

# VANCOUVER INTERNATIONAL AIRPORT

## Roadmap to Net Zero Carbon in 2030



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## Executive Summary

Vancouver International Airport (YVR) is boldly pursuing a greener, more resilient future and has committed to eliminating carbon emissions from our operations, becoming net zero by 2030. To achieve this objective, we have created our Roadmap to Net Zero, which is an action-oriented plan that includes innovative thinking and solutions-based tactics backed by our operational expertise, collaboration with partners, science and data.

The YVR Roadmap to Net Zero is a shared corporate guidance document and outlines how we will effectively decarbonize our operations by reducing operational energy use, replacing remaining fossil fuel use with renewable fuels, and balancing out remaining emissions with an equivalent amount of carbon removals.

**At YVR, the four decarbonization pathways that are required to achieve net zero emissions are:**

1. Green fleets (right-sizing vehicles to match operational requirements, electrification and renewable fuels for mobile equipment)
2. Building energy conservation and electrification (meeting operational requirements more efficiently and using less energy for heating/cooling, cooking, lighting and other electrical loads. Switching from natural gas to electricity where possible)
3. Replacement of fossil fuels with renewable alternatives (investing in 100% green electricity and on-site solar, purchasing renewable natural gas for heating/cooking, and purchasing renewable diesel for generators)
4. Closing the gap (purchasing carbon offsets, removals and assessing business travel)

Actions between now and 2030 will reduce both current emissions and the anticipated 40% growth from 2012 to 2030. In 2021 dollars, the costed plan requires \$85-135 million, with the potential to reduce through the pursuit of rebates. Several alternate scenarios have been contemplated outside of these costs and require additional monitoring as technology and business cases are developed.

We are pleased to share our Roadmap to Net Zero. We think of our climate action activities as a journey and welcome the opportunity to engage with our employees, passengers, airport community and industry partners to align our collective initiatives to our ambitious net-zero emissions goal. We know that achieving our climate goals requires innovative thinking and solutions-oriented actions. Above all, it requires teamwork. Thank you for joining us on our journey.

## 1.0 Introduction

Every five years, YVR develops a strategic Environmental Management Plan (EMP). This EMP articulates our responsibility to reduce the impacts of climate change. Specifically, it sets clear, measurable activities and targets in four key areas: water conservation, waste reduction, ecosystem health and carbon reduction.

Targets for carbon reduction include commitments to be Carbon Neutral in 2020 and Net Zero Carbon by 2030. As such, our Roadmap to Net Zero is a shared corporate guidance document, investment plan and philosophy that stems from our EMP and will demand advocacy in decision making and continued innovation across departments in the years to come.

For YVR to get from carbon neutral to net zero, we will need to **reduce operational energy use and displace remaining fossil fuel use with renewable fuels**. Unfortunately, total zero is not yet possible, given the source of some of our emissions, current infrastructure and technology gaps, but it is something we will work towards. **To become net zero, any remaining emissions will need to be balanced with an equivalent amount of carbon removals**. While reducing carbon through offsets is part of our interim carbon management strategy, offsets are being used as a bridging tool in the transition to net zero and are also used to offset corporate business travel. As we decarbonize, we will purchase fewer carbon offsets and ultimately shift to remove the small amount of remaining carbon we still produce. That is the “net” part of Net Zero carbon. Both carbon neutrality and net zero emissions take a three-phase approach. First, an inventory of carbon emissions is calculated. Second, reduction opportunities are identified. Lastly, the remaining emissions are accounted for through the purchase of offsets or removals.

Accelerating deep emissions reductions to advance a net zero organization by 2030 will require significant investments in decarbonization pathways, some of which are more straightforward than others due to technology maturity. At the same time, the potential for greater carbon reductions from emissions created within our airport community (scope 3 emissions are about 35 times greater than ours) is significant and will be pursued in parallel to our strategy to achieve net zero carbon for our organizational emissions (Vancouver Airport Authority). Some of these scope 3 emissions are ours – the reduction of embodied carbon in construction activities for example, but also those of our business partners. Reducing these airport community emissions includes our continued efforts to electrify our airfield, encourage sustainable aviation fuel adoption at YVR, support business partners with emission reduction from buildings and invest in green transportation.

