Enbridge Consumers Gas

1999 Action Plan Update

for submission to the

Climate Change Voluntary Challenge and Registry

September, 1999

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Letter of Commitment

On behalf of Enbridge Consumers Gas (Enbridge), I am pleased to present our 1999 Annual Update to the Voluntary Climate Change Challenge and Registry (VCR).

We remain committed to being a part of Canada's solution to climate change. Enbridge has been active in the VCR program since its inception, and this update is our fifth annual submission to the registry.

Enbridge has a proud tradition of commitment to environmental stewardship, and remains confident of meeting the challenge of climate change while providing for Canadians' energy needs. This commitment has resulted in recognition by the VCR Inc. at its 1998 Leadership Awards Ceremony for our continuing efforts in reducing greenhouse gas emissions.

We believe voluntary measures can be an important part of Canada's response to climate change and can achieve environmental objectives without harming Canada's economic position. Our company strongly supports the Climate Change Voluntary Challenge and Registry program.

The 1999 Update moves the company closer to realization of our aggressive emission reduction targets and goals, despite the pressures of significant growth in the Company's customer base and volume sales.

For the year 2000, Enbridge is committed to a target of a 25 per cent reduction of greenhouse gas emissions arising from company operations as compared to 1990 levels, both in absolute terms and on a "per unit of production" basis (natural gas volume sales). We will also develop post year 2000 targets for ourselves.

Enbridge is also committed to working with our customers towards a goal of reducing their greenhouse gas emissions.

This 1999 Update outlines the continuing initiatives Enbridge is undertaking or proposing. We will continue to reduce fugitive methane emissions from the operation of our distribution system; lower the energy used in our daily business activities, increase the practice of energy efficiency and conservation by the company's customers; introduce and promote emerging technologies in the marketplace; and encourage fuel-switching to natural gas from more polluting fuels.

At Enbridge, we are proud of our achievements to date and are confident of meeting tomorrow's challenges.

Rudy Riedl
President

ENBRIDGE
Consumers Gas

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1. Executive Summary

Enbridge Consumers Gas (Enbridge) believes that the increased use of natural gas can play an important role in meeting the climate change challenge. The company is pursuing its commitments to reduce greenhouse gas (GHG) emissions from both the company's operations and its customers. This report documents past and projected GHG emissions with and without emission reduction initiatives undertaken by Enbridge for the company and its customers. It is part of Enbridge's continued support and participation in the national Climate Change Voluntary Challenge and Registry (VCR) program and the National Climate Change Process.

Getting our House in Order

Enbridge has set an aggressive stretch target to emit less than 75% of its 1990 emissions in 2000. In this year's report, we've improved our inventory by including additional fugitive emissions from gate, district, header and feeder stations as well as customer meter sets. This improved inventory has added 75.93 thousand tonnes of carbon dioxide equivalent (kt CO_2e) to our 1990 emissions baseline (now estimated at 440.27 kt CO_2e). It has also forced us to recalculate our target. The revised target for 2000 is 330.20 kt CO_2e. In 1998, Enbridge emitted 355.09 kt CO_2e, a level 24.89 kt CO_2e above its target.

The company target of reducing GHG emissions to at least 75% of 1990 levels in 2000 was set in the 1996 Action Plan. Since that time, Enbridge has increased its baseline emissions by 85.8 kt CO_2e by adding emissions from new sources. Increasing the baseline emissions requires greater emission reductions to meet a target based on percentage. As shown in Figure 1, Enbridge is currently forecast to miss its revised target in 2000. Even with substantial emission reductions the company emissions in 2000 will only be 22% below 1990 levels. However, work on improving the accuracy of the determination of the additional GHG sources added in this update may result in meeting the 2000 target due to an overestimation of these sources. Regardless, they will be 32% below 1990 emissions by 2005.

Enbridge also has a target for GHG emissions per volume of sales gas (GHG intensity). This target provides a measure of efficiency. The target for GHG intensity in 2000 was set at 75% below 1990 levels. Even with the additional emissions included

Figure 1: Past and Projected Company Emissions

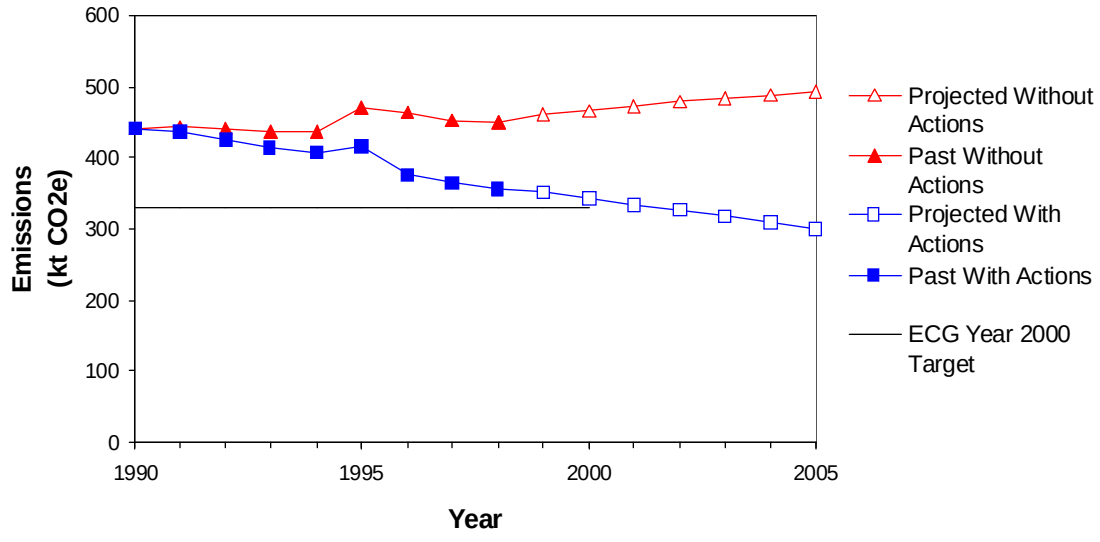
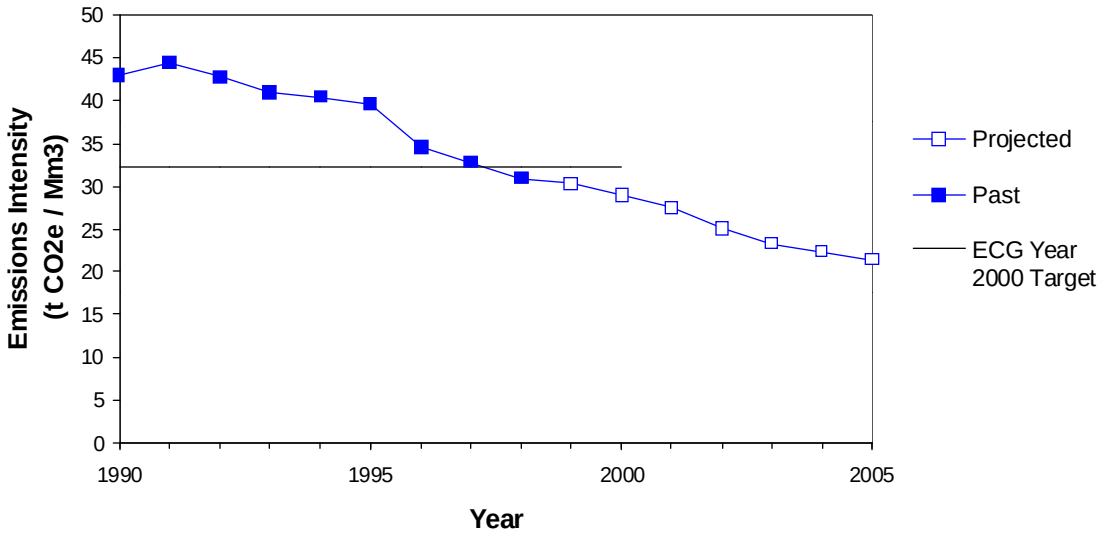


Figure 2: Past and Projected Company Emission Intensity



in the base year inventory, Enbridge has already surpassed its emission intensity target of 32.14 t CO_2e / Mm^3.

In 1990, GHG intensity was 42.85 t CO_2e / Mm^3. By 1998, this had been reduced to 30.80 t CO_2e / Mm^3. In 2000, Enbridge is projected to have an emission intensity that is 68% of the 1990 baseline level. Figure 2 displays past and projected company emission intensity.

The reduction in the company's GHG emissions has been accomplished through implementation of aggressive programs to reduce fugitive methane emissions from the distribution system. The largest reduction in emissions has come as a result of the company's program to replace old cast iron pipe with newer corrosion-free polyethylene pipe. Other reductions in fugitive emissions have come from:

- switching older pneumatic instruments with low-bleed units;
- reducing natural gas volumes purged during construction and maintenance activities; and
- reducing venting at the Tecumseh Gas Storage Facility by installing a flaring system.

Enbridge also reduced emissions from its operations by making its facilities more energy efficient and increasing the consumption of natural gas in place of gasoline in the company's vehicle fleet.

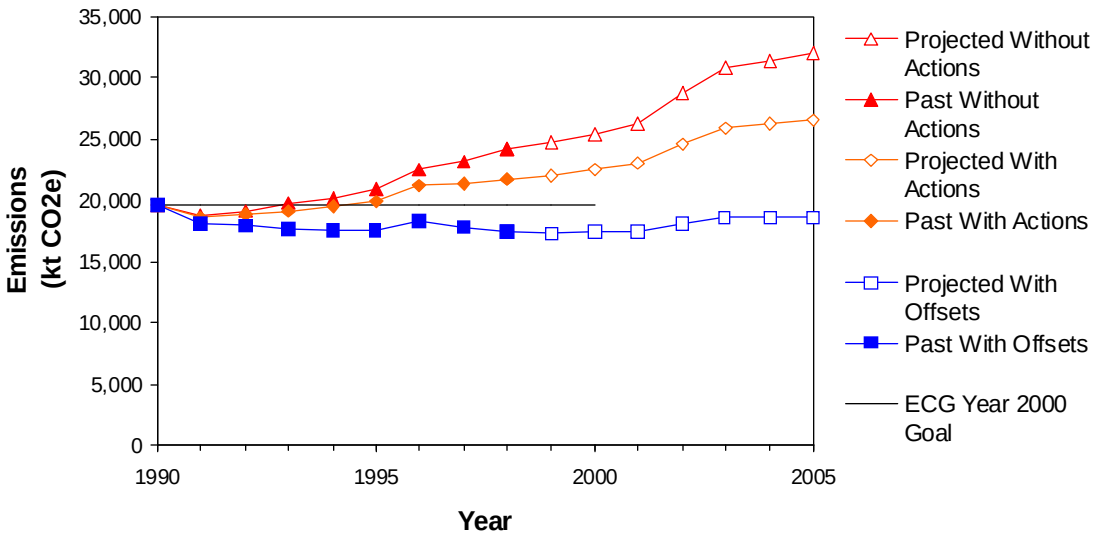
In 1998, Enbridge estimates that actions undertaken by the company reduced emissions by 93.15 kt CO_2e in that year alone. Since 1990, the cumulative GHG emission reductions total 394.75 kt CO_2e (equivalent to the annual emissions from 8,100 cars).

Enbridge Consumers Gas will establish new targets for the 2000 to 2005 period as part of the company-wide GHG management strategy under development by the Enbridge Inc. group of companies. These new targets will be published in next year's VCR Update.

Helping Our Customers Contribute to Canada's Greenhouse Gas Emission Goal

Enbridge also has goals to reduce the GHG emissions and the emission intensity of its customers. The company is working to stabilize customer net GHG emissions at the 1990 level and improve its aggregated customers' emission intensity to a level 12% below their 1990 value.

Figure 3: Past and Projected Customer Emissions



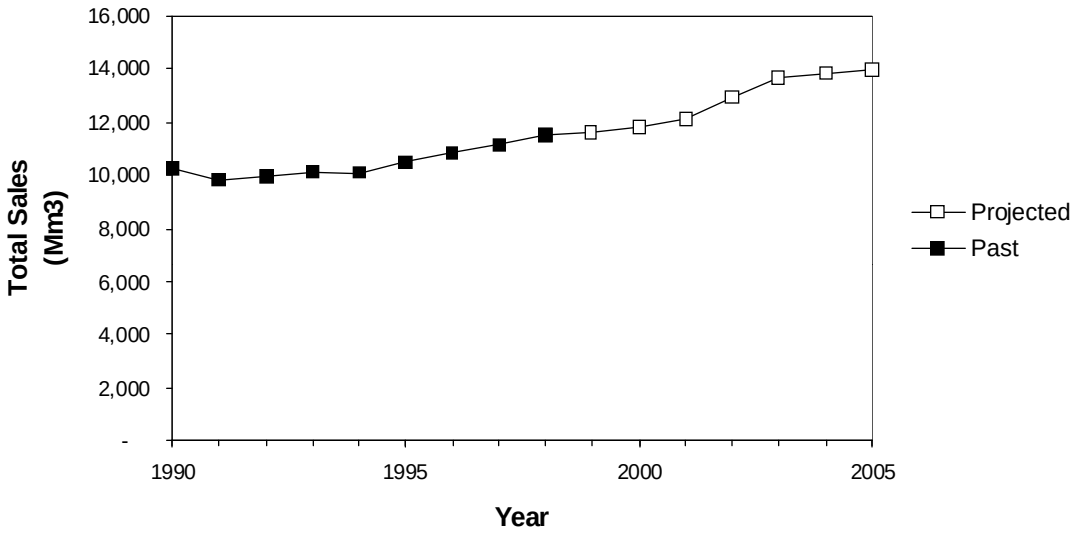
In 1998, Enbridge's customers emitted 21,766 kt CO_2e in total GHG emissions. However, after accounting for the GHG emissions "saved" by the switching from other more GHG intense fuels, the customers' net emissions were 17,430 kt CO_2e . (Note: the emission reductions for the more GHG intense fuels may have also been recorded to the VCR Inc. as a decrease in emissions by the electrical utilities and oil companies). This is well below the customers' 1990 emissions of 19,685 kt CO_2e (Figure 3). The customers' GHG emission intensity is also more than 12% below the 1990 baseline level.

Without initiatives undertaken by the company, the customers would have emitted 24,164 kt CO_2e in 1999. This includes an estimated 27% increase in emissions that would have been emitted from the use of more GHG intense fuels had the additional customers not switched to natural gas.

