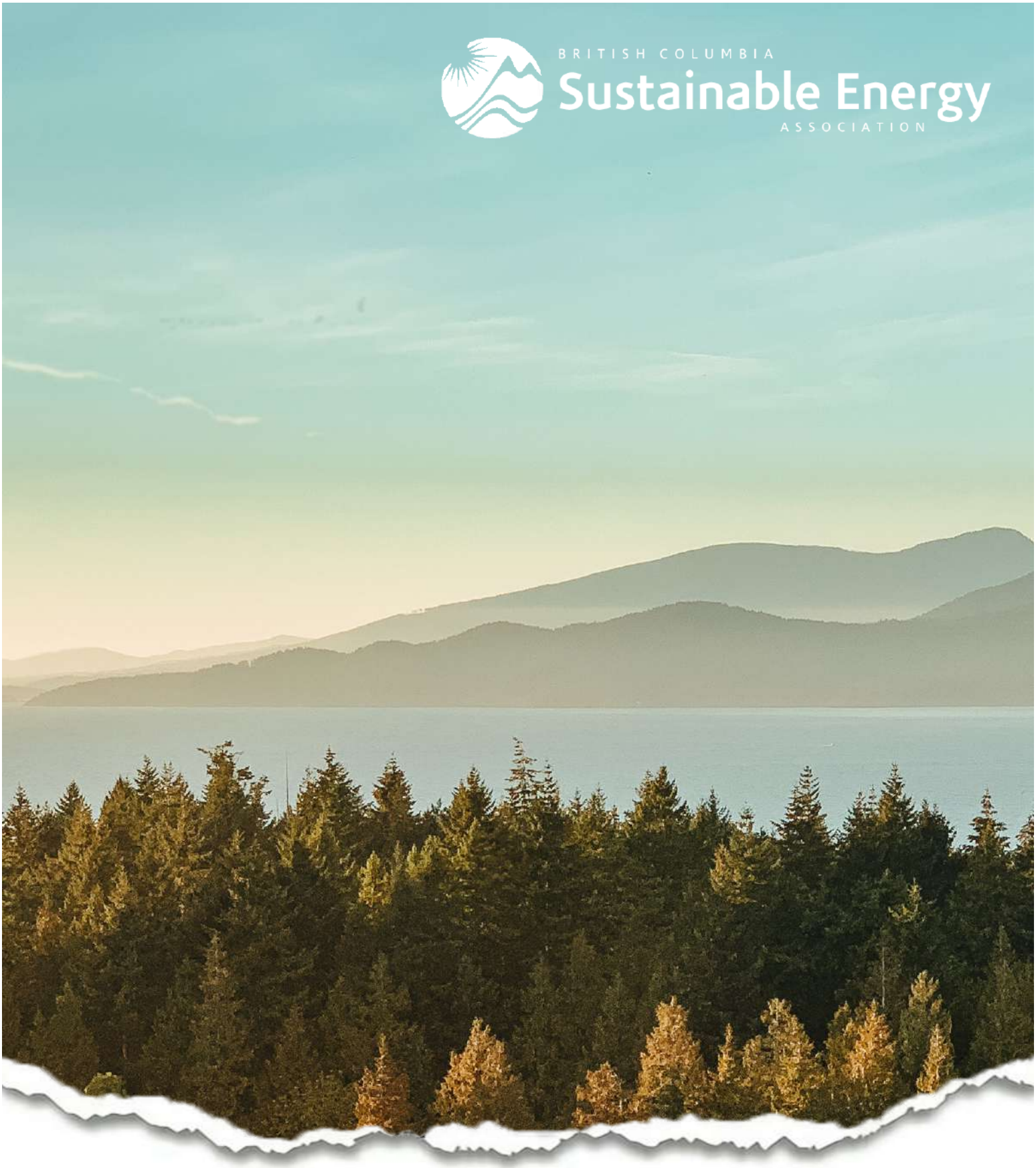

ENERGY CONNECTIONS 2019

SFU Harbour Centre | September 20, 2019

Conference Summary Report

Acknowledgments

Energy Connections 2019 was a 100% volunteer led initiative. We'd like to acknowledge the hard work and dedication of the BCSEA Vancouver Chapter Steering Committee and volunteers, especially Yaser Roshan, for taking on the role of project manager. Thank you to our sponsors at FortisBC, The Government of British Columbia, The Real Estate Foundation of BC, Bullfrog Power and TransLink. Thank you to our Donors at Simon Fraser University School of Sustainable Energy Engineering, MistyWest and Nano One Materials Corp. We'd also like to thank our hosts and caterers at Simon Fraser University, and Hives for Humanity for making Energy Connections 2019 memorable. We would like to acknowledge that all of the moderators and speakers listed in this report volunteered their time to share their experiences, educate, connect and inspire a group of passionate forward-thinking individuals to further progress sustainable energy in BC - thank you moderators and speakers!

Report Contributors

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About BCSEA

The BC Sustainable Energy Association is a network of action takers supporting sustainable energy policy, innovation and education in British Columbia.