Why work to become zero ourselves? We have control over our emissions and are accountable for them. Simply put, it is our responsibility to get to zero and we cannot ask our partners to reduce their emissions if we are not leaders.

**Our Roadmap to Net Zero is based on the following principles:**

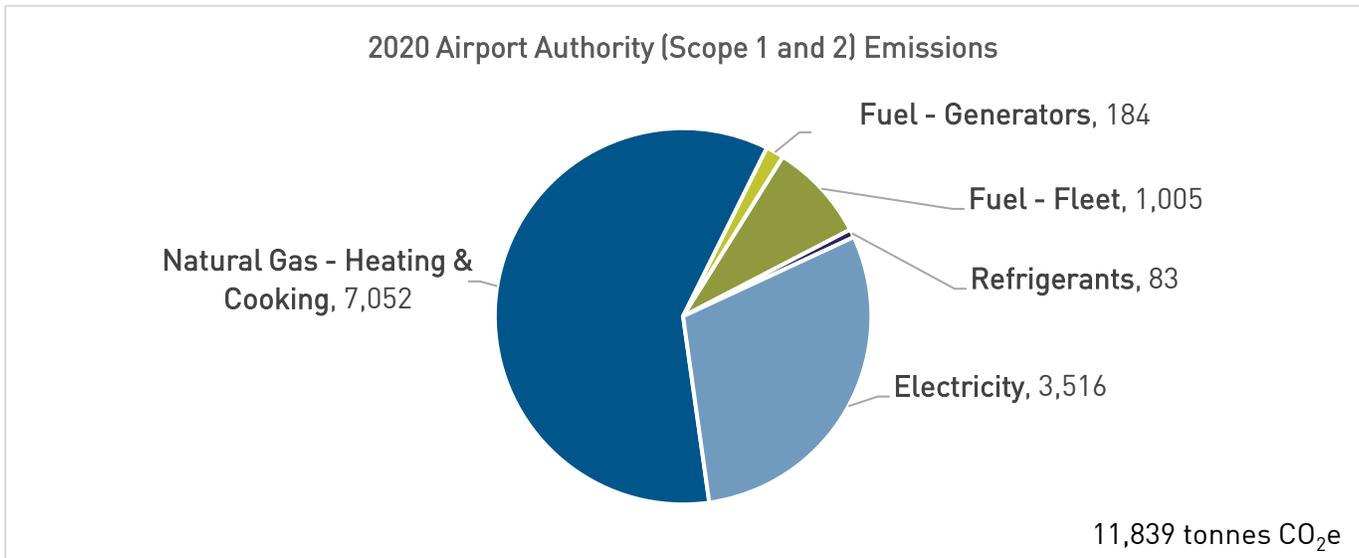
- We will reduce our emissions footprint first, then optimize with renewable fuels, and finally fully green through technology that removes/eliminates emissions.
- In many cases, assets are being replaced at end-of-life and then replaced with a green version.
- Standards will be developed to support these actions, to institutionalize our behaviour and guide future investments.
- Reductions from efficiency savings and asset replacements must achieve as close as possible to 'absolute zero' carbon emissions as practical and feasible in a given year, in alignment with what the IPCC is outlining to achieve a 1.5 degree reduction pathway, before carbon removals considered.
- Some carbon removals will be considered earlier in the plan, in order to secure access to the supply.

## 2.0 Our Emissions Footprint

YVR follows greenhouse gas accounting protocols and is accountable and responsible for managing the emissions from our operations and energy consumption (our scope 1 and 2 emissions). We are certified under Airport Carbon Accreditation at the 'Neutrality' level, which acknowledges that we measure, reduce, and engage our business partners in managing emissions.

