TOWARDS DEVELOPMENT OF POLICIES ENHANCING SINGLE FAMILY RESIDENTIAL DWELLING ENERGY EFFICIENCY IN THE ONTARIO BUILDING CODE:

A HOLISTIC APPROACH WHICH CAN SUPPORT MORE AGGRESSIVE REQUIREMENTS

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Towards Development of Policies Enhancing Single Family Residential Dwelling Energy Efficiency in the Ontario Building Code: A Holistic Approach Which can Support more Aggressive Requirements

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ABSTRACT

Single family residential dwelling energy efficiency in building codes can contribute in reducing energy consumption and GHG emissions that contribute to global warming and climate change. This research investigates enhancing policies with the use of recommendation sets for more rapid change and aggressive energy efficient residential building codes in Ontario, which can be successfully implemented presently. Currently, there are not enough effective and stringent policies addressing energy efficiency in the residential building codes and standards in Ontario. Methods and data collection were received through a policy analysis of progressive EU in addition to 13 semi-structured interviews. Results were indicated through a recommendation set established using the information from the data collected. The recommendation set consisted of 5 policies that, if implemented, will provide and allow for more aggressive RBCs. If the recommendations are successfully implemented, there should be more aggressive and increased levels of energy efficiency in future RBCs.

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TABLE OF CONTENTS

List of Figures

LIST OF ABBREVIATIONS

BC	Building Codes
BCB	Building Control Bodies
BDT	Blower Door Test
CDM	Conservation Demand Management
CHBA	Canadian Home Builders Association
DC	Development Charges
DSM	Demand Side Management
ECM	Energy Conservation Methods
ECO	Environmental Commissioner of Ontario
EG	Energuide
EGNH	Energuide for New Homes
EPBD	Energy Performance in Buildings Directive
EPC	Energy Performance Certificate
EU	European Union
FIT	Feed In Tariffs
GEA	Green Energy and Economy Act
GHG	Green House Gas
MHA	Mandatory Home Audits
MMAH	Ministry of Municipal Affairs and Housing
NZEB	Nearly Zero Energy Buildings
OBC	Ontario Building Code
OPA	Ontario Power Authority
OREA	Ontario Real-Estate Association
RBC	Residential Building Code

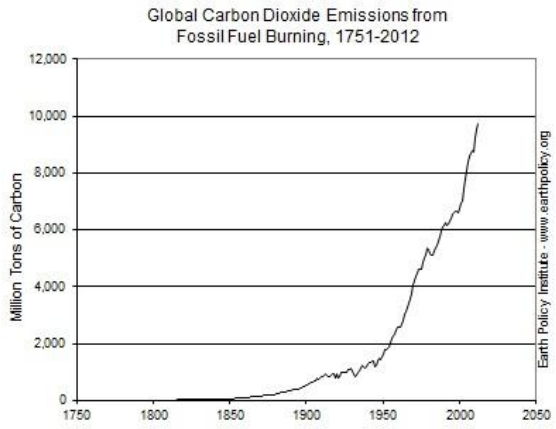
SB-12 Supplementary Standard 12

ZNE Zero Net Energy

CHAPTER I- Introduction/Significance:

Since the industrial revolution in 1760, Green House Gases(GHGs) specifically carbon have been rapidly increasing in the atmosphere. GHGs increased just over 1% a year in the 1990s despite agreements including the Kyoto Protocol between governments to reduce GHG emissions (Raupach, 2007). Since 2009, GHG emissions have raised by 2.6% each year and in 2012 carbon emissions hit an all time high of approximately 9.7 billion tons (Raupach, 2007). Figure 1.1 demonstrates the GHG increasing trend and global emissions. Anthropogenic GHG emissions contributes to global warming and climate change. The IPCC states that due to GHG emissions from anthropogenic activities, for the next two decades, a global warming of approximately 0.3^{o}C per decade is expected (IPCC, 2007). The IPCC contains reports on climate change and its negative effects on the environment and human health.

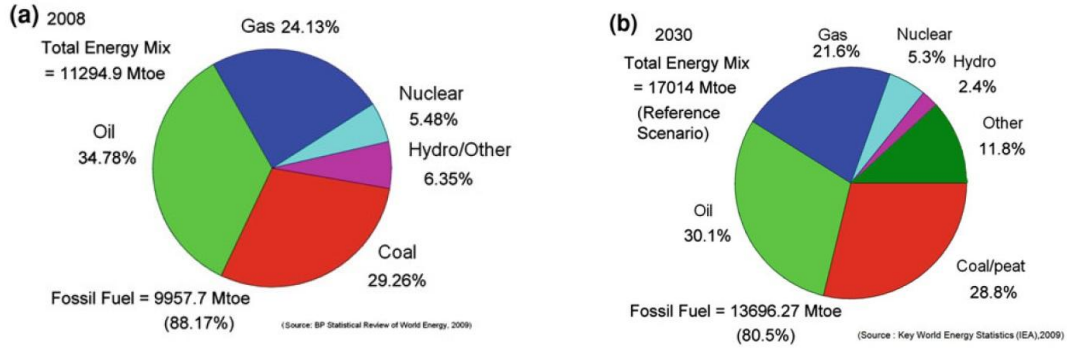
Figure 1.1- Global CO_2 from fossil fuels source: (Raupach, 2007)



Furthermore, global energy demand is expected to rise 1.5% per year from 2007-2030, which equals to a 40% increase. Fossil fuel energy such as oil, coal, and natural gas are the dominant sources of energy and represent a 50% increase from 2008 to 2030 (Pode, 2011). Figures 1.2(a) and 1.2(b) demonstrate the global energy mix in 2008 and 2030, which is based on

2008 policies. It is evident that the total energy mix is projected to increase from 11, 294.9 million tonnes of oil equivalent (Mtoe) to 17, 014 Mtoe between the year 2008 to 2030 (Pode, 2011). This will cause a rapid increase in amount of GHGs in the atmosphere. The population growth and industrialization of many emerging economies are two driving factors in the continued reliance of fossil fuels (Pode, 2011). However, these fossil fuels are depleting at a rapid pace and World Oil has stated that oil reserves could be depleted in 40 years. Also, natural gas and coal will likely be depleted in 167 and 417 years, respectively (Pode, 2011). Therefore, more attention should be focused on reducing energy demand and consumption through energy efficiency. This will decrease the intensity of fossil fuel use in providing energy to demanding global populations.

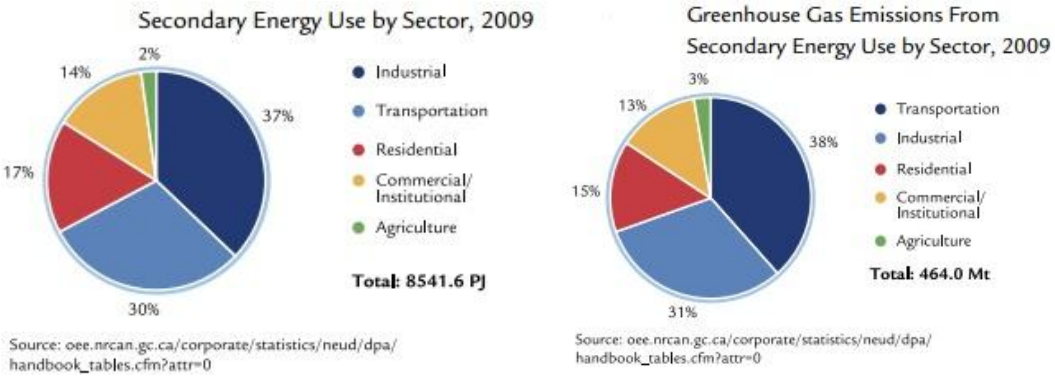
Figure 1.2(a) and 1.2(b)- The global energy mix in 2008 and 2030, respectively source:(Pode,2011)



The purpose of the study is to identify, enhance, and support the implementation of policies that aim for more aggressive and stringent energy efficient residential building codes and regulations in Ontario. It is important to develop policies that are deliverable and are able to achieve the highest possible performance levels. This will be achieved through a sample policy framework, which, is a set of recommendations demonstrating how to speed up the implementation process of energy efficient policies for residential building codes.

