

# REGULATORY IMPACT STUDY FOR NATURAL GAS FIRED BOILERS

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AUGUST 31<sup>ST</sup>, 2012

COMMENTS MUST BE RECEIVED BY OCTOBER 30, 2012

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## SCOPE AND REQUIREMENTS

<b>TYPE OF DEVICE</b>	<p><b>Natural gas fired water boilers (input rate &lt;300,000 BTU/h; &lt;88 kW)</b> - a commercially available product designed solely for the purpose of raising the temperature of incoming water.</p> <p>The product uses an input of natural gas and oxygen to initiate combustion, thereby creating heat that is transferred to the water circuit by virtue of a heat exchanger. Given the small capacity of the boilers included within this scope, the heated space is usually a single family dwelling (SFD) - either a detached or semi-detached house – or a small commercial space/building.</p> <p><b>Included:</b></p> <ul style="list-style-type: none"> <li>• Natural gas or propane to hot water boilers (primarily for space heating through hydronic heat distribution systems)</li> </ul> <p><b>Not included:</b></p> <ul style="list-style-type: none"> <li>• Natural gas and propane fired hot water tanks (primarily for domestic water heating)</li> <li>• Natural gas and propane to steam systems</li> <li>• Oil-fired boilers</li> </ul>
<b>TEST STANDARD</b>	<p>CAN / CSA-P.2-07 standard used to measure the annual fuel utilization efficiency (AFUE) of residential gas-fired furnaces and boilers (2008).</p>
<b>PROPOSED ENERGY PERFORMANCE STANDARD</b>	<ul style="list-style-type: none"> <li>• Annual Fuel Utilization Efficiency (AFUE) ≥ 90% for new construction</li> <li>• Automatic means of adjusting water temperature</li> <li>• AFUE ≥ 82% for retrofit (replacement) installations</li> <li>• No constant burning pilot</li> <li>• The first item harmonizes with the National Building Code Section 9.36 standard which can be viewed at (see section 9.36.3.10): <a href="http://nationalcodes.ca/eng/public_review/2012_1/technical.shtml">http://nationalcodes.ca/eng/public_review/2012_1/technical.shtml</a></li> <li>• The last three harmonize with the NRCan federal standard effective April 12, 2012 which can be viewed at: <a href="http://oe.nrcan.gc.ca/%20/2950">http://oe.nrcan.gc.ca/%20/2950</a></li> </ul> <p><b>Note:</b> <u>Boiler replacements in existing buildings (renovations) have a lower (82% AFUE) standard due potential technical challenges of adapting high-efficiency (condensing) boilers to existing hydronic infrastructure.</u></p>
<b>EFFECTIVE DATE</b>	<p>Products manufactured and sold after September 1, 2013</p>

<b>CERTIFICATION</b>	<p>Compliance with the proposed regulation will be based on testing and verification by Standards Council of Canada accredited Certification Organizations on adherence of manufactured products with the “Proposed Energy Performance Standard” using the proposed "test standard".</p> <p>No unique British Columbia labeling will be required. Rather, a product listing on the Natural Resources Canada database is sufficient.</p>
<b>NEED FOR REGULATION</b>	<p>The proposed regulation reduces energy costs for consumers, improving the affordability of houses and buildings. It also supports the BC’s greenhouse gas (GHG) reduction targets as stated in the <i>Greenhouse Gas Reduction Targets Act</i> of 2007:</p> <ul style="list-style-type: none"> <li>• By 2020, 33% less than the level of emissions in 2007</li> <li>• By 2050, 80% less than the level of emissions in 2007</li> </ul> <p>The regulation is identical to the proposed level in the City of Vancouver Building Bylaw (council reading on June 28, 2012).</p> <p>If adopted, the new minimum efficiency performance standard (MEPS) would extend the City of Vancouver standard across British Columbia (BC).</p>
<b>TRANSPARENT REGULATION DEVELOPMENT</b>	<p>Development of the regulation followed the succeeding procedure:</p> <ul style="list-style-type: none"> <li>• Initial market analysis including manufacturer inventory</li> <li>• Economic assessment</li> <li>• Regulatory assessment</li> </ul> <p>A stakeholder pre-consultation meeting was held on January 30, 2012 at which time feedback on the proposed regulation was received. Further stakeholder feedback was received until May 9, 2012 to support drafting the regulatory impact statement. The regulatory impact statement will subsequently be posted for written comment over a 60-day formal public consultation period.</p>
<b>MARKET TRANSFORMATION STRATEGY</b>	<p>Data from the City of Vancouver (2009-2010) shows that approximately 60% of new homes are outfitted with hydronic systems (space heating by virtue of hot water circuits); this proportion was previously around 5%. The market shift was initiated, in part, by the 2009 Vancouver building code update that mandated the installation of heat-recovery ventilators (HRV’s) in new construction. HRV’s are currently being considered for the new provincial code, which will continue to make hydronics an attractive option for home heating.</p> <p>Secondly, condensing boilers are ideally suited for radiant heating since low water-return temperatures are more practically achievable in this application. In Vancouver, more than 70% of residential boilers installed from 2009-2010 were condensing (<math>\geq 90\%</math> AFUE), while only 30% were in the mid-efficiency range (<math>\sim 80\%</math> AFUE), the current BC minimum standard. BC wide market data shows that market transformation is well underway across BC.</p> <p>The Green Homes Program in the City of Vancouver attempts to reduce GHGs associated with the construction and operation of one- and two-family homes. To that end, a proposed Vancouver Building Code amendment would mandate condensing boilers as well as an energy factor (EF) of 0.78 for domestic hot water (DHW) tanks. The code will increase the market share of condensing boilers.</p>

