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August 14, 2009

Jim Ciccateri
Senior Policy Advisor
Energy Efficiency Branch
Ministry of Energy, Mines and Petroleum Resources
Policy and Royalty Branch, Oil and Gas Division
5th Floor, 1810 Blanshard Street
P.O. Box 9323 Stn Prov Govt
Victoria, BC V8W 9N3

Attention: Mr. Ciccateri

Dear Mr. Ciccateri:

Re: Terasen Gas Inc. ("Terasen Gas")
2010 and 2011 Revenue Requirements and Delivery Rates Application

Response to the Ministry of Energy, Mines and Petroleum Resources (MEMPR") Information Request ("IR") No. 1

On June 15, 2009, Terasen Gas filed the Application as referenced above. In accordance with Commission Order No. G-89-09 setting out the Regulatory Timetable for the Application, Terasen Gas respectfully submits the attached response to MEMPR IR No. 1.

If there are any questions regarding the attached, please contact the undersigned.

Yours very truly,

TERASEN GAS INC.

Original signed:

Tom A. Loski

Attachment

cc (e-mail only): BCUC and Registered Parties

1.0 Reference: Energy Efficiency and Conservation and Alternative Energy Solutions - Part III: Section C – Tab 3, p. 232

In regards to the stakeholder consultations conducted around the development of industrial energy efficiency and conservation (EEC) programs, the Application states:

> *“There was support for additional funding and programs and energy efficiency audits. However, participants and Terasen Gas Inc (TGI) acknowledged: TGI does not have experience with developing industrial programs, and will require further time to develop suitable programs”*

During TGI’s industrial demand-side management (DSM) consultation workshop on May 19, 2009, a suggestion was made for TGI to integrate some of its industrial measures with existing programs at electric utilities. There are several benefits to taking this approach, including:

- Promotes coordination and supports Policy Action #2 of The BC Energy Plan: A Vision For Clean Energy Leadership (i.e. joint sponsorship and promotion of BC Hydro’s Sustainable Energy Management Planning program)
- Industrial DSM activities are already happening with electric utilities and a natural gas component could begin immediately,
- Costs associated with program structure and administration would be minimized,
- Consolidation of outreach would present a common message to customers in an efficient and cost-effective manner, and
- Collaboration in this was would support the Ministry of Energy, Mines and Petroleum Resources’ all-fuel approach to industrial energy efficiency.

1.1 Is TGI pursuing these opportunities for collaborative execution of industrial DSM with other utilities?

<u>Response:</u>

It should be noted that the Application under consideration requests funding for interruptible Industrial customers only. As noted on page 231, the approvals received in BCUC Order G-36-09 include rates 4, 5, 23 and 25. However, the programs put forward in the EEC Application did not include manufacturing/industrial process energy efficiency programs for these customers. Terasen is in the process of commissioning a study on a potential design for manufacturing process load for customers in these rate classes.

TGI has not, at this time, pursued opportunities for collaborative execution of industrial DSM with other utilities as it is not yet in the position to do so. As such, TGI is not aware of definitive opportunities for collaboration at this time; more work is required to generate such opportunities.

As noted in the response to BCUC IR 1.29.3, with a dedicated staff person in place for Interruptible Industrial EEC programs, further consultation with stakeholders, risk analysis, program design, and program analysis, TGI will be able to better able to analyze the opportunities for collaboration with other utilities. That said, TGI continues to be proactive in developing relationships with its key stakeholders, as well as other utilities, that helps in the establishment and delivery of potential Industrial DSM programs. TGI has had a good track record of working with the other utilities on DSM programs, as noted in section 7.3.2 of the EEC Application. TGI anticipates that the Company would follow the same process that has been followed in past collaborations where a formal Agreement regarding program partnership with other utilities and any other contributing entities is developed over the course of informal discussions.

1.2 If so, are those collaborative efforts covered in the Application?

Response:

Please see the response to MEMPR IR 1.1.1. TGI has not included in this filing any particular specific collaborative effort with other utilities directly related to the execution of an Industrial DSM program.

1.3 And if those efforts are included in the Application, what activities are planned and what is the size of the budget assigned to those activities?

Response:

Please see the responses to MEMPR IR 1.1.1 and 1.1.2. There is no budget specifically assigned for collaborative activities; rather budgets will be expended with as much efficiency as possible. Should the TGI find through stakeholder consultation that collaboration with other entities is in some instances the most efficient way to achieve efficiency in the interruptible Industrial sector that budgets will be allocated to those activities as appropriate.

1.4 If collaborative industrial DSM activities are not included in the Application, please estimate the budget that would be required to support such activities.

Response:

Please see the responses to MEMPR IR 1.1.1, 1.1.2 and 1.1.3.

2.0 Reference: Energy Efficiency and Conservation and Alternative Energy Solutions - Part III: Section C – Tab 3, p. 232

The Application addresses TGI's plans regarding its conservation potential review (CPR), stating:

> *"TGI will commission an update to the 2006 Manufacturing CPR. An updated report will give the Company a very high-level indication of the size and nature of EEC opportunities in this sector."*

In light of the Commission's April 16, 2009 decision, on Terasen Gas Inc. and Terasen Gas (Vancouver Island) Inc. Energy Efficiency and Conservation Programs Application, which supported EEC expenditures directed at fuel switching from fossil fuels with a higher carbon content than that of natural gas, please answer the following questions:

2.1 Will the updated CPR include identification and assessment of fuel switching opportunities in the industrial sector where fossil fuels with a higher carbon content than that of natural gas are currently used?

Response:

TGI has now received the updated CPR and is included as Attachment 2.1 (as noted in Attachment 2.1, this CPR is for firm industrial rate classes not interruptible rate classes), and it does not include an identification and assessment of high-carbon fuel switching opportunities in the interruptible Industrial sector.

TGI would support an initiative to identify fuel switching opportunities that would address the substitution from fossil fuels with a higher carbon content than that of Natural Gas for its industrial customers. It has been TGIs' experience that its industrial customers are motivated by fuel costs and formulate any decisions in regards to fuel switching based on current and projected market prices.

2.2 If not, please estimate the cost and timing impacts of including that additional scope in the CPR update.

Response:

The CPR update has now been received, so including this additional scope in that work is not an option. TGI has received a confidential quote for performing this work, and would anticipate that it would take approximately 10 to 12 weeks to complete the work once a contract is awarded.

3.0 Reference: Respected and Trusted Operator – The Past

Part III: Section B – Tab 1, p. 99-120

With regards to overall utility performance evaluation, the Application states:

"The Terasen Utilities successfully uses [sic] a Balanced Scorecard approach to deliver on a series of key success measures, align its business activities and maintain its focus on Operational Excellence for the benefit of customers and shareholders. Terasen Gas' Scorecard is made up of four categories comprised of 10 measures that describe and guide Terasen Gas' overall performance in meeting the goals and targets that are set annually."

Later, in the same section, the Application mentions that:

"Terasen Gas believes that EEC programs are the core of its strategy to reduce emissions, promote the efficient use of gas, and to encourage the adoption of low carbon energy alternatives."

Given TGI's newly approved expansion in EEC funding and the recent amendments to the Utilities Commission Act, which encourages the pursuit of adequate, cost-effective demand-side measures, it is clear that achieving energy efficiency and market transformation are important goals.

3.1 Are you planning to add an indicator of energy efficiency and market transformation to TGI's Balanced Scorecard?

Response:

TGI believes the importance of promoting and adopting energy efficiency is reflected already in the Customer measure as part of the existing scorecard. Financial, Customer, Key Processes and Employee currently comprise the four categories of measures on the Scorecard, reflective of the company's focus and commitment to Operational Excellence. Included in the Customer category is the Customer Satisfaction measure which monitors customers' satisfaction with how TGI meets their needs. TGI is firmly committed to promoting energy efficiency and customers will see that, respond to it and express their satisfaction through the Customer Satisfaction measure.

TGI recognizes that its business and priorities continue to evolve and regularly reviews its scorecard measures to ensure they are appropriate. The use of the balanced scorecard brings balance and transparency to TGI business; provides focus to deliver on a series of key success measures critical to its business; aligns its business activities and maintain its focus on Operational Excellence for the benefit of customers and shareholders.

3.2 What measure(s) can be integrated into the scorecard to reflect the company’s overall performance in this area?

Response:

Please see the response to MEMPR IR 1.3.1.

4.0 Reference: Energy Efficiency and Conservation and Alternative Energy Solutions - Part III: Section C – Tab 3, p. 228

In describing the current funding request, the Applications states:

"We are also seeking approval of funding for 2010 and 2011 for Interruptible Industrial programs …"

4.1 Please indentify what percentage of TGI's business interruptible industrial service represents, both from a volumetric perspective and from a revenue perspective.