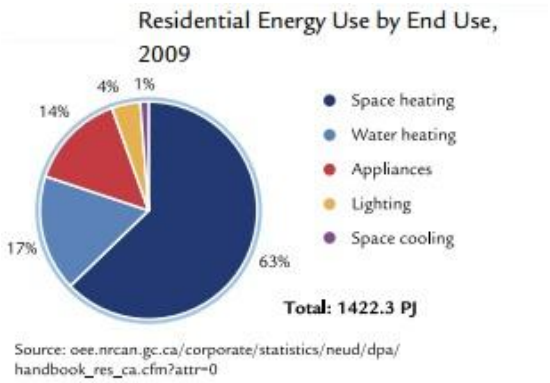
In Canada, approximately 13% of GDP equalling to 189 billion dollars was spent on energy consumption to heat and cool residential and commercial buildings, transportation, and appliances. Secondary energy use, energy for final consumer, accounted for approximately 70% of primary energy, energy required to transform energy to different forms (NRC, 2011). Figure 1.3 provides a visualization of secondary energy use by sector in 2009. Further it is shown that residential energy consumption is 17% of total secondary energy use. Figure 1.4 demonstrates the related GHG emissions associated with the secondary energy use and residential emissions were equivalent to 15% of the overall (NRC, 2011).

Figure 1.3 and 1.4- secondary energy use by sector and GHG emissions associated source: (NRC, 2011)



There are four types of residential buildings in Canada which are single detached, single attached, apartments, and mobile homes(NRC, 2011). Single detached houses represent the largest type of dwelling representing 56%. In addition, space heating and water heating were the two major end use consumptions of residential energy and represented 63% and 17% respectively (NRC, 2011). Figure 1.5 displays the end use energy for residential buildings.

Figure 1.5- residential end use energy source:(NRC, 2011)



Energy efficiency in residential building codes could reduce energy consumption and GHG emissions that contribute to global warming (NRC, 2011). However, in Ontario, according to the Environmental Commissioner of Ontario(ECO), in 2012 the government did little to impose and increase energy efficient and conservation measures(ECO, 2012). As a result, there are not enough effective and stringent policies addressing energy efficiency in residential building codes and standards in Ontario. It is necessary to investigate the potential to which more aggressive policies can be formed and as a first step identifying common problems or barriers that could be encountered when developing policies for energy efficiency in residential building codes.

1.1 Problem Statement:

Currently, there are not enough effective and stringent policies addressing energy efficiency in the residential building codes and standards in Ontario (ECO, 2012). This research will attempt to bridge the gap between energy efficient policies for residential buildings and how to support the successful implementation into the OBC. In summary, the main gap this research addresses is how to improve and develop policies in Ontario that have more aggressive but realistic objectives that can be currently implemented.

1.2 Thesis Objectives and Purpose:

The purpose of the thesis is to:

i) Identify, enhance, and support the implementation of policies that aim for more aggressive and stringent energy efficient residential building codes and regulations in Ontario. It is important to develop policies that are deliverable and are able to achieve the highest possible performance levels.

ii) Investigate what types of policies are necessary in order to achieve the most rapid change with the greatest uptake and results.

iii) Formulate a sample policy framework, which is a set of recommendations demonstrating how to speed up the implementation process of energy efficient policies for residential building codes. The recommendations are a holistic strategy for supporting the implementation of more aggressive codes and can transcend just the OBC.

This could significantly contribute to decreased energy use in residential buildings, which could improve energy security and drastically reduce future GHG emissions related to climate change. Understanding the current state of Ontario with regards to energy efficiency in residential buildings will contribute to knowing what needs to be done in the future to improve success.

Contribution to Study:

The major contribution in the study is that the 5 recommendations, although different, can work in conjunction with each other in order to allow for aggressive energy efficient Residential Building Codes(RBCs) that provide the most rapid change with greatest uptake.

1.3 Thesis Statement/Question:

How can we enhance policies with the use of recommendation sets for more rapid change and aggressive energy efficient residential building codes in Ontario which can be successfully implemented presently? The main goal is to improve and develop policies in Ontario that have more aggressive but realistic objectives that can be currently implemented.

1.4 Research Questions:

1. What type of policies are needed to achieve the most rapid change with the largest uptake?

Some sub-questions arising from this main research question are:

- How does Ontario, through the MMAH and OBC, attempt to implement policies for energy efficiency in residential buildings? What approach is currently being used?
- What is the current method in Ontario for implementing policies improving energy efficiency in residential building codes?
- Are prescriptive or performance based policies more effective for implementation in Ontario?
- What goals and customizations need to be made to a policy(current or future) in order to optimize success and implementation rates for energy efficient residential building codes?

2. How does Ontario currently address energy efficient policies and implementation in existing residential buildings?

A sub question stemming from this is:

- What is being done for existing residential buildings that will be undergoing renovations? What needs to be done?

3. What policy considerations have to be made to affect and inform those involved in the decision making processes in Ontario?

CHAPTER II- Literature Review:

It is necessary to understand the current state of research regarding energy efficiency policies in residential buildings. Europe is a progressive nation in terms of energy efficiency in buildings and so it is important to review their current barriers and opportunities to policies regarding residential energy code and regulation implementation.

2.1 Progressive European Union

2.1.1 Compliance and Lack of Knowledge:

Pan et al 2012, discusses the problem of compliance with implementing energy building codes in new build dwellings in the U.K, specifically England and Wales. Compliance refers to acting in accordance with legislation, in this case building regulations in the U.K (Planning Portal, 2013). The policy under investigation was Building Regulation part L "Conservation of fuel and power" particularly part L1 2002 and L1A 2006, which deals with newly constructed residential buildings (Pan, 2012). Part L1 deals with specifically residential dwellings either new or existing, while L1A deals with only new build residential dwellings (Planning Portal, 2013). Part L1 2002 reduced the allowable carbon emissions of new build residential dwellings by approximately 25% from pre-2002 levels, while L1A 2006 further reduced the carbon emissions by 20% from 2002 requirements (Pan, 2012). Both the L1 2002 and L1A 2006 are building regulations that provide energy efficient building standards and each outline paths and methods for ensuring compliance. Part L1 2002 offered three methods of obtaining compliance. The first was the elemental method which provided the highest allowable U-values for various elements in the building including windows, doors, and frames (Planning Portal, 2013). U-values represent a measure of heat loss in the buildings material and is expressed W/m^2k, a lower one being more

favourable for energy efficiency. (Planning Portal, 2013). The second method is the target U-value method which is a formula that, in essence, gives the builder and designer a target heat loss number for the entire dwelling (Planning Portal, 2013). The last method is the carbon index method and this measures and predicts the total amount of emitted CO_2 resulting from the buildings energy use and consumption. The builder and designer must ensure that the dwelling achieves at least a 8.0 on the carbon index (Planning Portal, 2013). Next Part L1A 2006 used five criteria for ensuring compliance. The first criteria deals with achieving the CO_2 target emission rate (TER), which states that a the dwelling CO_2 emission rate (DER) will not exceed its target CO_2 emission rate. Both DER and TER are measured in CO_2 mass which is in kg/m2 of floor area and it is calculated per year taking into account CO_2 emitted through heating, lighting, and water (Planning Portal, 2013). The Standard Assessment Procedure(SAP) is used to calculate the TER and DER which is the method used by the U.K government to measure energy performances in dwellings. Criteria 2 prevents inappropriate design tradeoffs by setting minimum energy consumption limits on various aspects of the house design such as air leakage, lighting, and U-values (Planning Portal, 2013). Criteria 3 requires that new build dwellings limit the overheating attributed by solar gains during the summer (Planning Portal, 2013). Criteria 4 essentially reinforces Criteria 1 as it ensures that the energy performance of the house is in accordance to meet the DER (Planning Portal, 2013). Criteria 5 provides the knowledge and operating instructions, including maintenance to the occupant or buyer (Planning Portal, 2013). This includes the energy performance certificate(EPC) which demonstrates the energy rating of the building and SAP and also provide and informs the occupant of the building's energy costs (Planning Portal, 2013). These are the methods to achieve compliance of both the L1 2002 and L1A 2006 building regulations.

Pan et al, 2012 further explained that there were many factors that influenced the levels of compliance such as dwelling type, build type, EPC, Standard Assessment Procedure (SAP) calculation submission, and part L1A checklist. The compliance level improved from the revision of the part L1 2002 to the L1A 2006 as the compliance increased from 11% to 35% respectively (Pan, 2012). However, that increase to 35% was still considered a relatively low compliance level for building codes. In addition the compliance of flats was 38% while houses were 35% and the compliance level of timber built houses were 61% compared to 32% in masonry built houses (Pan, 2012). These results indicate that new build flats were more likely to be compliant with the building regulations and codes in L1A 2006 than new build houses and timber frame dwellings are more compliant than masonry built dwellings Further, 71% of the dwellings that were issued an EPC were compliant with the part L1A 2006 building codes and regulations but only 78 out of 376 were even issued an EPC (Pan, 2012). Also there was a 53% compliance rate for the 184 dwellings that used part L1A 2006 checklist compared to the 18% compliance rate of the 192 dwellings that did not use the checklist. The results would suggest improved compliance with the part L1A 2006 building codes and regulations could likely be due to the EPC and part L1A 2006 checklist. Overall only one third of the 404 included dwellings were compliant with part L of the building codes and regulations. The majority of the other two thirds were either grey compliant or grey non compliant, which are terms that express that there was a lack of or insufficient evidence, mainly no SAP calculations and DERs, to demonstrate that compliance was achieved (Pan, 2012). There is a substantial lack of compliance with results indicating that lack of knowledge and training is a main component of low compliance levels and that training and awareness within building control bodies(BCBs) could improve the effectiveness and compliance (Pan, 2012).

