability and resilience.

Residents have indicated that their version of responsible development is development that supports healthy salmon, clean water, clean air, and resilient communities. As such, SkeenaWild Conservation Trust is conducting a research-based Responsible Development Initiative (RDI) to advance conversations about economic development in northwest BC that supports both healthy salmon populations and healthy communities. This report is part of that initiative.

The Responsible Development Initiative fills a knowledge gap, providing research to support economic conversations beyond the benefits and drawbacks of large industrial projects. Rather than further polarize the resource development debate, the RDI encourages respectful dialogue between those who primarily support industrial development and those who are more cautious or have concerns about the social, environmental and lifestyle ramifications of large developments, by providing up-to-date information about specific sectors, current initiatives, challenges, and opportunities. This report is part of the RDI and attempts to:

1) Provide an overview of the renewable energy sector in Canada, British Columbia, and northwest BC.
2) Understand the current status and potential future of northwest BC's renewable energy sector.
3) Provide information that may help promote economic stability while maintaining the values of northwest BC's communities.

This report was initially written in February 2017, then updated in June 2021. The global COVID-19 pandemic of 2020 and 2021 upended most national and international economies and understanding how the pandemic affected the renewable energy sector in northwest BC will be an exercise for the future. In the meantime, this report attempts to summarize current activities in the sector, in the midst of the pandemic.




## Findings

Renewable energy is generated from natural processes that are continuously replenished, such as biomass, the earth (geothermal), flowing rivers, rainwater, sun rays (solar), tides, waves, and wind. The main benefit of using renewable sources is that they are indeed renewable, are not finite, and the original source is not depleted when they are utilized. Depending on the source, renewable energy may be called clean energy, alternative energy, or green power. However, it's important to recognize that producing energy from renewable sources can have environmental impacts, just like energy-producing processes that utilize non-renewable sources[1]. So, carefully considering whether a source is actually renewable or not, as well as understanding the environmental impacts associated with the use of the resource, is imperative for effective decision-making.

As the effects of greenhouse gases – primarily due to the use of non-renewable energy sources by humans – have become clear culprits in the rapid advancement of climate change, renewable energy has gained significant support, become increasingly economical, and garnered great interest. In the past 15 years or so, renewable energy research, technologies and projects across the globe have rapidly expanded and renewable energy is quickly becoming a mainstay of global energy production.

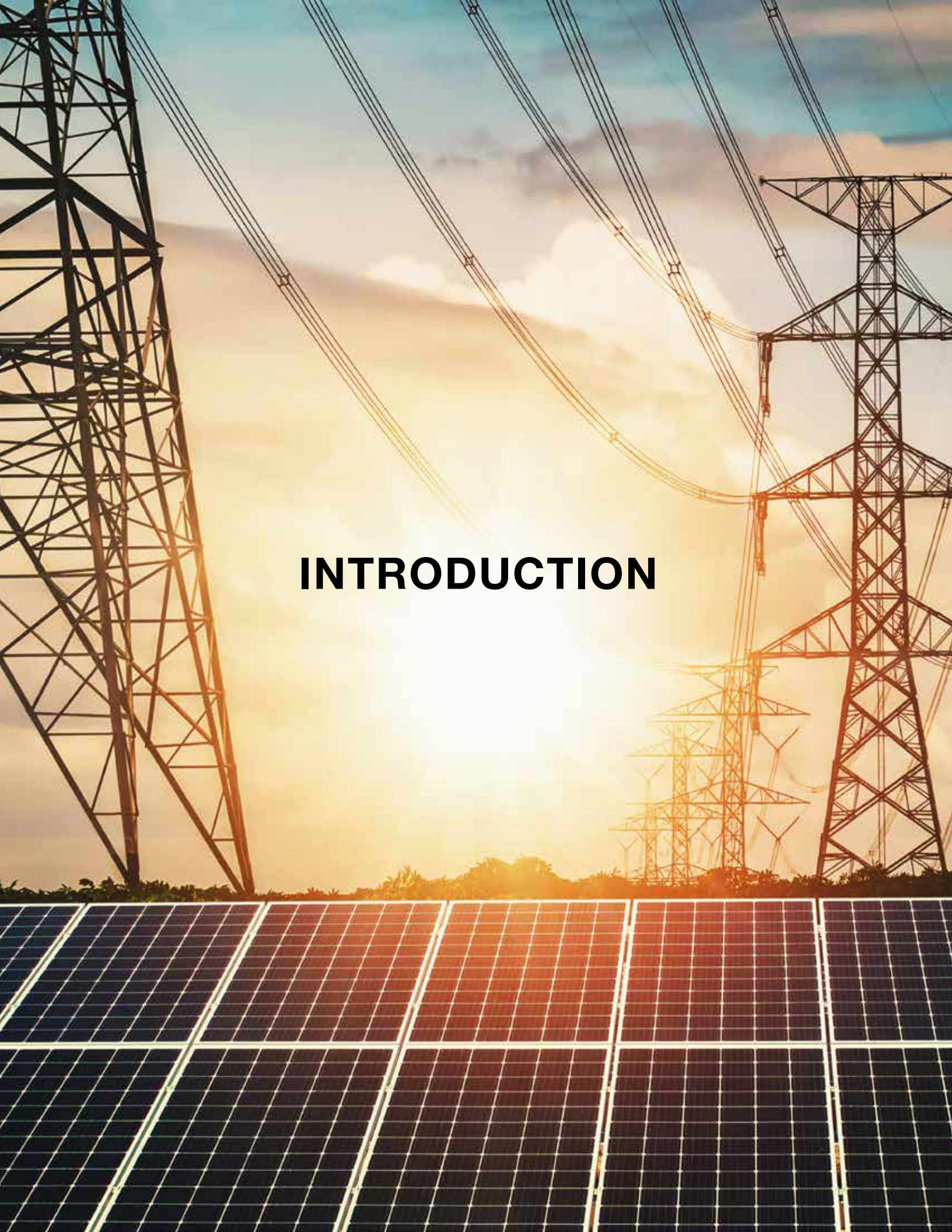
In 2015, Canada ranked in the top five for renewable energy investments in only two categories: hydropower capacity investment and ethanol production. In terms of renewable energies, Canada ranked third in hydropower generation, and fifth overall for hydroelectricity capacity, meaning that Canada relies on hydroelectricity for most energy needs and the use of hydroelectric power in Canada is exceedingly high. However, due to the downturn in the oil and gas sector of Canada's economy, renewable energy sources are slowly coming online, and training opportunities are increasing as out-of-work oil and gas sector employees upgrade their skills for the clean energy sector. There is significant room for Canada's renewable energy sector to grow and forecasters suggest that by 2050, 100% of Canada's energy needs could potentially be supplied by renewable energies, which would generate more than 700,000 direct and indirect jobs. Over the last 15 years, investment and new innovative technologies have continued to grow and develop the sector, however, political will remains a significant obstacle.

The renewable energy sector in BC has evolved from a handful of small development companies to 146 substantial development, operating, and supply chain companies delivering approximately 16% of the Province's supply. The energy mix includes proven technologies such as small (run-of-river) hydro, wind, solar, natural gas, biomass,

1 For example, cutting down British Columbia's last remaining valley-bottom old growth forests to produce bio-energy, is not renewable.

and biogas and emerging technologies such as geothermal, ocean/tidal, and biofuels. According to Clean Energy BC, clean energy projects are an important part of the future of British Columbia. The Province has abundant clean energy resources, and the prudent, cost-effective development of these resources is fundamental to the province's future prosperity and sustainability.

Northwest BC is endowed with resources well suited to the renewable energy sector, and biomass, geothermal, solar, and run-of-river hydroelectric projects have already been developed. However, there are undoubtedly more opportunities and renewable energy projects in northwest BC than those summarized in this report. Plus as the effects of the COVID-19 pandemic recede, regional initiatives and opportunities will change, disappear or become outdated, and new ones will take their place. But currently, the renewable energy sector in Northwest BC has substantial room for growth, paralleling the state of the global industry and in keeping with increasing social conscience regarding energy sources.



# INTRODUCTION

# 1 INTRODUCTION

Northwest BC covers the upper left-hand corner of British Columbia, from Haida Gwaii in the west to Burns Lake in the east, and from Kitimat in the south to Dease Lake in the north. The region has its own unique economy and is included in Statistics Canada's North Coast and Nechako economic regions. It's also lcoated within North Coast Regional District (NCRD), Regional District of Kitimat-Stikine (RDKS), and the western portion of Regional District of Bulkey-Nechako (RDBN).

The area is fortunate to be endowed with renewable energy sources including flowing rivers, geothermal energy sources, solar energy, tides, wind, waves, and extensive biomass sources in the form of trees. Not only does this allow the region to consider utilizing renewable resources for energy, but it also greatly contributes to the commodity based industries that drive the northwest BC economy, including forestry, mining, and oil and gas. The agriculture, manufacturing and tourism sectors also play key roles.

Although residential and commercial enterprises always need energy, some of the regions' industries are highly energy-intensive, so commercial and industrial demand for power could – and in some cases already does - contribute to a healthy renewable energy sector in northwest BC.

## 1.1 Background

This report is part of SkeenaWild Conservation Trust's research-based Responsible Development Initiative (RDI) which aims to advance conversations about economic development in northwest BC. SkeenaWild believes that salmon are the backbone of the cultures, economy, and ecosystems of the Skeena region, therefore, protecting salmon is fundamental to maintaining and building a healthy Skeena watershed, including the communities within it. Responsible development, where human and salmon populations coexist, is part of that. So the rationale for the Responsible Development Initiative, and this report, is to further conversations about economic development that supports both healthy salmon populations and healthy communities.