The association collaborates with government, industry, academic institutions, non-governmental organizations, and citizens to provide education and well-reasoned policy-oriented research, analysis and recommendations on sustainable energy issues, in order to accelerate the province's transition to a low-carbon economy.

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Introduction

Energy Connections is an annual conference organized by the BC Sustainable Energy Association (BCSEA) that brings together citizens, industry, government and academics to discuss the latest innovations and issues in sustainable energy.

This year, Energy Connections 2019 investigated BC's current energy policies and practices, and what this means for initiating the significant long-term emission reductions planned in CleanBC. Discussion topics included Transportation Transformations, the State of Fuels, Energy Efficiency and Grid Modernization, and What's Next for BC. This year's event also included a special Innovation Lunch hosted by Mitacs.

Energy Connections 2019 engaged over 120 driven individuals and members of industry, government, NGOs and academics Some of the organizations represented at the conference included TransLink, SES Consulting, Enerpro Systems Corp., Signature Renewables Inc., Simon Fraser University, Community Energy, Vanadiumcorp Resources, Hydrogen In Motion Inc, the BC Utilities Commission, City of Rossland, New York Tech-Vancouver, Canadian Institute for Climate Choices, Thompson Rivers University, BC Hydro, Government of BC, Parkland, Heiltsuk Tribal Council, FortisBC, University of British Columbia, PowerTech Labs, Clir Renewables, Enbala, Carbon Engineering, ChargePoint, Ecofitt, BC Ministry of Jobs, Trade and Technology, Aboriginal Housing Management Association, Clean Energy BC, BC Bioenergy Network, Siemens, WSP, Stantec, Nano One Materials Corp, Real Estate Foundation of BC, Bullfrog Power, and many more.

This report includes a summary of the presentations, panel discussion and audience interactions that took place on September 20th, 2019 at Simon Fraser University Harbour Centre campus.

Session 1: Transportation Transformations

Moderator: Jeff Phillips, *Dawson Strategic & Board of Trade (Transportation and Infrastructure)*

Panellists:

- Joanna Clark, *Senior Transportation Planner, City of Vancouver*
- David Rehimi, *Western Canadian Sales Director, ChargePoint*
- Dom Repta, *Senior Sustainability Advisor, TransLink*

Picking up from where we left off on the theme of transportation at Energy Connections 2018, Jeff Phillips began the discussion by pointing out three significant observations for the adoption of EVs:

1. Technology is changing fast and is already here
2. The need to collaborate with various stakeholders
3. Infrastructure

Joanna Clark then took the stage and discussed some of the City of Vancouver's initiatives connected to transit and GHG reductions including the Greenest City Plan, Transport 2040, Climate Emergency Response and the Renewable City Plan.

Transport equates to 38% of emissions in the city of Vancouver in 2018. To reduce this The City would like to:

- Increase walking, biking and transit
- Increase zero emissions vehicles
- Decrease private vehicle trips
- Have 50% of trips taken by foot by 2020
- Reduce GHG by 50% by 2020 (using 2007 levels)

Joanna indicated that transportation falls under 3 of the six big moves that are part of the Climate Emergency Response:

1. walkable cities - 90% of people will live within walking distance of their daily needs by 2030
2. Safe and convenient active transportation/transit- two-thirds of trips will be taken by transit in 2030
3. Pollution-free cars, trucks and buses- 50% of kms will be driven by zero emission vehicles by 2030

Some examples of things the city is doing to meet these goals include:

- Expanding the travel network
- Increasing transit
- Conducting an electric bus pilot
- Electrifying the city fleet; currently the City of Vancouver has 100 EVs and 50 hybrids, making it the largest eco fleet in Canada
- Creating an ecosystem for EV- with 175 charging stations currently in commission
- Increasing car sharing; 34% of adults in Vancouver have a car share membership

In the future the City of Vancouver plans to work on micro-mobility options such as electric bikes, alternative transport pricing (determining the value of the 'curb'), and urban freight strategies.

David Rehimi then introduced the audience to ChargePoint, an EV charging technology company with the mission to have EV charging everywhere. ChargePoint currently has 75% of the market-share with the goal of achieving 2.5 million stations by 2025. ChargePoint envisions 55% of all

vehicles on the road to be EV by 2040, and are ready for an ever-changing industry over the next 20 years.

David pointed out three motivations for EV adoptions:

- Governments seeking to reduce emissions (GHGs)
- Automakers investing in this technology
- Consumer demand for electric vehicles

David believes fleet vehicles are a great place to start because of the return on investment, and the ability to provide focused charge points and good transportation. However, one obstacle charging facilities face is electrical capacity in parking lots. ChargePoint provides a free app for locating charging stations. It provides users with all the information needed such as maps with locations, how much and how long the EV needs to charge at the station, the charging impact, energy reduction, etc.