<p><b>MARKET TRANSFORMATION STRATEGY</b></p>	<p>The current ENERGY STAR<sup>®</sup> standard is 85% AFUE, applying to boilers for both new construction and replacement applications in existing buildings. The ENERGY STAR<sup>®</sup> standard is subject to review in 2012 and may increase shortly thereafter (2013). This is another indication that the market is gradually moving toward higher efficiency boilers irrespective of the proposed regulation.</p> <p>Certain incentives offered by various agencies have increased the uptake of condensing boilers. ENERGY STAR<sup>®</sup> boilers qualified for a PST exemption prior to 2010. FortisBC has offered a \$500 incentive for high-efficiency boilers for nearly a decade, and is now offering \$1,000 for ENERGY STAR<sup>®</sup> natural gas condensing boilers with 94% AFUE or better (up to 299MBH). LiveSmart BC is offering an incentive for boilers with 90% AFUE or higher, with a value of \$500 for the south coastal region and \$600 for the northern/interior region of BC. The federal ecoENERGY grant offered a \$750 rebate for condensing boilers until March 31, 2012. The BC Hydro Power Smart New Home program offers \$1,500 from BC Hydro and an additional \$500 from FortisBC for houses that achieve EnerGuide 80 or higher. Finally, the BuiltGreen BC program offers extra points for a high efficiency boiler, which is one of the easiest ways to earn points under the guidelines. This list of numerous incentives has helped transform the market toward condensing boilers.</p> <p><b>Availability:</b> NRCan reports 267 models of boilers from all manufacturers with input rates less than 300 MBH that achieve ≥90% AFUE. More than 80% of all manufacturers have at least one model that meets this high-efficiency target, and over 60% have a selection of at least three models. Of all the products that are above 82% AFUE, approximately 45% of them are above 90% AFUE.</p> <p><b>Awareness:</b> Home builders are aware of the fact that boilers with ≥90% AFUE do exist. Most manufacturers have at least one product that meets this criterion; such products are marketed as “high-efficiency” boilers that qualify for rebates and cut energy bills substantially. Homebuilders and manufacturers, as well as the agencies that represent them - Canadian Institute of Plumbing and Heating (CIPH), Heating and Refrigeration and Air Conditioning Institute of Canada (HRAI), Thermal Environment Comfort Association (TECA) - all generally believe that the industry is in a state of transition to condensing boilers. Since the current federal regulation mandates furnaces to be 90% AFUE, this proposed regulation would align the boiler regulation for new homes in BC with the furnace regulation (the furnace standard applies across the market, including retrofits and new construction).</p> <p><b>Accessibility:</b> All product lines are featured on manufacturer’s websites, along with product brochures outlining key benefits and specifications. Pamphlets are available at distribution outlets with the same information. Retailers stock and promote ENERGY STAR as well as high-efficiency products.</p> <p><b>Affordability:</b> Reputable manufacturers as well as home builders quote a system incremental cost on the order of \$1,000 for a condensing boiler versus a mid-efficiency boiler. With the cost savings (approximately \$700) in designing and building a b-vent, the incremental cost to the builder can be as low as \$300. The initial cost can be recuperated through fuel cost savings.</p> <p><b>Acceptability:</b> The data from new homes in the City of Vancouver from 2009-2010 clearly shows that the products are already a majority and will continue to be widely accepted. There is a mutual understanding among manufacturers, homebuilders, and agencies representing hydronic contractors that the industry is gradually moving</p>
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	<p>toward condensing boilers.</p> <p><b><i>Demand Side Management (DSM) programs to increase market share:</i></b> This proposed regulation can be promoted by energy utilities through their Demand-Side Management (DSM) programs, leading to increased market share of compliant products prior to the effective date. In turn, part of the energy savings from the proposed regulation can be attributed back to those DSM programs as per Section 4 (Subsection 1.4) of the Demand-Side Measures Regulation under the <i>Utilities Commission Act</i>:</p> <p><a href="http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_326_2008">http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_326_2008</a></p>
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## ASSESSMENT FROM AN INDUSTRY PERSPECTIVE

