Environmental Labelling for Hydrogen in Canada

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Prepared for:

Canadian Transportation Fuel Cell Alliance

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Executive Summary

Industry and governments are positioning hydrogen as a new, clean solution to the problems associated with conventional fuels. An environmental label is one method of marketing the environmental benefits of hydrogen and will likely be used wherever it proves beneficial. Environmental labels have often been voluntarily adopted for marketing purposes. However, it has become increasingly important to develop clear guidelines for products to help consumers make informed purchases because the wide variety of environmental statements currently in the marketplace can be misleading and lack credibility. An environmental label's value depends directly on consumers' trust in the label.

This report has several objectives:

- to summarize the existing environmental label mechanisms used for other products;
- to identify and evaluate different environmental label options for hydrogen fuel; and
- to recommend how Canadian companies and government should proceed in developing a label for hydrogen fuel.

First, a variety of existing labelling standards was reviewed; these standards are summarized in Table E1. It should be noted that, at this time, no environmental labelling standards for hydrogen were identified anywhere in the world.

Table E1: Summary of Environmental Label Types

ISO* Type 1 label • Indicates environmental preferability within a sector. • Based on life-cycle performance of pre-defined and weighted set of core environmental attributes. • Independently verified. • E.g., Environmental Choice EcoLogo — provides logo to top performers.
ISO Type 2 label • Environmental declaration made by manufacturers/importers/distributors. • Based on a single attribute. • Not independently verified. • Declaration may be defined by a regulatory body. • E.g., "green power," "recycled content," or "biodegradable."
ISO Type 3 label • Comprehensive data list that gives environmental information on a product, similar to a nutritional label for food. • Based on life-cycle performance of pre-defined and weighted set of core environmental attributes. • Independently verified. • E.g., Environmental Profile Data Sheet — used by the pulp and paper industry in Canada.
Performance standard • Indicates environmental preferability within a sector. • Based on a single performance standard. • Independently verified. • E.g., Energy Star — provides logo to top products based on energy efficiency

*ISO = International Organization for Standardization

Different combinations of these label types are also used. For example, EnerGuide labels address a single attribute similar to a performance standard, but provide explicit data on the attribute, similar to a Type 3 label, which the consumer can use in making a value judgment.

Next, a set of criteria for evaluating potential options for environmental labelling standards for hydrogen was defined as summarized in Table E2. These criteria and the subsequent evaluation consider the primary purpose of a hydrogen label, the prospective audience (the general public and sophisticated consumers such as commercial customers), and timing (short and long term).

Table E2: Proposed Evaluation Criteria for Potential Environmental Labelling Standards for Hydrogen

Clarity • The consumer needs to be able to easily understand the label.
Credibility • The consumer needs to understand, recognize, and acknowledge the label and the value it represents (i.e., its ability to protect the environment).
Comprehensiveness • The label needs to address information that is of most concern to the consumer.
Balance between stringency and inclusiveness • The label must be stringent enough to create an incentive and value for the consumer; yet it must not be so stringent that companies cannot meet the criteria, resulting in the label not obtaining adequate adoption.
Ease of implementation • Labelling procedures should not be a prohibitive factor for companies to join the program.

Table E3 outlines a range of potential environmental labels for hydrogen in Canada and offers a preliminary evaluation of whether each one would be a suitable standard to pursue based on the above criteria. This range is intended to cover the spectrum of environmental labels outlined in Table E1 in order to identify many possible alternatives for discussion purposes. Overall, each standard has advantages and disadvantages, which are discussed in more detail in Section 4.

Table E3: Potential Environmental Labelling Standards for Hydrogen

Label Description	Recommendation	Primary Reasons for Recommendation
Environmental Choice EcoLogo (Type 1) — Renewable Low-impact	Recommended for consideration	• Relatively simple and well known • High credibility
Descriptive (Type 3) — Detailed	Recommended for consideration for sophisticated consumers	• Level of detail promotes well-informed decisions • Consumers make value judgments
Descriptive — Simple	Recommended for consideration with precautions	• Consumers make value judgments without requiring high level of knowledge • Consequences of not including some attributes requires consideration

Environmental Choice EcoLogo (Type 1) — Top 20% of Performers	Not recommended	• Difficulty defining top 20% of performers • Uncertain credibility for consumers based on expectations for standard similar to EcoLogo for electricity
Green Leaf (graduated label using an evaluation similar to Type 1, but inclusive to all)	Not recommended	• Graduated labelling of hydrogen may cause confusion • Complexity of ranking multiple levels of performance
Self-defined (Type 2 — currently used)	Not recommended	• Lower credibility than regulatory-defined and third-party-verified standards • Potential consumer confusion • Typically not comprehensive
Regulatory-defined (Type 2)	Not recommended as a first alternative	• Typically not comprehensive • Type 1 label offers more credibility • Preferred over self-defined Type 2 if no other standard established
Performance standard	Not recommended	• Limited comprehensiveness and credibility

From this analysis, five potential alternatives for proceeding remained for consideration in the short term. It should be noted that it may be viable to pursue more than one alternative.

1. The first alternative is to not establish a standard at all. In this case, marketers will likely use self-defined, self-verified (Type 2) labels to promote hydrogen based on its environmental benefits. However, it is recommended that standardized labels be established before confusion is generated regarding the credibility of self-defined labels, particularly concerning their comprehensiveness and confidence in the source of information. Credibility issues could significantly weaken the potential to successfully market hydrogen based on its environmental benefits into the future.

2. Implementing the Environmental Choice EcoLogo standard, using renewable low-impact energy criteria, will offer a very high-quality product that won't discourage consumers with weaker labels of lower value. The implementation process for such a label could begin immediately. One important drawback for such a standard, which should be considered, is its exclusivity. Environmental Choice renewable low-impact electricity is currently targeted for 1% to 2% of the market. In an emerging market, this type of label would likely be used in niche applications to educate the public about the potential for hydrogen to provide low-impact renewable fuel.

3. For more sophisticated consumers, a descriptive label can be used. This would allow certain consumers to make their own judgments about the type of hydrogen they wish to purchase and would serve to increase consumer knowledge regarding the environmental attributes of hydrogen.

4. A more inclusive and accessible label for hydrogen in an emerging market is a simple descriptive label. This label could be applied to all hydrogen fuel products and offer valuable information to general consumers about the environmental attributes of the hydrogen available for purchase. However, since only a few attributes are listed, careful consideration must be given to those attributes not included to assess the impact this will have on the label's effectiveness.

5. If no other standard is established, a regulatory-defined, self-verified (Type 2) label is a preferred alternative to the self-defined, self-verified label. This may avoid some of the credibility issues associated with a self-defined label, depending on how well the regulatory body defines the label and how effectively the information is communicated. The credibility and comprehensiveness of a regulatory-defined, self-verified label are not as great as for the other options identified above.

Following a review of a draft report, three more alternatives for proceeding were developed. These were based on feedback received that was not initially considered as it lay outside the scope of the study. Once again, each of these alternatives may be pursued in parallel with others. It is recommended that studies similar to this one be performed to examine these three alternatives in detail. The information thus gathered could then be used to inform decisions regarding the first five alternatives in pursing a labelling standard for hydrogen alone.

1. An environmental labelling standard for all fuels may be more appropriate to pursue at this time than a standard for hydrogen. The usefulness of an environmental labelling standard for hydrogen alone is potentially limited in an immature market. It may take 10 to 20 years before hydrogen, as a fuel, is common enough in the marketplace that the average consumer will be able to differentiate between its various methods of production. However, the opportunity to choose between hydrogen and other fuels will be presented to consumers much sooner than this and is of much greater concern to industry players at this time.

2. An environmental label on products such as vehicles concerning both operating and fuel-cycle impacts could be used instead of a fuel label as this is the ultimate point of fuel selection for most products. The existing EnerGuide label for vehicles could be adapted to include more than just energy consumption, or a new label all together could be established.

3. A broader marketing strategy for hydrogen and the products that use hydrogen, such as fuel cell vehicles, would assist in identifying how various marketing mechanisms, including environmental labelling, should be pursued. Undoubtedly, each company will have its own strategy for the future, but there is benefit to understanding how governments, industry associations and non-governmental organizations can encourage their adoption through market mechanisms, advertising, education, and labelling standards among others in both emerging and established markets.

The next steps proposed for pursuing environmental labels for hydrogen in Canada are as follows:

- industry and government should consider the alternatives presented in this paper; and
- interested groups should pursue the development of a labelling standard that meets their needs at an appropriate time in the development of a retail hydrogen market. A single co-ordinated effort is recommended to reduce consumer confusion.

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1. Introduction

Industry and governments are positioning hydrogen as a new, clean solution to the problems associated with conventional fuels. An environmental label is one method of marketing the environmental benefits of hydrogen and will likely be used wherever it proves beneficial. Standards and guidelines have become necessary to differentiate between electricity sources that have a low environmental impact and conventional electricity sources, and it is expected that the same trend will occur for hydrogen. The primary purpose of marketing hydrogen using environmental labels is to encourage consumers to purchase environmentally friendly hydrogen. Environmental labels have often been voluntarily adopted for marketing purposes. However, it has become increasingly important to develop clear guidelines for products to help consumers make informed purchases because the wide variety of environmental statements currently in the marketplace can be misleading and lack credibility. An environmental label's value depends directly on consumers' trust in the label. At this time, no environmental labelling standards for hydrogen were identified anywhere in the world.

The Canadian Transportation Fuel Cell Alliance (CTFCA) is interested in investigating environmental labelling options for hydrogen to further its mandate of developing a hydrogen fuelling infrastructure for fuel cell vehicles. Environmental labelling will play a small but possibly important role in retail consumer acceptance of hydrogen, as it can be used to differentiate environmentally friendly hydrogen from other sources of hydrogen and from other fuels. One of the primary drivers for using hydrogen as a fuel is its potential to reduce the environmental impact of conventional fuels. Producers and retailers can make hydrogen a more attractive choice than conventional fuels by applying effective marketing labels to hydrogen products.[1]

Eco-labels can serve to educate the public about labelled products. First, people must be educated about the value and meaning of the environmental label itself. Once the public understands the label's meaning, it becomes possible to achieve consumer awareness about the environmental issue the label is addressing. There is then an information gathering stage, as outlined by Consumers International, during which consumers achieve greater understanding of the issue and their ability to act. Action in the marketplace can then lead to long-term changes in consumption behaviour.[2]

This report provides background information and context for the development of an environmental labelling standard for hydrogen in Canada. The paper begins with background on environmental labelling, including its history and the International Organization for Standardization (ISO) framework. It then introduces a sample of environmental labelling standards in Canada. Next, a range of potential hydrogen labelling alternatives are presented and evaluated based on defined evaluation criteria. Finally, recommendations of next steps are made.