Dom Repta explained that there were 160 million trips taken on TransLink in 2018. The biggest GHG emitters in TransLink's fleet are buses so they have decided to focus on EV buses and reducing bus emissions.TransLink would like to see 100% renewable by 2050 and will be replacing 550 buses by 2026 to either EV or RNG. They currently have 4 EV buses which took 2 years to implement; the biggest challenge is infrastructure set up and how best to charge buses based on the length of the routes. Dom's team has conducted assessments on a few options:

1. Charging stations on the routes. This would require 98 chargers for their 750 buses. Considerations to make with this option include: (i) where to put the chargers along route, (i) where they would be getting their power from and (iii) the cost of the infrastructure.
2. Depot charging. This would need to happen for 4-8 hours overnight and would require buses be switched out throughout the day on most routes (with the current range, TransLink would require 1.35 buses per route). Considerations to make with this option includes: (i) limited space and the current cost of the technology is significant, (ii) additional land and capacity to store chargers and batteries.

After the initial presentations the panel discussed questions from the audience. This year, Energy Connections used the Sli.do app allowing the audience to ask questions online and 'upvote' questions they considered most relevant. In addition to having audience members voice their questions and comments to the panellists directly, Sli.do enabled questions the audience marked as important to take priority. The following provides a summary of questions and answers for the Transportation Transformation panel:

1. *Life cycle of the batteries and the impact on the environment?*
    - David indicated that the beginning of life of an EV and its battery (mining and extraction, etc) is not factored into the analysis.
    - If an EV battery is recycled and used as a stationary battery its total useful life is 15-20 years.
    - New vehicle production (beyond the battery) is not zero emissions

2. *Why did TransLink move away from fuel cell technology?*
    - Dom indicated that the transportation industry in general is adopting EVs vs fuel cells and TransLink is following the industry's lead. The decision to not continue with fuel cells also included difficulties with supply, cold weather, reliability, and issues with fuel cells in compact urban areas.
3. *Were autonomous options built into the TransLink analysis?*
    - The analysis conducted was up to 2030. TransLink predicts they will still have drivers at that point in time.
4. *Who is paying for the roads? How will taxes be impacted?*
    - Gas tax is about 20-40% of the cost of our roads and the rest comes from infrastructure budgets
    - City of Vancouver would go out to public consultation. They are also looking at options such as congestion pricing and mobility pricing
5. *What have you looked at in regard to the health benefits of EVs?*
    - The City of Vancouver is working with Vancouver Coastal Health to assess public health issues associated with transportation. They are beginning by looking at the main routes, areas close to schools and other areas where children and elderly spend their time. This study will take an integrative approach that includes GHG reduction, human health and ecological health
    - Translink is focusing more on equity and neighbourhood diversity; where and how EV bus routes will be placed to benefit the most people.
6. *People love EVs, will we just be adding more cars to the road/encouraging more driving?*
    - The concern with private vehicles is that they will not alleviate congestion-the focus will be more on shared options in general.
    - The City of Vancouver is looking at mobility pricing options and working on strategies to re-allocate road space (make it not just for cars)
7. *How can we encourage landlords to put in charging stations?*
    - David indicated that Right-to-Charge legislation is something that is being looked into. This would make it possible for tenants to install chargers without requiring landlord approval.

Session 2: State of Fuels

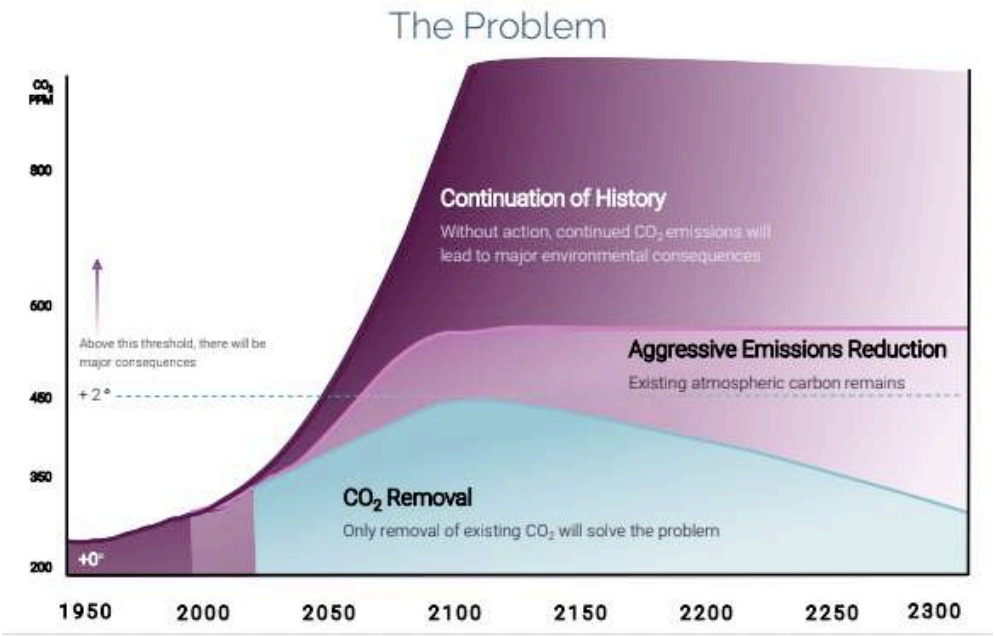
Moderator: Martin Mullany, *Interim Executive Director Clean Energy BC*

Panellists:

- Dana Wong, *Policy Manager, FortisBC*
- Anna Stukas, *Business Development, Carbon Engineering Ltd.*
- Laura Guzman, *Director of Government Affairs, Hydra Energy*

Martin Mullany opened up the discussion by stating BC's goal of 80% reduction in GHG's by 2030; indicating that BC is going through a transition period - solutions we see now may be obsolete in the future.