<b>RANGE OF PRODUCTS AFFECTED</b>	<p>The 90% standard applies to all small capacity natural gas-fired water boilers (input &lt;300,000 BTU/h; &lt;88 kW) installed in new buildings (not a replacement product), representing less than half of total product sales (estimate based on conversations with a number of distributors and retailers).</p> <p>The 82% standard applies to all other products, aligned with the NRCan standard.</p> <p>The no pilot light and automatic means of adjust water temperature apply to all products.</p>
<b>COST IMPACT</b>	<p>Many high-efficiency boilers are cost-competitive for consumers when considering energy savings. This is outlined in the consumer economics section in more detail. For building developers, BTY Group cost consulting identified in its report for the City of Vancouver that the incremental cost of a condensing boiler is \$1,000, with \$700 in savings in some cases due to simplified piping requirements. The net cost to the developer would be in the range of \$300.</p>

<b>COMPETITIVE ANALYSIS AND HARMONIZATION</b>	<p>There are two B.C. manufacturers of the products covered by this regulation:</p> <ul style="list-style-type: none"> <li>• Allied Engineering Company (North Vancouver, BC)</li> <li>• IBC Technologies Inc. (Vancouver, BC)</li> </ul> <p>The following manufacturer distribution outlets located in British Columbia will similarly adjust their product lines to meet the regulation:</p> <ul style="list-style-type: none"> <li>• Viessmann Manufacturing Company Inc. (Langley, BC)</li> </ul> <p>Marketing and distribution of gas boilers is done on a continental basis and as such, several other manufacturers' products are available in British Columbia.</p> <p>The City of Vancouver has proposed the 90% standard under the Vancouver Building Bylaw. This would apply to new construction only. The National Building Code of Canada is currently proposing a 90% AFUE standard for residential boilers in 2012. British Columbia will consider this standard for the BC Building Code (new construction) in the fall of 2012. The Nova Scotia building code currently includes this standard.</p> <p>The Canadian federal regulation for all products (including retrofits) currently mandates a minimum of 82% AFUE on residential gas-water boilers in the 11<sup>th</sup> amendment which has taken effect as of April 12, 2012. Manitoba's boiler regulation affecting both the new construction and replacement market was introduced in January 1, 2010 and also mandated a minimum 82% AFUE.</p>
<b>MARKET SHARE</b>	<p>Current market share for products subject to the proposed regulation:</p> <p>NRCan's online database lists natural gas boilers that meet or exceed the federal MEPS of 82% AFUE (effective April 12, 2012). Approximately 45% of the products listed are in the condensing range (<math>\geq 90\%</math> AFUE). Competitive strategies among manufacturers and demand for higher-efficiency homes are expected to increase this ratio in the near future. Of all the boiler manufacturers listed on NRCan's database, only 1 Canadian company does not have a condensing model.</p> <p>The current market share in British Columbia for the condensing gas-fired boilers is estimated at 50-55% of all boilers.</p>

### ASSESSMENT FROM A CONSUMER PERSPECTIVE

<b>INCREMENTAL PURCHASE COSTS</b>	<p>The incremental cost of a condensing boiler vs. a mid-efficiency boiler in a hydronic system is approximately \$1,000; however, the reduced venting requirements could save up to \$700 on construction materials and labour. This figure has been corroborated by both manufacturers and homebuilders, although further input is invited through the consultation period.</p> <p>Not all homes will have the opportunity for backyard or sidewall venting, and in these cases the construction cost savings are likely less. Concerns surrounding different piping requirements for condensing boilers remain unsubstantiated to this point.</p> <p>The optional incremental cost of an indirect DHW tank over a standard water heater is about \$300, for a tank that costs in the range of \$700-\$1,500 installed.</p>
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<p><b>COST-BENEFIT ANALYSIS</b></p> <p><b>ENERGY SAVINGS FOR EACH CONSUMER</b></p>	<p><b>Assumptions:</b></p> <ul style="list-style-type: none"> <li>• The analysis was based on a natural gas cost of approximately \$11/GJ in BC inclusive of taxes, franchise fees and carbon tax, with an 8% discount rate over a typical product lifetime of 15 years. FortisBC has forecasted a 2% annual natural gas price increase, reflected in this analysis.</li> <li>• The base case is assumed to be 84% AFUE since a wide variety of boiler efficiencies are expected to be installed. There is very limited product availability in the 86-90% AFUE range.</li> <li>• NRCAN reports more than 250 models in their database that meet or exceed 90% AFUE. The average of all these models is approximately 94% AFUE. As a conservative assumption, 92% AFUE is used as the proposed case following the regulation.</li> <li>• A typical newly constructed detached home uses approximately 51GJ of thermal energy annually for space heating (average of 2006-2008 data from NRCAN), translating to 65 GJ of natural gas purchased after efficiency losses are factored in. Similarly, a semi-detached home demands 32GJ.</li> <li>• Most gas-fired DHW tanks are approximately 58% efficient; the current provincial standard is 62%. When an indirect DHW tank is coupled to a condensing boiler, DHW efficiency increases to about 78%.             <ul style="list-style-type: none"> <li>○ Detached DHW demand is 25GJ annually.</li> <li>○ Semi-detached DHW demand is 24GJ annually.</li> </ul> </li> </ul>
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**COST-BENEFIT  
ANALYSIS  
ENERGY SAVINGS  
FOR EACH  
CONSUMER**

