

The University of British Columbia

Climate Action Plan 2020

VANCOUVER CAMPUS



a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

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1 EXECUTIVE SUMMARY

With five years of experience implementing the 2010 Climate Action Plan, UBC's Climate Action Plan 2020 provides a major update, outlining the actions the University can take at the Vancouver campus to work towards the target of reducing greenhouse gas (GHG) emissions by 67% from 2007 levels by 2020.

Climate policy is changing

The evolution of climate policy from 2010 to 2015 at the international, national, provincial and university levels has changed the context in which UBC is taking further climate action. Recognizing the critical urgency in addressing GHG emissions globally, in December of 2015 the international community reached the Paris Agreement at the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21). The federal government has shown renewed interest in supporting climate action across Canada and is currently working with provincial governments to explore the possibility of national GHG emissions management strategies not considered to date, such as a national carbon tax or a national cap and trade system.

The provincial carbon tax affects the financial feasibility of UBC's climate actions. If carbon tax is increased in the future as per the provincial Climate Leadership Team recommendations (adding \$10 per tonne per year starting in 2018), UBC's annual carbon costs could increase by over \$1,000,000 by 2021, and \$5,000,000 by 2040, if UBC was to take no new climate action. In addition, as a public institution, UBC is committed to ensuring that our operations are run responsibly and in compliance with provincial climate legislation.

UBC is leading the way

UBC has reduced its GHG emissions 30% as of the end of 2015 below 2007 levels, and we expect to reach the 33% reduction target by the end of 2016 - a significant achievement given increases in campus floor space of 16 percent and student enrolment of 18 percent since 2007. Per full time student, we have reduced emissions approximately 40% percent since 2007. This result, along with other accomplishments in sustainability performance, have positioned UBC as a recognized global leader in sustainability in operations and academics amongst peer institutions. Key projects enabled by smart business decisions are largely responsible for the GHG reductions: the district energy steam to hot water conversion, the Bioenergy Research and Development Facility, and the Building Tune-Up program. Because of these projects, energy and carbon costs paid by UBC have decreased significantly. However if UBC takes no new actions to continue reducing GHG emissions, they will begin to rise steadily after 2016 as the campus continues to grow.

Heating buildings is the largest contributor

Approximately 88% of UBC's operational GHG emissions come from burning natural gas to heat buildings. It is clear that based on UBC's emissions profile, in order to make further substantial emissions reductions, we need to reduce the consumption of natural gas significantly.



Actions are in five main areas in two phases

- In order to structure the CAP 2020, climate actions to reduce emissions toward the targets are organized into the following action areas:
- Existing buildings (accounting for the bulk of current emissions)
- New buildings (future sources of emissions)
- Behaviour change (influencing energy use and emissions from buildings)
- Energy supply (serving the buildings on campus)
- Fleet (operations and departmental vehicles and motorized equipment)

The CAP 2020 is being developed in two phases. In the initial phase, the suite of proposed actions (which are primarily Demand Side Management or DSM actions) across existing and new buildings, behaviour change, and fleet areas, are expected to be able to reduce GHG emissions an additional 8% following 2015, resulting in emissions 38% below 2007 levels by 2020. The majority of these actions can be implemented by leveraging existing programs and resources; the CAP also seeks to strengthen some key programs in order to achieve the desired outcomes.

In order to achieve additional reductions and potentially meet the 67% reduction target, energy supply “heavy lift” projects will be required. Due to the number of additional variables in play, an additional phase of work (primarily energy supply financial and risk studies) will be conducted prior to proposing new energy supply solutions, the results of which are expected in early 2017.

A longer term perspective

Achieving the long-term GHG reduction targets will require a continued decrease in emissions after 2020, which will require additional actions. Evaluation of alternative energy supplies indicates that some options such as solar energy and waste heat recovery may become technically and financially viable in the near future. The CAP 2020 can also be a vehicle to stimulate innovation and research opportunities in new areas, such as carbon capture or development of new energy technology through ‘Campus as a Living Lab’. In assessing energy supply options, it is essential to consider the best investments in moving toward the 67% reduction target, and beyond to reach the 2050 target of zero emissions.

Making it happen

Resources required to implement the majority of actions outlined in this plan will be prioritized through existing budgets and staff. There are a few actions that will require additional resources for implementation for both hard (e.g. new energy supply infrastructure) and soft (e.g., behaviour change program staffing) costs. However, all actions requiring additional resources are proposed based on the opportunity to achieve a life cycle positive return on investment.

A unit-level strategic planning initiative led by Sustainability & Engineering is assisting major units such as Building Operations, Energy & Water Services and others in integrating climate action and other sustainability goals, actions, and reporting metrics within their own operational plans and activities.



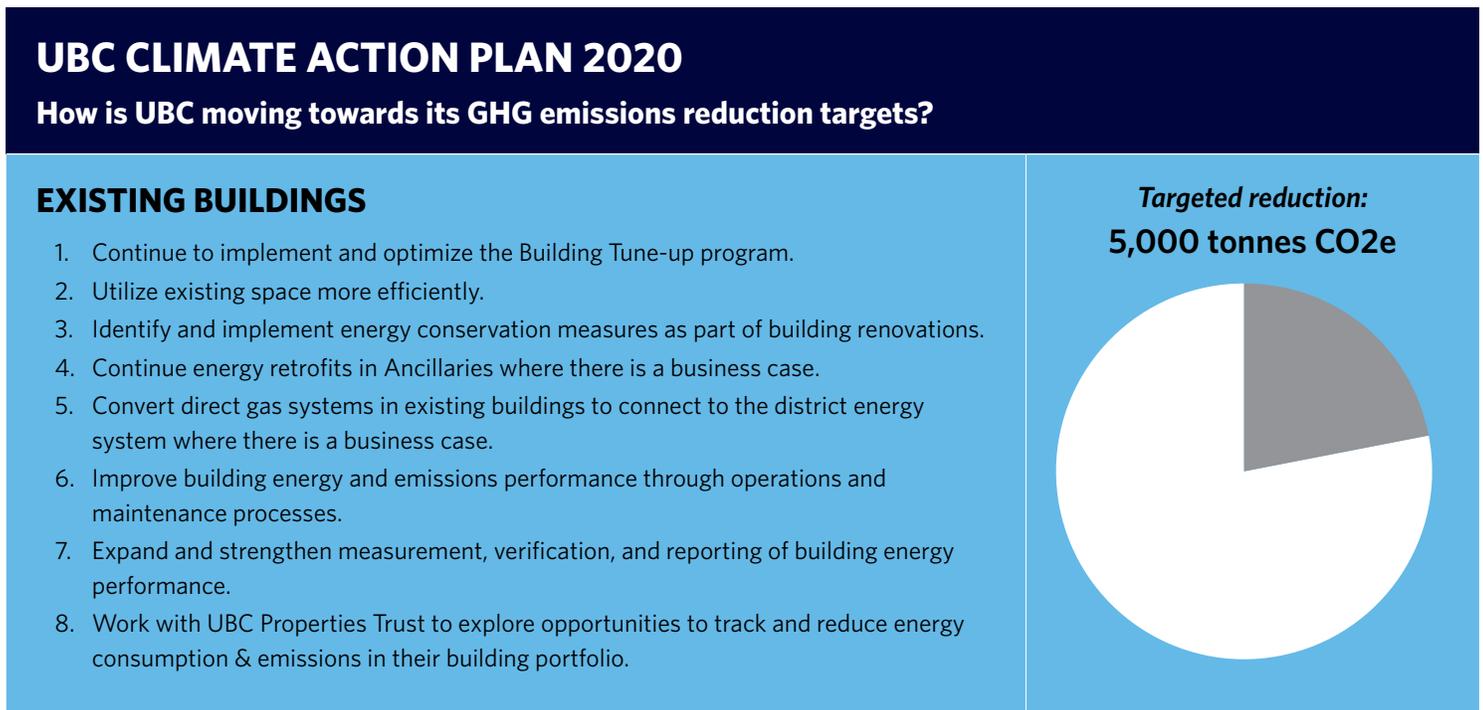
Moving forward, the actions and monitoring requirements developed in this plan will be regularly reassessed and refined. Monitoring includes two components: monitoring of plan actions via an Action Matrix and the unit level planning processes; and performance monitoring, primarily through the existing Carbon Neutral Action Reporting process.

UBC's Climate Action Plan 2020 sets out actions for the Point Grey campus to advance toward the adopted 2020 GHG reduction target. 2020 will mark another milestone in assessing progress, and is recommended as an appropriate timeframe to develop an update to the Climate Action Planning process.

In order to meet UBC's ambitious and challenging goals and targets for 2020 and beyond, many departments will need to continue to collaborate and develop innovative and effective solutions that can be integrated into operations in a financially responsible way. 2020 will mark another milestone in assessing progress, and is recommended as an appropriate timeframe to develop an update to the Climate Action Planning process, including developing interim GHG reduction targets for the period between 2020 and 2050.

1.1 ACTION SUMMARY

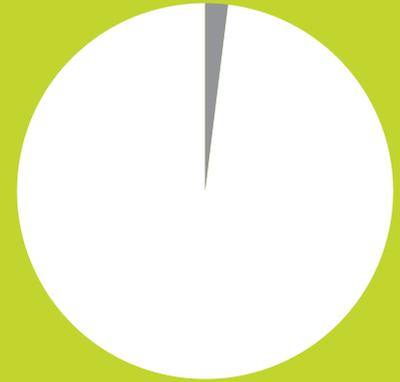
The following table summarizes the high-level CAP 2020 actions at a glance. Dark shaded portions of the pie chart indicate the target reduction for that reduction area – e.g., existing buildings, new buildings, etc.



NEW BUILDINGS

9. Develop a new Green Building Plan that identifies measures to reduce energy use, GHG emissions and total cost of building ownership through the operational life of buildings.
10. Develop Net Positive Buildings Pathways to inform and support building design teams in achieving the best possible performance and in providing directions on UBC's future performance targets.
11. Reduce the performance gap between modelled and actual building performance.
12. Enhance UBC's Technical Guidelines to better align energy, GHG emissions reductions, sustainability and cost objectives and achieve better project outcomes.
13. Explore a policy that requires new buildings to connect to the Academic District Energy System, or where connection is not feasible, require building design to result in comparable emissions intensity relative to ADES-connected buildings.