Response:

TGI's interruptible industrial service represents approximately 15% of TGI's overall volumes and 2% of TGI's overall revenues over the Forecast Period. Gas costs are not included in the 2% of overall revenues, as the majority of interruptible customers source their own gas.

4.2 Are you planning to align your industrial DSM budget in the same proportion to gross revenues as the DSM budget for buildings?

Response:

TGI is not planning to align its Interruptible Industrial DSM budget in proportion to gross revenues. Rather the budget presented in this Application was built "from the bottom up", based on the Company's best estimate of potential activity for this sector in 2010 and 2011. This is how the budgets for Residential and Commercial Energy Efficiency that were approved in the EEC Application were developed. The Company's view is that aligning DSM budgets for any sector in proportion to gross revenues from that sector would result in DSM budgets being set in a somewhat arbitrary manner. The Company prefers to develop a budget based on the available, cost effective, prudent projects that can be developed and implemented without exposing customers to undue risk. The Company will continue consultations with the Interruptible Industrial stakeholder group to ensure that budgets for this sector are reasonable and prudent.

Attachment 2.1

Manufacturing Sector Conservation Potential Review—2009 Update

Prepared for:

Sarah Smith
Manager, Marketing and Energy Efficiency
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16705 Fraser Highway
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Prepared by:

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July 30, 2009

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List of Exhibits

1 INTRODUCTION

On May 28, 2008, Terasen Gas Inc. (TGI) and Terasen Gas (Vancouver Island) Inc. (TGVI) (collectively Terasen) filed its Energy Efficiency and Conservation (EEC) Programs Application with the British Columbia Utilities Commission (BCUC). The BCUC Decision of April 6, 2009 ordered Terasen to begin the planning process for the development of an Industrial EEC program, with a filed report due by July 15, 2009. As one of the first steps, Terasen has asked Willis Energy Services (Willis) to update the data and information concerning the savings measures as reported in the February 2006 *Terasen Gas Conservation Potential Review Manufacturing Sector Report* (2006 CPR).

The purpose of reviewing the manufacturing sector data for the gas energy savings measures included in the 2006 CPR is to provide updated information for input into EEC programming for Terasen's industrial and manufacturing customers.

This update applies to the same market segment as the 2006 CPR, which was the manufacturing sector within sales Rate Schedules 2, 3, 5, 23, and 25 in the Lower Mainland and Interior and within sales Rate Schedules LGS-3, ILF, and HLF on Vancouver Island. Additional information supplied for this update enabled the consultant to provide a breakdown of those customers who consumed more than 100 gigajoules (GJ) annually amongst sales Rate Schedules 2 and 3 manufacturing customers located in the Lower Mainland and Interior.

It is understood that Terasen is also interested in the conservation potential with respect to its large interruptible and transportation customers. A detailed conservation potential for customers being served under interruptible/transportation Rate Schedules 7, 22, and 27 was not included within this report because the approach to these customers would be considerably different than the one used for the general manufacturing sector.

2 SUMMARY

Billing data for 2009 was used to revise the conservation potential model that was developed in the 2006 CPR. In addition, key changes in economic conditions since 2006 were reviewed and current conditions were considered. Exhibit 1 indicates the updated Most Likely and Upper Achievable Energy Savings.

Exhibit 1: Summary of Achievable Energy Savings—Total Terasen Service Area

Action	**Achievable Energy Savings (Reference Forecast minus Achievable Forecasts)**			
	2015/16		**2020/21**	
	Most Likely	**Upper**	**Most Likely**	**Upper**
M1: Efficient Lumber Dry Kilns	271,611	361,487	326,806	422,965
M2: Efficient Veneer Dryers	10,074	23,672	10,324	25,497
M3 Efficient Boilers	642,444	853,380	751,942	882,757
M4: Fully Insulated Process Heat Distributed Systems	167,028	231,571	163,713	227,009
Other	47,446	126,620	72,078	460,533
Total All Service Areas	**1,138,603**	**1,596,729**	**1,324,863**	**2,018,762**

The Most Likely Achievable is the suggested target for the industrial and manufacturing sector programs. The Upper Achievable is the potential that could technically be obtained but would require extraordinary effort.

It is important to note that the results in Exhibit 1 do not take into consideration any savings potential from large interruptible/transportation customers. These customers were not considered in the original 2006 CPR and for consistency and comparison purposes were not included in the CPR updated model reruns.

2.1 Key Changes From 2006 CPR

The following table compares the Upper Achievable Potential from the 2006 CPR with the 2009 updated Upper Achievable for the fiscal year 2015/16. The potential for lumber dry kilns and veneer dryers is significantly reduced, the main reason being the current decline in the lumber sector. The other reductions are mainly due to a revision in the overall industrial and manufacturing sector natural gas growth forecast.

Exhibit 2: 2006 CPR and 2009 Update Potential - Variance for 2015/16

Action	**2015/16 Upper Achievable Potential**		
	2006 CPR	**2009 Update**	**Change**
M1: Efficient Lumber Dry Kilns	1,006,222	361,487	(644,735)
M2: Efficient Veneer Dryers	108,630	23,672	(84,958)
M3: Efficient Boilers	1,008,253	853,380	(154,873)
M4: Fully Insulated Process Heat Distribution Systems	277,091	231,571	(45,520)
Other	222,950	126,620	(96,330)
Total All Service Areas	**2,623,145**	**1,596,729**	**(1,026,416)**

The quality of the model estimate, compared to the 2006 CPR analysis, has improved due to better customer information from which the breakdown of the manufacturing sector was derived.

The load variance between 2003/04 and 2008/09 represents the result of a “typical” business cycle, albeit, in this instance, coupled with the impact of global recession. The benefit of the time lag between the 2006 CPR and this 2009 update is that market risk to DSM programs becomes clearly evident. A severe downturn in customer demand reduces the portfolio acquisition rate of savings. In some cases, businesses and plants may shut down altogether, removing any opportunity to recover the efficiency investment. These risk considerations need to be defined and addressed early in the design phase of program planning for the manufacturing sector.

2.2 Potential Manufacturing Sector Programs

The update results were in line with the 2006 CPR in identifying the same four specific Actions for achieving energy efficiency in the manufacturing sector. Each Action consists of several natural gas savings opportunities, bundled by end use. The Actions represent potential measures for inclusion in an industrial and manufacturing sector EEC program. Broadly speaking, the Actions target the large natural gas consuming wood products and food and beverages subsectors, with many of the Actions applicable to smaller subsectors as well. For example, although the food and beverages subsector uses the largest proportion of process heat boilers over the entire manufacturing sector, smaller subsectors such as chemicals or nonmetallic minerals would also benefit from a program to increase the energy efficiency of process heat boilers.

This section includes a brief summary of the Actions. Detailed descriptions of the Actions and recommended strategies are provided in Section 9 of this report, and complete profiles of Actions M1 to M4 are provided in Appendix A.

2.2.1 Action M1—Efficient Lumber Dry Kilns

The majority of lumber dry kilns in British Columbia use natural gas and this Action will encourage the purchase of high efficiency lumber dry kilns and major efficiency retrofits of existing kilns. In addition to control systems, a number of upgrades are possible to convert an average kiln into an energy efficient kiln. These upgrades include automatic venting, load balancing, improved insulation, baffling, variable speed drives, and heat recovery.

Strategies for implementing this Action include promoting the Action to customers, vendors, and trade allies to emphasize the cost savings that can be realized from efficiency upgrades and new efficient kiln purchases; holding energy efficiency workshops; providing incentives to install metering to track efficiency upgrades, providing consulting assistance for customers; and providing financial incentives for customers to improve equipment efficiency.

2.2.2 Action M2—Efficient Veneer Dryers

Veneer dryers are the major consumer at plywood plants in the wood subsector and this Action will encourage the purchase of high efficiency veneer dryers and upgrade of existing dryers. The largest efficiency and production improvement opportunity for veneer dryers is upgrading insulation and seals. As with lumber dry kilns, the current trend in the plywood sector is away from natural gas as a heat source and towards wood waste.

Strategies for implementing this Action include educating the industry on the economics of improving the efficiency of existing systems; assisting with metering to track efficiency upgrades; holding energy efficiency workshops; and providing financial incentives for customers to improve equipment efficiency.

2.2.3 Action M3—Efficient Process Heat Boilers

This Action will encourage the purchase of efficient boilers for process heat in the food manufacturing sector, including greenhouse and food and beverages processing. Opportunities for improvement also exist in the chemicals, nonmetallic minerals, paper, and other manufacturing sectors. Energy efficiency opportunities for boilers include near condensing and condensing boilers; boiler economizers, boiler combustion air preheating; boiler condensation heat recovery; and advance boiler controls.