Both customer goals have been achieved by improving customer efficiency and reducing consumption via Demand-side Management (DSM) programs. Enbridge also sponsors a natural gas vehicle conversion program thus reducing consumption of gasoline while increasing consumption of natural gas. As well, every time the company helps a customer switch to natural gas from light oil or electricity generated by more GHG intensive fuels, emissions are saved. Finally, the company is involved with cogeneration projects. Cogeneration is a natural gas-fired industrial process that simultaneously produces heat and electricity in plants and factories. This electrical energy is additional to the thermal energy that would have been produced in the absence of the cogeneration project. Cogeneration projects allow the company to expand its market base while displacing some GHG emissions from the generation of electricity.

In 1998, Enbridge estimates that all its programs saved 2,198 kt CO_2e in emissions by its customers. The significance of this achievement is enhanced by the company's expanding natural gas sales (Figure 4).

Figure 4: Natural Gas Sales



2. Organization Profile

Enbridge Consumers Gas is the natural gas distribution business unit of the Enbridge Inc. group of companies. As Canada's largest natural gas distributing utility, Enbridge Consumers Gas serves some 1.4 million residential, commercial and industrial customers in Ontario. In 1990, Enbridge (then known as The Consumers' Gas Company Ltd.) sold 10,274 Mm^3 of natural gas to just over one million customers. By 1998, sales of natural gas had grown by 12% to 11,528 Mm^3 (Figure 4).

The Company owns and operates the Tecumseh Gas Storage Facility, which includes underground gas storage and transmission facilities south of Sarnia. The company was also engaged in the rental and sale of appliances during the period covered by this update. The head office of Enbridge Consumers Gas (Enbridge) is located in Metropolitan Toronto, with regional offices in Ottawa, Whitby, Richmond Hill, Mississauga and Thorold.

The utility business of Enbridge is conducted under statutes and municipal by-laws that grant the right, generally on a non-exclusive basis, to operate in the areas served. The Ontario Energy Board, the company's principal regulator, regulates the storage, transmission, distribution, sale and supply of natural gas in Ontario.

During 1998, Enbridge initiated major restructuring in response to the continuing deregulation and unbundling of the energy sector. Whereas in the past the distribution and retail services of natural gas were integrated within the one company, they will be separated effective October 1st 1999 between Enbridge Consumers Gas, a core distribution utility and Enbridge Services, an energy services company. In this year's VCR Update, the results reflect the activities of Enbridge Consumers Gas as it was structured in 1998. Future reporting after unbundling will only include the core utility activities.

3. Senior Management Support

3.1 Management Commitment

The senior management team at Enbridge has established several initiatives to ensure that the company continues to build upon its solid record of GHG emission reductions. These include:

- a commitment to identify and implement cost effective GHG emission reduction initiatives across the company;
- establishment of a target to reduce greenhouse gas emissions from its own operations by 25 per cent by the year 2000 relative to 1990 levels as measured on both an absolute basis and on a per unit of production (volume sales) basis;
- establishment of a customer based goal to work with the company's customers to stabilize their greenhouse gases emitted at 1990 levels by the year 2000 on an absolute basis, and to reduce customers' emissions per volume sales by 12 per cent below 1990 levels by expanding the customers' utilization of a range of company programs; and
- a commitment to publicly report on the company's greenhouse emissions through participation in the Voluntary Challenge and Registry (VCR) program on an annual basis.

3.2 Internal Practices and Management Systems

Enbridge completes an annual inventory of its GHG emissions associated with the operation of the natural gas distribution system. The report is circulated to senior management for review and forms the basis for the VCR Updates.

Enbridge also continuously monitors its demand side management programs so that the results can be reported to its regulators. This information is integrated into the company's submissions to the VCR.

Enbridge's progress on climate change initiatives is regularly reported to the Environment, Health and Safety Committee of the company's Board of Directors.

Representatives from the company are members of the VCR Inc.'s Technical Advisory Committee, and are members on the national Issues Tables on Credit for Early Action, and Enhanced Voluntary Action.

Over the last five years, the company has improved its reporting procedures each year by adding emissions from new sources and being as transparent and complete as possible. As new methodologies for calculating GHG emissions become available, they are reviewed for their applicability to Enbridge.

Enbridge is in the process of establishing an Enbridge Inc. Climate Change Task Force mandated to co-ordinate GHG emission reduction initiatives and offsets acquisitions across the entire Enbridge Inc. group of companies.

Emission reduction projects are evaluated for their ability to produce real, measurable and verifiable reductions. Projects passing these criteria are being submitted to the Pilot Emission Reduction Trading (PERT) program for review and posting.

4. Base Year Quantification

Enbridge Consumers Gas has chosen 1990 as its base year.

4.1 Methodology

There are five types of GHG emissions calculated.

4.1.1 Combustion Emissions

Except where noted, all estimates of greenhouse gas emissions arising from combustion are made by multiplying actual consumption of fuels by the appropriate constant listed in Appendix V. Exceptions occur where actual data were not available or another more appropriate method was applied.

Actual data from the compressors at the Tecumseh Gas Storage Facility (TGSF) are not available for the 1990. Natural gas volumes consumed by the TGSF compressors are extrapolated from a linear relationship between compressor use and sales volumes.

Total electricity use in the company's buildings is also not available for 1990. This electricity consumption was calculated by multiplying the known electricity consumption per floor area in a few buildings by the total floor area operated by the company. This value is then converted to CO_2e emissions using Ontario's net emission intensity for 1990 (Appendix V). Finally, the relative proportions of CO_2, CH_4 and N_2O are estimated assuming the same relative proportions as for coal-fired generating stations.

4.1.2 Vented Emissions

The actual volume vented from the Tecumseh Gas Storage Facility (TGSF) is also not available for 1990. As a result, the methane volumes vented in 1990 were estimated as the average for the period 1991 to 1994.

Accidental releases (third party damages) are estimated based on studies by Enbridge's engineering department.

4.1.3 Fugitive Emissions

In the company's emissions inventory, fugitive emissions from equipment and pipelines were calculated using emission factors published by Gas Technology Canada[1]. These calculations are based upon the company's catalogue of metering and regulation stations designs used within the distribution system, and the lengths and materials of pipe existing in the distribution system.

4.1.4 Gas Supply Related Emissions

In the Customer Emissions Inventory, as reported last year, consumption has been normalized to remove the variations due to weather fluctuations and to allow for a more accurate comparison between years. For completeness, actual customer emissions without normalization are given in Appendix I.

Emissions occur when natural gas vehicles (NGV) burn natural gas. It was assumed that these emissions would not have occurred without Enbridge's actions to promote this natural gas. Instead, emissions would have occurred from an energy equivalent volume of gasoline. In general, these emissions are included in the calculation of customers' emissions that would have occurred "without Enbridge actions". For 1990, though, NGV is not considered an action.

Cogeneration is an industrial process that simultaneously produces heat and electricity in plants and factories. Overall, cogeneration projects have energy efficiencies that range from 60% to 80%. It is assumed that electrical energy is generated by gas fired cogeneration projects at an average of 3.3 kWh / m^3 of natural gas (~ 32% efficiency). This electrical energy is additional to the thermal energy that would have been produced in the absence of the cogeneration project. The generation of this electricity by another source would create GHG emissions. For 1990, cogeneration is not considered an action.

[1] Gas Technology Canada (1998), Handbook for Estimating Methane Emissions from Canadian Natural Gas Systems.

Curtailment emissions occur when the company limits the supply of natural gas to a customer. This is a normal operating procedure used to balance demand for the company's natural gas requirements and supply. The effected customers are subject to curtailment based upon the nature of their gas supply contracts. It is assumed that when curtailment occurs the customer uses light fuel oil to replace the non-delivered natural gas.

In 1991, Enbridge added 16,189 new customers that switched to natural gas for heat from light oil or electricity. The emissions from the additional gas sales are part of the customers' GHG inventory resulting from Enbridge actions.

The emissions that would have occurred had these customers not switched to natural gas are included in customers' GHG inventory without any Enbridge actions. These have been calculated by estimating the volume of natural gas consumed by the new customers (average consumption). This volume is converted to the equivalent light oil or electricity consumption assuming 67% of the new customers previously used light oil as their fuel source and that natural gas and oil furnace efficiencies were 80% and 60% respectively. For the remaining customers, electric baseboard heat has a 95% efficiency[1]. The effect of furnace efficiencies was not included in last year's VCR Update. For 1990, fuel switching is not considered an action.

4.1.5 Displacement Emissions

Finally, specific marketing and sales actions by the company create offsets. These are calculated as the GHG emissions that would have occurred if the other more GHG intensive fuels had not been replaced by natural gas. These are generated by three actions: gasoline displaced by natural gas in NGVs, light oil and electricity displaced by natural gas consumed by new customers (fuel switching), and electricity generated by the electrical utilities that is displaced when electricity is generated by natural gas-fuelled cogeneration projects.

There are no displacement emissions, since natural gas volumes consumed by NGVs, fuel switching and cogeneration are not considered actions for 1990.

[1] Natural Resources Canada, Canada Mortgage and Housing Corporation (1995), A guide to residential wood heating. Cat. No. M92-23/1993Erev. 41 pp.

Table 1: 1990 Company Emissions

Source	Volume	Units	kilo tonnes (kt) CO2	CH4	N2O	CO2e	Previous Value
Heat	6.813	Mm3	12.81	0.0003	0.0001	**12.86**	12.86
Fleet (gasoline)	2.746	ML	6.48	0.0007	0.0006	**6.67**	6.88
Fleet (natural gas)	1.710	Mm3	3.21	0.038	0.0001	**4.04**	4.10
Fugitive Equipment Emissions	3.984	Mm3		2.860		**60.07**	8.36
Fugitive Pipeline Emissions	19.074	Mm3		13.69		**287.59**	263.44
Process Venting	1.336	Mm3		0.959		**20.14**	20.22
Third Party Damages	0.594	Mm3		0.426		**8.95**	8.79
Other	0.007	Mm3		0.005		**0.10**	0.09
Venting - TGSF	*0.183*	Mm3		*0.131*		***2.76***	2.76
Flaring - TGSF	0.000	Mm3	0.00	0.0000	0.0000	**0.00**	0.00
Compressors - TGSF	*13.484*	Mm3	*25.35*	*0.0006*	*0.0003*	***25.45***	25.44
Total - Direct			**47.85**	**18.12**	**0.0011**	**428.63**	**352.95**
Electricity	*41.58*	GWh	*11.57*	*0.0001*	*0.0002*	*11.64*	11.40
Total - Indirect			**11.57**	**0.0001**	**0.0002**	**11.64**	**11.40**
Grand Total			**59.42**	**18.12**	**0.0013**	**440.27**	**364.34**
Tree Planting	0	trees	0.00			0.00	0.00
Net Emissions			**59.42**	**18.12**	**0.0013**	**440.27**	**364.34**
Emission Intensity (t CO2e / Mm3)						**42.85**	**35.46**

Italicized values are estimated or extrapolated. Numbers may not add up exactly due to rounding-off

4.2 Quantification

4.2.1 Company Emissions

Enbridge's volumes of GHG emissions from both direct and indirect sources are listed in Table 1. This year, Enbridge estimates its total 1990 emissions are 440.27 kt CO_2e. Last year's estimates are also listed for comparison purposes (labelled as previous values).

An explanation of the increase in the calculated 1990 baseline follows.

There has been a small change in Fleet emissions due to the adoption of the VCR's emission constants for gasoline and natural gas vehicles.

Fugitive emissions from equipment, pipelines, process venting and accidental releases are substantially higher than previously reported. This is due to the introduction of a more thorough methodology for equipment emissions. It now includes emissions from gate, district, header and feeder stations as well as customer meter sets. Fugitive pipeline emissions are calculated from the company's records of installed lengths of nine different pipe materials.

Process venting includes more accurate calculations of emissions from instruments, pumps and purging. These were reported as separate sources last year.

There is a slight change in GHG emissions from TGSF compressors. Actual volumes consumed by the compressors in 1990 are not available but are extrapolated from a linear relationship to sales volumes using data from 1992 to 1996.

4.2.2 Customer Emissions

Last year, GHG emissions from Enbridge's customers were reported from adjusted sales. They were defined as actual volumes plus volumes saved through Demand Side Management (DSM) programs and volumes not sold because of curtailment. The net additional emissions because of curtailment (presuming oil replacement) were added. Finally, emissions from fuels saved as a result of company actions were treated as offsets and subtracted from the gross emissions.

This year, in an effort to be more transparent, 1990 GHG emissions from each customer source are identified. They are based on the actual consumption after DSM programs. Emissions from curtailment are now reported solely as the energy equivalent volume of light oil consumed in place of the curtailed volumes of natural gas.

In 1990, Enbridge's customers' GHG emissions were 19,685 kt CO_2e (Table 2). These include emissions from natural gas vehicles (NGVs), cogeneration projects and curtailment. For refer-

Table 2: 1990 Customer Emissions

Source	Volume	Units	kilo tonnes (kt) CO2	CH4	N2O	CO2e	Previous Value
Residential	3,382	Mm3	6,359	0.145	0.0676	**6,383**	6,383
Apartment	1,079	Mm3	2,028	0.046	0.0216	**2,035**	2,035
Commercial	2,868	Mm3	5,392	0.123	0.0574	**5,413**	5,412
Industrial	2,938	Mm3	5,524	0.141	0.0588	**5,545**	5,544
NGV	7	Mm3	12	0.143	0.0004	**15**	12
Cogeneration	1	Mm3	1	0.0000	0.0000	**1**	1
Curtailment	107	Mm3	293	0.0006	0.0013	**293**	306
Emissions with Actions			**19,608**	**0.600**	**0.2071**	**19,685**	**19,699**
NGV (gasoline saved)		ML					-17
Fuel Switching (oil saved)		ML					-303
Fuel Switching (electricity saved)		GWh					
Cogeneration (electricity saved)		GWh					-1
Emissions with Offsets			**19,608**	**0.600**	**0.2071**	**19,685**	**19,377**
Emission Intensity (kt CO2e / Mm3)						**1.916**	**1.886**

Note: Demand Side Management does not appear as a specific offset because the decreased volumes are already included in the emissions with actions.

ence, last year's reported emissions are listed. Differences in emissions from Industrial and NGV customers are caused by the adoption of the emission constants in the Registration Guide (see Appendix V).