This report focuses on hydrogen gas as a fuel. However, the argument can be made that other materials, such as methanol, chemical hydrides, or even gasoline, can act as hydrogen carriers, and thus should not be excluded from any labelling standard. These other forms of hydrogen should be taken into consideration when developing a standard. Whether any or all of these fuels are included will depend on how inclusive the environmental labelling standard is, as will be discussed further in Section 4.3, Next Steps.

[1] Labelling is one of a broad range of policies, including regulations and incentives, that may be required to increase the attractiveness of using environmentally friendly hydrogen.
[2] Commission for Environmental Cooperation. 1999. *Supporting Green Markets: Environmental Labeling, Certification and Procurement Schemes in Canada, Mexico and the United States*. Montreal: CEC.

2. Environmental Labelling Overview

2.1 The Value of Environmental Labels

Environmental labels provide products with certification, through a symbol or list of performance criteria that indicates the environmental attributes of the product to the purchaser. Thus, environmental labels act to increase environmental awareness among consumers.[3]

According to the International Organization for Standardization (ISO), the goal of environmental labelling is to encourage supply and demand for products and services that cause less stress on the environment, through a means of communication that is verifiable, accurate, and not misleading. This will then stimulate market-driven continuous environmental improvement.[4]

Some argue that voluntary labelling schemes could eventually remove the need for regulatory schemes.[5] In theory, consumer demand for environmental labels could drive companies to meet particular environmental standards included within the labelling criteria in order to maintain market share, thus resulting in reduced environmental impact by participating companies. Labelling standards could also be made continuously more stringent, resulting in continuous improvement of environmental protection. However, studies have shown that market response to environmental labels varies, and may largely depend on the marketing of the label,[6] consumer environmental awareness, label credibility, and product price, thus limiting the effectiveness of labels when compared to government regulations. As well, labels that are exclusive by nature and target only top performing products cannot replace regulations designed to affect entire industries.

Labels can provide substantial value to stakeholders from a variety of perspectives, as summarized in Table 1.

Table 1: Value of Environmental Labelling

Stakeholder	Value of Environmental Labelling
Consumer	• increased awareness of environmental issues • increased product information resulting in more informed choices • greater ability to influence the market • reduced environmental impact
Product/service manufacturer	• differentiation to increase market share • differentiation to obtain a premium price • potential for technology advancement • possibility of creating a market niche • reduced environmental impact
Financial community	• improved ability to make corporate predictions of long-term performance based on environmental performance • may impact insurance, financing and stock valuation
Retailer	• increased ability to provide information to consumers

[3] Rotherham, Tom. 1999. *Selling Sustainable Development: Environmental Labelling and Certification Programs.* Miami: Dante B. Fascell North-South Center, University of Miami.
[4] ISO 14001 on Global Ecolabelling Network Web site. 2003. www.gen.gr.jp/publications.html.
[5] Rotherham, Tom. 1999. Selling *Sustainable Development: Environmental Labelling and Certification Programs.* Miami: Dante B. Fascell North-South Center, University of Miami.
[6] United States Department of Energy. 2001. *Energy Star Program: Partner Satisfaction — Draft of Final Report 2001.* Washington, DC: US Department of Energy.

	• positive image • competitive advantage • reduced environmental impact
Government	• a tool to drive forward government green procurement initiatives • international recognition • opportunities for international networks and further trade harmonization • increased voluntary environmental initiatives from industry • greater ability to meet Kyoto targets • a tool to standardize market information about a product • reduced environmental impact
ENGOs	• ability to drive voluntary environmental standards through label development • increased transparency from industry • a tool to measure relative environmental performance of companies • reduced environmental impact

Value in the Marketplace

Understanding the value placed on environmental labels in the marketplace may be key to evaluating the effectiveness of the label. Studies have been inconclusive as to whether sales of a product increase when an eco-label is used, though some anecdotal evidence suggests a positive correlation.[7] Some studies have shown that as little as 8% of the population is willing to pay more for a product with an environmental label.[8] This may change over time as eco-labelling finds its place in the market. Consumers International (CI) has developed an evolutionary pathway for eco-labelled products that indicates there are three distinct potential outcomes for an eco-label in the marketplace.

1. Market Standard: Eco-label is widely accepted and becomes a market standard. Competitors must obtain a label to successfully enter the market.
2. Market Niche: Eco-label is viable, but not widely accepted. A market niche for labelled goods develops and may be profitable.
3. Market Failure: Consumers do not accept the label, and it fails.

Consumers International predicts that most eco-labelling programs will only reach the Market Niche level, without advancing to the Market Standard stage. This is because current consumer awareness of the value of environmental labels is relatively low.[9] Eco-label awareness was shown to be higher when both the media and consumer groups advocated for label recognition.[10]

2.2 History of Environmental Labelling Standards in Canada

Environmental labelling standards in Canada have their roots in the Environmental Choice EcoLogo, a 1988 federal government initiative. The EcoLogo was among the first national environmental labelling

[7] Commission for Environmental Cooperation. 1999. *Supporting Green Markets: Environmental Labeling, Certification and Procurement Schemes in Canada, Mexico and the United States.* Montreal: CEC.
[8] Commission for Environmental Cooperation. 1999. *Supporting Green Markets: Environmental Labeling, Certification and Procurement Schemes in Canada, Mexico and the United States.* Montreal: CEC.
[9] Commission for Environmental Cooperation. 1999. *Supporting Green Markets: Environmental* Labeling, Certification and Procurement Schemes in Canada, Mexico and the United States. Montreal: CEC.
[10] Organisation for Economic Co-operation and Development. 1997. *Eco-labelling: Actual Effects of Selected Programmes.* OCDE/GD (97) 105.

programs in the world, following in the footsteps of the German Blue Angel Label, created in 1977,[11] and leading the way for the Nordic Swan (1989), the U.S. Green Seal (1990), and the French NF Environment Label (1991). Since then, a number of other countries have developed tailored environmental labelling systems. Twenty-five nations are represented in the Global Ecolabelling Network (GEN),[12, 13] a non-profit association founded in 1994 with a mandate to "improve, promote, and develop the ecolabeling of products and services." Members of GEN include third-party ISO Type I environmental labelling organizations. Environmental Choice is also a member of GEN.

To address a growing need for environmental management standardization, ISO created a task committee, TC 207, to develop environmental management standards. Canada was chosen to manage TC 207 because of its previous experience with environmental management systems. The Canadian Standards Association administers the program. A subgroup of TC 207, called TC 207 SC3, was formed specifically to develop standards for eco-labelling. In 1997, this subgroup published guidelines and standards for developing an environmental labelling program. The Standards Council of Canada subsequently adopted these guidelines and standards as the Canadian National Standards. TC 207 SC3 continues to publish guidelines on eco-labelling as the needs of programs evolve and change. With the ISO guidelines leading the way, variations of voluntary labelling programs developed in Canada, alongside EcoLogo.

Energy Star is a performance standard label that considers the energy efficiency of a product. It was developed independently from EcoLogo, initiated instead in the United States in 1992 to address growing concerns regarding greenhouse gas emissions and energy security, and brought to Canada in 2001.

2.3 Label Types and Definitions

Numerous labels exist worldwide, but each generally falls into one of three categories, based on the ISO labelling standards. These standards are the only generic, international method of standardizing and classifying environmental labels,[14] have strengthened the credibility of environmental labelling schemes, and have been adopted worldwide. The authors view them as the most appropriate system by which to organize the various label types within this report. However, the commonly used "performance standard" label does not fit within the ISO classification and is therefore discussed separately.

2.3.1 Type 1 Labels

ISO defines a Type 1 label system as a:

> …voluntary, multiple-criteria-based third party programme that awards a licence which authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations.[15]

[11] Kevin Gallagher, Vice President, TerraChoice Environmental Services Inc., personal communication, 28 March 2003. kgallagher@terrachoice.com.
[12] Global Ecolabelling Network. www.gen.gr.jp/eco.html.
[13] Global Ecolabelling Network. www.gen.gr.jp/eco.html.
[14] Rotherham, Tom. 1999. *Selling Sustainable Development: Environmental Labelling and Certification Programs*. International Institute for Sustainable Development. Miami: Dante B. Fascell North-South Center, University of Miami.
[15] CAN/CSA-ISO 14024-99 *Environmental Labelling and Declarations – Type I Environmental Labelling – Principles and Procedures.*

Type 1 labels provide consumers with product information without requiring them to have extensive knowledge and understanding of the environmental attributes of the product in order to make informed decisions. This provides clarity for consumers, and the label is a credible source of information because it must be comprehensive and verified. Since a certifying body is involved, there is usually a cost associated with obtaining the label.

Type 1 labels are also known as an "eco-labels" and, as mentioned, a number of them exist worldwide. The Global Ecolabelling Network (GEN) is an international organization that monitors Type 1 labels and has a mandate to harmonize the different versions for trade purposes. The ISO guidelines for Type I criteria development are intended to "provide uniformity while allowing decision on the final criteria to be the result of the consultation process between the ecolabelling body and interested parties."[16] Guidelines must include life-cycle considerations and demonstrate validity, transparency, and accessibility, among other requirements. As there is inherent flexibility in the ISO labelling standards, and because the environmental issues that are perceived to be most relevant are highlighted in the label criteria, it is plausible that there would be many variations of a Type 1 label for a given product. This can lead to consumer confusion when products containing international labels are imported, unless it is clear how the labels can be compared. One of the goals of the Global Ecolabelling Network is to create greater harmonization among international Type 1 labels.[17]

Trade issues may also be of concern. Certification criteria that involve the production processes may favour conditions in the importing country to the exclusion of developing countries, creating an unfair disadvantage. The quantity of products with criteria that specify production processes is an indicator of trade effect, as many products are produced in developing countries before arriving in the country of sale. In the past, production processes of the life cycle were not emphasized in most criteria, particularly for the Canadian EcoLogo. However, current information indicates that production is being included to a greater degree.[18] Thus, trade issues as a result of environmental labelling should be given continued attention, especially as international awareness of environmental labelling continues to grow.