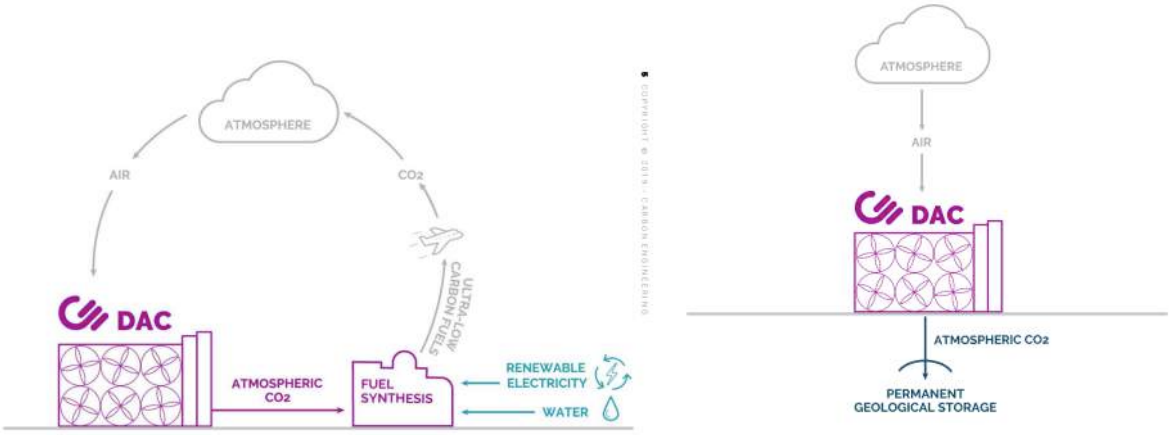
Anna Stukas took the stage and directly addressed the problem: we continue to see CO_2 levels rise. The Paris commitments, if met would mean 3.5 degrees warming. We need to get to net zero and clean up what we have already released if we intend to limit warming to 1.5 degrees.



REDUCING EXISTING ATMOSPHERIC GAS IS A GLOBAL NECESSITY

Anna emphasized that we need a variety of solutions. One of these solutions is negative emission by removing and cleaning up what has been released into the atmosphere while also using what's in the atmosphere to create renewable energy. Carbon Engineering has been working on this in Squamish since 2017.

Carbon Engineering's Direct Air Capture technology enables ultra-low carbon fuels and enables negative emissions:

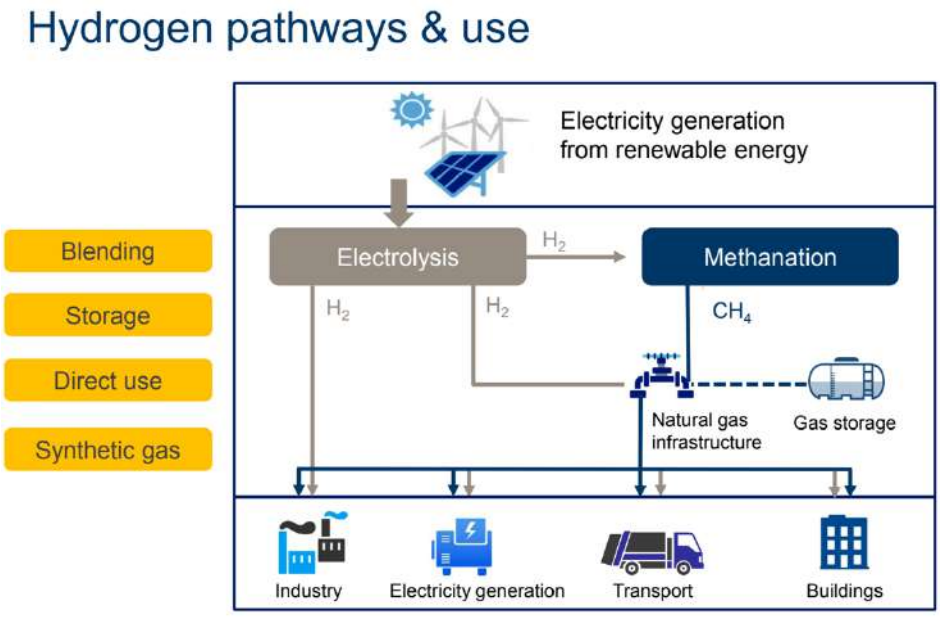


Direct Air Capture has lower land and water impact than biofuels and produces fuel that works with existing infrastructure.