Most of our emissions are generated by the natural gas consumed for heating our buildings and tenant operated cooking activities (60%). Other sources of emissions include fleet activities (8%), emission from purchased electricity (30%), and other smaller sources (refrigerants and generator fuel).

The emissions tracked encompass all energy used in buildings and infrastructure owned and operated by the Airport Authority. This includes apron electricity used by airline partners (electrical power for aircraft and ground support equipment) and electricity and natural gas used by in-terminal business partners (food and beverage and retail operators as well as leased office space).



### 3.0 Actions Required to Achieve Net Zero

Our business-as-usual forecast shows a 40% growth in emissions by 2030 from 2012. There are four decarbonization pathways that we are pursuing to achieve net zero emissions:

1. Green fleets (right-sizing vehicles to match operational requirements, electrification and renewable fuels for mobile equipment)
2. Building energy conservation and electrification (meeting operational requirements more efficiently and using less energy for heating/cooling, cooking, lighting and other electrical loads. Switching from natural gas to electricity where possible)
3. Replacement of fossil fuels with renewable alternatives (investing in 100% green electricity and on-site solar, purchasing renewable natural gas for heating/cooking and purchasing renewable diesel for generators)
4. Closing the gap (purchasing carbon offsets, removals and assessing business travel)

Working with responsible internal stakeholders and external parties, pathway options have been assessed for costs, risks and opportunities for multiple wins. Although some costs are only estimated as they are nascent (i.e.: totally green electricity, carbon removals), cumulative incremental costs to 2030 are approximately \$85 - \$135 million in 2021 dollars, with the potential to reduce with available incentives/grants.

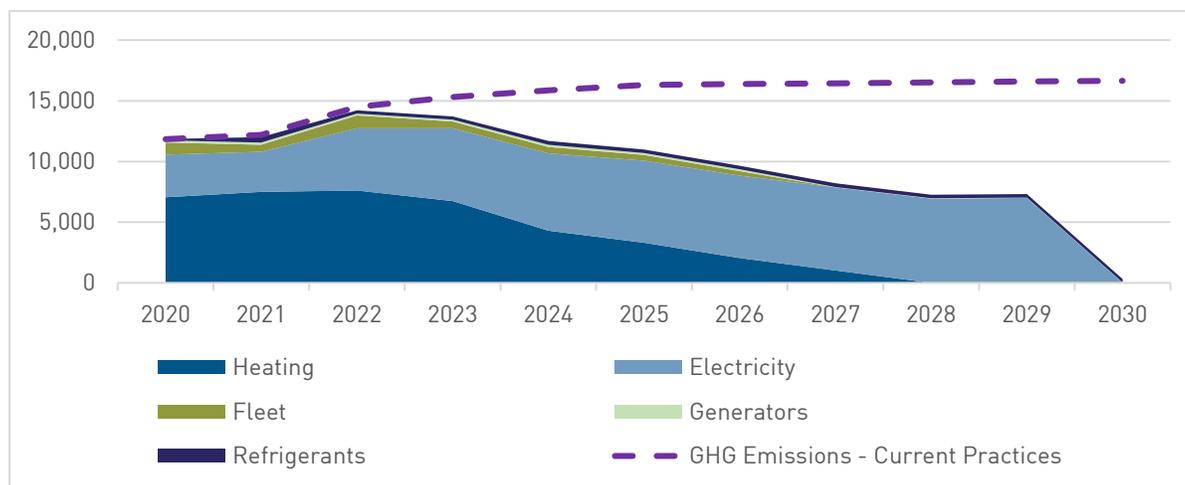
The pathway to achieve net zero assumes a strategic but straightforward, cost minimized approach. Alternative technologies and approaches have been vetted and some are included as options for consideration, while others are not reflected due to the emerging or cost prohibitive nature of the solution.

