THE UNIVERSITY OF BRITISH COLUMBIA

REPORT TO THE BOARD OF GOVERNORS
Agenda Item #4.1

SUBJECT	**CLIMATE ACTION PLAN 2020 AND CAMPUS ENERGY UPDATE**
MEETING DATE	**APRIL 13, 2017**

Forwarded to the Board of Governors on the Recommendation of the President

APPROVED FOR SUBMISSION

Santa J. Ono, President and Vice-Chancellor

DECISION REQUESTED

IT IS HEREBY REQUESTED that *the UBC Board of Governors:*

i. ***Receive for information the results of the Climate Action Plan 2020 update including the Phase 2 Energy Supply Study results; and,***

ii. ***Direct staff to move forward with final due diligence on the expansion of biomass boiler capacity to address immediate operational needs and move UBC closer to meeting its next GHG emission reduction target of 67% below 2007 levels.***

Report Date	March 8, 2017
Presented By	Philip Steenkamp, Vice-President External Relations Andrew Simpson, Vice-President Finance & Operations Michael White, Associate Vice-President, Campus and Community Planning David Woodson, Managing Director, Energy and Water Services

EXECUTIVE SUMMARY

If this item was previously presented to the Board, please provide a brief description of any major changes since that time.	The UBC Climate Action Plan 2020 Update was presented to the Board of Governors on June 14, 2016 recommending a two phase approach. Phase 1 focused on demand side management actions to reduce GHG emissions and Phase 2 included an analysis of energy supply options including an energy commodity study and preliminary financial analysis. This report presents the results from Phase 2.

UBC is recognized globally for aggressive GHG reduction targets set out in the 2010 Climate Action Plan, which have been reached while reducing energy and operational costs. Under the plan, UBC Vancouver achieved its 33% reduction target in GHG emissions in 2016, despite a 16% increase in building floor space and a 23% increase in student enrolment.

Building upon UBC's GHG reduction success, Phase 1 of the Climate Action Plan 2020 (CAP2020) was presented to the Board of Governors in 2016 to advance toward its 67% reduction target. CAP2020 Phase 1 focused on Demand Side Management[1] (DSM) actions and initial development of campus energy supply options which were to be advanced in Phase 2. The Board also identified two main energy supply questions to be addressed:

[1] Demand Side Management includes building energy efficiency, energy conservation via behaviour change and other strategies to reduce consumption of energy.

1. Is expansion of biomass energy a financially viable option?
2. Given potential demand for biomass in the region and beyond, and considering potential changes in carbon pricing or other climate policies from senior governments, is there sufficient supply to minimize risks of prices exceeding a threshold for a positive business case?

To address these questions, Phase 2 work included an energy commodity study, an external peer review[2] process, and a financial analysis in collaboration with UBC's Strategic Decision Support. The results of the financial analysis show that biomass expansion has a positive NPV of $6m over 15 years against the base case, taking into account conservative estimates for both future natural gas and carbon tax pricing. The results of the supply study show even if all of the anticipated biomass projects proceed within the lower mainland, many of which are at conceptual stages, the availability of biomass supply will still be nearly double what the industry requirement would be in 2035.

A key consideration in moving forward with the Climate Action Plan is addressing an imminent need to increase the thermal capacity on the campus. The Campus Energy Centre (CEC) currently uses three gas boilers with the design to allow for the expansion of boiler capacity, as dictated by future campus growth. The rate of new connections of both existing and new buildings to the highly efficient hot water district energy system is progressing faster than originally anticipated, triggering a need for an additional boiler to be installed in order to maintain thermal energy supply redundancy requirements.

Rather than simply installing a fourth natural gas boiler at the CEC (Base Case), two alternative options were evaluated as part of the CAP2020 process, considering operational needs, the business case, and the potential to reduce GHG emissions.

1. Option 1 proposes to run boilers on Renewable Natural Gas (RNG)[3], a zero carbon emissions fuel to displace use of conventional fossil-based natural gas.
2. Option 2 proposes the addition of a 12 MW capacity biomass boiler to the Bioenergy Research and Demonstration Facility (BRDF).