Anna affirmed that electrification is important, but that we need to address emissions using a portfolio approach; there is no silver bullet. Direct Air Capture can play a critical role in addressing emissions that are too difficult or costly to eliminate at the source.

Dana Wong began her presentation by providing a background on FortisBC – a utility with over 1.2 million customers in 135 communities. Back in the mid-1800s, the first fuel in BC was made from coal. Then there was a transition from coal to natural gas in the 1960's. FortisBC has begun the transition to renewable natural gas, and are poised to evolve to hydrogen. Infrastructure is critical to achieving our climate targets and there are many innovative ways that we can make progress today as we take the steps required to transition to a net zero energy system.

Renewable natural gas (RNG) involves capturing methane from landfills, agriculture waste and waste water. FortisBC was the first utility in Canada to use this technology. Today there are 10 000 customers using RNG. FortisBC is committed to driving innovation and meeting customer needs; they plan on introducing hydrogen technology to further reduce emissions while using existing infrastructure and providing reliable means of energy storage.



Additional clean growth strategies FortisBC is working on include:

- Expanding efficiency and conservation spending.
- Partnering with Natural Resources Canada to expand EV charging
- Converting marine bunkering to LNG (with local marine opportunities at BC Ferries)
- LNG exports to replace coal use in China

Dana echoed that we need to take an 'all of the above', or portfolio approach to reducing carbon emissions. She concluded that renewable gas is a low cost, practical solution to decarbonize heating applications and that today's natural gas system will play a critical role in achieving BC's climate targets.

Laura Guzman emphasized that now is the time for hydrogen as a solution for climate change. Hydrogen was a spotlight of the last G20 meeting with China, Japan and Germany all making a push for hydrogen. The World Energy Council highlighted optimism in their New Hydrogen Economy report and the IEA Future of Hydrogen report identified near-term opportunities to encourage widespread hydrogen use. The end uses of hydrogen are through fuel cells and direct combustion. Laura indicated that high carbon intensity in production and cost were the reasons for hydrogen not taking off previously.

The prices of renewables are coming down and there is a lot of pressure to change to less energy intensive needs and more demonstrations of ways to produce hydrogen (and develop options to make it more accessible). Canada is developing a hydrogen plan which will include codes and standards, refuelling stations and advancing vehicle technology. Canada, along with Japan, the EU and the US are co-leading a collaboration between 20 countries for commercial scale hydrogen deployment.

A hydrogen study was recently conducted in BC (September 2019). It found that deployment of hydrogen will be required for BC to meet its 2030 and 2050 GHG reduction goals. Direct electrification and increased supply of RNG is not enough to transition to low carbon energy sources. Hydrogen will play a critical role, particularly in energy intensive applications currently reliant on fossil fuels such as long-range transportation and heating. BC's hydrogen roadmap predicts that hydrogen can abate 31% of BC's GHG emissions by 2050 (15.6 Mt CO_2e/year reduction).

Laura indicated that clean fuels are attractive but there are still challenges:

- New engine and fuel cell technology must be further developed, and cost reduced in order to reduce emissions
- New fuels must be further developed and produced in volume at lower cost to make economic sense
- Performance and cost targets must meet or beat current standards for high adoption
- Billions in distribution infrastructure must be invested upfront by consumers and fleets, potentially taking decades. The question is: who will pay?

Hydra Energy provides an economic model for supplying hydrogen as a fuel:

- Hydra technology enables retrofitting of existing semi-trucks to run on both hydrogen and diesel – eliminating technology risk without compromising performance
- Hydrogen fuel captured from waste sources and delivered directly to fleet, with no fleet investment required.
- Hydrogen-as-a-service: fleets only pay for hydrogen fuel priced below market rate for diesel, reducing fuel costs and emissions.

After the initial presentations the panel discussed questions from the audience. This year, Energy Connections used the Sli.do app allowing the audience to ask questions online and 'upvote' questions they considered most relevant. In addition to having audience members voice their questions and comments to the panellists directly, Sli.do enabled questions the audience marked as important to take priority. The following provides a summary of questions and answers for the State of Fuels panel:

1. *Do we have to convert our appliances to hydrogen?*
   - This needs to be determined; might need to look at safety within the home
   - The existing natural gas system can blend 5-20% hydrogen
   - FortisBC is looking into supplying 100% hydrogen using their existing infrastructure
   - LEEDs moving 100% hydrogen in the UK

2. *How does the cost of carbon capture technology compare to the cost of planting trees that naturally capture carbon?*
   - Both planting trees and technology are needed; the cost of the technology is higher, however Direct Air Capture can sequester more carbon using less landmass. There's a scaling point where the price of Direct Air Capture goes down significantly (based on existing manufacturing processes) and the drivers are improving; reducing costs of equipment, supply chain, and more renewables

3. *What policies could be in place to make this happen faster?*
   - BC has lots of good policies and incentive for tech (low carbon fuels incentive)
   - A performance based approach can allow for innovation in policy
   - Policy is not going to help it get out faster; we need alignment with frameworks and existing system