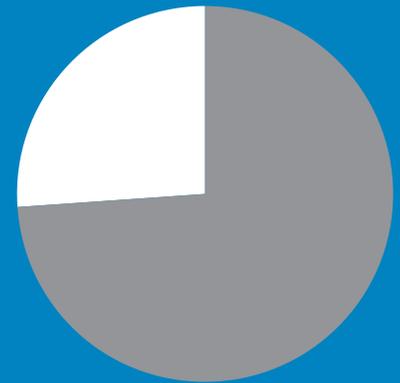
Targeted reduction:
340 tonnes CO₂e



ENERGY SUPPLY

14. Incorporate additional alternative, low-carbon energy supply sources including wood waste biomass and renewable natural gas to provide heat to the ADES, based on additional analysis of supply cost and risk.
15. Continue to explore and evaluate other energy supply research and partnership opportunities.

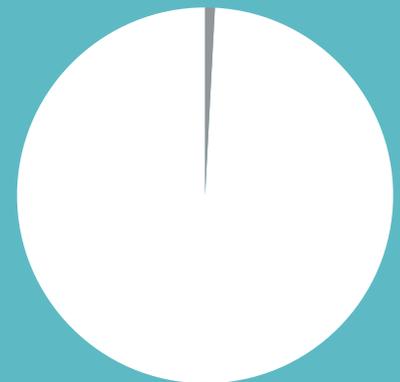
Targeted reduction:
16,600 tonnes CO₂e



BEHAVIOUR CHANGE

16. Strengthen and ensure adequate resourcing of the Green Labs program, which is the behaviour change program with the greatest potential impact on energy and GHG emissions.
17. Develop a plan and business case for an integrated, coordinated behaviour change program, with ongoing review and updating of program design focused on achieving targeted results.

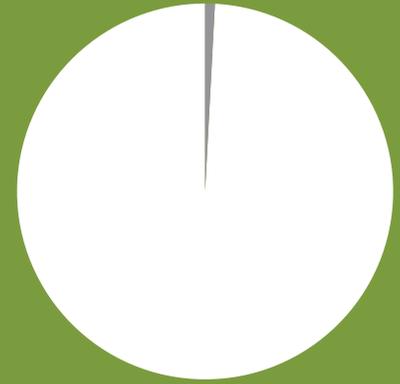
Targeted reduction:
300 tonnes CO₂e



FLEET

18. Continue to increase the efficiency of UBC's fleet through procurement of right sized, high efficiency, and alternate fuel (such as electric and compressed natural gas) vehicles and motorized equipment wherever possible.
19. Develop a business case and potential implementation strategy for centralizing procurement and management of more UBC vehicles.
20. Explore an enhanced bicycle or e-bike share program for on campus travel.

**Targeted reduction:
260 tonnes CO2e**



COMPLIMENTARY OPPORTUNITIES

21. Explore and potentially promote smartphone apps to facilitate car sharing & transportation mode shifting.
22. Research opportunities to reduce business travel emissions, including data collection and evaluation of potential solutions such as virtual meeting infrastructure and incentives.
23. Continue implementation of the Zero Waste Action Plan and the associated engagement program in order to further reduce emissions from waste management.
24. Develop and implement more rigorous Scope 3 emissions accounting methods where feasible.
25. The above actions represent a total potential CO2e reduction of approx. 23,000 tones to achieve a 67% emissions reduction from 2007 levels, subject to approval and implementation of key actions including alternative energy supply.
26. For a more detailed list of climate actions, please reference "Priority Actions" in the Climate Action Plan 2020.

2 CLIMATE LEADERSHIP AT UBC

2.1

POLICY CONTEXT AND THE CASE FOR ACTION

Changes in climate change policy from 2010 to 2015 at the international, national, provincial and university levels has changed the context in which UBC is taking climate action. These policy changes present both opportunities and challenges as we move towards our 2020 and 2050 GHG reduction targets. Acting strategically within the present climate policy context will ensure that UBC remains an international leader on climate action for years to come while working within a fiscally responsible framework.

International Context

In December of 2015, the international community reached the Paris Agreement at the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21). This new agreement includes commitments of member states, including Canada, to do their part to limit global temperature increase below 2 degrees Celsius, while aspiring towards limiting the increase to 1.5 degrees Celsius. The new agreement requires member states to conduct regular GHG emissions reporting. This has placed additional pressure on the Canadian government to take further action to decrease national GHG emissions.

National Context

The federal government has shown renewed interest in supporting climate action and is currently working with provincial governments to explore fiscal mechanisms to reduce GHG emissions, including development of a national carbon strategy that places a price on carbon emissions. The Government of Canada has created a \$2 billion Low Carbon Economy Trust to fund projects that reduce carbon and a commitment to phase out subsidies for the fossil fuel industry. These federal policies, once implemented, will help support the business case for transitioning UBC's energy supply to low carbon sources.

Provincial Context

As a public institution, UBC is committed to ensuring that our operations are run responsibly and in compliance with provincial climate legislation. Under the Provincial Greenhouse Gas Reduction Targets Act and the Carbon Neutral Government Regulation, UBC is required to be carbon neutral in its operations, as are all public sector organizations. Currently, in order to achieve carbon neutrality, UBC annually purchases offsets for the GHG emissions that remain after our reduction efforts.

The provincial carbon tax affects the financial feasibility of UBC's climate actions. In addition to the cost of purchasing energy, UBC is required to pay \$55 per tonne of carbon emitted - a combination of a \$30/tonne carbon tax and a \$25/tonne tax for offsets to meet public sector carbon neutrality, as required by carbon neutral public service organization regulations. Therefore, reducing our emissions will also reduce our carbon costs going forward (or carbon liability). If carbon tax is increased in the future

as per the provincial Climate Leadership Team recommendations (adding \$10 per tonne per year starting in 2018), UBC's annual carbon costs could increase by over \$1,000,000 by 2021, and \$5,000,000 by 2040, if UBC was to take no new climate action.

The UBC Climate Action Plan team has accounted for the uncertainty in provincial climate policy by evaluating all potential climate actions using a set of evaluation criteria, and by conducting additional risk analyses to better understand various scenarios that could materialize in the coming months and years¹.

University Context

In 2010, UBC became the first Canadian university to announce bold greenhouse gas reduction targets putting it on course to be net zero emissions by 2050. The UBC Board of Governors adopted the Climate Action Plan and GHG reduction targets with a series of supportive actions and capital projects supported by sound business case analysis. This plan applies to the academic portion of the Vancouver campus; a Community Energy and Emissions Plan (CEEP) was also developed for the University Neighbourhoods in 2013. Since then, the Board of Governors also adopted the UBC Vancouver Campus Plan (2010), the UBC Transportation Plan (2014), the UBC Zero Waste Action Plan (2014), and the UBC Land Use Plan (2015). Each of these plans indirectly support UBC's Climate Action Plan. The diverse range of climate-conscious Board approved plans demonstrates UBC's commitment to holistic approaches to sustainability on campus.

In 2014 UBC created a 20-Year Sustainability Strategy in consultation with the campus community, including students, faculty, staff, campus residents, the University Neighborhood Association (UNA), the Musqueam First Nation and external community partners. The vision expressed in this strategy reaffirmed UBC's commitment to be a leader in sustainability generally, including climate action.

Co-Benefits of Climate Action

In spite of the critical importance of mitigating climate change by reducing greenhouse gas emissions, the case for climate action is not limited to this objective. There are many potential co-benefits of further climate action at UBC, including:

- Reducing energy and carbon costs relative to business as usual by millions of dollars per year
- Mitigating UBC's exposure to future volatility in conventional energy costs and increasing carbon liability;
- Creating more comfortable, durable and reliable buildings;
- Leveraging technology innovation, research and development at UBC and with industrial partners;
- Leveraging external funding for innovation and research;
- Supporting the integration of sustainability challenges within the academy and capitalizing on teaching and learning opportunities; and
- Bolstering UBC's internationally recognized reputation and leadership in climate action and sustainability in operations and the academy.

¹ For more information on how climate actions' feasibility was assessed, see page 14.

These co-benefits are considered alongside technical, financial, risk and other criteria when assessing new climate actions.

UBC's Bioenergy Research and Development Facility (BRDF) is an example of a project that has played a large role in reducing campus GHG emissions, in addition to achieving many of the above co-benefits.

2.2 EARLY LEADERSHIP ON CLIMATE ACTION AT UBC

The CAP 2020 builds on a long legacy of sustainability and climate action at UBC. In 1997, UBC was the first university in Canada to adopt a sustainable development policy (Policy #5). A year later, the university established the first Campus Sustainability Office in the country. The Campus Sustainability Office (currently integrated into Campus and Community Planning as Sustainability and Engineering) has successfully implemented a number of sustainability initiatives on campus. By 2007, UBC had already reached the Canadian GHG emissions reduction targets, as outlined in the Kyoto Protocol (6% below 1990 levels). In March 2008, UBC was one of the first signatories to the "University and College Presidents' Climate Statement of Action for Canada". As a signatory, UBC committed to develop a "comprehensive plan to reduce greenhouse gases by creating a planning body that includes students, staff, faculty, researchers, administrators and other partners to set emissions reduction targets".

In 2010, UBC took further climate leadership by completing its first Climate Action Plan, which was adopted by UBC's Board of Governors. The plan set three aggressive GHG reduction targets that surpassed provincial, federal and international targets. To date, UBC's CAP 2010 is internationally renowned for its aggressive targets, which are more ambitious than any other top-40 university in the world. The university is currently very close to meeting the first of the targets.

2.3 2010 CLIMATE ACTION PLAN TARGETS

UBC's Climate Action Plans outline what actions the university will take toward reaching its three GHG reduction targets:

27. 33% reduction in GHG emissions below 2007 levels by 2015
28. 67% reduction in GHG emissions below 2007 levels by 2020
29. 100% reduction in GHG emissions below 2007 levels by 2050 (carbon neutrality)

The 2010 plan outlines what actions the university committed to taking to reach its first GHG reduction target, a 33% decrease below 2007 levels by 2015. The plan identified 107 actions across seven action areas.