As discussed above, curtailment emissions listed in last year's VCR Update did not include additional emissions due to curtailment. The values shown this year are the emissions due to an energy equivalent amount of light fuel oil. There is a slight decrease over last year because of the adoption of the emission constants in the Registration Guide.

NGVs, cogeneration and new customers that switch from oil or electricity to natural gas create offsets by saving emissions from the displaced fuel. Last year they were considered part of the 1990 baseline emissions. This year, so as to consolidate and simplify its 1990 baseline, Enbridge considers that these actions would have occurred. The offsets caused by these actions are not considered in the 1990 baseline.

5. Target Setting

5.1 Targets

Based on the data that it had in 1995, Enbridge set targets for the company's emissions and emission intensity in 2000. As well, Enbridge stated goals – less firm than targets as they involve parties and actions outside the company's direct control – for customer emissions and emission intensity in 2000.

Every year since then, Enbridge has needed to update all targets and goals due to continuous improvements in reporting procedures and methodologies. Generally, these revisions have been small. The 1999 Update is unusual in that this year the revision includes a large previously unrecorded emission source (fugitive equipment emissions). This new source adds 51.71 kt CO_2e to the company baseline. As well, changes in calculation methodology for fugitive emissions from pipelines have added a further 24.15 kt CO_2e. When combined these new sources have increased the company's baseline emissions by 21%.

The company emission target of 273.26 kt CO_2e, documented in 1998, represented a 25% reduction from the 1990 baseline as it was calculated in 1998. This target resulted an absolute reduction of 91.08 kt CO_2e. In this year's inventory (1999), new sources have added 75.93 kt CO_2e to the 1990 baseline. The new company emissions target is the same 25% reduction, or 330.20 kt CO_2eThis translates to an absolute reduction of 110.07 kt CO_2e. The impact of the new emissions added to the 1990 baseline is that the company's 25% reduction target will be much more difficult to achieve. The updated emission intensity target is 32.14 t CO_2e / Mm^3 .

The company also has a goal to work towards stabilizing customer emissions at the 1990 level after offsets and to reduce customer emission intensity by 12%. These goals have been updated to reflect changes in the customer inventory that resulted from differences the calculation used. The revised targets and goals are listed in Table 3.

Table 3: Targets and Goals

	Old Target or Goal	Revised Target or Goal
Company Emissions Target	273.26 kt CO_2e (75% of former 1990 value)	330.20 kt CO_2e (75% of revised 1990 value)
Company Intensity Target	26.60 t CO_2e / Mm^3 (75% of former 1990 value)	32.14 t CO_2e / Mm^3 (75% of revised 1990 value)
Customer Emissions Goal	19,377 kt CO_2e (former 1990 level)	19,685 kt CO_2e (revised 1990 level)
Customer Intensity Goal	1.660 kt CO_2e / Mm^3 (88% of former 1990 value)	1.686 kt CO_2e / Mm^3 (88% of revised 1990 value)

5.2 Process for Target Review and Update

Next year, Enbridge will continue to monitor its progress towards its 2000 targets and identify potential areas for further improvement. The 2001 Update will report on the company's success in meeting in targets for 2000.

The company will reassess its ability to meet its 2000 customer goals given the unbundling of the company (scheduled for October 1st 1999). The transfer of energy retail and services to Enbridge Services will have an impact on the core utility's ability to meet its customer goals. As a result, Enbridge Consumers Gas may eliminate this goal in the post unbundling environment.

The company will also take steps to establish new goals and targets for the period 2000 to 2005. As part of the establishment of new post 2000 targets and goals, the company will take steps to ensure that they are coordinated with those of other key business units of the Enbridge group of companies. This will occur as part of the parent company's formalization of a Enbridge Inc. wide GHG management strategy during 2000. This strategy will include the use of offsets and market instruments to help all companies within the Enbridge Inc. group of companies set and reach emission targets in accordance with Canada's climate change commitments.

6. Measures to Achieve Targets

6.1 List of Key Activities/Projects

6.1.1 Activities/Projects to Reduce Company Emissions

Enbridge has six activities that specifically reduce emissions from company operations. In 1998, they accounted for a 93.15 kt CO_2e reduction. In this section, a description of each activity is described. The methodology used to calculate emissions WITH and WITHOUT Enbridge actions is described in detail in section 7.1.

Heat

Enbridge has installed energy management systems in many facilities and buildings. These systems automatically control the heating, ventilation and cooling of a building based on its occupancy loading.

Other energy saving initiatives at the company's facilities include: Night Setback Thermostats on air conditioning systems; measures to reduce heat losses; increasing maintenance on heating systems and reducing hot water temperatures.

Since 1990, through its actions, Enbridge has reduced its average annual energy consumption per unit area from 70.8 to 51.5 m^3 of natural gas per m^2 of floor space.

		Emissions (kt CO2e)			Intensity
	Year	Without Actions	With Actions	Savings	(t CO2e / Mm3)
Baseline	1990	12.86			1.25
Results	predicted 1998	*13.06*	8.33	*4.73*	0.79
	actual 1998	15.60	13.25	2.35	1.25
Forecast	1999	15.60	11.35	4.25	0.98
	2000	15.91	11.58	4.34	0.98
	2005	17.02	12.38	4.64	0.88
	2010	18.20	13.25	4.96	0.89

Values in italics were not published in last year's Action Plan

Note: last year's estimate of natural gas consumption in 1999 for heat was significantly lower than the actual consumption. It did not adequately account for the growth in the building area operated by Enbridge. Also, the annual energy consumption per unit area was mistakenly quoted as 3.78 m^3 per m^2 of floor space. It was actually 3.78 m^3 per ft^2.

Company Vehicle Fleet

In 1998, compressed natural gas was 57.1% of Enbridge's gasoline equivalent total fleet consumption. This is up from 40.1% in 1990. Approximately 90% of the company's fleet can use natural gas or gasoline and the company encourages vehicle operators to use the former wherever possible.

Enbridge has another initiative designed to reduce gasoline use and increase natural gas consumption. In 1996, under a new policy, operators were allowed to drive their company vehicles home. While this increased company fuel consumption by approximately 558,000 L of gasoline and gasoline equivalent natural gas, it reduced the operators' personal consumption of gasoline. Since over 50% of the company's increased volume is compressed natural gas rather than gasoline there is an estimated saving of 74 t CO_2e per year.

		Emissions (kt CO2e)			Intensity
	Year	Without Actions	With Actions	Savings	(t CO2e / Mm3)
Baseline	1990	10.71			1.04
Results	predicted 1998	*16.29*	13.80	*2.49*	1.30
	actual 1998	13.79	13.50	0.29	1.28
Forecast	1999	14.23	14.09	0.14	1.21
	2000	14.52	14.19	0.33	1.20
	2005	15.60	15.19	0.41	1.08
	2010	16.58	16.10	0.49	1.08

Values in italics were not published in last year's Action Plan

Note: last year the estimated increase in fuel as a result of the new policy was 596,000 L. The estimated savings were erroneously reported as 1.5 kt CO_2e. These are the emissions from this amount of fuel if it was all gasoline and does not take into account emissions from the increase in natural gas consumption. The savings should have been documented as 79 t CO_2e per year. They arise from crew being able to drive directly to their first work assignment in the day.

Fugitive Pipeline Emissions

Fugitive pipeline emissions (FPEs) accounted for 66% of Enbridge's total company emissions in 1990. They include emissions from underground valves and fittings and emissions through the pipe wall itself due to deterioration, corrosion and defects.

Although FPEs are a large source of emissions for Enbridge, they represent 0.1% of sales gas volumes. It is estimated that the older cast iron pipes within the company's system were the source of 39% of the company's total GHG emissions in 1998.

Since 1990, Enbridge has spent approximately $ 200 million to replace ageing cast iron pipes with corrosion-free polyethylene pipes. In 1998, over 85 kilometres were replaced. In 1998, the company's ongoing program saved 278.43 kt CO_2e.

		Emissions (kt CO2e)			Intensity
	Year	Without Actions	With Actions	Savings	(t CO2e / Mm3)
Baseline	1990	287.59			27.99
Results	predicted 1998	*263.44*	169.43	*94.01*	16.00
	actual 1998	278.43	208.33	70.10	19.68
Forecast	1999	280.22	196.36	83.85	16.88
	2000	282.00	184.40	97.60	15.57
	2005	290.76	124.58	166.18	8.89
	2010	299.30	64.75	234.55	4.35

Values in italics were not published in last year's Action Plan

Note: Though the 1998 predicted savings are similar to the actual savings the emissions with actions are significantly larger than expected. This is a result of improved methodology for estimating FPEs.

Process Venting

This new category combines sources documented separately in earlier VCR reports. Process venting includes fugitive emissions from purging lines into and out of service, odourant injection pumps and pneumatic instruments. They have been grouped this year due to their relatively small individual contributions to total GHG emissions and the similar venting nature of these processes.

Purging occurs when new lines are added or older lines are replaced or repaired. Since 1990, Enbridge has been reducing emissions from purging lines out of service by bleeding the natural gas into adjacent lines prior to purging. The company investigated other techniques such as flaring and compressing gas in lines to be purged. Both methods are not cost effective for small volumes of purged gas.

An odourant is added to natural gas for safety reasons at 38 gate stations within the system. There are four types of odourant injection systems in use. The oldest and predominant system (at 32 gate stations) is the odourant pump. It releases a small amount of natural gas each time a "stroke" to inject odourant is made. Enbridge is replacing them with newer systems (by-pass, air driven or pulsafeeder). These systems are emission-free.

Pneumatic instruments located in gate stations regulate the flow and pressure of natural gas throughout the distribution system. Older instruments are driven by the pressure within the system and release gas during normal operations. Since 1990, Enbridge has spent $220,000 to replace older high bleed equipment with new low or no-bleed instruments. In 1990, the company had 271 instruments within the system of which 259 were high bleed models. In 1998, as a result of the company's program, there were only 170 instruments of which 71 were high bleed models.

		Emissions (kt CO2e)			Intensity
	Year	Without Actions	With Actions	Savings	(t CO2e / Mm3)
Baseline	1990	20.14			1.96
Results	predicted 1998	*20.30*	3.68	*16.62*	0.35
	actual 1998	19.50	3.47	16.03	0.33
Forecast	1999	19.63	3.45	16.18	0.30
	2000	19.75	3.43	16.33	0.29
	2005	20.37	3.32	17.05	0.24
	2010	20.96	3.21	17.75	0.22

Values in italics were not published in last year's Action Plan

Venting and Flaring at the Tecumseh Gas Storage Facility

Methane emissions from the Tecumseh Gas Storage Facility (TGSF) are emitted from storage wells, compressors, plant piping and meters. They result from regular operations, maintenance and construction of storage wells, and occasionally as accidental releases.

In 1995, a flaring system was added to the TGSF to reduce methane emissions since vented methane has a higher global warming potential than an equal volume of flared methane. The flare system increases emissions from flaring but reduces emissions from venting. In other tables each source is a line item. In the table below, emissions from both sources are combined to emphasize the emission reductions from the combined actions.

Improved well maintenance will also reduce volumes vented. In late 1998, the company initiated a new program to repair and service storage wells. Four well repairs were completed in early 1999. The remaining wells will be serviced in 1999/2000.

		Emissions (kt CO2e)			Intensity
	Year	Without Actions	With Actions	Savings	(t CO2e / Mm3)
Baseline	1990	2.76			0.27
Results	predicted 1998	*5.48*	3.31	*2.17*	0.31
	actual 1998	6.94	3.49	3.45	0.33
Forecast	1999	5.80	3.32	2.48	0.29
	2000	5.80	3.32	2.48	0.28
	2005	5.80	3.32	2.48	0.24
	2010	5.80	3.32	2.48	0.22

Values in italics were not published in last year's Action Plan

Note: Venting and flaring at the TGSF are combined in this section so that net emission reductions can be shown. They are recorded as separate sources in the company inventories.

Electricity

Since 1991, Enbridge has been retrofitting the lighting and electrical systems in its buildings and stores. In December 1998, three offices (Ottawa, Mississauga and Thorold) were added to the retrofit list and, in 1999, three more facilities will be upgraded to the most energy efficient and environment friendly office lighting available (EXO XP lamps – long life low mercury).

Enbridge will continue to review and improve its lighting efficiency in the future. Since 1990, electrical consumption per unit area has dropped from 434 to 290 kWh / m^2 of floor space.

		Emissions (kt CO2e)			Intensity
	Year	Without Actions	With Actions	Savings	(t CO2e / Mm3)
Baseline	1990	11.64			1.13
Results	predicted 1998	*7.98*	7.00	*0.98*	0.66
	actual 1998	13.27	10.74	0.90	1.01
Forecast	1999	11.99	9.03	0.94	0.78
	2000	12.18	9.18	0.89	0.78
	2005	12.98	9.82	0.91	0.70
	2010	14.61	11.38	0.98	0.76

Reported savings do not include savings attributable to the electrical utility

Note: Total electrical savings are estimated on a per area basis from buildings where records exist. Buildings that have been retrofitted, but which do not have records to substantiate savings are not included. Electrical savings are converted to emission reductions using the provincial net electrical emission intensity. Emissions without actions are calculated using the provincial gross electrical emissions intensity. For these reasons, emissions with actions plus savings do not equal emissions without actions due to reductions attributable to the electrical utilities.

6.1.2 Other Initiatives

There are other activities with GHG benefits that are difficult to estimate accurately. These include the compressor upgrades at the TGSF, station upgrades that reduce fugitive equipment emissions and reductions in third party damages resulting in accidental releases through the “One Call” system.

Compressors at the Tecumseh Gas Storage Facility

At the TGSF, three compressors were replaced with "lean-burn" models that reduce the emission of oxides of nitrogen (NO_x) and volatile organic compounds (VOCs). This program has other significant environmental benefits since both NO_x and VOC are smog precursor gases. Even though the emission intensity of the TGSF compressors has decreased since 1990, it is difficult to estimate whether this is a direct result of the program. This program is under review due to engine mechanical concerns with the new compressors.

	Year	Emissions (kt CO2e) With Actions	Intensity (t CO2e / Mm3)
Baseline	1990	25.45	2.48
Results	predicted 1998	26.53	2.58
	actual 1998	17.62	1.72
Forecast	1999	28.36	2.76
	2000	28.99	2.82
	2005	35.71	3.48
	2010	38.44	3.74

Third Party Damages

Enbridge implemented the "One Call" system in 1996 to reduce accidental releases of methane caused by other parties. Even with this program, emissions from and emission intensity of accidental releases have increased over time. This increase indicates that an improved economic activity in southern Ontario influences the potential for accidental releases. Emission reductions are hard to quantify on a year by year basis.