Our Net Zero Roadmap relies heavily on the purchase of renewable forms of energy (renewable natural gas and diesel, green electricity) and the improvements or conversion of our capital infrastructure (fleet, buildings) to support those clean energy shifts. The roadmap is a plan, not a blueprint and will be reviewed annually to provide an update to the forecasted initiatives, costs and effects based on implementation, new data and technologies and to accommodate adjustments as necessary. For example, we expect to draw upon lessons learned from pilot programs using our Digital Twin and the evolution of applied Internet of Things to enhance smarter, more efficient use of our buildings and vehicles in the next few years.

Successful reduction initiatives are being further enhanced by deepening existing and developing new partnerships, assessing policy regimes and involving our teams in looking at the opportunities to be innovative, technologically progressive, resilient and advance multiple elements of our strategy. As such, while the building blocks of our net zero plan are solid, there will be an absolute necessity to respond to emerging windows of opportunity throughout the life of the plan.

## 4.0 Forecast

The graph below compares the pathway we are on now, with the possible impacts of actions described in this Roadmap.



## 5.0 Decarbonization Pathways

### 5.1 Green Fleets

With 8% of scope 1 and 2 emissions from our vehicle fleet, this decarbonization pathway outlines an approach that electrifies vehicles wherever possible and cost effective and uses renewable diesel for the balance of fleet vehicles.

#### Right-sizing

The first focus of our green fleet strategy is to right size our fleet to our operational needs and use common-use fleet structures to minimize the number of fleet assets and ensure utilization is high.

#### Light-duty Vehicles

Our next focus will shift to electrifying light duty vehicles through 2030, with roughly 10-16 vehicles transitioning each year with installation of fleet charging infrastructure.

The Government of British Columbia is targeting all new light duty and truck sales to be zero emissions in 2040. Forecasts for the global uptake of electric cars, vans and sport utility vehicles indicate that electric versions will be less expensive to produce than gas-powered equivalents by 2027. And, recent advances in battery technology are resulting in longer battery life, meaning less frequent charging for newer vehicle models.

We will continue to assess technology for vehicles where operational restrictions prevent use of electric technology.

### **Heavy-duty Vehicles and Buses**

The electric market is still emerging for heavy-duty vehicles and equipment. While some electric heavy-duty alternatives are available, in many cases options are still limited. As a result, the strategy is to use renewable diesel until alternatives become commercially viable.

There are 201 pieces of equipment in our heavy-duty fleet, which ranges from small maintenance equipment, firetrucks, groundside and airside shuttle buses, specialised airfield equipment (i.e.: snow removal) and bus operations. The groundside shuttle bus fleet will transition to electric technology before 2030. While electrification of other pieces of equipment is an option, there is a cost premium due to the emerging nature of this technology. With technological and market availability improvements over time, conversion of these specialized vehicles to electric will continue to be evaluated as lifecycle replacements occur. In the interim, renewable diesel will be used as a bridging strategy.

### **Charging Infrastructure**

Annual investments in charging infrastructure are necessary to support electrification of our fleet. There is an opportunity to deploy a mix of charging infrastructure in centralised locations to optimize the asset being installed and result in more efficient infrastructure investments. This includes fast charge ports, dual head level two chargers and possibly specialty chargers for buses, among others.

### **Renewable Diesel**

Renewable diesel will be introduced in phases to pilot the fuel before full utilization.

No infrastructure modifications are required to use renewable diesel for either vehicle or fuel tank—the fuel is drop-in and meets the specifications for diesel fuel oils. Renewable diesel is manufactured with the same bioproduct as biodiesel but is processed in a different manner. The feedstock is comprised of vegetable residues and green waste. It is a diesel fuel, meeting diesel specifications, and does not experience performance issues similar to biodiesel used at higher blends. Additional supply is being generated at a global scale, as low carbon fuel standards emerge and the demand for clean fuel grows. The pilot phase will also enable supply chain logistics to be structured for ongoing use.