Strategies for implementing this Action include promoting the Action to customers, vendors, and trade allies; and providing financial incentives towards the design, purchase, and monitoring of condensing or near condensing boilers.

2.2.4 Action M4—Fully Insulated Process Heat Distribution Systems

This Action will encourage the installation and improvement of insulation on the process heat distribution systems of new and existing manufacturing facilities.

Strategies for implementing this Action include promoting the Action to customers, vendors, and trade allies; partnering with technical associations; providing financial incentives to both customers and vendors; and providing information to customers regarding the current losses and potential benefits of upgrading insulation at their facility.

3 CPR APPROACH

The CPR approach involved progressing through a series of steps as summarized as follows:

1. Develop base year calibrations

Base year calibrations that provided a detailed description of "where" and "how" energy was used in the existing manufacturing sector were developed using Terasen billing data. The base year for the 2006 report was fiscal 2003/04 and for the 2009 update was fiscal 2008/09.

2. Develop reference cases

Reference cases were developed for each major subsector to estimate the expected level of natural gas consumption that would occur over the study period in the absence of new demand side management program initiatives.

3. Develop and assess energy efficiency and fuel choice technologies

Energy efficiency and fuel choice technologies that met the study scope criteria were assessed and measure information developed. For each option identified, technology cost and performance data were compiled relative to the baseline technology used in the reference case. In addition, a measure total resource cost (TRC) was calculated.

4. Estimate economic energy efficiency potential

Economic potential for the energy efficiency technologies that had a positive TRC was estimated. The economic potential was defined as the level of energy consumption that would occur if all technologies were upgraded to the level that is cost-effective from Terasen's perspective against the long-run avoided cost of new natural gas supply.

5. Estimate achievable savings potential

Achievable savings potential, defined as the proportion of savings identified in the economic energy efficiency potential forecast that could be realistically achieved within the study period, was estimated. The achievable savings potential recognized that it would be difficult to induce customers to purchase and install all the energy efficiency technologies identified. The results of the achievable savings potential were presented as "most likely" and "upper."

6. Estimate peak day load impacts of achievable savings potential

Peak day load impacts from the natural gas savings contained in the achievable savings potential results were estimated for each rate schedule and service region using load factors provided by Terasen.

3.1 Total Resource Cost (TRC) Test

Terasen uses a Total Resource Cost (TRC) Test to evaluate EEC programs. The TRC test, as described in the *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects,* compares the benefits of a conservation program with program costs, where benefits are defined as the avoided supply costs and costs are defined as program costs paid by the utility and participants as well as any increase in supply costs when load is increased. TRC test results can be expressed as a benefit-cost ratio, i.e., the discounted total program benefits to discounted total program costs over a specified period of time. A benefit-cost ratio greater than one indicates the program is beneficial on the basis of the TRC test.[1]

Further, the benefits portion of the TRC test is made up of the avoided supply costs, valued at their marginal cost, for periods when a load reduction results. The costs portion of the TRC test includes all equipment costs, installation, operation and maintenance costs, cost of removal, and administration costs, regardless of who pays, less any tax credits.[2]

[1] Terasen Gas Inc. and Terasen Gas (Vancouver Island) Inc. May 28, 2008. *Energy Efficiency and Conservation Programs Application*. Vancouver, B.C. Appendix 12: State of California. July 2002. *California Standard Practice Manual: Economic Analysis of Demand Side Programs and Projects*. Governor's Office of Planning and Research. pp 18-19.

[2] Terasen Gas Inc. and Terasen Gas (Vancouver Island) Inc. May 28, 2008. *Energy Efficiency and Conservation Programs Application*. Vancouver, B.C. Appendix 12: State of California. July 2002. *California Standard Practice*

3.2 Update Approach

The approach to update the 2006 CPR results involved the following steps.

- Update base year to 2008/09.
- Input to the model 2008/09 billing data.
- Determine the Reference forecast for years 2015/16 and 2020/21.
- Determine the Economic and Achievable forecasts for years 2015/16 and 2020/21.
- Review the Action Plans from 2006 CPR and adjust as necessary.
- Calculate the Achievable Potential.

A more extensive breakdown of the customers in sales Rate Schedules 2 and 3 was available for this update from Terasen. A North American Industry Classification System (NAICS) breakdown for the customers in sales Rate Schedules 2 and 3 made it possible to include these customers in the model's subsectors. The update thus included customers in sales Rate Schedules 5, 23, and 25, and industrial accounts with annual consumption greater than 100 GJ per year from sales Rate Schedules 2 and 3. This assumes that customers with consumption less than 100 GJ per year may not be practical to serve with a manufacturing sector EEC program targeted to large consumers.

4 KEY RESULTS FROM 2006 CPR

4.1 Base Year—Manufacturing Sector Consumption

The manufacturing sector consumption reported in the 2006 CPR, based on 2003/04 billing information, is shown in Exhibit 3 below.

Exhibit 3: Base Year (2003/04) Gas Sales by Manufacturing Subsector and Service Area[3]

Manufacturing Subsector	Division	Base Year Natural Gas Consumption (GJ)			
		Lower Mainland	Vancouver Island	Interior	Total
Food	Food – Drinks Food – Food Processing Food – Agriculture Food – Poultry Food – Bakery Food – Greenhouses	6,527,366	100,000	637,465	7,264,833
Chemicals		467,127	N/A	227,005	694,132
Fabricated Metal		745,217	N/A	45,339	790,555
Non-Metallic Minerals		593,449	50,000	193,119	836,567
Paper		458,266	N/A	67,800	526,066
Wood	Wood – Lumber Wood – Plywood Wood – Other Wood	738,585	350,000	6,007,217	7,095,802
Other		1,139,302	50,000	131,773	1,321,074
Total		**10,669,312**	**550,000**	**7,309,718**	**18,529,031**
% of Total		**58%**	**3%**	**39%**	**100%**

Note: minor discrepancies in numbers due to rounding.

Manual: Economic Analysis of Demand Side Programs and Projects. Governor's Office of Planning and Research. pp 18-19.

[3] Marbek Resource Consultants/Willis Energy Services Ltd. February 2006. *Terasen Gas 2006 Conservation Potential Review Manufacturing Sector Report*. Vancouver, B.C. p 9.

4.2 Distribution of Natural Gas by End Use

The following two exhibits from the 2006 CPR provide information on the breakdown of natural gas use by end use within subsectors.

Exhibit 4: Natural Gas Consumption by End Use Manufacturing Sector[4]

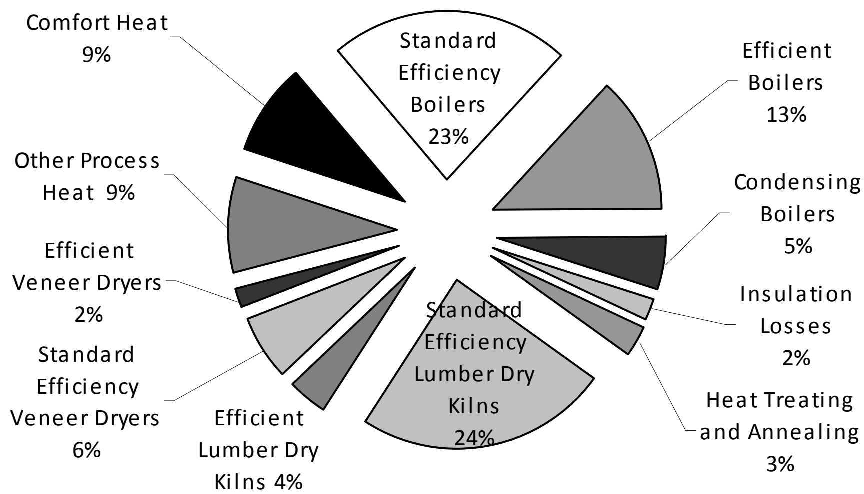
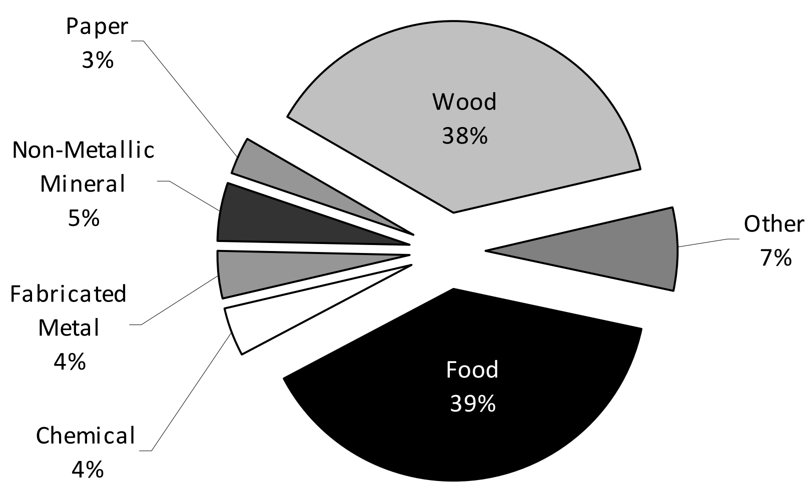


Exhibit 5: Natural Gas Consumption by Subsector[5]



[4] Marbek Resource Consultants/Willis Energy Services Ltd. February 2006. *Terasen Gas 2006 Conservation Potential Review Manufacturing Sector Report*. Vancouver, B.C. p E-v.
[5] Marbek Resource Consultants/Willis Energy Services Ltd. February 2006. *Terasen Gas 2006 Conservation Potential Review Manufacturing Sector Report*. Vancouver, B.C. p E-vi.