Inherent subjectivity in label criteria development could be considered a drawback, because cultural, social, and political biases are not communicated to the consumer. Multistakeholder dialogue during criteria selection may help ensure that well-rounded criteria are developed.

In Canada, the Environmental Choice EcoLogo is an example of a Type 1 label. This label is described in a case study in Section 3.

2.3.2 Type 2 Labels

The ISO guidelines define Type 2 labels as "informative environmental self-declaration claims,"[19] meaning that the producers establish the labels themselves. There is no requirement that they be independently verified, or that predetermined or accepted criteria be used as reference points. Since there is no certifying body, there are no regulatory costs associated with using the label. Type 2 labels usually address a single issue without detailed consideration of the life cycle of the product. While the message may be easy for the consumer to understand, such as "green power," "recycled content," "phosphate-free," or "biodegradable," its usefulness and credibility are limited. This is especially true

[16] CAN/CSA-ISO 14024-99 *Environmental Labelling and Declarations – Type I Environmental Labelling – Principles and Procedures*.
[17] Kevin Gallagher, Vice President, TerraChoice Environmental Services Inc., personal communication, 28 March 2003. kgallagher@terrachoice.com.
[18] Kevin Gallagher, Vice President, TerraChoice Environmental Services Inc., personal communication, 28 March 2003. kgallagher@terrachoice.com.
[19] Global Ecolabelling Network. www.gen.gr.jp/eco.html.

when consumers have a high degree of environmental knowledge and are sceptical of non-verified claims.[20] Label credibility may be increased if claim definitions are outlined at the federal level. For example, the U.S. Federal Trade Commission's (FTC's) "Guides for the Use of Environmental Marketing Claims" define the use of terms such as "EcoSafe" and "Biodegradable." While the guides are not regulatory, they do provide marketers with a reference point for making environmental claims. They are reviewed and petitions may be made for new guides.[21] In Canada, the Consumer Bureau publishes "Principles and Guidelines for Environmental Labelling and Advertising," which outlines the following principles for green marketing labels:[22]

> *1)* Those making environmental claims are responsible for ensuring that any claims and/or representations are accurate, and in compliance with the relevant legislation.
>
> *2)* Consumers are responsible, to the extent possible, for appropriately using the information made available to them in labelling and advertising, thereby enhancing their role in the marketplace.
>
> *3)* Environmental claims and/or representations that are ambiguous, vague, incomplete, misleading, or irrelevant, and that cannot be substantiated through credible information and/or test methods should not be used.
>
> *4)* Claims and/or representations should indicate whether they are related to the product or the packaging materials.

There are many examples of Type 2 labels in Canada, including "green power," "recycled content," and "biodegradable."

2.3.3 Type 3 Labels

Type 3 labels are similar to food labels in that they list data of interest to the consumer within established categories – in this case, categories of environmental attributes. The ISO guidelines define a Type 3 label as quantified environmental data that includes a set of minimum requirements, categories of parameters, a defined involvement of third parties, and a method of external communication. The parameters must be based on the ISO 140450 series of standards, though not to the exclusion of additional environmental information.[23]

Furthermore, the ISO guidelines recommend that the label be third-party verified (not necessarily by a certification body), that a life-cycle approach be used, and that interested parties have input into the process. Unlike Type 1 labels, these conditions are not mandatory.[24] The usefulness of the Type 3 label is that it provides a format that makes it possible to compare information about products without passing judgment on them, which allows the consumer to weigh the options. This label type may be most relevant for green procurement purchasing where there is a high level of knowledge about product production. Environmentally educated consumers may also find Type 3 labels useful; however, label

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[20] Rotherham, Tom. 1999. *Selling Sustainable Development: Environmental Labelling and Certification Programs*. Miami: Dante B. Fascell North-South Center, University of Miami.
[21] US Federal Trade Commission. 2003. *Guides for the Use of Environmental Marketing Claims*. Part 260. www.ftc.gov/bcp/grnrule/guides980427.htm.
[22] Consumer Bureau. 2003. *Principles and Guidelines for Environmental Labelling and Advertising*. strategis.ic.gc.ca/epic/internet/incb-bc.nsf/vwGeneratedInterE/cp01029e.html.
[23] International Organization for Standardization. 2000. *Environmental Labels and Declarations – Type III Environmental Declarations*. CAN/CSA-ISO/TR 14025-01.
[24] International Organization for Standardization. 2000. *Environmental Labels and Declarations – Type III Environmental Declarations*. CAN/CSA-ISO/TR 14025-01.

credibility and verification will likely be necessary for success. From an international perspective, Type 3 labels offer a level playing field within a product category, and harmonization would likely be less arduous than with a Type 1 label due to reduced cultural and social bias.

In Canada, the Environmental Profile Data Sheet (EPDS) used by the pulp and paper industry is an example of a Type 3 label.

Table 2: Summary of ISO Environmental Label Types[25]

	Type 1	Type 2	Type 3
Information on Label	Indicates environmental preferability within its sector.	Environmental declaration made by manufacturers/importers/ distributors.	Comprehensive data lists that give environmental information on a product throughout its life cycle.
Value Judgment	Certifying organization evaluates product. Customer chooses product because it has the label. Label is selective to products that meet criteria.	Consumer evaluates product based on declaration. Label is non-selective.	Consumer evaluates product based on data provided. Label is non-selective.
Verification	Third-party verified through a testing or auditing process	Not independently verified.	May be verified through a third-party audit.
Criteria	Based on LCA criteria.	Single issue/criterion.	May use an LCA approach.
Benefits	Clarity and ease of choice to the consumer.	Easy and free for manufacturers to adopt.	Label provides "unbiased" information.
Limitations	Label has inherent cultural, social, and environmental biases.	Credibility and consumer confusion over term definitions may result.	Higher level of consumer awareness needed for label to be meaningful.
Examples	• TerraChoice EcoLogo • Green Leaf Hotel Rating Program • CSA Mark • Green Seal (U.S.) • Blue Angel (Germany) • Nordic Swan (Scandinavia)	• Green Power • Recycled Content • Phosphate-free • Biodegradable	• Environmental Performance Data Sheets (EPDSs) • Environmentally Preferable Electricity Program (Scientific Certification Systems, U.S.)

2.3.4 Performance Standards

Performance standards are developed around a single criterion based on system performance. They are focused on product use, and do not include life-cycle information. They may or may not be verified. The Energy Star label is an example of a verified performance standard.

[25] Rotherham, Tom. 1999. *Selling Sustainable Development: Environmental Labelling and Certification Programs. International Institute for Sustainable Development*. Miami: Dante B. Fascell North-South Center, University of Miami.

3. Environmental Labelling Programs in Canada

This section describes some of the main environmental labelling programs in Canada, representing Type 1, Type 3, and performance standard labels.

3.1 Environmental Choice EcoLogo

The Environmental Choice EcoLogo is a Type 1 label that certifies products based on environmental attributes. The voluntary program was developed in 1988 by Environment Canada, and has been managed by TerraChoice Environmental Services Inc. since 1995. The EcoLogo symbol consists of three intertwining doves, representing government, business, and consumers. As of 2003, guidelines are in place for over 125 categories of products, including a guideline for electricity. Review committees – composed of representatives from business, academia, environmental organizations, consumers, trade unions, and federal, provincial, and/or municipal levels of government – develop guidelines based on life-cycle review, industry profile, economic analysis, and market assessment of the product category. The label cannot be granted without third-party verification, and TerraChoice randomly checks for compliance during the two years the label is valid. Labels are reviewed every two years, and requirements become more stringent if product market share has increased beyond the top 20% of products in the category. This ensures that the label is leading-edge. EcoLogo is marketed to consumers and to green procurement divisions through the *EcoBuyer* magazine, updated with regular postings. The EcoLogo is well known internationally and is a member of the Global Ecolabelling Network.

EcoLogo has established guidelines for products such as appliances, cleaning products, mutual funds, and electricity. The guidelines for electricity and ethanol-blended gasoline — energy products similar to hydrogen — will be looked at in more detail.

EcoLogo's Renewable Low-Impact Electricity guideline includes criteria for the following technologies: alternative-use electricity; biogas-fuelled electricity; biomass-fuelled electricity; solar-powered electricity; water-powered electricity; and wind-powered electricity. The guideline requires that there be consultation with community and stakeholders, that land-use issues be resolved, that generation be reliable and practical, that there be no adverse impacts to threatened species, and that there be no irreparable degradation to the production site. More specific criteria are provided for each type of electricity:[26]

Biogas-fuelled electricity:

- Operational air emissions of carbon monoxide (CO), particulate matter (PM), nitrogen oxides (NO_X, measured as NO_2), and sulphur oxides (SO_X, measured as SO_2) must not exceed a given level.

Biomass-fuelled electricity:

- Same operational air emissions requirements as biogas-fuelled electricity.
- If generated from wood wastes and/or agricultural wastes, the source must be from operations with a sound environmental management system and practices (a sustainable rate of harvest, and not using wastes from endangered species).

[26] Environmental Choice™ Program Certification Criteria Document CCD-003.

- If generated from clean biomass fuel sources, the facility must not emit polychlorinated dioxins or funans in excess of 100pg I-TEQ/m3 or limits specified in the "Canada Wide Standards for Dioxins and Furans."
- If generated from dedicated energy crops, the source must be from operations with a sound environmental management system and practices.

Solar-powered electricity:

- Adequate arrangements must be made for "proper disposal or recycling of all solid waste resulting from the generation of electricity, including the disposal of equipment or machinery used in the generation process itself that contains measurable levels of cadmium."

Water-powered electricity:

- Must operate in compliance with all regulatory licences pertaining to fisheries, water levels, and flows.
- Must not produce harmful alteration, disruption, or destruction of fish habitat.
- Must be co-ordinated with other water-control facilities that influence water levels and flows.
- As a maximum, must cause as much water to flow out of the head pond as is received in any 48-hour period.
- Reduced water flows must not harm indigenous aquatic and riparian species downstream.
- Water quality and changes in water temperature must not be detrimental to aquatic and riparian species.
- A fish passage must be provided when a human barrier is created to allow for migration.
- Must provide measures to minimize fish mortality.

