

**LUMBER MOISTURE CONTENT
COST/BENEFIT ANALYSIS**

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1.0 EXECUTIVE SUMMARY

The Canada Mortgage and Housing Corporation retained ADI Limited to assess the cost/benefit implications of using dry lumber (19% moisture content or less) in housing construction in the Atlantic Provinces, and to provide a practical strategic plan for moving ahead with builders, consumers, and the sawmill industry to achieve improved compliance with the 19% moisture content standard.

A recent decision by the Atlantic New Home Warranty (ANHW) Program makes the use of lumber with 19% or less moisture content a requirement in order to receive certification under the warranty plan. This decision follows the requirement of the National Building Code (Section 9.3.2.5) which states, "Moisture content of lumber shall not be more than 19% at the time of installation". In its meeting on February 28, 1994, the Board of the ANHW passed a motion to start implementation of the building code, including the 19% MC requirement, as of July 1, 1994. The Warranty Corporation also intends to lobby regulators, banks, consumers, etc. to require that all residential construction (both new houses and renovation) use lumber that has a Moisture Content of 19% or less.

An Ad Hoc Committee was formed after the ANHW first raised the issue in May 1993, to discuss how to move ahead on the issue. The Committee had representation from the construction industry, the Atlantic New Home Warranty Program, building supply dealers, the sawmill industry, the Canadian Wood Council, the Canadian Homebuilders Association (NB and NS), building inspectors, provincial Departments of Natural Resources, and the Canada Mortgage and Housing Corporation. As part of its work, the Committee decided to commission a cost/benefit analysis of the mandatory enforcement of the 19% moisture content requirement of the National Building Code of Canada, which is part of the focus of this study.

Analysis of Impacts

ADI consulted with stakeholders, industry representatives, and other knowledgeable individuals to gain an understanding of the issues involved. A number of plausible alternative future scenarios were identified, and a selection of representative scenarios were chosen for cost/benefit analysis, in consultation with the client. The chosen scenarios include the extreme positions associated with the issue, as well as several potential "compromise" scenarios that might be acceptable to the stakeholders involved. For each alternative scenario, the changes in costs and benefits associated with identified variables were identified and quantified relative to the existing "base case" situation. A brief outline of each scenario, and its Net Benefits (Benefits minus Costs) relative to the existing situation, are presented below:

Base Case: This scenario assumes that the existing situation continues, and the use of dry lumber is governed by market demand, not regulatory forces.

Immediate Implementation: This scenario assumes that the ANHW's plans are immediately and fully implemented, across the Atlantic Provinces. As a whole, stakeholders would be \$18 million per year worse off under this scenario, relative to the existing situation.

Total Testing: This scenario includes all the assumptions from the "Immediate Implementation" scenario, except that the grade stamp on lumber is not accepted as proof of its moisture content without testing, ie, it is assumed that every house and renovation project will be tested, regardless of whether it is built from S-Grn or S-Dry lumber. As a whole, stakeholders would be \$23 million per year worse off under this scenario, relative to the existing situation.

Guidelines for S-Grn Lumber Construction Adopted: This scenario assumes that a set of guidelines are developed, dealing with acceptable sheathing materials and construction techniques that allow post-enclosure drying to take place, thus allowing builders to confidently use S-Grn lumber in house construction and renovation projects, knowing that they comply with regulations. As a whole, stakeholders would be \$6 million per year worse off under this scenario, relative to the existing situation.

Implementation for Warrantied Houses Only: This scenario assumes that the first phase of the ANHW's plans are immediately implemented, across the Atlantic Provinces. As a whole, stakeholders would be \$4 million per year worse off under this scenario, relative to the existing situation.

Implementation in Urban Areas Only: This scenario assumes that the ANHW's plans are immediately implemented, but are limited to the urban areas in the Atlantic Provinces. As a whole, stakeholders would be \$12 million per year worse off under this scenario, relative to the existing situation.

Strategic Options

The situation faced by the stakeholders seems to one of "action and reaction". From the beginning, the ANHW has made it clear that they are proceeding with their chosen course of action, and their participation on the Committee was not to negotiate a compromise. Since the ANHW has little to lose by implementing their plan, there is little motivation for them to withdraw from their original position. It seems that, at a minimum, the ANHW will implement the 19% MC requirement internally, effectively resulting in all warrantied houses using S-Dry lumber, and a negative net

benefit to stakeholders of about \$4 million per year. The sawmill industry is faced with the difficult task of finding a way to effectively react to the plans of the ANHW.

It must be noted that there cannot be a positive net benefit resulting from the options considered unless producers, builders and consumers derive sufficient benefits from dry lumber to offset the extra cost associated with it. Unless there can be agreement that there is a net benefit, it appears fruitless to attempt to find a better option.

1.0

RÉSUMÉ

La Société canadienne d'hypothèques et de logement a mandaté ADI Limitée pour évaluer les coûts-avantages d'utiliser du bois sec (teneur en eau de 19 % ou moins) pour la construction d'habitations dans les provinces atlantiques et fournir un plan stratégique pratique pour amener les constructeurs, les consommateurs et le secteur du bois de sciage à mieux se plier à cette exigence.

Le bureau chargé du Programme de garantie des maisons neuves de l'Atlantique décidait récemment d'assujettir la certification à l'utilisation de bois de construction d'une teneur en eau de 19 % ou moins. Cette décision fait suite à l'exigence du Code national du bâtiment (article 9.3.2.5) prévoyant que «la teneur en eau du bois de construction ne doit pas être supérieure à 19 % lors de la mise en oeuvre». À sa réunion du 28 février 1994, le conseil d'administration du Programme adoptait une résolution fixant au 1^{er} juillet 1994 la mise en vigueur des exigences du code, dont la teneur en eau de 19 %. Le bureau responsable du Programme se propose également d'exercer des pressions sur les organismes de réglementation, les banques, les consommateurs et autres pour qu'ils exigent l'utilisation de bois de construction sec dans toute construction résidentielle (maisons neuves et rénovations).

Le bureau chargé du Programme a soulevé la question la première fois en mai 1993, ce qui a mené à la formation d'un comité ad hoc pour discuter des différentes façons de faire avancer le dossier. L'industrie de la construction, le Programme de garantie de maisons neuves de l'Atlantique, les fournisseurs de matériaux de construction, le secteur du bois de sciage, le Conseil canadien du bois, les sections N.-B. et N.-É. de l'Association canadienne des constructeurs d'habitations, les inspecteurs en bâtiment, les ministères provinciaux de Ressources naturelles, et la Société canadienne d'hypothèques et de logement sont représentés au sein du comité. Dans le cadre de ses travaux, le comité a décidé de commander une analyse des coûts-avantages de rendre obligatoire l'exigence de s'en tenir à la teneur en eau de 19 %.

Analyse des répercussions

ADI a consulté les groupes cibles, les représentants de l'industrie et d'autres personnes averties pour bien comprendre la question. En consultation avec le client, un certain nombre de différents scénarios, éventuels et plausibles, ont été cernés, les plus représentatifs ayant été retenus pour les fins de l'analyse coûts-avantages. L'éventail de scénarios retenus comprend tant les positions extrêmes que quelques scénarios de compromis que les groupes cibles pourraient juger acceptables. Chaque scénario identifie et quantifie les changements de coûts et avantages associés aux variables relevées par rapport à la situation existante, le cas de base. Voici un aperçu de chaque scénario et

Analyse coûts-avantages de l'utilisation de bois de construction sec

de ses avantages nets (les avantages moins les coûts) par rapport à la situation présente:

Cas de base : ce scénario suppose que la situation présente persiste et que l'utilisation de bois de construction sec dépend de la demande et non de la réglementation.

Mise en vigueur immédiate : celui-ci suppose que les plans du Programme de garantie des maisons neuves de l'Atlantique sont mis en vigueur immédiatement et totalement dans les provinces atlantiques. Résultat, les groupes cibles feraient face à des coûts additionnels de 18 millions de dollars par rapport à la situation présente.

Vérification intégrale : dans celui-ci, la mise en vigueur immédiate serait suivie d'une vérification de tout le bois de construction utilisé dans les maisons et les projets de rénovation, qu'il s'agisse de bois estampillé S-Grn ou S-Dry, l'étampe y apparaissant n'étant pas acceptée comme preuve de la teneur en eau. Résultat, les groupes cibles se verraient imposer des coûts additionnels de 23 millions de dollars.

Adoption de directives pour la construction à partir de bois de construction S-Grn : ce scénario suppose que des directives portant sur les revêtements d'ossature et les techniques de construction acceptables et permettant le séchage, une fois les matériaux en place, sont adoptées, les constructeurs pouvant, par la suite, utiliser en toute confiance du bois de construction S-Grn. En vertu de ce scénario, les groupes cibles feraient face à des coûts additionnels de 6 millions de dollars.

Mise en vigueur pour les maisons couvertes par la garantie seulement : il est supposé ici que la première phase des plans du Programme de garantie des maisons neuves de l'Atlantique est mise en vigueur immédiatement dans toutes les provinces atlantiques. Résultat : une facture additionnelle de 4 millions de dollars.

Mise en vigueur dans les régions urbaines seulement : les plans du Programme de garantie des maisons neuves de l'Atlantique sont mis en vigueur immédiatement mais seulement dans les régions urbaines des provinces atlantiques. Les groupes cibles se verraient imposer alors une facture additionnelle de 12 millions de dollars.

Choix stratégiques

Les groupes cibles se trouvent donc obligés de réagir à des décisions déjà prises. Les représentants du Programme de garantie des maisons neuves de l'Atlantique ont clairement indiqué, dès le début, qu'ils avaient l'intention de s'en tenir à leur décision et qu'ils ne participaient pas au comité dans le dessein d'en arriver à un compromis. Risquant peu en mettant son plan en vigueur, le bureau responsable du Programme est peu motivé à changer sa prise de position initiale. Il appert que l'utilisation obligatoire de bois avec une teneur en eau de 19 % deviendra au moins une

Analyse coûts-avantages de l'utilisation
de bois de construction sec.

exigence interne du Programme de garantie des maisons neuves de l'Atlantique. Toutes les maisons pour lesquelles on demandera une garantie seront alors construites avec du bois S-Dry, ce qui causera une perte nette de 4 millions de dollars par année aux groupes cibles. Le secteur du bois de sciage se trouve donc dans l'obligation de réagir efficacement aux plans du Programme de garantie des maisons neuves de l'Atlantique.

Mentionnons qu'aucun des choix envisagés ne procurera d'effet net tant que les producteurs, les constructeurs et les consommateurs ne retireront pas suffisamment d'avantages à utiliser du bois de construction sec pour en contrebalancer les coûts. À moins de s'entendre sur un avantage net, il apparaît inutile de tenter de trouver une meilleure solution.



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2.0 INTRODUCTION

The Canada Mortgage and Housing Corporation (CMHC) retained ADI Limited to study the implications of using dry lumber (19% moisture content or less) in housing construction in the Atlantic Provinces. The objectives to be addressed by the study were as follows:

1. Provision of an assessment of the cost/benefit implications of imposing a 19% Atlantic Region Building Code requirement on the lumber industry, builders, and mills.
2. Provision of a practical strategic plan for moving ahead with builders, consumers, and the sawmill industry to achieve improved compliance with the 19% moisture content standard.

The background associated with the requirement for this study, ADI's approach to the study objectives, and the results of the analyses are presented in the following chapters.

3.0 BACKGROUND

As noted in the study Terms of Reference, there has been much discussion recently within the Atlantic Region on the economic and housing quality impacts of the use of "dry" lumber (possessing a moisture content of 19% or less) in residential housing construction. Although there are various regulatory standards which require the use of such lumber in wood-frame construction, a number of factors have worked to inhibit the level of its application in residential building.

However, a recent decision by the Atlantic New Home Warranty (ANHW) Program makes the use of such lumber a requirement in order to receive certification under the warranty plan. This decision follows the requirement of the National Building Code (Section 9.3.2.5) which states, "Moisture content of lumber shall not be more than 19% at the time of installation". In its meeting on February 28, 1994, the Board of the ANHW passed a motion to start implementation of the building code, including the 19% MC requirement, as of July 1, 1994. The Warranty Corporation also intends to lobby regulators, banks, consumers, etc. to require that all residential construction (both new houses and renovation) use lumber that has a Moisture Content of 19% or less.

An Ad Hoc Committee was formed after the ANHW first raised the issue in May 1993, to discuss how to move ahead on the issue. The Committee had representation from the construction industry, the Atlantic New Home Warranty Program, building supply dealers, the sawmill industry, the Canadian Wood Council, the Canadian Homebuilders Association (NB and NS), building inspectors, provincial Departments of Natural Resources, and the Canada Mortgage and Housing Corporation. As part of its work, the Committee decided to commission a cost/benefit analysis of the mandatory enforcement of the 19% moisture content requirement of the National Building Code of Canada, which is part of the focus of this study.

4.0 APPROACH

ADI's assignment in this project was twofold:

1. Provision of an assessment of the cost/benefit implications of imposing a 19% Atlantic Region Building Code requirement on the lumber industry, builders, and mills.
2. Provision of a practical strategic plan for moving ahead with builders, consumers, and the sawmill industry to achieve improved compliance with the 19% moisture content standard.

The approach taken by ADI was to consult with stakeholders to gain an understanding of the issues involved, and then identify and assess a number of plausible alternative future scenarios. The study's proposal, budget and schedule did not allow for analysis of all possible scenarios, and a selection of representative ones was therefore chosen, in consultation with the client. These scenarios included the extreme positions associated with the issue, as well as several potential "compromise" scenarios that might be acceptable to the stakeholders involved. For each alternative scenario, the changes in costs and benefits associated with identified variables were identified and quantified relative to the existing "base case" situation.

It must be noted that while there was reasonably good information to use in identifying costs and benefits, there was a tremendous lack of reliable data for use in the quantitative analysis. Time after time in this study, the consultants found that there was no reliable information available upon which to base the cost/benefit calculations. Therefore, the calculations were based on data whose sources range from reliable records to educated speculation. The assistance of the Ad Hoc Committee was beneficial in ensuring that, in many of the cases where reliable data was unavailable, the estimates used for calculations were reasonable. With the assistance of the Maritime Lumber Bureau and the Newfoundland Lumber Producers Association, a brief survey of lumber producers was conducted to assess what their response might be if the ANHW's plans were implemented.

In approaching the second objective of this assignment, it was anticipated that an acceptable and practical strategy would be discernable as a result of discussions with stakeholders (which would yield an understanding of their positions), and an analysis of the "extreme" and "compromise" scenarios (which would indicate the relative impacts of the alternative actions).

5.0 THE ISSUES

The 19% Moisture Content issue involves a number of groups, each having legitimate concerns. Some groups, such as the Atlantic New Home Warranty Corporation, are concerned about the impact of failing to implement the 19% MC requirement. Other groups, such as those sawmills producing green lumber, are concerned about the impact of implementing the 19% MC requirement. The following sections present a brief assessment of the issues, from the point of view of stakeholder groups such as:

- The Atlantic New Home Warranty Corporation
- Building Supply Dealers
- Sawmills
- Building Inspectors
- Banks
- Consumers

Atlantic New Home Warranty Corporation (ANHW)

The ANHW represents a diverse group of builders, and it appears that there is a significant range of home construction practices, abilities, and knowledge within their membership. Leaders within the Corporation are trying to raise the overall quality of their member-builders' work through a variety of internal methods, like training seminars, newsletters, etc. Issues such as the 19% MC are promoted to the membership to increase their awareness and make them better builders.