Financial analysis of Option 1 shows that, due to uncompetitive RNG pricing, this option has a 15 year Net Present Value (NPV15) of negative $9 million, relative to the base case. Financial analysis of Option 2 shows that the biomass expansion option is expected to result in an NPV15 of approximately positive $6 million relative to the base case.

The biomass expansion, in addition to the demand side actions underway, would achieve GHG reductions of 60% relative to 2007, with approximately one third of those reductions from DSM and two thirds from the biomass expansion. This leaves a gap of approximately 4,300 tonnes of reductions needed to meet the 67% target. This gap may be met through a combination of future alternative energy supply options, new DSM opportunities, and research/industry partnerships in new technologies.

Based on the analysis, staff are recommending that the biomass boiler capacity expansion proceed to the next level of due diligence in accordance with UBC's operational, financial and sustainability objectives.

INSTITUTIONAL STRATEGIC PRIORITIES SUPPORTED

☐ **Learning** ☐ **Research** ☐ **Innovation** ☐ **Engagement (Internal / External)** ☐ **International**

or ✔ **Operational**

[2] The UBC commodity study, conducted by Energy & Water Services, with involvement of Campus & Community Planning, was peer reviewed by Dr. Mark Jaccard, Reshape Strategies, and Brian McCloy. See Appendix A for more detail on the peer review and analysis process.

[3] RNG is functionally interchangeable with fossil-based natural gas however is produced biologically from landfills or other organics waste materials and has a zero GHG emissions factor.

DESCRIPTION & RATIONALE

The Climate Action Plan 2020 (CAP2020) Phase 1 update was presented to the Board in June 2016, with additional steps identified to further analyze energy supply options for the Vancouver campus, as outlined in the table on page 5.

A key consideration in the recent conversion from a steam-based campus district energy system to hot water was to manage costs through aligning infrastructure investment with load growth. As a result, only three boilers were installed in the Campus Energy Centre, while a fourth bay was left vacant for future expansion. In addition to the buildings that were connected to the old steam system, more existing buildings that previously had standalone boilers are being connected (and will continue to be connected) to the highly efficient hot water system, at a rate that is faster than originally anticipated. This has increased the demand for district energy from existing buildings, and combined with on-going construction of new buildings on campus, has triggered the need for an additional boiler to be installed in order to maintain thermal energy supply redundancy requirements. Winter 2016/17 has provided an opportunity to evaluate the performance of the campus energy systems under full load conditions, taking into account the growth in demand and extended cold weather conditions.

Rather than simply adding natural gas boiler capacity at the Campus Energy Centre, alternative options were evaluated as part of the CAP2020 process, with consideration given to operational needs, the business case, the potential to reduce GHG emissions, and other criteria as outlined in the following sections.

The “base case” energy option assumes adding a fourth natural gas boiler to the Campus Energy Centre. This boiler would generally only be used in the event that one of the other boilers was inoperable. In addition to the base case CEC expansion, to address GHG reduction targets Option 1 proposes to run CEC boilers on zero-carbon Renewable Natural Gas (RNG) instead of conventional fossil-based Natural Gas (NG).

As an alternative to an additional CEC boiler, Option 2 proposes adding a 12 MW capacity biomass boiler to the BRDF facility, within the existing building footprint, taking advantage of much of the existing facility and supporting infrastructure. In contrast to the base case CEC gas boiler option, this biomass boiler would be used to provide “base load” heating, meaning it would be utilized throughout the year.

BENEFITS
Learning, Research, Financial, Sustainability & Reputational

Since its implementation, the BRDF facility has supported significant academic research activities and partnerships; an expansion of biomass energy would continue to support UBC research and innovation opportunities.

A biomass expansion reduces annual energy spending, primarily due to reductions in carbon cost payments, leading to a positive business case. It also diversifies fuel sourcing and reduces dependence on natural gas, which accounted for 90% of UBC’s heating energy and carbon costs in 2016.