	Year	Emissions (kt CO2e) With Actions	Intensity (t CO2e / Mm3)
Baseline	1990	8.95	0.87
Results	predicted 1998	7.71	0.75
	actual 1998	9.50	0.92
Forecast	1999	9.31	0.91
	2000	9.12	0.89
	2005	8.25	0.80
	2010	7.45	0.73

Fugitive Equipment Emissions

Fugitive emissions from equipment are a new source that the company is beginning to monitor. Future investigations will be undertaken to identify potential emission reduction initiatives.

Currently, Enbridge is using industry averages to calculate GHG emissions from gate, district, header and feeder stations as well as customer meter sets. The company believes that because of superior engineering and design, its actual installed distribution equipment produces less fugitive emissions that the industry average. To verify this, the company is planning to further study fugitive emissions from its distribution equipment. By doing this study, Enbridge will quantify its fugitive equipment emissions more precisely and incorporate practices that reduce these emissions in the future.

	Year	Emissions (kt CO2e) With Actions	Intensity (t CO2e / Mm3)
Baseline	1990	60.07	5.85
Results	predicted 1998	9.75	0.95
	actual 1998	75.12	7.31
Forecast	1999	76.79	7.47
	2000	78.46	7.64
	2005	86.91	8.46
	2010	95.51	9.30

Note: Last year, regulation stations were a source of fugitive emissions. They are a small component of the total fugitive equipment emissions.

6.1.3 Activities/Projects to Reduce Customer Emissions

Enbridge has four sets of utility programs that help its customers reduce their emissions. These activities successfully reduced customer emissions by 2,198 kt CO_2e (9% of those emissions that would have resulted without company actions) in 1998. In this section, a description of each activity is presented. The methods used to calculate emissions WITH and WITHOUT actions are described in detail in section 7.1.

Demand-Side Management (DSM)

Enbridge has an aggressive program to reduce residential, commercial and industrial consumption. These DSM initiatives are changing in response to the restructuring of the Ontario energy industry and the separation of Enbridge's utility and competitive functions. As part of these changes the long list of discrete DSM programs reported last year is being replaced with a portfolio program that focuses on key market segments. This approach identifies seven target sectors: New homes, Existing homes, New buildings, Commercial sector, Multi-residential sector, Industrial sector and Agricultural sector. The latter is new for 1999.

In Enbridge's service area, approximately 22,000 new homes, 1,500 commercial buildings and 30 new multi-residential buildings are expected to be constructed per year until 2005.

The New Homes DSM initiative has a goal to improve the space and water heating efficiency in new homes and buildings and encourage the adoption of high efficiency gas appliances. This will be accomplished in conjunction with the Canadian Energy Efficiency Alliance (CEEA) by:

1. encouraging the development and implementation of R2000 building standards;
2. training the sales staff of participating builders on the benefits of energy efficient homes and appliances;
3. giving incentives to purchase energy efficient gas water heaters (residential) and high efficiency boilers (commercial and multi-residential); and
4. offering EcoLogo labelled gas appliances to new homebuyers.

Enbridge is also piloting a new "Comfort Guarantee Program" that uses building plan reviews, and air tightness testing to guarantee heating costs. Finally, the company is researching market opportunities for Low E windows.

Existing homes comprised 1.2 million residential customers in 1998. Of these, Enbridge estimates 20% have high efficiency and another 15% have mid efficiency furnaces. Working with the Green Communities Association, the DSM program will continue reducing customer consumption by focusing on improving thermal envelope efficiency, installing programmable thermostats, high efficiency furnaces and low-flow showerheads and setting back water heater thermostats during service visits.

It is expected that the market for low-flow showerheads and setting back water heater thermostats will be saturated within a few years. However, the program will continue:

1. encouraging the installation of high efficiency furnaces through retail partners;
2. providing programmable thermostats with high efficiency furnaces;
3. promoting Low E windows through retail partners;
4. offering weatherization packages; and
5. labelling to educate consumers on gas appliances and fireplaces.

In the Commercial sector, the DSM program has a goal to encourage owners and property managers to use “best practices” when replacing equipment and retrofitting buildings. In this manner, space and water heating efficiency within commercial buildings will improve. This will be accomplished by:

1. educating building owners and managers on energy efficiency in building equipment and systems;
2. supporting the Ontario Ministry of the Environment (OME) and the Building Research Establishment Environmental Assessment Method (BREEAM) ISO 14001 initiatives for improving building environmental effectiveness;
3. participating with the City of Toronto and City of Ottawa in energy management projects;
4. focusing Enbridge’s Energy Management Consultants on helping customers access a broader range of energy management products and services; and
5. providing financial incentives for comprehensive and higher efficiency boiler replacement projects.

In the past, this program has demonstrated energy savings of 20% or more.

Within Enbridge’s franchise area there are approximately 6,800 multi-residential customers. Most of these buildings (74%) were built prior to 1980 and have the largest potential for energy efficiency improvements through improved insulation and air tightness. Using a strategy similar to DSM in the commercial sector, the company expects potential natural gas savings of 15% or more.

In 1998, Enbridge had 769 large volume customers that account for 85% of the industrial natural gas volume. These firms consume more than 2,600 Mm^3 annually (23% of total sales volumes). Enbridge estimates that through DSM programs there is the potential to reduce natural gas use by these customers by 5%. To achieve these reductions, the company will:

1. continue providing energy audits and promoting energy efficiency;
2. target two specific markets: Pulp and Paper and Food and Beverage;
3. provide financial, technical and marketing support for the ISO 14001 initiative being undertaken with OME;
4. develop energy awareness through energy monitoring;
5. provide financial incentives for energy saving projects; and
6. promote energy awareness and energy efficiency options through workshops and presentations at trade shows and industry specific conferences.

Finally, Enbridge is investigating DSM opportunities in the Agriculture sector. Greenhouse operations in the company's franchise area are also large volume customers. Some 75 customers consume 60 Mm^3 of natural gas annually. These customers, in general, operate old small boilers (20+ years old) that are heavy users during the winter months. Enbridge estimates that 10% of their consumption can be saved through a DSM program. As well, with deregulation of the electricity generation market, there are excellent opportunities for small cogeneration applications. The company's strategy for its agricultural customers is to:

1. initiate research into the total DSM potential in this sector;
2. test the applicability of direct contact heaters in place of boilers (in conjunction with Union Gas);
3. provide financial incentives for energy saving projects; and
4. promote energy efficiency options and energy awareness through workshops at conferences and trade fairs.

A summary table of the 1998 DSM results and the 1999 projected DSM activities is given in Appendix III.

		Emissions (kt CO2e)		
	Year	Without Actions	With Actions	Savings
Baseline	1990	19,376		
Results	predicted 1998	21,060	*20,948*	112
	actual 1998	20,977	20,868	109
Forecast	1999	20,979	20,805	174
	2000	21,408	21,175	233
	2005	23,387	22,797	590
	2010	25,226	24,383	843

Values in italics were not published in last year's Action Plan

Fuel Switching

Every time Enbridge convinces an existing oil or electricity user to switch to natural gas there is a reduction in greenhouse gas emissions. In 1998, 22,134 customers switched to natural gas. The number of new customers is expected to decline to some 15,000 per year by 2005 because of market saturation. Even so, the GHG savings will continue to increase since previously switched customers continue to accumulate savings year after year.

		Emissions (kt CO2e)		
	Year	Without Actions	With Actions	Savings
Baseline	1990	19,376		
Results	predicted 1998	*22,241*	*20,948*	*1,293*
	actual 1998	22,650	20,868	1,643
Forecast	1999	22,712	20,805	1,719
	2000	23,225	21,175	1,833
	2005	25,666	22,797	2,561
	2010	28,004	24,383	3,269

Values in italics were not published in last year's Action Plan

Note: there has been an improvement in methodology for calculating GHG savings from fuel switching. Heating efficiencies of various fuels (previously unaccounted for) are included in the calculation. This is the reason for the increase in GHG savings. As well, emissions with actions plus savings do not equal emissions without actions due to reductions attributable to the electrical utilities. Last year, avoided emissions by fuel switching were reported. This year, net emission reductions are reported. This is in keeping with the Guide's new emphasis on emission reductions.

Natural Gas Vehicles (NGVs)

The transportation sector is the source of over 27% of Canada's greenhouse gas emissions. This sector is also a prime contributor to the smog problems in southern Ontario. A solution to these problems is to promote the use of Natural Gas Vehicles (NGVs). They emit 10% less GHGs and 80% less NO_x per gasoline equivalent litre than gasoline-fuelled vehicles.

Enbridge continues to work closely with Original Equipment Manufacturers (OEM) in improving NGV technology. As well, the company also assists customers by providing financial incentives to purchase OEM natural gas vehicles.

		Emissions (kt CO2e)		
	Year	Without Actions	With Actions	Savings
Baseline	1990	15		
Results	predicted 1998	*60*	*53*	7
	actual 1998	33	31	2
Forecast	1999	49	45	3
	2000	50	46	3
	2005	92	85	7
	2010	125	115	11

Values in italics were not published in last year's Action Plan

Note: Last year, avoided emissions by NGVs were reported. This year, net emission reductions are reported. This is in keeping with the Guide's new emphasis on emission reductions. 1998 NGV actuals are substantially lower than predicted due to substantially lower sales. As well, last year it was reported that NGVs emit 20% less GHGs than gas-fuelled vehicles. These were based on US DOE estimates[1]. The change this year is a result of adopting the constants listed in the 1999 Registration Guide.

Cogeneration

In last year's Action Plan, cogeneration was removed from the list of emission-saving activities. This year, the methodology for calculation of emissions and information supplied by Enbridge's cogeneration department was reviewed.

Cogeneration is an industrial process that simultaneously produces heat and electricity in plants and factories. Overall, cogeneration projects have energy efficiencies that range from 60% to 80%. It is assumed that electrical energy is generated by gas fired cogeneration projects at an average of 3.3 kWh / m^3 of natural gas (~ 32% efficiency). This electrical energy is additional to the thermal energy that would have been produced in the absence of the cogeneration project.

Enbridge continues to promote the use of natural gas in efficient cogeneration applications. As well, the company is investigating new opportunities such as direct natural gas-fired cogeneration in conjunction with space heating of greenhouses.

		Emissions (kt CO2e)		
	Year	Without Actions	With Actions	Savings
Baseline	1990	1		
Results	predicted 1998	*1,526*	*1,016*	*510*
	actual 1998	1,367	862	443
Forecast	1999	1,690	1,083	510
	2000	1,694	1,100	492
	2005	5,488	3,538	1,613
	2010	5,680	3,588	1,770

Values in italics were not published in last year's Action Plan

Note Electricity generated is converted to emission reductions using the provincial net electrical emission intensity. Emissions without actions are calculated using the provincial gross electrical emissions intensity. For these reasons, emissions with actions plus savings do not equal emissions without actions due to reductions attributable to the electrical utilities.

Tree-Planting

This year, carbon sequestration as a result of Enbridge's tree planting initiatives is considered an offset (section 8.4).

[1] United States Department of Energy (1994) Sector-specific issues and reporting methodologies supporting the general guidelines for the voluntary reporting of greenhouse gases under sections 1605(b) of the Energy Policy Act of 1992, Volume II, p 4.18 and 4.19, DOE/PO-0028.

7. Projections

7.1 Methodology

There are five types of GHG emissions calculated.

7.1.1 Combustion Emissions

Except where noted all estimates of greenhouse gas emissions are made by multiplying actual consumption of fuels by the appropriate constant listed in appendix V. Projected consumption of natural gas by the company and its customers, as well as forecasted customer additions have been provided by Enbridge's Economic Studies Department. They are consistent with Ontario Energy Board guidelines for rate case applications. The exceptions occur when another method was applied.

In the Company Emissions Inventory, future consumption for heating company buildings WITH actions is based on the 1999 consumption per unit area operated and forecasted growth in the area operated. Future consumption WITHOUT actions uses the average consumption per unit area from 1990 to 1994 since, in 1994, the company renovated a number of buildings.

Total gasoline equivalent consumption by Enbridge's natural gas and gasoline-fuelled fleet is assumed to have a linear relationship to the number of customers with a constant correction after 1995. This correction is added to account for the policy change that allowed operators to drive company vehicles home. Consumption WITH actions assumes that future growth will be accommodated by increased natural gas consumption including decreasing consumption by gasoline vehicles as a result of improvements in fuel efficiency. Consumption WITHOUT actions uses the 1990 ratio of natural gas to gasoline consumption and assumes that there was no policy change.

Projected volumes flared at the Tecumseh Gas Storage Facility (TGSF) WITH actions are approximated by the annual average volumes since 1995 excluding 1996. In 1996, there were anomalously large volumes flared due to a drilling program that altered the well spacing to improve storage capacity. It is assumed that WITHOUT actions all volumes would have been vented. Forecasted consumption of natural gas to power the TGSF compressors is calculated from a linear relationship to sales volume. There is no difference between WITH and WITHOUT actions.

Electricity use WITH actions in the company's buildings is calculated from projected operating floor area and the average electrical use per unit area since 1995. Consumption WITHOUT actions is estimated by adding the 1999 electrical savings from renovated buildings with complete electrical records to estimated consumption WITH actions. Consumption WITH actions is then converted to CO_2e emissions using Ontario's net emission intensity (appendix V). This varies each year and assumes that Ontario Hydro will meet its published emission targets and will not increase generation capacity. Increased demand will be met by natural gas-fired power stations not operated by Ontario Hydro. Emissions WITHOUT actions are calculated by multiplying consumption WITHOUT actions by Ontario's gross emission intensity (Appendix V). Finally, the relative proportions of CO_2, CH_4 and N_2O are estimated using the same relative proportions as for coal-fired generating stations.

7.1.2 Vented Emissions

Projected volumes vented at the TGSF WITH actions are the annual average volumes vented since 1990 excluding 1995. In this year, a major venting incident occurred.

7.1.3 Fugitive Emissions

Fugitive emissions from equipment and pipelines were calculated using emission factors published by Gas Technology Canada. Emissions WITH actions include the company's proposed pipe and instrument replacement program. Emissions WITHOUT actions assume no pipe replacement and instrument replacement program. Use of polyethylene pipe was assumed for system expansion in both cases. Projections were provided by the company's Engineering Department.