The National Building Code of Canada (NBCC) states that: *"Moisture content of lumber shall be not more than 19 percent at the time of installation"*. ANHW officials recognize that a house built with green lumber probably does not comply with this requirement if the house is framed and enclosed quickly; a practice that is common among most professional builders. The ANHW wishes to comply with the requirements of the NBCC, and has therefore indicated its intention to require that all houses registered under the Warranty in Atlantic Canada be built with lumber that has a Moisture Content of 19% or less. In practice, the ANHW will consider this requirement fulfilled if the lumber is stamped "S-Dry". The Warranty Corporation also intends to lobby regulators, banks, consumers, etc. to require that all residential construction (both new houses and renovation) use lumber that has a Moisture Content of 19% or less. Again, the ANHW will consider this requirement fulfilled if the lumber is stamped "S-Dry".

A very important point to note is that the NBCC does not state that S-Dry lumber is required; it says that $\leq 19\%$ MC lumber is required. This leads to two important distinctions:

1. S-Grn lumber will meet the requirements of the NBCC if it is at or below 19% MC at the time of installation.
2. S-Dry lumber will not meet the requirements of the NBCC if it is above 19% MC at the time of installation.

There are at least three issues raised by the ANHW. One is the **liability** issue. Another is the reported **cost/benefit advantage** of using dry lumber. The other is the **level playing field** issue. These are discussed below:

LIABILITY:

Basically, homes built with >19% MC lumber do not comply with the National Building Code of Canada (NBCC). The ANHW believes that the builder is liable for the results of such a failure to comply, and the ANHW is therefore liable if the builder defaults. It is noted that, if liability was the only issue, the ANHW could easily require its members to build with dry lumber, as an internal matter. ANHW officials report that there has never been a case where a builder was found liable for using >19% MC lumber in a house. Obviously, the ANHW prefers to err on the side of caution.

COST/BENEFIT ADVANTAGE:

Some builders believe that using dry lumber has a cost/benefit advantage over using green lumber. ANHW estimates that on all claims and conciliation repair work, carried out under warranty, an average of \$300 per unit is directly related to the use of green lumber¹. This figure does not include the cost of repair work not covered by the Warranty, such as repainting. ANHW officials report that the most common complaints from Warrantied homeowners relate to drywall problems, and that these complaints cause the most administrative work. It is recognized that there are other complaints that might be related to the use of green lumber, such as squeaking floors, siding detachment, etc. However, it seems that these complaints are far outweighed by complaints related to drywall. Obviously, any change in construction practice that reduces drywall problems also benefits home owners by reducing the frustration, inconvenience, etc. associated with invoking the Warranty on their home.

Surprisingly, the ANHW has limited, and sometimes conflicting, evidence regarding whether or not simply using dry lumber will eliminate the drywall problems that cause problems for the ANHW. The ANHW maintains a database of recorded, legitimate complaints by owners of warrantied houses, a copy of which was provided to ADI as

¹ ANHW Bulletin "On the Level", March 1993, as referenced in MLB and ABSDA presentation to ANHW, May 13, 1993.

part of the study. However, there are several problems with the data collected by the ANHW which make interpretation difficult or impossible:

First, there is no way of knowing how many complaints are made by owners of warrantied houses. The data kept by the ANHW is only a sample because it is based only on the written complaints that ANHW's administration receives. Typically, an owner's complaint is made directly to his builder, who handles it satisfactorily, and ANHW's administration never knows about the complaint. ANHW officials found it impossible to estimate how many complaints are handled satisfactorily for every one recorded in the ANHW database. For example, in 1993, 4,248 new houses were registered under the Warranty, and 174 complaints regarding walls/drywall were recorded in the database. Anecdotal evidence suggests the number of walls/drywall complaints is much higher, but there is no information to indicate how much higher.

Second, it is not known if the houses with walls/drywall complaints were built from dry or wet lumber, since no records have been kept of this fact. It is understood that ANHW inspectors have started noting whether lumber is S-Dry or S-Green as they visit construction sites. However, it is also understood that an established ANHW builder might only get inspected once per year. Therefore, this database of dry vs. green will not include all Warrantied houses.

Third, it is not known if the database's distribution of complaints by province of origin and type of complaint is actually representative of "real life". Early in the study, ANHW officials stated that the fact that proportionally more walls/drywall complaints were recorded from Nova Scotia homeowners, combined with the fact that Nova Scotia had less dry kiln capacity than New Brunswick, made it clear that green lumber caused more walls/drywall complaints. This is simply speculation. The data could be used to speculate other points as well. For example, the number of houses registered rose 150% from 1992 to 1993, but the number of recorded walls/drywall complaints rose by 620%. This could mean that established builders were busier and therefore less attentive to detail, or that small, less experienced builders re-entered the market as conditions improved, but built lower quality houses. It could also mean that builders "abandoned" their houses in 1992, leaving the ANHW to handle their problems. All of these points are simply speculation, and are included to illustrate the problems with interpreting incomplete data. Excerpts from the ANHW database are presented in Table 5.1.

It is noted that those builders who perceive the cost/benefit advantage of using dry lumber already have the choice of using dry lumber open to them. If they use dry lumber, it should not matter what other builders or regulators do. It would be a marketing feature, and member-builders would reap the benefits of using dry lumber.

Table 5.1
Complaint Data from ANHW Database

	Data for the year ending February 28:				
	1990	1991	1992	1993	1994 (11 months only)
# of current builder members in:					
Nova Scotia	442	416	367	376	383
New Brunswick	322	305	303	327	339
Prince Edward Island	66	64	60	59	57
Newfoundland	171	180	166	166	152
Total	1,001	965	896	928	931
# of houses enrolled in the year in:					
Nova Scotia	1,677	1,358	982	1,808	1,847
New Brunswick	1,372	1,192	1,032	1,687	1,414
Prince Edward Island	231	159	200	242	222
Newfoundland	771	837	617	511	580
Total	4,051	3,546	2,831	4,248	4,063
Total houses registered in:					
Nova Scotia	16,158	17,279	17,997	19,658	21,354
New Brunswick	10,733	11,644	12,417	13,891	15,008
Prince Edward Island	1,974	2,083	2,202	2,414	2,583
Newfoundland	6,068	6,841	7,352	7,730	8,169
Total	34,933	37,847	39,968	43,693	47,114
# Recorded Walls/Drywall Complaints					
Nova Scotia	55	44	16	83	83
New Brunswick	23	7	4	50	41
Prince Edward Island	4	0	1	20	3
Newfoundland	9	11	7	21	46
Total	91	62	28	174	173

Building supply dealers would be expected to supply the demand for dry lumber. It is further noted that, if the cost/benefit advantage was perceived by every ANHW member-builder, they would all use dry lumber because it would save money on call-backs and make home buyers more satisfied. Since all ANHW builders do not use dry lumber, it seems reasonable to conclude that they do not all perceive a cost/benefit advantage to using dry lumber.

LEVEL PLAYING FIELD:

ANHW builders are business people, working in a competitive market. If home buyers do not perceive extra value in the use of dry lumber in their house, they will not pay extra for it. For example, if dry lumber added an extra \$1,000 to the cost of a house, then two potential problems are foreseen by ANHW officials:

1. If the ANHW mandated the use of dry lumber, but the home buyer (for whatever reason) would not pay extra for dry lumber, then the Warrantied builder either loses \$1,000 off his bottom line, or loses the job to a competing, but non-warrantied, builder who can use green lumber and reduces his price by \$1,000. It is considered that this is an unrealistic scenario.
2. If the ANHW does not require the use of dry lumber, and a home buyer (for whatever reason) would not pay extra for dry lumber, then a warrantied builder who wants to use dry lumber either loses \$1,000 off his bottom line, or loses the job to a competing builder (either warrantied or non-warrantied) who uses green lumber and reduces his price by \$1,000.

It is considered that ANHW's desire to have **everyone** (non-warrantied builders, owner-builders, renovators, etc.) comply with the 19% MC requirement has nothing to do with the 19% MC requirements of the NBCC or the cost of call-backs. It is entirely due to ANHW's desire to eliminate any competitive disadvantage associated with warrantied builders using dry lumber.

The ANHW has also raised the issue that transportation costs may be lower for dry lumber than they are for wet lumber. It is obviously true that "dry" lumber weighs less than "wet" lumber, and therefore more can be carried on a truckload. Clearly, unit transportation costs per kilometre are lower for dry lumber, for a particular transportation movement. However, it not certain that such economies will automatically apply to a situation that involves changes to the production and distribution of lumber in the Atlantic Provinces. It can be argued that although more dry lumber can fit on a truck, the truck may have to come from a dry lumber supplier located farther away than the previous wet lumber supplier.

Dealers:

Basically, building supply dealers are in the business of supplying the needs of people who use building supplies. If a product is in regular demand, they will stock it. If a product is demanded sporadically, dealers will special order it. It does not matter what the product is, dealers are business people - they will sell it if they can make money at it.

Dealers' have expressed concerns about the costs associated with carrying double inventories of dry and green lumber. This is a legitimate concern, but it is anticipated that two factors would mitigate associated impacts:

1. Dealers who carried both green and dry lumber would be unlikely to carry as much of each type as they do now, unless their sales were double their existing levels. Costs would therefore be higher, but not double present costs.
2. Dealers would tend to specialize in the type of lumber they carried. This happens now. Dealers that cater to the do-it-yourself homeowner would probably stock green lumber. Dealers that cater to the professional builder would probably stock dry lumber.

Concerns have also been raised about the extra costs associated with handling and storing S-Dry lumber, so that it remains dry. It is considered that costly handling and storage procedures will only be implemented if dry lumber is subjected to moisture content testing at the time of installation in a house. In such a situation, covered storage in dealer yards and special unloading methods at job sites will probably be demanded. These requirements will add to the dealers' costs, and will have to be reflected in the retail price of S-Dry lumber.

A concern that relates to dealers and sawmills alike is that builders are perceived to want dry lumber at the price of green. While it is common business practice to seek "Cadillac" quality at "Volkswagen" prices, it has to be assumed that dealers must recover their costs to stay in business. Presumably, dealers could not bear the cost of any type of additional inventories unless they could recover those costs in some manner.

Sawmills:

Two lines of thought have been expressed on this issue:

1. Sawmill owners are business people. They are not in business to make 2x4's; they are in business to make money. If they can produce lumber (green or dry) and sell it at a profit, then they will do so. If they cannot, they will go

out of the sawmilling business, and another mill will supply the lumber demand.

2. Small sawmills are a part of the socio-economic fabric of many small or rural communities. Regulations like the 19% MC requirement may be useful in bigger centres, but different attitudes, relationships and tolerances in smaller communities make such regulations unnecessary, and unwanted, in smaller communities.

Organizations representing sawmills, such as the Maritime Lumber Bureau (MLB) and the Newfoundland Lumber Producers Association (NLPA), have been forced to react to the stated intentions of the ANHW. The NLPA has no members with kilns, and so it can clearly represent its members by opposing the 19% MC requirement. About 25% of the mills in the MLB are capable of producing kiln dried lumber, and the other 75% have no kilns. Therefore, the MLB is careful to point out that it does not support the ANHW proposal, but does not oppose the use of dry lumber, if governed by market forces.

Those opposing the ANHW plan have pursued several lines of argument, as discussed below:

1. **The National Building Code is wrong - there has to be a good reason why the 19% requirement has not been enforced in the past.** It does not matter whether or not this argument is true; it is irrelevant at this point. Arguing that a NBCC clause is wrong, when it has been in the Code since the 1950s, seems to be fighting the wrong battle at the wrong time. The NBCC is finalized years in advance of its issue, and therefore the argument cannot be resolved in time to help the present situation.
2. **Elected representatives will not allow it.** Again, it is difficult to envisage this argument as being realistic, if organizations such as the ANHW and provincial homebuilders' associations support the 19% requirement. Many of the influencing factors are beyond the scope of government control, and relate to the internal policies of organizations such as the ANHW and lending institutions. It is considered that government intervention is more likely to come in the form of efforts to mitigate the impacts caused by the implementation of the 19% MC requirement.
3. **The ANHW proposal does not meet the NBCC.** It is considered that this argument is correct. The MLB has clearly stated that an S-Grn or S-Dry stamp on a piece of lumber is not proof of its moisture content at the time of

installation; the stamp only relates to the moisture content at the time the grade stamp was applied. Therefore, it seems that the method of avoiding liability favoured by the ANHW (using S-Dry lumber) cannot be used as proof of having met the moisture content requirements of the NBCC. Lumber producers can rightfully question why the ANHW, who are being so cautious that they are acting to avoid liability where none has ever been proven, would be so imprudent as to recommend a course of action that does not meet the NBCC.

It has also been noted that increasing lumber costs serves to encourage builders to try various types of building materials, other than lumber. This includes steel studs, poured concrete walls (such as the polycrete system), and vinyl house components. If this happened, builders would still build houses; they would simply not be using as much lumber. Dealers would still sell building supplies; they would simply not be selling as much lumber. It is not known how much material switching would occur, but it is obvious that the lumber industry would suffer.

It is not certain what would happen to the market price of S-Dry and S-Grn lumber if the ANHW's plans were implemented. If a significant portion of the market for S-Grn lumber disappears, then competitive pressures might force S-Grn prices down. Similarly, if a significant demand for S-Dry appears, buyers might end up competing with export markets for S-Dry lumber, thus contributing to an increase in its price. This is only speculation, and it is noted that opinions as to what will actually happen are varied.

Building Inspectors:

Building inspectors are professional people who can be expected to be very knowledgeable regarding the regulation of residential construction. It is considered that every building inspector in the Atlantic Provinces would have a personal and professional opinion on the 19% MC issue. However, for the purposes of this study, it is simply noted that they are government employees without an economic stake in the issue. Regardless of their personal or professional feelings on the 19% MC issue, it is considered that they will all respond the same way if an organization of builders such as the ANHW presents them with an argument such as:

1. Most green lumber used in house construction does not meet the 19% MC requirements of the NBCC, and you know it.
2. You still issue building permits, and approve construction with green lumber.
3. You are knowingly participating in a failure to comply with the NBCC, and therefore **YOU ARE LIABLE.**

If an S-Dry stamp is considered to be acceptable evidence of moisture content, then inspectors will look for it on their site visits. If testing is required, it is assumed that inspectors will not do the testing themselves, but will require third-party evidence of moisture content compliance, ie, a report from an approved testing agency.

Banks:

If banks hold mortgages on houses, they have an economic stake in the issue. If the 19% MC requirement is presented to them as a high profile issue, sponsored by respected organizations such as the ANHW and the provincial homebuilders' associations, it is assumed that the banks will react as they usually do when faced with a situation involving collateral or pledged assets - they will take action to increase their security. They will want to ensure that their mortgaged houses are likely to maintain or increase their value, and the homeowner/borrower is not likely to be faced with big repair bills or dissatisfaction with the house. Obviously, high ratio mortgages will continue to require the ANHW warranty. While ANHW's approach to the banks would probably emphasize the benefits of warrantied houses, issues such as the 19% MC one will certainly be a part of the discussion. If the 19% MC requirement becomes a big enough issue, it seems realistic to foresee the banks requiring dry lumber in any new house on which they hold a mortgage. It is assumed that the banks would require a "Certificate of Moisture Content Compliance" from an accredited inspector before advancing funds beyond the framing stage. If an S-Dry stamp is considered to be acceptable evidence of moisture content, then the banks' inspectors will look for it on their site visits. If testing is required, it is assumed that the banks will require evidence of moisture content compliance.