The reason this RDI is underway now, it that the northwest BC region has a long boom-and-bust history. However, in 2013, following a significant economic slump due to a flat-lined forestry industry, $60 billion worth of industrial projects were proposed for northwest BC. This gold rush of projects resulted in conversations - some of which were confrontational - about how the region might develop.

Subsequently in October 2018, LNG Canada and Coastal GasLink announced final investment decisions to go ahead with a $40 billion LNG liquefaction and export facility in Kitimat (LNG Canada) and a supporting $6 billion gas pipeline (Coastal GasLink) to deliver natural gas from the Dawson Creek area of northeast BC to Kitimat. Both projects are now under construction.

LNG Canada will reportedly be powered by both natural gas from fracked wells in the gas fields of northeast BC (non-renewable energy), and electricity sourced from BC Hydro's Site C dam which is currently under construction in northeast BC (renewable energy). Both energy sources have significant environmental impacts. For example, the first phase of LNG Canada's project is expected to emit 4 mega tonnes (mT) of greenhouse gases, and the project as a whole – including the second phase – is expected to emit between 8.6 and 9.6 mT, which is approximately three-quarters of BC's 12.6 mT target emissions for 2050. The impacts of fracking gas wells are also substantial – from the extensive use of freshwater, to waste water ponds, human health effects, and more recently, earthquakes. Although hydroelectric power is considered renewable energy, the construction of BC Hydro's Site C dam is also creating substantial impacts. So while renewable energy is considered a much better choice than the use of non-renewable resources to produce energy, the environmental impacts of using renewable resources to create energy can be substantial and must be taken into account when considering the benefits and drawbacks of renewable energy projects.

This is just one example of the topics regional residents are discussing in their attempts to maintain the lifestyle and quality of life they love, while protecting the Skeena watershed's ecosystems and advancing development which promotes stability and resilience. Through focus groups, polling, responses to open-ended questions about development in the region, residents in northwest BC defined responsible development as development that supports healthy salmon, clean water, clean air, and resilient communities[2]. So responsible development

a. Is well planned, which means government plays an active role in determining appropriate sites for developments. This will, in turn, prevent crisis and division in northwest BC communities.

b. Includes projects that are assessed objectively, in the interest of communities and the environment.

c. Ensures a fair share of benefits remain in the communities where development takes place.

d. Embraces the shift towards First Nations' co-management.

e. Takes a long view.

The Responsible Development Initiative fills a knowledge gap. It provides research to support economic conversations beyond the benefits and drawbacks of large industrial projects. Rather than further polarize the resource development debate, the RDI encourages respectful dialogue between those who primarily support industrial development and those who are more cautious or have concerns about the social, environmental and lifestyle ramifications of large developments, by providing up-to-date information about specific sectors, current initiatives, challenges, and opportunities. This report is part of that effort, supporting the belief that with good information, planning, engaged communities, and a long view, better resource development decision are possible.

## 1.2 Purpose and Scope

The purpose of this report is to provide an overview of the renewable energy sector in Canada, British Columbia, and northwest BC. It attempts to:

1. Understand the current status and potential future of northwest BC's renewable energy sector.
2. Provide information to further conversations about economic development that maintains the values of northwest BC's communities, and promotes economic stability.

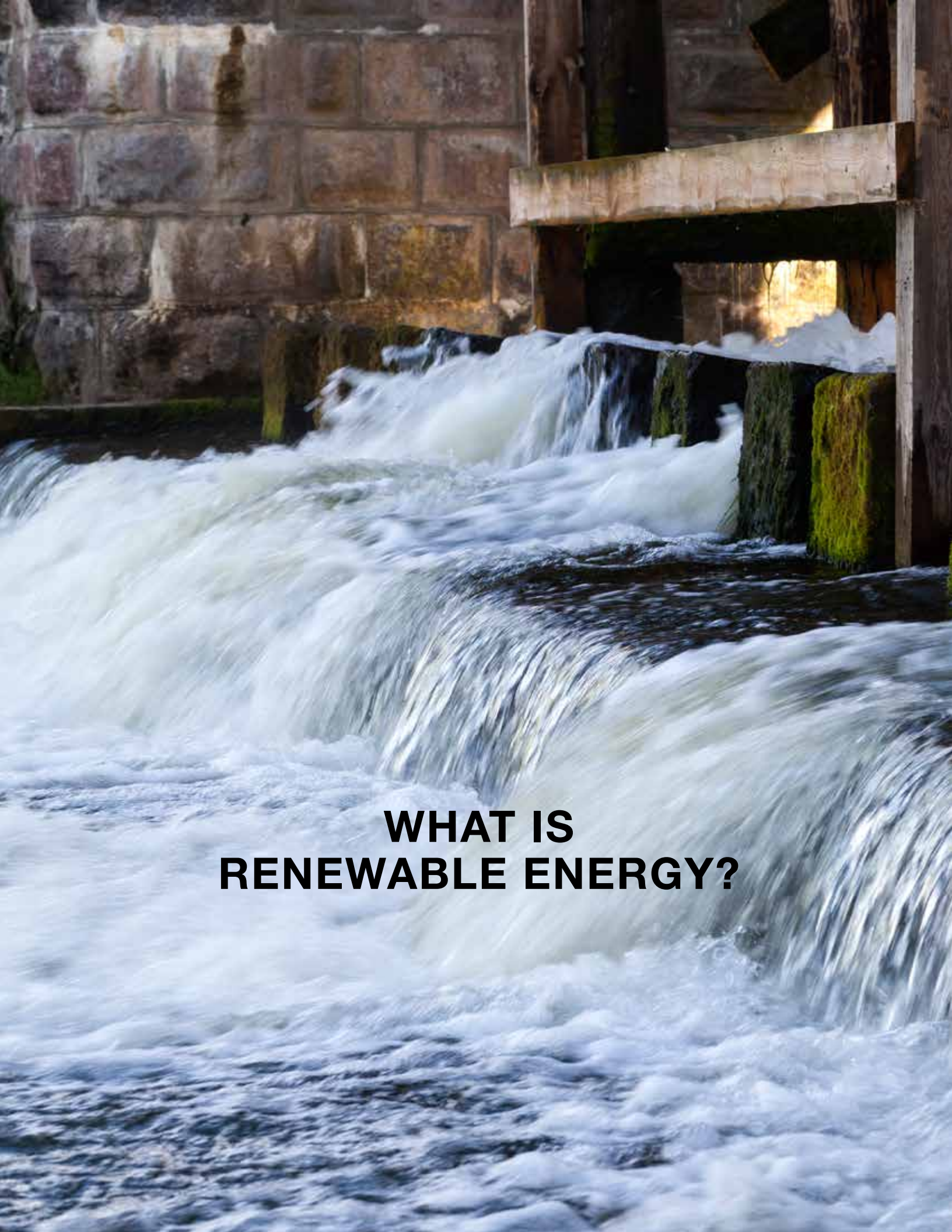
Information and data was primarily sourced from reports and news about the sector plus online websites regarding specific projects. Sources are footnoted where applicable.

## 1.3 Limitations

This report was initially written in February 2017, and was revised and updated in June 2021.

Due to technological advances and international pressures the renewable energy sector is changing and developing rapidly. Information in this report was primarily sourced from annual reports which quickly become outdated, plus online websites which are often not up-to-date. As such this report provides a snapshot in time, and may not reflect ongoing developments.

2 https://skeenawild.org/wp-content/uploads/2020/05/skeena2050_in_words.pdf



# WHAT IS RENEWABLE ENERGY?

# 2 WHAT IS RENEWABLE ENERGY?

Renewable energy is generated from natural processes that are continuously replenished, such as biomass, earth (geothermal) energy sources, flowing rivers, rain, sun rays (solar), tides, waves, and wind. The main benefit of using renewable sources is that they are indeed renewable, are not finite, and the original source is not depleted when they are utilized. Depending on the source, renewable energy may be called clean energy, alternative energy, or green power. However, it's important to recognize that producing energy from renewable sources can have environmental impacts, just like energy-producing processes that utilize non-renewable sources.

To further explain what renewable energy encompasses, well-known sources are summarized below.

**Biomass and Bioenergy**

Biomass energy, or bioenergy, is the energy stored in biomass — non-fossil organic materials such as wood, straw, vegetable oils and wastes from forestry, agriculture and industry, as well as municipal solid waste.

The majority of Canada's biomass energy is in solid form, such as wood chips, sawdust, wood pellets, charcoal, and garbage. Like the energy in non-renewable fossil fuels, bioenergy is derived from solar energy stored in plants through the process of photosynthesis. Similar to coal and oil, when biomass is burned, stored energy is released as heat. However, burning biomass releases carbon dioxide, and the amount of energy produced by burning a specific volume of biomass - such as wood pellets – is less than the energy produced by burning the same volume of coal. Wood typically has one quarter to one third of the specific energy (MJ/kg), or energy density, of hydrocarbon resources which means that burning wood for energy is associated with greater initial carbon dioxide emissions[3]. Pound for pound, coal produces more heat energy than wood pellet biomass, which means a greater volume of wood pellets must be burned to produce the same heat energy as a smaller mass of coal. So while it makes sense for forestry companies to utilize waste wood – residues from logging and milling – to make pellets instead of burning slash (waste) piles in the bush, grinding up healthy, young, and mature forests to make pellets or biofuels is not good practice.