4.3 Achievable Potential

Achievable Savings Potential—Energy Efficiency Scenario

The natural gas savings opportunities identified in the Economic Potential Forecast were "bundled" by end use into a set of "Actions," reflecting a way in which initiatives may be undertaken. A brief profile is provided for each of the identified Actions in Section 2 of this report. The 2006 CPR results are presented in the following table by Action and by Milestone Year[6] in Exhibit 6.

Consistent with the results in the Economic Potential Forecast, the most significant Achievable Savings opportunities were in the Actions that addressed lumber kilns and process boilers.[7]

Exhibit 6: Summary of Achievable Savings—2006 CPR
Terasen Service Area by Action and Milestone Year [8]

Action	Savings Re: Reference Case			
	2010/11		2015/16	
	Most Likely	Upper	Most Likely	Upper
M1: Efficient Lumber Dry Kilns	599,514	798,313	781,518	1,006,222
M2: Efficient Veneer Dryers	40,189	94,396	45,828	108,630
M3: Efficient Boilers	650,831	868,150	750,760	1,008,253
M4: Fully Insulated Process Heat Distribution Systems	193,101	267,040	200,123	277,091
Other	92,650	185,300	111,475	222,950
Total All Service Areas	1,576,286	2,213,198	1,889,704	2,623,145

5 KEY MARKET CHANGES FROM 2006 CPR

5.1 Base Year Consumption Change 2003/04 to 2008/09

Exhibit 7: Base Year Consumption Change 2003/04 to 2008/09

Manufacturing Subsector	2008/09 CPR Base Year Consumption (GJ)	2003/04 CPR Base Year Consumption (GJ)	Difference in Base Year Consumption (GJ)
Food	5,887,241	7,264,831	(1,377,590)
Chemical	833,868	694,132	139,736
Fabricated Metal	1,157,308	790,556	366,752
Non Metallic Mineral	714,039	836,568	(122,529)
Paper	301,774	526,066	(224,292)
Wood	3,747,461	7,095,802	(3,348,341)
Other	2,992,966	1,321,075	1,671,891
Total	**15,634,656**	**18,529,030**	(2,894,374)

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6 Ibid. p E-vii.
7 Ibid.
8 Marbek Resource Consultants/Willis Energy Services Ltd. February 2006. *Terasen Gas 2006 Conservation Potential Review Manufacturing Sector Report*. Ottawa, Ontario. p E-vi.

5.2 Manufacturing Sector Gas Consumption Growth Rates

Exhibit 8 compares the annual growth rate assumptions for the 2006 CPR and this 2009 update.

Exhibit 8: Manufacturing Subsector Growth Rates

Manufacturing Subsector	2006 CPR Forecast for Period 2010/11 to 2015/16	2009 Update Forecast Values	
		2010/11 to 2015/16	2015/16 to 2020/2021
	Annual Growth	Annual Growth	Annual Growth
Wood	1.50%	0%	0%
Food	3.00%	2%	2%
Paper	3.00%	0%	0%
Chemical	3.00%	0%	0%
Other Subsectors	3.00%	2%	2%

The wood subsector is experiencing a significant downturn in the market for its products, mainly due to the decline in the North American housing market. While the normal number of housing starts in North America is approximately 2 million per year, the present level is 500,000.

5.3 Current Economic Factors

The following table identifies the key economic factors for estimating achievable conservation potential and also indicates how these factors have changed from the 2006 CPR to current conditions.

Exhibit 9: Economic Factor Changes

Economic Factor	Changes from 2006 CPR to Current Conditions
Cost of implementing efficiency measures	A review with boiler suppliers indicates that for this key measure costs have increased by about 25% compared to the values used in the 2006 CPR.
General growth in industrial natural gas market	The 2006 CPR study assumed a 3% annual growth rate for most sectors. Based on growth over the last six years, a general growth rate of 2% would seem more appropriate.
Growth in lumber drying natural gas market	There has been a significant downturn in the lumber sector. However, it is expected that this sector will recover over the next two to three years.

6 REVISED REFERENCE CASE FORECAST

6.1 Reference Forecast

This report section presents the manufacturing sector Reference Case Forecast for natural gas consumption during the study period 2009/2010 to 2020/2021. The Reference Case Forecast estimates the expected natural gas consumption that would occur over the study period in the absence of new energy efficiency or fuel choice initiatives. The Reference Case Forecast therefore provides the point of comparison for the subsequent calculation of economically attractive energy efficiency or fuel choice opportunities.

6.2 Reference Case Forecast

The following table indicates the Reference Case Forecast that was assumed for this study.

Exhibit 10: Reference Case Forecast Natural Gas Consumption for Total Terasen Service Area GJ/yr

Year	Lower Mainland	Interior	Vancouver Island	Total
Previous Base Year (2003/04)	10,699,312	7,309,718	550,000	18,529,030
Revised Base Year (2008/09)	10,276,252	4,774,299	584,107	15,634,658
Milestone Year 2015/16	11,470,441	4,943,906	633,124	17,047,471
Milestone Year 2020/21	12,385,440	5,077,915	672,025	18,135,381

7 PRIME ENERGY EFFICIENCY TECHNOLOGIES

The energy efficiency technologies included in this section were originally described in the 2006 CPR.[9] Exhibit 11 summarizes the measures.

Exhibit 11: Energy Efficiency Technologies

Measure	Efficiency Impact	Subsector
Near Condensing Boiler	Efficiency increase from 68% for a standard boiler to 80% for a near condensing boiler.	Food & Beverage, Chemicals, Other
Condensing Boiler	Efficiency increase from 68% for a standard boiler to 92% for a condensing boiler.	Food & Beverage, Chemicals, Other
Boiler Economizer	Efficiency increase of 4% when added to a standard efficiency boiler.	Food & Beverage, Chemicals, Other
Boiler Combustion Air Pre-Heating	Efficiency increase of 4% when added to a standard efficiency boiler.	Food & Beverage, Chemicals, Other
Bundled Standard Boiler Upgrades	Efficiency increase from 68% for a standard efficiency boiler to 85% for a standard boiler with all upgrades.	Food & Beverage, Chemicals, Other
Turbulator	Increases heat exchange in older fire-tube boilers until complete replacement of boiler is feasible.	Food & Beverage, Chemical, Other
Advanced Dry Kiln Controls	Efficiency increase from 55% from a standard kiln to 60% for a standard kiln with advanced controls.	Wood Products
Efficient Dry Kiln	Efficiency increase from 55% from a standard kiln to 85% for an efficient kiln.	Wood Products
High Efficiency Veneer Dryer	Efficiency increase from 50% from a standard veneer dryer to 70% for an efficient veneer dryer.	Wood Products
Sequential Firing, High Velocity Burner	Efficiency increase from 25% for a standard burner to 40% for an upgraded burner.	Metal
Furnace Ceramic Fibre Insulation	Natural gas reduction of 15% after replacing standard furnace insulation with ceramic fibre insulation.	Metal
High Efficiency Oven	Efficiency increase from 65% for a standard oven to 80% for an efficient oven.	Food & Beverage

[9] Marbek Resource Consultants/Willis Energy Services Ltd. February 2006. *Terasen Gas 2006 Conservation Potential Review Manufacturing Sector Report*. Ottawa, Ontario. pp 33-40.