Consumers:

It cannot be assumed that house buyers are fully knowledgeable consumers that make their purchase decisions based on a full understanding of the capital and operating cost implications associated with the components used in their house. However, it is a common marketing approach to raise consumers' perception of the value and importance of certain product features that are offered in a house (such as kiln dried lumber). On the other hand, dry lumber is a hidden feature, and builders know that "shine sells", ie, what the buyer can see often sells a house, not hidden features.

It is noted that the ANHW's proposal, and most of the other possible "compromise" scenarios considered in this study, result in increased house prices. It is expected that all of the extra costs associated with using S-Dry wood in houses will be passed along the economic chain until they are finally borne by the house buyer. Common sense suggests that increasing house prices in this manner will tend to reduce the market demand for houses. However, CMHC has no data on the demand elasticities that might apply in this case.

6.0 THE SCENARIOS CONSIDERED

The initial part of ADI's assignment in this project was to provide an assessment of the cost/benefit implications of imposing a 19% Atlantic Region Building Code requirement on the lumber industry, builders, and mills.

The approach taken by ADI was to consult with stakeholders to gain an understanding of the issues involved, and then identify and assess a number of possible scenarios. A list of contacts is presented in Appendix A. The study's proposal, budget and schedule did not allow for analysis of all possible scenarios, and a selection of representative ones was therefore chosen, in consultation with the client. These scenarios included the extreme positions associated with the issue, as well as several potential "compromise" scenarios that might be acceptable to the stakeholders involved.

This section presents and discusses the various scenarios developed through consultation with stakeholders and knowledgeable individuals. It should be noted that any factors which are unchanged throughout all scenarios are not included in the analysis. A total of ten scenarios were identified and, after discussions with the client, five were chosen for cost/benefit analysis. An additional scenario was developed and included in the cost/benefit analysis following a suggestion offered during a meeting with the Ad Hoc Committee.

Base Case

This scenario assumes that the existing situation continues, and the use of dry lumber is governed by market demand, not regulatory forces. Other assumptions are described in Chapter 8.

Immediate Implementation

This scenario assumes that the ANHW's plans are immediately and fully implemented, across the Atlantic Provinces. It is assumed that there will be a nominal choice between two acceptable alternatives: using S-Dry lumber, or using S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all builders using grade stamped lumber will not risk failing the certification test, and will choose to use S-Dry lumber. Other assumptions are described in Chapter 8.

Total Testing

This scenario includes all the assumptions from the "Immediate Implementation" scenario, except that the grade stamp on lumber is not accepted as proof of its moisture content without testing, ie, it is assumed that every house and renovation

project will be tested, regardless of whether it is built from S-Grn or S-Dry lumber. It is assumed that both dealers and builders will have to employ special handling and storage practices, and incur extra costs, to help ensure the lumber used in a house does not fail the moisture content test. It is assumed that a Moisture Content Certification test will cost \$150. Other assumptions are described in Chapter 8.

Guidelines for S-Grn Lumber Construction Adopted

In this scenario, it is assumed that a set of guidelines are developed, dealing with acceptable construction practice using S-Grn lumber. Items such as sheathing materials and construction techniques that allow post-enclosure drying to take place would be specified, thus allowing builders to confidently use S-Grn lumber in house construction and renovation projects, knowing that they are in compliance with regulations. This scenario was suggested in a meeting with the Ad Hoc Committee, and it was agreed that ADI would include it in the cost/benefit analysis. Other assumptions are described in Chapter 8.

Implementation in New Brunswick and Nova Scotia Only

This scenario assumes that the ANHW's plans are immediately and fully implemented in New Brunswick and Nova Scotia, but are not implemented in Prince Edward Island or Newfoundland. In NB and NS, it is assumed that there will be a nominal choice between two acceptable alternatives: using S-Dry lumber or using S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all builders using grade stamped lumber will not risk failing the certification test, and will choose to use S-Dry lumber.

Implementation for Warrantied Houses Only

This scenario assumes that the first phase of the ANHW's plans are immediately implemented, across the Atlantic Provinces. It is assumed that all houses registered under the Warranty will have to be either built using S-Dry lumber, or S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all Warrantied builders will not risk failing the certification test, and will choose to use S-Dry lumber. Other assumptions are described in Chapter 8.

Implementation in Urban Areas Only

This scenario assumes that the ANHW's plans are immediately implemented, but are limited to the urban areas in the Atlantic Provinces. Non-Warrantied builders in rural areas will be able to use green lumber. All houses (urban and rural) registered under the Warranty will have to be either built using stamped S-Dry lumber, or S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all Warrantied builders will not risk

failing the certification test, and will choose to use S-Dry lumber. Other assumptions are described in Chapter 8.

Implementation for New Houses Only

This scenario assumes that the ANHW's plans are immediately implemented for new houses only, ie, renovation projects can still use S-Grn lumber. This scenario is not consistent with the stated intentions of the ANHW, who have also noted that it might be even more important to use dry lumber in a renovation project, since the rest of the lumber in the house is already dry. It is considered that this scenario is probably not realistic because the NBCC Part 9 does not make a distinction between the use of lumber for new construction or renovation applications.

Implementation for Selected Components Only

This scenario assumes that it is recognized that some lumber components are more critical than others, and only the most important components are required to meet the 19% MC requirement. It is considered that this scenario is probably not realistic because the NBCC Part 9 does not make this distinction.

Phased Implementation

This scenario assumes that some type of phased implementation is agreed upon. For example, the 19% MC requirement could be implemented in urban centres immediately, but not implemented in rural areas until later. Another example could be implementation for Warrantied builders immediately, but later for non-Warrantied builders. Since this type of scenario is a variation on previously described scenarios, it was considered that the impact could be intuitively judged, based on the results of other scenarios.

7.0 SURVEY OF ATLANTIC REGION SAWMILLS

One question that needed to be answered in this study was: "How will Atlantic Region sawmills respond to the changes planned by the ANHW?" Opinions received from knowledgeable individuals ranged from "little or no impact" to "massive extra-provincial sourcing of dry lumber". At the suggestion of the Ad Hoc Committee, and with the aid of the MLB and the Newfoundland Lumber Producers Association, a brief survey was faxed to MLB and NLPA members, and 38 responses were received. A copy of the survey questionnaire and covering letter is included in Appendix B. It is recognized that this survey is not a random, representative sample of the industry as a whole, but it is assumed that the responses do provide a general indication of industry thinking on the issue. The survey responses are presented in Table 7.1, sorted by size of respondent, and in Table 7.2, sorted by province of respondent. The MLB has been provided with a copy of the survey responses, for their own analyses. Observations drawn from the survey responses are outlined below:

Selected Statistics

Of the 17 mills, producing < 5 million fbm per year, who responded:

- 2 currently had dry kilns already installed
- 2 currently had plans to install dry kilns
- 13 had no kilns and no current plans to install kilns

Of the 21 mills, producing > 5 million fbm per year, who responded:

- 14 currently had dry kilns already installed
- 6 currently had plans to install or add to their dry kiln capacity
- 3 had no kilns and no current plans to install kilns

Of the 17 mills, producing < 5 million fbm per year, who responded:

- 5 said that the ANHW plans might force them out of business
- 0 said that they would use existing kilns to meet the change in demand
- 5 said that they might invest in new kilns to meet the change in demand
- 8 said they might produce S-Dry by air drying to meet the change in demand
- 1 said selling rough sawn lumber to a mill with a kiln was a possibility
- 5 said they might form a co-op kiln with other mills
- 7 said they might find new markets for their lumber (either domestic or export)

Of the 21 mills, producing > 5 million fbm per year, who responded:

- 0 said that the ANHW plans might force them out of business
- 12 said that they would use existing kilns to meet the change in demand
- 8 said that they might invest in new kilns to meet the change in demand
- 4 said they might produce S-Dry by air drying to meet the change in demand
- 0 said selling rough sawn lumber to a mill with a kiln was a possibility
- 0 said they might form a co-op kiln with other mills
- 6 said they might find new markets for their lumber (either domestic or export)

NOTE: total of possible options exceeds number of mills due to multiple options chosen by some mills.

Table 7.1
Summary of Survey Responses, by Production Volume

VOLUME (million fbm/year)	# EMPLOYED		DRY KILN		RESPONSE TO FULL IMPLEMENTATION								
	Directly	Indirectly	Installed	Planned	Capacity	Out of business	Existing kilns	New kilns	Air dry	Sell rough	Co-op kilns	New markets	
<1	20		N	N					P		P		
<1	10		N	N					P			P	
<1	10		N	N							Y		
<1	10	25	N	N		P						P	
<1	8		N	N				Y					
1-5	70	20	N	N		P						P	
1-5	60	100	N	N					Y				
1-5	56	138	N	N				P	P		P	P	
1-5	46	76	N	N			Not Answered						
1-5	40	60	Y		175 M/chg	Y						Y	
1-5	40	30	N	N									
1-5	33	60	N	Y	4 MM			Y					
1-5	28	10	N	N		P			P		P		
1-5	25	0	Y		2.8 MM			Y					
1-5	22	30	N	Y	60 M/chg			P	P			P	
1-5	20	20	N	N		P			P	P	P	P	
1-5	20		N	N					P			P	
5-10	100		Y		12 MM		Y						
5-10	75	25	Y	Y	300 M now, 80 M/chg plan		P	P	P			P	
5-10	70	30	N	Y	??		P		P				
5-10	35	75	N	Y	250 M			P				P	
5-10	27	10	Y		3.5-4 MM		P					P	
5-10	12		Y		15 MM			Not Answered					
>10	1,000		Y		>300 MM		Y						
>10	200	260	Y		30 MM		Y						
>10	145	150	N	Y	60 MM			Y					
>10	140	60	N	N				Y				Y	
>10	110	150	Y		25 MM							Y	
>10	100	90	N	N									
>10	90	50	Y		20 MM			Y				Y	
>10	85	140	Y	Y	70 MM now, 40 MM plan		Y						
>10	85		Y		12 MM		P					P	
>10	65	400	N	Y	150 M/chg			Y					
>10	65	200	Y		30 MM		P		P				
>10	55	200	Y		20 MM		Y						
>10	48	30	Y	Y	10 MM		P	P					
>10	40	75	Y		15 MM		Y						
>10	35		N	??				P	P				

"N" = No

"Y" = Yes

"P" = Possibility

Table 7.2
Summary of Survey Responses, by Province

Province	VOLUME (million fbm/year)	# EMPLOYED		Installed	DRY KILN		RESPONSE TO FULL IMPLEMENTATION						
		Directly	Indirectly		Planned	Capacity	Out of business	Existing kilns	New kilns	Air dry	Sell rough	Co-op kilns	New markets
NB	>10	40	75	Y		15 MM		Y					
NB	>10	55	200	Y		20 MM		Y					
NB	>10	65	200	Y		30 MM		P		P			
NB	>10	65	400	N	Y	150 M/chg			Y				Y
NB	>10	100	90	N	N								Y
NB	>10	110	150	Y		25 MM							Y
NB	>10	145	150	N	Y	60 MM			Y				
NB	>10	200	260	Y		30 MM		Y					
NB	>10	1000		Y		>300 MM		Y					
NB	5-10	27	10	Y		3.5-4 MM		P					P
NB	5-10	35	75	N	Y	250 M			P				P
NB	1-5	20		N	N					P			P
NB	1-5	20	20	N	N		P			P	P		P
NB	1-5	28	10	N	N		P			P			Y
NB	1-5	40	30	N	N								P
NB	1-5	70	20	N	N		P						P
NB	0-1	8		N	N				Y				
NF	>10	140	60	N	N				Y				
NF	1-5	56	138	N	N				P	P		P	P
NF	1-5	60	100	N	N					Y			
NF	0-1	10		N	N							Y	
NF	0-1	10	25	N	N		P						P
NF	0-1	10		N	N					P			P
NF	0-1	20		N	N					P	P		
NS	>10	35		N	??					P			
NS	>10	48	30	Y		10 MM		P	P				
NS	>10	85		Y		12 MM		P					P
NS	>10	85	140	Y	Y	70 MM now, 40 MM plan		Y					
NS	>10	90	50	Y		20 MM			Y				
NS	5-10	12		Y		15 MM				Not Answered			
NS	5-10	70	30	N	Y	??				P			
NS	5-10	75	25	Y	Y	300 M now, 80 M/chg plan		P	P	P			P
NS	5-10	100		Y		12 MM		Y					
NS	1-5	22	30	N	Y	60 M/chg			P	P			
NS	1-5	25	0	Y		2.8 MM			Y				
NS	1-5	33	60	N	Y	4 MM			Y				
NS	1-5	40	60	Y	Y	175 M/chg	Y		Y				
NS	1-5	46	76	N	N					Not Answered			

Note:

"N" = No

"Y" = Yes

"P" = Possibility

Sawmill Closures or Downsizing of Production

It is estimated that full implementation of the ANHW's plans would result in a change in market demand from green to dry lumber, involving about 100 million fbm of lumber in the Atlantic Provinces. This represents about 11% of all lumber produced in the Atlantic Provinces. As noted above, 5 of the 38 sawmills responding to the survey said that such a change in market demand might force them out of business. An attempt was made to estimate the quantity of lumber production represented by this response, assuming that the survey results were representative of sawmills in Atlantic Canada. Based on available data, ADI roughly estimated that the sawmills that anticipated being forced out of business represented about 50 million fbm of lumber production, i.e., about half the amount of lumber involved in the change in demand. It was further assumed that this ratio would apply to all potential changes in market demand considered in this study.

It was assumed that half of the lumber involved in the change in demand from green to dry, in a particular province, would be supplied by mills within that province. It was also assumed that 25% would be supplied by other mills in the Atlantic Provinces, and another 25% would come from mills outside the Atlantic Provinces.

Job Losses and Gains Due to Changes in Market Demand

It was expected that the lumber production lost through the closure or downsizing of small mills would be replaced by increased lumber production at larger mills. While jobs would be lost through mill closures, new jobs would be created by increased production at larger mills. However, the larger mills would be less labour-intensive than the small mills, and would therefore create fewer jobs than those lost through small mill closures.

In order to estimate job gains and losses in the Atlantic Provinces, it was necessary to estimate the lumber production per employee for different sizes of mills. This task was difficult because data on sawmill production and total employment was either considered confidential, or was reported as a range of numbers that did not allow an exact calculation of lumber production per employee. The survey data, combined with industry production estimates, suggests that the production figures applying to direct and indirect employees are as shown in Table 7.3.

Table 7.3
Estimated Sawmill Production per Employee

Sawmill Categories	Estimated Production Output per Employee		
	Output per Direct Employee	Output per Indirect Employee	Output per Direct and Indirect Combined
Affected sawmills, producing <5 million fbm/year	80,000 fbm	60,000 fbm	34,000 fbm
Larger, more efficient mills, in the same province as the affected mills	120,000 fbm	120,000 fbm	60,000 fbm
Still larger mills in the Atlantic Provinces	140,000 fbm	210,000 fbm	85,000 fbm

The information shown in Table 7.3 can also be used to estimate the value of lumber sales per job (both direct and indirect employees). Assuming a value of \$475 per thousand fbm for green lumber, then the sales value per job, by mill size, is as follows:

- Affected sawmills, producing <5 million fbm/year: \$16,150 per job;
- Larger, more efficient mills, in the same province as the affected mills: \$28,500 per job;
- Still larger mills in the Atlantic Provinces: \$40,375 per job.