Another article by Pan et al 2012, further highlights the lack of knowledge of Part L1A 2006 and investigated the specific issues and root causes for the non compliance. The main conclusion is that the building regulations Part L1A 2006 was not implemented properly (Pan, 2012). This is due to the fact that the SAP calculation submissions and compilations demonstrate that there were incorrect submissions by the builders and developers during the process (Pan, 2012). This was particularly evident as all dwellings were issued completion certificates, which points towards a lack of proper verification of the SAP calculation submissions by the building control bodies. All 376 new build dwellings in the study received a completion certificate (Pan, 2012). However, the study revealed, through compliance and non compliance rates, that 244 of the total could have been granted the completion certificate incorrectly or without proper justification (Pan, 2012). This is demonstrated as those 244 buildings either were missing or did not have a DER calculation, which is mandatory for compliance according to the L1A 2006 (Pan, 2012). This indicates a lack of knowledge of compliance stipulations by building control bodies and authorities. It is a significant issue that BCBs approve dwellings when there is insufficient evidence of compliance levels.

Furthering the Pan et al, 2012 study, Cox, 2006 performed a study that examined the non compliance associated with Part L1 2002 using interviews from 59 building control officers in different regions in the U.K that worked with Part L of the building regulation (Cox, 2006). Compliance was poor because Part L of the building regulations are ranked low to building control bodies (BCB) as the codes are deemed non life threatening. This is reflected in the fact that BCBs were less likely to take the necessary steps for proper enforcement or chose not to deny completion certificates (Cox, 2006). The high levels of non compliance for part L1 2002 was due to BCBs perceiving that the other aspects of the building regulations were more

important than the energy efficient aspects outlined in Part L (Cox, 2006). The non compliance levels were not quantified at all in this study.

Garmston et al, 2013 reinforces Pan et al, 2012 and Cox, 2006 stating that BCBs lack of knowledge, training, and SAP software were reasons for non compliance with Part L building codes and regulations. Further, non compliance was generally due to the failure to achieve Criteria 1 in L1A building regulations in England and Wales which states that the target emission rate(TER) where a residential building is constructed must not be exceeded by the dwelling emission rate (DER) (Garmston, 2013). Garmston et al, 2013 states that one of the major reasons for failing to achieve Criteria 1 is the lack of knowledge and training of BCBs in Part L1A 2006 due to the short familiarity and transitional periods, which were designed to improve enforcement. The U.K's government states that the aim is to provide a six month familiarity period, which is pre-enforcement, in order to improve BCBs familiarity with the newly formed building regulations prior to the start date of enforcement (Garmston, 2013). The familiarity period was drastically reduced from Part L 2002 to Part L 2006 from 6 months to 3 weeks respectively which is likely a reason for the BCBs lack of knowledge for Part L regulations and reduced time for training would have also played a significant role (Garmston, 2013).

In summary, lack of knowledge and training demonstrated to be the most significant barrier to compliance.

2.1.2 Vocational Training Programs:

Heinen et al 2010, explained that energy consultants in Germany were not structured and did not contain a systematic approach to energy training. Further, many trainees of different career disciplines and vocations including engineers, craftsmen etc, take the same programs required to

become an energy consultant (Heinen, 2010). Therefore, systematic energy consulting is necessary in order to improve uncertainties between consumers and suppliers. Current curricula for energy consulting is aimed at technical and material knowledge and not focussed on how to implement that knowledge into the design and regulations in residential buildings (Heinen, 2010). They also miss skills such as customer communication and interaction. The curricula does not sufficiently address how to prepare consulting services effectively and develop the trainees competencies regarding the knowledge of energy consulting. Heinen et al 2010, continues to discuss the concept of a qualification framework which focuses on work tasks and competence related structures.

The results demonstrate that specialized vocational training programs can be developed which fit into energy consulting services (Heinen, 2010). This could be one method to improve the compliance rate of energy codes and regulations.

2.1.3 Existing Buildings:

Meijer et al (2009) and Poel et al (2007), state that existing dwellings have greater potential to conserve energy compared to newly built houses. Poel et al (2007) further proclaim that existing residential energy consumption accounts for 63% of total building consumption in the member states of the European Union. In addition, Tommerup et al (2006), claims that there are energy savings in the existing residential buildings in Denmark due to the fact that approximately 75% of those buildings are dated prior to 1979 before energy performance were even established. The energy saving measures for renovated buildings are cost effective and they offer savings within 30 years (Tommerup, 2006). It was also identified that savings in space heating had the potential of 80% in current Danish buildings by 2050 (Tommerup, 2006). Europe Union studies

demonstrate that existing residential buildings could be a significant investment and contribution for future energy efficient policies.

2.1.4 Building Typologies:

Dascalaki et al (2011) explain that understanding building typologies in Europe, specifically Greece, can contribute in reducing energy consumption in existing buildings through energy conservation methods(ECM). Dascalaki et al (2011) defines building typologies as: "a classification of buildings according to some specific characteristics"(Dascalaki, 2011). In this case it is energy performance. Further a buildings energy consumption depends on age, weather, building size, envelope, type, and efficiency of household appliances and miscellaneous loads. The building typology method used for the residential buildings is known as TABULA(Typology Approach for Building Stock Energy Assessment) and it is a tool and facilitator for energy performance assessments of building stock (Dascalaki, 2011). This is important because in order to reduce energy consumption and GHG emissions associated with the residential building sector, information must be known about energy related features of the existing building stock. The study used 24 classes of building typology through 4 climatic zones, 2 types of buildings(single family and multi-family buildings), and ages of buildings(pre 1980, 1981-2001, and after 2001) (Dascalaki, 2011). Furthermore, the study used existing model buildings from Greece to demonstrate energy performance assessments and energy savings using various ECMs and two different refurbishment scenarios for each building type: the standard scenario and the ambitious scenario. The ECMs are specifically aimed for thermal building envelope and heat supply systems such as insulation of windows and exterior walls, hot water supply and production, and maintenance of boilers (Dascalaki, 2011). The standard scenario uses interventions for the thermal envelope and heating supply systems to meet and comply with the

minimum standards and building codes, while the ambitious scenario considers all the standard interventions but includes more innovative technology and renewable energy systems to significantly improve the energy performance. A software program known as TEE-KENAK was used to access energy performance and savings by applying the two scenarios to the model buildings (Dascalaki, 2011). The two scenarios demonstrate a high potential of energy conservation because they directly affect the energy efficiency in the buildings envelope and heating supply systems and as expected the ambitious scenario results in higher energy savings (Dascalaki, 2011). Therefore, these scenarios could contribute to reducing residential building energy consumption substantially. The results demonstrated the estimated energy consumption of the model residential buildings and also the potential energy savings by applying various ECMs (Dascalaki, 2011). The building typology concept demonstrated to be a viable tool for measuring the impact of potential energy savings, through different scenarios, on the energy performance of existing building stock. Building typology can be used as energy advice for homeowners as it offers an energy performance assessment and possible ECMs to improve efficiency (Dascalaki, 2006).

2.1.5 Summary

The European Union analysis demonstrated some opportunities and barriers to developing policies to improve energy efficiency in residential building codes. The opportunities included the use of building typologies and existing buildings in residential dwelling energy code policy, while the major barriers consisted of lack of knowledge, compliance, and vocational training.

2.2 Background of Energy Efficiency for Residential Building Codes in Ontario

It is necessary to understand the current state of Ontario with regards to energy efficient policies for more aggressive building codes in order to demonstrate areas of improvement.