3 Pojar, Jim. Forestry and Carbon in BC. February 2019

Likewise, logging old forests (including irreplaceable old growth) solely to produce pellets makes no sense economically, ecologically, or in terms of carbon stewardship. High-grading old decay-rich forests to retrieve saw logs for milling or whole log export, while producing pellets from the rest, is a bankrupt approach. Salvage logging strictly to produce pellets from beetle-killed or fire-killed forest often compromises the recovery of already stressed forests. Stands partially affected by beetles or fire will continue to sequester and store carbon and provide wildlife habitat, and could contribute to mid-term timber supply, thus could be managed for continued provision of multiple values instead of mere salvage[4]. For these and other reasons, the environmental impacts of utilizing renewable forests for fuel can be greater than anticipated when compared with non-renewable energy sources.

Another renewable biomass resource is landfill gas or methane, which is produced by the anaerobic digestion of municipal solid waste. The use of this resource is becoming more widespread, and global energy-from-waste projects include steam production for industrial or commercial use or electricity generation. Biofuels, such as methanol and ethanol, are liquid fuels produced from biomass.

Bioenergy comprises about 4% of Canada's total energy supply, and is the country's second largest source of renewable energy after hydroelectricity. Historically, consumption of bioenergy was very important for heating and cooking. Now, the pulp and paper industry is the largest industrial consumer of bioenergy with forest industries using wood wastes for firing boilers in mills to produce heat and energy.

4 Ibid.

**Flowing Water**

Renewable hydro-electric power can be produced via both run-of-river turbines set into the stream beds of flowing creeks and rivers, and more typical dam-and-penstock methods whereby a river is dammed and a lake (penstock) floods lands behind the dam. In both cases when water flows through turbines in the dam, potential energy stored in water is converted into mechanical or kinetic energy and ultimately, electricity.

**Geothermal or Earth Energy**

Geothermal systems generally use heat from the earth to regulate temperatures in residential and commercial buildings. Since the upper two to three metres of the earth remains a constant temperature, water pipes laid in the earth at those depths can be used to heat and cool buildings via a heat exchanger.

On a larger scale, wells may be drilled into hot springs or underground reservoirs of hot water, then a geothermal power plant can use the steam to power a turbine/generator, or the hot water can be boiled and the steam used to turn a turbine.

### Rainwater

Since approximately 2014, rainwater flowing off residential roofs and into gutters and downspouts has been harnessed to produce power via micro-turbines. Although the authors of this report were unable to find examples of micro-turbines in use in northwest BC, there is great potential for this technology in the region due to the prevalence of rainfall.

Another technology which converts rainwater into power via a catalytic reaction is the hydrogen boiler, which has been used in residential and small commercial operations[5]. However, the technology is in its infancy and no large commercial or industrial projects that convert rainwater to power are underway at the time this report was written.

### Solar or Sun Rays

The sun is a powerful source of energy that can generally be used either for heating or to create power via photovoltaic panels. Since the sun doesn't shine 24 hours per day, the biggest challenge that solar energy systems have to solve, is how to store power so that it's available when needed.

Solar energy systems are composed of photovoltaic cells – panels which convert the sun's energy to electricity, inverters which convert direct current (DC) to alternating current (AC), and either a grid-tie system or batteries for storing energy.

Solar panels are most effective in direct sunlight but panels can still generate power when the sun is blocked by clouds – more than enough, in fact, to remain a viable source of electricity. For example, in both Germany and Haida Gwaii it's not particularly warm or sunny, but Germany is a world leader in solar energy and Haida Gwaii has several successful solar energy projects underway. Also, solar panels are powered by light, not heat, and because of the way the technology works, they're just as effective — if not more effective — in cooler temperatures, as in hot ones.

So contrary to what residents of northwest BC may think, both grid-tie (systems that are connected to BC Hydro and Power Authority's hydroelectric grid system) and off-grid (not grid-connected) solar power systems can operate successfully in northwest BC. Skeena Energy Solutions' website[6] provides a useful overview of small residential and commercial systems operating in the region.

5 www.renewableenergyfocus.com/view/42554/converting-rainwater-into-energy/

6 skeenaenergy.com/projects/solar/

**Tides**

Tidal energy is produced by the rising and falling of tides according to the pull of the moon. Capturing tidal energy has significant potential environmental impacts and is quite costly, as such very few tidal energy projects have been developed globally.

There are three ways tidal energy is harnessed: by placing turbines in tidal streams (fast flowing 'rivers' of tidal change), by constructing a barrage or dam to capture the energy of tidal flow – similar to dams that are built in a river, or by constructing a partial dam across a bay to create a tidal lagoon with turbines that are powered by the incoming and outgoing tides.

Nova Scotia is considered a prime location for tidal energy projects and in September 2018, the Nova Scotia government issued a permit to test a turbine project in the Bay of Fundy.

**Waves**

Wave energy is generated from the power found in ocean waves, with the energy available dependent on the wave's length and height. Wave energy is highly forecastable and since waves are created by collecting wind energy over large areas, it's considered relatively persistent.

Wave energy devices are designed to capture the energy found near the surface of the water and convert it to power. The energy harvesting devices exploit the changing water surface from wave trough to crest and the dynamics of water movements in the wave.

There are five basic types of wave energy devices:

- BUOYS – floating structures which are carried up and down and/or pushed side to side by the waves and convert that movement into power to drive a generator.
- SURFACE FOLLOWING – floating structures hinged together following the surface movement of passing waves using the relative motion of the parts to drive a generator.
- OSCILLATING WATER COLUMN – enclosed column of air which rises and falls with the motion of the waves, pushing out and sucking back through a turbine which drives a generator.
- TERMINATORS – a line of floating structures placed facing the oncoming waves and forced to move against each other using the power to drive a generator, and
- OVERTOPPING – an offshore reservoir is created as waves flow up a ramp into the structure, then flow back out through a turbine that drives a generator.

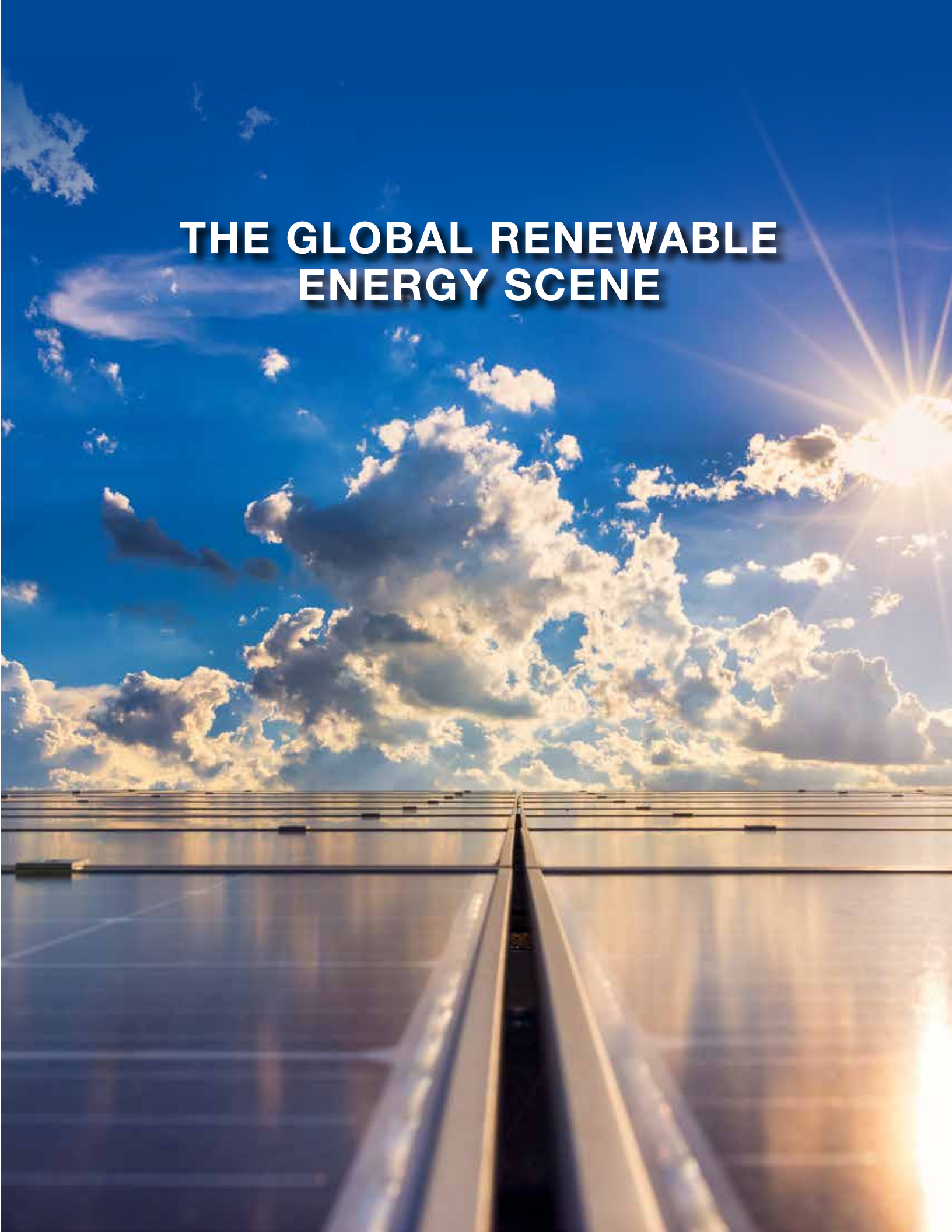
The west coast of BC has been identified as having some of the best wave energy potential in the world, and two projects off the west coast of Vancouver Island have received funding so that industry and the BC government can develop modeling expertise, advance the development of wave energy projects in BC, and provide critical information to wave energy device developers[7].

7 www.cleanenergybc.org/about/clean-energy-sectors/wave

**Wind**

Wind is used to turn the blades of a windmill which spins a turbine inside a small generator, and then produces electricity. Wind farms are simply a collection of wind turbines that harness the natural energy of wind.