Measure	Efficiency Impact	Subsector
Direct-Fired Heating	Increases natural gas efficiency to 90%.	Food & Beverage
Radiant Tube Heating	Increases natural gas efficiency to 85% by allowing poultry barns to operate at a lower overall temperature.	Food & Beverage
Distribution System Insulation	Efficiency increase from 50% heat retention for a partially-insulated system to 92% heat retention compared to bare piping.	All
Pinch Technology	Plant-wide reduction in energy consumption of 10%.	Pulp & Paper, Oil Refineries, Food & Beverage
Direct Fired Paper Drying	Fuel use reduction of 7% and production increase of 17%.	Pulp & Paper
Direct Fired Water Heater	Efficiency increase from 75% for a tank type water heater to 95% for a direct fired water heater.	Food & Beverage

7.1 Boilers

Boilers are used for process steam or process hot water heating. For the purposes of this study, it is assumed that boiler load is negligible in the fabricated metal manufacturing sector and in the lumber and plywood and divisions of the wood subsector.

Seasonal efficiency is used throughout this discussion. Seasonal boiler efficiencies for process heat applications range from 68% for a standard efficiency boiler to 92% for a condensing boiler. For manufacturing sector retrofits, it is assumed that the installed cost is 2.5 times capital cost. Installed cost may be higher in the manufacturing sector than for a comparable boiler size in the commercial sector due to the complexity of some retrofits.

Energy efficiency opportunities for boilers include:

- Near condensing boilers
- Condensing boilers
- Boiler economizers
- Boiler combustion air pre-heating
- Boiler condensation heat recovery
- Advanced boiler controls
- Low excess air burners
- Turbulators

Near Condensing Boilers

Near condensing boilers are suitable for process hot water applications where the return water temperature is above that required for condensing boilers; for example, laundries. Near condensing boilers typically have a peak efficiency of 85 %. These boilers achieve high efficiency with advanced heat exchangers, modulating burner control, high quality insulation, and a number of other features including those treated separately below.

An installed cost of about $40/kBTU capacity is reported by vendors and in the literature for near condensing boilers. The useful life of near condensing boilers is assumed to be 25 years. There is no substantial increase in maintenance or electricity consumption compared to a standard boiler. The average seasonal natural gas efficiency is assumed to increase from 68% for a standard boiler to 80% for a near condensing boiler.

Condensing Boilers

Condensing boilers are appropriate for process hot water heating where the return water temperature can be maintained below 49° C; for example, greenhouse heating. Condensing boilers have high efficiency components such as modulating control and low excess air burners, and they also have condensing heat exchangers that transfer heat from the exhaust flue gas to the return water. Condensing boilers need low return water temperatures (below 49° C) and low flow rates to operate at peak efficiency. If return water temperatures below 49° C cannot be provided, a condensing boiler will operate at efficiencies typical of a near-condensing boiler. Condensing boilers are not always feasible in the manufacturing sector as complex retrofits may be required. For steam applications, a condensation heat exchanger can be used to transfer heat from the exhaust flue gases to boiler make up water or some other heat sink. Condensation heat exchangers are treated separately below.

An installed cost of about $60/kBTU capacity is reported by vendors and in the literature for condensing boilers. The useful life of a condensing boiler is 25 years. The average seasonal natural gas efficiency increase is assumed to be from 68% seasonal efficiency for a standard boiler to 92% seasonal efficiency for a condensing boiler. Increased maintenance costs of approximately $1,600 annually (two days labour for a skilled tradesperson) over a standard efficiency boiler are assumed.

Bundled Standard Boiler Upgrades

Bundled standard boiler upgrades include advanced control, efficient burners, and condensation heat recovery. These upgrades are suitable for steam applications where a heat sink, such as boiler make up water, is available e.g., a steam boiler in the Chemicals subsector. This analysis assumes that the upgrades are added as a bundle to a standard efficiency boiler, although it may be possible to add each technology individually.

The addition of a condensation heat recovery unit to a boiler combustion stack recovers the latent heat of the flue gases for combustion air preheating and/or makeup water preheating. This is an economic retrofit for processes that have a heat sink, such as boiler make up water, but do not necessarily have conditions appropriate for a condensing boiler.

Advanced boiler controls can lead to significant energy savings. For example, integrating the boiler control system with the process automation system allows for remote monitoring and changing of set points, and usually improves operation of the boiler system. Most advanced boiler controls enable higher turndown ratios than standard controllers. This contributes to energy efficiency by allowing the boiler to safely operate at a low firing rate.

Because perfect mixing between fuel and oxygen is never achieved, excess air is used to ensure complete combustion. Lowering the amount of excess air needed by the burner directly increases the fuel efficiency by reducing heat losses in the exhaust gas. A standard efficiency fire tube boiler usually operates at approximately 20% excess air. A low excess air natural gas burner may operate with 5% excess air.

An installed cost of about $40/kBTU is reported by vendors and in the literature for the above bundle of upgrades on a standard efficiency boiler. The useful life of the upgrades is assumed to be 15 years. The average natural gas efficiency increase is assumed to be from a seasonal efficiency of 68% for a standard boiler to a seasonal efficiency of 85% for a standard boiler with all of the upgrades. No increase in maintenance costs, over a standard efficiency boiler, is assumed.

Other Boiler Improvements

A number of boiler improvements exist that are suitable for minor efficiency improvements to existing boilers. In general, these technologies may be considered low cost retrofits for applications where replacing the entire boiler is not feasible.

Boiler Economizers

Economizers transfer waste heat from boiler exhaust gas to boiler feedwater or makeup water, thereby reducing the amount of heat that must be supplied by the fuel.

Economizers are suitable when flue temperatures are below 230° C. Most high efficiency boilers are equipped with internal economizers; consequently, this technology is primarily applicable to retrofit applications.

The cost of an installed economizer in a retrofit application varies greatly depending on boiler configuration. Experience has shown that only a modest number of retrofit applications have configurations that make this option practical.

The useful life of economizers is 15 years. The average natural gas seasonal efficiency increase is approximately 4% when added to a standard efficiency boiler.

Boiler Combustion Air Preheaters

Boiler combustion air preheaters capture waste heat in the boiler flue gases to preheat the combustion air. This transfer reduces the amount of fuel needed to bring the air up to combustion temperature.

A simple payback period of one year is reported by vendors and in the literature for installations on standard efficiency boilers. The useful life of combustion air preheaters is 15 years. The average natural gas seasonal efficiency increase is 4% when added to a standard efficiency boiler.

Boiler Turbulators

Older fire-tube boilers can benefit from installation of turbulators in boiler tubes to increase heat exchange. This measure might be considered as a short-term measure, until complete replacement of the boiler is feasible.

7.2 Wood Technologies

Lumber and wood products drying are the major uses of natural gas in the wood products subsector. Energy use in wood kiln drying is specific to operating conditions such as wood moisture content and species. Conventional heat and vent kilns are used in British Columbia and, in addition to using significant amounts of thermal energy, they require large amounts of electricity for fan power. Some larger sawmill operations have converted to boiler heated steam or thermal oil for kiln heating, in which case the fuel is wood waste, not natural gas. The sawmill industry as a whole is moving away from natural gas and towards wood waste alternatives for heating dry kilns.

Three energy efficiency technologies were assessed:

- Advanced dry kiln controls,
- Efficient dry kilns, and
- High efficiency veneer dryers.

Advanced Dry Kiln Controls

Perhaps the most promising energy saving opportunity for conventional kilns is improved control. Most conventional kilns are operated on fixed time schedules. Computer controls with in kiln moisture metering, fan speed control and vent control can offer significant energy savings. Replacing the old pneumatic controls with advanced controls improves energy efficiency, drying time, and final product quality.

A simple payback period of two years is reported by vendors and in the literature for control upgrades to heat and vent kilns. The useful life of these control systems is 15 years. The average natural gas efficiency increase is assumed to be from an efficiency of 55% for a standard kiln to 60% for a standard kiln with advanced controls. The average reduction in electricity consumption is assumed to be 15% following the installation of advanced controls. No increase in maintenance costs is assumed.

Efficient Dry Kilns

In addition to control systems, a number of upgrades are possible to convert an average kiln into an energy efficient kiln. These upgrades include automatic venting, load balancing, improved insulation, baffling, variable speed drives, and heat recovery.

An average simple payback period of four years is reported by vendors and in the literature for efficiency upgrades to heat and vent kilns. The useful life of the upgrades is 15 years. The average natural gas seasonal efficiency is assumed to increase from 55% for a standard kiln to 85% for an advanced kiln. The average reduction in electricity consumption is assumed to be 20% following the upgrades. No increase in maintenance costs is assumed.

High Efficiency Veneer Dryers

Veneer dryers are the major gas consumer at plywood plants in the wood subsector.