With respect to achievement of CAP targets, Phase 1 (Demand Side Management) actions, including building energy optimization and behaviour change programs, would reduce emissions by approximately 6,000 tonnes.

The addition of a biomass expansion would further reduce emissions by approximately 10,800 tonnes, for an overall GHG reduction of 60%, as shown in the following chart.

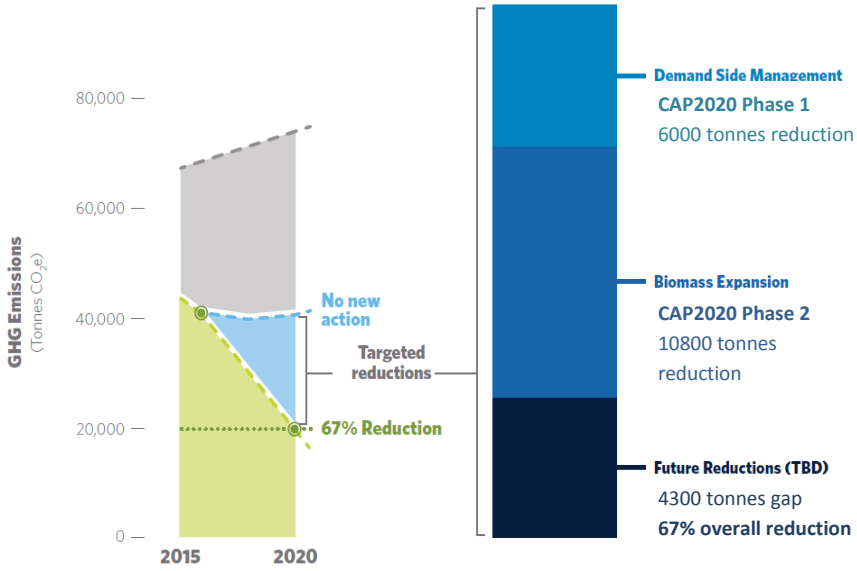

Figure 1:Demand and Supply Side GHG Emission Reductions

This leaves a gap of approximately 4,300 tonnes of GHG reductions needed to meet the 67% target. This gap may potentially be met in the future through a combination of renewable energy supply options, increased demand side management, and via research/industry partnerships in new technology such as carbon capture.

RISKS
Financial, Operational & Reputational

Each energy option, including UBC's use of natural gas, entails risks. Risks related to energy supply and cost were assessed as part of the commodity study and financial analysis. Risk factors and strategies related to biomass supply include the following:

1. Energy supply diversification: adding more biomass capacity to our baseload further reduces the present over-dependency on natural gas.
2. Biomass availability: Currently less than a third of the lower mainland's waste biomass is being utilized. The proposed UBC biomass expansion would consume only an additional 2% of the biomass available. Even if all of the anticipated biomass projects proceed within the lower mainland, many of which are at conceptual stages, the availability of biomass supply will still be nearly double what the industry requirement would be in 2035. This is expected to result in a stable biomass price within the region. The biomass supply comes from a diversity of sources that includes wood waste from saw mills, wood manufacturing industries, residuals from tree pruning, clean construction and demolition wood waste and used pallets.
3. Carbon pricing: presently at $55 per tonne ($30 for the carbon tax, and $25 for carbon offsets), this is the primary differentiating factor in comparing the cost of biomass to the price of natural gas. The federal government proposal is expected to bring carbon tax to $50 per tonne by 2022, which would bring UBC's cost of carbon to $75 per tonne or $3.75/gigajoule (GJ) including offsets.

The financial analysis has incorporated sensitivities on energy and carbon pricing in order to assess the potential impact on financial performance, as described in Appendix A.

Without implementation of energy supply options, GHG reductions will be limited to approximately 38%, far short of the 67% target. Given UBC's recognized leadership on climate policy and action, this could create a reputational risk.