The 2020 CAP builds on the success of the 2010 plan, and focuses on actions for the next five years, toward meeting the 2020 target of 67% reduction, with consideration given to strategic planning for the longer term.



2.4 ACHIEVED GHG REDUCTIONS

The series of actions taken over the past 5 years have resulted in a total GHG emissions reduction of 30% below 2007 levels, as of December 2015. UBC is expecting to reach its 33% GHG emissions reduction target by the end of 2016. This is a significant achievement given increases of 16% in floor space and 18% in student enrollment between 2007 and 2015. When floor space growth is factored in, the university's total reduction in GHG emissions at 2016 will be approximately 40% relative to "business as usual" or BAU.

As the majority of UBC's emissions come from buildings, our GHG emissions reductions have been largely achieved through improving the energy and GHG performance of our buildings, and integrating renewables into and increasing energy efficiency of the district energy system that supplies heat to these buildings.

Specifically, UBC's success to date has been achieved largely through three major projects:

1. Converting the Academic District Energy System (ADES) from steam to hot water, which resulted in a 24% increase in overall energy efficiency with proportional savings in operations and reductions in GHGs;
2. Establishing the Bioenergy Research and Demonstration Facility (BRDF) to provide renewable heat and power to the ADES;
3. Implementing the Building Tune-Up Program to improve energy and emissions performance in existing buildings.

UBC's decision to update its steam-based district energy system to hot water addressed multiple objectives. Originally built in 1924 and fueled with coal, it was eventually converted to gas boilers with the most recent of those boilers installed in 1967; consequently, much of the system was near end of service life. The conversion helped avoid \$42 million of capital spending to keep the legacy steam system operating, and operating costs have been reduced by \$5.5 million per year, contributing to the business case.

Since 2012, UBC has been paying \$55 per tonne for carbon (\$30 for the carbon tax and \$25 for legislated carbon offsets). However these carbon costs have been reduced by over half a million dollars just between 2012 and 2014 with a large proportion of this reduction being attributed to the BRDF and the steam to hot water conversion.

Additional GHG emission reductions were achieved by significantly decreasing paper use on campus and implementing green building regulations with an emphasis on energy efficiency for the construction of new buildings.

Other factors outside of UBC's control, particularly weather patterns and a change in the GHG emissions factor for electricity (a value set by the provincial government that is used in the GHG emissions accounting process), also played a role in emissions reductions from 2010 to 2015.

The chart below illustrates the achieved (historical) GHG emissions reductions to 2015, and forecasted emissions for 2016, relative to the business as usual (BAU) forecast from 2007 which includes growth. The reductions are considerably larger than what would have been needed to meet the target had there been no growth since 2007, and in fact represent a 40% reduction relative to BAU.



Forecast Reductions Relative to BAU at 2016

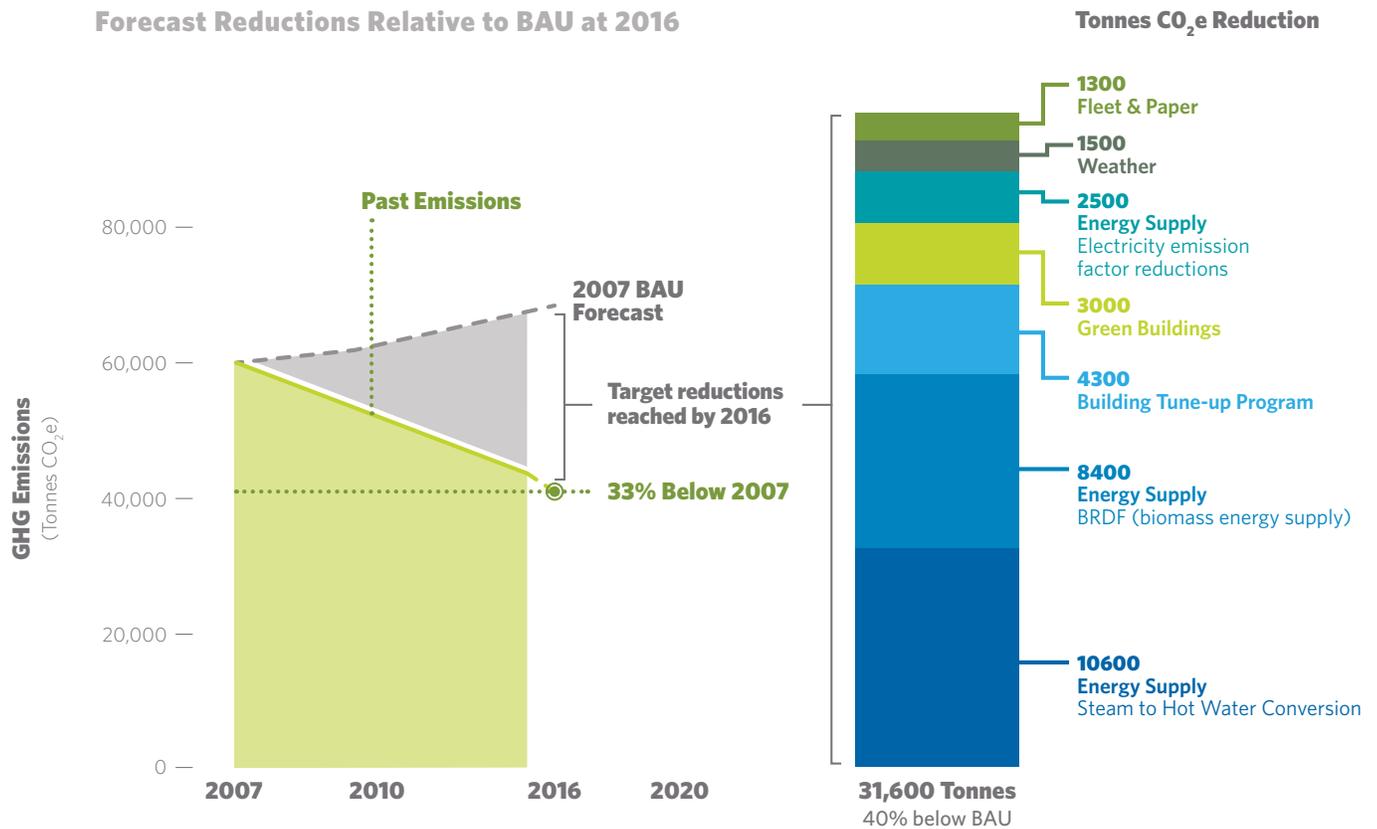


Figure 1. Historical emissions and forecasted reductions from the 2010 CAP.

2.5 MEETING OUR FUTURE GHG REDUCTION TARGETS

If UBC takes no new climate actions, emissions will begin to rise steadily after 2016, as the campus continues to grow. The chart below shows the two possible paths forward: no new actions (business as usual), and a proactive path toward the GHG emissions reduction targets that the university committed to in 2010. Continuing to follow the latter path provides new opportunities for UBC to realize savings on energy and carbon related costs and undertake world-leading research, all while further reducing GHG emissions and remaining an international leader in climate action.

Based on the current data², UBC GHG emissions in 2015 were approximately 43,000 tonnes, a 30% reduction below the 2007 baseline. An additional 23,000 tonnes will need to be eliminated in order to achieve the 2020 target of 67% reduction below 2007 levels.

² To be confirmed upon publication of the 2015 Carbon Neutral Action Report (CNAR).

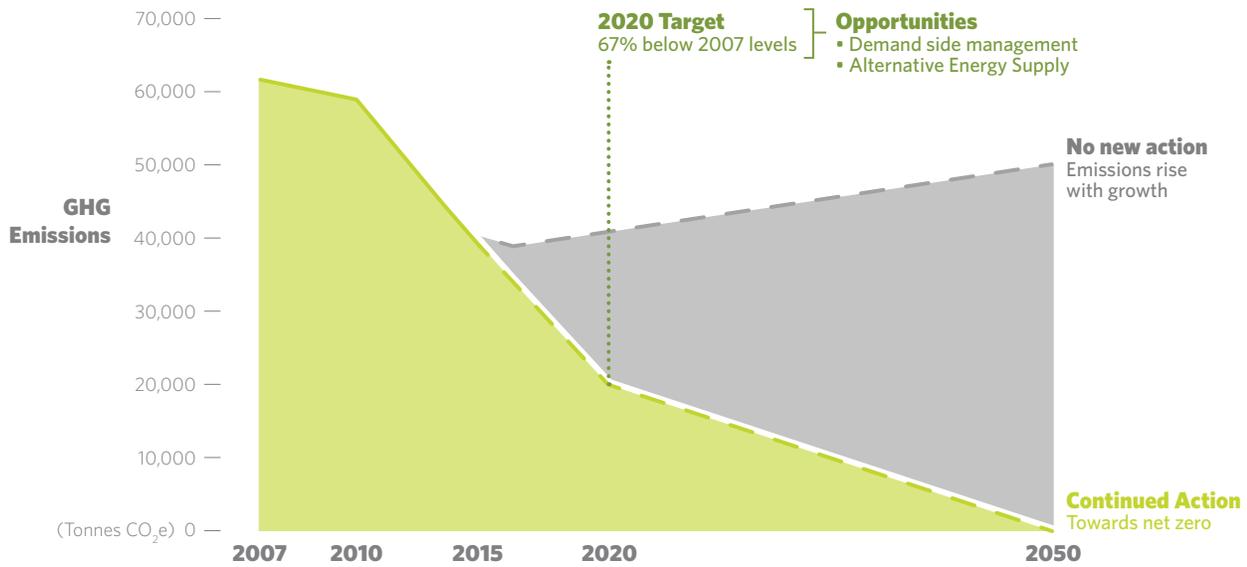


Figure 2. The CAP 2020 challenge and opportunity.

The grey shaded portion in the above figure illustrates the gap between ‘business as usual’ emissions (if UBC takes no new climate actions) and UBC’s GHG emissions reduction targets (represented by the green shaded portion).