Veneer dryers operate as a continuous process with multiple lines of veneer. The typical configuration of a veneer dryer is a long chamber with rollers on belts to move the veneer through the dryer. Temperatures in the dryer may be as high as 100° C. Veneer dryers are either direct natural gas fired, or indirectly heated with thermal oil or steam from a natural gas or wood waste fired boiler. The largest efficiency and production improvement opportunity for veneer dryers is upgrading insulation and seals. As with lumber dry kilns, the current trend in the plywood sector is away from natural gas as a heat source and towards wood waste.

A simple payback period of three years is reported by vendors and in the literature for upgrades to veneer dryers. The useful life of a veneer dryer upgrade is 15 years. A reduction in natural gas consumption of up to 40% is reported for some veneer dryer upgrades, but a more conservative value of 20% is used in this study. The natural gas seasonal efficiency is assumed to increase from 50% for a standard veneer dryer to 70% for an efficient veneer dryer. No increase in maintenance costs is assumed.

7.3 Metal Technologies

Heat treating and annealing are used primarily in the fabricated metal sector. Two measures were assessed:

- Sequential firing, high velocity burners, and
- Furnace ceramic fibre insulation.

Sequential Firing, High Velocity Burners

Sequential firing is when multiple burners are fired cyclically at full power. This creates a very agitated atmosphere within the furnace, increasing turbulence, and thereby increasing heat transfer by convection. An added benefit of pulse firing is that consistent temperature can be achieved within the furnace with variations as low as 4° C.

High velocity burners are a type of nozzle mix burner with a burner velocity up to 150 m/sec. They provide deep penetration of heat into the stock, good rates of heat transfer and uniform temperature distribution in a furnace.

For the purpose of this study, it is assumed that sequential firing, and high velocity burners are added as a bundle to standard efficiency heat treating furnaces.

A simple payback period of three years is reported by vendors and in the literature for new installations. The useful life of these technologies is assumed to be 15 years. The average natural gas seasonal efficiency increase is from a standard burner efficiency of 25% to an upgraded burner efficiency of 40%. For high temperature applications such as heat treating, efficiency is typically low, and is defined as the heat that is transferred from the flame to the metal. No increase in maintenance costs is assumed.

Furnace Ceramic Fibre Insulation

High temperature ovens used in forges, foundries and metal fabrication require insulation capable of withstanding severe thermal cycling and sometimes, abrasive and chemical attack. Ceramic insulation was demonstrated on the space shuttles and other re-entry vehicles to be capable of withstanding these stresses, and soon became popular in industry.

Ceramic fibre insulation is now made in blanket, board and block form to meet all installation and application requirements.

The installed cost of ceramic fibre insulation in new installations or scheduled replacement of refractory is about the same as for traditional insulating refractory brick and block. Retrofit installations usually pay back the cost in three years. When applied in the proper applications there is no net change in maintenance costs. The useful life of ceramic fibre insulation is about ten years. It is assumed that a 15% reduction in natural gas use is observed after replacing standard furnace insulation with ceramic fibre insulation. No increase in maintenance costs is assumed.

7.4 Food Technologies

Two technologies were assessed that are applicable specifically within the food subsector. They are:

- High efficiency ovens, and
- Direct- fired and radiant tube heat.

High Efficiency Ovens

High efficiency ovens are found in the food processing and baking divisions of the food subsector.

A simple payback period of three years is reported by vendors and in the literature for new installations of high efficiency ovens over standard ovens. The useful life of high efficiency ovens is 15 years. The average natural gas seasonal efficiency increase is from 65% for a standard oven to 80% for an efficient oven. No increase in maintenance costs is assumed.

Direct-Fired and Radiant Tube Heating

Direct fired heating and radiant tube heating are both used in the food subsector. Direct fired heating is used in food processing and in poultry barns, and radiant tube heating is used only in poultry barns. Direct fired heating offers savings over boiler heat because it has higher natural gas efficiency and radiant tube heating offers savings over boiler heat because it allows poultry barns to operate at a lower overall temperature.

A natural gas seasonal efficiency of 90% is assumed for direct fired heating, and 85% for radiant tube heating. A useful lifetime of 25 years is assumed for both of these technologies. A simple payback of three years is assumed for the installation of radiant tube heating or direct fired heating over boiler heat. No increase in maintenance costs is assumed.

7.5 Other Applicable Technologies

In addition to the preceding technologies, there are a number of others that have application in a range of subsectors. They are:

- Distribution system insulation,
- Pinch technology,
- Direct fired paper drying, and
- Direct fired water heating.

Distribution System Insulation

This measure assesses insulating a facility's piping distribution system at partial and full levels. The baseline was assumed to be a food processing plant with a partially insulated distribution system, which retains 50% of the heat lost in bare piping. A model facility was developed to calculate the potential savings on a plant wide basis. A fully insulated distribution system was assumed to be insulated to the economic thickness of one inch, and to retain 92% of the heat that would be lost from bare piping, as per the North American Insulation Manufacturers Association (NAIMA) software 3E Plus. The simple payback period for the installation of fully insulation was calculated to be one and a half years with a lifetime of 20 years, as per NAIMA.

Pinch Technology

Pinch technology software for process heat integration provides a methodology to optimize heat recovery between operations at different temperatures. Pinch technology is most effective at facilities that have a range of different temperature applications such as pulp mills, oil refineries and drink processing plants.

Many manufacturing processes require heat to process materials into their final form. Examples include the conversion of wood into pulp and paper, hops into beer, and gas, oil and coal into plastics and pharmaceuticals. In each of these processes, different forms of heat and different temperatures may be required, such as high temperature combustion gases, high and low pressure steam, and hot or warm water. In the late 1980s, with the rising cost of fuel and electricity, industries developed methods to decrease fuel requirements by capturing the waste heat from one process and using that waste heat in another stage of the process. Pinch analysis provided the tools to analyze and optimize the "recycling" of heat within a plant to minimize the requirement for purchased energy.

As pinch technology developed, benefits went beyond energy conservation. Pinch analysis considers an entire multi-step manufacturing process as one integrated process, permitting process optimization, resulting in improved product yield, decreased emissions, de-bottlenecking, improved flexibility, and safety of the processes.

An example of the use of pinch technology was presented in an article in Innovation, the monthly newsletter of the Professional Engineers and Geoscientists of BC, November 2002. A pinch analysis of a thermo-mechanical pulp mill operation in BC uncovered opportunities which resulted in the reduction of 275,000 GJ of natural gas annually, with the potential for a further 155,000 GJ per year. When completed, the mill may save $2.1 million per year in fuel costs, providing a seven month payback on the expected $1.3 million capital cost. This example is not fully representative of a typical pinch case because the customer is much larger than the customer group which is the subject of this study and because the savings resulted primarily from de-bottlenecking.

Pinch technology crosses over to all process streams within an operation. This study assumes that a plant-wide reduction in energy consumption of 10% is possible with an investment that would result in a five year payback. This payback is an estimated average value. The application of pinch technology will increase maintenance requirements in some areas, but will decrease maintenance in others. This study assumes no net change.

Direct Fired Paper Drying

The paper subsector that is the subject of this study primarily consists of board paper manufacturers and cellulose-based absorbent manufacturers. Traditionally, large industrial boilers provide steam to heat and dissolve the cellulose feedstock, and then to dry the final product after the cellulose is shaped into the desired form.

Drying board paper is usually accomplished by passing the sheet over steam-heated drums. However, the rate of drying is quite limited due to the low temperature of the steam. Therefore, the production rate of most paper machines is limited by the slow rate of drying from the steam drums. As a result, the dryer section of a paper mill can be as large as a football field.

Various technologies have been developed to use natural gas to directly dry paper. Non-contacting infra red emitters have been developed to assist in moisture profiling of the sheet. The primary purpose of this technology is for moisture consistency, but it also allows the speed of the machine to be increased due to the additional drying capacity. Gas-heated dryer drums are the most common method of direct gas heating on paper machines. Overall thermal efficiencies can increase from 65% with steam to 90% with gas-heated dryer drum technology. The major benefit, however, is an increase in production of 15% due to the higher rate of drying. A board paper mill in Texas, Corrugated Services LP, recently installed both an infra-red radiation dryer section and a gas-heated dryer drum on its corrugated board machine. The company claims the fuel savings and increase in production due to these direct gas heating technologies have provided significant economic benefits.

Total project costs of $1,500,000 were reported to add two gas-fired cylinders to a newsprint machine, with a resultant net revenue increase of $3,800,000 per year, much of it due to the increase in production rate. No change in maintenance costs is expected.