Co-operative Kiln Drying

It is noted that the idea of several mills forming a "kiln drying co-op", and collectively accomplishing what a single mill could not afford to do, has been suggested as a potentially attractive alternative that might be appropriate for some mills. The concept of co-op kilns had been previously discussed by members of the Ad Hoc Committee, with the MLB pointing out that being a member of a co-op kiln would tend to result in a loss of identity for individual mills, and possible changes related to marketing lumber.

Under the co-op kiln concept, member mills would bring their rough sawn lumber to the co-op kiln, where the lumber would be separated by species. Lumber dried in a particular kiln charge would therefore have similar drying characteristics, but would likely come from several different mills. When the kiln was unloaded, it would be difficult or impossible to determine ownership of individual pieces of lumber, thus

preventing member mills from retrieving, dressing and grade stamping their own lumber. It therefore seems likely that lumber dried in the co-op kiln would be dressed in a planer mill at the kiln site, and then grade stamped in the name of a single entity (presumably the co-op).

It has been noted that mills have reputations to cultivate and protect when they sell lumber as individual business entities. However, when their product is lumped together with lumber from other mills, the resulting lumber quality and prices are the "average" for the group. Mills producing high quality lumber would tend to lose, and mills producing lower quality lumber would tend to gain if prices received by the co-op reflected the average quality of the group's production. Perhaps some form of pre-drying grading and pricing could overcome this potential difficulty.

It is worthwhile to note that, among responding mills producing <5 million fbm per year, the idea of forming co-op kilns with other mills was considered to be a legitimate possibility. 5 of the 17 respondents said they might form co-op kilns with other mills. This is equal to the number of respondents who said that they might invest in new kilns for their mills.

Assumptions and Observations Drawn from Survey

For the purposes of this study, the assumptions drawn from the survey results and other industry data is as follows:

1. Small sawmills, producing less than 5 million fbm per year, will bear the greatest negative impact.
2. A significant change in demand from S-Grn to S-Dry would result in the closure or significant downsizing of small sawmills. The survey data, combined with industry production estimates, roughly suggests that the total production of the mills that would close or downsize is about 50% of the amount of lumber involved in the change in demand.
3. It is assumed that the production lost from closed mills, combined with the change in demand from S-Grn to S-Dry, would be supplied from other mills in the province, other mills in the Atlantic Provinces, and other mills outside the Atlantic Provinces.
4. The assumption that lost production can be supplied by mills in the province or the Atlantic Provinces is considered to be reasonable, given the interest expressed in changing to the production of S-Dry lumber by either air drying or kiln drying.
5. Small sawmills are more labour-intensive than larger mills, and an industry restructuring in which lumber production shifts from small mills to larger mills will result in a net loss of jobs.

8.0 THE COSTS AND BENEFITS OF POSSIBLE SCENARIOS

Cost/benefit analysis is a technique often used to assist decision-makers in choosing between alternative courses of action. For each alternative, the costs and benefits associated with identified variables are quantified relative to the existing "base case" situation. Those alternatives whose net benefits (Benefits minus Costs) are positive, compared to the base case, are considered favourable choices. Clearly, cost/benefit analysis is very dependent on having reliable data to use in identifying and quantifying benefits and costs.

The situation associated with this study is somewhat unique for two reasons:

First, it is considered that the overall results of the cost/benefit analysis are unlikely to have any influence on the course of action chosen by those involved. The actions of the ANHW are based on the results of their own "cost/benefit" analysis, which considers the alternatives from their point of view alone. On this basis, their actions are logical in that the benefits of the ANHW's plan outweigh the costs, compared to the existing situation. The fact that costs are imposed on other parties is not considered in their calculation.

Second, while there was reasonably good information to use in identifying the different cost and benefit factors, there was a tremendous lack of reliable data for use in the quantitative analysis. Time after time in this study, the consultants found that there was no reliable information available upon which to base the cost/benefit calculations. Therefore, the calculations are based on data whose sources range from reliable records to educated speculation. The assistance of the Ad Hoc Committee was beneficial in ensuring that, in many of the cases where reliable data was unavailable, the estimates used for calculations were reasonable.

In the following sections, the assumptions associated with each scenario are described, and the Net Benefits, relative to the base case, are summarized in tabular form. Detailed calculations for each scenario are included in Appendix C.

There are many assumptions which apply to all scenarios. These general assumptions are listed below:

- 9,000 houses are built each per year in Atlantic Canada
- 1,800 non-warranted houses are built per year in Atlantic Canada, using ungraded lumber, and will not be impacted by events considered in any of the scenarios
- 75 % of houses built with S-Grn lumber will have complaints related to the lumber

- 25% of houses built with S-Dry lumber will have complaints related to the lumber
- the average cost of repairing problems related to the lumber is \$300 per house
- complaints regarding warrantied houses are repaired at no cost to the owner
- 50% of relevant complaints regarding non-warrantied houses are repaired at no cost to the owner
- 50% of relevant complaints regarding non-warrantied houses are repaired at the owner's expense
- the cost of incurring liability by choosing to use S-Grn (or the benefit of avoiding it by using S-Dry) cannot be quantified. It has an intangible value.
- an average house of 1,500 square feet contains 10,000 fbm of lumber, not including sheathing
- S-Grn lumber wholesales for \$475 per Mfbm and S-Dry wholesales for \$555 per Mfbm (it is recognized that lumber prices fluctuate over time, but these prices were considered reasonable for early 1994)
- S-Dry lumber retails for \$100 per Mfbm more than S-Grn lumber
- renovation uses the same total amount of lumber as new construction
- renovation uses the same ratio of dry vs. green lumber as new construction
- it is assumed that those situations in which the 19% MC requirement is enforced will also be the cases where the NBCC requirement for grade stamped lumber is enforced. Therefore, it is assumed that only grade stamping sawmills will be impacted by events considered in any of the scenarios
- any extra costs incurred by dealers will be recovered by them in some manner
- houses built with dry lumber cost less to heat than houses built with green lumber. The Present Value of this annual saving is \$100.

8.1 Scenario 1: Existing Situation Continues

This scenario assumes that the existing situation continues, and the use of dry lumber is governed by market demand, not regulatory forces. It is based on the general assumptions listed previously, as well as the following specific assumptions:

- 2,100 Warrantied houses are built per year, using S-Grn lumber
- 2,100 Warrantied houses are built per year, using S-Dry lumber
- 2,700 non-warrantied houses are built per year, using S-Grn lumber
- 300 non-warrantied houses are built per year, using S-Dry lumber
- the market price of a house built with dry lumber is the same as for a house built with green lumber

For the purposes of the cost/benefit analysis, the existing situation is considered to be the "base case", against which all other alternative scenarios are compared.

8.2 Scenario 2: Immediate and Full Implementation of ANHW Plans

This scenario assumes that the ANHW's plans are immediately and fully implemented, across the Atlantic Provinces. It is assumed that there will be a nominal choice between two acceptable alternatives: using S-Dry lumber, or using S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all builders using grade stamped lumber will not risk failing the certification test, and will choose to use S-Dry lumber. This scenario is based on the general assumptions listed previously, as well as the following specific assumptions:

- zero Warrantied houses are built per year, using S-Grn lumber
- 4,200 Warrantied houses are built per year, using S-Dry lumber
- zero non-warrantied houses are built per year, using S-Grn lumber
- 3,000 non-warrantied houses are built per year, using S-Dry lumber
- the market price of a house built with dry lumber is greater than that for a house built with green lumber, by an amount equal to the costs associated with the dry lumber in the house.
- a change in lumber demand (from S-Grn to S-Dry) occurs, involving 96,000 Mfbm of lumber per year. This results in the closure or downsizing of sawmills, whose total production is 48,000 Mfbm per year. The market demand is supplied as follows:
 - 48,000 Mfbm of S-Dry supplied by other mills in the province
 - 24,000 Mfbm of S-Dry supplied by mills in the other Atlantic Provinces
 - 24,000 Mfbm of S-Dry supplied by mills outside the Atlantic Provinces
- for illustration purposes, in terms of jobs losses and gains at sawmills in the Atlantic Provinces, it is roughly estimated that:
 - the mill closures will result in about 600 direct job losses in small mills, and about 800 indirect job losses.
 - larger, less labour-intensive mills, in the same province, will supply 50% of the lumber production lost due to mill closures, thus creating about 400 new direct jobs and 400 indirect jobs.
 - still larger, less labour-intensive mills, in the Atlantic Provinces, will supply 25% of the lumber production lost due to mill closures, thus creating about 170 new direct jobs and 115 indirect jobs.

The changes in the benefits and costs associated with this scenario were calculated from the perspective of each identified stakeholder, relative to the base case scenario. Totalling all the changes in benefits and costs shows that this scenario yields negative net benefits, relative to the existing "base case" situation. As a whole, the stakeholders would be \$18 million per year worse off under this scenario. This is

summarized in Table 8.1, and shown graphically in Figure 8.1.

8.3 Scenario 3: Implementation of ANHW Plans, with Mandatory MC Testing

This scenario includes all the assumptions from the "Immediate Implementation" scenario, except that the grade stamp on lumber is not accepted as proof of its moisture content without testing, ie, it is assumed that every house and renovation project will be tested, regardless of whether it is built from S-Grn or S-Dry lumber. It is assumed that both dealers and builders will have to employ special handling and storage practices, and incur extra costs, to help ensure the lumber used in a house does not fail the moisture content test. This scenario is based on the general assumptions listed previously, as well as the following specific assumptions:

- zero Warrantied houses are built per year, using S-Grn lumber
- 4,200 Warrantied houses are built per year, using S-Dry lumber
- 1,000 non-warrantied houses are built per year, using S-Grn lumber which is dried to a moisture content of 19% or less by the time of installation
- 2,000 non-warrantied houses are built per year, using S-Dry lumber
- all houses and renovation projects are tested for moisture content compliance, at a cost of \$150 per test
- dealers will be required to employ special storage and handling practices for S-Dry lumber, which will add \$20/Mfbm to their costs, which will be passed on to buyers
- builders will be required to employ special practices for both S-Dry and S-Grn lumber, at a cost of \$200 per house
- the market price of a house built with dry lumber is greater than that for a house built with green lumber, by an amount equal to all the costs associated with the dry lumber in the house.
- a change in lumber demand (from S-Grn to S-Dry) occurs, involving 86,000 Mfbm of lumber per year. This results in the closure or downsizing of sawmills, whose total production is 43,000 Mfbm per year. The market demand is supplied as follows:
 - 43,000 Mfbm of S-Dry supplied by other mills in the province
 - 21,500 Mfbm of S-Dry supplied by mills in the other Atlantic Provinces
 - 21,500 Mfbm of S-Dry supplied by mills outside the Atlantic Provinces
- for illustration purposes, in terms of jobs losses and gains at sawmills in the Atlantic Provinces, it is roughly estimated that:
 - the mill closures will result in about 540 direct job losses and 720 indirect job losses in small mills
 - larger, less labour-intensive mills, in the same province, will supply 50% of

the lumber production lost due to mill closures, thus creating about 360 new direct jobs and 360 indirect jobs.

- still larger, less labour-intensive mills, in the Atlantic Provinces, will supply 25% of the lumber production lost due to mill closures, thus creating about 150 new direct jobs and 100 indirect jobs.

The changes in the benefits and costs associated with this scenario were calculated from the perspective of each identified stakeholder, relative to the base case scenario. Totalling all the changes in benefits and costs shows that this scenario yields negative net benefits, relative to the existing "base case" situation. As a whole, the stakeholders would be \$23 million per year worse off under this scenario. This is summarized in Table 8.1, and shown graphically in Figure 8.1.

8.4 Scenario 4: Guidelines Developed for Acceptable S-Grn Construction

In this scenario, it is assumed that a set of guidelines are developed, dealing with acceptable construction practice using S-Grn lumber. Items such as sheathing materials and construction techniques that allow post-enclosure drying to take place would be specified, thus allowing builders to confidently use S-Grn lumber in house construction and renovation projects, knowing that they are in compliance with regulations. This scenario is based on the general assumptions listed previously, as well as the following specific assumptions:

- 1,050 Warrantied houses are built per year, using S-Grn lumber
- 3,150 Warrantied houses are built per year, using S-Dry lumber
- 2,250 non-warrantied houses are built per year, using S-Grn lumber
- 750 non-warrantied houses are built per year, using S-Dry lumber
- the market price of a house built with dry lumber is the same as for a house built with green lumber
- a change in lumber demand (from S-Grn to S-Dry) occurs, involving 30,000 Mfbm of lumber per year. This results in the closure or downsizing of sawmills, whose total production is 15,000 Mfbm per year. The market demand is supplied as follows:
 - 15,000 Mfbm of S-Dry supplied by other mills in the province
 - 7,500 Mfbm of S-Dry supplied by mills in the other Atlantic Provinces
 - 7,500 Mfbm of S-Dry supplied by mills outside the Atlantic Provinces
- for illustration purposes, in terms of jobs losses and gains at sawmills in the Atlantic Provinces, it is roughly estimated that:
 - the mill closures will result in about 190 direct job losses and 250 indirect job losses in small mills

- larger, less labour-intensive mills, in the same province, will supply 50% of the lumber production lost due to mill closures, thus creating about 125 new direct jobs and 125 indirect jobs.
- still larger, less labour-intensive mills, in the Atlantic Provinces, will supply 25% of the lumber production lost due to mill closures, thus creating about 55 new direct jobs and 35 indirect jobs.

The changes in the benefits and costs associated with this scenario were calculated from the perspective of each identified stakeholder, relative to the base case scenario. Totalling all the changes in benefits and costs shows that this scenario yields negative net benefits, relative to the existing "base case" situation. As a whole, the stakeholders would be \$6 million per year worse off under this scenario. This is summarized in Table 8.1, and shown graphically in Figure 8.1.

8.5 Scenario 5: ANHW Plans Implemented for Warrantied Houses Only

This scenario assumes that the first phase of the ANHW's plans are immediately implemented, across the Atlantic Provinces. That is, all new home construction registered under the Warranty will have to be either built using S-Dry lumber, or S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all Warrantied builders will not risk failing the certification test, and will choose to use S-Dry lumber. Renovation work and houses not registered under the Warranty will not be affected. This scenario is based on the general assumptions listed previously, as well as the following specific assumptions:

- zero Warrantied houses are built per year, using S-Grn lumber
- 4,200 Warrantied houses are built per year, using S-Dry lumber
- 2,700 non-warrantied houses are built per year, using S-Grn lumber
- 300 non-warrantied houses are built per year, using S-Dry lumber
- the market price of a Warrantied house built with dry lumber increases by an amount equal to the costs associated with the dry lumber in the house.
- a change in lumber demand (from S-Grn to S-Dry) occurs, involving 42,000 Mfbm of lumber per year. This results in the closure or downsizing of sawmills, whose total production is 21,000 Mfbm per year. The market demand is supplied as follows:
 - 21,000 Mfbm of S-Dry supplied by other mills in the province
 - 10,500 Mfbm of S-Dry supplied by mills in the other Atlantic Provinces
 - 10,500 Mfbm of S-Dry supplied by mills outside the Atlantic Provinces
- for illustration purposes, in terms of jobs losses and gains at sawmills in the

Atlantic Provinces, it is roughly estimated that:

- the mill closures will result in about 260 direct job losses and 350 indirect job losses in small mills
- larger, less labour-intensive mills, in the same province, will supply 50% of the lumber production lost due to mill closures, thus creating about 175 new direct jobs and 175 indirect jobs.
- still larger, less labour-intensive mills, in the Atlantic Provinces, will supply 25% of the lumber production lost due to mill closures, thus creating about 75 new direct jobs and 50 indirect jobs.