2.2.1 Background of OBC, and MMAH

The Ontario Building Code(OBC) also referred to as O.Reg 332/12 is regulations that set the technical requirements of buildings in the province through the Building Code Act of 1992. The Ministry of Municipal Affairs and Housing(MMAH) is responsible for developing and administering the OBC, but each municipality much be in charge of enforcement. (Hershfield, 2015). Energy efficiency for residential buildings is referenced in Part 9 of the OBC. The OBC energy performance, required as of January 2012, is a rating of EnerGuide (EG) 80(discussed in section 2.2.2 and 2.2.3) (Bradford West Gwillimbury Building Division, 2012). The Environmental Commissioner of Ontario stated that in 2012, a new version of Ontario regulation 332/12 of the OBC which is concentrated on energy efficiency in buildings was finalized by the MMAH (ECO, 2012). The OBC is responsible for establishing energy efficiency requirements in buildings but only operates on a five year cycle. The 2012 energy code contains increased levels of energy performance in buildings in comparison to the previous 2006 codes. There is a targeted 15% performance increase for houses but this is not going to be in effect until January 2017 (MMAH, 2013). However, the MMAH are able to make changes related to the OBC in the interim of the cycles. In 2013, the MMAH made an amendment to supplementary standard(SB-12) which incorporated drain water heat recovery technology. Furthermore, this allows builders to use that technology instead of requiring a higher level of energy efficient requirements in insulation or furnaces. The MMAH allows for builders to create packages of various technologies aimed to meet the performance standards of the code and some examples are highly

efficient insulation, heat pumps, furnaces, and others. These technologies are listed in the SB-12 and are weighted and traded off against others in order to meet the performance requirements. Because the amendment of the drain water heat recovery technology was added to the SB-12 prescriptive requirements allows for further reduction to building insulation performance levels, as package "J" already allows for a trade off for reduced insulation. The ECO made a recommendation that the OPC and MMAH should alter the 2012 code in order to limit the possibility of tradeoffs that can sacrifice the energy performance of the residential building envelope as it is one of the major components in overall energy consumption.(ECO 2012). However, this is just a recommendation and as it currently stands builders can accept tradeoffs that include the building envelope as long as the overall efficiency meets the requirements. Currently, a majority of builders opt to use the SB-12 prescriptive path because there is no requirement for energy modeling, which can cost time and money. The package used by most builders is package "J". One of the issues with this is that each SB-12 package does not include all energy efficient technology and in the future there could be problems with the exclusion of important or beneficial technologies (ECO, 2012). Also, the Ontario Building Code has essentially excused existing buildings, including residential, that undergo renovations from the energy efficient requirements and provisions (ECO, 2012). The MMAH has studied this issue but have not made or proposed any possible changes. One problem is that the energy efficient requirements that make sense for newly constructed buildings may be more complicated to achieve when partially or fully retrofitting existing buildings (ECO, 2012). However, there is a large potential for energy savings in the market of existing residential buildings, but no mandatory policies are in place. It can be assessed that the OBC and MMAH have not done enough to improve energy efficiency in residential buildings.

2.2.2 Supplementary Standard (SB-12):

Supplementary Standard (SB-12) demonstrates prescriptive requirements necessary in order to comply with the allowable air leakage rate. These prescriptive paths act as an alternative to achieving an EG rating of 80 as outlined by NRCan EGNH(EnerGuide for New Homes) (MMAH, 2011). This is a design option in the OBC as an attempt to provide a predictable solution to meet the energy efficiency rating of 80 and is intended to meet or exceed that performance level. There are two methods in the OBC for complying with the energy efficiency requirements of EG 80: The first is previously mentioned, SB-12, and the second is achieving an EG rating of 80 or higher through the evaluation of the technical requirements of NRCan EGNH (MMAH, 2011). SB-12 also offers three methods for achieving compliance:

choose one of the options in the prescriptive paths section (subsection 2.1.1) in SB-12,

design to the required performance (subsection 2.1.2), or

meet the necessary requirements of Energystar (subsection 2.1.3) (MMAH, 2011).

Figure 2.1 SB-12 Compliance Paths source:(MMAH,2012)

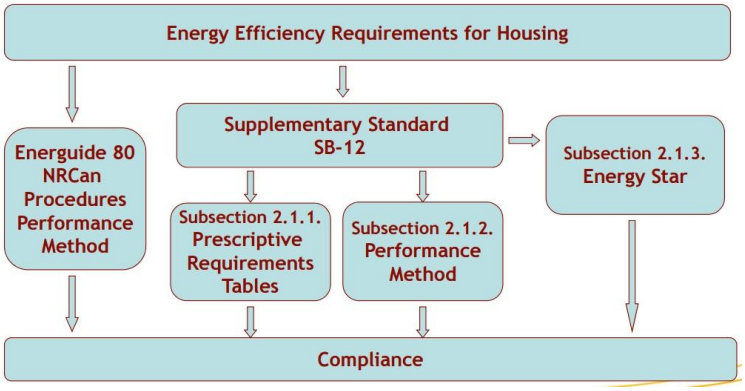


Figure 2.1 demonstrates the compliance options for SB-12 and performance testing (MMAH, 2012). In addition, subsections 2.1.1 and 2.1.2 do not require a blower door test in order to successfully comply with the OBC. The SB-12 performance method of compliance is measured based on a simulated annual energy use of a residential building whereas the energy use of the

proposed building shall not exceed that of the building conforming to one of the compliance packages (MMAH, 2011). There is a comparison between the energy performance of the proposed design against the performance level of one of the permitted prescriptive compliance packages. The blower door test is optional as there are air barrier requirements that can be applied in a subsection in SB-12 (Bradford West Gwillimbury Building Division, 2012). Therefore, a residential building will be accepted as compliant using any one of the prescriptive packages outlined in subsection 2.1.1 or by ensuring that building is compliant with the requirements of NRCan Energystar program (MMAH, 2011). The research indicates that because there is no requirement for a blower door test(BDT), compliance throughout Ontario is generally unknown.

2.2.3 NRCan EnerGuide for New Homes(EGNH)

The EGNH program is a regulatory means of meeting and complying with the building code in Ontario and other jurisdictions in Canada, which is a performance level of EG 80. The program was also intended to be a comparative tool for energy consumption in homes (Buchan, 2007). NRCan developed the EGNH program with the purpose of providing a framework for implementing a energy efficient rating system. The EGNH also supplies an energy efficient label to home owners and builders. The purpose of the EGNH assessment and evaluation is to increase energy efficiency in residential buildings through encouraging upgrades that will reduce overall operating costs of the house and impact on the environment, while increasing comfort (NRCan, 2005). The EGNH is usually used for new buildings, but there is a component for existing buildings. EGNH begins during the construction planning stage for a residential building and an energy advisor works alongside a builder to develop energy efficient upgrades using HOT2 XP or HOT2000 software (NRCan, 2005). EGNH encourages energy efficiency improvements and

does not favour one fuel or technology type over another. In addition, an air tightness test will be performed on all residential buildings to ensure compliance. If an EG 80 rating is not achieved through the BDT, then remedial action must be taken, usually through energy efficient upgrades, and an updated report demonstrating EG 80 must be provided (NRCan, 2005).

However, a 2007 report demonstrated issues with EGNH as a method of OBC compliance. EG ratings may not demonstrate or may misrepresent the actual energy efficiency and performance of the residential building (Buchan, 2007). The EG rating system favours multi unit buildings as well as smaller homes with respect to building size and factors such as occupancy, and electricity and hot water use. There is also an assumption that there will be an average family in the building and therefore, actual performance could vary depending on the size and behaviour of the family (Buchan, 2007). Furthermore, the typical home that is compliant with the requirements of the code will have a rating close to EG 70, while, for example, the minimum energy efficiency of the R-2000 is EG 80. This change in ratings could have been the result of 100 percent increases in various aspects of the home including space heating, insulation, and hot water consumption, but the EG rating change is not substantial. This creates confusion for homeowners as there might not be understanding of the vast differences of an EG 70 home versus an EG 80 home (Buchan, 2007). Another issue is that the software used to calculate the ratings is constantly being updated and revised and so a building could be compliant with EG 80 at one point and then could be considered a failure later. And HOT2000 modeling software for determining the EG rating and compliance level with the building code is the only method for demonstrating compliance. It appears the EG rating system, used in the OBC, has issues that are problematic with compliance levels and consumer awareness or education (Buchan, 2007).

2.2.4 The Green Energy and Green Economy Act(GEGEA):

In addition when the Ontario government released the approved legislation of the Green Energy and Economy Act, it did little to promote energy efficiency and conservation in residential buildings. The Green Energy and Green Economy Act (GEGEA) was established and passed into law on May 14, 2009 in Ontario, to contribute to the GHG emissions reduction and commitment to cease coal fired power production (Streich, 2010). As far as legislations go in Ontario, the GEGEA has been the most ambitious step in reducing GHG emissions (Streich, 2010). However, the main focus of this act is to make a commitment and encourage renewable energy development and generation through various projects and create green energy careers and jobs (Streich, 2010). This is evident through the fact that the centerpiece of the GEGEA was feed in tariffs(FIT). In September 2009, the Ontario Minister of Energy Infrastructure directed the Ontario Power Authority to officially implement the FIT program (Yatchew, 2011). The purpose was to increase the capacity of renewable energy supply, enable green industries through investments, job creation, and provide incentives for renewable energy technology investments (Yatchew, 2011). The other concentration of the GEGEA is clean energy jobs for a clean economy. There will be about 4.7 billion dollars invested in GEGEA, which includes 90,000 new jobs per year (Pollin, 2009). The job creation could also grow with the introduction of offshore wind development and smart grid investment, as two new initiatives in the GEGEA (Pollin, 2009). It is evident through the analysis of the GEGEA that there is little effort put towards energy efficiency and conservation in buildings.