## 5.2 Building Energy Conservation and Electrification

Building emissions reduction starts with conservation through energy-efficiency. Conservation measures leading to reduced natural gas use in heating, ventilation and air conditioning (HVAC) and primary domestic hot water (DHW) systems in the terminal buildings present the greatest opportunities for carbon reduction. These include a combination of using the equipment we already have in a more efficient way by upgrading controls and reprogramming for efficiency, replacing inefficient equipment with newer technology, recovering heat, where possible, before it leaves the building, and optimizing our existing solar thermal systems for heating water.

While improving the efficiency of equipment, natural gas use and carbon emissions can be further reduced by using electricity to transfer heat to where it is needed. This is referred to as fuel-switching or electrification and involves using heat pumps, geexchange (ground-to-air heat pumps) and heat recovery chillers. Similarly, switching from natural gas cooking equipment to electric reduces emissions as well. BC Hydro and FortisBC offer funding programs to investigate and implement energy conservation and electrification. These opportunities will continue to be explored through implementation of conservation and fuel switching projects.

### HVAC Energy Conservation Measures

A detailed energy efficiency study is underway to review energy efficiency opportunities for HVAC and DHW systems, and while this work continues, several opportunities have been identified:

- Optimize the domestic hot water system by recommissioning our solar thermal systems and replacing aging boilers with more efficient boilers or heat pumps.
- Recommission HVAC controls to optimize the use of air handling units, temperature set points, ventilation controls and schedules to ensure that the terminal building operations are as energy efficient as possible.
- Optimize ventilation systems as fan and coils are replaced as part of our equipment replacement schedule and improved pumping efficiency.
- Convert HVAC heating loops to accommodate lower temperatures and cooling loops to accommodate higher temperature. This will greatly reduce the energy required for heating and cooling the main terminal.
- Replace existing boilers with condensing boilers.
- Replace existing chillers with heat recovery chillers that would reject heat into the heating water loop and install cooling towers.

- Capture sources of waste heat that would otherwise be vented into the atmosphere by installing additional air-to-air energy recovery ventilators and adding heat recovery coils to existing air handling units.

### Green Kitchens

One key source of emissions in the terminal building is the natural gas used by food and beverage tenants for cooking. Emission reductions can be achieved by increasing energy efficiency and switching kitchen equipment to electric where feasible. In partnership with the City of Vancouver, we developed a Low Carbon Commercial Kitchen guide to help restaurant kitchen designers choose electric and energy efficient equipment. Any remaining natural gas cooking equipment should be fueled by renewable natural gas (see section 3.0 Renewable Energy Production and Purchases).

### Refrigerants

HVAC equipment used for cooling contains refrigerants that, when released, have a carbon impact. The industry has been working to transition away from high-global warming potential refrigerants in a way that is technically feasible and allows for continued service. Canada has phased out R-22 refrigerants in 2020 and is phasing out production of new R-123 in 2030.

While there are next-generation refrigerant replacements available, refrigerants will need to be selected using a sustainability lens to ensure the most appropriate solution for our building systems, to understand potential trade offs between global warming potential and higher flammable refrigerants or if there are health and safety elements. Infrastructure upgrades will also need to be considered in order to build out an investment strategy. In the interim, all regulatory protocols with respect to refrigerants will be followed and annual leak tests and audits will minimize the risk of release. The accidental release of refrigerants is one of the reasons why a true net zero will be extremely difficult to achieve for some time and thus the need to invest in carbon removals.

### Lighting and Additional Projects

Lighting conversion projects will help reduce the energy load to assist with fuel switching projects, including installation of more LED lamps and occupancy sensors and improving digital controls. Typical lighting replacements occur at the end of asset life and efficiencies are not realized in our Net Zero Roadmap. A study undertaken in 2020 has identified an additional lighting retrofit opportunities beyond that timeframe and are being completed in 2021 with BC Hydro's support through incentives to complete this work.