3 DEVELOPING THE 2020 CLIMATE ACTION PLAN

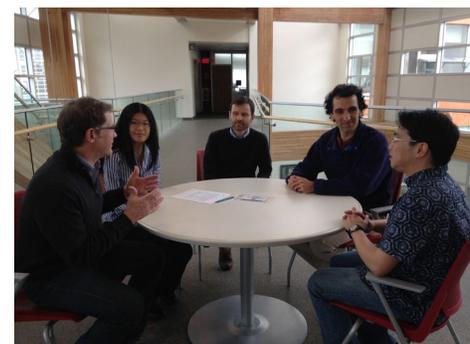
Campus and Community Planning, in collaboration with Energy and Water Services, began the planning process for the CAP 2020 in the spring of 2015. A steering committee that included key representatives from UBC’s operational units, faculty and students was formed to oversee the planning process. Committee members provided guidance to the Climate Action Team at each of the five phases of CAP development: review, innovate, evaluate, integrate and adopt. In addition, CAP 2020 reports were presented at key intervals to UBC’s Executive Committee to obtain feedback from a senior university level.



Figure 3. The CAP 2020 process.

3.1 REVIEW

The CAP 2020 planning process provided time to evaluate UBC’s success to date on making GHG emissions reductions, and assessing progress against the 2010 CAP actions. During the “Review” phase of the project, the Climate Action Team met with each of the university’s operational units to review their GHG reduction initiatives and accomplishments made since the plan was adopted in 2010. Based on these check-ins and the energy and emissions reporting done by Energy and Water Services, energy baselines and forecasts of emissions for 2020 and beyond were developed to inform the rest of the planning process.



3.2 INNOVATE

An important part of the planning process was listening to the campus community about their vision for climate action at UBC. In order to start this conversation with the university community, a series of Ideas Workshops were organized for staff, faculty, students and technical experts who are closely involved with climate and energy efficiency initiatives on campus. Participants were encouraged to generate ideas on what UBC could be doing in each climate action area to advance toward its 2020 GHG emissions reduction target.

Campus and Community Planning also put out a call for proposals to UBC researchers in order to tap into the great depth of knowledge and expertise on climate change and climate action that we have in our academic community. Researchers were asked to review current practices and suggest additional climate actions the university could take. This call for proposals was also put forth to the entire campus community.

3.3 EVALUATE

A key outcome from the stakeholder consultation and engagement that took place in the Innovate phase was a list of potential actions for reducing UBC's GHG emissions. The Climate Action Team assessed these potential actions in the Evaluate phase of the planning process, against a set of evaluation criteria that were developed by the project team and approved by the Climate Action Plan Steering Committee and reflected the following considerations:

- Alignment with existing UBC policies and plans;
- Potential impact on GHG emissions and energy reductions;
- Financial performance (business case);
- Level of risk;
- Extent to which the idea is within UBC's jurisdiction and control;
- Ease of implementation including lack of institutional barriers; and
- Potential for research and innovation opportunities and other co-benefits.

This evaluation served as a preliminary feasibility analysis, considering environmental, technical, social and institutional impacts of each action at a high-level. Promising actions that the Climate Action Team identified in consultation with UBC staff and faculty were then prepared for presentation to the UBC community for further feedback.

3.4 INTEGRATE

Feedback on climate actions that made it through the evaluation process was collected through a series of six Open Houses in spring 2016. The campus community's feedback was then considered within the development of a matrix of climate actions, which guided the development of the CAP 2020 draft plan. The climate action matrix was refined based on further analysis and feedback from UBC operational units.

3.5 FINALIZE

The CAP 2020 is presented to UBC's Executive Committee for approval, including actions with associated budget requests, and is then presented to UBC's Board of Governors. An update that may include a proposal for energy supply projects is also anticipated to be brought to the Board of Governors in early 2017 (see Section 7, Implementing the Plan section of the plan for more information).



4 UBC'S GHG EMISSIONS AND REDUCTION OPPORTUNITIES

4.1 GHG EMISSIONS INVENTORY AND SCOPE OF THE CLIMATE ACTION PLAN

The 2010 CAP and CAP 2020 apply only to Vancouver Point Grey Campus of UBC, not including the residential areas within the University Neighbourhoods Association. GHG emissions totals for 2014 (the most recent emissions inventory currently available) for this campus are summarized in Table 1 below, as per the Carbon Neutral Action Reporting (CNAR) 2014 report.

Table 1. UBC Vancouver campus emissions in 2014

Emissions Source	Scope	Tonnes	Offsettable ³	Within UBC's GHG Targets
Vancouver Campus core academic & ancillary buildings, fleet, energy supply, and paper	Scope 1 & 2 ⁴ plus paper	47,814	Yes	Yes
UBC Properties Trust buildings	Scope 1 & 2	2,021	Yes	See footnote ⁵
Commuting, business travel, building lifecycle, and solid waste	Scope 3 ⁶	55,463	No	No



³ Subject to purchase of offsets as per carbon neutral public sector requirements.

⁴ Scope 1 emissions are direct emissions from fuel use on campus; Scope 2 emissions are indirect (due to energy use of campus - i.e., to produce electricity that is then supplied to UBC).

⁵ Operation of UBC Properties Trust buildings are not included in the 2010 CAP. Emissions from these buildings are also reported separately in the annual CNAR report. Emissions and potential reductions for these buildings will continue to be tracked separately from the CAP 2020 targets. However, due to the growing portfolio of these buildings, the CAP 2020 is proposing actions to integrate UBC Properties Trust buildings into the scope of UBC's forthcoming climate action plans.

⁶ Scope 3 emissions are primarily off-campus emissions not included in UBC's GHG reduction targets and not offsettable under carbon neutral provincial regulations, however they are estimated and reported as part of UBC's GHG inventory in the annual Carbon Neutral Action Reports.

4.2 GHG ENERGY & EMISSIONS SOURCES

The majority of UBC's off-settable GHG emissions come from the use of natural gas to heat buildings. As shown in the figure below, operations of core academic buildings and ancillary buildings (including student housing and athletics facilities) accounted for 96% of emissions in 2014. A forecast of future energy sources, illustrated in the figure below, indicates that 88% of campus emissions in 2016 will come from the use of natural gas to operate core academic and ancillary buildings.

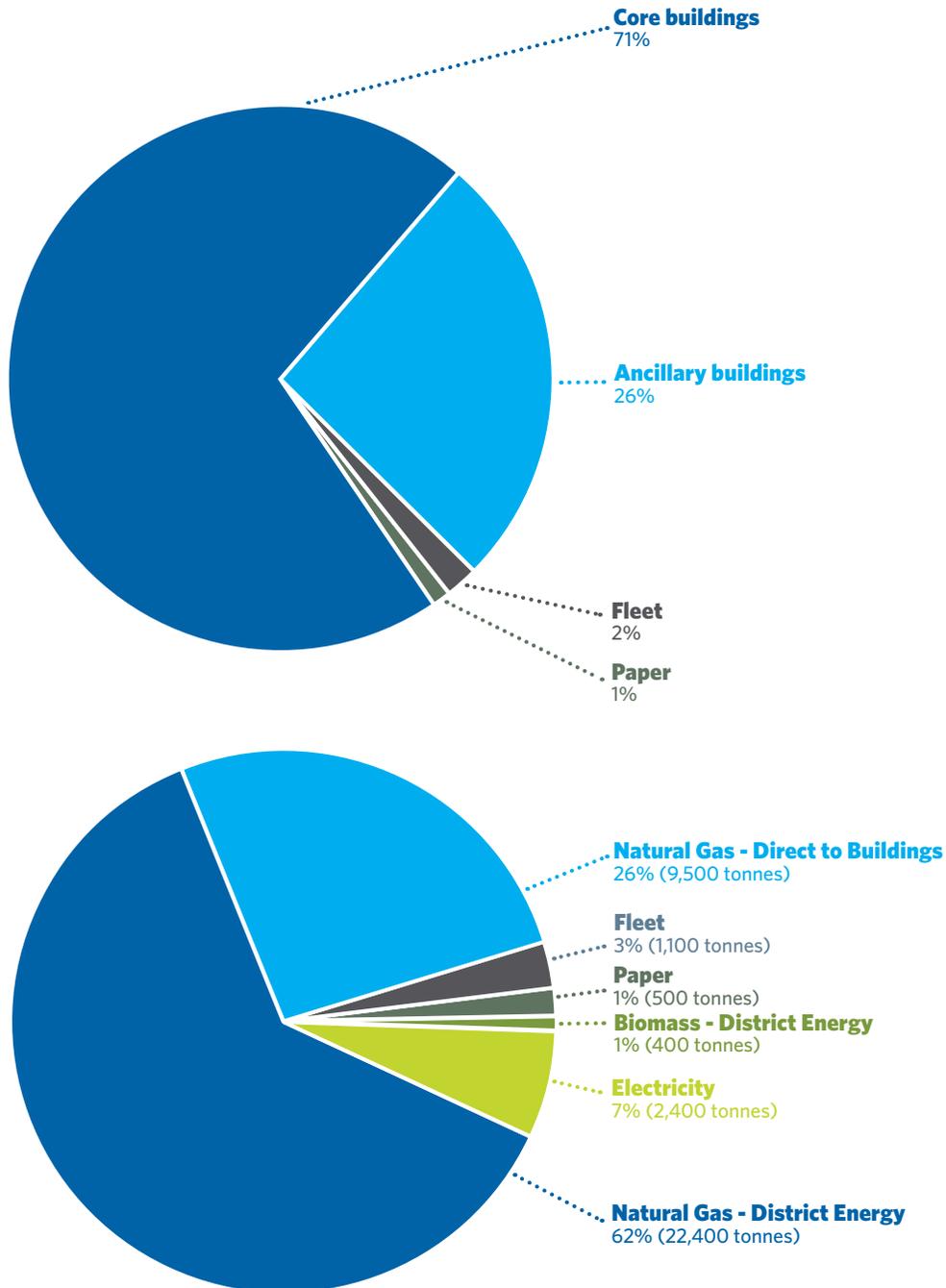


Figure 4. UBC emissions by sector in 2014 and by energy source forecasted for 2016.

The figure below illustrates UBC's GHG emissions relative to the energy source and system they come from. The ADES distributes heat from the Campus Energy Centre and the BRDF to the majority of buildings on campus that are connected to the campus district energy system. Buildings that are not connected to the ADES are supplied directly with natural gas.