The changes in the benefits and costs associated with this scenario were calculated from the perspective of each identified stakeholder, relative to the base case scenario. Totalling all the changes in benefits and costs shows that this scenario yields negative net benefits, relative to the existing "base case" situation. As a whole, the stakeholders would be \$4 million per year worse off under this scenario. This is summarized in Table 8.1, and shown graphically in Figure 8.1.

8.6 Scenario 6: ANHW Plans Implemented in Urban Areas Only

This scenario assumes that the ANHW's plans are immediately implemented, but are limited to the urban areas in the Atlantic Provinces. Non-Warrantied builders in rural areas will be able to use green lumber. All houses (urban and rural) registered under the Warranty will have to be either built using stamped S-Dry lumber, or S-Grn lumber that is subsequently certified for 19% MC compliance by a third party testing agency. However, it is further assumed that all Warrantied builders will not risk failing the certification test, and will choose to use S-Dry lumber. This scenario is based on the general assumptions listed previously, as well as the following specific assumptions:

- 5,450 houses, using grade stamped lumber, are built each year in urban areas
- 1,750 houses, using grade stamped lumber, are built each year in rural areas
- zero Warrantied houses are built per year, using S-Grn lumber
- 4,200 Warrantied houses are built per year, using S-Dry lumber
- 1,500 non-warrantied houses are built per year, using S-Grn lumber
- 1,500 non-warrantied houses are built per year, using S-Dry lumber
- the market price of an urban area house built with dry lumber increases by an amount equal to the costs associated with the dry lumber in the house.
- a change in lumber demand (from S-Grn to S-Dry) occurs, involving 66,000 Mfbm of lumber per year. This results in the closure or downsizing of sawmills, whose total production is 33,000 Mfbm per year. The market demand is supplied

as follows:

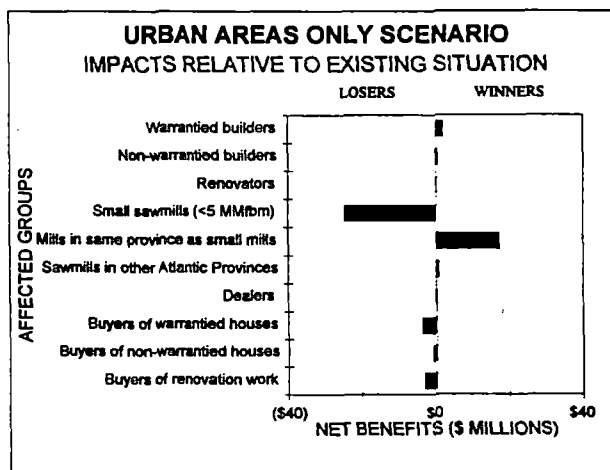
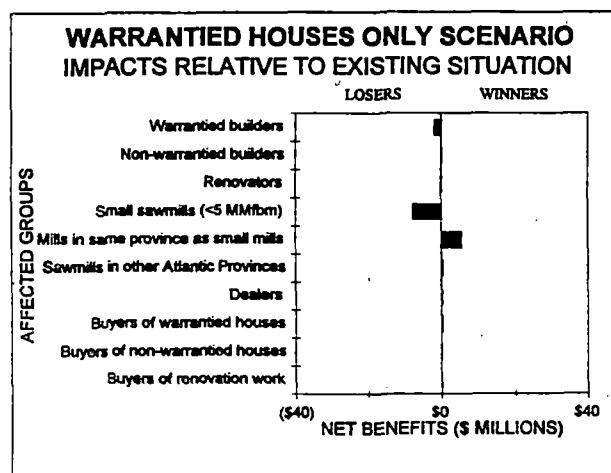
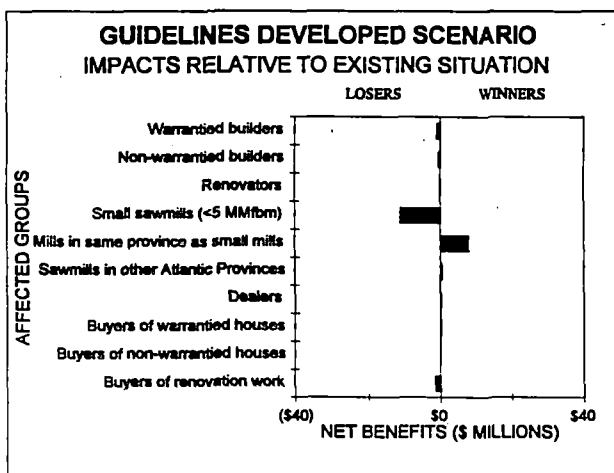
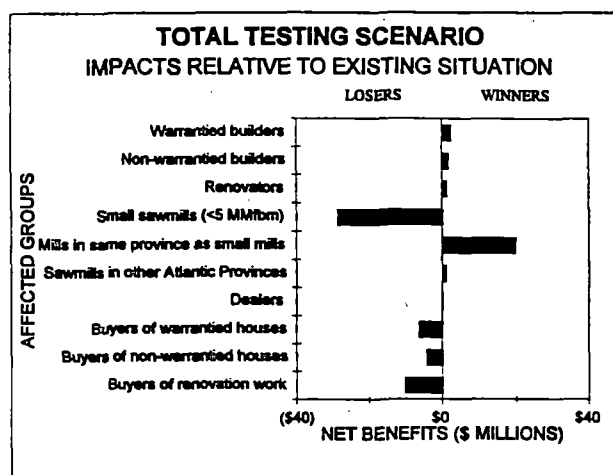
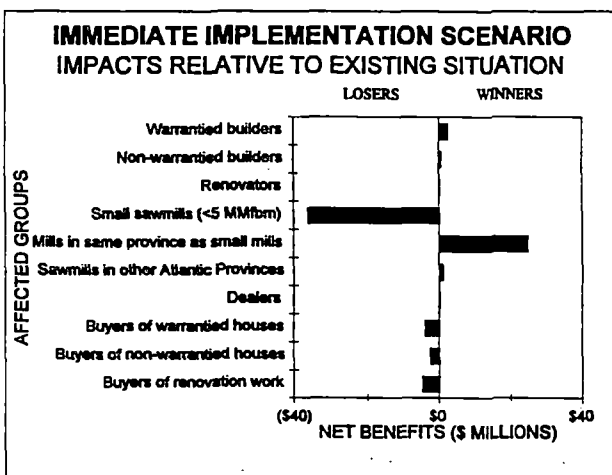
- 33,000 Mfbm of S-Dry supplied by other mills in the province
- 16,500 Mfbm of S-Dry supplied by mills in the other Atlantic Provinces
- 16,500 Mfbm of S-Dry supplied by mills outside the Atlantic Provinces
- for illustration purposes, in terms of jobs losses and gains at sawmills in the Atlantic Provinces, it is roughly estimated that:
 - the mill closures will result in about 410 direct job losses and 550 indirect job losses in small mills
 - larger, less labour-intensive mills, in the same province, will supply 50% of the lumber production lost due to mill closures, thus creating about 275 new direct jobs and 275 indirect jobs.
 - still larger, less labour-intensive mills, in the Atlantic Provinces, will supply 25% of the lumber production lost due to mill closures, thus creating about 120 new direct jobs and 80 indirect jobs.

The changes in the benefits and costs associated with this scenario were calculated from the perspective of each identified stakeholder, relative to the base case scenario. Totalling all the changes in benefits and costs shows that this scenario yields negative net benefits, relative to the existing "base case" situation. As a whole, the stakeholders would be \$12 million per year worse off under this scenario. This is summarized in Table 8.1, and shown graphically in Figure 8.1.

Table 8.1
Summary of Impacts on Stakeholders, Relative to the Existing Situation

STAKEHOLDER GROUPS	Benefits Relative to Existing (Base Case) Situation	Costs	Benefits - Costs
IMMEDIATE IMPLEMENTATION			
Warrantied builders	\$4,515,000	\$2,100,000	\$2,415,000
Non-warrantied builders	\$3,202,500	\$2,700,000	\$502,500
Renovators	\$4,800,000	\$4,800,000	\$0
Small sawmills (<5 MMfbm)	\$0	\$36,120,000	(\$36,120,000)
Mills in same province as small mills	\$24,960,000	\$0	\$24,960,000
Sawmills in other Atlantic Provinces	\$1,080,000	\$0	\$1,080,000
Dealers	\$9,600,000	\$9,600,000	\$0
Buyers of warrantied houses	\$210,000	\$4,200,000	(\$3,990,000)
Buyers of non-warrantied houses	\$472,500	\$3,000,000	(\$2,527,500)
Buyers of renovation work	\$0	\$4,800,000	(\$4,800,000)
TOTAL BENEFITS - COSTS			(\$18,480,000)
TOTAL TESTING			
Warrantied builders	\$6,825,000	\$4,410,000	\$2,415,000
Non-warrantied builders	\$4,852,500	\$3,150,000	\$1,702,500
Renovators	\$10,320,000	\$9,120,000	\$1,200,000
Small sawmills (<5 MMfbm)	\$0	\$28,595,000	(\$28,595,000)
Mills in same province as small mills	\$19,760,000	\$0	\$19,760,000
Sawmills in other Atlantic Provinces	\$855,000	\$0	\$855,000
Dealers	\$9,120,000	\$9,120,000	\$0
Buyers of warrantied houses	\$210,000	\$6,510,000	(\$6,300,000)
Buyers of non-warrantied houses	\$472,500	\$4,850,000	(\$4,377,500)
Buyers of renovation work	\$0	\$10,320,000	(\$10,320,000)
TOTAL BENEFITS - COSTS			(\$23,460,000)
GUIDELINES DEVELOPED			
Warrantied builders	\$157,500	\$1,050,000	(\$892,500)
Non-warrantied builders	\$33,750	\$450,000	(\$416,250)
Renovators	\$1,500,000	\$1,500,000	\$0
Small sawmills (<5 MMfbm)	\$0	\$11,287,500	(\$11,287,500)
Mills in same province as small mills	\$7,800,000	\$0	\$7,800,000
Sawmills in other Atlantic Provinces	\$337,500	\$0	\$337,500
Dealers	\$3,000,000	\$3,000,000	\$0
Buyers of warrantied houses	\$105,000	\$0	\$105,000
Buyers of non-warrantied houses	\$78,750	\$0	\$78,750
Buyers of renovation work	\$0	\$1,500,000	(\$1,500,000)
TOTAL BENEFITS - COSTS			(\$5,775,000)
WARRANTIED HOUSES ONLY			
Warrantied builders	\$315,000	\$2,100,000	(\$1,785,000)
Non-warrantied builders	\$0	\$0	\$0
Renovators	\$0	\$0	\$0
Small sawmills (<5 MMfbm)	\$0	\$7,901,250	(\$7,901,250)
Mills in same province as small mills	\$5,460,000	\$0	\$5,460,000
Sawmills in other Atlantic Provinces	\$236,250	\$0	\$236,250
Dealers	\$2,100,000	\$2,100,000	\$0
Buyers of warrantied houses	\$210,000	\$0	\$210,000
Buyers of non-warrantied houses	\$0	\$0	\$0
Buyers of renovation work	\$0	\$0	\$0
TOTAL BENEFITS - COSTS			(\$3,780,000)
URBAN AREAS ONLY			
Warrantied builders	\$4,265,000	\$2,100,000	\$2,165,000
Non-warrantied builders	\$1,590,000	\$1,200,000	\$390,000
Renovators	\$6,600,000	\$6,600,000	\$0
Small sawmills (<5 MMfbm)	\$0	\$24,832,500	(\$24,832,500)
Mills in same province as small mills	\$17,160,000	\$0	\$17,160,000
Sawmills in other Atlantic Provinces	\$742,500	\$0	\$742,500
Dealers	\$6,600,000	\$6,600,000	\$0
Buyers of warrantied houses	\$210,000	\$3,950,000	(\$3,740,000)
Buyers of non-warrantied houses	\$210,000	\$1,200,000	(\$990,000)
Buyers of renovation work	\$0	\$3,300,000	(\$3,300,000)
TOTAL BENEFITS - COSTS			(\$12,405,000)

Figure 8.1
Graphical Comparison of Impacts on Stakeholders,
Relative to the Existing Situation



9.0 STRATEGIC OPTIONS

The second objective of ADI's assignment in this project was the provision of a practical strategic plan for moving ahead with builders, consumers, and the sawmill industry to achieve improved compliance with the 19% moisture content standard. Unfortunately, it is considered that none of the identified "compromise" scenarios are sufficiently attractive to entice the opposing parties to seek a middle ground position.

The situation faced by the stakeholders seems to one of "action and reaction". From the beginning, the ANHW has made it clear that they are proceeding with their chosen course of action. Their participation on the Ad Hoc Committee was intended to help the other affected stakeholders in coordinating the work they would have to do to accommodate the ANHW plans. ANHW participation on the Committee was clearly not intended to negotiate a compromise. The ANHW has been criticized as an influential group who has initiated an action that has serious repercussions, without having a capital stake at risk. The point being made in the criticism essentially is that the ANHW seems to be able to cause a serious situation in the lumber industry, without being affected by it themselves, since they can simply buy lumber from another source outside the Atlantic Region. If the ANHW has little to lose, then there is little motivation for them to withdraw from their original position.

The sawmill industry is faced with the difficult task of finding a way to effectively react to the plans of the ANHW. Members of the Ad Hoc Committee were critical of the approach taken by this study, which they felt treated the ANHW's plans as if they were an accomplished fact. However, the scenarios chosen for analysis were the most plausible of those identified through stakeholder consultation, and it was considered to be of little value to analyze scenarios that did not appear to be achievable alternatives.

As an independent consultant observing the situation among the stakeholders, ADI believes that "action and reaction" will continue to be the method of operation for those involved. Although the ANHW has stated that they intend to pursue their plans to full implementation, it is certain that full implementation will take several years to achieve. In that period of time, it is entirely possible that ANHW's initial motivation(s) for initiating the action will change, and the issue will come to rest at some partially implemented stage. It seems that, at a minimum, the ANHW will implement the 19% MC requirement internally, effectively resulting in all warranted houses using S-Dry lumber. As noted in this study, such an action will generate negative net benefits for those involved, leaving the Atlantic Region worse off by about \$4 million per year, compared to the existing situation.

It is further considered that the Ad Hoc Committee will soon reach the point where it can accomplish little more, and it will disband. It is very likely that Committee members will feel frustrated that more substantial progress was not forthcoming.

It must be noted that there cannot be a positive net benefit resulting from the options considered unless producers, builders and consumers derive sufficient benefits from dry lumber to offset the extra cost associated with it. Unless there can be agreement that there is a net benefit, it appears fruitless to attempt to find a better option.