**Table 1: Annual Summary for Each Consumer\*:**

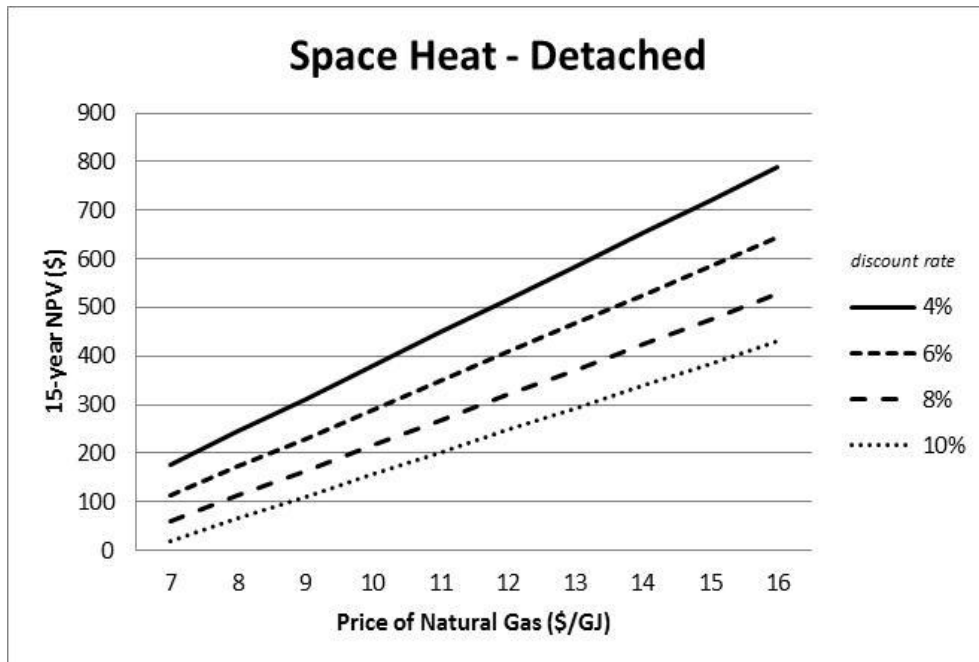
	SPACE HEAT		+DHW (COMBO)	
	<i>Detached</i>	<i>Semi Detached</i>	<i>Detached</i>	<i>Semi Detached</i>
Heat Requirement (GJ/yr)	51	32	67	47
NG Savings (GJ/yr)	5.3	3.3	10.3	8.1
Cost Savings - First Year	\$58	\$36	\$113	\$89
GHG Savings (kg CO <sub>2</sub> e/yr)	266	167	517	408
Incremental Cost, Boiler System	\$300	\$300	\$600	\$600
Simple Payback Period (yrs)	5.2	8.2	5.3	6.7
NPV (15 yrs, 6% discount rate)	\$349	\$107	\$664	\$398

In summary, a consumer will benefit from \$36 to \$113 lower energy bills per year for an incremental capital cost of \$300-\$600, resulting in a net benefit (profit) of \$107 to \$664 over the life of the product.

\*Actual operating conditions (part-load efficiency) dictate that savings will be 5%-15% higher in reality. Higher operational and maintenance costs of condensing boilers in some regions could decrease savings.

A sensitivity analysis was performed on varying natural gas prices and the resulting charts are presented below. Barring a substantial drop in natural gas prices, the 15-year NPV remains positive in the majority of cases.