For future energy supply options and GHG reduction opportunities beyond those explored through this process, the strategy is to continue to evaluate emerging opportunities and technology using the CAP evaluation criteria including financial performance and risk, and if meeting the criteria, to bring forward any recommendations through the Steering and Executive Committees.

COSTS
Capital & Lifecycle Operating

Current RNG (Option 1) pricing is uncompetitive at over $12/GJ compared with approximately $7/GJ for conventional natural gas, including carbon costs, and as such RNG is not a financially viable option. In the future, it may be possible that UBC is able to purchase RNG at a more competitive price; however there are no indications that the price of RNG will be competitive with natural gas within the next five years.

Based on external peer reviewed energy supply price forecasts, Option 2 (biomass expansion) is expected to result in a Net Present Value (NPV) of approximately positive $6 million over 15 years, relative to the base case. In contrast, the RNG option is expected to result in an NPV15 of negative $9 million.

	Base Case: CEC+NG	**Option 1: CEC+RNG**	**Option 2: Biomass**
Total capital cost	$3 - 4M	$3 - 4M	$8 - 12M
Net present value of operational savings (expected scenario)	-	-$9M	$6M

Each option was also evaluated under sensitivity analyses. Refer to Appendix A for additional information on the range of NPVs calculated for each option and supporting information.

FINANCIAL
Funding Sources, Impact on Liquidity

The table below summarizes potential funding sources, in particular "restricted" funding sources (i.e., funds only applicable to eligible project types) that may be applied to energy options that reduce UBC's greenhouse gas emissions.

	Base Case: CEC+NG	**Option 1: CEC+RNG**	**Option 2: Biomass**
Restricted funding sources	$3 - 4M	$3 - 4M	$4.6 - 7.2M
Infrastructure Improvement Charges (IIC)	*$3 - 4M*	*$3 - 4M*	*$3 - 4M*
Carbon Neutral Capital Program (CNCP)	*Not eligible*	*Not eligible*	*$1.6-3.2M*

SCHEDULE Implementation Timeline	Pending Board approval, staff will undertake further due diligence and develop detailed project and program requirements together with preliminary capital and operating budgets which would be presented for Board 1 approval later in 2017. This would be followed by the typical capital approval and development approval process. The implementation timeline is approximately two years, allowing the recommended expansion to be operational in the fall of 2019.
CONSULTATION Relevant Units, Internal & External Constituencies	UBC staff, internal stakeholders and the UBC community members were consulted during the CAP2020 Phase 1 process which indicated strong support for both demand and supply options, including biomass expansion – full documentation is available on the C&CP website. If a biomass energy expansion were to be implemented, additional consultation with local community members would be conducted prior to final approval, as per the typical capital development process.

Previous Report Date	June 14, 2016
Decision	Received for Information
Action / Follow Up	To Report Back on Phase 2 Energy Supply Analysis

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APPENDIX TO REPORT
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APPENDIX A – ANALYSIS RESULTS AND ASSUMPTIONS

Commodity Study and Peer Review Process

To address questions related to the financial feasibility of biomass expansion and to better understand the supply, demand, cost and risk factors associated with current and alternative fuel sources, an energy supply commodity study was undertaken by UBC Energy and Water Services (EWS). Findings from this study were then fed into a business case analysis which was undertaken jointly by EWS, Strategic Decision Support and Sustainability & Engineering. The CAP team also commissioned three external energy and biomass and energy economics experts[4] to review and provide input on the commodity study and the assumptions used in the financial analysis.

Financial Performance

The Net Present Value of the two options (CEC boilers with RNG, and biomass boiler) was calculated relative to the base case (CEC boiler with natural gas), under three energy pricing scenarios: an "expected" forecast scenario, plus two sensitivity scenarios. One of these scenarios was based on assumptions that supported fossil fuel economics, and the other was based on assumptions that supported biomass economics. These scenarios established the upper and lower financial boundaries for the financial analysis. Each scenario combines assumptions including capital costs, energy commodity pricing, carbon tax, and carbon offset costs. The development of these assumptions was informed by the commodity study and peer reviewer input in order to provide a high confidence that the analysis results span the range of foreseeable outcomes.