In northwest BC, wind turbines have been considered for offshore and near shore locations where the wind from the ocean could produce consistent power. High wind speeds are not generally considered beneficial – it's consistent wind that commercial operations seek.



# THE GLOBAL RENEWABLE ENERGY SCENE

# 3 THE GLOBAL RENEWABLE ENERGY SCENE

Renewable energy has gained significant support and garnered great interest as the effects of greenhouse gases – primarily due to the use of non-renewable energy sources by humans – have become the clear culprits in the rapid advancement of climate change. As such, over the past 15 years or so, renewable energy research, technologies and projects across the globe have rapidly expanded.

In 2004, only 48 countries had energy policy targets, but now, more than 164 countries have renewable energy program targets, and global investments into renewable energies have increased more than 500%. Since 2006, annual renewable energy investments have risen from $45 billion (US) to $270 billion, with the largest gains seen in the solar power sector. Since 2009, the price for solar generated electricity has dropped 62% and it's now being manufactured at a record breaking pace.

In 2013, renewables provided 19.1% of the energy demanded globally, and bio-fuel production increased after a plateau in 2011-2012. However, the fastest growing renewable energy sectors are wind, solar photovoltaic, and hydroelectric power.

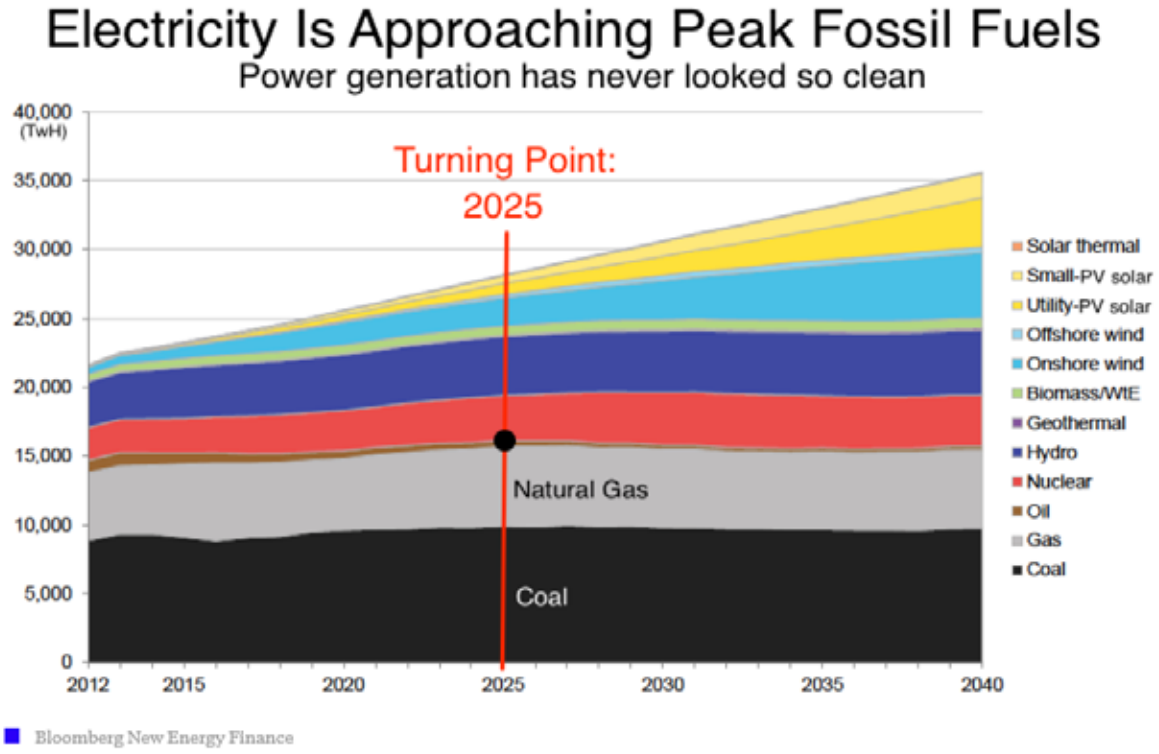
In 2014, the worldwide renewable energy sector hit an all-time high, providing more than 7.7 million jobs, and in 2015, the world added an additional 400,000 jobs to the renewable energy sector.

Although global investment continues, only about 20% of current global energy needs are derived from renewable sources. However, major milestones have been achieved since 2012[8], and the proliferation of renewables in the energy market in recent years is due to the increased cost-competiveness of renewable sources compared to conventional methods of energy production.

Renewable energy is quickly becoming a mainstay of global energy production, and China is leading the world in renewable investments with wind, hydro and tidal energy at the top of the investment list[9].

8 World Energy Council. *World Energy Perspectives, 2016: Executive Summary*. 2016.

9 Reuters. *China to plow $361 billion into renewable fuel by 2020.* January 4, 2017.



Uruguay set a record in 2015 by getting 95% of its electricity from clean energy sources – a big shift from 2000 when 27% of the country's imports were oil. Now, the biggest item on Uruguay's import balance sheet is wind turbines, which fill the country's ports on their way to installation. Biomass and solar power have also been ramped up, and adding to existing hydropower, this means that renewables now account for 55% of the country's overall energy mix (including transport fuel) compared with a global average share of 12% [10].

In 2016 Portugal powered their entire country with renewable energy for four days. During that time, the country's electricity consumption was fully covered by solar, wind and hydro power[11].

Meanwhile, 2016 was the first year that global renewable energy generation surpassed that of coal, suggesting that global dependence on fossil fuels will drop drastically by 2026[12].

In 2017, Tesla and Panasonic launched their new Gigafactory[13] to build a better battery system and take Tesla's electric cars to a new level. It's forecasted that electric cars will make up 35% of the global vehicular market by 2035.

Not only that, but in 2018, Japan finished building the largest floating solar plant in the world – on a reservoir – in an effort to exploit more renewable energy in the wake of the 2011 Fukushima disaster[14]. Plus India is now home to the world's first solar powered airport. Cochin International Airport's solar power plant produces 50,000 to 60,000 units of electricity per day which are consumed by its operational functions, making the airport 'power neutral'[15].

In 2018, Renewable Energy Policy Network for the 21st Century (REN21) reported the following in their 2018 Global Status Report.

*Positive developments show that the renewable energy transition is possible, but advances so far are uneven across sectors. The year 2017 was another record-breaking one for renewable energy, characterised by the largest ever increase in renewable power capacity, falling costs, increases in investment and advances in enabling technologies. Many developments during the year impacted the deployment of renewable energy, including the lowest-ever bids for renewable power in tenders throughout the world, a significant increase in attention to electrification of transport, increasing digitalisation, jurisdictions pledging to become coal-free, new policies and partnerships on carbon pricing, and new initiatives and goals set by groups of governments at all levels.*

*Increasingly, sub-national governments are becoming leaders in renewable energy and energy efficiency initiatives. At the same time, many developing and emerging countries are expanding their deployment of and investment in renewables and related infrastructure. The private sector is also increasingly playing a role in driving the deployment of renewable energy through its procurement and investment decisions.*

10 www.theguardian.com/environment/2015/dec/03/uruguay-makes-dramatic-shift-to-nearly-95-clean-energy
11 www.theguardian.com/environment/2016/may/18/portugal-runs-for-four-days-straight-on-renewable-energy-alone
12 International Energy Agency. *IEA Raises Its Five-Year Renewable Growth Forecast as 2015 Marks Record Year.* October 25, 2016.
13 www.bloomberg.com/news/articles/2017-01-04/tesla-flips-the-switch-on-the-gigafactory
14 www.theguardian.com/environment/2016/jan/27/japan-begins-work-on-worlds-largest-floating-solar-farm
15 cial.aero/Pressroom

According to Clean Energy Canada, there are five trends which are driving this global energy transition16:

1. China is a clean energy leader. The country is banking on clean energy technology exports to compete with USA and Russia's oil and gas, thereby becoming the world's leader in renewable energy and electric vehicles.
2. Big oil companies such as Shell, are investing in renewable energy.
3. Multi-national corporations are choosing to use clean energy, and have made it a badge of honour. As of April, 2021, 386 United States-based organizations – including Google LLC, Microsoft Corporation, Intel Corporation, The Proctor and Gamble Company, Equinix Inc., Apple Inc., Bank of America, Wells Fargo, Samsung Electronics, and Cisco Systems Inc. – were powered by 100% renewable energy. These organizations utilized nearly 47 billion kilowatt-hours of green power, which is equivalent to the annual electricity use of more than 4.4 million average American homes[17].
4. Countries are setting dates when sales of internal combustion energy (ICE) vehicles will be prohibited. This includes Norway (2025), Netherlands (2030), Scotland (2032), and France (2040).
5. Energy is going virtual. The largest virtual power plant to date will soon be finished in Australia, digitally connecting solar panels and Tesla batteries, allowing excess energy to be stored for when it's needed.

Since 2018, the renewable energy landscape has continued to change. Concerns about climate change and the need for action have grown worldwide. International calls for net-zero by 2050 whereby there is an equal balance between anthropogenic emissions of greenhouse gases to the atmosphere and anthropogenic removals of those gases, have resulted in many countries pledging change.

The COVID-19 pandemic in 2020 and 2021 caused economic crises and drastic changes in the global energy landscape. According to McKinsey & Company, a consulting company that studies markets, trends, and emerging best practices in every industry and region, the world's energy systems are going through rapid transitions that are triggered by shifts in technological development, regulations, consumer preferences, and investor sentiments. In 2020, total global energy demand dropped by 7% due to reduced economic activity as a result of COVID-19 and McKinsey & Company anticipates that it will take until late 2021 to see energy demand return to pre-COVID-19 levels [18].