*Figure 1: Varying Discount Rates - Single Family Dwelling*





**COST-BENEFIT ANALYSIS**  
**ENERGY SAVINGS FOR EACH CONSUMER**

Figure 2: Varying Discount Rates – Semi Detached

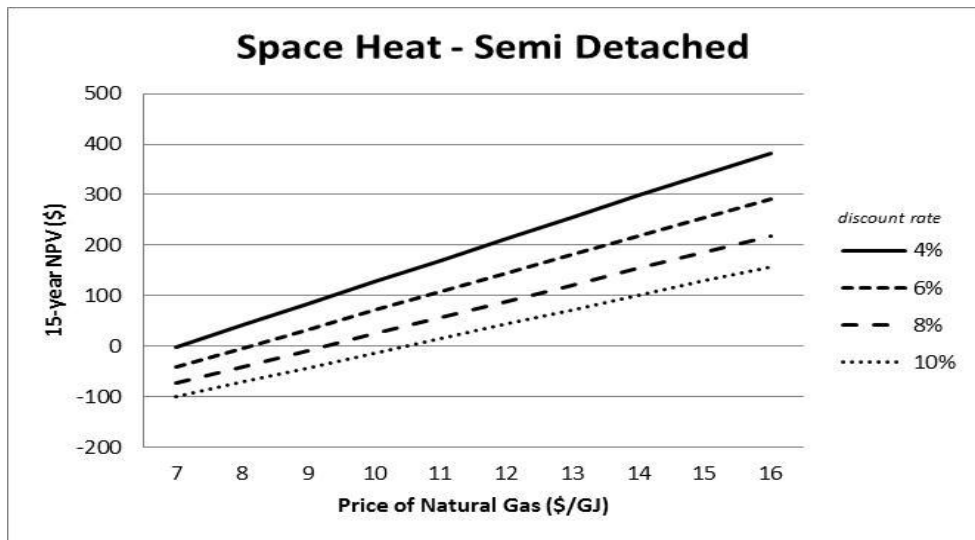


Figure 3: Varying Discount Rates – Detached with Indirect Domestic Hot Water

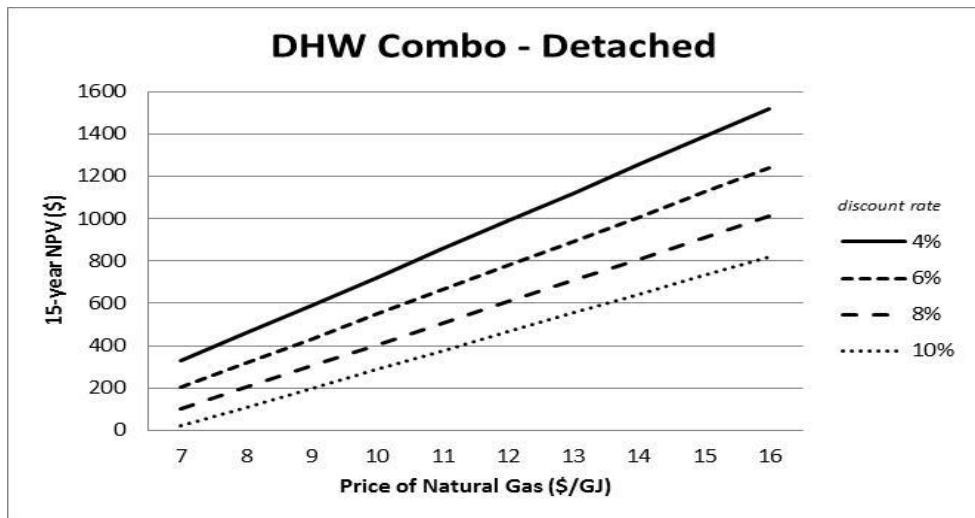
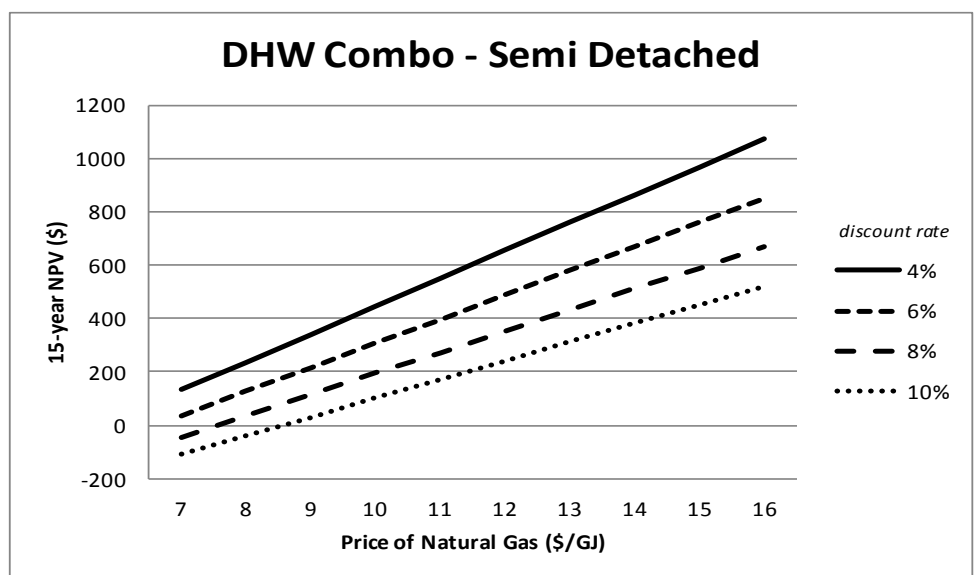