Supplementary opportunities exist to invest in additional lighting and other building envelope projects (increased insulation, sealing leaks and installation of air curtains) that offer emission reductions, but the impact is almost impossible to quantify without building a detailed energy model. These opportunities will continue to be considered and evaluated as more information is available.

### **Monitoring**

A basic principle of energy management is measure so you can manage. The terminal has hundreds of meters already in place and thousands of data points are being tracked. We will develop an Energy Monitoring Information System to look at data collected by meters and sub-meters in the terminal to build a more integrated system that allows for measurement, trend logs and further energy savings identification. Funding from BC Hydro will enable work to start later in 2021. Once the scope of the opportunity has been developed further, additional projects and savings could be identified. In addition, the project to replace outdated legacy HVAC controls will also enable more digital integrated applications.

### **Building Expansion**

The Pier D expansion project completed in late 2020 is the most energy efficient terminal build completed under our terminal expansion program. Lessons learned from Pier D will inform future expansion projects, as the project maximised what today's technology can achieve at a reasonably affordable rate.

## **5.3 Renewable Energy Production and Purchases**

This pathway includes purchases of renewable natural gas and green electricity, and investments in on-site renewable production.

### **Renewable Natural Gas**

Purchasing Renewable Natural Gas (RNG) is our bridging strategy to achieve net zero carbon from our greatest emissions, those associated with heating the terminal, along with that used in cooking from food and beverage operators in the terminal. A program offering by Fortis BC has a customer waiting list for new sources of RNG. To secure our intentions for this fuel, it is recommended that we join the wait list and scale up purchase of RNG gradually at an even adoption rate. As the resale of natural gas is under the purview and review of British Columbia Utilities Commission, YVR has indicated that we plan to inform tenants and ultimately switch them over to use of renewable natural gas or electric versions of their equipment.

### **Clean Electricity**

Although the BC Hydro electrical grid is already quite clean, with most of the power provided by hydroelectric sources, it still has a significant (30% in 2020) and growing emissions footprint at YVR. While a 100% renewable electricity purchase option is currently not offered by BC Hydro, we will support reductions to the carbon intensity of power and opportunities to purchase should options be made available.

### **Back-up Power**

Back up generators have a relatively small emissions footprint and are required to operate emergency power systems and airfield lighting. Efforts underway to install flywheel technology to reduce the emissions impact aligns with the conservation pathway. However, renewable fuels will be required to get to net zero. An early pilot of fleet renewable diesel will inform how this fuel behaves to inform adoption with the generators and opportunities for trials.

### **On-site Renewable Energy**

Advancing on-site clean energy systems will reduce reliance on purchased green alternative fuel. Our Roadmap to Net Zero outlines an investment in a small solar array system and continued explorations into geexchange technology, an initiative that was halted in 2020 as a result of unsupportable costs during the global COVID-19 pandemic. The recently completed but not fully operational Pier D terminal expansion project installed a solar hot water array and additional work will occur to assess additional installation opportunities.

## **5.4 Offsets, Removals and Corporate Business Travel**

The residual emissions remaining after reductions and investments in green fuels, combined with corporate business travel, require additional investment in carbon offsets and removals. The residual emissions left over include refrigerants, and small amounts within heating, fleet and generators because of the accounting treatment of renewable fuels for the non-biogenic content of the fuel. These sources are forecast to be less than 350 tonnes.

### **Corporate Travel**

In addition to the sources outlined above, corporate business travel produces emissions are included in the scope of carbon neutrality and net zero. Our travel emissions have primarily been associated with flights; rail, road and sea and represent only a small percentage. A corporate green travel policy that minimizes emissions from business travel will be developed.

### **Carbon Offsets**

For the period from 2020 to 2030, YVR has committed to being carbon neutral. This required the purchase of carbon offsets to account for emissions from Scope 1 and 2 sources, plus corporate business travel.