A reason why not more realistic policies are created in energy efficiency in buildings in Ontario is because too much focus is being placed on renewable energy instead of energy efficiency.

2.2.5 Bill 124 in 2005:

Bill 124 was a reform to the OBC and Building Code Act(BCA) which directly affected the building permit process. It was designed to change the way municipalities and the construction industry contribute. (RCCAO, 2008). Bill 124 contained provisions that took effect in September 2003 and July 2005. In 2003, the most significant amendment stated that building officials must take various examinations relating to the OBC. The rest of the provisions commenced in 2005 (MMAH, 2003). There was the addition of mandatory courses for building inspectors and designers through the Registered Code Agencies(RCAs). Each municipality is allowed to appoint their own RCAs for inspection services. Also, buildings were to receive inspection during various stages of the construction. Buildings are mandated to undergo inspections at 7 stages of construction (MMAH, 2003). In addition, 2005 signaled the date in which qualifications for building officials became mandatory. The mandatory building code knowledge exams were designed to ensure that building inspectors have all the required building code knowledge and so there was compliance in the building designs. In order to improve compliance levels in the OBC, these mandatory exams were also used for guaranteeing those responsible for the reviewing and inspecting processes are qualified (MMAH, 2003). The overall objective of Bill 124 was committing and mandating that those practitioners involved in the building industry to be tested on building code knowledge in order to be officially qualified. In addition, the municipality would have the right to reject a building permit if the building official or designer is not tested and qualified (MMAH, 2003).

However, Bill 124 has been criticized. Building Officials viewed the legislation as stringent towards municipalities but did not explain the role of builders. Many builders are not fully aware of the requirements of a complete application for a permit and do not take time to manage the

application (RCCAO, 2008). Municipalities also argue that builders should ensure sites are ready for inspection and that the site supervisors are available to meet with the inspectors. Currently, the responsibilities of the builders in the inspection aspect of the process are not clear in the BCA. Builders also state that the site supervisors are not in complete understanding of the Building Code requirements (RCCAO, 2008). Further, municipalities argue that these site supervisors are under qualified and could be responsible for slowing down the inspection process. In addition, although there are mandatory exam requirements and qualifications on building officials, Bill 124 does not contain any requirements on the designers and builders (RCCAO, 2008).

2.2.6 OBC "Part 9" Wood Frame Residential Construction:

The traditional method of construction in Ontario is wood based framing. This method involves a wood frame on the interior of the house with insulation filling the cavities between the studs. The wood frame systems allows for many different insulation options. Batts of fibreglass are one of the more common approaches, but spray foam is also becoming more prevalent (MMAH, 2008). In addition, advanced framing , which is essentially the optimum use of wood framing, is being promoted. This practice eliminates wood in areas where it is unnecessary. Traditional wood framing uses 2"x4" stud walls at 16", while advanced wood framing uses 2"x6" stud walls at 24" (CMHC, n.d). The difference is mainly traditional framing uses wood studs placed 16 inches apart but the advanced framing places wood studs 24 inches apart with the exception of structural requirements and code standpoint. The requirement for fewer studs results in less thermal bridging because the walls will have more and improved insulation in the cavities of the studs in the building. In most provinces in Canada use the advanced framing design as it does not use more lumber but provides more insulation (CMHC, n.d).

The OBC, as of January 2015, allows wood based construction for not only residential buildings with a maximum height of 4 storeys, but now residential, business or personal offices of up to a maximum of 6 storeys. Previously, the OBC limited residential wood based construction to 4 or less storeys. Increasing this height of wood construction on mid rise housing to 6 storeys allows builders to generate more affordable buildings (Hershfield, 2015).

Mullens and Aril conducted a study demonstrating that SIPs provide more energy efficient and airtight residential buildings than conventional wood framing. In 2006, SIPs were only used in 1 percent of newly constructed homes as builders decided it was necessary to fully comprehend and understand before use (Mullens, 2006). Aldrich et al, reinforces that SIPs will produce better r-values than conventional wood framing. Also, it is explained that SIPs could be instrumental in achieving R-30 walls in residential buildings (Aldrich, 2010). Ontario is currently using and expanding conventional wood framing construction but SIPs have demonstrated to offer higher performance, but are not more widespread. Ontario will only achieve so much energy efficiency from wood framing.

2.2.7 Summary

The background of Ontario determines that there are areas that could be improved in order to achieve more aggressive residential building codes. Further, the background demonstrates that there are not enough effective and stringent policies to increase aggressive energy efficient RBCs. SB-12 allows for prescriptive requirements in order to meet the energy performance of the OBC without a BDT. Also, Bill 124 in 2005 and the GEA 2009 were both Ontario policies that did not significantly benefit energy efficiency in residential codes. The EG rating system, used in the OBC, demonstrated that there are problems with compliance and consumer awareness which indicates improvements should be considered. Furthermore, there are not

enough mandatory policies related to existing buildings, although they comprise a majority of the building stock. Last, Ontario continues to pursue timber based construction even though other materials such as SIPs have demonstrated greater energy efficiency.

CHAPTER III- Methodology and Methods:

3.1 Policy Analysis using Progressive European Union:

This research uses literature to understand how cities and regions in the Europe Union were successful at implementing policies that increase energy efficiency in residential building codes. The policy analysis will analyze various success and failures within the European Union in order to develop the most suitable method for implementing policies with the highest performance levels. Policy analysis is a strong method for this research because they involve multiple sources of data and can produce a vast amount of data that can be used for analysis (Soy, 1997). The main research question that the analysis will answer is: "What have more progressive countries in the Europe Union done to implement energy efficient policies?" The lessons from the EU will provide a foundation for successful implementation strategies that could be used to benefit the Ontario system. Understanding this will be instrumental in determining suitable policies for improving energy efficient residential building codes in the OBC.

3.2 Semi-Structured Interviews:

Interviews, 13 in total, will provide a qualitative data collection. Semi-structured interviews will be conducted with representatives or presidents of the following organizations: buildABILITY, MMAH, EnerQuality, Environmental Commissioner of Ontario (ECO), Ontario Home Builders Association(OHBA), Q4 Architects Inc., Love Energy Consultants, Cricket Energy Inc., Sustainable Buildings Canada, Blue Green Consulting Group Inc., S.F. Pope Sustainability Consulting, and Energy Profiles Limited. The interviews will consist of a list of predetermined key questions used to help enhance and define the areas that will need to be explored and are included in Appendix "A". This method of interviewing allows for elaboration within the key questions in order to obtain quality information that could be useful for the research (Gill, 2008).

Furthermore, the interview questions will be subject to change given the responses by interviewees in order to improve the quality of the received information. Also, in order to determine the most suitable interviewees for the subject, the snowball sampling method was used. This method asks that interviewees suggest another organization that would contribute to my thesis. The purpose of the interview method is to investigate various views, experiences, and facts of organizations or individuals regarding energy efficient policy implementation. In addition, the interview could contribute to identifying possible methods for improving the likelihood of success for policy implementation to improve energy efficiency in residential building codes. Interviews should also provide a deeper understanding of the issues that might be unattainable through quantitative analysis. The purpose of selecting 13 interviews was determined through the continuous overlap of information provided by the experts. Similar theories and ideas provided enough overlap that it was decided 13 was adequate. Therefore, the trends were evident within the experts opinions and 13 was assessed to be sufficient. The questions will be designed to provide as much information and data as possible for addressing the specific research questions and objectives (Gill, 2008). They will also provide more than "Yes" or "No" questions. The interviewee will be provided an informed consent form and an ethics form will also be filed and completed prior to the interview. The sample interview questions are provided in appendix "A".

3.3 Sample Policy Framework Modelling:

Using the data collected through methods outlined in section 3.1 and 3.2, a sample policy framework model will be developed and tested with willing stakeholders in order to assess the success of implementing a policy to improve energy efficiency in residential building codes in Ontario.