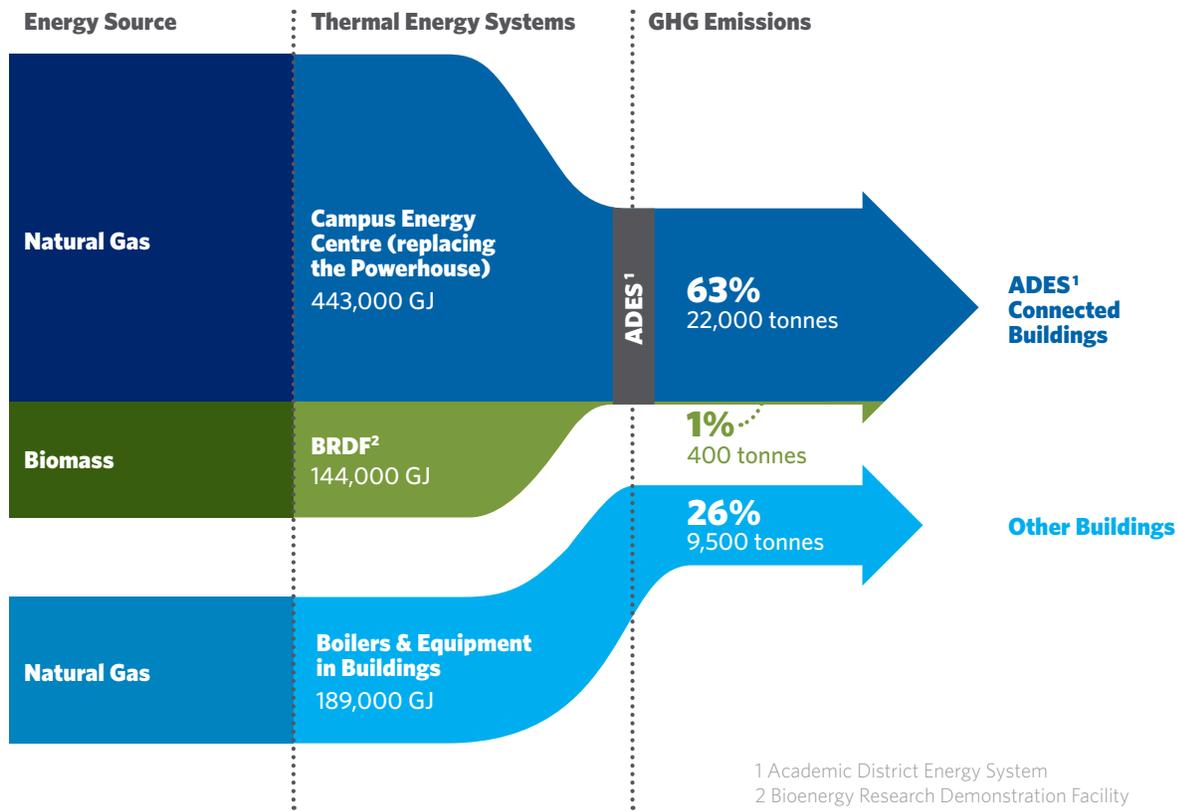


Figure 5. UBC's GHG emissions by energy sources and systems⁷

As evident in Figure 5, a significant portion (approx. 20%) of heating energy is provided by biomass (clean wood waste) used in the BRDF. However, this only contributes 1% of UBC's emissions, since the biomass fuel is carbon dioxide neutral.

Given UBC's emissions profile, in order to make further substantial emissions reductions, we need to reduce the consumption of natural gas significantly. The emissions reductions associated with natural gas can also be complemented with smaller GHG reductions related to electricity and vehicle fuels.

Reductions in GHG emissions can be achieved in two primary ways:

- Demand side: reduce the demand for energy through conservation measures; and
- Supply side: shift from natural gas and other fossil fuels to alternative, lower emissions energy sources including renewable energy to operate the campus and vehicles.

⁷ Note that the height of each band is proportional to the amount indicated.

The CAP 2020 climate actions to reduce emissions toward the targets are organized into the following action areas, which align with the mandate of UBC’s operational units:

- Existing buildings (accounting for the bulk of current emissions);
- New buildings (future sources of emissions);
- Behaviour change (influencing energy use and emissions from buildings);
- Energy supply (serving the buildings on campus); and
- Fleet (operations and departmental vehicles and motorized equipment).

Scope 3 Emissions, falling outside UBC’s reduction targets, were attributed to the following sources in 2014, based on the CNAR 2014 report. UBC is not required to report on Scope 3 emissions under the Carbon Neutral Government Regulations, however, it is important to understand where emissions are being generated and identify measures to reduce them, where possible.

Table 2. Scope 3 emissions in 2014 (CNAR).

Source	Tonnes
Commuting	30,726
Staff and Faculty Air Travel	12,048
Building Lifecycle	11,796
Solid Waste	893

5 CLIMATE ACTIONS

5.1 OVERALL STRATEGY

The CAP 2020 is being developed in two phases. In the initial phase, the suite of proposed actions (which are primarily Demand Side Management (DSM) actions) across existing and new buildings, behaviour change, and fleet vehicles, are expected to be able to reduce GHG emissions a further 8% to reach a 38% reduction by 2020. The majority of these actions can be implemented by leveraging existing programs and resources; the CAP also seeks to augment key programs with additional staff and operational resources to support Green Labs Programming and Engagement in order to achieve the desired outcomes. Forecasted savings are expected to help fund these positions.

In order to achieve additional reductions and potentially meet the 67% reduction target, energy supply “heavy lift” projects will be required. Due to the number of additional variables in play, an additional phase of work will be conducted prior to proposing new energy supply solutions.

Actions proposed in each of the areas are summarized in the following sections.

5.2 EXISTING BUILDINGS

Targeted Reduction for 2020: 5000 tonnes CO₂e

The thermal energy used to heat over 400 institutional and ancillary buildings on campus is the largest contributor to UBC’s GHG emissions. Over the past two decades, UBC has developed and implemented a range of energy conservation programs that have not only reduced GHG emissions in these buildings, but have also achieved ongoing cost savings and positive returns to the University.

- Completed between 2001 and 2008, the ECOTrek program retrofitted 288 academic buildings, reducing GHG emissions intensity (per unit floor area) by 23% and water consumption by 35% from 2000 levels, and eliminating an estimated \$20 million from accumulated deferred maintenance debt.
- The Building Tune-Up program reduced total GHG emissions by over 4000 tonnes, between 2007 and 2015, with concurrent energy cost savings.
- Student residences have been undergoing ongoing energy conservation retrofits such as window replacement, building envelope improvements, high efficiency lighting and plumbing fixtures as an integrated part of building renovations.

Continuing to implement and optimize the Building Tune-Up program for core academic buildings is central to reducing GHG emissions going forward. However, the growth of ancillary buildings (student housing and athletic facilities) is increasing the proportional share of energy and emissions relative to core academic buildings; to ensure GHG and cost reduction opportunities are maximized, additional focus on energy management in these buildings may be needed.

The ongoing implementation of existing buildings energy conservation measures has demonstrated that GHG reductions can be achieved with a positive return on investment and can be addressed in large part through existing programs and resources.

Priority Actions

1. Continue to implement and optimize the Building Tune-up program for academic buildings, focusing on the largest energy consuming buildings, and buildings heated by direct natural gas (not connected to the district energy system). Include:
 - a. Deep energy efficiency analysis in high energy use buildings to identify further energy reduction measures.
 - b. Utilization new technology such as Wi-Fi occupancy data to help align Building Management Systems (BMS) with building occupancy and optimize building energy performance.
 - c. Auditing building systems where appropriate, including sensors, lighting and mechanical insulation.
 - d. Integration of audits and analysis outputs into project planning.
2. Utilize existing space more efficiently.
 - a. Increase intensity of space use as part of major renovations, where possible.
 - b. Utilize occupancy data to enhance facilities planning and increase space utilization.
3. Identify and implement energy conservation measures as part of building renovations wherever possible.
 - a. Reduce thermal demand through envelope enhancements, low grade and waste heat recovery and utilization of high-efficiency mechanical equipment where appropriate.
 - b. In renovation projects that entail design or equipment choices that impact sustainability performance (particularly energy and water consumption), include life cycle costing in the project scoping and budgeting process.
 - c. Where appropriate, include a recommissioning step in major renovations following occupancy and building handover to ensure building systems are functioning and performing efficiently.
4. Continue energy retrofits in Ancillaries where there is a business case, including energy efficiency upgrades to windows, shower heads and other equipment.
 - a. Conduct energy audits when renovations are planned.
 - b. Explore further ways to optimize ancillary building performance, for example by building capacity for additional re-commissioning and BMS system optimization.
5. Convert direct gas systems in existing buildings to connect to the district energy system when appropriate and there is a positive business case.
6. Improve building energy and emissions performance and operational efficiency through operations and maintenance processes.
 - a. Periodically recommission buildings to ensure building performance is optimized.



- b. Explore ways to build the capacity of building operations and maintenance staff to support increased energy efficiency and increasingly complex building systems.
 - c. Explore ways to further integrate building energy and emissions objectives, measurement and feedback into building-level decision-making and operations.
 - d. Pilot the utilization of “expert” software systems including automated fault detection systems to manage operations and maintenance for energy efficiency.
7. Expand and strengthen measurement, verification, and reporting of building energy performance.
- a. Include further exploration of dashboard systems for energy reporting and supporting behaviour change programs, and development of Key Performance Indicators for building energy and emissions.
 - b. Update energy billing systems to better support energy conservation efforts. (For example, comparative utility consumption with previous periods or other buildings in the same class)
 - c. Include energy benchmarking for ancillary buildings.
8. Work with UBC Properties Trust to explore opportunities to track and reduce energy consumption & emissions in their building portfolio.

Actions for Future Consideration

1. Create a trades energy team (e.g., electrical, refrigeration, mechanical, plumbing) responsible for implementation of building energy optimization including field investigations, sensor and metering calibration and replacement.

5.3 NEW BUILDINGS

Targeted Reduction for 2020: 340 tonnes CO₂e

UBC has established itself as a leader in green building design and construction thanks to our Residential Environmental Assessment Program (REAP 3.0) and requirement that all new academic building projects achieve LEED Gold certification. Our enhanced Sustainability Process and UBC’s LEED Implementation Guide support the development of green building projects on campus.