APPENDIX A

List of Contacts

LIST OF CONTACTS

Keith Barrett, Barrett Lumber, NS, 902-856-2330
John Black, CMHC - Saint John, 636-4473
Diana Blenkhorn, Maritime Lumber Bureau, 902-667-3889, personal interview
Rick Campbell, NB Homebuilders Assoc., 459-7219
Roger Côté, NB Dept. of Municipalities, Culture and Housing, 453-2845
Jerry Gavin, Director of Operations, PEI Dept. of Energy and Forestry, 902-368-4700
Tim Gross, CMHC - Saint John, 636-4473
John Johnston, Director of Building Inspection, Saint John, 658-2911
Tom Jollimore, ANHWP - NS, 902-835-9880
Eric Jones, Canadian Wood Council, 613-731-7800
Ron Kellestine, CMHC - Saint John, 636-4473
Bob Law, ANHWP, 902-835-9880
Phil LePage, Project Executive - Trade, NB ED&T, 453-3649
Marvin MacDonald, NSDNR, 902-424-8621
John Mowat, Director of Building Inspection, Moncton, 853-3534
Dr. Mo Nazir, Assistant Deputy Minister, Forestry Branch, Nfld Dept. of Forestry and Agriculture, 709-729-2704
Todd Selby, CMHC - Fredericton, 452-3050
Keith Steeves, Primary Wood Sector, NB ED&T, 453-2727
Glen Thompson, ANHWP, personal interview
John Ward, ABSDA, 858-0700
Kelly Ward, Betts Mills Ltd., PEI, personal interview
Sue Watling, Bank of Montreal, 453-0276
Bob Watson, Executive Director, Policy and Planning Branch, NBDNR, 453-2684
Roland Winters and Gloria Saunders, Nfld Lumber Producers Assoc., 709-533-2206

APPENDIX B

Survey of MLB and NLPA Members



ADI Limited

P.O. Box 44, Station "A", Fredericton, NB, Canada, E3B 4Y2
1133 Regent Street, Suite 407, Tel: (506) 452-9000 Fax: (506) 459-3954

March 15, 1994

Dear MLB Member:

The Atlantic New Home Warranty Corporation has indicated its intention to require that all houses registered under the Warranty in Atlantic Canada be built with lumber that has a Moisture Content of 19% or lower, as required in the National Building Code of Canada. The Warranty Corporation also intends to lobby regulators, banks, consumers, etc. to require that all residential construction (both new houses and renovation) use lumber that has a Moisture Content of 19% or lower.

ADI Limited has been hired by CMHC to examine the economic impact that the Warranty Corporation's action could have on builders, sawmill operators, and consumers.

As part of ADI's study, I have prepared the attached brief survey. It would be appreciated if you could complete it and fax it to me before March 22, 1994.

All responses will be kept confidential. Thank you for your assistance.

Sincerely,

A handwritten signature in cursive script, reading 'Brent M. Howe'.

Brent M. Howe, P.Eng.
Project Manager

Attach.

Engineering, Consulting, Procurement and Project Management

*Charlottetown, Moncton, Saint John, Ottawa, Victoria, Sydney,
St. John's, Halifax, Fredericton and Salem, NH*

SURVEY QUESTIONNAIRE

Please complete this brief survey and fax it to:

ADI Limited
Fax #: 506-459-3954
Attention: Brent Howe

ALL RESPONSES WILL BE KEPT CONFIDENTIAL.

1. Which of the following categories represents your production volumes?
 - ☐ < 1 million fbm per year
 - ☐ between 1 and 5 million fbm per year
 - ☐ between 5 and 10 million fbm per year
 - ☐ over 10 million fbm per year.
2. How many people do you directly and indirectly employ in your peak season?
Directly: _____ Indirectly: _____
3. If you have a dry kiln, what is its capacity in fbm per year? _____
4. If you do not have a dry kiln, do you currently have plans to install a dry kiln?
No: _____ Yes: _____ If yes, what capacity? _____
5. If the Warranty Corporation's intentions are fully implemented, it will result in residential construction (both new houses and renovation) using lumber that has a Moisture Content of 19% or lower. This involves about 100 million fbm of lumber, broken down as follows:
 - 40 million fbm in New Brunswick - 5 million fbm in Prince Edward Island
 - 34 million fbm in Nova Scotia - 21 million fbm in Newfoundland

If this happened, what would your business do?

 - ☐ Go out of business.
 - ☐ Use existing kiln capacity to meet this change in demand for dry lumber.
 - ☐ Invest in new or additional kiln capacity.
 - ☐ Air dry your lumber before dressing and grading it.
 - ☐ Sell rough sawn lumber to another lumber producer with a kiln, who would dry, dress, and grade the lumber himself.
 - ☐ Work with other sawmills in your region to set up a co-operative kiln drying facility that would be owned and operated by the member sawmills.
 - ☐ Find new markets (domestic or export) for green lumber.

APPENDIX C

Cost/Benefit Calculations

**Immediate implementation of the 19% MC requirement, across Atlantic Provinces
All builders choose to use S-Dry lumber rather than risk testing S-Gm**

STAKEHOLDERS	#	Units	\$/Unit	Benefits	Costs	Benefits - Costs
				Relative to Existing (Base Case) Situation		
BUILDERS						
Warrantied Builders using green lumber - 2,100 switch to dry lumber						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible		
Cost of dry vs. green lumber	2,100	houses	\$1,000		\$2,100,000	
Extra savings in repairs, due to dry lumber	1,050	houses	\$300	\$315,000		
Extra selling price of house	2,100	houses	\$1,000	\$2,100,000		
Total				\$2,415,000	\$2,100,000	\$315,000
Warrantied Builders using dry lumber - 2,100 still use dry						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible		
Extra selling price of house	2,100	houses	\$1,000	\$2,100,000		
Total				\$2,100,000	\$0	\$2,100,000
Non-warrantied Builders using green lumber - 2,700 switch to dry lumber						
NBCC compliance = no liability	2,700	houses	Intangible	Intangible		
Cost of dry vs. green lumber	2,700	houses	\$1,000		\$2,700,000	
Extra savings in repairs, due to dry lumber	675	houses	\$300	\$202,500		
Extra selling price of house	2,700	houses	\$1,000	\$2,700,000		
Total				\$2,902,500	\$2,700,000	\$202,500
Non-warrantied Builders using dry lumber						
NBCC compliance = no liability	300	houses	Intangible	Intangible		
Extra selling price of house	300	houses	\$1,000	\$300,000		
Total				\$300,000	\$0	\$300,000
RENOVATORS						
Renovators using green lumber - 48,000 Mfbm switch to dry lumber						
Cost of dry vs. green lumber	48,000	M fbm	\$100		\$4,800,000	
Higher cost reflected in project price	48,000	M fbm	\$100	\$4,800,000		
Total				\$4,800,000	\$4,800,000	\$0
Renovators using dry lumber						
Total				\$0	\$0	\$0
SAWMILLS						
Grade-stamping sawmills in Atlantic Provinces						
Sales lost due to mill closures	48,000	M fbm	\$475		\$22,800,000	
Sales gained by other mills in province	48,000	M fbm	\$475	\$22,800,000		
Extra net sales (S-Dry) by other mills in province	48,000	M fbm	\$45	\$2,160,000		
Extra net sales (S-Dry) by mills in other Atlantic Provinces	24,000	M fbm	\$45	\$1,080,000		
S-Dry sales lost to mills outside Atlantic Provinces	24,000	M fbm	\$555		\$13,320,000	
Total				\$26,040,000	\$36,120,000	(\$10,080,000)
DEALERS						
Businesses dealing in lumber						
Extra sales associated with dry lumber	96,000	M fbm	\$100	\$9,600,000		
Extra cost associated with dry lumber	96,000	M fbm	\$100		\$9,600,000	
Total				\$9,600,000	\$9,600,000	\$0
BUYERS						
Buyers of Warrantied houses (green lumber) - 2,100 switch to dry lumber						
Lower heating costs	2,100	houses	\$100	\$210,000		
Higher house prices	2,100	houses	\$1,000		\$2,100,000	
Total				\$210,000	\$2,100,000	(\$1,890,000)
Buyers of Warrantied houses (dry lumber)						
Higher house prices	2,100	houses	\$1,000		\$2,100,000	
Total				\$0	\$2,100,000	(\$2,100,000)
Buyers of Non-warrantied houses (green lumber) - 2,700 switch to dry lumber						
Lower heating costs	2,700	houses	\$100	\$270,000		
Extra savings in repairs, due to dry lumber	675	houses	\$300	\$202,500		
Higher house prices	2,700	houses	\$1,000		\$2,700,000	
Total				\$472,500	\$2,700,000	(\$2,227,500)
Buyers of Non-warrantied houses (dry lumber)						
Higher house prices	300	houses	\$1,000		\$300,000	
Total				\$0	\$300,000	(\$300,000)
Buyers of renovation work						
Extra cost of dry vs. green lumber	48,000	M fbm	\$100		\$4,800,000	
Benefits perceived and purchased	0	M fbm	\$100	\$0		
				\$0	\$4,800,000	(\$4,800,000)
TOTAL BENEFITS - COSTS						(\$18,480,000)

19% MC LUMBER BENEFIT COST MODEL
TOTAL TESTING

Immediate implementation
All houses tested

STAKEHOLDERS	#	Units	\$/Unit	Benefits Relative to Existing (Base Case) Situation	Costs	Benefits - Costs
BUILDERS						
Warrantied Builders using green lumber - 2,100 switch to dry lumber						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible		
Cost of dry vs. green lumber	2,100	houses	\$1,200		\$2,520,000	
Cost of special handling for dry lumber	2,100	houses	\$200		\$420,000	
Extra savings in repairs, due to dry lumber	1,050	houses	\$300	\$315,000		
Cost of testing	2,100	houses	\$150		\$315,000	
Extra selling price of house	2,100	houses	\$1,550	\$3,255,000		
Total				\$3,570,000	\$3,255,000	\$315,000
Warrantied Builders using dry lumber - 2,100 still use dry						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible		
Extra cost of dry lumber	2,100	houses	\$200		\$420,000	
Cost of special handling for dry lumber	2,100	houses	\$200		\$420,000	
Cost of testing	2,100	houses	\$150		\$315,000	
Extra selling price of house	2,100	houses	\$1,550	\$3,255,000		
Total				\$3,255,000	\$1,155,000	\$2,100,000
Non-warrantied Builders using green lumber - 1,700 switch to S-Dry lumber & 1,000 dry S-Gm themselves						
NBCC compliance = no liability	2,700	houses	Intangible	Intangible		
Cost of dry vs. green lumber	1,700	houses	\$1,200		\$2,040,000	
Cost of special handling to keep or help lumber dry	2,700	houses	\$200		\$540,000	
Extra savings in repairs, due to dry lumber	675	houses	\$300	\$202,500		
Cost of testing	2,700	houses	\$150		\$405,000	
Extra selling price of house	2,700	houses	\$1,550	\$4,185,000		
Total				\$4,387,500	\$2,985,000	\$1,402,500
Non-warrantied Builders using dry lumber						
NBCC compliance = no liability	300	houses	Intangible	Intangible		
Extra cost of dry lumber	300	houses	\$200		\$60,000	
Cost of special handling for dry lumber	300	houses	\$200		\$60,000	
Cost of testing	300	houses	\$150		\$45,000	
Extra selling price of house	300	houses	\$1,550	\$465,000		
Total				\$465,000	\$165,000	\$300,000
RENOVATORS						
Renovators using green lumber - 38,000 Mfbm switch to S-Dry lumber & 10,000 dry S-Gm themselves						
Cost of dry vs. green lumber	38,000	Mfbm	\$120		\$4,560,000	
Cost of special handling to keep or help lumber dry	48,000	Mfbm	\$20		\$960,000	
Higher lumber and handling cost reflected in project price	48,000	Mfbm	\$140	\$6,720,000		
Testing cost reflected in project price	16,000	houses	\$150	\$2,400,000		
Cost of testing	16,000	houses	\$150		\$2,400,000	
Total				\$9,120,000	\$7,920,000	\$1,200,000
Renovators using dry lumber						
Cost of testing	8,000	houses	\$150		\$1,200,000	
Testing cost reflected in project price	8,000	houses	\$150	\$1,200,000		
Total				\$1,200,000	\$1,200,000	\$0
SAWMILLS						
Grade-stamping sawmills in Atlantic Provinces						
Sales lost due to mill closures	38,000	M fbm	\$475		\$18,050,000	
Sales gained by other mills in province	38,000	M fbm	\$475	\$18,050,000		
Extra net sales (S-Dry) by other mills in province	38,000	M fbm	\$45	\$1,710,000		
Extra net sales (S-Dry) by mills in other Atlantic Provinces	19,000	M fbm	\$45	\$855,000		
S-Dry sales lost to mills outside Atlantic Provinces	19,000	M fbm	\$555		\$10,545,000	
Total				\$20,615,000	\$28,595,000	(\$7,980,000)
DEALERS						
Businesses dealing in lumber						
Extra sales associated with dry lumber	76,000	M fbm	\$120	\$9,120,000		
Extra cost associated with dry lumber	76,000	M fbm	\$120		\$9,120,000	
Total				\$9,120,000	\$9,120,000	\$0
BUYERS						
Buyers of Warrantied houses (green lumber) - 2,100 switch to dry lumber						
Lower heating costs	2,100	houses	\$100	\$210,000		
Higher house prices	2,100	houses	\$1,550		\$3,255,000	
Total				\$210,000	\$3,255,000	(\$3,045,000)
Buyers of Warrantied houses (dry lumber)						
Higher house prices	2,100	houses	\$1,550		\$3,255,000	
Total				\$0	\$3,255,000	(\$3,255,000)
Buyers of Non-warrantied houses (green lumber) - 2,700 switch to dry						
Lower heating costs	2,700	houses	\$100	\$270,000		
Extra savings in repairs, due to dry lumber	675	houses	\$300	\$202,500		
Higher house prices	2,700	houses	\$1,550		\$4,185,000	
Total				\$472,500	\$4,185,000	(\$3,712,500)
Buyers of Non-warrantied houses (dry lumber)						
Higher house prices	300	houses	\$1,550		\$465,000	
Total				\$0	\$465,000	(\$465,000)
Buyers of renovation work						
Extra cost of dry vs. green lumber + handling	48,000	M fbm	\$140		\$6,720,000	
Benefits perceived and purchased	0	M fbm	\$100	\$0		
Cost of testing	24,000	houses	\$150		\$3,600,000	
Total				\$0	\$10,320,000	(\$10,320,000)
TOTAL BENEFITS - COSTS						(\$23,460,000)

19% MC LUMBER BENEFIT COST MODEL
GUIDELINES DEVELOPED FOR ACCEPTABLE GREEN LUMBER CONSTRUCTION PRACTICES

Guidelines developed regarding sheathing materials, construction methods, etc. for the use of green lumber, so that builders can confidently use S-Gm lumber, knowing that it will be accepted by regulators, the ANHW, etc.