McKinsey & Company notes that there is growing momentum toward decarbonization of the global economy and the coming decades will likely see an acceleration of the energy transition away from fossil fuels. Additionally, renewable resources continue to decline in cost, and when combined with battery technology, renewables will become cost competitive with fossil-fuel-based power generation in many parts of the world. Similarly, electric vehicles (EVs) are likely to become the most economic choice in many parts of the world in the next five years[19].

McKinsey & Company also suggest that cheaper renewables will result in a sharp uptake in the installed capacity of solar photo-voltaics and onshore and offshore wind, surmising that 5 TW of new solar and wind capacity will be installed by 2035 - equivalent to fivefold growth from today. By 2050, 50% of global energy generation will come from renewable sources[20].

16 Clean Energy Canada. Tracking the Energy Revolution, 2018. 2018
17 www.epa.gov/greenpower/green-power-partnership-100-green-power-users
18 McKinsey & Company. *Global Energy Perspective 2021.* January 2021.
19 ibid
20 ibid

These aren't pie-in-the-sky predictions. BloombergNEF (BNEF) also predicts that wind and solar sources will supply almost 50% of worldwide electricity by 2050, ending the era of fossil fuel dominance in the power sector[21]. BNEF states that companies, governments and households invested $303.5 billion in new renewable energy capacity in 2020, including the biggest-ever build-out of solar projects and $50 billion in offshore wind capacity. An additional $139 billion was spent on electric vehicles and associated charging infrastructure, totalling over $500 billion in investment in the energy transition sector in 2020 – an impressive nine percent greater than the amount spent in pre-pandemic 2019.

Jon Moore, chief executive of BNEF said, 'The coronavirus pandemic has held back progress on some projects, but overall investment in wind and solar has been robust and electric vehicle sales jumped more than expected. Policy ambition is clearly rising as more countries and businesses commit to net-zero targets, and green stimulus programs are starting to make their presence felt. This should drive increasing investment in the coming years.'[22]

In 2020, the top five countries investing in energy transition away from fossil fuels were: China ($135 Billion), USA ($85B), Germany ($29B), Japan ($27B), and the United Kingdom ($26B). Global investment in renewable energy capacity – excluding large hydro facilities - is about $300 billion. Solar led the way, with investment of $148.6 billion, up 12%, while wind saw a 6% decline to $142.7 billion. The latter figure disguises a record year for offshore wind, and a sizeable fall in onshore wind commitments. Biomass and waste-to-energy capacity attracted $10 billion in capacity investment, down 3% on 2019.[23].

These trends are well-recognize with the International Renewable Energy Agency, which states, 'New solar photovoltaic and onshore wind power are on the verge of costing less than the marginal operating cost of existing coal-fired plants and steadily improving competitiveness has made renewables the backbone of the world's energy transformation.'[24]

BNEF predicts that by 2025 solar power will be cheaper than coal production.

In May 2021, the International Energy Agency released a flagship report titled *Net Zero by 2050: A Roadmap for the Global Energy Sector which is the world's first comprehensive study of how to transition to a net zero energy system by 2050 while ensuring stable and affordable energy supplies, providing universal energy access, and enabling robust economic growth. It sets out a cost-effective and economically productive pathway, resulting in a clean, dynamic and resilient energy economy dominated by renewables like solar and wind instead of fossil fuels. The report also examines key uncertainties, such as the roles of bioenergy, carbon capture and behavioural changes in reaching net zero. The report summarizes that the global energy sector holds the key to responding to the world's climate crisis; however, achieving net-zero emissions by 2050 will require a complete transformation of the global energy system.*[25]

With so much support for renewable energy and global momentum for decarbonisation, it's a great time to be invested in the renewable energy sector. The following section summarizes Canada's involvement.

21 BloombergNEF. *New Energy Outlook 2019*. 2019
22 BloombergNEF. *Energy Transition Investment Hit $500 Billion in 2020 – For First Time.* January 19, 2021
23 BloombergNEF. *Energy Transition Investment Trends*. 2021
24 International Renewable Energy Agency. *Renewable Power Generation Costs in 2018*. 2018
25 International Energy Agency. *Net Zero by 2050: A Roadmap for the Global Energy Sector*. May 2021

# RENEWABLE ENERGY IN CANADA

# 4 RENEWABLE ENERGY IN CANADA

Unlike China which tops the list of global investments for renewable energy technologies, in 2015, Canada only ranked in the top five for renewable energy investments in two categories: hydropower capacity investment and ethanol production[26]. In terms of renewable energies, Canada ranked third in hydropower generation, and fifth overall for hydroelectricity capacity, meaning that Canada relies on hydroelectricity for most energy needs and the use of hydroelectric power in Canada is exceedingly high.

However, in 2015, there were nearly 26,900 direct renewable energy jobs which employed Canadians, which Clean Energy Canada suggested surpassed that of the oil and gas sector in 2014. The same year, $11 billion was invested into new clean energy projects in Canada, in increase in investment of 88% over 2013. Between 2010 and 2014, a total of $31.36 billion was invested in renewable energy.

Due to the downturn in the oil and gas sector of Canada's economy, renewable energy sources are slowly coming online, and training opportunities are increasing as out of work oil and gas sector employees upgrade their skills for the clean energy sector. Iron and Earth is an organization founded in 2015 which aims to connect skilled workers with projects in the renewable energy sector[27].

In 2016, 17.4% of Canada's energy supply came from renewable sources, compared to 13.4% for the rest of the world lumped together. Canada ranked seventh (at 3%) in the world in terms of renewable energy production, outranked by China (first at 14%), India (second at 11%), and USA (third at 8%)[28].

The vast majority of Canada's renewable energy (67.5%) comes from moving water or hydroelectric sources, with 22.6% coming from solid biomass (wood waste), and 5.4% from wind. In 2016, Canada was the second largest producer of hydroelectric power in the world with China ranked first. That year, a total of 563 hydroelectric power facilities in Canada produced 80,859 megawatts of power. Six of the largest producing plants are located in Quebec, three are located in BC, and one is situated in Newfoundland/ Labrador[29].

Biomass is Canada's second largest source of renewable energy, and there are 111 electricity and co-generation facilities with capacity of at least 1 MW in Canada which use biomass. There are also 364 bio-heat projects, of which 70% produce less than 1MW. Institutions, including schools and hospitals, are the strongest market for bio-heat in Canada.

26 Renewable Energy Policy Network for the 21st Century. Renewables 2015 Global Status Report – Executive Summary. 2015

27 www.ironandearth.org

28 www.nrcan.gc.ca/energy/facts/renewable-energy/20069

29 www.nrcan.gc.ca/energy/facts/renewable-energy/20069

Wood derived material is the largest source of biomass in Canada and comes from four sources: solid wood waste, liquid wood waste, pellets and firewood.

Wind energy is one of the fastest growing sources of electricity both in the world, and in Canada. Canada ranks ninth in the world in terms of global wind power capacity at 2%, with China leading the world at a whopping 35% of global production. In 2017, Ontario (4,900 MW), Quebec (3,510 MW) and Alberta (1,479 MW) led Canada's wind energy production.

In 2017, Canada ranked ninth in the world in solar power production, with China again leading at 33% of global productions. Total solar production capacity in 2017 in Canada was 2,911 MW, with almost all of Canada's solar power farms located in Ontario.

Canada also produces 2% of the world's liquid biofuels, which are enhanced biomass-derived fuels such as ethanol or renewable diesel fuels. These liquid biofuels are mixed with traditional gasoline and diesel to reduce the overall greenhouse gas emissions associated with the blended fuel[30].

In 2021, the Canada Energy Regulator (CER), a federal organization which reviews energy development projects and enforces their safety and environmental standards, stated that Canada is a world leader in renewable power and generates almost two-thirds of its electricity from renewables with hydro as the dominant source.[31] Further, as of March 2021, CER advised that

- By 2023, 71% of Canada's total electricity generation will be from renewable sources.
- New large-scale hydro, wind, and solar projects will increase the renewable sources of Canada's electricity to 71% by 2023.
- Hydro is the dominant source of electricity in Canada accounting for 55% of total installed capacity and 59% of generation. British Columbia, Manitoba, Quebec, Newfoundland and Labrador, and Yukon derive more than 90% of their power from hydro.
- The provinces with the highest percentage of non-hydro renewable electricity generation are PEI (100%), Nova Scotia (15.8%), and Ontario (10.5%).[32]

Additionally, the renewable energy sector was helped along in 2021 by the federal budget which was billed as '*a plan to build a clean economy, with tax incentives to grow zero-emission technology manufacturing, carbon capture, utilization, and storage, and green hydrogen.*'[33]

It included providing $5 Billion for the Net Zero Accelerator program which is geared to help large industry decarbonize projects and scale up clean technologies; an investment tax credit for carbon capture, utilization, and storage (CCUS) technologies; and interest free loans to enable homeowners to conduct home energy retro-fits including adding on site renewable energy sources such as solar photovoltaic panels.