7.1.4 Displacement Emissions

In the Customer Emissions Inventory, natural gas emissions WITH actions use the company's forecasted customer demand. Enbridge's DSM department provided the forecasted volumes saved by DSM projects.

Natural gas consumption WITHOUT actions has been estimated by assuming that:

1. savings made by Enbridge's DSM did not occur;
2. additional volumes from fuel switching customers would not exist; and
3. no natural gas would have been sold for use in NGVs.

As a result, had Enbridge not taken actions, there would be three additional sources of emissions. Gasoline would be consumed in place of the NGV sales volumes. Light oil and electricity would be consumed by customers had they not switched to natural gas. These amounts are estimated by assuming 67% of the new customers previously used light oil as their fuel source and that the natural gas and oil furnace efficiencies were 80% and 60% respectively. Electrical baseboard heat has a 95% efficiency[1]. The effect of furnace efficiencies was not included in last year's calculation.

Finally, there would be additional emissions from electricity that would need to be generated to replace electricity generated by cogeneration projects. This has been calculated assuming an average generation of 3.3 kWh / m^3 .

These additional sources of emissions that would have occurred WITHOUT Enbridge's actions can be used to offset additional emissions attributable to Enbridge's customers as a result of the company's actions.

7.2 Quantification

7.2.1 Company Emissions With Actions

Projected company emissions with actions are listed in Table 4. Changes to the 1990 baseline made in this VCR Update have resulted in Enbridge forecasting that it will not make its revised emissions target of 330.20 kt CO_2e until 2002.

The predicted delay in reaching the company's emission target is due to the addition of fugitive equipment emissions to the company's GHG inventory. However, the calculation of these emissions is based upon industry values that may not accurately reflect Enbridge's distribution system, and may be an overestimation. Over the next year, engineering investigations will be undertaken to determine if industry standards are appropriate for the company's use or need to be modified to reflect company circumstances.

The company has already surpassed its emission intensity target of 32.14 t CO_2e/Mm^3 . By 2000, Enbridge expects to emit 22% less GHGs than in 1990. By this time, company will have improved its emission intensity by 32%. Nearly all of this will be accomplished by reducing Fugitive Pipeline Emissions (FPEs) as a result of the Cast Iron Replacement Program.

[1] Natural Resources Canada, Canada Mortgage and Housing Corporation (1995), A guide to residential wood heating. Cat. No. M92-23/ 1993Erev. 41 pp.

Table 4: Projected Company Emissions With Actions

Source	1998	1999	2000	2001	2002	2003	2004	2005	2010
	Emissions (kt CO2e)								
Heat	13.25	11.35	11.58	11.73	11.89	12.05	12.22	12.38	13.25
Fleet (gasoline)	6.12	6.17	6.13	6.10	6.06	6.02	5.98	5.94	5.75
Fleet (natural gas)	7.38	7.92	8.06	8.34	8.58	8.81	9.03	9.24	10.34
Fugitive Equipment Emissions	75.12	76.79	78.46	80.14	81.82	83.51	85.21	86.91	95.51
Fugitive Pipeline Emissions	208.33	196.36	184.40	172.44	160.47	148.51	136.54	124.58	64.75
Process Venting	3.47	3.45	3.43	3.40	3.38	3.36	3.34	3.32	3.21
Third Party Damages	9.50	9.31	9.12	8.94	8.76	8.59	8.42	8.25	7.45
Other	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Venting - TGSF	3.00	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97
Flaring - TGSF	0.49	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Compressors - TGSF	17.62	28.36	28.99	29.86	32.50	34.67	35.17	35.71	38.44
Total - Direct	**344.39**	**343.14**	**333.61**	**324.38**	**316.90**	**308.95**	**299.33**	**289.76**	**242.14**
Electricity	10.74	9.06	9.03	9.18	9.34	9.50	9.66	9.82	11.38
Total - Indirect	**10.74**	**9.06**	**9.03**	**9.18**	**9.34**	**9.50**	**9.66**	**9.82**	**11.38**
Grand Total	**355.14**	**352.20**	**342.64**	**333.56**	**326.24**	**318.44**	**308.99**	**299.58**	**253.52**
Tree Planting	-0.04	-0.05	-0.05	-0.06	-0.06	-0.07	-0.07	-0.08	-0.10
Net Emissions	**355.09**	**352.16**	**342.59**	**333.50**	**326.18**	**318.38**	**308.92**	**299.51**	**253.41**
Emission Intensity (t CO2e / Mm3)	30.80	30.31	28.98	27.56	25.18	23.32	22.36	21.41	17.04

Company emissions with actions listed by gas type are presented in Appendix IV

7.2.2 Company Emissions Without Actions

Without initiatives to reduce its emissions, it is projected that Enbridge would have emitted 6% more GHGs in 2000 than it did in 1990 (Table 5). This translates into 124.08 kt CO_2e more than with the company's actions. Much of this growth would have occurred as a result of system expansion (Fugitive Equipment Emissions and Fugitive Pipeline Emissions), reduced cast iron pipeline replacement and additional compressor use at the Tecumseh Gas Storage Facility. There would have been minor increases due to increased fleet use and consumption for heat.

Even so, emission intensity would have decreased by 4% because natural gas sales volumes would grow faster than fugitive emissions from the distribution system due to the fact that Enbridge is using low emission polyethylene piping to expand its distribution system.

Table 5: Projected Company Emissions Without Actions

Source	1998	1999	2000	2001	2002	2003	2004	2005	2010
	Emissions (kt CO2e)								
Heat	15.60	15.60	15.91	16.13	16.35	16.57	16.79	17.02	18.20
Fleet (gasoline)	9.10	9.38	9.56	9.72	9.86	9.99	10.11	10.23	10.84
Fleet (natural gas)	4.68	4.85	4.96	5.06	5.14	5.22	5.30	5.37	5.74
Fugitive Equipment Emissions	75.12	76.79	78.46	80.14	81.82	83.51	85.21	86.91	95.51
Fugitive Pipeline Emissions	278.43	280.22	282.00	283.77	285.53	287.28	289.02	290.76	299.30
Process Venting	19.50	19.63	19.75	19.88	20.00	20.12	20.25	20.37	20.96
Third Party Damages	9.50	9.31	9.12	8.94	8.76	8.59	8.42	8.25	7.45
Other	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Venting - TGSF	6.94	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80
Flaring - TGSF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compressors - TGSF	17.62	28.36	28.99	29.86	32.50	34.67	35.17	35.71	38.44
Total - Direct	**436.61**	**450.04**	**454.67**	**459.40**	**465.88**	**471.86**	**476.17**	**480.52**	**502.36**
Electricity	13.27	11.88	11.99	12.18	12.38	12.57	12.78	12.98	14.61
Total - Indirect	**13.27**	**11.88**	**11.99**	**12.18**	**12.38**	**12.57**	**12.78**	**12.98**	**14.61**
Grand Total	**449.88**	**461.92**	**466.66**	**471.58**	**478.25**	**484.43**	**488.95**	**493.50**	**516.97**
Emission Intensity (t CO2e / Mm3)	43.28	44.44	44.44	44.11	41.72	40.07	40.12	40.14	40.19

Company emissions without actions listed by gas type are presented in Appendix IV

Table 6: Projected Customer Emissions With Actions

Source	1998	1999	2000	2001	2002	2003	2004	2005	2010
	Emissions (kt CO2e)								
Residential	7,745	7,784	8,035	8,247	8,405	8,542	8,663	8,782	9,398
Apartment	2,358	2,300	2,319	2,337	2,352	2,363	2,374	2,389	2,445
Commercial	5,673	5,746	5,845	5,966	6,094	6,218	6,340	6,463	7,149
Industrial	5,093	4,975	4,976	4,994	5,042	5,093	5,134	5,162	5,391
NGV	31	45	46	59	68	76	80	85	115
Cogeneration	862	1,083	1,100	1,249	2,502	3,490	3,500	3,538	3,588
Curtailment	5	85	148	148	148	148	148	148	148
Emissions with Actions	**21,766**	**22,019**	**22,469**	**23,000**	**24,611**	**25,930**	**26,239**	**26,568**	**28,235**
NGV (gasoline saved)	-17	-33	-34	-48	-58	-67	-72	-77	-110
Fuel Switching (oil saved)	-2,886	-3,178	-3,491	-3,792	-4,075	-4,341	-4,591	-4,828	-5,884
Fuel Switching (electricity saved)	-990	-1,000	-1,044	-1,137	-1,226	-1,311	-1,391	-1,469	-1,938
Cogeneration (electricity saved)	-443	-510	-492	-561	-1,128	-1,579	-1,589	-1,613	-1,770
Emissions with Offsets	**17,430**	**17,298**	**17,408**	**17,462**	**18,123**	**18,632**	**18,595**	**18,581**	**18,532**
Emission Intensity (kt CO2e / Mm3)	1.512	1.489	1.472	1.443	1.399	1.365	1.346	1.328	1.246

Customer emissions with company actions listed by gas type are presented in Appendix IV

7.2.3 Customer Emissions With Actions

Table 6 displays projected emissions by Enbridge's customers with the company actions and initiatives. Both the company's goals for its customers were already met prior to 1998. By 2000, the customers' gross emissions will have grown by 14.1%. This is due in part to an increase in sales volumes of 13.9% as a result of new customers switching from other fuel sources. After customer offsets, in the form of saved emissions from other fuels, emissions from Enbridge's customers will be 12% below the 1990 level. The customers' net emissions will still be 6% below 1990 levels by 2010. Enbridge will have helped nearly 2 million customers contribute to Canada's national GHG target as stipulated in the Kyoto Protocol.

The customers' emission intensity will be 23% below the 1990 level by 2000.

7.2.4 Customer Emissions Without Actions

Without Enbridge's actions, emissions from its customers would have grown by 29% by 2000 (Table 7). A large portion of this growth (93%) are the emissions that were not avoided because an equivalent number of Enbridge's new customers cosumed more GHG intensive fuels than natural gas.

Table 7: Projected Customer Emissions Without Actions

Source	1998	1999	2000	2001	2002	2003	2004	2005	2010
	Emissions (kt CO2e)								
Residential	6,804	6,760	6,922	7,048	7,133	7,211	7,280	7,336	7,769
Apartment	2,117	2,058	2,071	2,079	2,088	2,095	2,104	2,116	2,153
Commercial	4,965	4,957	4,981	5,032	5,087	5,139	5,189	5,241	5,555
Industrial	4,858	4,745	4,733	4,755	4,809	4,866	4,916	4,958	5,196
NGV	15	15	15	15	15	15	15	15	15
Cogeneration	862	1,083	1,100	1,249	2,502	3,490	3,500	3,538	3,588
Curtailment	5	85	148	148	148	148	148	148	148
Gasoline	17	33	34	48	58	67	72	77	110
Oil	2,886	3,178	3,491	3,792	4,075	4,341	4,591	4,828	5,884
Electricity	1,634	1,794	1,856	2,052	2,847	3,495	3,606	3,727	4,381
Emissions without Actions	**24,164**	**24,709**	**25,351**	**26,219**	**28,763**	**30,869**	**31,421**	**31,985**	**34,801**
Emission Intensity (kt CO2e / Mm3)	2.324	2.377	2.414	2.453	2.509	2.553	2.578	2.602	2.706

Customer emissions without company actions by gas type are listed in Appendix IV

8. Results Achieved

8.1 Current Reporting Year - 1998

8.1.1 Company Emissions With Actions

Table 8 lists Enbridge's GHG emissions in 1998. GHG emissions from heat, accidental releases, flaring and fugitive sources (equipment and pipeline) were substantially larger than predicted. The increase in accidental releases is attributable to increased construction activity in Ontario. Unexpected maintenance at one of the compressor stations at the Tecumseh Gas Storage Facility (TGSF) resulted in increased flaring. The changes in fugitive emissions from equipment and pipelines are due to improved calculation methodology.

Emissions from compressors at the TGSF were substantially lower than expected due to decreased demand for natural gas by Enbridge's customers. This is largely a result of the warm winter experienced in 1998.

Direct and indirect emissions from the company are 19% below 1990 levels. Currently, Enbridge does not expect to reach its 2000 emission target as the company is still 24.89 kt CO_2e above this value. As the estimated fugitive equipment emissions are further refined over the next few years, this deficiency may disappear as a calculation inaccuracy.

Enbridge has already reached its emission intensity target of 32.14 t CO_2e / Mm^3.

8.1.2 Company Emissions Without Actions

Direct and indirect emissions by Enbridge would be 2% above 1990 levels in the absence of any Enbridge actions. The company's emission intensity would have grown by 10% (Table 9).

Due to initiatives outlined in section 6.1.1, Enbridge has successfully reduced its emissions by 93.15 kt CO_2e in 1998. These reductions occurred as a result of programs to reduce emissions from heat, fleet operations, the distribution system, process venting and the reduction of venting and flaring at the TGSF.