Improved energy efficiency in new buildings constructed since 2010 is already reducing campus GHG emissions by an estimated 2400 tonnes per year. By continuing to support energy efficiency in buildings as UBC grows, we will continue to reduce the GHG emissions intensity from buildings. Looking forward to 2050, the future Green Building Plan could reduce building GHG emissions by as much as 9,000 tonnes per year, with attendant energy cost and carbon cost savings.

An important part of maximizing our green building initiatives is addressing the gap between expected energy performance (as modelled in the development process) and actual energy performance achieved. This gap has been identified in some buildings on campus, including LEED certified buildings. Factors that are likely contributing to this performance gap include design and/or commissioning issues, changes in end-user requirements, changes in building occupancy, and shortfalls in project budgets.



In addition, energy and efficiency measures within green building projects need to achieve life cycle positive return on investment.

Priority Actions

1. Develop a new Green Building Plan⁸ that identifies measures to reduce energy use, GHG emissions and total cost of building ownership through the operational life of buildings while maintaining or improving building livability standards and expectations. The Green Building Plan will explore:
 - a. A strengthened Sustainability Process that includes a stronger focus on life cycle costs;
 - b. Enhanced building commissioning processes;
 - c. More robust and accessible reporting of actual building performance.
2. Develop Net Positive Buildings Pathways to inform and support building design teams in achieving the best possible performance and in providing directions on UBC's future performance targets. These Pathways will include a comprehensive roadmap toward *net positive*⁹ building design by outlining whole building energy modelling techniques for specific building types, which will be phased in over time.
3. Identify and implement strategies to reduce or eliminate the performance gap between a new building's designed or modelled performance and the actual performance achieved. This step is essential to achieving higher levels of building performance to be targeted in the Green Building Plan.
 - a. Include recommissioning of major buildings following handover and occupancy to ensure building performance is optimized under actual operational conditions.
4. Enhance UBC's Technical Guidelines to better align energy, GHG emissions reductions, sustainability and cost objectives and achieve better project outcomes. UBC Technical Guidelines are the code of quality and performance for the design, construction and renovation of University-owned institutional buildings and thus are an essential part of achieving desired project outcomes.
5. Explore a policy that requires new buildings to connect to the Academic District Energy System, or where connection is not feasible, require building design to result in comparable emissions intensity relative to ADES-connected buildings. The ADES offers the ability to provide an efficient heat source with a lower GHG profile to buildings across campus, while lowering operations and maintenance and simplifying the heating equipment required in the buildings.



Actions for Future Consideration

1. Adapt the Sustainability Revolving Fund to incent higher performance in new buildings.
2. Organize student design competitions for energy efficient UBC buildings - contributing innovative design aspects and research.

⁸ The Green Building Plan will also address building renewals and major renovations where appropriate, pending confirmation of plan scope.

⁹ Net Positive in this case refers to buildings that do not require energy input, and do not produce any net emissions.

5.4 ENERGY SUPPLY

Targeted Reduction for 2020: 18000¹⁰ tonnes CO2e

Over the last five years, UBC has converted the aging steam heating system to hot water district energy, improving the overall system efficiency by 24%. Connected to the district energy system, the Biomass Research and Development Facility (BRDF) has significantly reduced natural gas consumption by utilizing clean waste wood as a heating fuel. This biomass fuel, which must meet UBC's stringent requirements (i.e. less than 20% moisture, no contaminants and less than 4 inches in size) and with emissions that must satisfy Metro Vancouver's air quality standards, reduces UBC's GHG emissions because it is a CO₂-neutral fuel under Provincial accounting regulations. Together with the new Campus Energy Centre replacing the old powerhouse, these energy projects are contributing to UBC's emissions reductions, achieving millions in annual operations savings and contributing to campus energy resiliency.



With these three energy projects in place, the primary energy supply opportunity for further GHG reductions is to substitute additional alternative energy sources for natural gas, and to connect more buildings that currently have direct natural gas connections to the district energy system in the longer term.

As part of the 2010 Climate Action Plan, a comprehensive alternative energy analysis was undertaken. For the CAP 2020, this study was reviewed and updated to reconsider supply options including biomass, renewable natural gas (RNG, or biogas)¹¹, solar thermal and PV, geothermal, waste heat recovery (including from TRIUMF), wind power, electric boilers and others. This analysis shortlisted two potential energy options, biomass and renewable natural gas, for further consideration as described below.

With UBC already utilizing low-carbon hydroelectricity, a common question is, “why not expand its use for heating (e.g., via electric boilers)?” We are currently not pursuing electricity as a large-scale thermal energy source because:

- It has a higher cost per unit thermal energy compared with our existing sources (gas, RNG and biomass);
- UBC's electricity supply infrastructure currently has a limited capacity (though this may be addressed by 2020); and
- Using electricity directly as a heat source (e.g. electric boilers) is not generally considered the best use for this valuable resource.

However, UBC will continue the efficient use of electricity in building thermal energy systems, for example to power heat pumps that recover waste heat.

Option 1: Expand BRDF biomass capacity.

This option would triple the thermal capacity of the existing BRDF from 6 MW to 18

¹⁰ Assuming alternative energy supply projects with sufficient capacity can proceed based on feasibility studies and funding.

¹¹ In the UBC case, RNG would be generated by a supplier at a site off-campus, and injected into the natural gas distribution system. UBC would still draw conventional natural gas from the system, but the same amount of RNG purchased would be injected into the system.

MW. Of all options evaluated, this one has the most promising financial performance, with a potentially positive 25-year NPV under base case assumptions. It offers potential GHG reductions of approximately 12,000 tonnes per year, though this is not large enough to meet the 67% target fully on its own. While requiring a capital investment of about \$12 million, the project would build upon the existing infrastructure including the hot water district energy system and would also utilize the existing BRDF facility. This option also considers research proposals that are currently being explored including the creation of a bio-refinery.

Option 2: Renewable Natural Gas.

Purchasing Renewable Natural Gas (RNG) does not require UBC to undertake a capital project on campus. However, the viability of this option is dependent on the amount of RNG supply available, the contracted fuel price, which is still under investigation, and future carbon pricing. Under base case assumptions, the NPV of this option would become positive if carbon pricing increases significantly in the future. This option offers potential GHG reductions that are scalable in magnitude, depending on the supply availability and contractual terms.

Option 3: Partnership Opportunities

Based on preliminary discussions with potential research and industrial partners, there may be additional energy supply options that integrate new research elements or technology opportunities with biomass and/or RNG supply systems. These opportunities will continue to be explored in parallel with the main two options above.

Achieving the 67% reduction target will likely require a combination of Options 1, 2 or 3.

Preliminary risk analysis also identified that while each type of alternative fuel supply, such as biomass or RNG, comes with its own risks such as fluctuations in long term prices, keeping the status quo also entails risk. With a heavy dependence on natural gas for heating, UBC is exposed to price fluctuations that have occurred in the past and have had significant impacts on UBC's energy budget. Diversification of energy supply is one strategy to mitigate the volatility of any one supply source.

Future increases to the carbon tax will also add to the cost of energy for UBC, in particular the cost of natural gas, which has a much higher GHG emissions factor than the alternative options.

Priority Actions

1. Conduct additional energy supply and financial risk analysis¹² using UBC's considerable depth of expertise, followed by a peer review process. This analysis will consider:
 - a. Future biomass & RNG supply & demand, and future pricing risks
 - b. Balancing risks of current & alternative fuel supplies
 - c. Risk mitigation strategies
2. Undertake a more detailed costing and feasibility study of the potential biomass expansion (option 1).



¹² Risk analysis will include developing risk registries for key energy supply options.

3. Continue to incorporate information on carbon pricing into options analysis as it becomes available.
4. Continue to explore and evaluate other energy supply research and partnership opportunities (option 3).
5. Based on the outcomes from the above actions, recommend energy supply alternatives for implementation.

Actions for Future Consideration

1. Re-evaluate other energy supply options such as solar thermal, solar electricity generation and waste heat recovery as technology evolves and economic factors change.
2. Facilitate a research project or partnership to develop or demonstrate carbon capture and utilization technology on campus.

5.5 BEHAVIOUR CHANGE

Targeted Reduction for 2020: 300 tonnes CO₂e

Changes in occupant behaviour, which can also be thought of as changes in practices and processes, influence energy consumption and as a result, GHG emissions.

Depending on the building type, behaviors that influence GHG emissions include:

- Closing fume hoods when not in use in laboratory buildings (depending on the type of fume hood). Fume hoods have been estimated to consume approximately 10% of UBC's total energy¹³;
- Keeping windows closed in residences or offices (depending on the building and temperatures);
- Adjusting indoor temperature set points; and
- Avoiding long showers and choosing cold water for laundry in student residences.

Other behaviours such as turning off lights and computer monitors when not in use will not affect GHG emissions significantly because the GHG footprint of electricity is low relative to natural gas, however this will reduce energy costs.

UBC's over 400 laboratories play a big role in consumption of energy, water and materials, and in contributing to GHG emissions; UBC laboratory buildings account for 49% of campus electricity consumption and 24% of campus water use.

UBC has developed behaviour change initiatives including the award-winning Sustainability Coordinator Program, the Green Labs program, the Sustainability in Residence program, and is currently scoping a Green Office program. Though it is challenging to fully quantify energy savings from behaviour change, these existing programs have demonstrated successes, and evidence from programs at other institutions indicate that there is a large range of potential savings. With annual energy costs of over \$20 million per year dominated by energy use in buildings, the potential for reductions is significant: a one percent reduction across campus, for example, would



13 2015 Shut the Sash Report

result in a \$200,000 in savings. Behaviour change can also contribute to reduction in peak electricity demand, mitigating the risk of exceeding the capacity of UBC's electrical supply.

Reducing emissions through behaviour change integrates UBC's extensive research in this area, and builds on existing programs that have already been developed. Strengthening the behaviour change programs leverages faculty expertise and creates opportunities for students and researchers to mobilize as agents of change, with support and guidance from staff.