Figure 4: Varying Discount Rates – Semi Detached with Indirect Domestic Hot Water



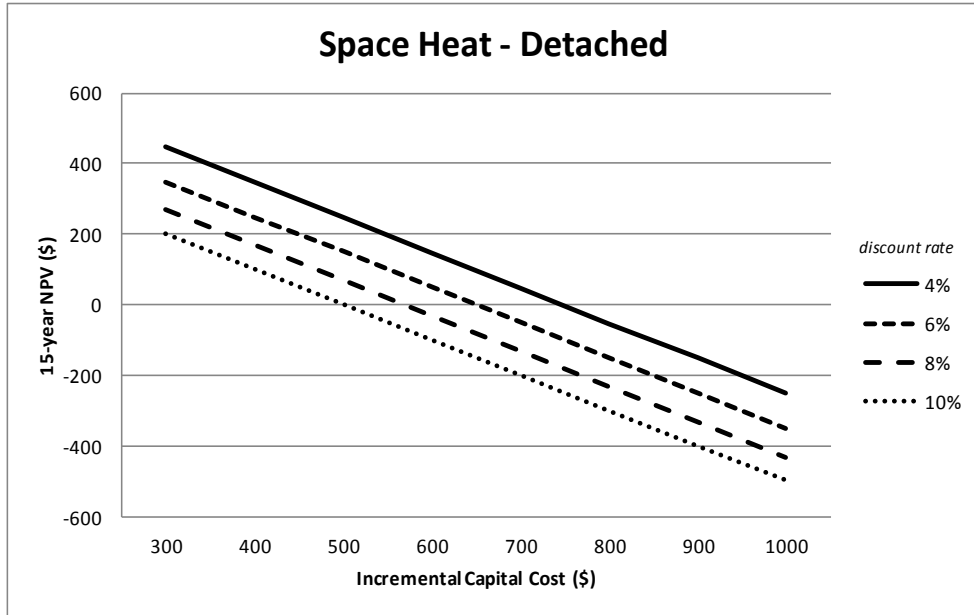
**COST-BENEFIT  
ANALYSIS**

**ENERGY SAVINGS  
FOR EACH  
CONSUMER**

Additionally, a sensitivity analysis was completed on the incremental capital cost of high-efficiency boilers and optional indirect DHW tanks for combo systems.

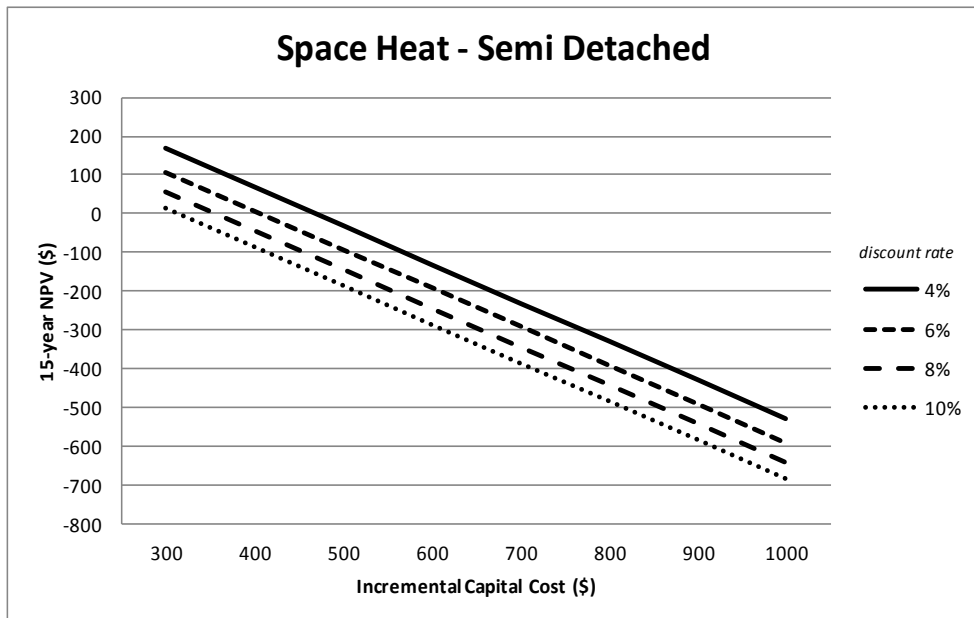
For space heat – consumers in detached homes would gain a positive NPV (with 6% discount rate) if incremental cost for the system is under \$700.

*Figure 5: Sensitivity of Incremental Capital Cost (Space Heat, Detached)*



For space heat – consumers in semi-detached (duplex) homes would gain a positive NPV (with 6% discount rate) if incremental cost for the system is under \$400.