Table 8: 1998 Company Emissions With Actions

Source	Volume	Units	kilo tonnes (kt) CO2	CH4	N2O	CO2e	Predicted Value
Heat	6.366	Mm3	13.20	0.0003	0.0001	**13.25**	8.33
Fleet (gasoline)	2.519	ML	5.95	0.0006	0.0005	**6.12**	6.31
Fleet (natural gas)	3.125	Mm3	5.88	0.069	0.0002	**7.38**	7.49
Fugitive Equipment Emissions	4.982	Mm3		3.577		**75.12**	9.75
Fugitive Pipeline Emissions	13.817	Mm3		9.920		**208.33**	169.43
Process Venting	0.230	Mm3		0.165		**3.47**	3.68
Third Party Damages	0.630	Mm3		0.452		**9.50**	7.71
Other	0.007	Mm3		0.005		**0.10**	0.09
Venting - TGSF	0.199	Mm3		0.143		**3.00**	3.31
Flaring - TGSF	0.261	Mm3	0.49	0.0000	0.0000	**0.49**	0.31
Compressors - TGSF	9.338	Mm3	17.55	0.0004	0.0002	**17.62**	26.53
Total - Direct			**43.07**	**14.33**	**0.0010**	**344.39**	**242.95**
Electricity	*36.89*	GWh	*10.68*	*0.0001*	*0.0002*	*10.74*	7.00
Total - Indirect			**10.68**	**0.0001**	**0.0002**	**10.74**	**7.00**
Grand Total			**53.74**	**14.33**	**0.0013**	**355.14**	**249.95**
Tree Planting	0	trees	-0.04			-0.04	-0.04
Net Emissions			**53.70**	**14.33**	**0.0013**	**355.09**	**249.91**
Emission Intensity (t CO2e / Mm3)						**30.80**	**22.76**

Table 9: 1998 Company Emissions Without Actions

Source	Volume	Units	kilo tonnes (kt) CO2	CH4	N2O	CO2e	Predicted Value
Heat	8.266	Mm3	15.54	0.0004	0.0002	**15.60**	not reported
Fleet (gasoline)	3.745	ML	8.84	0.0009	0.0008	**9.10**	not reported
Fleet (natural gas)	1.985	Mm3	3.73	0.044	0.0001	**4.68**	not reported
Fugitive Equipment Emissions	4.982	Mm3		3.577	0.0000	**75.12**	not reported
Fugitive Pipeline Emissions	18.466	Mm3		13.26	0.0000	**278.43**	not reported
Process Venting	1.293	Mm3		0.929	0.0000	**19.50**	not reported
Third Party Damages	0.630	Mm3		0.452	0.0000	**9.50**	not reported
Other	0.007	Mm3		0.005	0.0000	**0.10**	not reported
Venting - TGSF	0.460	Mm3	0.00	0.330	0.0000	**6.94**	not reported
Flaring - TGSF	0.000	Mm3	0.00	0.0000	0.0000	**0.00**	not reported
Compressors - TGSF	9.338	Mm3	17.55	0.0004	0.0002	**17.62**	not reported
Total - Direct			**45.66**	**18.60**	**0.0013**	**436.61**	**not reported**
Electricity	39.97	GWh	13.19	0.0001	0.0003	13.27	not reported
Total - Indirect			**13.19**	**0.0001**	**0.0003**	**13.27**	**not reported**
Grand Total			**58.85**	**18.60**	**0.0015**	**449.88**	**not reported**
Emission Intensity (t CO2e / Mm3)						**43.28**	**not reported**

8.1.3 Customer Emissions With Actions

Table 10 displays the GHG emissions in 1998 from Enbridge's customers after incorporating the results of initiatives to reduce emissions that were undertaken by the company.

The customers' gross emissions even with the company's actions are 3% larger than expected, but net emissions after offsets have been incorporated are only 2% greater than predicted. These differences are due to the adoption of a more transparent and precise calculation methodology. The calculation changes include increases arising to the clearer reporting of emissions from curtailment activities and larger offsets as a result of the addition of furnace efficiencies and the improved cogeneration assumptions (see section 7.1).

Since 1990, gross emissions have increased by 11%. This is primarily due to Enbridge expanding its customer base. However, even though gross emissions have increased, net emissions have decreased by 11%. Enbridge has already surpassed its customer emissions and emission intensity goals.

Table 10: 1998 Customer Emissions With Actions

Source	Volume	Units	kilo tonnes (kt) CO2	CH4	N2O	CO2e	Predicted Value
Residential	4,104	Mm3	7,716	0.176	0.0821	**7,745**	7,744
Apartment	1,249	Mm3	2,349	0.054	0.0250	**2,358**	2,358
Commercial	3,006	Mm3	5,651	0.129	0.0601	**5,673**	5,672
Industrial	2,699	Mm3	5,073	0.130	0.0540	**5,093**	5,092
NGV	13	Mm3	25	0.289	0.0008	**31**	25
Cogeneration	457	Mm3	859	0.022	0.0091	**862**	862
Curtailment	2	Mm3	5	0.0000	0.0000	**5**	70
Emissions with Actions			**21,677**	**0.800**	**0.2311**	**21,766**	**21,060**
NGV (gasoline saved)	7	ML	-17	-0.002	-0.0015	-17	-60
Fuel Switching (oil saved)	1,017	ML	-2,879	-0.218	-0.0061	-2,886	-3,304
Fuel Switching (electricity saved)	3,400	GWh	-984	-0.006	-0.0197	-990	
Cogeneration (electricity saved)	1,520	GWh	-440	-0.003	-0.0088	-443	-510
Emissions with Offsets			**17,358**	**0.572**	**0.1950**	**17,430**	**17,073**
Emission Intensity (kt CO2e / Mm3)						**1.512**	**1.554**

Note: Last year individual sources of emissions were not listed. Instead only emissions from adjusted sales were reported. In this table the equivalent emissions from individual sources have been included had they been predicted. Their sum does not equal last year's gross emissions due to changes in calculation methodology.

Table 11: 1998 Customer Emissions Without Actions

Source	Volume	Units	kilo tonnes (kt) CO2	CH4	N2O	CO2e	Predicted Value
Residential	3,606	Mm3	6,778	0.155	0.0721	**6,804**	not reported
Apartment	1,122	Mm3	2,109	0.048	0.0224	**2,117**	not reported
Commercial	2,631	Mm3	4,946	0.113	0.0526	**4,965**	not reported
Industrial	2,574	Mm3	4,839	0.124	0.0515	**4,858**	not reported
NGV	7	Mm3	12	0.143	0.0004	**15**	not reported
Cogeneration	457	Mm3	859	0.022	0.0091	**862**	not reported
Curtailment	2	Mm3	5	0.0000	0.0000	**5**	not reported
Gasoline	7	ML	17	0.002	0.0015	**17**	not reported
Oil	1,017	ML	2,879	0.218	0.0061	**2,886**	not reported
Electricity	4,920	GWh	1,624	0.010	0.0325	**1,634**	not reported
Emissions without Actions			**24,069**	**0.834**	**0.2483**	**24,164**	**not reported**
Emission Intensity (kt CO2e / Mm3)						**2.324**	**not reported**

8.1.4 Customer Emissions Without Actions

Emissions by Enbridge's customers in 1998 without the benefits of the company's programs are shown in Table 11. They are estimated to be 23% above the 1990 baseline. This is primarily due to the company's programs to expand its market and attract new customers from other higher GHG intensity fuels. Since 1990, Enbridge has increased its customer base by 34%. The company estimates that 51% of these new customers have switched from other more GHG intensive fuel sources.

As noted in section 6.1.1, Enbridge successfully reduced emissions from its customers by 2,198 kt CO_2e in 1998.

Table 12: Interim Company Emissions With Actions

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Heat	12.86	20.55	12.49	14.70	12.39	9.82	9.94	8.84	13.25
Fleet (gasoline)	6.67	6.45	6.31	6.14	5.82	6.01	6.85	6.30	6.12
Fleet (natural gas)	4.04	4.53	4.80	5.20	5.46	5.97	6.56	7.21	7.38
Fugitive Equipment Emissions	60.07	61.88	63.72	65.58	67.42	69.30	71.28	73.28	75.12
Fugitive Pipeline Emissions	287.59	281.37	272.64	267.01	260.43	250.73	229.65	218.34	208.33
Process Venting	20.14	20.06	18.44	16.40	14.55	6.80	4.25	3.64	3.47
Third Party Damages	8.95	7.37	7.19	6.78	7.83	7.52	7.54	8.94	9.50
Other	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Venting - TGSF	2.76	2.21	4.39	1.34	3.10	33.41	4.09	2.85	3.00
Flaring - TGSF	0.00	0.00	0.00	0.00	0.00	0.33	1.86	0.24	0.49
Compressors - TGSF	25.45	22.51	27.39	24.96	25.99	22.63	29.41	28.41	17.62
Total - Direct	**428.63**	**427.03**	**417.47**	**408.22**	**403.10**	**412.63**	**371.53**	**358.17**	**344.39**
Electricity	11.64	10.33	7.43	4.92	3.87	3.90	4.72	6.95	10.74
Total - Indirect	**11.64**	**10.33**	**7.43**	**4.92**	**3.87**	**3.90**	**4.72**	**6.95**	**10.74**
Grand Total	**440.27**	**437.36**	**424.89**	**413.13**	**406.98**	**416.53**	**376.25**	**365.12**	**355.14**
Tree Planting	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.04	-0.04	-0.04
Net Emissions	**440.27**	**437.36**	**424.89**	**413.12**	**406.96**	**416.51**	**376.21**	**365.08**	**355.09**
Emission Intensity (t CO2e / Mm3)	42.85	44.49	42.69	40.90	40.38	39.66	34.62	32.67	30.80

Company emissions with actions listed by gas type are presented in Appendix IV

8.2 Interim Years – 1990 to 1997

8.2.1 Company Emissions

Table 12 and Table 13 list company emissions since 1990 with and without Enbridge actions respectively. Every year since 1990, Enbridge has successfully decreased its emissions as a result of its continuing emission reduction programs. The exception occurred in 1995 when there was an anomalously large amount of methane vented from an “upset” incident at a storage well at the Tecumseh Gas Storage Facility.

8.2.2 Customer Emissions

Interim emissions by Enbridge’s customers with and without actions are shown in Table 14 and Table 15 respectively. Since 1990, even though customer gross emissions have increased year after year, net emissions have decreased significantly. There was a large increase in both gross and net emissions in 1996 due to a more buoyant economy and exceptionally large emissions from curtailment activities.

Table 13: Interim Company Emissions Without Actions

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Heat	12.86	20.55	12.49	14.70	12.39	13.66	13.89	14.12	15.60
Fleet (gasoline)	6.67	6.87	6.96	7.13	7.11	7.56	8.99	9.10	9.10
Fleet (natural gas)	4.04	4.15	4.21	4.31	4.30	4.57	4.62	4.68	4.68
Fugitive Equipment Emissions	60.07	61.88	63.72	65.58	67.42	69.30	71.28	73.28	75.12
Fugitive Pipeline Emissions	287.59	288.05	287.18	286.51	284.48	283.69	282.50	280.00	278.43
Process Venting	20.14	20.18	20.12	20.07	19.93	19.87	19.79	19.61	19.50
Third Party Damages	8.95	7.37	7.19	6.78	7.83	7.52	7.54	8.94	9.50
Other	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Venting - TGSF	2.76	2.21	4.39	1.34	3.10	36.04	18.94	4.78	6.94
Flaring - TGSF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compressors - TGSF	25.45	22.51	27.39	24.96	25.99	22.63	29.41	28.41	17.62
Total - Direct	**428.63**	**433.87**	**433.74**	**431.48**	**432.66**	**464.95**	**457.06**	**443.03**	**436.61**
Electricity	11.64	10.43	7.83	5.37	4.32	5.55	6.81	9.38	13.27
Total - Indirect	**11.64**	**10.43**	**7.83**	**5.37**	**4.32**	**5.55**	**6.81**	**9.38**	**13.27**
Grand Total	**440.27**	**444.30**	**441.57**	**436.84**	**436.98**	**470.50**	**463.87**	**452.41**	**449.88**
Emission Intensity (t CO2e / Mm3)	42.85	45.82	45.63	45.28	46.14	48.22	46.50	44.62	43.28

Company emissions without actions by gas type are listed in Appendix IV

Table 14: Interim Customer Emissions With Actions

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Residential	6,383	6,230	6,449	6,435	6,503	6,811	7,350	7,465	7,745
Apartment	2,035	2,061	2,086	2,074	2,083	2,184	2,213	2,288	2,358
Commercial	5,413	5,327	5,319	5,151	5,080	5,251	5,511	5,584	5,673
Industrial	5,545	4,904	4,875	4,815	4,624	4,760	4,680	4,907	5,093
NGV	15	26	35	41	43	33	35	50	31
Cogeneration	1	7	26	553	696	785	728	802	862
Curtailment	293	13	60	115	450	37	691	248	5
Emissions with Actions	**19,685**	**18,567**	**18,850**	**19,183**	**19,478**	**19,862**	**21,208**	**21,345**	**21,766**
NGV (gasoline saved)	0	-11	-22	-29	-30	-20	-22	-38	-17
Fuel Switching (oil saved)	0	-311	-655	-1,077	-1,453	-1,805	-2,185	-2,564	-2,886
Fuel Switching (electricity saved)	0	-95	-160	-187	-223	-284	-396	-649	-990
Cogeneration (electricity saved)	0	-3	-9	-144	-160	-185	-198	-304	-443
Emissions with Offsets	**19,685**	**18,148**	**18,004**	**17,747**	**17,613**	**17,568**	**18,409**	**17,790**	**17,430**
Emission Intensity (kt CO2e / Mm3)	1.916	1.846	1.809	1.757	1.748	1.673	1.694	1.592	1.512

Customer emissions with actions listed by gas type are presented in Appendix IV

Table 15: Interim Customer Emissions Without Actions

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Residential	6,383	6,135	6,255	6,103	6,033	6,213	6,620	6,618	6,804
Apartment	2,035	2,035	2,010	1,949	1,925	2,003	2,012	2,065	2,117
Commercial	5,413	5,242	5,150	4,887	4,722	4,804	4,974	4,953	4,965
Industrial	5,545	4,869	4,807	4,702	4,486	4,596	4,482	4,684	4,858
NGV	15	15	15	15	15	15	15	15	15
Cogeneration	1	7	26	553	696	785	728	802	862
Curtailment	293	13	60	115	450	37	691	248	5
Gasoline	0	11	22	29	30	20	22	38	17
Oil	0	311	655	1,077	1,453	1,805	2,185	2,564	2,886
Electricity	0	97	169	332	388	606	781	1,178	1,634
Emissions without Actions	**19,685**	**18,736**	**19,169**	**19,762**	**20,198**	**20,885**	**22,509**	**23,166**	**24,164**
Emission Intensity (kt CO2e / Mm3)	1.916	1.932	1.981	2.048	2.133	2.140	2.256	2.285	2.324

Customer emissions without actions listed by gas type are presented in Appendix IV

8.2.3 Realized Emission Reductions

Table 16 and Table 17 list the annual and cumulative emission reductions from the company's programs since 1990. These tables show the importance of the Cast Iron Replacement program and Fuel Switching to reductions in company and customer emissions respectively. Reductions in fugitive pipeline emissions accounted for 75% of total reductions in company emissions in 1998. Savings as a result of fuel switching made up 75% of total savings in customer emissions in 1998.