The results of the analysis are summarized in the following cost band chart showing the Net Present Value (15 year) relative to the base case (CEC boilers and natural gas). The black circle represents the NPV associated with the "expected" forecast scenario; the upper and lower bars represent the upper and lower boundaries described above. For example, under "worst case" assumptions around capital cost, gas prices and biomass prices all combined, the 15 year NPV is negative $3 million. However under "best case" assumptions, it is positive $18 million.

[4] Mark Jaccard, SFU School of Resource & Environmental Management and former Chair and CEO of BC Utilities Commission; Reshape Strategies consultants, advisory & development services for energy & infrastructure; Brian McCloy, forestry & environmental consultant and former VP Environment & Energy for Council of Forest Industries.

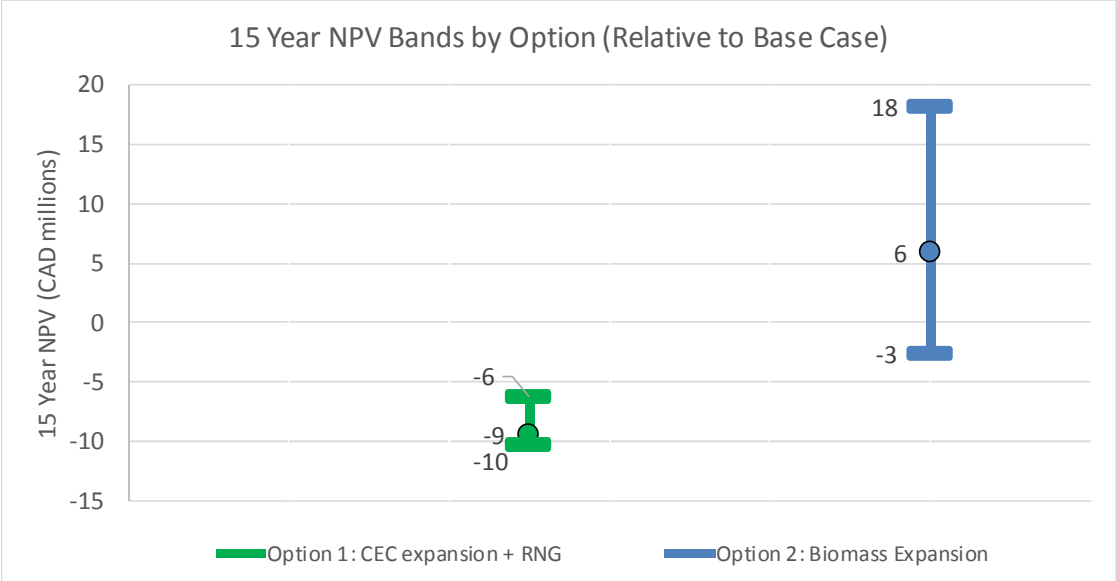

Figure 1. NPV comparison of options relative to base case.

Biomass Energy Supply

As part of the commodity study, the biomass energy supply for UBC was investigated, considering the demand and supply forecasts for the region. UBC's current and proposed additional supply is waste wood sourced within the Lower Mainland region, and does not include pellets or harvested wood from the interior. In fact UBC's current supplier of biomass fuel sources material from over 100 different locations within the region, providing a diversity of sources and clean waste wood from a variety of different types of operations. The majority of these locations are within 40 km of the supplier's collection point.

The results of the supply and demand investigation are summarized in the following chart. One large potential biomass energy project, Creative Energy, if implemented would account for a significant portion of biomass demand, and so was specifically identified on the chart. The blue dotted line indicates the cumulative biomass demand in the region based on all anticipated biomass energy projects being implemented, including Creative Energy. This cumulative demand resulting from all known projects going forward could account for approximately 60% of the projected supply, much less than the available biomass. Consequently, the expected scenario is for relatively stable pricing going forward, noting also that fuel is sourced based on fixed price contracts of typically at least five years, resulting in more predictable cash flows.