Meanwhile, the Canadian Renewable Energy Association (CERA) believes that growing corporate demand and customer interest in wind and solar energy, industry optimism, and government policy commitments promise strong growth in the renewable energy sector in 2021 and beyond. Data from CERA indicates that in January 2021,

- Canada's total wind capacity was 13,588 MW and total solar capacity was approximately 3,000 MW
- New wind power generation installed in 2020 was 166 MW, and new solar power generation installed in 2020 was 70 MW
- The capacity of solar energy projects currently under construction, for commissioning in 2021 is 240 MW and the capacity of wind energy projects currently under construction, for commissioning in 2021 is 745 MW.[34]

30 www.nrcan.gc.ca/energy/facts/renewable-energy/20069

31 https://www.cer-rec.gc.ca/en/about/news-room/news-releases/2021/prairie-provinces-to-lead-canada-in-renewable-energy-growth.html

32 Canada Energy Regulator. *Canada's Renewable Power*. Online report, March, 2021

33 https://www.canada.ca/en/department-finance/news/2021/04/government-of-canada-highlights-budget-2021-investments-to-create-a-healthy-environment-for-a-healthy-economy.html

34 https://renewablesassociation.ca/forecast-the-future-is-bright-for-renewable-energy-in-canada/

Overall, there is significant room for Canada's renewable energy sector to grow and forecasters suggest that by 2050, 100% of Canada's energy needs could potentially be supplied by renewable energies, which would generate more than 700,000 direct and indirect jobs. At a time when Canada needs to both recharge the economy and tackle the climate crisis, the renewable energy sector provides significant opportunities.

## 4.1 Summary of the Renewable Energy Sector in British Columbia

According to Clean Energy BC, clean energy projects are an important part of the future of British Columbia. The Province has abundant clean energy resources, and the prudent, cost-effective development of these resources is fundamental to the province's future prosperity and sustainability.

The renewable energy sector in BC has evolved from a handful of small development companies to 146 substantial development, operating, and supply chain companies delivering approximately 16% of the Province's supply. The energy mix includes proven technologies such as small (run-of-river) hydro, wind, solar, natural gas, biomass, and biogas and emerging technologies such as geothermal, ocean/tidal, and biofuels[35].

British Columbia holds huge potential for renewable energy production, however, the province continues to fall behind Ontario and Quebec when it comes to renewable energy capacity generation and overall investment. In 2014, BC's investment in the clean energy sector was just over $5.2 billion and grew by 12% but with a favourable provincial government, BC could be on the cutting edge of the renewable energy sector in Canada.

According the Pembina Institute, there were an estimated 14,100 jobs in BC in 2015 that are related to the clean energy economy[36]. Hydroelectric power production was a source of 5,800 jobs, there were 4,400 biomass and biogas-related jobs, 2,600 jobs related to run-of-river projects, and 1,300 jobs in the solar and wind power sector.

In 2015, there were 156 renewable energy projects in BC, with nearly a quarter of those under construction. Solar power, run-of-river hydroelectric power projects, large scale hydroelectric projects, plus biomass and bio fuels are becoming more prevalent in BC and continue to prove to be economically viable.

Forecasts by prominent organizations indicate that renewable energies are globally on track to overtake fossil fuels in the next eight years. British Columbia has a huge opportunity to benefit from the transition to renewable energy as innovation and technology associated with the sector continues to grow throughout the province, and in 2019 the BC government launched CleanBC. This initiative includes a plan to increase the use of clean and renewable energy in transportation, construction, and fuelling industry. The 2021 BC provincial budget included funding for the CleanBC initiative, primarily supporting rebates for those purchasing zero emission vehicles through the Go Electric program, a PST exemption on electric bicycles, funding to develop policy on reducing the carbon intensity of fuels, and growing the hydrogen economy.

35 www.cleanenergybc.org
36 www.pembina.org/bcjobsmap

### 4.1.1 SOURCES OF RENEWABLE ENERGY IN BC

The renewable energy sector in BC is composed of eight different types of technologies, each of which are summarized below[37].

**Biomass**

Biomass energy generation is the creation of heat and/or power from carbonaceous substances such as solid wood or wood residues, agricultural crop residues, aquatic plants, animal wastes, and dedicated energy crops such as tree farms.

Biomass energy can refer to stand-alone heat generation such as lumber drying kilns associated with sawmills, stand-alone power generation, or cogeneration of heat and electricity which is common at pulp mills. Technologies utilized to create bioenergy include direct combustion, gasification, fast pyrolysis, fermentation, and gas collection.

Bioenergy production in BC is limited to wood and wood residues, plus landfill gas collection. In 2018, pulp and paper facilities currently had over 600 MW of capacity, with 30 MW produced by plywood mills, plus 65 MW produced by Clean Energy Producers. Future woody biomass sources in the province include existing mill wood residues, roadside debris and standing pine beetle. Although biomass is generally considered to be renewable and carbon neutral, when total cost accounting is conducted and current science is considered, biomass does not end up carbon neutral which is contrary to many provincial claims. Hence it's important to carefully consider the source of biomass – and whether utilizing biomass for energy is its best use – prior to asserting that biomass is part of a renewable energy solution.

**Geothermal**

In areas of volcanic activity or at the juncture of the earth's tectonic plates, heat from the earth's molten core flows toward the cooler surface to form hot springs, geysers, steam vents, and boiling mud pots. Geothermal power plants utilize subsurface hot water or steam created by heat beneath the earth's surface to create power. High temperature (240° C+) sources are extracted via standard wells as hot water or steam to power turbines and produce electrical energy. Low temperature geothermal sources can be utilized to heat and cool residential and commercial buildings by installing heat pump systems.

While initial project investments are high, lifetime power plant costs are low because the fuel source is free, it's located at the plant site, and it's renewable. Plants can operate continuously at up to 98% capacity because they have a constant source of fuel and require little downtime for maintenance, plus plants are not affected by weather conditions.

BC Hydro has identified 16 prospective geothermal sites in the province, with the six most likely prospects having an estimated geothermal potential of over 1,000 megawatts collectively. The best prospect for immediate development in BC is the South Meager Geothermal Project located 55 km north of Pemberton. South Meager, with average temperatures of 260 degrees Centigrade, has been assessed as having a

37 www.cleanenergybc.org/about/clean-energy-sectors

potential generating capacity of up to 100 MW (enough to supply 80,000 homes). Other geothermal prospects include Pebble Creek at North Meager (est. 300–700 MW); Canoe Hot springs near Valemount (est. 50 MW); Mount Cayley near Squamish (est. 20–100 MW); Lakelse Lake Hot Spring south of Terrace (est. 10–50 MW); and Mount Edziza in northwest BC (est. 200–800 MW). All these prospects are hydrothermal – based on hot water rather than steam.

**Large Scale Hydroelectric**

This technology is one of the most familiar, whereby electricity is generated by moving or falling water via a dam and reservoir (artificial lake) system.

Greenhouse gas emissions from large hydroelectric projects in Canada are about 60 times less than those from coal-fired power plants and approximately 18 to 30 times less than natural gas power plants. The projects have long viability – lasting 50 to 100 years - and low operation and maintenance costs once constructed. However, they also significantly impact the river ecologies that are flooded to produce reservoirs, and the downstream ecology which subsequently receives less water. All, or almost all, of the water is impounded behind the dam and the flow downstream is regulated, which changes the natural variation of flow significantly for the entire length of the downstream river. Hydroelectric dams have serious impacts on fish passage and habitat, and other migratory wildlife. The development of hydroelectric dams often results in the loss of important agricultural lands. Reservoirs can also alter weather patterns in the valleys where they are built. In BC, large scale hydroelectric projects are considered those greater than 50 MW.

Hydroelectricity is British Columbia's largest source of electric power generation and BC Hydro is the largest electric utilities in British Columbia, operating 31 hydroelectric facilities and three thermal generating plants.

Most of BC Hydro's 11,800 megawatts (MW) of installed generating capacity is located away from the province's major population centres and delivered to customers through a network of nearly 80,000 kilometres of transmission and distribution lines. BC Hydro's hydroelectric facilities provide over 95% of the total electricity generated – between 42,000 and 52,000 gigawatt hours (GWh) of electricity per year during the past five years – and are located throughout the Peace, Columbia and Coastal regions of B.C.

**Run-of-River**

ROR projects have a smaller environmental footprint compared to traditional reservoir storage hydro projects, since ROR projects typically have very little water storage capacity compared to reservoirs of conventional large hydro projects. The advantage of not having a large amount of water storage is that less land has to be flooded and therefore the potential footprint impacts are reduced, but without storage, ROR projects can only supply electricity as the river flow allows and flow conditions conducive to ROR power generation in BC do not always correspond to times when electricity demand in the province, is high.

As of late 2014 there were 56 independent run-of-river projects supplying electricity to BC Hydro and another 25 that were anticipated to reach operation by 2018 in BC. Nearly two-thirds of these projects had an installed capacity of less than 10 megawatts (MW) and an additional 15% of projects were 50 MW or more. No additional information regarding the number of run-of-river projects in BC in 2021, was identified.

**Solar**

Solar photovoltaic (PV) power is the conversion of sunlight into electricity via solar cells within a solar panel or module. To date, energy has been very cheap in Canada, but with oil and gas prices rising, solar power has an important role in filling some demand.

B.C.'s best solar energy resources are located in the northeast and southern interior of the province, with additional potential in areas along the southeast coast of Vancouver Island and the Lower Mainland. The annual solar radiation in the Kootenay Region is among the highest in the country.

Currently, in BC, PV modules are mainly used to power radio repeater stations, monitoring stations and off-grid communities in remote areas. For these applications the costs of

PV technology compete aggressively with the costs of electricity derived from fossil fuel. Areas requiring extensive power line construction may find solar PV to be more cost effective as well.

The Sunmine Solar Power Project[38] in Kimberly is the first MW scale project in British Columbia as well as the first Canadian project of its size outside of Ontario.

The Tsilhqot'in Solar Farm is the first large-scale solar power plant 100% owned and operated by a First Nations in Western Canada

**Tide**

BC has numerous areas of tidal energy potential, located in the coasts many fjords and channels. The west coast of BC has been identified as having some of the best tidal energy potential in the world. A 2006 tidal energy resource assessment identified 89 tidal energy project sites in BC with an estimated 4,000 MW of potential energy.