Wind-powered electricity:

- The generating facility and structure must not be detrimental to indigenous or migratory avian species.
- It must not be located in a protected area for avian species designated as endangered or threatened.
- Its construction must not cause excessive soil erosion that would be harmful to aquatic or riparian species, and excavated soil must be replaced and uprooted vegetation replanted after construction or scrapping, where feasible.

The goal of these guidelines is to target 2% of the electrical load in Canada. To date, less than 1% of the load has been certified.[27] Note that greenhouse gas (GHG) emissions are not explicitly listed as criteria in the above guidelines due to the fact that the eligible technologies are already assumed to have very low life-cycle GHG emissions compared with conventional fossil fuel electricity sources.

The EcoLogo for ethanol-blended gasoline has been in place since 1992 and currently has five companies listed under the program. The environmental benefits of using the product are listed in the guideline as reducing both motor vehicle emissions and the use of non-renewable petroleum resources. Certification criteria include containing a minimum of 5% (by volume) biomass-derived ethanol, with the remainder being gasoline, and meeting the Canadian General Standards Board standard for oxygenated unleaded automotive gasoline containing ethanol (CAN/CGSB 3.511-M).[28]

[27] Kevin Gallagher, Vice President, TerraChoice Environmental Services Inc., personal communication, 28 March 2003. kgallagher@terrachoice.com.
[28] Environmental Choice Program Web site, www.environmentalchoice.com/Company.cfm?group=18&cat=36. Accessed 28 July 2003.

3.2 Environmental Profile Data Sheet (EPDS)

The Environmental Profile Data Sheet (EPDS) is a reporting mechanism of the Environmental Profile program, developed for the pulp and paper industry. The EPDS is a Type 3 label that lists the environmental attributes of a pulp and paper mill, mainly for procurement purposes. It was developed through collaboration between the Canada Pulp and Paper Association and TerraChoice Environmental Services Inc. in 1997. The data sheets themselves provide information about the corporate environmental management system, forest management plans, fibre sources, energy sources and use, water use, effluent, and waste. A statement of third-party verification is included on the sheets and is valid for 12 months.

The layout of the EPDS is designed to create a level playing field within the pulp and paper industry by providing criteria that are common to all members of the industry. The data sheets were developed to provide information to wholesale customers, governments, and non-governmental organizations, including environmental groups. The Canadian Pulp and Paper Association (CPPA) predicts that the data sheets will be useful in the future for measuring environmental progress in the industry.[29] An additional benefit of labels such as the EPDS is that data collected about the state of an industry could be used in the future development of an EcoLogo guideline.

Refer to Appendix A for a sample EPDS. As of 2002, 17 Canadian mills controlled by three companies had completed the EPDS process.

3.3 Green Leaf Hotel Rating Program

The Green Leaf program is a rating system for hotels, marinas, and golf courses. The Green Leaf Hotel Association and TerraChoice Environmental Services Inc. collaborated to create the program, which grants hotels between one and five leaves based on their environmental attributes, as revealed in a checklist completed by the hotels and verified by TerraChoice. Every year TerraChoice verifies the checklist, and every three years hotels must reapply for the label, providing an opportunity to increase the number of leaves they are awarded.[20]

The program is similar to a Type 1 label in that it provides selective information about hotels. It differs in that it is a ranking system that was developed to be as inclusive as possible. The EcoLogo, for example, targets the top 20% of industry performers, while the Green Leaf program targets most of the market, with top performers receiving the top ranking. The Green Leaf rating system is considered ideal for industries with a large number of players, such as the hotel industry, where there is a large competitive incentive to improve ratings. An outcome has been that hotels with the highest ranking, such as the Banff Springs Hotel, have requested more prestigious certification, and this has led to the development of EcoLogo guidelines for hotels.

According to Kevin Gallagher, vice president at TerraChoice, a Green Leaf system was considered for the electrical industry, but was not developed because of potential consumer confusion. For example, a nuclear plant, large-scale hydro plant, and coal operation could each potentially achieve one or two leaves in the Green Leaf system, given a variety of trade-offs. The consumer would then be confronted with the question, "Overall, which operation is better for the environment?" To avoid this confusion, the EcoLogo guideline was developed instead.

[29] CPPA Web site. www.cppa.org.

3.4 Energy Star

The Energy Star energy efficiency label was developed to promote greenhouse gas reductions and economical savings during product use. The Energy Star program was initiated in 1992 in the United States, and has since migrated to Canada where it is monitored and promoted by the Office of Energy Efficiency (OEE) within Natural Resources Canada. The voluntary label differentiates products based on energy efficiency and is considered a performance standard. Both institutional and consumer markets are targeted for label use. The Energy Star label certifies a variety of product categories, including office equipment, office buildings, residential buildings, computers, and transformers. In Canada, third-party verification is required, unlike in the U.S., where self-verification is required. Products must exceed the minimum performance standard set out in the OEE's Canadian Energy Efficiency Guide by 10% to 50%, depending on what is most suitable given current technology and economic feasibility. The target market share for the Energy Star label is the top 20% to 25%. As market share increases for a product, minimum standards are increased. Interest groups are involved in setting the standards.

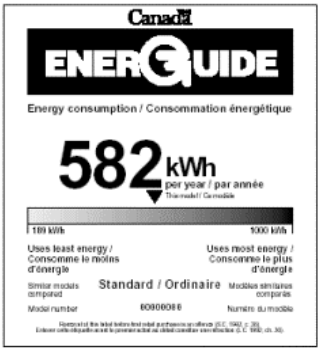
The Natural Resources Canada Energy Star Web site lists the following benefits of using the Energy Star label:[30]

- provides access to government-sponsored promotional activities;
- encourages market competition;
- showcases leadership in dealing with climate change and pollution;
- provides opportunities for joint marketing/promotion, incentive programs, and potential to be part of a pilot program;
- offers networking and information sharing opportunities with other Energy Star members, including access to information, consumer surveys, and studies; and
- promotes improved energy efficiency within an organization.

3.5 EnerGuide

The EnerGuide label, as shown in Figure 1, is essentially a combination of a performance standard and a Type 3 label where a single attribute — energy consumption — is presented explicitly to allow the consumer to make a value judgment. It was developed by the OEE to help consumers choose energy efficient products. The EnerGuide label also presents information regarding the product's energy consumption relative to other products in the same class and size. In Canada, the EnerGuide label is integrated with the Energy Star label when both labels exist for the same product, presenting similar information in different forms.

Figure 1: Sample EnerGuide Label



[30] Energy Star Web site. www.energystar.gov

4. Potential Environmental Labels for Hydrogen

The following section outlines a range of potential environmental labels for hydrogen in Canada. This range is intended to cover the spectrum of environmental label types outlined above in order to identify many possible alternatives for discussion purposes. A general description of the alternative is presented along with a preliminary evaluation of its suitability for use as a hydrogen labelling standard. First, however, the criteria for evaluating each alternative are defined.

These alternatives are presented as theoretical examples for the purpose of discussion and are not intended to be the only alternatives available.

4.1 Label Evaluation Criteria

To usefully evaluate potential environmental labels for hydrogen, a set of evaluation criteria and the context of the evaluation need to be defined. Our evaluation criteria are based on past evaluations[31,32] of the conditions that make a label successful, although some conditions were not included because they are beyond the scope of this report. For example, one identified condition for success is alignment of the standard with green procurement initiatives. This type of condition can be evaluated in more detail once particular labelling standards have been developed further.

In regards to context, it is important to consider the specific purpose of the label, the audience, and when the label can be applied most effectively. Individual companies will have many varied purposes for using environmental labels to market hydrogen, but the primary purpose is assumed to be to encourage consumers to purchase hydrogen with environmental benefits. The audience for this product can be categorized into two groups: the general public and sophisticated consumers such as commercial and industrial customers. For large-scale adoption of hydrogen as a vehicle or fuel cell fuel, sophisticated consumers will be important to establish early trials, but the general public is ultimately the larger consumer group. Two timeframes for the application of hydrogen will be considered: short-term, during the development of the hydrogen market; and long-term, once the market has matured.

Based on this context and the scope of the evaluation, we propose the following evaluation criteria:

Ability to influence purchasing and promote consumer awareness through:

- Clarity — The consumer needs to be able to easily understand the label. For the general public, a clear, simple message will be important.

- Credibility — The consumer needs to understand, recognize, and acknowledge the label and the value it represents (i.e., its ability to protect the environment). In all instances, credibility will be judged by the content, source, and interpretation of the message. An unclear or unrealistic message will harm credibility. Consumer access to detailed information regarding the label's claims, independent verification, and past trustworthiness of the certification source will increase credibility. The certification method needs to be relatively aligned with consumer values and include sound scientific data.

[31] Rotherham, Tom. 1999. *Selling Sustainable Development: Environmental Labelling and Certification Programs." International Institute for Sustainable Development*. Miami: Dante B. Fascell North-South Center, University of Miami.
[32] Organisation for Economic Co-operation and Development. 1997. *Eco-Labelling: Actual Effects of Selected Programmes*. OCDE/GD (97) 105.

- Comprehensiveness — The label needs to address information regarding environmental attributes that is of most concern to the consumer.

  Producing hydrogen and producing electricity involve similar life-cycle activities, so it is assumed that over the entire product life cycle the environmental attributes considered important for hydrogen will be similar to those outlined for electricity in Section 3.1: source, greenhouse gas emissions, air pollutant emissions, land use issues, site degradation, impact on species, water quality and temperature, community and stakeholder concerns, and material disposal.

- Balance between stringency and inclusiveness — The label must be stringent enough to create an incentive and value for the consumer; yet it must not be so stringent that companies cannot meet the criteria, resulting in the label not obtaining adequate adoption. An appropriate level of stringency will also provide value to the producer by introducing a competitive advantage. As well, effective differentiation between products will promote continuous product improvement.

  The need to balance stringency and exclusivity can be met somewhat by creating a label that is inherently inclusive, similar to the Green Leaf program for hotels and the EPDS for the pulp and paper industry. These labels allow every product to be eligible and require the consumer to make some or all of the value judgment.