For the smaller mills that are the subject of this study (about 10% the capacity of a newsprint machine), costing data was not available. It is assumed that a $1,000,000 investment will provide a reduction in fuel usage of about 7% per tonne of product, but will allow an increase in production of approximately 17%, providing a simple payback of three years. The useful life of direct-heated gas drying technologies is assumed to be 20 years.

Direct Fired Water Heating

Direct gas fired water heaters have 98% or greater heat transfer efficiency. Direct fired hot water heaters are suitable for applications where process hot water is consumed, rather than re-circulated as in a boiler system; for example, sanitation in a poultry plant.

In one design the combustion chamber is submersed in the water and the combustion gases are forced through the water, heating it by direct contact. This design is suitable for manufacturing applications with poor water quality, such as log or effluent ponds. In another design cold water is sprayed downwards while combustion gases flow upwards. This design is appropriate for sanitary water applications such as laundries and food processing. This design is also used to heat boiler make up water. No heat exchanger is needed with either design.

A simple payback period of three year is assumed for the installation of direct fired water heaters over standard tank type water heaters. The natural gas efficiency increase is assumed to be from a tank type water heater efficiency of 75% to a direct fired water heater seasonal efficiency of 95%. The useful life of the technology is assumed to be ten years.

8 REVISED ACHIEVABLE FORECAST

8.1 Achievable Forecast Consumption Explanation

This section presents the manufacturing sector Achievable Potential Forecast for the study period (2009/10 to 2020/21). The Achievable Potential Forecast is defined as the natural gas consumption that would occur once all achievable energy savings projects are implemented.

8.2 Description of Achievable Potential

Achievable Potential recognizes that in many instances it is difficult to induce all customers to purchase and install all the energy efficiency technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement energy-efficient measures can be constrained by important factors such as:

- Higher first cost of efficient product(s),
- Need to recover investment costs in a short period (payback),
- Lack of product performance information, and
- Lack of product availability.

The rate at which customers purchase energy-efficiency technologies will be influenced by the level of financial incentives, information and other measures put in place by Terasen Gas, BC Hydro, governments, and the private sector to remove barriers such as those noted above.

8.3 Revised Achievable Forecast Natural Gas Consumption

The following tables, Exhibits 12 and 13, present total natural gas sales by service area, following the implementation of savings measures under the Most Likely and the Upper Achievable savings forecasts.

Exhibit 12: Most Likely Achievable Forecast Natural Gas Consumption—Total Terasen Service Area GJ/yr

Year	Lower Mainland	Interior	Vancouver Island	Total
Revised Base Year 2008/09	10,276,252	4,774,299	584,107	15,634,658
Milestone Year 2015/16	10,737,000	4,545,469	621,168	15,903,637
Milestone Year 2020/21	11,557,199	4,610,044	646,207	16,813,450

Exhibit 13: Upper Achievable Forecast Natural Gas Consumption—Total Terasen Service Area GJ/yr

Year	Lower Mainland	Interior	Vancouver Island	Total
Revised Base Year 2008/09	10,276,252	4,774,299	584,107	15,634,658
Milestone Year 2015/16	10,464,586	4,386,186	599,970	15,450,742
Milestone Year 2020/21	11,042,083	4,438,201	636,335	16,116,619

9 ACHIEVABLE ENERGY SAVINGS

The Achievable Energy Savings are determined by comparing the Reference Forecast with the Achievable Forecast. In other words, the energy savings is the forecast gas consumption at a future date in a business as usual scenario (Reference Case) minus the forecast consumption if energy saving measures (Action M1, etc.) are implemented (Achievable Forecast). The table below indicates this savings forecast.

Exhibit 14: Summary of Achievable Energy Savings—Total Terasen Service Area

Action	Achievable Energy Savings (Reference Forecast minus Achievable Forecasts)			
	2015/16		2020/21	
	Most Likely	Upper	Most Likely	Upper
M1: Efficient Lumber Dry Kilns	271,611	361,487	326,806	422,965
M2: Efficient Veneer Dryers	10,074	23,672	10,324	25,497
M3 Efficient Boilers	642,444	853,380	751,942	882,757
M4: Fully Insulated Process Heat Distributed Systems	167,028	231,571	163,713	227,009
Other	47,446	126,620	72,078	460,533
Total All Service Areas	**1,138,603**	**1,596,729**	**1,324,863**	**2,018,762**

9.1 Action M1—Efficient Lumber Dry Kilns

This Action will encourage the purchase of high efficiency lumber dry kilns and major efficiency retrofits of existing kilns. The majority of the lumber dry kilns in British Columbia use natural gas. During the period from 1985 to 2000, natural gas in real terms became relatively inexpensive compared to other alternatives. As a result of the low price for natural gas and the wood industry's interest in high volume production, the efficiency of gas fired kilns in some cases deteriorated and, in general, efficiency improvements due to technology improvements were not installed or adopted. The industry has become very aware of the cost of natural gas and is seriously considering fuel alternatives. It is important for the industry to realize the opportunities of improved efficiency before they make large capital expenditures in going to other fuel alternatives.

The broad strategy envisioned for this Action consists of:

- Strong up-front promotional efforts directed towards customers, vendors and trade allies emphasizing the cost savings through efficiency upgrades and new efficient kiln purchases.
- Two initial items would be workshops, jointly sponsored by Terasen, BC Hydro and Natural Resources Canada (NRCan).
- Incentives to install metering on a kiln by kiln basis so efficiency upgrades could be tracked.
- Consulting assistance to enable customers to objectively evaluate the cost of natural gas and the advantages of efficiency improvements.
- Financial incentives for customers who decide to continue to use natural gas as a fuel and to improve their equipment efficiency.

9.2 Action M2—Efficient Veneer Dryers

This Action will encourage the purchase of high efficiency veneer dryers and the upgrade of existing dryers for the plywood and engineered wood industries. A number of observations and reviews of existing veneer dryer operations have indicated that there are significant efficiency improvement opportunities with many veneer dryers. The industry is seriously investigating alternatives to natural gas. These alternatives involve wood waste energy systems and large capital expenditures. It would be useful for industry to understand the economics of improving the efficiency of their existing systems prior to making large capital expenditures.
The broad strategy envisioned for this Action consists of:

- A promotional effort to help the industry understand the economics of improving the efficiency of their existing systems.
- Assistance with metering so the efficiency of dryers could be accurately monitored and immediate operational savings obtained.
- Work with BC Hydro and NRCan in holding efficiency workshops.
- Financial incentives for veneer dryers that remain on natural gas and improve their efficiency of operation.

9.3 Action M3—Efficient Process Heat Boilers

This Action will encourage the purchase of efficient boilers for process heat. The largest opportunity is in the food manufacturing sector that includes greenhouses, and food and drinks processing. Opportunities also exist in the chemicals, nonmetallic minerals, paper, and other manufacturing sectors. It is assumed that there is an opportunity to extend the existing Terasen

Gas Efficient Boiler Program to process heat applications from its current scope of strictly comfort heat application. This extension could include participation by NRCan.

The broad strategy envisioned for this Action consists of:

- Strong up-front promotional efforts directed towards customers, vendors, and trade allies, including workshops and technical information.
- Financial incentives towards the design, purchase, and monitoring of condensing or near condensing boilers.
- A schedule for review and completion of the program based on market penetration targets.

9.4 Action M4—Fully Insulated Process Heat Distribution Systems

This Action will encourage the installation and improvement of insulation on the process heat distribution systems of new and existing manufacturing facilities.

The broad strategy envisioned for this Action consists of:

- Strong up-front promotional efforts directed towards customers, vendors and trade allies.
- Partnerships with trade and technical associations.
- Financial incentives targeted to both customers and vendors for the first five years to boost market momentum.
- Access by Terasen customers to information on the current losses and potential benefits of upgrading insulation at their particular facility.