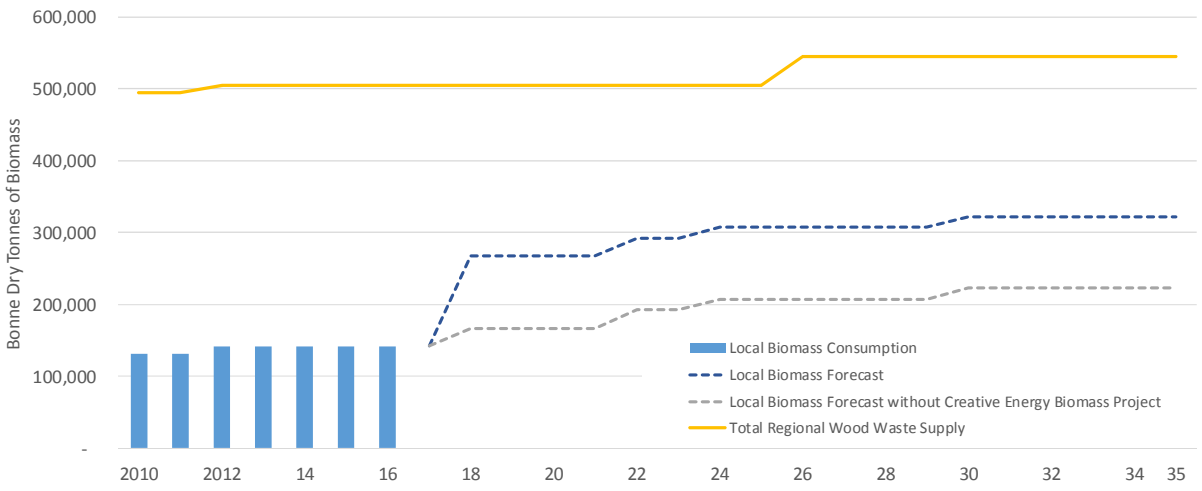

Figure 2. Regional biomass supply and demand forecast.

Carbon Pricing

The expected scenario forecasts that carbon tax stays constant at $30/tonne, then increases to $50/tonne by 2022 in accordance with the announced federal increase, and stays constant thereafter. Carbon offsets are assumed to increase only with inflation.

Energy Costs

Based on the commodity study, natural gas commodity costs for the expected scenario are based on the five-year average paid by UBC[5], and no commodity increases beyond inflation.

Based on the commodity study and peer review, the following chart shows the forecast costs for RNG, natural gas, and biomass used for the expected financial analysis scenario, including delivery costs and carbon costs. As currently sourced through FortisBC, the RNG price is linked with natural gas price and is not expected to become competitive in the near future, unless UBC can directly source RNG directly from a large scale production project.

[5] For 2017, the gas price assumption is $4.13/GJ with delivery and taxes, not including carbon costs.