- Ease of implementation — Labelling procedures should not be a prohibitive factor for companies to join the program.

4.2 Description of Potential Labels for Hydrogen

The following list of labels range from independently certified with a built-in value judgment (ISO Type 1) to relatively self-defined and self-monitored (ISO Type 2) to fully explicit (ISO Type 3). Table 3 summarizes the potential labels with more detailed descriptions below.

Table 3: Summary of Potential Hydrogen Labels

Label Type	Information on Label	Value Judgment Made By	Verification	Criteria	ISO Type
Environmental Choice EcoLogo	Indicates preferred product with single logo	Labelling system	Third-party audit	Core environmental attributes over life cycle	1
Green Leaf	Indicates degree of preference with graduated logo	Labelling system and consumer		Relative impact of core environmental attributes over life cycle	N/A
Type 2 — Self-defined	Self-generated declaration	Consumer	Self-verified	Self-defined	2
Type 2 — Regulatory-defined				Defined by an independent regulatory body	

Descriptive — Detailed	List of all core attributes	Consumer	Self-verified or third-party audit	Core environmental attributes over life cycle	3
Descriptive — Simple	List of one or more attributes			Select core environmental attributes over life cycle	N/A
Performance standard	Indicates preferred product with single logo	Labelling system	Third-party audit	Single performance attribute	N/A

4.2.1 Environmental Choice EcoLogo — Top 20% of Performers

The Environmental Choice EcoLogo is Canada's leading Type 1 label. It is, therefore, one of the most likely choices for a Type 1 label for hydrogen. The specific criteria used for a hydrogen EcoLogo would need to include the environmental attributes of primary interest to the consumer on a life-cycle basis – including all activities required to produce, deliver, and use hydrogen. Following certification, the hydrogen retailer would be able to display the EcoLogo to advertise its product for two years, until the verification was due for renewal.

When defining "top performers" in an established product category, TerraChoice targets 15% to 20% of the market for EcoLogo certification in order to ensure that it is both accessible to a large number of products and somewhat exclusive to provide adequate consumer value.

This is an obvious guideline for establishing a set of certification criteria for hydrogen. The criteria would need to be developed through a multistakeholder process and would likely be based on the same environmental attributes listed for EcoLogo electricity in Section 3.1. The criteria would need to be reviewed on a continuous basis to ensure that the standards continued to provide value to the consumer.

The ability for this type of label to meet the requirements for a hydrogen product is discussed within the context of the evaluation criteria introduced in Section 4.1.

Clarity
- Relatively well known and easy for the consumer to understand
- Potential confusion over label meaning

Credibility
- Independently verified
- Bias of weighting system based on cultural, social, and environmental attitudes
- Consumer does not make value judgment
- May or may not meet consumer expectations for environmentally friendly hydrogen

Comprehensiveness
- Based on life-cycle performance of core environmental attributes

Stringent vs. inclusive
- Relatively inclusive
- Top 20% of performers

Implementation
- Established processes
- Limited flexibility
- Difficulty in defining top 20% of performers in early market
- Difficulty in establishing weighting system
- Requires verification of a wide range of attributes

Based on several key limitations of a label with this system of establishing certification criteria, development of this labelling system is not recommended. Specifically, the key limitations are difficulty with defining the top performers and uncertain credibility for the consumer.

A well-defined marketplace is necessary to define the top 20% of performers. Currently, the market for retail hydrogen is not developed; therefore, this criterion may have to wait for market development before it can be established. Alternatively, the criterion could be developed based on the expected make-up of the market or based on the current vehicle fuels market. A projection of the future hydrogen market brings increased uncertainty to the process. Basing standards on the current vehicle fuels market will create a label for all transportation fuels, not just hydrogen. Evaluation of this alternative is beyond the scope of this report, however, further investigation in this area is recommended.

4.2.2 Environmental Choice EcoLogo — Renewable Low-Impact

Based once again on the Environmental Choice EcoLogo, this label type uses certification criteria similar to the renewable low-impact electricity criteria. The reason TerraChoice decided to base the electricity criteria on an absolute target rather than targeting the top 20% of performers was primarily because of consumer expectation.

When marketing and labelling of environmentally friendly electricity began, it was confined solely to renewable low-impact sources – setting them apart from more conventional electricity sources due to their relatively low overall environmental impact. Consumer education about this product developed the expectation that electricity considered "environmentally friendly" or "green" comes from renewable energy sources with relatively low environmental impact. Hydrogen is similar to electricity in that it is an energy product. Thus, consumer expectations are likely to be that "environmentally friendly" or "green" hydrogen comes from renewable low-impact energy sources as well. That being said, the question remains about when and how the marketing of renewable low-impact hydrogen with an environmental label will be appropriate. Application could range from an emerging market with the purpose of demonstrating the potential of "green" fuels, to a well-developed market with the purpose of offering consumers the choice of renewable low-impact hydrogen.

We discuss the ability of this type of label to meet the requirements of a hydrogen product within the context of the same defined evaluation criteria.

Clarity
- Relatively well known and easy for the consumer to understand
- Potential for confusion over label meaning
- Comparable to EcoLogo for electricity

Credibility
- Independently verified
- Bias of weighting system based on cultural, social, and environmental attitudes
- Consumer does not make value judgment

Comprehensiveness
- Based on life-cycle performance of core environmental attributes

Stringent vs. inclusive
- Fairly exclusive criteria
- Stringent criteria result in a high value label for the consumer

Implementation
- Established processes
- Limited flexibility
- Difficulty in establishing weighting system
- Requires verification of a wide range of attributes

Based on several key benefits, further consideration of this type of label is recommended either for very specific educational purposes in a developing market or within an established market. The Environmental Choice EcoLogo is relatively simple and well known to the consumer, with a high degree of credibility due to independent verification. As well, EcoLogo has an established set of procedures, making the labelling process well known to retailers. The advantages for this set of criteria include compatibility with similar, existing standards (i.e., electricity) and appeal to consumers. By using criteria that meet likely consumer expectations for environmentally friendly hydrogen (expected to be similar to the expectations for environmentally friendly electricity), the renewable low-impact criteria for hydrogen will likely eliminate most consumer uncertainty regarding the credibility of the standard, particularly considering that the performance is independently verified. By using the most stringent criteria expected by consumers, the label will be of the highest value.

The main limitation to using the renewable low-impact criteria for hydrogen is its exclusivity. Similar to electricity, renewable low-impact hydrogen will likely make up only a small portion of the marketplace in its early years (TerraChoice is currently targeting 1% to 2% of electricity in Canada for EcoLogo). This will limit the number of retailers using the EcoLogo for hydrogen and will also limit the availability of this product to the consumer. This factor is particularly important in an immature hydrogen marketplace. There is a benefit to using a low-impact renewable hydrogen label for educating consumers about the potential for "green" fuel, but this must be weighed against the benefit of a much broader labelling standard for all fuels, beyond that of only hydrogen. This broader standard would thus serve to demonstrate to consumers that hydrogen is more environmentally friendly than other fuels. The feasibility of developing such a standard for all fuels has not been evaluated in this report, however, further investigation in this area is recommended.

4.2.3 Green Leaf

A Green Leaf type label is one alternative for a graduated labelling system for hydrogen. This type of label allows multiple classifications to be given for a product and allows the consumer to choose which product to purchase based on the rankings awarded. The ranking system would range from one leaf to three, four or five leaves, depending on the number of categories defined. The method of ranking would need to be developed through a multistakeholder process and reviewed on a continuous basis. It is likely that renewable low-impact hydrogen would receive the highest ranking, while conventional sources of hydrogen with some degree of improvement over regulated environmental standards would receive one leaf.

The ability for this type of label to meet the requirements for a hydrogen product is discussed within the context of the defined evaluation criteria.

Clarity
- Somewhat easy for the consumer to understand
- Potential confusion over label meaning and categorization of different hydrogen types in the same level

Credibility
- Independently verified
- Bias of weighting system based on cultural, social, and environmental attitudes
- Consumer does not make value judgment

Comprehensiveness
- Based on life-cycle performance of core environmental attributes

Stringent vs. inclusive
- Inclusive
- Many levels of standards

Implementation
- Established processes
- Limited flexibility
- Difficulty in establishing weighting system
- Requires verification of a wide range of attributes

Based on several key limitations, the development of this type of label is not recommended. First, a graduated labelling system for hydrogen may cause consumer confusion. With this system, it is likely that two or more very different types of hydrogen will be ranked within the same category, leading to uncertainty as to the true meaning of the ranking. A second difficulty with a graduated label is establishing criteria for each level of ranking. Weighting each environmental attribute for multiple categories increases the complexity of implementation.

4.2.4 Type 2 — Self-defined Declaration

A label that is self-defined and self-verified is one that does not require any standards to be set or any verification body. This is generally the first type of environmental label that any product has and is used by retailers to advertise particular environmental attributes of their product before the market has matured to a stage at which a standardized environmental label is established. This label is considered Type 2 by ISO.

For hydrogen, this type of label likely already exists for some products as producers promote their product as “zero emission,” “renewable,” or “green.” Producers and retailers may develop many other declarations in the future to advertise the environmental attributes of their products. These declarations could potentially be used in combination with another labelling system to perhaps enhance the information supplied to the consumer.

We discuss the ability of this type of label to meet the requirements of a hydrogen product within the context of the defined evaluation criteria.

Clarity
- Simple message
- Potential for confusion over definition of declaration

Credibility
- Consumer makes value judgment
- No independent verification leads to questionable credibility

Comprehensiveness
- Usually based on a single attribute
- May or may not consider life cycle of product

Stringent vs. inclusive
- Inclusive
- Stringency determined by labeller

Implementation
- Easy and free for manufacturers to adopt
- Flexible

This type of label may be the most likely to be used at the start of environmental labelling for a particular product, but it has several significant drawbacks that should be considered by all prospective labellers; these include a lack of credibility and potential confusion for the consumer. Being self-verified and self-defined means that the consumer needs to trust the retailer in order for there to be value in the label. Invariably, the credibility of this type of label will be lower than for an independently verified label. Secondly, by having the retailer determine the label declaration, similar products may have declarations that vary widely. The declarations are also likely to present only one environmental attribute or to be somewhat ambiguous aggregate terms, such as "green," thus presenting only a partial or unclear representation of environmental performance. Credibility issues such as these could significantly weaken the potential to market hydrogen based on its environmental benefits. This could have serious implications for the adoption of hydrogen as a more environmentally friendly fuel and it is recommended that a labelling standard be established before hydrogen is marketed to general consumers. An example of the risk that industry runs if standards are not put in place can be found within the organic food industry. The number and variety of labels on organic foods is so great that confusion and scepticism on the part of consumers damages the labels' effectiveness.