10 APPENDIX A—DETAILED DATA FOR ACTION PROFILES

Exhibit 15: Action Profile M1—Lumber Efficient Dry Kilns

Energy Efficiency Measure	**M1- Efficient Lumber Dry Kiln**					
Participant Definition	**New or Major Retrofit of an Efficient Lumber Dry Kiln at Sawmills and Planer Mills in the Wood Sub Sector**					
Service Area	**Interior**			**Lower Mainland and Vancouver Island**		
Major Technology and % of Economic Potential	Technology		% of Potential	Technology		% of Potential
	Efficient Lumber Dry Kilns		100%	Efficient Lumber Dry Kilns		100%
Approximate % of Action Savings by Service Area	82%			18%		
Economic Potential Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
	460,760	118,247	579,007	99,132	25,975	125,107
Approximate Total Number of Participants	21	5	26	5	1	6
Number of Participants Eliminated by Constraints	16	4	20	3	1	4
Economic Potential Available for DSM	345,570	88,685	434,255	74,349	19,481	93,830
Approximate Economic Potential Savings per Participant per Year (GJ/year)	22,000			22,000		
Approximate Benefit Cost Ratio (Marginal Supply Cost of Gas ~ $6/GJ)	1.4			1.2		
Approximate Customer Payback (Customer Cost of Gas ~ $9/GJ)	4 years			4 years		
Participation Rate (% of Available Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	64%	50%	-	70%	55%	-
Upper	85%	60%	-	91%	42%	-
Action Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	219,567	44,480	264,047	52,044	10,715	62,759
Upper	293,735	53,211	346,946	67,753	8,267	76,019
Participation Rate (% of Total Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	48%	38%	46%	53%	41%	50%
Upper	64%	45%	60%	68%	32%	61%

	Period One to 2015/16	**Period Two to 2020/21**	**Total by 2020/2021**
Total Savings (GJ/year)			
Economic Potential	559,892	144,222	704,114
Most Likely	271,611	55,195	326,806
Upper	361,487	61,478	422,965

Exhibit 16: Action Profile M2—Efficient Veneer Dryers

Energy Efficiency Measure	M2- Efficient Veneer Dryers					
Participant Definition	New or Major Retrofit of an Efficient Veneer Dryer at Engineered Wood Facilities					
Service Area	Interior			Vancouver Island		
Major Technology and % of Economic Potential	Technology		% of Potential	Technology		% of Potential
	Efficient Veneer Dryers		100%	Efficient Veneer Dryers		100%
Approximate % of Action Savings by Service Area	89%			11%		
Economic Potential Savings (GJ/year)	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021
	39,878	2,347	42,225	4,750	242	4,992
Approximate Total number of Participants in Period	3	0	4	0	0	0
Number of Participants Eliminated by Constraints	3	0	3	0	0	0
Economic Potential Available for DSM	35,890	2,112	38,003	3,563	182	3,744
Approximate Economic Potential Savings per Participant per Year (GJ/year)	12,000			12,000		
Approximate Benefit Cost Ratio (Marginal Supply Cost of Gas ~ $6/GJ)	1.9			1.5		
Approximate Customer Payback (Customer Cost of Gas ~ $9/GJ)	3 years			3 years		
Participation Rate (% of Available Economic Potential)	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021
Most Likely	24%	10%	-	40%	20%	-
Upper	60%	78%	-	60%	98%	-
Action Savings (GJ/year)	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021
Most Likely	8,649	214	8,863	1,425	36	1,461
Upper	21,534	1,648	23,182	2,138	178	2,315
Participation Rate (% of Economic Potential)	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021
Most Likely	22%	9%	21%	30%	15%	29%
Upper	54%	70%	55%	45%	73%	46%

Total Savings (GJ/year)	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021
Economic Potential	44,628	2,589	47,217
Most Likely	10,074	250	10,324
Upper	23,672	1,825	25,497

Exhibit 17: Action Profile M3.1—Condensing or High Efficiency Process Heat Boilers

Energy Efficiency Measure	**M3.1-Condensing or High Efficiency Process Heat Boilers**					
Participant Definition	**Condensing Process Hot Water or High Efficiency Process Steam Boilers**					
Service Area	**Lower Mainland**			**Interior and Vancouver Island**		
Major Technology and % of Economic Potential	Technology		% of Potential	Technology		% of Potential
	Condensing Boilers		75%	Condensing Boilers		75%
	Efficient Process Steam Boilers		15%	Efficient Process Steam Boilers		15%
	Direct Fired Heat		10%	Direct Fired Heat		
Approximate % of Action Savings by Service Area	84%			16%		
Economic Potential Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
	1,476,824	92,972	1,569,796	288,446	54,523	342,969
Approximate Total number of Participants in Period	283	18	301	55	10	66
Approximate Total Number of Participants Eliminated by Constraints	90	6	96	18	3	21
Economic Potential Available for DSM	1,004,240	63,221	1,067,461	196,143	37,076	233,219
Approximate Economic Potential Savings per Participant per Year (GJ/year)	5,222			5,222		
Approximate Benefit Cost Ratio (Marginal Supply Cost of Gas ~ $6/GJ)	1.8			1.5		
Approximate Customer Payback (Customer Cost of Gas ~ $9/GJ)	4 years			4 Years		
Participation Rate (% of Available Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	24%	25%	-	40%	22%	-
Upper	38%	13%	-	40%	5%	-
Action Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	238,170	16,100	254,270	78,457	8,157	86,614
Upper	383,943	8,150	392,093	78,457	1,854	80,311
Participation Rate (% of Total Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	16%	17%	16%	27%	15%	25%
Upper	26%	9%	25%	27%	3%	23%

Total Savings (GJ/year)	Period One to 2015/16	Period Two to 2020/21	Total by 2020/2021
Economic Potential	1,765,270	147,495	1,912,765
Most Likely	316,628	24,256	340,884
Upper	462,400	10,003	472,404

Exhibit 18: Action Profile M3.2—Near Condensing Process Heat Boilers

Energy Efficiency Measure	**M3.2: Near Condensing Process Heat Boilers**					
Participant Definition	**New Efficient Process Heat Boilers**					
Service Area	**Lower Mainland**			**Interior and Vancouver Island**		
Major Technology and % of Economic Potential	Technology		% of Potential	Technology		% of Potential
	Near Condensing Boilers		100%	Near Condensing Boilers		100%
Approximate % of Action Savings by Service Area	84%			16%		
Economic Potential Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
	742,900	488,803	1,231,703	125,944	27,809	153,753
Approximate Total number of Participants in Period	237	156	393	40	9	49
Approximate Total Number of Participants Eliminated by Constraints (beyond DSM influence)	59	39	98	10	2	12
Economic Potential Available for DSM	557,175	366,602	923,777	94,458	20,857	115,314
Approximate Economic Potential Savings per Participant per Year (GJ/year)	3,132			3,132		
Approximate Benefit Cost Ratio (Marginal Supply Cost of Gas ~ $6/GJ)	3.7			3.2		
Approximate Customer Payback (Customer Cost of Gas ~ $9/GJ)	2 years			2 years		
Participation Rate (% of Available Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	50%	22%	-	50%	22%	-
Upper	60%	5%	-	60%	5%	-
Action Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	278,588	80,652	359,240	47,229	4,588	51,817
Upper	334,305	18,330	352,635	56,675	1,043	57,718
Participation Rate (% of Total Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	38%	17%	29%	38%	17%	34%
Upper	45%	4%	29%	45%	4%	38%

Total Savings, by Year (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Economic Potential	868,844	516,612	1,385,456
Most Likely	325,817	85,241	411,057
Upper	390,980	19,373	410,353

Exhibit 19: Action Profile M4 – Fully Insulated Process Heat Distribution Systems

Energy Efficiency Measure	**M4: Fully Insulated Process Heat Distribution Systems**					
Participant Definition	**A Manufacturing Facility with Incomplete Process Distribution System Insulation**					
Service Area	**Lower Mainland**			**Interior and Vancouver Island**		
Major Technology and % of Economic Potential	Technology		% of Potential	Technology		% of Potential
	Insulation		100%	Insulation		100%
Approximate % of Action Savings by Service Area	84%			16%		
Economic Potential Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
	240,922	4,413	245,335	46,858	1,450	48,308
Approximate Total number of Participants in Period	344	6	350	67	2	69
Approximate Total Number of Participants Eliminated by Constraints (beyond DSM influence)	310	6	315	60	2	62
Economic Potential Available for DSM	216,830	3,972	220,802	42,172	1,305	43,477
Approximate Economic Potential Savings per Participant per Year (GJ/year)	700			700		
Approximate Benefit Cost Ratio (Marginal Supply Cost of Gas = $6/GJ)	4.3			3.5		
Approximate Customer Payback (Customer Cost of Gas = $9/GJ)	2 years			2 years		
Participation Rate (% of Available Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	65%		64%	60%		50%
Upper	90%		88%	85%		75%
Action Savings (GJ/year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	141,725	250	141,974	25,303	-3,565	21,739
Upper	195,725	-1,324	194,401	35,846	-3,238	32,608
Participation Rate (% of Total Economic Potential)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
Most Likely	59%		58%	54%		45%
Upper	81%		79%	77%		68%
			Total Savings (GJ/Year)	**Period One to 2015/16**	**Period Two to 2020/21**	**Total by 2020/2021**
			Economic Potential	287,780	5,863	293,643
			Most Likely	167,028	-3,315	163,713
			Upper	231,571	-4,562	227,009