4. *What can you do to bring costs down to increase renewables on the grid?*
   - Keeping policies fuel neutral and using a portfolio approach
   - RNG is currently 2 times the price of CNG but the cost should be like the price of renewable energy
   - Government must understand that they cannot name tech/fuels (compliment), development of codes and standards for hydrogen
   - Industry must work with market users and investors and promote diverse applications (hydrogen) and change perception of safety and reliability

5. *Why would we work so hard to remove carbon from air to make it into a fuel again?*
    - Recycling more carbon is captured than produced
    - Electrification is important and necessary, however, how do we deal with the waste if we were to switch existing system directly to electric? Direct Air Capture can be considered a transition tool
    - Full electrification of BC industries would require the equivalent of building 8-23 Site C projects, if we electrified everything immediately.

6. *What other monetization opportunities are there for carbon capture that does not include burning it?*
    - California provides a $200USD/tonne tax credit for putting carbon dioxide underground
    - Shopify and Stripe are investing in renewables and negative emission technology to power their companies

7. *What is the forecast for RNG supply in BC?*
    - expecting 5-7 peta joules through existing system
    - New technology can potentially increase projections; for example, RNG with hydrogen
    - Fortis in an energy provider and owns infrastructure (utility) will adapt and evolve as needed

Mitacs Innovation Lunch

This year, Mitacs hosted an Innovation Lunch for interested attendees. Mitacs organized attendees into small groups and brought in facilitators for engaging discussions on the following topics:

- Transportation Infrastructure
- Electric Vehicles
- Smart/Micro Grids, Energy decentralization
- Biofuels in BC
- Renewable Energy & Energy Storage
- Fuel Cell and Hydrogen technologies
- Clean BC and Energy Planning

Session 3: Energy Efficiency & Grid Modernization

Hosted by

Moderator: Selina Liu, *Energy Efficiency Engineer, SES Consulting*

Panellists:

- Dr. Matthieu Loos, *Electrical and Software Engineer, Powertech Labs*
- Amir Ekhlasi, *Principal, Enersaver Solutions*
- Farshid Borjian, *Executive Director, Masonry Institute of BC*

Mattieu Loos discussed the impact of EVs on the distribution grid. He mentioned Norway's electric vehicle market share is 58.4% so there has been a massive switch. There will be around a 20% increase in demand on the electrical grid as a result of EV adoption. The utility service will have to adapt – Matthieu predicts utilities will rely more on big data.

At a household level there are peaks in electrical use when smart meters are used, so there will need to be adaptations. Usually a few hours per week you'll need to charge your vehicle, depending on use. Using the Power Wall to charge a Tesla vehicle had a significant decrease in peak demand. Some transformer upgrades will be necessary as electric vehicles will use the majority of their capacity.

Individual behaviours need to adapt. The daily energy needs of EV's are 2 – 3 hours of charge, but usually they are plugged in for 10 hours per day at home, or 8 hours while at work. There needs to be intelligent organizing of chargers in neighbourhoods. Utilities will need to know the charging demands in the future; the timing, the capacity, the distribution required. The electrification of transport will have an impact on the power system, but there are opportunities for utilities to develop to accommodate these needs.

Amir Ekhlasi explained the *house-as-a-system* concept: this program started as a Step Code to calculate all of the effective R values for buildings and as a prescriptive method to get the required R value for the BC Building Code. It was then changed so it is now based on building performance, rather than based on each individual component. Now energy consumption is measured in a building to determine its performance.

At least 50% of energy used by the house should be from the source (solar panels, wind, etc).
The goal of the BC Energy Step Code is to take enough time for the markets, builders and owners, to be ready for net zero new consumption (which is step 5 of the Code). Energy step code explained where buildings need to perform: airtight building, efficient mechanical, insulated envelope. These are the three categories that have to be worked on to get the requirements for each step.

Farshid Borjian discussed thermal performance of concrete masonry systems. 40% of the total energy used in the BC is consumed through the daily operation of residential and commercial buildings. Globally, the US accounts for about 19% of the world's annual energy consumption.

Interior versus exterior temperature fluctuations are influenced by thermal mass. Thermal mass can be incorporated into good housing environments – regardless of climates, as long as the

building is built appropriately. R value is not the same as thermal mass. R value is the resistance to heat flow (thermal resistance). The R value of a concrete masonry assembly is determined by the shape and size of the unit, density, type and location of insulation, finishes and detailing.

Thermal bridging allows heat transport if it is not properly designed. It can result in increased energy use, condensation and damage to materials. Higher R-values do not always equal improve energy efficiency: other energy efficiency measures may need to added along with insulation and materials to continue to increase energy savings.

International Energy Code IECC provides information on minimum energy efficiency requirements. There are 3 options for complying with the IECC:

1. Prescriptive – this includes specific options and techniques
2. Trade-off (also called system performance) – each component must meet energy efficiency requirements, but focus can be directed on areas with the largest savings (i.e. Increase roof insulation with less wall insulation, retaining the overall R value).
3. Whole building analysis – compares estimated energy use to a standardized measurement.