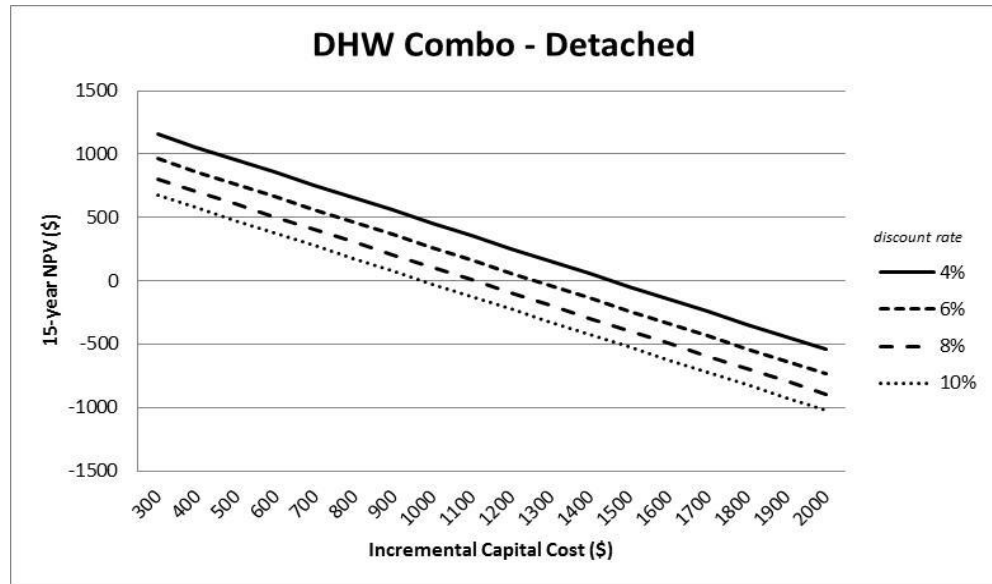
*Figure 6: Sensitivity of Incremental Capital Cost (Space Heat, Semi Detached)*



**COST-BENEFIT  
ANALYSIS**
**ENERGY SAVINGS  
FOR EACH  
CONSUMER**

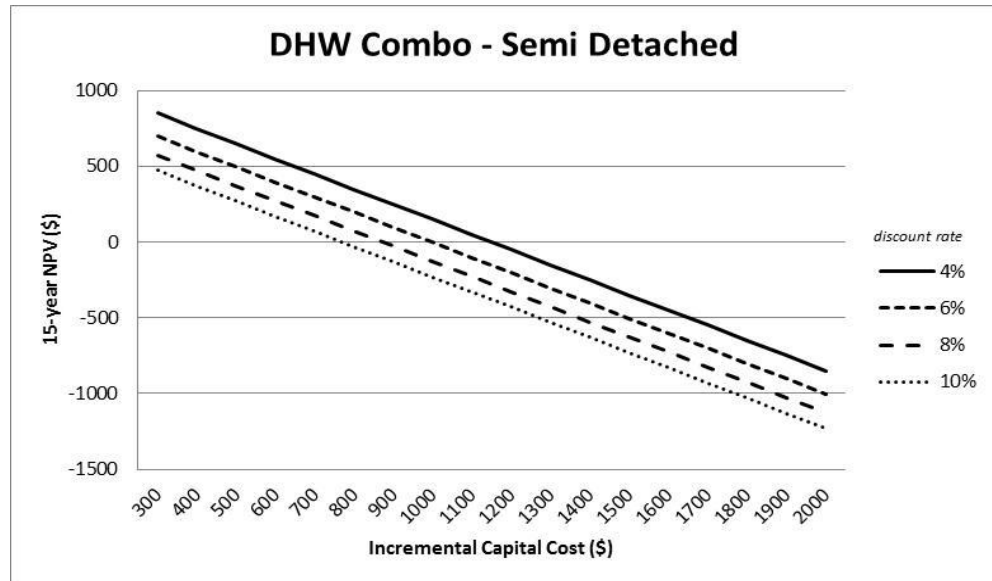
For DHW Combo – consumers in detached homes would gain a positive NPV (with 6% discount rate) if incremental cost for the system is under \$1,300.

*Figure 7: Sensitivity of Incremental Capital Cost (Combo System, Detached)*



For DHW Combo – consumers in semi-detached homes would gain a positive NPV (with 6% discount rate) if incremental cost for the system is under \$1,000.

*Figure 8: Sensitivity of Incremental Capital Cost (Combo System, Semi Detached)*



In addition, an increasingly competitive market could support lower capital costs.

The indirect DHW tank is a logical upgrade once a condensing boiler is already installed for space heating. Considerably more savings can be realized by coupling an indirect DHW tank to the condensing boiler thereby serving both space and water heating with one combustion unit. The indirect tank itself has substantially better insulation and can last up to 40 years as opposed to the traditional 12 year lifetime of a typical DHW tank.