Modern tidal turbines are also being installed in rivers, irrigation canals, wastewater flows, and estuaries and BC's abundant river and estuary networks provide further renewable energy opportunities for the majority of its population.

In September of 2006, Clean Current Power Systems installed a tidal turbine at the Race Rocks ecological station. The turbine, in combination with a solar and battery system, became the first complete ocean energy power system displacing diesel on the island.

**Wave**

The west coast of BC has been identified as having some of the best wave energy potential in the world, including the west coast of Vancouver Island and Haida Gwaii. Wave energy is highly forecastable, and, since it collects wind energy over large areas, is relatively persistent. Wave energy is also most intense in winter months when BC energy needs are highest.

Two wave energy projects have received provincial ICE funding: SyncWave Energy Systems and the Pacific Coastal Wave Energy Corp. Both projects are located off the west coast of Vancouver Island.

The West Coast Wave Collaboration Project is a government and industry resource assessment initiative that will develop modeling expertise, advance the development of wave energy projects in BC, and provide critical information to wave energy device developers.

**Wind**

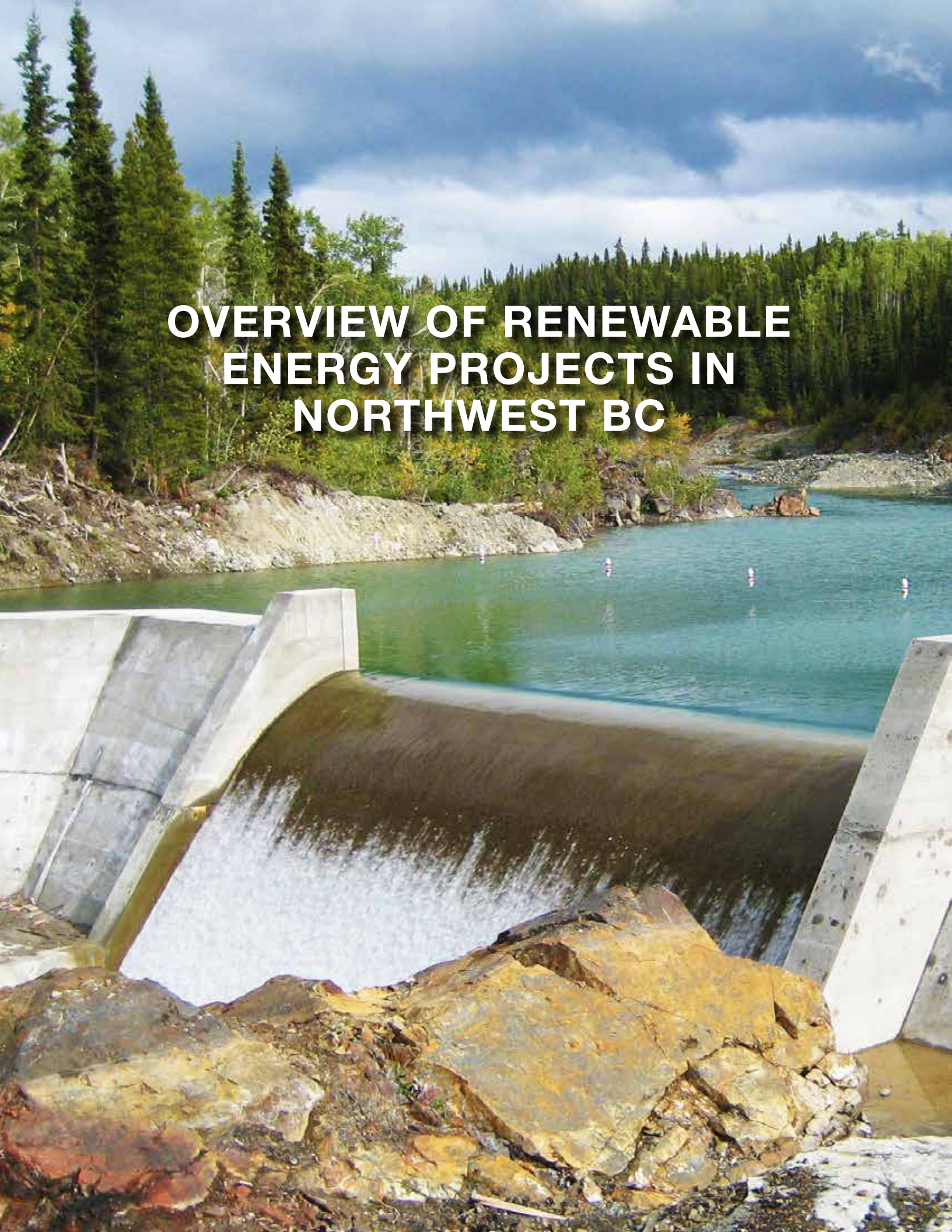
British Columbia has some of the strongest, most consistent wind regimes in Canada and the ideal hydro resource base to integrate wind power. According to Clean Energy BC, the province currently has eight operating wind power projects[39]:

- Pennask Wind Farm
- Shinish Creek Wind Farm
- Cape Scott Wind
- Dokie Ridge Wind Farm
- Bear Mountain Wind Park
- Meikle Wind Project
- Moose Lake Wind
- Quality Wind

BC also has vast offshore wind potential; particularly along the north coast where the seabed is flat, the water is shallow, and winds are strong.

38 www.sunmine.ca

39 https://www.cleanenergybc.org/about/clean-energy-sectors/wind



# OVERVIEW OF RENEWABLE ENERGY PROJECTS IN NORTHWEST BC

# 5 OVERVIEW OF RENEWABLE ENERGY PROJECTS IN NORTHWEST BC

Northwest BC is endowed with resources well suited to the renewable energy sector, and many biomass, geothermal, and run-of-river hydroelectric projects have been proposed and developed by communities, private companies, and First Nations in the region.

The advantages of utilizing renewable energy to First Nation and Settler communities is obvious and reducing a community's carbon footprint and energy costs has become a priority for many.

Several small, remote First Nations' communities rely on diesel generated power which is both costly to transport and utilize, plus produces a large carbon footprint. Many of these communities – and others that have high energy costs even though they don't rely on diesel generated power - would like to switch to renewable energy sources. However, while the desire to develop renewable energy sources is strong, the barriers to developing renewable energy projects can be overwhelming. These include lack of skills and knowledge about renewable options, lack of funds and community personnel to pursue funding opportunities, and, other infrastructure projects competing for the assets needed for renewable energy projects[40].

Fortunately, a few companies specialize in developing renewable energy in small and remote communities while working with the communities and ensuring projects benefits remain in situ. These include Barclay Project Group based in Nanaimo, BC and W Dusk Energy Group Inc. based in West Vancouver, BC both of whom work with First Nations communities in BC. Additionally, Coast Funds has funding grants available to some First Nations communities in the northwest BC region specifically for economic development projects.

Unfortunately, in 2019, BC Hydro indefinitely suspended their Standing Offer Program that purchases power from independent power producers in the province. This action stalled many renewable energy developments and in response, communities have changed course, mothballed, or had to completely revamp their renewable energy projects.

With that being said, the following is an incomplete summary of proposed and operating renewable energy projects in northwest BC although there are undoubtedly more projects in the planning stages.

40 Personal conversation with Christine Smith-Martin, Executive Director of Coastal First Nations.

### Atlin Hydro Expansion Project

Tlingit Homeland Energy Limited, a company 100% owned by Taku River Tlingit First Nation citizens, plans to expand hydro power production in Atlin, BC. The proposed project would expand the infrastructure and power production capacity on Pine Creek from 2.1 MW to approximately 10 MW. The additional energy generated would be exported entirely to Yukon to meet a shortfall in clean energy production needs in the winter. To accomplish this increase in production, the storage of the reservoir (Surprise Lake) will be increased and two new powerhouses will be developed.[41]

### Burns Lake Band Biofuel Plant

Status: Proposed
Location: near Burns Lake
Employment: Unknown
Energy Capacity: Unknown
Type of Project: Biofuel

Due to the high volume of wood waste in the Burns Lake area, the Burns Lake Band is investigating the viability of an approximately $60 million facility that would produce energy sourced from biofuel such as neighboring communities wood wastes. In 2017, the Band was in the pre-feasibility stage and received $2 million from the provincial government to start the project in conjunction with a greenhouse and fish plant[42].

41 https://thelp.ca/strategic-plan/
42 www.bclocalnews.com/news/burns-lake-band-receives-2-million

### Burns Lake Biomass Heating System[43]

The Village of Burns Lake is using a pellet boiler, in conjunction with salvaging surplus heat from a number of Village facilities, to provide heat for a community network.

### Dasque-Middle Hydro Facility[44]

Dasque-Middle Hydroelectric Facility consists of two run-of-river hydroelectric facilities - one on Dasque Creek and one on Middle Creek – which are located approximately 2.1 km apart, and flow into the Skeena River, 25 km southwest of Terrace[45]. The facility uses natural grade and flow to convey water downstream to a turbine and powerhouse.

Construction of the facility was completed in 2014 at a cost of $75 million, creating more than 200 construction jobs, and included the construction of a power line to connect the flow gates with the hydroelectric turbine. The project has contracts to supply BC Hydro with electricity until 2053 and was bought by Bluearth Renewables, in Calgary, in 2017.