After the initial presentations the panel discussed questions from the audience. This year, Energy Connections used the Sli.do app allowing the audience to ask questions online and 'upvote' questions they considered most relevant. In addition to having audience members voice their questions and comments to the panellists directly, Sli.do enabled questions the audience marked as important to take priority. The discussions for EVs and construction are summarized below.

EVs:

- Battery degradation depends on the management system of the vehicle. All brands have different degradation patterns that are dependent on how they are utilized.
- Heavy duty fleets have higher utilizations and different constraints than personal EVs and passenger fleets. There is a debate; high powered chargers create a large peak so alternatively charge fleets overnight or use spare batteries, etc. Specific challenges depend on the industry and business case -- the impacts could be far bigger and weighted differently.
- Smart EV Chargers can be connected to wifi and can be used in the home to tell EV owners the level to charge, enabling start/stop of charging, etc.
- Modelling vehicle to grid opportunities (V2G): This involves using an EV's battery as an energy source for the grid. This is being researched, and Powertech Labs is considering a pilot program. However, they have not found any commercialized technologies on the market at the moment. There is less of a business case in BC because our abundance of energy supply.

Construction:

- In terms of incentives, if you can get to Step 5 there will be rebates. If you produce any on site electricity and send extra electricity to the system BC Hydro will pay for it.
- How is Passive House standards integrated in the BC Energy Step code? Net Zero is a different program to Passive House. Passive House is an isolated certificate. Similar program, but not part of the BC Building Code. Passive Houses will be Step 5.
- What is the lowest CO_2 emitting material set? Masonry is considered a green material – because you can reuse concrete units. By focusing on thermal mass you save a lot of energy. Life expectancy of masonry materials is longer than other comparative materials.
- How can the hemp industry allow for hempcrete and use of marijuana by-products? The Code requires minimum structural requirements. Different materials may not be able to reach the structural stability threshold, as well as sound insulation, proper fire ratings, proper construction, etc.
- The Code only applies to new buildings. But if you are doing a renovation you can propose meeting the requirements of one of the steps.
- How can we incorporate the fundamentals of the BC Step Code in Indigenous communities? It depends on the community, council, builders and consumers. If consumers demand for better quality building and builders, the industry has to respond.
- Reasons for more concrete and less glass in construction: in Vancouver buildings should have an R rating of R21, 22. People are requesting a lot of glass, but it is better to have rigid insulated materials, to increase performance. Smart designs are necessary that are appropriate for the environment and location.
- When will the building code allow rammed earth, cob, and indigenous construction techniques? A home can be made of any material the builder wishes to use, as long as it meets the performance requirements. This allows you to use any methods or materials; as it isn't so prescriptive this allows for innovation. For example, you can build a wall from glass as long as the other wall compensates to keep the performance requirements.
- Challenges with airtightness includes condensation, mould, polluted air through offgassing, pets, laundry, etc. Heat Recovery Ventilation (HRV) combat these, ventilate and filter each room. It filters and distributes at the same temperature; distributes evenly.
- What about the concern of airtightness and CO_2? One suggestion could be for a smart meter that assesses the level of CO_2 in the room. HRVs allow air in but it is fresh air and it changes the temperature of the air.
- Discussion about wood vs concrete: One concern with wood buildings is the fire risk, but this can be combated by proper fire extinguishers and fire management. Concrete is a very high emitting industry. In terms of concrete's durability – a lot of energy can be saved throughout the life span of a building, so shouldn't just look at the emissions associated with production of concrete.

Closing Remarks – What's Next for BC?

Moderator: Jonathan Ho, Chair of the Board, BC Sustainable Energy Association

Panellists:

- Neil Dobson, *Executive Director of CleanBC*
- Martin Mullany, *Interim Executive Director Clean Energy BC*

Closing remarks were conducted as a discussion between Neil Dobson, Marin Mullany and Jonathan Ho. Dr. Judith Sayers from the Nuu-chah-nulth Tribal Council and BC Ferries was originally scheduled to join this discussion, however was unable to attend due to unforeseen circumstances.

Neil introduced CleanBC as the Government of British Columbia's strategy to create a low carbon economic future. We have a decade to reduce emissions by almost half (40%). CleanBC works on three pillars: (i) Climate, (ii) Economy and (iii) Energy, focusing on transportation, the built environment and industry. Neil explained that the easy solutions is new buildings. But what do we do about the old buildings? What are the policy and political pieces of the puzzle that will help business associations and entrepreneurs address the challenges (i.e., create market signals and remove structural barriers).

Martin Mullany supports the direction of CleaBC but disagrees on the values used. The gas industry is almost 20% of BC's GHG emissions; realistically the gas industry has plans to almost double in size over the next 10 years and is trying to reduce emissions at the same time. If the gas industry electrifies and doubles in size then it's GHG emissions stay the same. This is a huge economic driver in BC, for both export of LNG and electricity production within BC.