The sample policy framework will be a set of recommendations that will optimistically lead to more successful energy efficient policy implementation for residential building codes. Analyzing Ontario's current situation with regards to the energy efficient aspects of Part 9(Residential and Small Buildings) in the OBC will determine what energy efficient processes and policies will lead to more successful implementation of aggressive residential building codes and standards. In addition, the lessons learned from the policy analysis and the information obtained from the semi-structured interviews will be essential in achieving an optimal set of recommendations. This policy framework is a set of recommendations and will be tested with two architects: one with experience in speculative buildings and high performance custom housing and the other has a more varied practice but also specializes in low energy houses. The discussion and further analysis of the provided results will contribute in improving the framework. The roadblocks will be discussed but will be indicated as areas that require improvement to the current framework. The study will not do further testing of the success of the set of recommendations therefore, re-testing and piloting projects will require an additional study and are beyond the scope of this thesis. The policy framework will provide clear aims and objectives of the policies and provide an explanation of how the goals will be achieved and how it will contribute to successful implementation. The purpose of the sample policy framework will be to develop deliverable policies that can achieve the highest performance levels. Therefore, the policy framework will be designed to resolve the problem of ineffective energy efficient policies in Ontario. Before designing the policy framework, preliminary research will be done in order to understand the current knowledge and information regarding the problem. In addition, it will demonstrate the process of knowing what we want in the future and what must be achieved to influence the

desired change. The policy framework will identify how we can accomplish the desired outcome (Bonehill, 2007).

3.4 Limitations to Study:

3.4.1 Cross Evaluation of EU with Ontario System

In section 4.1, the EU policy analysis, a lessons scenario was presented for the purpose of demonstrating what progressive nations have achieved with aggressive energy efficient building codes. The limitation is that there was no cross evaluation of the EU study with Ontario to determine which of the various lessons from the successes and failures of EU MS would be likely and possible in the current Ontario system. The cross evaluation would provide insight into variables such as energy prices, political support, economy, and necessity that would be used to determine if any of the lessons from EU could be directly applied by Ontario to find similar success in aggressive energy efficient residential building codes. Instead the policy analysis was to be used as a template and model for Ontario to understand the level of performance achieved and what elements made the codes or standards effective in the EU MS. EU also demonstrated how aggressive building code transformation can occur provided there is support and desire for change. However, the lessons from EU can still provide guidance for Ontario and although not all lessons can be effectively applied to the Ontario system, different variations could still be beneficial.

3.4.2 Cost

Throughout the thesis report, cost was not a major factor in designing and enhancing energy efficient policies for more aggressive residential building codes. Financial subsidies and incentives discussed in section 4.3 do not consider Ontario government's available funding for

energy efficiency in residential buildings. Also, the state of Ontario's priority for energy efficient policies and funding was not revealed in this thesis. In addition, overall cost of various technologies, procedures, training programs, public awareness measures, among others, is not evaluated. However, affordability was addressed in a minor way to contribute in mitigating a cost issue regarding to the OBC getting too aggressive with energy efficient requirements. Generally, cost was not a significant consideration of this report as the main argument centered around energy efficient policies that could be successful in leading to more aggressive residential building codes in Ontario. However, cost will not affect the conclusions of the study. It will affect the depth in which the recommendations can be successfully implemented. An example would be the cost of the improved financial subsidies. The amount of allowable and possible financial subsidies in Ontario is not known or researched as part of the scope of the study. In addition, the life cycle cost was not included in the study. That includes the cost of technology and material necessary to implement more aggressive energy efficient policies. A cost analysis could be presented in an additional follow up study.

3.4.3 Amanda Yip Thesis Plausibility

Although AY thesis was used, in section 4.2.5, as a guideline and example of an aggressive building code that could be implemented provided effective policies were in place, there is no definite results indicating that it will. The interview question was designed to discuss whether or not it was a realistic goal and the policies that could contribute for successful implementation. However, there was no further research or policies designed specifically for this 80% reduction in space heating consumption by 2030. The recommendation sets could easily be applied in order to meet this performance level suggested, but because there were no pilot projects to test success,

the implementation is still unknown. There were mixed views about that level being implemented into the OBC by 2030 given current Ontario situation.

CHAPTER IV- Analysis and Discussion

4.1 Policy Analysis Of Progressive European Union:

The European Union and Member States are considered relatively progressive with regards to energy efficiency in buildings. It is necessary to investigate how Europe was successful at implementing policies that increase energy efficiency in residential building codes. The policy analysis will examine various success and failures within Europe in order to understand the most suitable method for implementing policies with the highest performance levels. The policy analysis can be further used as a lessons learned scenario for implementing aggressive energy efficient policies in Ontario.

4.1.1 Explanation of Current EU Energy Efficient Building Policies:

Reducing energy consumption is one of the main goals of the EU and promoting the improvement of energy efficiency will provide security, supply, and contribute in mitigating climate change and global warming.(Mlecnik, 2012). The EU announced the legislation - The Energy Performance in Buildings Directives(EPBD) - in an attempt to reduce energy consumption, as buildings in the EU contribute up to 40% of energy consumed (Mlecnik, 2012). In addition, the EPBD was also used to help fortify EU's plans and targets of 20% energy reduction and 20% carbon reduction by 2020 (EPC, 2010).

The EU put forth the first major directive on the EPBD in 2002 was referred to as Directive 2002/91/EC. The purpose was to require that all the EU countries improve energy efficiency in buildings by complying with Articles 7, 8, and 9, which is energy performance certificates, inspection of boilers, and inspection of air conditioning, respectively(EPC, 2002). In January 2008, a new directive was launched and referred to as the Directive 2010/31/EU, also

known as the recast EPBD and was responsible for clarifying, simplifying, and improving certain provisions as well as extending the scope of the Directive 2002/91/EC (EPC, 2010).

The reason for the recast directive was because Directive 2002/91/EC legislation allowed the member states(MS) governments substantial flexibility in how to implement it into national law which led to different standards in the various MS. Another major limitation was that provisions applied only to buildings exceeding 1000m^2, which would exclude most residential buildings. (Glass for Europe, 2010) According to the recast EPBD, the threshold is 500m^2 for buildings which will be further reduced to 250m^2 in July 2015 (EPC, 2010). Due to the growing concern with energy efficiency, it was decided that the 2002/91/EC was not effective at achieving its objectives and therefore the recast EPBD was designed to create more aggressive and ambitious frameworks at national levels (Glass for Europe, 2010). Directive 2010/31/EU was to be adopted in 2010 and to be transposed into all member states national law by 2012 in order to enter force in 2013.

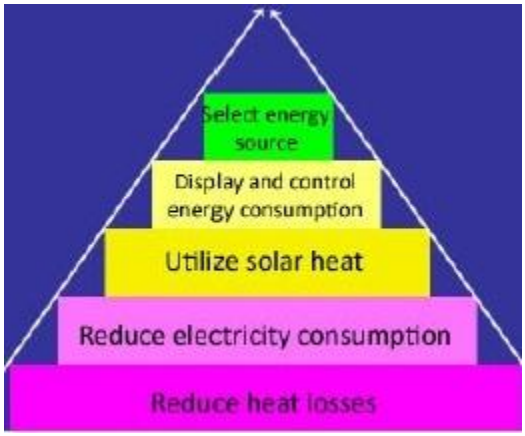
In addition, the recast EPBD introduced the nearly zero energy buildings(NZEB) to be implemented by 2018 onwards (public buildings)-2020 onwards(all new buildings) in article 9 of the policy(EPC, 2010). NZEB was one of the most significant plans and proposals of the recast EPBD with the aim to ensure that all EU member states create and develop national plans to reduce energy consumption in buildings as well as increasing the overall number of NZEB in order to meet the nearly zero energy buildings initiative (ENNEREG, 2009). The EU gave no global definition of low energy buildings but this generally indicates a building that has higher energy performance than the energy efficient requirements in the national building codes (ENNEREG, 2009). Therefore, the recast EPBD requires that all member states define NZEB and implement building policies, standards, or codes that will enable them to abide to the

requirements (Mlecnik, 2011). It is also mandatory that intermediate targets for NZEB will be presented by MS for newly constructed buildings by 2015. Also, beginning from December 2012 and every 3 years after, the EU will publish the results and progress of all the MS and the level of NZEB. (EPC, 2010). The recast EPBD is the most significant energy efficient building policy in the EU.

4.1.2 Successes from Member States(MS) and Cities: Brussels, Belgium

Brussels implemented the Passive House Standard in order to meet the recast EPBD's nearly zero energy buildings by 2020 policy. Passive houses are how Brussels defined NZEB in the recast EPBD. Passive houses can be defined by maintaining a comfortable indoor climate without the use of active systems for heating and cooling (Stephan, 2010). In essence passive houses exchange the current active heating and cooling systems for passive means and this is achieved through super insulation, extreme air tightness, and solar gains which all contribute in substantially reducing the heat load and the need for traditional heating systems (Stephan, 2010). Regulating the climate indoors by only passive means is not practical in many climates and therefore active systems must still be used but because peak heat load is significantly reduced by the energy efficient building envelope, the ventilation system can deliver the required heat. Therefore, the functional definition of the passive house as described by professor Wolfgang Feist: “A Passivhaus is a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air” (Stephan, 2010). Therefore, a passive house can be defined as a super insulated and air tight building that uses very low levels of heating and cooling peak load. The passive house design process is outlined in Figure 4.1 (Stephan, 2010).