Currently, the criteria outlining the acceptability of offsets under carbon neutrality is determined by the Airport Carbon Accreditation (ACA) program, which certifies YVR's carbon neutral status. Lessons learned from the development of our own additional criteria to support our selection of offsets for 2020 will be used in the evolution of our approach to carbon offsetting and removals.

Investments in Sustainable Aviation Fuel (SAF) could be made as a proxy for offsets, to support the aviation sector in reducing emissions. This is acceptable under the ICAO program which determines the criteria under which airlines can ensure their growth from 2020 is carbon neutral. This would enable YVR to coordinate with airlines to purchase SAF to account for emissions from corporate business travel by air, rather than purchase traditional carbon offsets.

### **Carbon Removals**

To achieve net zero, we will need to transition from investing in offsets for residual emissions to investing in carbon removals. The main difference between the two is that while carbon offsets prevent greenhouse gas emissions from occurring, carbon removals directly remove and sequester carbon from the atmosphere. Examples of carbon removal projects include restoration of wetlands/bogs and trees, agricultural soil carbon practices, direct air capture and carbon sequestration.

The concept of carbon removals is still in its nascent stage. As opposed to offsets, which have established methodologies, verification and public disclosure registries in place to ensure a robust market, carbon removals are still developing these elements. Carbon removals, called CORCs (CO<sub>2</sub> Removal Certificates) are now becoming available from specific projects, and vary significantly in price from \$30/tonne to \$500/tonne.

## **6.0 Emerging Spaces and Innovation**

YVR has a longstanding connection to innovation as a way of testing and trialing new processes and technology for a wide variety of applications. As we build back from the impacts of COVID-19, we want to build back stronger, and introduce standards and emission budgets that institutionalize our approach to emissions reductions.

An emerging space in construction is to measure and manage the embodied carbon of a project. YVR airport projects would have a high embodied carbon footprint, as they mostly involve asphalt, concrete or steel. Embodied carbon are all the indirect carbon emissions produced over the lifetime by infrastructure construction, from extraction of material through to disposal. Once a project life cycle analysis is complete, different low carbon mitigation strategies (material selection, design consideration or reduction of construction stage impacts) can be applied.

Utility incentives and technology cost reductions will advance the commercial viability of many energy technologies and as the race to zero heats up, commercial viability of emerging products are expected to become mainstream. Direct air capture, fuel cells and medium- and heavy-duty electric fleet applications are expected to emerge before 2030.

Hydrogen fuels have been profiled with recent funding announcements and the release of federal and provincial strategies. Sustainably produced hydrogen holds enormous potential for heavy-duty truck transportation and will be an important aviation fuel source in the future. Green hydrogen is not available in our provincial supply chain but is expected to emerge. UBC and BCIT are researching and soon to be demonstrating use of hydrogen fuel to vehicles and fuel cells as the next generation technology from battery storage. Airports in Japan are trialing use of hydrogen in forklifts and we will monitor results and best practices in introducing this energy source into airport infrastructure. Hydrogen and fuel cell applications could easily find a home at YVR with commercial technology and a green fuel supply.

An alternate approach to carbon removals is to assess investment into on-site carbon removals to serve us and allow us to potentially sell to others if the balance allows. This could potentially be done through blue carbon projects or other emerging technology and include partnerships with other organizations.

As these technologies continue to develop, we will assess the business case for advancing solutions here at YVR, to help support shifts to carbon negative outcomes – activities that take us beyond net zero carbon to create an environmental benefit by removing additional carbon from the atmosphere.

## 7.0 Beyond 2030

In order to sustain net zero beyond 2030, investments will need to be made in renewable fuels and energy supply and storage, technologies and new capital projects considered as innovation in zero emission fuel sources evolves. While the new capital projects are unknown at this time and will reflect emerging technology between now and 2030, we know that there will need to be ongoing goods and services investments.