4.2.5 Type 2 — Regulatory-defined Declaration

A variation on the Type 2 self-verified, self-defined label is to have a regulatory body define the declaration placed on products. Essentially, retailers would be limited to using defined declarations and would need to ensure that their products met the declaration requirements. The result would be less flexibility for the retailer, but more credibility and clarity than with a self-verified, self-defined label.[33]

Even though this is an improvement over unregulated Type 2 labels, this label type is not recommended as a first alternative. Since proper definition of environmental declarations for hydrogen should include the life-cycle performance of core environmental attributes, a complex and broadly defined declaration is required. If this level of effort is pursued, we recommend that a Type 1 label be developed instead of a regulatory-defined Type 2 label, because a Type 1 label would provide increased credibility through the independent verification of attributes. If other more comprehensive and stringent Type 1 or 3 labels can not be developed and implemented, then a regulatory-defined Type 2 label is recommended as an improvement over a self-defined Type 2 label. This may avoid some of the credibility issues associated with self-defined labels depending on how well the regulatory body defines the label and how effectively it is communicated.

[33] See the previous section for the characteristics of the self-verified, self-defined label.

4.2.6 Descriptive — Detailed

An ISO Type 3 descriptive label provides a list of the environmental attributes of a product. Similar to the EPDS for the pulp and paper industry, a descriptive label for hydrogen would list the independently verified values of its core environmental attributes for consumers to base their purchasing decision on. This type of label is intended for sophisticated consumers, such as corporations, who are able to consider individual attributes without becoming so confused as to be discouraged from using this type of fuel.

A secondary use for a descriptive label is to assist in developing a Type 1 label. Both the development of guidelines and the actual certification of products for an EcoLogo type label can be facilitated using the information contained in a descriptive (Type 3) label.

The ability for this type of label to meet the requirements for a hydrogen product is discussed within the context of the defined evaluation criteria.

Clarity
- Uses a standard set of defined attributes
- Requires knowledgeable consumers

Credibility
- Consumer makes value judgment
- Independently verified
- No bias of weighting system based on cultural, social, and environmental attitudes

Comprehensiveness
- Based on life-cycle performance of core environmental attributes

Stringent vs. inclusive
- Inclusive

Implementation
- Established processes
- Limited target consumer group
- Requires verification of a wide range of attributes

Based on several key benefits, further consideration of this type of label for commercial and industrial customers is recommended. Specifically, the level of detail provided regarding environmental attributes allows sophisticated consumers to make well-informed decisions based on their own value judgment, avoiding bias by the labelling system. It is also inclusive of all types of hydrogen. To be most effective, a consumer education program is essential.

4.2.7 Descriptive — Simple

A variation of the Type 3 descriptive label is a label that provides an explicit list of one or more attributes considered to be of the highest priority to consumers. As this does not address the full range of core environmental attributes, it cannot be classified as a Type 3 label, but it does offer some of the same advantages while also being more accessible to the general public. This type of label would look similar to an EnerGuide label, but would provide values for attributes that could include the amount of energy input, its primary source, and life-cycle greenhouse gas emissions per unit of hydrogen.

The ability of this type of label to meet the requirements for a hydrogen product is discussed within the context of the defined evaluation criteria.

Clarity
- Simple message
- Relatively easy to understand
- Potential for confusion over reasons for selecting only a few attributes

Credibility
- Consumer makes value judgment
- Independently verified
- Attributes may not meet consumer expectations for environmentally friendly hydrogen

Comprehensiveness
- Only addresses a few attributes
- Based on life-cycle performance

Stringent vs. inclusive
- Inclusive

Implementation
- Similar to other labels
- Requires verification of a narrow range of attributes

Based on its benefits, further consideration of this type of label is recommended, although certain precautions are warranted to ensure it is not more harmful than helpful. Specifically, this label allows general consumers to make value judgments about the type of hydrogen to purchase without requiring them to have a high level of knowledge about the product. When selecting the attributes to display, however, it will be important to consider those attributes that have not been included and the potential resulting negative consequences. The credibility of such a label to the consumer and other stakeholder groups should also be assessed to avoid limiting its effectiveness as well as the effectiveness of other hydrogen labels. Due to these considerations, this label is not as attractive as others assessed, although it may be more effective than not having any labelling standards at all.

4.2.8 Performance Standard

Another alternative for environmental labelling of hydrogen is to develop a single performance standard label similar to Energy Star. This label would be based on meeting a single criterion, such as being in the top 20% of life-cycle energy efficiency or having low life-cycle greenhouse gas emissions. The label would likely be in the form of a logo similar to Energy Star or EcoLogo. This label type differs from an ISO Type 1 label or Environmental Choice EcoLogo in that it is based on only one performance standard and does not cover all of the core environmental attributes.

The ability for this type of label to meet the requirements for a hydrogen product is discussed within the context of the defined evaluation criteria.

Clarity
- Relatively well known and easy for the consumer to understand
- Possible confusion of label meaning

Credibility

- Independently verified
- May not meet consumer expectations for environmentally friendly hydrogen

Comprehensiveness
- Usually based on a single attribute
- May or may not consider life cycle of product

Stringent vs. inclusive
- Relatively inclusive

Implementation
- Established processes
- Requires verification of one attribute
- Limited flexibility
- Difficulty in defining top 20% of performers in early market

Based on its limited comprehensiveness and credibility, the development of this type of label is not recommended. A performance standard label considers only one environmental attribute. Consumers who are aware of the broad environmental impacts of hydrogen production are unlikely to place high value on a label that considers only one of these impacts.

The simple descriptive label, on the other hand, may consider only a few attributes, but it displays these attributes and their values explicitly and allows the consumer to make their own value judgment if they so choose. As it does not base judgment on a limited amount of information, a simple descriptive label thus offers increased credibility over a performance standard label.

4.3 Next Steps

The next steps proposed for pursuing environmental labels for hydrogen in Canada include the following:
- for industry and government to consider the labelling alternatives presented in this paper; and
- for interested groups to pursue the development of a labelling standard that meets their needs at an appropriate time in the development of a retail hydrogen market.

During these steps, there are several factors for proponents to consider when determining if, when and how to implement a labelling standard. The following list was compiled based on the research and analysis completed by the authors, as well as feedback from reviewers:

- The choice between different types of hydrogen will likely not be widely made until a mature market for the fuel develops. This could be 10 to 20 years away. Premature attempts to distinguish between varying types of hydrogen could hamper consumers' adoption of the fuel. However, further research into the effectiveness of placing environmental labels on hydrogen is required to help determine if and how such labels would best be applied (i.e., to what consumers would respond best).

- As they represent a relatively mature market, large industrial users could be the first targeted audience for an environmental label for hydrogen.

- A labelling standard could be constrained to niche markets until a broader consumer market is established.

- A labelling standard based on "top performers" will require a range of products from which to establish its selection criteria. Development of this type of standard will likely require a mature market.

- If early advertisement of the environmental benefits of a particular type of hydrogen is desired, then a self-defined label, a label based on an absolute standard (such as a renewable low-impact hydrogen standard), or a descriptive label can be pursued immediately. A descriptive label would also serve to educate consumers in an early marketplace about the environmental attributes of hydrogen.

- Consideration should be give to how the standard may apply to different forms of hydrogen. For example, compressed hydrogen, liquefied hydrogen, and hydrogen in a metal hydride as methanol, ethanol, or a chemical hydride or as gasoline or diesel fuel are all considered forms of hydrogen. For relatively stringent criteria, such as renewable low-impact energy, no fossil fuel will be relevant. It is expected that criteria including renewable low-impact hydrogen could easily apply to renewable low-impact methanol, ethanol, and chemical hydrides as well. More inclusive standards will have the potential to include all forms of hydrogen, and at that point consideration should be given to creating a fuels standard as opposed to simply a hydrogen standard.

- Consideration should be given to placing environmental marketing labels on the product that uses the fuel as opposed to the fuel itself. For example, with vehicles, the choice of fuel is most often made when purchasing the vehicle itself. In this way, the existing EnerGuide label for vehicles could be adapted to include more than just energy consumption, or a new label all together could be established, such as the simple descriptive label introduced in the previous section. A product label will not, however, ensure that the hydrogen fuel is produced in an environmentally beneficial way.

- For the market introduction of hydrogen as a vehicle fuel, a more effective environmental label may compare hydrogen to conventional fuels as opposed to focus on hydrogen alone. This seems to be indicated by previous comments that a mature market is required before certain types of hydrogen labelling become relevant.

- A broader marketing strategy for fuel cell vehicles needs to be developed, with environmental labelling as one possible component.

- Different types of hydrogen will be more prevalent in different regions of the country. Consideration should be given to the implication for each region for a given labelling standard?

- Consideration should be given to how transferable the standard is to other countries.

- Consideration should be given to how transparent the standard and its criteria are.

- Consideration should be given to how the standard applies to different sources of hydrogen and to different applications for hydrogen.

- The standard needs to encourage continuous improvement.

- Independent verification for standards would likely enhance their appeal to environmentally minded consumers who are sceptical about new technologies.

To establish a regulated environmental labelling standard, a group of interested representatives from industry, government, or the public can either approach an established standards organization such as TerraChoice or CSA, or initiate their own standardization body through a brand new organization or an existing organization such as the Canadian Hydrogen Association. The choice of label development method will have an impact both on how easy it is to establish a label, and on the credibility of the label itself. Working through an established organization such as TerraChoice has the advantage of potentially making the development process easier and increasing the label's credibility by using an established and well-known mark such as EcoLogo. A single co-ordinated effort is recommended to reduce consumer confusion arising from the use of multiple labels.