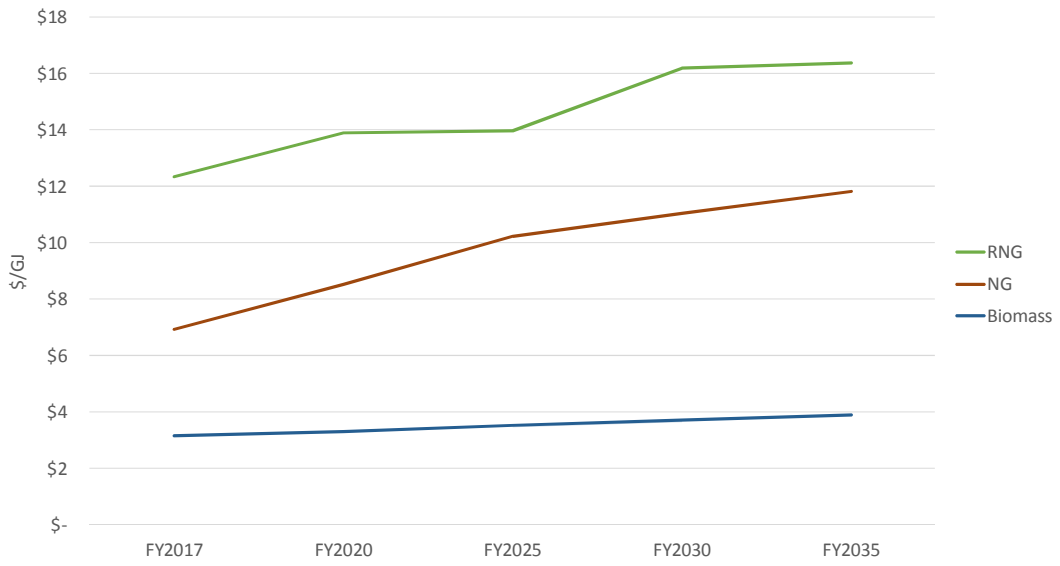

Figure 3. Expected unit energy costs.

For reference, the figure below shows historical energy spending for heating, and natural gas unit costs including carbon costs. Despite the current outlook of minimal growth in natural gas prices, longer term historical natural gas costs have shown significant variations.

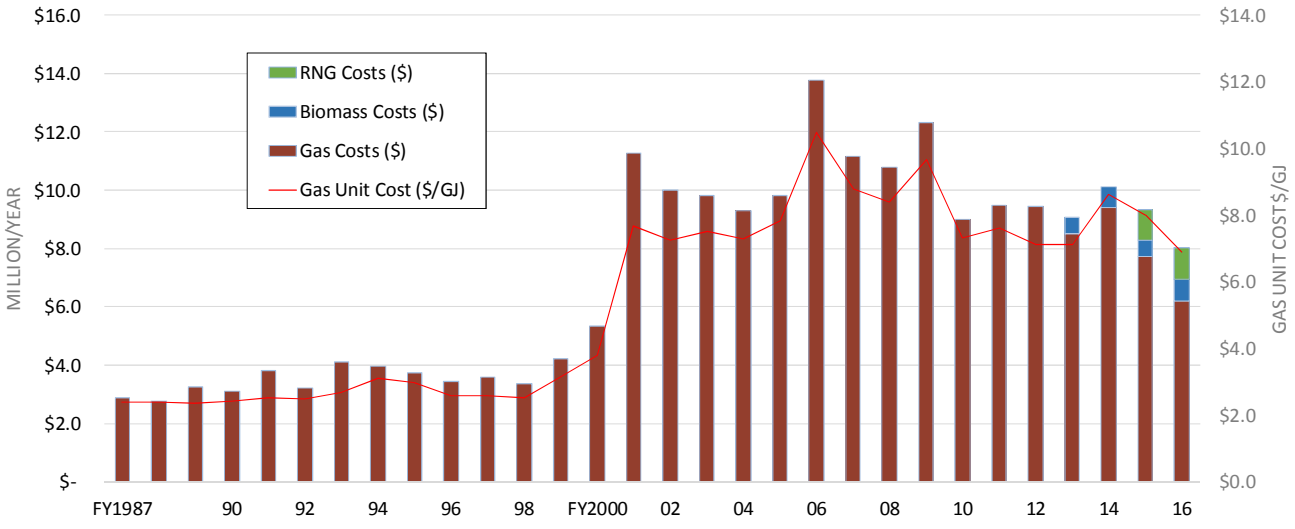

Figure 4. Historical energy costs.

CAP Evaluation Criteria

The CAP process identified seven criteria against which all actions and options would be evaluated. The following table shows a summary of the ranking of the two options considered alongside the base case.

Criterion	Base Case CEC+NG	CEC+RNG	Biomass
Alignment with UBC policies	●	●	●
GHG impact	●	●	●
Technology & operational risk	●	●	●
Jurisdiction & control	●	●	●
Ease of implementation	●	●	○
Research & innovation opportunities	●	○	●
Financial performance	○	●	●

Table 1. Evaluation of options against CAP criteria. Green=best, red=worst.