Table 16: Interim Annual Reductions in Company Emissions

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions Reductions (kt CO2e)								
Heat	0.00	0.00	0.00	0.00	0.00	3.83	3.95	5.28	2.35
Fleet (gasoline and natural gas)	0.00	0.04	0.06	0.09	0.12	0.15	0.21	0.27	0.29
Fugitive Pipeline Emissions	0.00	6.68	14.54	19.50	24.05	32.96	52.85	61.66	70.10
Process Venting	0.00	0.12	1.67	3.67	5.38	13.07	15.54	15.97	16.03
TGSF (venting and flaring)	0.00	0.00	0.00	0.00	0.00	2.30	12.99	1.69	3.45
Total - Direct	**0.00**	**6.84**	**16.28**	**23.26**	**29.56**	**52.32**	**85.54**	**84.87**	**92.21**
Electricity	0.00	0.10	0.40	0.43	0.38	0.39	0.45	0.63	0.90
Total - Indirect	**0.00**	**0.10**	**0.40**	**0.43**	**0.38**	**0.39**	**0.45**	**0.63**	**0.90**
Total	**0.00**	**6.95**	**16.67**	**23.70**	**29.94**	**52.71**	**85.99**	**85.50**	**93.11**
Tree Planting	0.00	0.00	0.00	0.01	0.02	0.02	0.04	0.04	0.04
Grand Total	**0.00**	**6.95**	**16.68**	**23.71**	**29.96**	**52.74**	**86.03**	**85.54**	**93.15**
Cumulative	0.00	6.95	23.63	47.33	77.29	130.03	216.06	301.60	394.75

Note: The reductions recorded are only those that can be documented as resulting directly from a company initiative. There may be other sources that have decreased emissions not directly attributable to a specific activity or that had expected decreased emissions that are not supported by the available data. Decreases in emissions from electricity consumption do not include reductions attributable to the electrical utilities.

Table 17: Interim Annual Reductions in Customer Emissions

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Demand Side Management	0	0	0	0	0	7	23	60	109
Natural Gas Vehicles	0	1	2	3	3	2	2	4	2
Fuel Switching	0	165	308	431	552	692	890	1,229	1,643
Cogeneration	0	3	9	144	160	185	198	304	443
Total	**0**	**169**	**319**	**577**	**714**	**886**	**1,113**	**1,596**	**2,196**
Cumulative	0	169	488	1,065	1,780	2,666	3,779	5,375	7,571

Note: The reductions recorded are only those that can be documented as resulting directly from a company initiative. There may be other sources that have decreased emissions not directly attributable to a specific activity or that had expected decreased emissions that are not supported by the available data. Decreases in emissions from electricity consumption do not include reductions attributable to the electrical utilities.

8.3 Verification

At this time, Enbridge does not have a third party verification process in place. However, operational expenditures on cast iron replacement program and other initiatives are subject to Ontario Energy Board review during rate case applications where funding for the programs is requested. All GHG savings have been estimated by Woodrising Consulting Inc. based on data supplied by Enbridge's engineering and planning departments. These data have not been independently verified.

8.4 Offsets

To date, Enbridge has not participated in any large-scale offset initiatives. Even though, Enbridge Consumers Gas does not need offsets to meet Kyoto commitments, the company is investigating the acquisition of customer based offsets as part of the parent company's company-wide GHG management strategy.

Tree Planting

The company has a small community-based tree planting program. Since 1990, the company has financed the planting of some 32,427 trees, seedlings and shrubs. Based on a 1994 census, trees, seedlings, and shrubs comprise 12%, 44% and 43% of the total planted respectively. The trees are estimated to sequester 7.4 kg CO_2e / tree / year and the seedlings about 0.9 kg CO_2e /year each. Combined, all trees and seedlings removed some 43 t CO_2e from the atmosphere in 1998.

Other Market Instruments

Enbridge Consumers Gas is investigating the use of other market instruments such as emission reduction trading, as part of the parent company's company-wide GHG management strategy.

9. Education, Training and Awareness

9.1 Our Corporate Response to Climate Change Issues

Enbridge Consumers Gas is proud of its track record in energy efficiency, environmental awareness and climate change. The company has established one of the more aggressive voluntary emission reduction targets listed within the VCR Registry, and is committed to working towards meeting those targets and goals for 2000.

The company realizes that greenhouse gas emissions are an important issue for the entire Enbridge Inc. group of companies and for Canada as a whole. For this reason, Enbridge Consumers Gas is taking a leading role in developing a GHG management strategy for Enbridge Inc. in the new millennium. The company plans to have this broad outline strategy in place for the next Action Plan Update.

Representatives of the company are engaged in the national process of developing a Climate Change Implementation Strategy, and are members of the federal Climate Change Issue Tables on Credit for Early Action and Enhanced Voluntary Action.

As well, Enbridge Consumers Gas will continue to promote natural gas as a cleaner, transition fuel until renewable technologies are a cost-effective source of energy. As part of its support for renewable energy, the company has taken a membership in the Toronto Renewable Energy Co-operative (TREC). This organization, in co-operation with Toronto Hydro, is developing a series of three 660 kW wind-turbines on Toronto's urban lakefront.

As well, to investigate the benefits of renewable energy firsthand, Enbridge has installed a passive Solarwall in its Victoria Park garage complex. This 204 m^2 structure is designed to deliver solar heated make-up air at the rate of 270 m^3 per minute. This warm air replaces air that was previously heated by natural gas. The company's Technology and Development Department is monitoring energy use within the garage complex and the company will be registering emission reduction credits generated by this project with the Pilot Emission Reduction Trading project (PERT).

Finally, Enbridge's Technology and Development Department and its partners are developing new uses for natural gas. These may allow natural gas to replace other more GHG intense energy sources. Projects under development include: natural gas fired dehumidification for hockey arenas, combination natural gas fired heating and electric cooling air conditioning units and improvements to commercial-sized gas fired ranges.

9.2 Climate Change and Our Employees

Enbridge Consumers Gas realizes that energy efficiency and greenhouse gas emission reductions start in its employees' homes. For this reason, the company continues to promote and distribute a variety of materials to its employees that outline the environmental benefits of natural gas and energy efficiency.

Last year Enbridge helped develop the Climate Change Chronicles in association with the Canadian Gas Association (CGA) and the Canadian Energy Pipeline Association (CEPA). This four-part document which discussed climate change, Canada's commitment and activities the company and its employees may take to reduce GHG emissions, was given to all company employees.

In 1999, each employee was made aware of a new employee program intended to improve energy efficiency within the home. The HOME COMFORT AND VALUE PROTECTION program was launched with the help of Green$aver, a non-profit energy-efficiency group. An expert from Green$aver conducts a "blower door fan" draft test to monitor the air leakage in the employees' home and provides an exact prescription for improving the comfort and energy efficiency of the home. As an incentive, each employee that participated early in the program was given a free water conservation kit.

The company is participating as a Tier I level company in the Energy Council of Canada sponsored "Action By Canadians (ABC) program and funded in part by the Climate Change Action Fund. One of the main components of the program is a two hour employee workshop which provides information on the climate change issue in a fun and interactive way and gives a number of suggestions on how one can presonally limit greenhouse gases without changing ones personal lifestyle. All employees will be provided an opportunity to attend an information session.

As well, Enbridge's VCR Updates are posted on the company's Internet site for employee and public access.

9.3 Climate Change and Our Partners

Enbridge Consumers Gas continues to participate in some 38 building, construction, educational, energy management and production, governmental, municipal and professional organizations or associations. They help promote energy efficiency and develop standards for building design and appliances.

Enbridge is actively involved with Toronto's Better Buildings Program, a collaboration between the city, utilities and business. In May of 1999, the City of Toronto and Enbridge officially signed the *Retrofit Facilitation Agreement*. The company also made a financial contribution of $739,000 to the *Loan Recourse Fund*.

This is a loan securitization fund designed to significantly reduce financial barriers to energy retrofits, specifically for small commercial and multi-residential buildings. Under the *Retrofit Facilitation Agreement*, Enbridge (and after unbundling, third parties coordinated by Enbridge) will provide financing to qualified customers. The company will also contribute $0.125 per m^3 of gas saved to the fund.

Another example is *Partners in Building*, a tree planting program developed in association with Scouts Canada, Ontario Council, the Ontario Ministry of the Environment, Gas Ready Building partners and Montana Steel Advertising (an active player in the builder market). A Gas Ready residence is any new home that is ready to accept gas appliances and services. For every Gas Ready home sold, Enbridge contributes $5, thereby ensuring that 10 seedlings are planted. This program helps market Gas Ready residences while promoting reforestation.

The company is supporting a Canadian Gas Association and City of Toronto Discussion Forum on Climate Change in September 1999 with the purpose of creating a national dialogue to foster municipal and industry collaboration on natural gas, energy efficiency and renewable energy options.

Through its participation in the CGA and the Canadian Gas Research Institute Canada (CGRI) the company continues to sponsor research into renewable energy technologies and their compatibility with the natural gas system. As well, Enbridge, CGA and CGRI are investigating ways to improve the accuracy of measuring emissions from vented volumes and natural gas –fired equipment within the natural gas system.

9.4 Our Public Education on Climate Change

Enbridge Consumers Gas actively promotes public education on energy efficiency and climate change. The company donated $15,000 to the Pembina Institute for Sustainable Development to develop and promote an educational website on climate change (http://www.piad.ab.ca) Furthermore, as part of its DSM program, the company distributes publications promoting energy efficiency to its customers. The company's *Energy Saver* magazine and *Pipeline* billing publication are sent to residential customers. The multi-family market receives *Multi-Choice* and *primeEnergy* is sent to large volume customers.

The Company will be working with the Canadian Gas Association to produce and distribute a generic customer bill insert on climate change plus energy efficiency tips customers can use to reduce their energy consumption. The project has received funding from the Climate Change Action Fund.

10. Appendix I – Emission Reduction Credits

Several initiatives undertaken by Enbridge are capable of generating Emission Reduction Credits (ERCs) as defined by the criteria used by both Canadian pilots - the Greenhouse Gas Emission Reduction Trading Pilot (GERT), and the Pilot Emission Reduction Trading (PERT) program.

ERCs are emission reductions that may be traded if a credit trading system emerges in the future. The estimates provided below are different than the ERCs reported in last year's plan due to the application of stricter requirements for eligible credits. Enbridge will continue to further refine its calculation of the ERCs arising from its activities, to meet the emerging requirements for future registration under a national registry.

Criteria from the two pilot programs indicate that eligible emission reductions must be real, measurable, verifiable and surplus. As well, ownership of the reductions must not be in dispute and they must be additional to what probably would have occurred in a "Business as Usual" scenario. The following criteria are used to define eligible emission reductions:

1. **Real:** The emission reductions are a result of some initiative to reduce emissions and not just the result of a decrease in activity;
2. **Measurable and verifiable:** The emission reductions must be supported by documented data. The methodology and assumptions used to estimate the emission reductions must be clear;
3. **Surplus:** ERCs are triggered when emission reductions are beyond what is required by legislation, regulation, and voluntary commitments. In this year's report, the assumed trigger level is the Kyoto Protocol target (6% below 1990 levels) as applied to the company's emission levels; and
4. **Clearly owned:** To avoid the opportunity for double accounting, only emission reductions that are clearly owned by the company and are a result of the company's initiatives are eligible. Emission reductions generated by Enbridge through its initiatives to lessen its consumption of electricity or its customers' emissions are currently not eligible as ERCs because the issue of ownership needs further clarification.

Table 18: Company Generated Emission Reduction Credits (ERCs)

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions Reductions (t CO2e)								
Heat	0	0	0	0	0	3,834	3,953	5,280	2,349
Fleet (gasoline and natural gas)	0	40	62	94	123	148	206	268	285
Fugitive Pipeline Emissions	0	6,685	14,541	19,501	24,053	32,964	52,850	61,658	70,103
Process Venting	0	119	1,674	3,668	5,381	13,068	15,540	15,971	16,031
TGSF (venting and flaring)	0	0	0	0	0	2,305	12,987	1,689	3,446
Tree Planting	0	0	3	13	20	25	37	43	43
Eligible Reductions	**0**	**6,844**	**16,280**	**23,275**	**29,577**	**52,344**	**85,573**	**84,908**	**92,257**
Emissions Without Action	440,269	444,303	441,569	436,843	436,982	470,500	463,872	452,414	449,884
Kyoto Emission Target	413,853	417,645	415,075	410,633	410,763	442,270	436,039	425,269	422,891
Required reductions	**26,416**	**26,658**	**26,494**	**26,211**	**26,219**	**28,230**	**27,832**	**27,145**	**26,993**
ERCs	**0**	**0**	**0**	**0**	**3,358**	**24,114**	**57,741**	**57,763**	**65,264**
Cumulative ERCs	0	0	0	0	3,358	27,472	85,213	142,976	208,240

11. Appendix II – Emissions Without Normalization

Normalization is a method of removing the annual weather fluctuations from the consumption of natural gas. For each customer type, consumption is divided into a base and non-base amount. The base volume is independent of the weather, and the non-base volume, such as space heating, fluctuates with the weather. Only the "heat" portion of the company's natural gas consumption fluctuates with the weather. Since this is a small proportion of the company's total emissions, normalization has little effect on company emissions.

Degree-day deficiency is a measure of coldness and is used to normalize natural gas consumption. This measure is calculated by accumulating from October 1 the total number of degrees each day by which the daily mean temperature falls below 18 degrees Celsius. The higher number of degree-days, the colder the year. In Table 19 and Table 20 sources that are affected by normalization are underlined. As well, the standardized degree-days as calculated by Enbridge's Gas Supply Department are displayed.

Figure 5 illustrates how normalization smoothes the customers' annual emissions.