After the initial remarks, Neil and Martin discussed questions received from the audience. This year, Energy Connections used the Sli.do app allowing the audience to ask questions online and 'upvote' questions. In addition to having audience members voice their questions and comments to the panellists, Sli.do enabled questions the audience marked as important to take priority. The following provides a summary of questions and discussions:

1. *Microgrids and resiliency; how can we make it easier for remote communities to come up with their own grid solutions?*
2. *Since BC has strong environmental regulations, wouldn't it make sense to export BC's low carbon LNG and use the $ to invest in new energy technologies at home?*
3. *What role will the Government of BC play in helping to develop the province's hydrogen economy?*
4. *China's emissions only went up 2.3% in 2018, less than US. China is bending the curve on fossils fuel demand faster than North America. Why is gas export considered relevant?*
5. *What type of policies can the government encourage to unlock private capital to help accelerate the CleanBC plan?*
6. *Does it make sense for BC to attempt an LNG export industry if it breaks our carbon budget?*
7. *Climate strikes are taking the streets today to protest global climate change – what would your messaging be to them about CleanBC initiatives?*

8. *CleanBC is pushing for heat pumps across BC. What, if any considerations are given to future affordability of heating when electricity prices go up?*

Neil indicated that the Government of British Columbia looks at projects that are economic, that help the community be more resilient and more self-sustaining. Funds are invested based on improvements to air quality, economic costs of fuels and carbon emissions

There is a 300 km distance between Fort St. John and For Nelson where there are no transmission lines. The oil and gas companies have historically powered their facilities with gas. Recently the provincial and federal governments have signed an MoU around getting transmission infrastructure into the right places, if the demand is necessary. Martin indicated that the capacity required for these projects is around 35 MW spread across 45 locations – this is something that can be done fairly easily using distributed renewable energy generation, with the right incentives.

Neil explained that we can power LNG Canada Phase I with BC Hydro's current capacity however we will not be able to meet the capacity of future phases. There is a 97% reduction in GHG emissions if the compression down the pipeline is electrified. However, Neil pointed out that this would require an entirely different type of system in order to account for the amount and consistency of electricity required at the pipeline compressor sites. There are organizations working on electrification at the wellhead — both Shell and Petronas are putting solar at wellheads.

There is a lot of wind, hydro and solar power in BC. Martin believes that ultimately, we can electrify the industry, but that the scale is daunting. Neill explained that there are always unforeseen challenges; one of the reasons we all benefit from low cost natural gas is because there is a plethora of supply on the North American market. If we are adding more and more costs to these industries because of environmental regulation too far ahead of other jurisdictions, then these projects just move somewhere else ("carbon leakage"). The challenge to BC is, if we say that everything needs to be electrified and the industry can no longer see the economic benefit in doing so, they'll move the project elsewhere and BC would lose out on the economic benefit. Neil explained, "if you assume LNG facilities will be built, then it's probably better that they be built in BC driven by electrification rather than be built in Texas where these facilities would be powered by methane combustion."

It is BC Hydro's responsibility to make decisions regarding IPPs and private capital investments to their system. These decisions are based on their assessment forecasts and overarching direction, which is part of the BC Hydro review. Government does not have the right to direct BC Hydro or the BC Utilities Commission; BC Hydro makes these decisions based on their own assessments. There are places where government has chosen to intervene on BC Hydro or the BC Utilities Commission procedures in the past, and this may be a course of action in the future.

Martin expressed that there's sometimes a disconnect between making a policy and what happens after the policy has been made. There has been a lot of funding invested by both the federal and provincial governments to develop IPP projects in the past. As per the Government of Canada, an estimated $2.7 trillion has been invested in clean energy projects in the past 9 years.

There is money available for projects if the risk and return is appropriate. BC has a lot of processes that a project must go through before getting a contract. There is a lot of cost and a lot of risk, with the expectations that electricity prices stay low. This is not the right balance to incentivize project development.

Neil explained that CleanBC supports the messages that come from the climate strikes. They fundamentally understand the impact of changing climate to BC. One of the biggest problems that we have in BC is that we are out front, and we are trying to go at it alone. This was not the case two years ago (elections in Canada and US have changed this). BC is a small economy and only accounts for 0.6% of global GHG emissions; we can't do it on our own. We need a critical mass at the table — car manufacturers are not going to make EVs just for BC, but they will make them for Canada as a whole. Same with carbon pricing; there's no competitive problem with carbon pricing **if** carbon pricing is the same everywhere.

Neil concluded the final remarks by stating that CleanBC is largely focused on delivering the 2030 greenhouse gas emission reduction targets. It is possible to do this with incremental change around the edges such as, replacing every internal combustion vehicle with an electric one, or keeping the same economy we have now but ensuring that it's all electric or running off biofuels. However, to get beyond 2030, we start needing to fundamentally change the systems in which we are operating. The shift that is going on now between CleanBC Phase I is the pathway to 75% of the 2030 target. Are we just trying to get to 2030, or are we trying to create an environment in which we can hit our 2040 and 2050 targets?

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