Priority Actions

1. Strengthen and ensure adequate resourcing of the Green Labs program, which is the behaviour change program with the greatest potential impact on energy and GHG emissions.
2. Develop a plan and business case for an integrated, coordinated behaviour change program, with ongoing review and updating of program design focused on achieving targeted results.
 - a. Leverage existing resources including the Behavioural Sustainability Group.
 - b. Create a Sustainable Campus Committee, including a coordinator role, to streamline engagement programming with building operators, offices, labs and student residents.
 - c. Integrate behaviour change that can address peak electricity demand, such as switching off non-essential equipment.



Actions for Future Consideration

1. Explore the possibility of a future energy incentive program that provides financial incentives for achieving savings in targeted buildings and departments, with a focus on laboratory buildings.

5.6 FLEET

Targeted Reduction for 2020: up to 260 tonnes CO₂e (to be confirmed)

Though UBC's fleet of vehicles and motorized equipment has a relatively small impact on overall GHG emissions, vehicles are a highly visible part of UBC's operations. More efficient fleet management has the potential to reduce departmental costs and support innovation such as charging and fueling systems.

UBC Building Operations has achieved the only E3 Fleet Platinum rating in Canada, and has reduced the GHG emissions of UBC's fleet by 43% between 2007 and 2014, through a wide range of strategies including fleet data tracking and analysis, vehicle "right-sizing", higher efficiency vehicles, and adoption of alternate fuel vehicles including electric and Compressed Natural Gas (CNG).



Priority Actions

1. Continue to increase the efficiency of UBC's fleet through procurement of right sized, high efficiency, and alternate fuel (such as electric and CNG) vehicles and

motorized equipment wherever possible.

- a. Regularly reassess fleet needs and adjust or reduce vehicles as appropriate.
2. Develop a business case and potential implementation strategy for centralizing procurement and management of more UBC vehicles.
 - a. Develop an online data collection tool and cost estimator for departments to use for cost and savings analysis – potentially starting with a SEEDS research project.
 - b. Explore a low-emissions car-sharing program for UBC-owned vehicles (for operations and academic uses).
 - c. Explore a strategy to promote electric vehicles and/or generate revenue using distributed charging stations.
3. Explore an enhanced bicycle or e-bike share program for on campus travel (i.e., for staff & faculty).

Actions for Future Consideration

1. Develop and demonstrate alternative fuels for fleet use including hydrogen and biodiesel.

5.7 OVERALL GHG REDUCTIONS

The following chart illustrates a scenario in which the key actions in each sector combine to reduce emissions by 67% by 2020. This scenario assumes that campus growth continues, and that energy supply options of sufficient capacity are implemented.

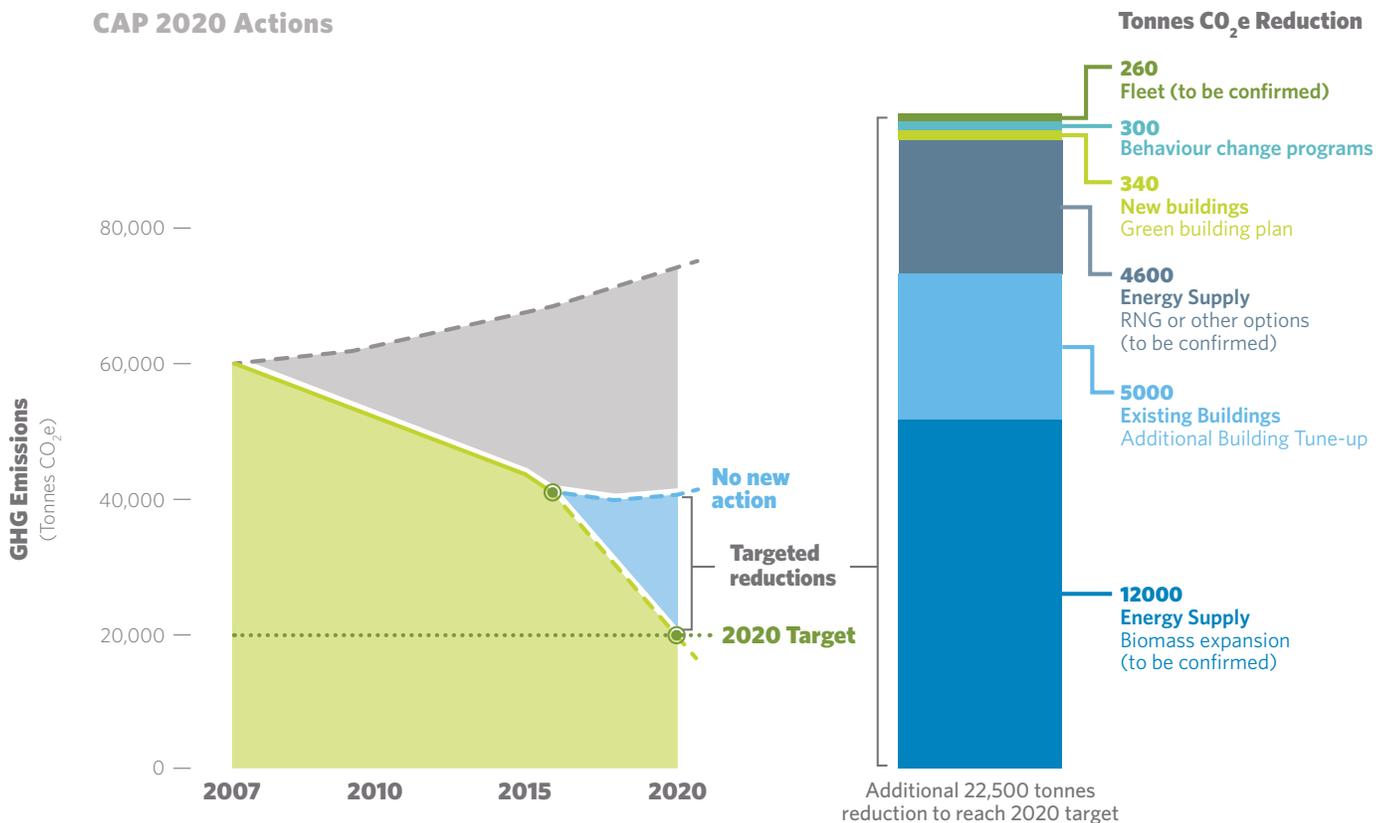


Figure 6. Targeted GHG reductions for 2020.

5.8 COMPLEMENTARY OPPORTUNITIES

Complementary opportunities are those actions that can reduce emissions (Scope 3 emissions) over which UBC has influence but limited control. Scope 3 emissions in UBC's inventory include those resulting from:

- Transportation (commuting) to and from campus;
- Business air travel for UBC staff and faculty;
- Solid waste management (e.g., landfilling of UBC's waste); and
- Building life cycle (including embodied energy in materials).

Other opportunities include those related to UBC's food system, carbon sequestration, and climate change adaptation.

While these areas are not the primary focus on this plan, many complementary opportunities allow students, staff and faculty to play a direct role in reducing emissions, and may involve activities that extend well beyond the boundaries of the campus. The strategy is to advance these areas wherever possible by leveraging existing resources, programs and expertise.

Priority Actions

1. Explore and potentially promote smartphone apps to facilitate car sharing & transportation mode shifting.
2. Research opportunities to reduce business travel emissions, including data collection and evaluation of potential solutions such as virtual meeting infrastructure and incentives.
3. Continue implementation of the Zero Waste Action Plan and the associated engagement program in order to further reduce emissions from waste management.
4. Develop and implement more rigorous Scope 3 emissions accounting methods where feasible.
 - a. Commuting transportation emissions.
 - b. Building life cycle emissions, for example as part of the future Green Building Plan.
5. Continue to explore opportunities to address emissions reductions related to food.

Actions for Future Consideration

1. Develop low-carbon food menus, or carbon ratings on food choices, at dining halls.
2. Research UBC's tree inventory and calculate the amount of carbon sequestration that they account for per year.
3. Explore opportunities to deduct the amount of carbon that is being sequestered by trees within non-designated areas (i.e. parks) to be used as a credit towards carbon offsets.



6 TOWARD 2050: LONG TERM STRATEGY

Achieving the long-term GHG reduction targets will require a continued decrease in emissions after 2020, which will require additional actions. At this stage, we anticipate continued implementation of energy conservation in buildings, behaviour change and other areas already established. However, implementation of additional energy supply options, or expansion of existing options, will also be required over time.

The following figure illustrates the additional GHG reductions that are needed after 2020 in the case that UBC meets the 2020 target and campus growth continues.

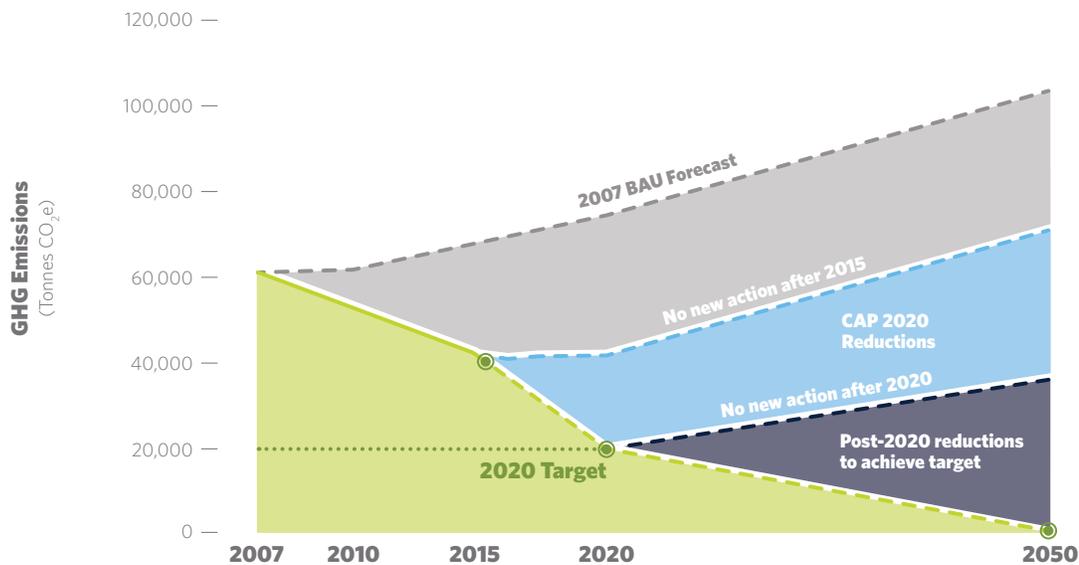


Figure 7. Post-2020 reductions following a 2020 target-meeting scenario.