<b>NON-ENERGY BENEFITS</b>	<p>In general, hydronic heating is widely regarded as one of the most comfortable heating systems on the market. It provides occupants with a quiet and steady heat source where it is needed most. It also offers considerable living space savings over forced-air systems by eliminating bulky ductwork. Condensing boilers with sidewall-vented sealed combustion can offer further space savings as some boilers can be wall-hung without the need for a separate mechanical room.</p>
<b>IMPACT ON BUILDERS</b>	<p>Installation of hydronic systems is somewhat simpler, without the need to route bulky ducts through the living space. This allows for more head clearance and potentially higher ceilings. Condensing boilers have the option of being vented through the backyard or sidewall instead of the traditional b-vent routed through the roof. This arrangement facilitates a much easier and consequently cheaper installation by the builder.</p>
<b>OTHER ISSUES</b>	<p>Some concerns have been raised about market players circumventing the regulation for higher efficiency products by using DHW heaters for the purpose of space heating. These may take the form of fan coil/unit heater arrangements which have poor heat distribution. Moreover, the efficiency of this arrangement suffers, and will subsequently translate into higher utility costs for consumers.</p> <p>In addition, the increased maintenance costs involved with condensing boilers has been raised but remains unsubstantiated, and is not able easily approximated with the current data.</p> <p>There are also some doubts surrounding the trades' understanding of condensing technology, and installing a system according to specifications. A strategy to educate the trades needs to be considered, since the efficiency of a hydronic heating system with a condensing boiler is dependent on the knowledge-level of the installer.</p> <p>Qualification for an extra LiveSmart BC incentive bonus (valued at \$100) currently requires installation by a TECA-approved installer who has completed the hydronics training course. This will be a mandatory requirement for the utility, on-bill financing pilot programs in 2013, driving the market for boiler replacements in existing buildings, but spilling over to the new construction market.</p> <p>MEM will investigate further opportunities to promote the TECA certification via other channels such as the Homeowner Protection Office and the Industry Training Authority.</p>

**ASSESSMENT FROM A PROVINCIAL GOVERNMENT PERSPECTIVE**
**ECONOMIC  
ASSESSMENT  
FROM A  
PROVINCIAL  
PERSPECTIVE**

*(Aggregate energy,  
emission and net cost  
savings)*

A province wide impact assessment considers the following assumptions and trends:

- On average, there are 9,600 detached and 1,200 semi-detached new constructions annually in BC (BC Stats, 1998-2010).
- 30% of new single family dwelling constructions in BC employ hydronic systems for space heating with boilers.
- In the City of Vancouver, approximately 70% of installed hydronic systems use condensing boilers. The remaining 30% installed standard efficiency boilers.
- A subgroup of homes with condensing boiler installed will opt to upgrade the benefit to include an indirect DHW tank. It was reported by one manufacturer that this fraction was around 90%.
- The typical lifetime of products is assumed to be 15 years, with a 6% discount rate.

The following three metrics illustrate the benefit of the regulation from an energy, emissions, and cost perspective:

Annual Natural Gas Savings (GJ/yr) in 2020	250,000 (with a provincial NPV of \$343,000)
Annual GHG Savings (tCO <sub>2</sub> e/yr) in 2020	12,600
Provincial NPV (\$) over the lifetime of products installed between 2013-2023	\$ 6,800,000

In summary, British Columbians as a whole will see 250,000 gigajoules of savings in 2020 and will save \$6.8 million over and above incremental capital costs. In addition, greenhouse gas reductions of 12,600 tonnes will be achieved in 2020.

There will be additional benefit incurred from indirect water heaters replacing inefficient water heaters and spill-over to the multi-family residential as well as commercial industries. Around 5% of residential boiler sales are currently utilized in such applications. However, thermal demand and user operation are highly variable in different cases. This additional benefit could be significant but is not quantifiable. The reduction in toxic SO<sub>x</sub> and NO<sub>x</sub> gases is a side benefit that certainly improves local air quality, especially in urban areas where boiler density is high.

<b>ADMINISTRATIVE FEASIBILITY FOR COMPLIANCE AND ENFORCEMENT</b>	<p>Compliance and enforcement approach under the <i>Energy Efficiency Act</i> is based on random inspections and response to compliance complaints. Therefore, municipal co-operation is required for effective enforcement. The Natural Resources Canada (NRCan) labelling standards for gas-fired boilers has taken effect as of April 12, 2012, and the updated Canadian Standards Association test standard has been finalized in 2008 (P.2-07). These two mechanisms will support compliance with the stated regulation.</p> <p>No unique labelling of BC products will be required. As such, enforcement will be based on product listings on the NRCan online database.</p>
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## NOTES

<b>REGULATORY ASSESSMENT COMPLETED BY</b>	<p>Voytek Gretka, M.Eng, EIT Tel: (250) 952-0626 E-mail: Voytek.Gretka@gov.bc.ca</p>
<b>DATE</b>	<p>August 31, 2012</p>