43 https://bcbioenergy.ca/resources/district-energy-systems/
44 bluearthrenewables.com/projects/dasque-middle-hydro-facility
45 mecanhydro.com/work/dasque-middle-creek

**Forrest Kerr, Volcan Creek and McLymont Creek Hydroelectric Project**[46]

Status: Operating
Location: Iskut
Employment: Unknown
Energy capacity: 277 MW
Type of Project: Run-of-river

The Forrest Kerr 195 MW Hydroelectric Project[47], operated by AltaGas, is located just west of Bell II on the Iskut River. It is the largest of three AltaGas run-of-river projects on the Iskut River, generating a total of 277-MW of electricity. The 66-MW McLymont Creek and 16-MW Volcano Creek projects have similar construction, but are much smaller. AltaGas has a long-term operation agreement for these facilities with the Tahltan First Nation.

Construction on Forrest Kerr began in 2010 and reached full capacity by 2014. The cost of all three projects totaled nearly $1 billion. The facility has a relatively small footprint and houses nine, 22-MW turbines that generate enough electricity to power nearly 30,000 homes.

46 www.altagas.ca/newsroom/news-releases/altagas-announces-sale-35-percent-northwest-british-columbia-hydro-electric

47 www.power-technology.com/projects/forrest-kerr-hydroelectric-project-british-columbia

**Fort St James Green Energy Project**

Status: Operating
Location: Fort St James
Employment: 23
Energy capacity: 40 MW
Type of Project: Biomass

This biomass energy production project has a 30 year energy purchasing agreement with BC Hydro. Construction was completed from 2013 to 2017 and the company needs 200,000 tonnes/year of fibre to operate[48].

**GidGalang Kuuyas Naay (GKNS) Secondary School**

Status: Operating
Location: Haida Gwaii, Queen Charlotte City
Employment: 6
Energy Capacity: 24 KW
Type of Project: Solar

GKNS installed 84 solar panels in 2016, which produce 24 KW of electricity, offsetting about 20% of the school's energy needs. A full financial return on the panels is expected after six years of production and GKNS is expecting to increase their offset energy by installing additional panels.

Although solar energy is somewhat intermittent during the cloudy winter months, solar production jumps in the summer producing twice as much energy. The system can also be closely monitored to track energy consumption and production in real time through the online portal. This project is the largest solar installation on Haida Gwaii.

48 http://fortstjames.ca/industry-development/

**Gitksan Wet'suwet'en Education Society (GWES) Bioheat Project**

In 2020, Gitxsan Energy Inc. – a subsidiary of Gitxsan Development Corporation - converted the GWES college building heating system in Hazelton from propane heat to bio-heat by installing a new boiler that runs on wood pellets[49].

**Hluey Lake Project**

Status: Operational
Location: Near Dease Lake
Employment: Unknown
Energy Capacity: 3 MW
Type of Project: Hydro storage facility

This project was operated by Tahltan Nation Development Corporation in the early 1990's but is now operated by MPT Hydro LP. The facility provides power to the community of Dease Lake and replaces diesel fuel generated power. A new 20-year power agreement has been signed with BC Hydro.

**Kitasoo Renewable Energy Projects**

In Klemtu, the Kitasoo/Xai Xais own and operate their own small storage hydro-electric plant. It delivers clean electricity to the community year round. The system has reached capacity in recent years and Klemtu is seeking to make significant upgrades to ensure an adequate supply of clean electricity in the future. Additionally, in 2015, the Kitasoo Xai Xais installed a 23-kilowatt solar electricity project on the roof of the local school.

49 https://www.newswire.ca/news-releases/canada-invests-in-nine-community-led-indigenous-clean-energy-projects-across-british-columbia-880410606.html

**Lake Babine Nation Biomass Project**

In 2020, Lake Babine Nation finally received enough funds to construct a biomass plant to heat several buildings, including the school, clinic, and water treatment plant.[50]

**Lakelse Geothermal: Kitselas & Borealis Geopower Project**[51]

Status: Proposed, fieldwork underway
Location: Lakelse Lake, south of Terrace
Employment: Unknown
Energy Capacity: 15 MW
Type of Project: Geothermal

Borealis Geopower and the Kitselas First Nation have partnered to develop a geothermal power plant capable of generating over 15 MW of electricity - the equivalent of powering nearly 2,500 homes. The project received exploratory permits in 2014 and as of March 2019, has received approval from Kitselas Development Corporation to proceed with the remaining fieldwork required to delineate the geothermal opportunity.

**Long Lake Hydro Inc.**

Status: Operating
Location: Near Stewart
Projected Employment: Unknown
Energy Capacity: 32 MW
Type of Project: Pump storage hydro-electric

Long Lake Hydro Inc. is a pump-storage hydroelectric project located near Stewart, B.C. Construction was completed in 2012 and provides 31 MW of power. The cost of the project was more than $100 million and included refitting a dam from the 1980s, along the Cascade Creek corridor[52].

Pump storage technology stores energy in the form of potential gravitational energy. Water is pumped from a lower elevation reservoir to a higher elevation where low-cost surplus electric power is redirected to run the pumps. During periods of high electrical

50 https://www.canadianbiomassmagazine.ca/construction-on-lake-babine-nations-biomass-plant-begins/
51 www.borealisgeopower.com
52 canprojects.com/projects/hydro/long-lake

demand, the stored water is released through turbines to produce electric power. Although the system uses net energy overall, pump-storage systems increase revenue by selling more electricity during peak periods.

The property owner remains unconfirmed.

### Old Masset District Heating System

The Village of Old Masset is employing a wood biomass boiler by way of a centralized heating system for a community hall, Band office, health center, social development and child family services building, and an elementary school[53].

### Sk'aadgaa Naay Elementary School Solar Panels

This school in Skidegate has 24 solar panels to produce power needed to run sump pumps continuously.[54]

### Skidegate Band Council Heat Pumps

In 2015 and 2016, heat pumps were installed in 350 homes in the Village of Skidegate. Soon, the recreation center will also have heat pumps installed to further offset the building's electricity needs. Heat pumps will also be installed on all band-owned buildings including the community hall, daycare and rental apartments, fire hall, nursery school, and water treatment plant.[55]

### Telkwa District Heating System

Status: Operating
Location: Telkwa
Projected Employment: Unknown
Energy Capacity: 300 KW; 500,000 BTUs
Type of Project: Biomass

In an attempt to utilize vacant buildings in the small Village of Telkwa and provide alternative energy for the local school, businesses and Village offices, a biomass boiler system was constructed in 2013. Funds were provided by the Federal Gas Tax, Omineca Beetle Action Committee, and the Village of Telkwa for the $700,000 project[56].

The project utilizes bio-waste from local sawmills and logging operations, which reduces some slash burning, and contributes to a healthier air shed[57].

The system provides 90% of the heat energy needs for Telkwa Elementary School, a local restaurant, bakery, five residential homes, and the Village office. The project also provided economic benefits including short-term construction jobs and purchase of local materials. The boiler eliminates the former production of 110 tonnes of $CO^2$ per year due to via natural gas heating, and generates 300 KW hours of electricity, reducing heating costs by 35%. The Village of Telkwa alone saves more than $2,800 per year.

### Various Small Scale Systems Installed by Energy Alternatives Ltd[58].

Status: Operating business which supports the small scale renewable energy sector

Location: near Smithers
Projected Employment: Company hires 1 to 5
Energy Capacity: 300 KW; 500,000 BTUs
Type of Project: Various types, including on/off-grid solar systems, micro-hydro, small-scale wind

Energy Alternatives is the longest operating renewable energy company in Canada, operating in BC since 1984. They have installed thousands of systems across BC and Canada and in 2016 completed 40 to 45 new installations. The majority of these new systems were solar installations, integrated with high capacity batteries which allow for full off-grid energy production, however, more and more customers are opting for off-grid technology. System costs range from $10,000 to over $100,000, depending on energy capacity needs, and in 2016, company revenues exceeded $1 million.

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56 www.toolkit.bc.ca/Success-Story/Telkwa's-Deep-Collaboration-Mini-Biomass-District-Heating-System
57 www.bclocalnews.com/news/telkwa-biomass-boiler-heating-headaches
58 www.energyalternatives.ca

**Yourbrook Energy Systems Ltd**[59]

Status: Prototype testing
Location: Haida Gwaii
Projected Employment: 10 jobs
Energy Capacity: 80 KW
Type of Project: Tidal

Founded in 2010, Yourbrook is a Haida Gwaii-based energy company that specialises in tidal energy technology. Their current project consists of a prototype tidal pump system that pumps sea water to a reservoir on shore which then flows through an electric generator to produce electricity. Yourbrook's technology differs from other tidal energy generators as it aims to be a consistent stream of power by using a reservoir about 900ft above sea level. The water is released downhill through a conventional electric turbine generator.

The company received a grant worth $280,000 from the National Research Council of Canada and fundraised an additional $600,000 to get the prototype built and tested. The small-scale prototype can generate 80 kilowatts of electricity; however, some studies suggest this tidal-energy at large scale could produce nearly 250 megawatts of electricity.

The prototype launched in June 2017, and in November 2018, the company was involved in a new engineering study they hope will lead to a larger prototype.

59 www.yourbrookenergy.com

# CONCLUSIONS

# 6 CONCLUSIONS

Provincial and federal governments have recently signalled their interest in decarbonisation and renewable energy economies, through increased funding and policy development in these areas. As Canada works to rebound economically from the COVID-19 pandemic and address heightened concerns surrounding climate change, the renewable energy sector should have a strong run.

The majority of the renewable energy projects in BC are in the southwest portion of the province; however, there are many great opportunities in northwest BC to develop renewable energy projects, particularly for First Nations, and in collaboration with organizations and businesses who already operate in the sector. As socially and environmentally conscious populations continue to demand change and as the global understanding of climate change evolves, there will be ever-greater need for regional energy solutions which support the economic and environmental health of northwest BC. However, addressing barriers to renewable energy projects will be paramount for projects to proceed.

# RESOURCES

# 7 RESOURCES

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