It should be kept in mind that before formal pursuit of a standardized label is undertaken, producers and retailers will likely continue to use self-verified, self-defined labels. These types of labels are the easiest to apply and may reduce the need for a regulated label in early markets, but they may also adversely affect their own credibility and the credibility of future environmental labels for hydrogen if consumers find them untrustworthy. It will likely be very important to establish a standardized label before hydrogen labelling credibility is compromised.

5. Conclusion

In closing, it has been demonstrated that there are a number of options developers and retailers can use to market the environmental attributes of hydrogen fuels using labels. These labels can range from self-defined, self-verified declarations, such as "green hydrogen," to descriptive labels, similar to nutritional labels on foods, which allow consumers to make their own judgment. It is recommended that the members of the Canadian Transportation Fuel Cell Alliance consider the options presented, as well as other variations not addressed, and engage in further discussions about pursuing a labelling standard.

Based on the research and analysis completed, as well as the review process, the following conclusions have been made:

- Environmental labels can be used to encourage the purchase of environmentally friendly hydrogen. Producers and society as a whole have an interest in seeing environmental labels for hydrogen applied effectively, and there are different approaches that can be taken to pursue their application. Also, as no other environmental label for hydrogen was found anywhere in the world, Canada has the opportunity to show leadership in the development of an environmentally friendly hydrogen economy by being the first to implement such a label.

- The usefulness of an environmental labelling standard for hydrogen alone is potentially limited in an immature market. It may be 10 to 20 years before hydrogen as a fuel is common enough in the marketplace for the average consumer to differentiate between its various methods of production. The choice between hydrogen and other fuels, however, will be presented to consumers sooner than this and should perhaps be the focus of any environmental labelling standard.

- In a developing hydrogen market, niche application of environmental labels may also be useful. This could assure early adopters that their choice of a hydrogen-fuelled product will have a positive environmental impact, and could serve to educate the public about the potential of low-impact renewable fuels.

- Instead of a fuel label, an environmental label on products such as vehicles outlining their operating and fuel-cycle impacts could be used, as this is the ultimate point of fuel selection for most products. The existing EnerGuide label for vehicles could be adapted to include more than simply energy consumption, or a new label all together could be established.

- A broader marketing strategy for hydrogen and the products that use hydrogen, such as fuel cell vehicles, would assist in identifying ways that various marketing mechanisms, including environmental labelling, should be pursued. Undoubtedly, each company will have its own strategy for the future, but there is benefit to understanding how governments, industry associations and non-governmental organizations can encourage the adoption of these products through market mechanisms, advertising, education, and labelling standards, among others, in both emerging and established markets.

- In the end, marketers are going to place environmental labels on hydrogen. It is in the best interest of both producers and consumers to develop standardized labels before too much confusion is generated regarding the credibility of various labels. Credibility issues could significantly weaken the potential to successfully market hydrogen based on its environmental benefits.

Appendix A – Sample Environmental Profile Data Sheet

Environmental Profile Data Sheet (EPDS)™

Pulp, Paper and Paperboard[1]

To develop a better informed marketplace in the pursuit of sustainable development

Product

Description: Specialty Bleached and Coated Linerboard (Temliner®, Flexprint®, Temlite® and Temlam® C1S)

Product unit: 1000 square metres (number in parentheses for a product unit of one air dry metric ton)

Production period: October 01, 1999 - September 30, 2000

Mill location: Témiscaming, Québec

Manufacturer

Company: Temboard Inc. (www.tembec.ca)

Address: P.O. Box 6000, Chemin Kipawa, Témiscaming, Québec J0Z 3R0 Canada

Contact person: Gerard Orlowski (819-627-4692, gorlowski@tembec.ca)

Corporate Environmental Management Attributes[2]

Environmental management system	The Témiscaming site completed the implementation of the Impact Zero® environmental management program (EMP) in June 2000. This EMP uses the ISO 14001 standard as a management tool. Temboard Inc. received ISO 14001 registration in January 2001.
Environmental/sustainable development report	Based on the Impact Zero® EMP strategy, an action plan was prepared to ensure waterways, atmosphere and lands are environmentally healthy and safe for employees/public. (See details including important effluent characteristics in Tembec's Annual Report on Tembec's WEB site.). Environmental compliance reports are submitted to site managers weekly and monthly. Action plan to manage Atmospheric Emissions under Canada's Greenhouse Gas Reduction Program (Voluntary Register) are submitted every 2 years (latest in 2000).
Sustainable forest management system	The implementation of Tembec's Forever Green® Environmental Management Program (EMP) was completed in 2000 for all forestry divisions except a recent acquisition in Eastern Quebec. Forever Green® includes an environmental management system (EMS) and sustainable forest management criteria. Tembec has received ISO 14001 registration of the EMS for these forest divisions, and the certificates were received in January 2001. Tembec is also committed to obtaining Forest Stewardship Council certification of all its forest divisions by 2005. (See details in Tembec's Annual Report.)

Forestry Attributes of Raw Fibre Sources[3]

			Comments
Forest Land Managed by Company			
Public ownership	(% of total)	99.3	Best estimate based on current available information.
Private ownership		0.7	Best estimate based on current available information.
Forest Management Plans			
Type and term			Ontario: "Forest Resource Licenses" (FRL) issued by Ministry of Natural Resources. Quebec: "Contrat d'Amenagement et d'Approvisionement Forestier" permits (CAAF) issued by Ministere des Ressources Naturelles. Both for up to 25 yrs, reviewed annually and renewed every 5 yrs. FRLs/CAAFs outline forest management for cutting a specific volume of a particular species. Includes: resource description, non-timber resource management, silvicultural strategies by stand type, allowable annual cut calculations, provisions for losses to insects, biodiversity analysis, etc.
Public participation			Meetings held 8 times per year with Local Citizen's Committees (Ontario) and Comites Aviseur (Quebec) to review forest management plans and potential impacts. Provincial Ministries obtain input from groups (e.g. munipalities, native groups, anglers, hunters, tourism, chambers of commerce, forest industry, local businesses) during development of management plans. In Ontario, members are appointed by MNR. Minutes of meetings are diastributed. As part of public participation process, special meetings may be organized with company foresters if requested by participants.
Non-timber values			Gov't prescriptions require non-timber values be respected (e.g. protection of fish, wildlife, aesthetics, biodiversity, endangered species). Outlined in publications (i.e. Québec's "Normes d'Intervention Forestiere"). These "normes" include provisions to minimize impacts of harvesting on the habitat (waterways, vegetation, etc.). Values are defined by gov't and include protection of: wildlife (e.g. moose and deer habitat), asthetics (e.g. landscape patterns, maintain panoramic views), breeding grounds, bird colonies, beaver habitat, wetlands, salmon streams, canoe routes, etc.
Government approval required			Harvesting approval obtained from Ontario's Ministry of Natural Resources (MNR) and Québec's Ministère des Ressources Naturelles (MNR) for 1, 5 and 25 year plans. Plans must indicate sectors/species to be harvested, road/bridge construction requirements, reforestation provisions for hardwoods/softwoods, silvicultural treatments (e.g. thinnings to encourage forest growths), etc. Plans reviewed annually and updated as required.
Performance inspections/audits			MNR conducts occasional performance inspections each year of forest management plans and other activities (e.g. adherence to silviculture practices; harvesting methods; respect of wetlands, waterways, animal preserves; etc.) at each Forestry Division. Performance inspections form an integral part of the Forever Green environmental management program (based on ISO 14001) that has been implemented as described in the section above on Sustainable forest management system. Annual 3rd party audits of forest management plans at the request of MNR who appoints an Advisory group to conduct audit.
Forest Renewal/Regeneration			
Natural	(% of total)	69	Naturally generated species of hardwood and softwood are used to produce these grades.
Planted and/or seeded		31	
• native species		31	On lands supplying fibre for pulp operations in the Témiscaming division, Tembec planted 3.244 million trees.
• non-native species		0	

Resource Attributes

		Comments
		Sources of off-site manufactured pulp are used in the production of this product, but data were not available for 21.5% of these sources. To ensure EPDS values adequately reflect all off-site sources, data from the available 78.5% were prorated to represent the total off-site contribution.
Fibre Use		
Efficiency (ADMT fibre/product unit)	0.208 (0.794)	
Chemical oxygen demand (COD)[4] (kg COD/product unit)	12.53 (47.79)	COD figures for Temboard are highly influenced by the different pulp supplies used (both internal and external).
Fibre content (% of total product weight)	93.0 (93.0)	The non-fibre content figures are due to the products being coated.
Non-fibre content	7.0 (7.0)	
Fibre Type		
Raw fibre (% of total fibre weight)	100	
• roundwood	0	
• chips	100	
Recovered fibre	0	
• planer shavings/sawdust	-	
• other pre-consumer	-	
• post-consumer	-	
Non-wood fibre	0	
Raw Fibre Source		
From land managed by company (% of total fibre weight)	78.5 (78.5)	
From other sources	21.5 (21.5)	See comment at top of page two regarding Forest Renewal/Regeneration. Considerable quantities of non-Tembec pulp products are used to produce Temboard's coated grades.
Under certified/registered forest management standard/program	0 (0)	
Energy Use		
Efficiency (GJ/product unit)	8.9 (33.8)	Calculated from direct as well as indirect (e.g. off-site sawmills, purchased bleaching chemicals, fuels to transport chips, etc.) energy sources used to manufacture the pulp.
Hydroelectric (% of total)	52.0 (52.0)	Calculated from direct as well as indirect energy sources.
Biomass	16.2 (16.2)	Calculated from direct as well as indirect energy sources.
Fossil fuels	29.4 (29.4)	Calculated from direct as well as indirect energy sources.
Nuclear	2.4 (2.4)	Calculated from direct as well as indirect energy sources.
Other sources	0 (0)	
Water Use		
Process water (m^3/product unit)	21.25 (81.04)	This value was determined using 10 months of data and prorating these for the full 12 months. Plans for changes to reduce water usage (e.g. water reduction program) are progressing. A new ultrasonic flow meter was installed in November 2000 to ensure more accurate water intake measurements.
Cooling water	0.79 (3.01)	No cooling water is used on-site at the mill. This value represents cooling water used by off-site manufactured sources of pulp.