Figure 4.1 Passive House Design Process source:(Stephan, 2010)



It demonstrates the importance of reducing heat and electricity consumption as well as overall energy load before considering other systems for energy supply.

Brussels was ranked amongst the worst in Europe for energy performance in buildings, which likely prompted consideration as to how to meet the recast EPBD and the NZEB initiative (Standen, 2013). In 2007, as a result of borrowing the idea from Germany, passive houses and buildings began to take shape in Brussels (EnEffect, n.d). Furthermore, Brussels-Capital region officially committed to the passive house standard after the completion of three calls for proposals for BatEx (Exemplary Buildings Program). The success of the BatEx demonstrated the viability of passive buildings and the passive house standard as it was affordable and cost effective for both construction and renovation (EnEffect, n.d). The passive house law was based on the success of the three BatEx trials in 2007, 2008, and 2009 (EnEffect, n.d). In 2009, the Brussels Capital and their government announced that the passivehouse standard for public buildings will be mandatory by 2010. Also, in May 2011, the law was voted that all new buildings including residential will be constructed to the passivehouse standard by January 2015. (EnEffect, n.d). Building regulations are issued at regional levels rather than national levels in

the Belgium federal government system and Brussels-Capital is one of the three regions. This is also the case for many EU member states. It is because of this that has enabled Brussels to progress so rapidly with low energy building policies (Standen, 2013). Currently, Brussels is largest city to have the most stringent energy efficient standards and regulations for buildings. The passivehouse law was established through 3 stages: The first was that the energy performance law was successfully passed by the Brussels' regional government. The second is that the law is supported by various subsidies in order to encourage energy efficiency in the market. The third is to substantially value training and communication with professionals. The two initiatives that were most significant to the adoption of the passivehouse law were Exemplary Building Program(BatEx) and free professional advice and communication (Standen, 2013)

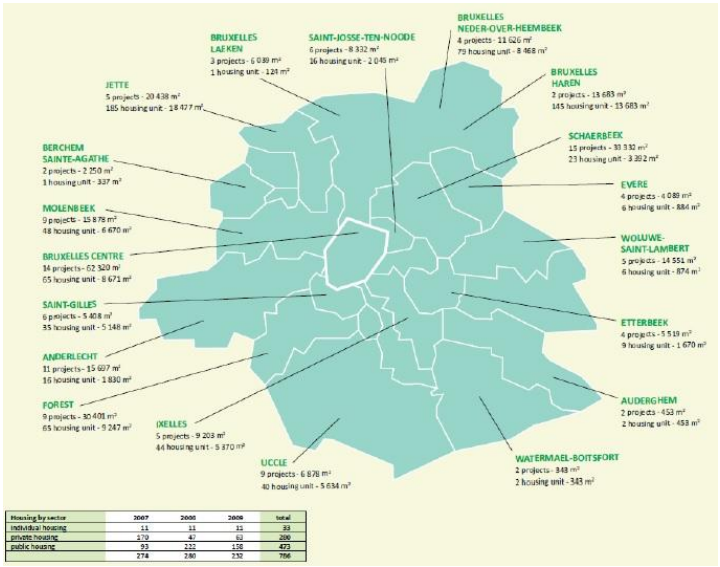
4.1.2.1 BatEx Program and Subsidy:

The Exemplary Building Program and Subsidy also referred to as Batiments Exemplaires (BatEx) was one of the financial incentive initiatives used by Brussels to promote the demand for energy efficient buildings and stimulate the market for energy efficient buildings (EnEffect, n.d). The exemplary building program and concept did not originate in Brussels but was a result of successful policy exchange and networking between different MS in the EU including regional districts (EnEffect, n.d). BatEx was launched in 2007 and had two primary objectives. One was to rapidly produce a critical mass of replicable energy efficient buildings as examples to aspire and with the purpose of stimulating the demand for low energy buildings (Standen, 2013). The second objective was to encourage the supply of energy efficient buildings and eco-construction by pushing the building industry to developing and constructing more low energy buildings in order for the market to be able to meet the demand. Furthermore, the BatEx program provides

financial subsidies to buildings meeting the requirements of exemplary energy performance (Standen, 2013). Since 2007, there have been 4 annual calls for proposals by BatEx and 192 of 294 were approved. The financed projects equivocate to approximately 470,000m^2 and of that 250,000m^2 are completely passive (EnEffect, n.d). Furthermore, every year the BatEx application goals improve and become more ambitious. For example, 63% of the approved applicant projects were fully passive in 2009 while only 21% were in 2007 and 2008. Each new edition of the BatEx proposals, the requirements are reviewed and improved for the next edition and allows for a lessons learned system that encourages applicants to fulfil higher performance projects (EnEffect, n.d). The BatEx program duration was planned to be between 2007 to 2014 and contain a budget of 45€ million (EnEffect, n.d). Further, the projects that are approved for construction are awarded a subsidy of 100€/m^2. The subsidy is divided between the contract authority and the developer which equivocates to 90€/m^2 and 10€/m^2, respectively (EnEffect, n.d). In order to be eligible for the BatEx program, it must be located in Brussels-Capital region. However, the program is flexible to both new and existing buildings and projects can include: dwellings such as housing and apartments, schools, educational facilities, childcare facilities, health care buildings, commercial offices, and sports facilities (Standen, 2013). There is also prerequisites for project funding. The approved projects will demonstrate energy and environmental performance that exhibit simple, realistic, and cost effective technical solutions that are replicable in the future. Also, environmental impacts and energy performance including low impact material and life cycle assessments should adequately addressed. Last, the exemplar buildings should aspire to zero net energy buildings and have high architectural quality (Standen, 2013). Projects that are funded will then be reviewed by external technical experts and a jury who assess the applications against the mentioned prerequisites (Standen, 2013). Once the

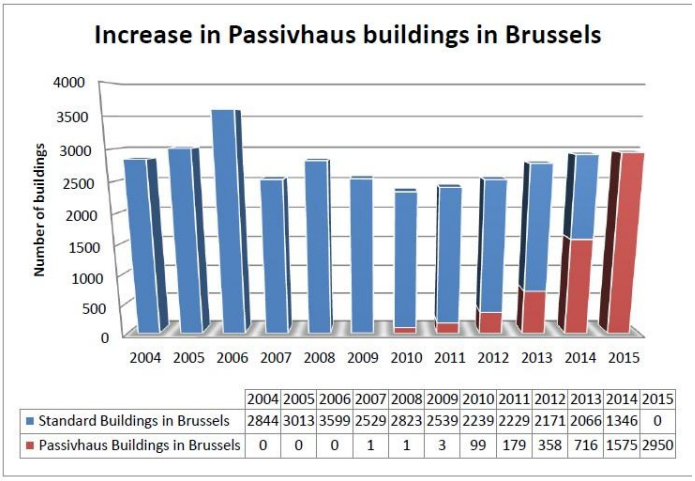
project has been approved there will be a contract that will be signed by the project and Brussels Environment which states the required commitments. Projects should be completed in 4 years and must submit regular reports on the energy consumption for 5 years following the completion of the building. Upon completion, buildings will be evaluated for the quality of implementation and then pending approval will be deemed exemplary buildings (Standen, 2013). Figure 4.2 demonstrates a map depicting various Passivhaus projects located in different areas of Brussels-Capital (Standen, 2013).

Figure 4.2 Passive House Projects in Brussels source:(Standen, 2013)



Overall, the main objective of the BatEx program is to leverage all projects in order to encourage the concept of eco-construction and how it can contribute in transforming cities one building at a time (EnEffect, n.d). By 2012, energy consumption per person decreased by 17% which Brussels' stated was a result of the BatEx program (Standen, 2013). Figure 4.3 demonstrates a comparison between 2004 and 2015 with reference to the amount of passive house buildings.

Figure 4.3 Passive House Buildings vs Standard Buildings in Brussels source:(Standen, 2013)



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Standard Buildings in Brussels	2844	3013	3599	2529	2823	2539	2239	2229	2171	2066	1346	0
Passivhaus Buildings in Brussels	0	0	0	1	1	3	99	179	358	716	1575	2950

Figure 5 Number of Passivhaus projects in Brussels

2004 is prior to the BatEx program and 2015is commencement of the passive house law. As the financial programs become more prevalent, there is a substantial increase in passive house buildings (Standen, 2013).