Evaluation of alternative energy supplies indicates that some options such as solar energy and biogas production from organic waste may become technically and financially viable in the near future. However, since most of these options have limited capacity to reduce GHG emissions, they will likely need to add to (rather than act as alternatives to) larger capacity sources such as biomass and RNG, in order to achieve the deep level of reductions required. These options can be implemented and/or integrated within campus development projects as they become technically and financially viable.

The CAP 2020 can also be a vehicle to stimulate innovation and research opportunities in new areas, such as carbon capture or development of new energy technology. Research partnerships and potential funding will continue to be explored in these areas.

In assessing energy supply options, UBC will continue to consider the best investments with the long term in mind, beyond the 67% by 2020 reduction target.

7 IMPLEMENTING THE PLAN

7.1 TIMELINE

Following Plan (Phase 1) adoption or approval, the target schedule for implementation of key actions (Phase 2) is outlined below.

Table 3. Target milestones for CAP 2020 implementation.

Focus Area	Key Milestone	Target Schedule
Overall	Phase 1 Plan approval	June 2016
Phase 2:		
Overall	Conduct research on climate actions as per action matrix and available resourcing	June 2016 & ongoing
Existing Buildings, Behaviour Change, Fleet	Implement established DSM initiatives	June 2016 & ongoing
Existing Buildings	Explore energy management opportunities, enhancements to building operations and performance reporting with ancillary building owners and Properties Trust	2016
New Buildings	Develop Green Building Plan including development/sustainability process review	2016-2017
Energy Supply	UBC analysis of energy supply and cost risks	May - Oct 2016
	Biomass feasibility & costing study	
	Peer review of UBC energy supply risk analysis	Nov 2016 - Jan 2017
	Recommend energy supply solutions for potential funding and approval	Feb 2017
	Energy supply system implementation and commissioning (pending approvals)	2018-2019
Behaviour Change	Scoping and business case analysis for CAP implementation and building engagement resource	May - Aug 2016
	Re-establish resourcing for Green Labs program	
	Recommend budget for CAP implementation and building engagement resource based on business case	Sep 2016
Overall	Completion of Phase 2 of CAP development	Feb 2017

7.2

RESOURCE REQUIREMENTS AND BUSINESS MODEL

Resources required to implement the majority of actions outlined in this plan will be prioritized through existing budgets and staff. There are a few actions that will require additional resources for implementation for both hard (e.g. new energy supply infrastructure) and soft (e.g., behaviour change program staffing) costs. Note that as initiatives are developed and rolled out, some implementation details may change, and resource requirements may also change and require refinement.

Demand side management actions that reduce energy consumption will result in concurrent energy savings. Normally, DSM projects will have an identified business case and acceptable payback or return on investment – typically a two year payback. Projects are identified and approved on an ongoing, case-by-case basis.

On the energy supply side, shifting to alternative supplies may or may not entail capital investment, and each supply will have its own ongoing cost (i.e., energy cost plus carbon cost, and potentially facility operating costs). As part of the evaluation criteria, the financial criteria include an acceptable business case, considering all capital and operating cost elements over the lifetime of the option. In addition, each supply has its own risk profile, in terms of future supply availability and price (including volatility). In evaluating the business case of supply options, these risks are also considered.

Preliminary energy supply financial analysis results are provided in Appendix 4. Note that prior to recommending energy supply options for implementation, additional analysis is being undertaken. This includes further characterization of future energy supply and cost risks, and the distribution of those risks across existing (business as usual) and alternative energy supplies.

7.3

UNIT LEVEL IMPLEMENTATION PLANNING

A unit-level strategic planning initiative led by Sustainability & Engineering is assisting major units such as Building Operations, Energy & Water Services and others in integrating climate action and other sustainability goals, actions, and reporting metrics within their own operational plans and activities. The consultation process is renewed periodically, and serves to monitor and report on committed sustainability actions. The success of this process is predicated upon adequate resourcing and continuity of the unit-level strategic planning initiative.

7.4

ACTION MONITORING AND CONTINUOUS IMPROVEMENT

As with the 2010 CAP, the actions and monitoring requirements developed in this plan will be regularly reassessed and updated in a continuous improvement process.

Monitoring includes two components: monitoring of plan actions, and performance monitoring. For action monitoring, a Climate Action Matrix has been developed

and reviewed by participating units, which will act as a centralized working tool for CAP action planning, monitoring and reporting on action implementation status on an ongoing basis. For each action, the matrix identifies lead and support units, implementation timelines and other implementation information. Informed by the unit-level sustainability planning consultations, the matrix will be updated on a periodic basis, aligning with the unit sustainability planning process. Status of actions for each unit will also be reflected in unit sustainability reporting.

For performance monitoring, the central performance indicators are the GHG emissions metrics as reported in the CNAR annual reports. These reports also capture key climate actions across the university and act as the primary public-facing report for the CAP.

Each unit involved in CAP implementation will also track their own performance metrics, confirmed within the unit sustainability planning process. Key energy and emissions metrics will continue be tracked by Energy and Water Services, including the metrics in CNAR, and core academic building energy benchmarking.

7.5 LOOKING AHEAD

UBC's Climate Action Plan 2020 sets out actions for the Point Grey campus to meet the adopted 2020 GHG reduction target. However, this plan is one step on the path toward the 2050 target of zero emissions or net positive.

2020 will mark another milestone in assessing progress, and is recommended as an appropriate timeframe to develop an update to the Climate Action Planning process, including developing interim GHG reduction targets for the period between 2020 and 2050.

In order to meet UBC's ambitious and challenging goals and targets for 2020 and beyond, many UBC operational units and researchers will need to continue to collaborate and develop innovative and effective solutions that can be integrated into operations in a financially responsible way. This collaboration is also key to realizing the many co-benefits and synergies that will benefit UBC.



8 GLOSSARY

Academic District Energy System (ADES): District energy systems produce steam, hot water or chilled water at a central plant and distribute it to buildings to provide space and water heating and/or cooling. UBC's ADES uses hot water to provide space and water heating to over 130 connected buildings.

Biomass: organic matter. In UBC's case, biomass fuel for the BRDF (see below) is clean wood waste.

Bioenergy Research and Demonstration Facility (BRDF): A plant that produces heat and electricity from biomass fuel, renewable natural gas and conventional natural gas. The biomass fuel is gasified to create syngas that is burned to produce steam. The heat produced by the BRDF is distributed by the ADES to connected buildings, in the form of hot water.

Building Tune-Up: A building maintenance program meant to ensure building systems (heating, lighting and ventilation) operate at optimal levels. The program was developed in partnership with BC Hydro during the development of the Climate Action Plan from 2010. It included 72 core academic buildings and reduced the university's annual GHG emissions.

Business as usual (BAU): Refers to a situational context or scenario that does not undergo any change - for example, a scenario where no climate action is taken.

Carbon capture: Collecting carbon dioxide that has been released into the atmosphere and concentrating it in a controlled environment in order to mitigate the negative effects it has on the environment if left in the atmosphere.

Carbon neutrality: A state in which balance is achieved between carbon emitting activities and actions that reduce or offset emissions, so that net annual emissions are equal to zero. In the context of UBC, BC's Greenhouse Gas Reduction Targets Act and the Carbon Neutral Government Regulation require all public sector organizations (PSOs) to reduce emissions as much as possible, measure and report any remaining GHG emissions, and purchase an equivalent amount of emission reductions (offsets) to get to net-zero (carbon neutrality). The focus on the Climate Action Plan is on the first objective (reducing emissions) and also reduces the costs of purchasing offsets.

Compressed natural gas (CNG): Natural gas that is kept in a high-pressure environment. CNG is used as an alternative fuel because it generates less GHGs relative to conventional fossil fuels.

Community energy and emissions plan (CEEP): A document prepared by a local government and/or community that outlines: (a) the jurisdiction's historical energy sources, energy demand and resulting emissions (often referred to as an energy profile); (b) the jurisdiction's future energy and emissions targets; (c) the jurisdiction's strategy for meeting energy and emissions targets. In the UBC context,

the CEEP applies to the areas within the University Neighbourhoods Association (UNA) community and therefore complements the UBC Climate Action Plan.

District energy: District energy systems produce steam, hot water or chilled water at a central plant and distribute it to buildings to provide space and water heating and/or cooling. See also Academic District Energy System.

Demand side management (DSM): Strategies to decrease energy use by controlling overall demand for energy, as opposed to increasing available energy supply.

Green Buildings Plan: A document that outlines what actions a jurisdiction will take to decrease the negative environmental impacts and maximize environmental, health and other aspects of its buildings. The Climate Action Plan 2020 identified the development of a comprehensive Green Buildings Plan as a strategy the university may pursue to support its GHG emissions reduction targets. Currently, UBC has a number of green building initiatives, including the UBC Sustainability Process, Residential Environmental Assessment Program (REAP), Building Tune-Up, UBC Renew and Bird Friendly Design Guidelines for Buildings.

Greenhouse gas (GHG) emissions: Gases emitted from fuel combustion and other sources that contribute to the greenhouse effect and global warming. These include carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons.

Green Labs: A UBC program that encourages actions to reduce the environmental impact of research activities that take place in laboratories. The program includes a number of initiatives, including Lab Recycling and Reuse, Shut the Sash, the Green Labs Newsletter, Virtual Green Labs Tour and the Green Lab Fund.

Net positive buildings: Buildings that produce as much energy as they consume in one year.

Net present value (NPV): A measure that represents the difference between revenue generated by a project or investment, and its anticipated cost. This measure is used to analyze the profitability of the project or investment.

Right size: Sizing and designing infrastructure, systems or equipment so that it is correctly aligned with end use requirements. Typically this includes avoiding over-designing.

Renewable natural gas (RNG): Renewable Natural Gas or RNG is a biogas (or biomethane) that results from bacteria breaking down organic waste from sources such as landfills, agriculture and wastewater treatment facilities, and is upgraded to a quality similar to fossil natural gas. Because of its biological source, as an energy source it is considered carbon dioxide neutral.