Process Attributes

		Comments
		Sources of off-site manufactured pulp are used in the production of this product, but data were not available for 21.5% of these sources. To ensure EPDS values adequately reflect all off-site sources, data from the available 78.5% were prorated to represent the total off-site contribution.
Liquid Effluent[5]		
Sublethal toxicity (TER_{sub}) (units TER_{sub})	Fat Head Minnow 18.8 Ceriodaphnia 36.3	Tembec complex has 2 effluent streams; reported values for biologically treated outfall. 2nd effluent stream is only cooling water. with values of 0.0 for fat head minnow and 7.8 for ceriodaphnia.
Acute lethal toxicity (for rainbow trout and daphnia magna)	Trout 95.5% pass Daphnia magna 99.8% pass	Tembec complex has 2 effluent streams; reported values for biologically treated outfall. 2nd effluent stream is only cooling water. Trout tested 25 times(21 passes; 4 failures). Daphnia magna tested 54 times (53 passes; 1 failure). Permitted provincially by Québec's Ministère de l'environnement; must be non-toxic.
Environmental Effects Monitoring[6]	Cycle 2 in progress	Cycle 2 was completed and submitted to Environment Canada at the end of March 2000.
Biochemical oxygen demand (BOD) (kg BOD_5/product unit)	2.56 (9.75)	Permitted provincially by Québec's Ministère de l'environnement at a daily limit of 43 kg/tonne and on an average limit of 27 kg/tonne.
Total suspended solids (TSS) (kg TSS/product unit)	6.65 (22.14)	Permitted provincially by Québec's Ministère de l'environnement at a daily limit of 40 kg/tonne and on an average limit of 20 kg/tonne.
Polychlorinated dioxins (PCDD) and Polychlorinated furans (PCDF) (ppb 2,3,7,8-TCDD equiv./product unit)[7] (ppb 2,3,7,8-TCDF equiv./product unit)[7]	0.0079 (0.0370) PCDD 0.0069 (0.0264) PCDF	No chlorine bleaching was performed in the production of this product. These values can be attributed to the off-site manufactured sources of pulp These grades have been tested for 2,3,7,8-PCDD and 2,3,7,8-PCDF, and are non-detectable to the parts per trillion level. Permitted provincially by Québec's Ministère de l'environnement at 15 ppq of 2,3,7,8-TCDDequivalents for both dioxins and furans. Permitted federally by Environment Canada at 20 ppq of 2,3,7,8-T_4CDD and 50 ppq of 2,3,7,8-T_4CDF.
Solid Waste		
Volume (m^3/product unit)	0.12 (0.48)	Calculated from on-site mill sources and off-site sawmill sources.
Landfilled (% of total solid waste)	13.2 (13.2)	Calculated from on-site mill sources and off-site sawmill sources.
Incinerated without energy recovery	11.4 (11.4)	Calculated from on-site mill sources and off-site sawmill sources.
Diverted	75.4 (75.4)	Calculated from on-site mill sources and off-site sawmill sources.

Air Emissions[8]	Grid breakdown	Marginal fuel	Comments
Total reduced sulphur compounds (TRS) (kg TRS/product unit)	0.003 (0.01)	0.003 (0.01)	Temboard Inc. does not use production process which generate TRS. Therefore, TRS measurements were not conducted. These values can be attributed to the off-site manufactured sources of pulp.
Total suspended particulates (TSP) (kg TSP/product unit)	0.03 (0.11)	0.03 (0.11)	This value is determined from values for boilers estimating from 1998 test data. Permitted provincially by Québec's Ministère de l'environnement at 200 mg/Nm^3 (corrected at 8% oxygen) for liquor recovery boilers.
Global warming potential (kg CO_2 equiv./product unit)	116.8 (445.4)	653.4 (2492.0)	"Grid breakdown" is based on actual energy sources. "Marginal fuel" is based on utilities fulfilling incremental energy demands with marginal fuels, which are generally fossil fuels in North America.
Acidification potential (kg SO_2 equiv./product unit)	18.5 (70.6)	293.0 (1117.3)	"Grid breakdown" is based on actual energy sources. "Marginal fuel" is based on utilities fulfilling incremental energy demands with marginal fuels, which are generally fossil fuels in North America.
• SO_2 (kg/product unit)	18.3 (69.9)		This value is determined from values for boilers estimating using 1998 test data and from emission factors. Calculated from direct as well as indirect (e.g. off-site sawmills, purchased bleaching chemicals, fuels to transport chips, etc.) energy sources used to manufacture the pulp. Permitted provincially by Québec's Ministère de l'environnement at 400 ppm for liquor recovery boilers, and 6 kg/tonne for division emissions excluding the liquor recovery boilers.
• NO_X	0.37 (1.41)		

Other Information

		Comments
Adsorbable (total) organic halogens (AOX)[9] (kg AOX/product unit)	0.025 (0.094)	No chlorine bleaching was performed in the production of this product. This value can be attributed to the off-site manufactured sources of pulp. Permitted provincially by Québec's Ministère de l'environnement at a daily limit of 2.5 kg/tonne, and an average daily limit of 2.0 kg/tonne.

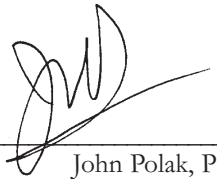
Verification

The Environmental Profile Program and its associated protocols have been developed under the auspices of the Canadian Pulp and Paper Association. This particular Environmental Profile Data Sheet (EPDS) has been prepared in accordance with the protocol as established by TerraChoice Environmental Services Inc. (TerraChoice) in its *EPDS User's Guide*. In calculating loadings, particular stressors and metrics were chosen to allow for the presentation of site-specific data. The data contained within this EPDS are based on annual values and thus represent average conditions that apply to the production of the product. The system boundary used in this quantification starts with cut wood and fibrous by-products from other related activities, and ends at the mill gate. This boundary includes the energy used for: the transportation and processing of all raw fibre, recovered fibre and non-wood fibre; the production of key bleaching chemicals; the on-site or off-site treatment of liquid effluent. It excludes the energy used for transportation of raw materials other than fibre to the mill, and any potential downstream effects after the product has left the mill.

This EPDS has been verified for accuracy and completeness pursuant to the EPDS User's Guide on April 26, 2001 *by TerraChoice Environmental Services Inc. located at Suite 400, 2781 Lancaster Road, Ottawa, Ontario, K1B 1A7, CANADA (tel.: 613-247-1900).*

Please address any enquiries, comments and/or concerns regarding this particular EPDS to TerraChoice.

EXPIRY DATE: December 25, 2002



John Polak, President
TerraChoice Environmental Services Inc.

Explanatory Footnotes

1 Reporting on additional environmental attributes may be required for some grades.

2 The first parameter in the *Corporate Environmental Management Attributes* section ("Environmental management system") applies exclusively to the specific mill, whereas the two other parameters ("Environmental / sustainable development report" and "Sustainable forest management system") can apply to all of the company's operations.

3 Forest management practices encompass a wide range of complex issues. While not all of these issues have been listed in the *Forestry Attributes of Raw Fibre Sources* section, the EPDS does address those for which meaningful data are available, and for which customer and general public concern has been expressed. It is also important to note that many companies are currently at various stages of pursuing forest management certification which deal with this broader complexity of issues. Although the effects of forest management practices are best evaluated on a long term basis, data have only been given for the stated annual production period in order to be consistent with other reported data.

4 Levels of COD in the treated effluent can be considered an indicator of slowly degradable and non-biodegradable organic matter, and of possible long term oxygen demand. This matter consists primarily of those organic materials removed from wood in the pulping process, since other organics are usually removed by primary and secondary treatment. Therefore, the amount of COD present in treated effluent is a measure of the poorly degraded compounds which are discharged, and in the case of kraft production, a measure of the efficiency and effectiveness of chemical recovery. For this reason, COD is being used as a measure of fibre efficiency, and is listed in the *Fibre Use* section of the EPDS.

5 The first three *Liquid Effluent* parameters ("Sublethal toxicity", "Acute lethal toxicity" and "Environmental effects monitoring") apply to the entire mill operation and, therefore, are not product specific.

6 Canadian mills are required to provide a report and supporting data to Environment Canada in accordance with the *Environmental Effects Monitoring Program*. The objective of this program is to allow Environment Canada to assess the adequacy of the federal *Pulp and Paper Effluent Regulations* for protecting fish, fish habitat and the use of fish resources based on the magnitude and spatial effects (if any) in receiving waters. Where effects are demonstrated, Environment Canada can apply more stringent regulations.

7 "ppb" means parts per billion (10^{-9}). This is equivalent to micrograms per litre.

8 The *Air Emissions* parameters have been calculated using two methodologies. The first is based on the breakdown of energy sources (as provided for the *Energy Use* parameter in the *Resource Attributes* section) including the average fuel ratio used to supply the electricity grid which provides electricity to the mill. The second is the marginal fuel approach. To supply electricity in Canada, utilities use either hydroelectric or nuclear facilities operating at the maximum required rate. To fulfill any incremental or marginal needs, as may be required by pulp and paper production, the utilities generally use fossil fuels. Therefore, these air emission calculations have been based upon the use of this marginal fuel as the energy source. This marginal fuel approach is recommended for internal mill use by the Canadian Standards Association's final draft standard *Guideline for Life Cycle Impact Assessment: Pulp and Paper Production Phase* (CAN/CSA-Z810-96) dated July 1996.

9 There is general consensus among scientists that AOX is not correlated to persistency, bioaccumulation or toxicity at levels below 2.0 kg per tonne (see listed references). Environment Canada considered and rejected an AOX regulation. [References: (1) J. Carey, and P. Hodson; "Recent Canadian Studies on the Physiological Effects of Pulp Mill Effluents on Fish," Environment Canada, Green Plan, 1990. (2) C.W. Dence, D.W. Reeve, eds.; Pulp Bleaching - Principles and Practice (Atlanta: TAPPI Press, 1996), Chapter 2 of Section VIII, "Assessing the Potential Impacts of Pulping and Bleaching Operations on the Aquatic Environment," by J.W. Owens, K-J Lehtinen, 778. (3) K-J. Lehtinen, et al; "Characterization of pulp mill effluents by the model ecosystem technique, SSVL - investigations in the period 1982-1990," Nordic Pulp and Paper Research Journal, no. 2/1991: 81-88.]