Table 19: Company Emissions Without Normalization

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Heat	12.86	19.25	12.54	14.94	13.12	9.55	10.40	8.97	12.01
Fleet (gasoline)	6.67	6.45	6.31	6.14	5.82	6.01	6.85	6.30	6.12
Fleet (natural gas)	4.04	4.53	4.80	5.20	5.46	5.97	6.56	7.21	7.38
Fugitive Equipment Emissions	60.07	61.88	63.72	65.58	67.42	69.30	71.28	73.28	75.12
Fugitive Pipeline Emissions	287.59	281.37	272.64	267.01	260.43	250.73	229.65	218.34	208.33
Process Venting	20.14	20.06	18.44	16.40	14.55	6.80	4.25	3.64	3.47
Third Party Damages	8.95	7.37	7.19	6.78	7.83	7.52	7.54	8.94	9.50
Other	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Venting - TGSF	2.76	2.21	4.39	1.34	3.10	33.41	4.09	2.85	3.00
Flaring - TGSF	0.00	0.00	0.00	0.00	0.00	0.33	1.86	0.24	0.49
Compressors - TGSF	25.45	22.51	27.39	24.96	25.99	22.63	29.41	28.41	17.62
Total - Direct	**428.63**	**425.73**	**417.51**	**408.45**	**403.83**	**412.36**	**371.99**	**358.30**	**343.16**
Electricity	11.64	10.33	7.43	4.92	3.87	3.90	4.72	6.95	10.74
Total - Indirect	**11.64**	**10.33**	**7.43**	**4.92**	**3.87**	**3.90**	**4.72**	**6.95**	**10.74**
Grand Total	**440.27**	**436.06**	**424.94**	**413.37**	**407.70**	**416.26**	**376.71**	**365.25**	**353.90**
Tree Planting	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.04	-0.04	-0.04
Net Emissions	**440.27**	**436.06**	**424.94**	**413.36**	**407.68**	**416.24**	**376.67**	**365.21**	**353.86**
Emission Intensity (t CO2e / Mm3)	42.85	46.91	42.56	40.20	38.50	40.63	33.28	32.26	33.43
Degree-days	**3,918**	**3,574**	**3,939**	**4,042**	**4,275**	**3,747**	**4,209**	**4,011**	**3,352**

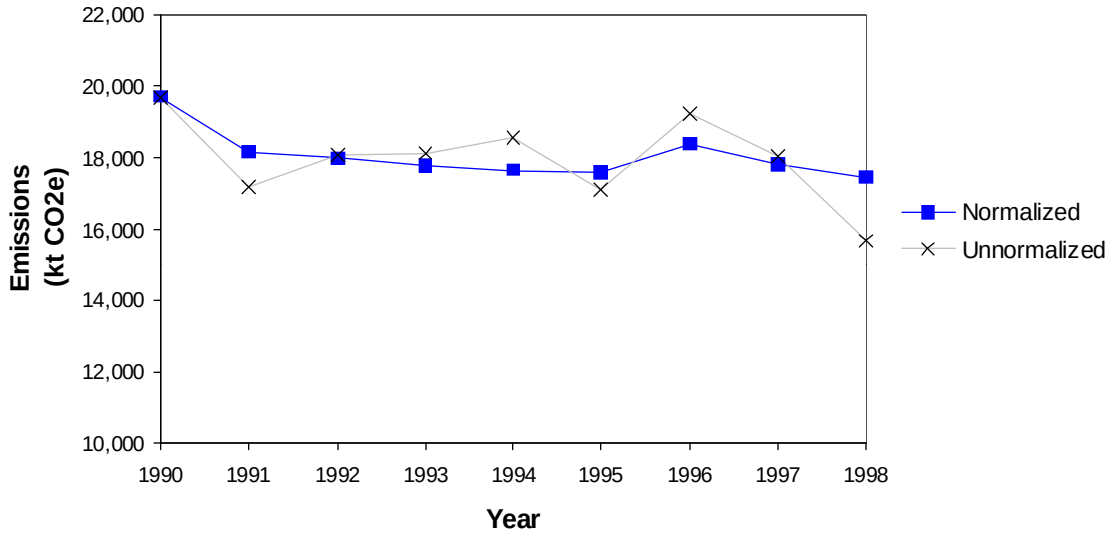
Note: The underlined sources are affected by normalizaton

Table 20: Customer Emissions Without Normalization

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Emissions (kt CO2e)								
Residential	6,383	5,850	6,472	6,578	6,919	6,602	7,735	7,589	6,946
Apartment	2,035	1,934	2,094	2,118	2,208	2,118	2,324	2,324	2,121
Commercial	5,413	4,990	5,340	5,233	5,377	5,107	5,768	5,667	5,143
Industrial	5,545	4,739	4,883	4,889	4,750	4,694	4,777	4,940	4,882
NGV	15	26	35	41	43	33	35	50	31
Cogeneration	1	7	26	553	696	785	728	802	862
Curtailment	293	13	60	115	450	37	691	248	5
Emissions with Actions	**19,685**	**17,560**	**18,910**	**19,528**	**20,444**	**19,378**	**22,058**	**21,620**	**19,989**
NGV (gasoline saved)	0	-11	-22	-29	-30	-20	-22	-38	-17
Fuel Switching (oil saved)	0	-293	-639	-1,068	-1,466	-1,809	-2,206	-2,591	-2,882
Fuel Switching (electricity saved)	0	-89	-155	-186	-225	-285	-400	-656	-989
Cogeneration (electricity saved)	0	-3	-9	-144	-160	-185	-198	-304	-443
Emissions with Offsets	**19,685**	**17,164**	**18,085**	**18,101**	**18,563**	**17,080**	**19,233**	**18,031**	**15,658**
Emission Intensity (kt CO2e / Mm3)	1.916	1.846	1.811	1.760	1.753	1.667	1.699	1.593	1.479
Degree-days	**3,918**	**3,574**	**3,939**	**4,042**	**4,275**	**3,747**	**4,209**	**4,011**	**3,352**

Note: The underlined sources are affected by normalizaton

Figure 5: Normalized Versus Non-normalized Customer Emissions



12. Appendix III – Customer Utilization of DSM Programs

Program	1998 Results	Future Actions
Existing Homes Water conservation Water heating efficiency Space heating efficiency Thermal envelope improvements	292,651 participants 19.05 Mm^3 (35.94 kt CO_2e) saved	1999 – 244,000 participants 1999 – 16.20 Mm^3 (30.38 kt CO_2e) saved
New Homes Water heating efficiency Space heating efficiency Thermal envelope improvements Gas appliances and fireplaces	56,491 participants 2.72 Mm^3 (5.13 kt CO_2e) saved	1999 – 47,100 participants 1999 – 2.31 Mm^3 (4.34 kt CO_2e) saved
Commercial Boiler efficiency Custom energy efficiency projects	53 participants 1.83 Mm^3 (3.46 kt CO_2e) saved	1999 – 44 participants 1999 – 1.56 Mm^3 (2.94 kt CO_2e) saved
Multi-Residential Boiler efficiency Custom energy efficiency projects Air conditioning efficiency	68 participants 2.65 Mm^3 (4.99 kt CO_2e) saved	1999 – 57 participants 1999 – 2.25 Mm^3 (4.25 kt CO_2e) saved
New Building Construction Boiler efficiency Workshops, education	2 participants 0.07 Mm^3 (0.13 kt CO_2e) saved	1999 – 0 participants 2000 – 65 participants 2000 - 0.26 Mm^3 (0.49 kt CO_2e) saved
Industrial Custom energy efficiency projects Workshops, education	46 participants 9.95 Mm^3 (18.77 kt CO_2e) saved	1999 – 38 participants 1999 – 8.46 Mm^3 (15.96 kt CO_2e) saved
Agriculture Custom energy efficiency projects Space heating efficiency Water heating efficiency Cogeneration		1999 – 4 participants 1999 – 0.45 Mm^3 (0.85 kt CO_2e) saved
Total	**1998 Actuals** **349,309 participants** (83% of budget) **36.19 Mm^3** (43% of budget) **68.29 kt CO_2e saved**	**1999 Budget** **291,258 participants targeted** **31.22 Mm^3 savings** **58.93 kt CO_2e savings**

13. Appendix IV - Historical and Projected Emissions by Gas Type

Table 21: Company Emissions With Actions by Gas Type

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Emissions (kt)																				
CO2	**59.42**	63.03	57.05	54.50	52.08	47.10	57.58	56.08	**53.70**	61.17	62.07	63.42	66.52	69.13	70.09	71.09	72.18	73.29	74.40	75.60	76.88
CH4	**18.116**	17.805	17.498	17.060	16.883	17.574	15.154	14.696	**14.334**	13.837	13.338	12.841	12.344	11.848	11.351	10.856	10.360	9.865	9.371	8.877	8.384
N20	**0.0013**	0.0013	0.0012	0.0012	0.0011	0.0011	0.0013	0.0013	**0.0013**	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015
CO2e	**440.27**	**437.36**	**424.89**	**413.12**	**406.96**	**416.51**	**376.21**	**365.08**	**355.09**	**352.16**	**342.59**	**333.50**	**326.18**	**318.38**	**308.92**	**299.51**	**290.20**	**280.92**	**271.66**	**262.49**	**253.41**

Table 22: Company Emissions Without Actions by Gas Type

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Emissions (kt)																				
CO2	**59.42**	63.24	57.62	55.20	52.86	52.65	62.31	64.26	**58.85**	68.57	69.89	71.39	74.64	77.40	78.50	79.64	80.85	82.09	83.32	84.64	86.05
CH4	**18.116**	18.126	18.265	18.155	18.273	19.879	19.100	18.461	**18.598**	18.707	18.870	19.032	19.194	19.356	19.518	19.680	19.842	20.005	20.167	20.329	20.491
N20	**0.0013**	0.0014	0.0013	0.0013	0.0012	0.0013	0.0015	0.0015	**0.0015**	0.0016	0.0017	0.0017	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019	0.0019	0.0020
CO2e	**440.27**	**444.30**	**441.57**	**436.84**	**436.98**	**470.50**	**463.87**	**452.41**	**449.88**	**461.92**	**466.66**	**471.58**	**478.25**	**484.43**	**488.95**	**493.50**	**498.12**	**502.77**	**507.41**	**512.14**	**516.97**

Table 23: Customer Emissions With Actions by Gas Type

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Emissions (kt)																				
CO2	**19,608**	18,074	17,929	17,672	17,538	17,494	18,332	17,713	**17,358**	17,223	17,332	17,384	18,042	18,549	18,511	18,496	18,442	18,402	18,372	18,399	18,443
CH4	**0.5998**	0.6498	0.7134	0.7468	0.7308	0.6338	0.6361	0.7592	**0.5721**	0.6857	0.6807	0.7839	0.8794	0.9612	0.9902	1.0237	1.0604	1.1014	1.1467	1.1977	1.2532
N20	**0.2071**	0.1935	0.1933	0.1919	0.1911	0.1959	0.2029	0.1978	**0.1950**	0.1939	0.1970	0.1978	0.2005	0.2027	0.2032	0.2038	0.2037	0.2035	0.2034	0.2039	0.2044
CO2e	**19,685**	**18,148**	**18,004**	**17,747**	**17,613**	**17,568**	**18,409**	**17,790**	**17,430**	**17,298**	**17,408**	**17,462**	**18,123**	**18,632**	**18,595**	**18,581**	**18,527**	**18,488**	**18,459**	**18,487**	**18,532**

Table 24: Customer Emissions Without Actions by Gas Type

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Emissions (kt)																				
CO2	**19,608**	18,662	19,094	19,684	20,120	20,804	22,423	23,076	**24,069**	24,612	25,252	26,116	28,649	30,745	31,296	31,857	32,396	32,957	33,508	34,057	34,662
CH4	**0.5998**	0.5979	0.6244	0.6579	0.6797	0.7185	0.7587	0.7982	**0.8341**	0.8592	0.8881	0.9219	0.9857	1.0402	1.0647	1.0886	1.1113	1.1340	1.1562	1.1780	1.2008
N20	**0.2071**	0.1979	0.2007	0.2051	0.2052	0.2131	0.2250	0.2363	**0.2483**	0.2538	0.2582	0.2677	0.3004	0.3271	0.3323	0.3378	0.3432	0.3491	0.3549	0.3607	0.3672
CO2e	**19,685**	**18,736**	**19,169**	**19,762**	**20,198**	**20,885**	**22,509**	**23,166**	**24,164**	**24,709**	**25,351**	**26,219**	**28,763**	**30,869**	**31,421**	**31,985**	**32,526**	**33,089**	**33,643**	**34,194**	**34,801**

14. Appendix V – Constants and Variables

14.1 Constants

	Natural Gas (industrial)	Natural Gas (commercial and residential)	Light Oil (residential)	Coal (average)
CO_2	1,880 g/m^3	1,880 g/m^3	2,830 g/l	2,500 g/kg
CH_4	0.048 g/m^3	0.043 g/m^3	0.214 g/l	0.015 g/kg
N_2O	0.020 g/m^3	0.020 g/m^3	0.006 g/l	0.050 g/kg
CO_2e	**1,887 g/m^3**	**1,887 g/m^3**	**2,836 g/l**	**2,516 g/kg**
Energy	0.03723 GJ/m^3	0.03723 GJ/m^3	38.68 GJ/m3	27.7 GJ/t

	Automobile (gasoline)	Automobile (natural gas)
CO_2	2,360 g/l	1.880 g/l
CH_4	0.250 g/l	0.022 g/l
N_2O	0.210 g/l	0.000 g/l
CO_2e	**2,430 g/l**	**2.361 g/l**
Energy	34.66 GJ/m3	0.03723 GJ/m3

14.2 Variables

Table 25: Ontario Gross Emission Intensities

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
t CO2e / MWh	0.28	0.26	0.21	0.15	0.13	0.17	0.20	0.27	0.33	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.33	0.33
t CO2e / TJ	77.78	71.94	57.37	41.09	36.72	47.92	56.25	73.77	92.25	88.12	85.15	85.45	85.77	86.09	86.41	86.74	87.76	88.77	89.76	90.75	91.72

From Ontario Hydro past Action Plans. Assumes that Ontario Hydro meets its published net emission goals without adding generation capacity to meet demand. Emission reductions from offsets and activities are added to net emissions. Addition generation to meet demand is met by other natural gas-fired generation stations.

Table 26: Ontario Net Emission Intensities

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
t CO2e / MWh	0.28	0.26	0.21	0.15	0.13	0.13	0.15	0.21	0.29	0.27	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.28	0.28
t CO2e / TJ	77.78	71.94	57.37	40.99	36.17	37.08	42.74	59.64	80.88	74.18	70.48	70.70	70.94	71.18	71.44	71.70	72.92	74.12	75.30	76.47	77.62

From Ontario Hydro past Action Plans. Assumes that Ontario Hydro meets its published net emission goals without adding generation capacity to meet demand. Addition generation to meet demand is met by other natural gas-fired generation stations.

Table 27: Automobile Fuel Efficiencies

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Litres / 100 km	10.60	10.45	10.30	10.15	10.00	10.00	9.94	9.88	9.82	9.76	9.70	9.64	9.58	9.52	9.46	9.40	9.34	9.28	9.22	9.16	9.10

Data from Transport Canada and Canada's Energy Outlook 1996-2020 (NRCan). Values interpolated where necessary.