STAKEHOLDERS	#	Units	\$/Unit	Benefits Relative to Existing (Base Case) Situation	Costs	Benefits - Costs
BUILDERS						
Warrantied Builders using green lumber - 1,050 switch to dry						
NBCC compliance = no liability	1,050	houses	Intangible	Intangible		
Cost of dry vs. green lumber	1,050	houses	\$1,000		\$1,050,000	
Extra savings in repairs, due to dry lumber	525	houses	\$300	\$157,500		
Total				<u>\$157,500</u>	<u>\$1,050,000</u>	(\$892,500)
Warrantied Builders using dry lumber - 2,100 still use dry						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible	\$0	
Total				<u>\$0</u>	<u>\$0</u>	\$0
Non-warrantied Builders using green lumber - 450 switch to dry						
NBCC compliance = no liability	450	houses	Intangible	Intangible		
Cost of dry vs. green lumber	450	houses	\$1,000		\$450,000	
Extra savings in repairs, due to dry lumber	113	houses	\$300	\$33,750		
Total				<u>\$33,750</u>	<u>\$450,000</u>	(\$416,250)
Non-warrantied Builders using dry lumber						
NBCC compliance = no liability	300	houses	Intangible	Intangible	\$0	
Total				<u>\$0</u>	<u>\$0</u>	\$0
RENOVATORS						
Renovators using green lumber - 15,000 M fbm switch to dry						
Cost of dry vs. green lumber	15,000	M fbm	\$100	\$1,500,000		
Higher cost reflected in project price	15,000	M fbm	\$100		\$1,500,000	
Total				<u>\$1,500,000</u>	<u>\$1,500,000</u>	\$0
Renovators using dry lumber						
Total				<u>\$0</u>	<u>\$0</u>	\$0
SAWMILLS						
Grade-stamping sawmills in Atlantic Provinces						
Sales lost due to mill closures	15,000	M fbm	\$475		\$7,125,000	
Sales gained by other mills in province	15,000	M fbm	\$475	\$7,125,000		
Extra net sales (S-Dry) by other mills in province	15,000	M fbm	\$45	\$675,000		
Extra net sales (S-Dry) by mills in other Atlantic Provinces	7,500	M fbm	\$45	\$337,500		
S-Dry sales lost to mills outside Atlantic Provinces	7,500	M fbm	\$555		\$4,162,500	
Total				<u>\$8,137,500</u>	<u>\$11,287,500</u>	(\$3,150,000)
DEALERS						
Businesses dealing in lumber						
Extra sales associated with dry lumber	30,000	M fbm	\$100	\$3,000,000		
Extra cost associated with dry lumber	30,000	M fbm	\$100		\$3,000,000	
Total				<u>\$3,000,000</u>	<u>\$3,000,000</u>	\$0
BUYERS						
Buyers of Warrantied houses (green lumber) - 1,050 switch to dry						
Lower heating costs	1,050	houses	\$100	\$105,000		
Total				<u>\$105,000</u>	<u>\$0</u>	\$105,000
Buyers of Warrantied houses (dry lumber)						
Total				<u>\$0</u>	<u>\$0</u>	\$0
Buyers of Non-warrantied houses (green lumber) - 450 switch to dry						
Lower heating costs	450	houses	\$100	\$45,000		
Extra savings in repairs, due to dry lumber	113	houses	\$300	\$33,750		
Total				<u>\$78,750</u>	<u>\$0</u>	\$78,750
Buyers of Non-warrantied houses (dry lumber)						
Total				<u>\$0</u>	<u>\$0</u>	\$0
Buyers of renovation work						
Extra cost of dry vs. green lumber	15,000	M fbm	\$100		\$1,500,000	
Benefits perceived and purchased	0	M fbm	\$100	\$0		
Total				<u>\$0</u>	<u>\$1,500,000</u>	(\$1,500,000)
TOTAL BENEFITS - COSTS						(\$5,775,000)

Immediate implementation of the 19% MC requirement, for Warrantied houses only
All Warrantied builders choose to use S-Dry lumber rather than risk testing S-Gm

STAKEHOLDERS	#	Units	\$/Unit	Benefits Relative to Existing (Base Case) Situation	Costs	Benefits - Costs
BUILDERS						
Warrantied Builders using green lumber - 2,100 switch to dry lumber						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible		
Cost of dry vs. green lumber	2,100	houses	\$1,000		\$2,100,000	
Extra savings in repairs, due to dry lumber	1,050	houses	\$300	\$315,000		
Total				\$315,000	\$2,100,000	(\$1,785,000)
Warrantied Builders using dry lumber						
NBCC compliance = no liability	2,100	houses	Intangible	Intangible		
Total				\$0	\$0	\$0
Non-warrantied Builders using green lumber						
Total				\$0	\$0	\$0
Non-warrantied Builders using dry lumber						
NBCC compliance = no liability	300	houses	Intangible	Intangible		
Total				\$0	\$0	\$0
RENOVATORS						
Renovators using green lumber						
Total				\$0	\$0	\$0
Renovators using dry lumber						
Total				\$0	\$0	\$0
SAWMILLS						
Grade-stamping sawmills in Atlantic Provinces						
Sales lost due to mill closures	10,500	M fbm	\$475		\$4,987,500	
Sales gained by other mills in province	10,500	M fbm	\$475	\$4,987,500		
Extra net sales (S-Dry) by other mills in province	10,500	M fbm	\$45	\$472,500		
Extra net sales (S-Dry) by mills in other Atlantic Provinces	5,250	M fbm	\$45	\$236,250		
S-Dry sales lost to mills outside Atlantic Provinces	5,250	M fbm	\$555		\$2,913,750	
Total				\$5,696,250	\$7,901,250	(\$2,205,000)
DEALERS						
Businesses dealing in lumber						
Extra sales associated with dry lumber	21,000	M fbm	\$100	\$2,100,000		
Extra cost associated with dry lumber	21,000	M fbm	\$100		\$2,100,000	
Total				\$2,100,000	\$2,100,000	\$0
BUYERS						
Buyers of Warrantied houses (green lumber) - 2,100 switch to dry lumber						
Lower heating costs	2,100	houses	\$100	\$210,000		
Total				\$210,000	\$0	\$210,000
Buyers of Warrantied houses (dry lumber)						
Total				\$0	\$0	\$0
Buyers of Non-warrantied houses (green lumber)						
Total				\$0	\$0	\$0
Buyers of Non-warrantied houses (dry lumber)						
Total				\$0	\$0	\$0
Buyers of renovation work						
				\$0	\$0	\$0
TOTAL BENEFITS - COSTS						(\$3,780,000)

APPENDIX D:

- a) Report Review -- Dr. Don Onysko (DMO Associates)**
- b) The Importance of Dry Lumber -- National Research
Council Canada**

September 13, 1994

Mr. Terry Marshall
Project Manager
Housing Innovation Division
Canada Mortgage and Housing Corporation
700 Montreal Road, Suite #C7412
Ottawa, Ontario
K1P 0P7

Dear Terry,

Re: Review of the ADI report Dated March 1994

Thank you for the opportunity to review the ADI draft report on "Lumber Moisture Content Cost/Benefit Analysis" dated March 1994. The report achieved the majority of its aims in that it identified the "losers" and "winners" and attempted to quantify the consequences of certain actions by the regulatory agencies, the warranty interests (effectively builders constructing the majority of the houses in question), and the lumber industry. Some of the assumptions are questionable and I will deal with some issues in this review. But at a minimum, the report provides a starting point to considered refinements, sometimes in the absence of reliable data to provide guidance to all parties, even those who are currently affected negatively.

In a nut shell, I do not think that the report has provided convincing evidence to either the regulatory bodies, the building industry or the lumber industry that the code requirements on moisture content of lumber framing in construction should be changed. One issue, which is societal in nature - the effect of a change in the market for S-GRN lumber on employment, seems to have dominated the study. If we are to include societal issues, then we have to open the examination up to other key issues that relate to health of occupants. There are enough imponderables in the assumptions made for the issues considered that we can only say that there will be some negative effects, but the actual effect may be substantially less than noted. In fact, there may be other, more productive, courses of action.

In performing this review, I will go beyond the specifics of the report and consider extensions in thinking about alternatives, with the hope that this may assist the ad hoc committee, should it decide to meet again.

Introduction

The status quo consists in the use of S-GRN lumber (and ungraded lumber) in a large proportion of new homes and in renovation work. There are also builders who use S-DRY lumber because they are convinced they benefit both themselves and their customers. The current market supply is a reflection of the demand by builders and other users. This is usually the case in a free market, except when one or more elements in the supply chain do not listen to the ultimate consumer. If builders were to decide on their own to use dry lumber for a combination of reasons, we wouldn't be discussing this at all. The market would adjust, supply would be provided, and those local S-GRN producers that would be most affected would be forced to adapt - by seeking other markets for their product, or by merging into larger units to more economically produce at least a portion of their product as S-DRY material. Or, if there wasn't enough demand for S-GRN material, to close down. That is life.

The market trend throughout Canada, and in foreign markets, has been moving in the direction of using "dry" lumber for many reasons. The market is characterized by continuous change. The ADI report attempts to foresee what would happen for several different scenarios. No thought was put to speculate about more distant consequences that could be a net benefit to society and the market. For example, more of the current S-GRN producers may be able to participate in the export market after they adapt to some production of S-DRY. Some of the intangibles in the production of higher quality housing may end up being more important than we now think.

Clarification of the 19% MC requirement

First, it is worth noting that the 19% MC requirement probably did not originate with the National Building Code of Canada. This level (or 20% in Europe) has become a generally accepted moisture level by the lumber industry worldwide that would minimize undesirable mould growth on lumber at the supply level. It is implicitly assumed that the lumber would dry even further from the danger level when it is used in a structure. Lumber producers have to dry lumber to perhaps 15% or lower on average so that no more than 5% of shipments will exceed the 19% MC level, as defined in the lumber industry grading rules. That is the industry practice concerning S-DRY material. When species are included that are very difficult to dry under the same kiln schedule as other species, large differences can be found. In the face of these circumstances, producers have found it more logical to segregate these species for individualized attention. This is possible in larger producer operations.

We count on wood drying below 19% moisture content. Wood held continuously at 19% MC and at constant room temperature would create a local climate around the wood of about 85% RH which would eventually lead to mould growth. If we allow the temperature to fluctuate even moderately at these conditions, as it would in a real wall, higher RH conditions will result at times that may even lead to some condensation (liquid wetting) of the material.

Increase the temperature and the danger intensifies; lower it, and mould growth is more inhibited. Fortunately, on completion of framing and closing in of structures, further drying takes place (by removal of moisture from wall cavities) to make the risk of mould growth less likely. On the other hand, use of S-GRN lumber which usually has a much higher MC will require a more extended drying time and the risk is intensified for the same climatic and local conditions.

Depending on the construction techniques and wall framing system design, mould growth may occur. Whether this leads to eventual and continuous degradation of the structure is not established. It is likely that such situations are possible but relatively rare. Instead, it is more likely that drying results in shrinkage and dimensional changes that lead to a degradation in quality for the ultimate consumer. The majority of these dimensional changes occur during the first year of occupancy. They result in measurable first time costs to builders, and ultimately to their consumers. But in the long term, relatively localized decay and structural damage could occur if the air tightness of the structure is degraded (combined with specific interior conditions). This could lead to deposition of moisture and conditions conducive to initiation of growth of decay organisms, as opposed to all the other fungi that could grow under these same conditions.

Contrary to what the ADI report implies, risk or liability may not come from some measurable actions by the ultimate consumer. It will probably not be possible to finger either the builder or the material producer for *long term liabilities* associated with exceeding of the 19% MC requirement within the current warranty period used in Canada - only the short term construction-related defects will likely be noticed and be dealt with, either by the builder or by the warranty programs.

It would also not be correct to say that the NBCC is wrong to require a 19% limit. What we might debate is, for which elements of the structure is it more critical for these requirements to be generally met; but that is for later discussion.

Are floor joists involved ?

The National Building code specifies only that the framing should be 19% at time of framing. It does not explain why. We know there could be many reasons, some related to health while others are related to integrity of the structure and aesthetics. The code also does not elect or specify priorities where it is more important that framing be at or under the 19% MC level.

Probably, when you examine all aspects of performance that are affected by shrinkage and mould growth, you can say that settlement of the structure is one consequence that should be minimized. Shrinkage transverse to the grain results in much greater settlement than shrinkage along the grain. This is well known and many have examined this situation and concluded that, in good building practices, one should minimize the number of sill plates in the structure. Joist shrinkage can contribute a large part of this settlement.

Based on building practices I am familiar with, and this is probably true for houses being built in the Atlantic region and the whole of Eastern Canada, most of the joist material used is shipped from Western Canada where there is a supply of larger trees for solid sawn joists. This material has already been kiln dried to 15% on average or below, and already meets the code requirement. If this is so, then we are only discussing the change in lumber purchasing practices for the walls and roof trusses only. Incidentally, in Alberta and BC you are more likely to find use of S-GRN floor joists, again because local supply is available and "*the lowest price is the law*" for some builders. Some Western builders have complained they cannot get dry joists - the reverse of the situation in Eastern Canada.

The ADI report stated an estimate of 10,000 fbm in a house of 1500 square feet. My rough estimate for a house this size was between 6,500 and 7,500 fbm which included the floors as well. Depending on the sizes of joist and wall stud material used and for the trusses (or roof rafters) this estimate can vary quite a bit. So, it would have been useful for the ADI report to document this more clearly, and to particularly define whether floor joists were involved. I suspect that 2 x 8 or larger joist material will have been brought in from Western Canada, except perhaps in some local markets where some solid sawn of that size is available. If my assumptions are correct, then 2x6 and smaller lumber is the primary product we need to be concerned about, and the estimates for the cost/benefit analysis will have to be substantially modified.

Specific comments on various topics arising from a review of the report.

1. **Testing:** Use of S-DRY lumber should not require re-testing for MC. Effectively, graded lumber stamped S-DRY implies that the lumber grader working for the producer has certified that, at time of grading (after drying and planning), the moisture content meets the intent of the grading rules. This requirement is enforced by the Chief Inspector(s) of the grading agency. What no one can predict is what moisture the lumber will attain when it leaves the mill. If it is protected in shipment, stored close-piled with proper stacking of bundles, it will survive quite well in outside storage. But once it is on the building site and put to use, depending on the weather and the building practices employed, re-wetting would likely be possible. The building practices used should reflect the type of materials being used in the construction. Do we have the information to recommend what changes would do the job ? No hard evidence I'm afraid after all this time, but we sure could come close to recommending likely solutions.

2. Costing and Qualifications: The price differential between dry and green lumber was assumed for this report, but the differential goes up or down depending on demand in the North American market. At times, the assumptions will hold and at times they will not. These qualifications and the lack of reliable data will hamper the application of the results. It would be appropriate to itemize the major uncontrolled variables and lack of solid evidence as qualification to the conclusions (including in the executive summary).

3. Liability: It is incorrect to attribute blame or liability to inspectors for not enforcing the MC regulation. The builders, in selecting use of S-GRN or ungraded material are making that decision. It is an economic decision which, if followed through, leads to costs they must absorb later from whatever profits they make. If they default and are unable to make up these costs, forcing the rest of the building community to pick up the tab, it is appropriate for the building industry, as represented by the ANHW, to attempt to minimize costs to other members who have registered in the program. Remember that the function of any voluntary warranty program is to protect the consumer (and the builder). Being voluntary, it is also a marketing tool. Anyone who climbs on board should be responsible for the costs. To minimize registration costs and minimize costs to the ultimate consumer, the total costs should be minimized, and the ANHW actions are in line with that goal so far. Anyone in the supply chain, whether material providers or builders, should not gripe about this without coming to the table with alternative action plans to achieve this end result.

One suggestion that could be made, for example, is that there be a system of refundable deposits, held by and administered by ANHW, so that if no moisture related defects had to be dealt with by ANHW within a reasonable length of time (say, a year), the builder would get the money back. This cost could be outside of the regular fees for registration in the program. The implementation of such a system would not force builders to use S-DRY wood, but it would place the onus on them to build in a manner to minimize their total costs. And only the builders who default would not get their money back.

It is a situation of **pay up front** (for straighter drier more uniform sized material, with some apparent quality benefits) or **pay later** (for removal of highly warped crooked walls studs and repair to same, and all the other consequences involving moisture in construction lumber that builders and homeowners complain about). The ADI report quotes the ANHW costs for moisture related effects as \$300 per unit. It is not clear whether this is current ANHW outflow per unit registered, or whether it represents a higher unit outflow for those units that ANHW must deal with, excluding the costs borne by registered builders whose construction was not involved in arbitration. If so, moisture related costs could very well be significantly higher per unit constructed.

4. Transport: The cost of transport of heavier S-GRN or ungraded material depends on the manner of shipment. In a diffuse distributed market, shipment to local building suppliers and building sites will be by truck transport. While the extra cost of gasoline or diesel fuel can be quantified, there are other societal cost related to wear and tear on the transportation infrastructure caused by heavier loading, and wear and tear on the trucks themselves, and their tires. Transport of lumber from neighboring provinces will also likely be by truck transport. These other costs have not been accounted in the cost/benefit analysis.

5. Winners and Losers: The economic examination provided in the ADI report suggests that, if builders remain unregulated with respect to the MC of lumber, and if they could be shown that dry lumber produces a convincing positive benefit for them and their customers, and if they would switch to using S-DRY lumber voluntarily, they and their customers would be ahead of the game. What is lacking are

reliable studies that would demonstrate the details of these cost/benefits, especially with respect to climatic influences, design decisions, and construction practices. The major negative costs shown are related to some temporary and perhaps permanent disruption to the current S-GRN supply chain, not to the consumer.

The assumption that home buyers would be forced to pay higher prices for houses need not hold if the benefits are real. Within the margin of error, I would be loath to say that costs to the ultimate consumer are higher. To prove that this is the case you would have to show that the unit market prices of houses built by current S-DRY builders are higher than comparable S-GRN builders.

6. Avoidable Problems: It is clear that even where we think the figures used in the report should be reliable, we experience uncertainty because of a lack of detail. We know that drywall cracking at ceiling/partition junctions occurs to varying degrees (truss uplift). But we also know that these effects are largely avoidable depending on the construction practices used, even when using S-GRN material. So if these defects are showing up in the cost figures, we can say these costs could be easily reduced (see CMHC documents on this topic). If these events are occurring, more technology transfer efforts are needed in areas where we already know the answers.

7. Trusses: The material selection for trusses fabricated by truss manufacturers is very often done by the manufacturer, not by the builder, unless he specifically asks for it. If the builder uses rafters, he has total control on choice of material. Builders know well enough that the exterior appearance of the house is critical to street appeal. Detecting crooked trusses and rafters leading to bowing or sagging, no matter how structurally sound, takes away from the perceived value of a building. Whether dry or green lumber is used, the design is critical to minimizing these effects.

On the whole, attic spaces can provide a drying environment, as long as there is moisture control to prevent it from entering from the living space below by air leakage, and by the provision of good flashing to prevent uncontrolled entry of precipitation of whatever form (rain or snow). Excessive ventilation should be avoided.

8. Partitions: We now come to enclosed spaces. Interior partitions are able to dry more easily than exterior envelopes, both before sheathing with gypsum, and after, by diffusion of water vapour through the gypsum. Except for crooked walls and nail popping, which are cosmetic defects, the danger of mould growth is minimal.

9. Exterior Walls: Exterior enclosed spaces are the most susceptible to hazards related to mould growth. They are intentionally designed to be weather barriers and have to restrict air, moisture, and heat flow. Because of these restrictions, inclusion of construction moisture has been our dominant concern. Good air/vapour barrier installation leads to no loss of moisture to the inside and drying must be to the outside. In some climates that is difficult to count on. If on the other hand poor practices are used, then entry of moisture by air leakage and so on lead to collection of moisture and longer term problems. When you come right down to it, this is where all of our research attention has been focused. As a consequence, this should suggest to all concerned that it is here that potential courses of action could be taken. It is not only cosmetic effects that we must be concerned with; durability and indoor air quality are the main concerns underlying this research effort.

10. Local Production Capabilities: In one of the scenarios, it was shown the current drying capability to produce S-DRY lumber is as high as 48,000 Mfbm (Scenario 2: Immediate and Full Implementation ..). Additional requirements were to be met in the Atlantic region and from outside the region. A particular split was assumed for all the sources. For all the other scenarios, the same split was assumed, even though the production requirements for dry lumber were smaller. Indeed, for some scenarios, all the additional requirements for S-DRY lumber could be met within the province given current capacity. The minutes of the 19% MC committee allude to there being excess capacity in the system.

11. Renovation: The do-it-yourselfer might very well choose the least cost lumber for this work. But it seems strange that those builders in the renovation business would use S-GRN wood. Differential shrinkage between new and old built portions of a building is not desirable. One would expect the ratio between use of S-DRY and S-GRN lumber in that industry to not be the same as for new construction. However, this criticism should not be taken too hard. Nobody really knows. Given the uncertainty, we must again stress the need expressed in comment 2, for stating the qualifications clearly. . *The net benefits should all be referred to as "estimated" net benefits.*

Anecdote about one builder's approach:

I find that builders are very common-sense individuals and they think quite a bit about what they do. I gave a talk on moisture in lumber at the New Brunswick Home Builder's meeting last year in Edmunston. Later, a builder from the audience approached me and told me of his approach. He explained that he used S-DRY lumber for the exterior walls and load bearing applications because they were more critical for drying and to minimize shrinkage effects on the total building height. There are more wall plates involved and this reduces that problem. There would be less warping and bowing because that tendency was detected in the lumber after drying and those pieces were graded out. For the interior walls, he used S-GRN lumber, because there was more time for that lumber to dry out. It was better protected by the building shell. Straightening of crooked lumber, if it happened, was more easily done at that stage before applying the drywall, and there wasn't any complication with insulation. Load bearing wasn't usually involved, so the repair techniques were not critical. Differential settlements due to differential shrinkage was kept under control, and the floor joists were from the West and were already kiln dried. His problems with moisture in framing lumber appeared to be minimal and he paid attention to his practices. He did not tell me how he dealt with his roof trusses, but it seems to me that, whatever he did, his practices avoided detectable problems.

Is 19% Low Enough ?

As explained earlier, we count on further drying to take place to get construction lumber out of the hazard condition. To achieve the benefit of lowest costs associated with shrinkage, we can say that if construction is to be done quickly with S-DRY lumber, perhaps only about half of the shrinkage has taken place before closing in, especially the exterior shell of the house. If the builder is unfortunate enough to have had his material re-wetted, it is very likely that, despite having used S-DRY lumber his framing would subsequently experience substantial shrinkage - much more than he should expect.

Some of us suspect that it is not enough to have lumber at 19% to avoid shrinkage problems and drywall problems. However, there have been no on-site studies to pin this down. However, the Cross Country

Framing Moisture Survey that Forintek did for CMHC showed that the incidence of complaints concerning drywall problems was very low on the Prairies - this coincided with very low moisture readings in the lumber framing - 12% and under, although the break-point on this is not known and is probably not precise. Only on-site studies could show this reliably.

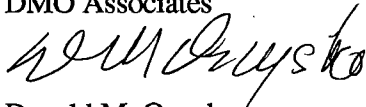
Strategic Planning

To say that it is fruitless to attempt to find better options because there can be no net benefit as defined in the report is probably incorrect. The problem has to do with the definition of *net benefit*. If all factors are accounted for, including some of the intangibles, I suspect there will be a net benefit to society. However, as explained earlier, it does mean disturbing the status quo, and it may mean a disruption for some producers. It would seem that we must seek to minimize the costs to the ultimate user and there are several ways to achieve this. One way is to stay self regulating. The ANHW might explore ways of making sure that their liabilities are better covered in advance of construction. Another way is for builders to act on the basis of better information. To secure better information, I suggest the following to all stakeholders.

- ◆ For both S-DRY or S-GRN construction, it would be desirable to correlate the costs of dealing with lumber drying in place with the moisture content of the lumber at time of construction and closing. You don't need a big study to do this, but it has to be well planned and you need to follow through with the specific houses chosen.
- ◆ For both S-DRY and S-GRN construction, it would be desirable to determine how various construction techniques and material choices mitigate the results of lumber drying. The studies to get this information could very well be run by the builders themselves with provision of some rudimentary equipment, proper accounting and oversight by the ANHW. Wherever 2 houses of a similar design are built, that is a possible experiment - one is used as a control, and the other is used for examination of one or two alterations in practice.
- ◆ For both S-DRY and S-GRN construction, it would be desirable to determine how construction scheduling together with construction practices and materials can be used to meet the intent of the code. As in the previous suggestion, good planning and firecracker technology (as opposed to rocket science) is all that is needed.
- ◆ Is there a place for combining S-DRY and S-GRN materials as related in the anecdote above ? Possibly, if the other questions above provide good guidance.
- ◆ Nothing will be gained by blindly doing something if you don't know or care why you are doing it. It is only when a builder understands what he is doing that he can get the best results. It will take education (some call it technology transfer). I would be satisfied if word of mouth does the job. But I am sure that if the building industry is serious about this, there will be no shortage of money to convey the information to those in construction.
- ◆ The S-GRN lumber producers should examine the options of marketing their product to meet the intent of the code, or to market their lumber to S-DRY producers who have excess drying capacity. It is presumptuous of me to even mention this I know, but studies have been done to examine the potential of forming cooperatives. These studies should be re-examined in light of potential changes to the status quo to better prepare for shifts in market preferences.
- ◆ Do I think the 19% MC Committee should be disbanded ? Personally, I think that when there is a forum for the positive exchange of ideas, and for the discussion of results from many sources run by and for the stakeholders, this better prepares some elements in the industry to apply the results and others to prepare for the consequences of those action shifts. Burying one's head in the sand is not a solution.

I hope that the above comments assist both the writers of the ADI report, and members of the 19% MC Committee in coming to grips with a course of action that will lead to most of the benefits of use of dry lumber with a minimum of disruption to the status quo involving S-GRN lumber use. I would certainly recommend moving forward with rational recommendations and, at the same time, begin relatively inexpensive construction practices studies to demonstrate those which are most cost effective in producing quality construction. The whole country could well benefit from this work.

Yours truly,
DMO Associates

A handwritten signature in black ink, appearing to read "DM Onysko", written over the printed name.

Donald M. Onysko



NRC · CNRC

The Importance of Dry Lumber

The National Building Code of Canada requires that lumber used for wood-frame construction have a moisture content no greater than 19% when installed. The reasons for this requirement are discussed below.

The drying process

More than half the weight of a tree can be attributed to water. As soon as the tree is cut into logs, these logs begin to lose moisture. If the logs are then allowed to dry, they develop cracks and splits because the outside shrinks more quickly than the inside. To eliminate or minimize this differential between inside and outside, lumber manufacturers saw the logs into smaller pieces (boards) while they are still "wet."

The sawn lumber dries out in two stages. First, the wood cells give up "free" water. Loss of this moisture does not cause the wood to shrink or distort. When the moisture content of the wood has dropped to between 25% and 30% (the fibre-saturation point), the wood begins to lose the moisture in the cell walls. It is during this second stage of drying that shrinkage and warping occur.

The amount of shrinkage and warping that actually takes place in the board depends on the angle of the grain, on how dry it gets and on how it is stored while drying. With proper protection, stacking and restraint to resist warping, most spruce, pine or fir species of wood can be air-dried flat and straight in one summer. Drying can be accomplished in days if done in a drying kiln. The exact number of days required will depend on the species and the size of the individual pieces of lumber. This drying process is called seasoning.

The grade stamp on lumber indicates the moisture content at the time the rough-sawn lumber is planed (called "surfacing"). S-Grn

indicates a moisture content greater than 19% (i.e., unseasoned), S-Dry indicates that no more than 5% of the batch exceeds 19% moisture content, and MC 15 means that there is a 15% maximum moisture content. Lumber stamped S-Grn is not prohibited from use, provided that it has been given the opportunity to dry out, either in storage or after framing.

Why the requirement for 19% moisture content?

The requirement in the National Building Code for a maximum 19% moisture content is based on several considerations. They are as follows:

- The drier the lumber when installed, the less shrinkage and warping there will be. The point at which the moisture content for wood stabilizes depends on the region and the season. The moisture content for wood stored under cover during the summer varies from 11% to 12% in most inland areas, while in coastal areas it ranges from 14% to 16%. At these levels, about half to two thirds of the wood's total potential for shrinkage has occurred, and the lumber will remain relatively dimensionally stable in use. If, however, framing that has a high moisture content is enclosed and then subjected to indoor winter heating conditions, the moisture levels can drop to 5% or 6%. This loss of moisture causes shrinkage to occur, resulting in improper seating of floor joists on sill plates and more apparent deflection and vibration as well as squeaking. Shrinkage can also increase the possibility of air leakage through walls, particularly around windows and doors.
- When construction proceeds rapidly, the framing may be enclosed before shrinkage has occurred and before any problems are

noticed. The effects of shrinkage are most apparent around windows and doors where the lintels shrink away from the supporting jack studs, creating gaps or cracks. The same problems can occur where metal joist hangers support unseasoned wood joists around floor openings. After the framing is enclosed, corrective action can not be taken.

- The phenomena of nail popping in drywall occurs when the wood shrinks due to rapid drying, forcing the nail head above the surface of the wood. If, however, the wood has been dried to a moisture content of 19%, the likelihood of nail popping is minimized because most of the shrinkage has already taken place. Using wood that has a moisture content below 15% reduces this possibility even further.
- The use of unseasoned lumber to build roof trusses contributes to the potential for truss-uplift problems. If the ceiling is installed before the moisture level of the trusses has had an opportunity to stabilize, the chances of bowing stresses and deformation are increased.
- The drier the lumber, the less prone it is to decay. The development of fungi on wood is largely controlled by moisture content. Most wood-decaying fungi require a moisture content above 25%. Even if there is insufficient moisture, once growth has started the fungi do not die; they merely become dormant. Active growth can start again later. Kiln-drying will kill the fungi, but the wood can get re-infected if it becomes wet again. Thus, the only way to eliminate the possibility of decay is to use wood with a moisture content below 20%.

Keep it dry!

The use of dry lumber makes it easier to build a quality product. However, some precautions must be taken to ensure that the lumber stays dry at the building site:

- Protect the lumber from rain and snow and don't pile it at low points where water may pond.
- Don't store the lumber on or next to bare ground, on concrete floors, near freshly plastered walls, or near other moisture sources.
- Keep S-Dry lumber sealed in its original wrapping until it is ready to be used.
- Store the lumber flat and support it well so that it does not deform. Encourage ventilation by separating layers in piles with sticks.
- Avoid materials or practices that might add moisture to the wood framing before it is enclosed.

This information was prepared by John W. Archer of the National Research Council's Institute for Research in Construction (IRC). The Technical Research Committee of the Canadian Home Builders' Association and Forintek Canada Corp. assisted in its review. For additional information, please contact IRC Client Services by telephone at (613) 993-2607, or by fax at (613) 952-7673.



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