- **The BatEx financial program was essential to the success of the passivehouse law in Brussels. BatEx lead Brussels to a significant growth in the amount of constructed passivehouse buildings.**

4.1.2.2 Free Professional Advice and Communication:

Appointment of Master Architect and Professional Advisors

One of the key elements of the passive house law and the exemplary building program was the appointment of a Master Architect as well as a network of expert advisors. These professionals are experts in different areas of sustainable development, work and assist on BatEx projects along with a design team (Standen, 2013). They provide free advice and best practice regarding the designs and implementation of passivehouse buildings. One of the major aims of the master architect and expert advisors is to circulate information that can be used on future

passivehouse buildings to the design teams (Standen, 2013). Furthermore, the advisors and master architect contribute in helping with energy audits, supervising new passivehouse building construction, assisting in forming energy strategies, and providing information on technology and suppliers (Standen, 2013). Aside from the master architect as a means for free professional advice, there are programs set up in Brussels such as the PMP and BEA as a means of communication, education, training, and professional advice.

- **The appointment of the master architect was a major element in the passivehouse law as it effectively ensured the quality of the building regarding the best methods and results.**

PMP (Plateforme Maison Passive)

Plateforme Maison Passive(PMP) is designed to promote energy efficient construction in Brussels Capital Region. This is mainly achieved through raising public awareness for the passive house law, offering consulting services in addition to a variety of professional development courses. PMP also participates in certifying passive buildings (EnEffect, n.d). One of PMP's major activities is the consultation of persons on passive buildings and this is done through various professional development courses such as summer internships designed for those with occupations in professional construction and passive building courses which can be beginner or advanced (EnEffect, n.d). In 2005 and 2007, PMP established training programs for designers and builders, respectively. Currently, those training programs include the majority of the building sector such as developers, contractors, investors, and property managers among others. This training program also encourages dialogue and training between contractors, investors, etc. Furthermore, PMP offers various passive house training courses that are

specifically tailored to the client which is necessary because clients in the private sector have different needs that clients in the tertiary sector (EnEffect, n.d). Not only does PMP tailor training based on clients interest but they also have training sessions regarding specific topics of passive buildings and encourage information exchanging between industries in order to start a dialogue between developers, architects, contractors, designers, craftsmen, etc. Lastly, PMP integrated higher education courses into the passive house training programs which contains different levels (EnEffect, n.d).

- **PMP was designed to increase public awareness and offer development courses regarding the passivehouse law which is critical to the successful implementation.**

Brussels Enterprise Agency (BEA)

The Brussels Enterprise Agency(BEA) was created in 2003 and it works to provide free and unbiased information in addition to consulting services to those that are trying to establish and start a business in Brussels. Also, in 2006, the BEA designed and created an eco-construction cluster known as Ecobuild Cluster which is an interface for businesses (EnEffect, n.d). It provides an umbrella organization for a diverse range of sustainable development and construction actors in Brussels. The cluster involves members in different categories such as: architecture firms, contractors, engineering and building services firms, partners, and property developers (EnEffect, n.d). The cluster also offers a variety of services including strategic networking, information sharing, best practice sharing, and promoting different enterprises (EnEffect, n.d).

- **BEA provides considerable support to projects involving green technologies and buildings, which are critically important for the passivehouse law.**

Therefore, Brussels BatEx subsidy programs along with free professional advice, communication and training resulted in the successful implementation of the passive house standard and law.

4.1.3 Failures: Member States Poland and Austria

4.1.3.1 Poland and Austria Failed to Transpose EPBD

Poland and Austria both failed to fully transpose the EPBD and as a result, the European Commission has referred both of them to the EU Court of Justice (European Commission, 2014). The directive stipulates that all member states must provide, for all buildings, minimum performance requirements in addition to requiring certification of buildings energy performance and ensuring regular inspections of systems such as air conditioning and heating. Another primary goal of the EPBD directive was to ensure that all buildings by 2021 were NZEB. Member States were required to have the directive fully transposed by July 9, 2012 and failing to do so resulted in a court referral (European Commission, 2014). The European Commission imposed a daily fine of €96, 720 and €39, 592 for Poland and Austria, respectively. The level of the fine is decided by the level of the infraction, considering the gravity, duration, and "n" factor, which is different between member states based on their GDP. After affirmative judgement, the fine is paid from that day until the directive is deemed to be transposed by the member state, but the final amount of the fine is decided by the Court (European Commission, 2014). Previously, the Commission, in 2012, sent both Austria and Poland a formal notice regarding transposing the directive followed by a reasoned opinion in 2013. However, both Austria and Poland had not made progress transposing the directive and it was considered incomplete. Major elements of the directive that were still not transposed in those MS were: measures pertaining to energy certificates, NZEB, and minimum performance requirements for buildings. Furthermore, the

Commission is investigating the circumstances in other Member States such as Slovenia, Italy, and Czech Republic to ensure complete transposition of the directive (European Commission, 2014).

Summary:

Currently, there have been no reports indicating the effectiveness of the financial penalties on Poland or Austria due to the failure to transpose the EPBD. However, it can be assessed that holding member states accountable, through financial penalties, for implementing proper measures and policies for improving energy efficiency in buildings will improve overall consideration for effective energy policies to improve building performance. Financial fines for not transposing the EPBD are not insignificant and could be enough to influence change.

4.1.3.2 Austria:

Austria's lack of progress with the recast EPBD that led to the failure could likely be due to both insufficient measures and policies on existing buildings and no clear indication of progress in NZEB targets.

According to Wolfgang Jilek, energy commissioner of Austria, existing buildings comprise 99 percent of Austria's buildings stock. Therefore, a substantial effort is required for existing buildings in order to raise the rates of renovation (Jilek, 2010). There are financial incentives for renovating existing buildings but come with special conditions and regulations pertaining to energy efficiency and the inclusion of renewable energy. Also, the roadmap to NZEB is in the process of negotiations and should be available in 2011 (Jilek, 2010).

According to experts, two thirds insist that throughout the last 3 years, there have been either a few policies introduced or little to no progress with policies. Also, almost 50 percent are assuming that the energy efficiency objectives will not be achieved (Egger, 2012). Experts state that although limited progress has been achieved with regards to building refurbishment, there is a general lack of commitment to renovate or retrofit buildings along with lack of funding. This is coupled with the major challenge of an increase in electricity consumption in the residential sector (Egger, 2012).

The recast EPBD states in Article 9, Paragraph 2 that Member States should follow the path of the public sector in the private sector and develop policies that will stimulate the transformation of buildings that are undergoing renovation into NZEB (Schimschar, 2013). Therefore, there should be transformation of refurbished buildings in the private and public sector into NZEB. In addition, Article 7 stipulates that Member States shall ensure that buildings undergoing significant renovation will meet the minimum energy performance requirements. It is important that the public sector is a leader and example for the transformation of existing buildings into NZEB (Schimschar, 2013). Any measure or policy created should provide information regarding the timeframe, implementation status, energy savings, and monitoring plan (Schimschar, 2013).

Some Member States have already reported various measures and policies for renovating and refurbishing existing buildings into NZEB such as Denmark, France , UK, among others. Furthermore, other Member States, such as Denmark and Ireland, have developed detailed building regulations for renovations in existing stock (European Commission, 2013). Although Austria acknowledges that existing buildings are of more importance due to the immense size of the existing stock, there have not been enough measure and policies supporting the refurbishment of the existing building stock into NZEB.

Also, Austria did not progress sufficiently with the EPBD directive objectives for NZEB. Austria contained no explicit policy targets that would demonstrate the proposed increase in the amount of NZEB. Further, Austria's energy strategy only considers NZEB as a focus for research and development and not as a primary objective or policy instrument (Hermelink, 2013). Austria's definition of NZEB is still in the development stages with the quality of the envelope the major reason that the definition does not fulfil the requirements of the EPBD. The roadmap for NZEB for 2021 is under development as well (Hermelink, 2013).

- **Austria's failure to meet the recast EPBD could be due to lack of existing building policies and no clear definition and objectives for meeting the NZEB plan.**

4.1.3.3 Poland

Poland failed the EPBD due to insufficient progress with energy certificates as well as no concrete definition or objectives for implementing NZEBs.

Poland had difficulty with the national calculation software for the certification process because only some companies provided the necessary tools for the calculation. And there were reports that there is no validation system for the software (Sowa, 2010). The calculation methodology is based on a monthly balance approach but it contains significant mistakes. The energy certificates that have been issued through this methodology result in major error and the buildings that have been assessed will not meet the requirements (Sowa, 2010). Experts are able to effectively correct mistakes, but this could lead to legal issues regarding the validity of the certification. There are measures in place with plans to change this methodology for the transposition of the recast EPBD. In addition, existing buildings require an energy certificate in the circumstance of

renting or selling, but because of lack of enforcement and penalties, there is only issuing when requested (Sowa, 2010).

Energy efficient policies are ranked low by the Polish experts as approximately 85 percent believe that ambition for energy efficient policies is low or only ambitious in some sectors and 76 percent insist that only a few new policies or even none have been introduced (Egger, 2012). One of the major issues which was established as the most substantial barrier was the lack or delay of energy efficient legislature and its implementation. The delay in legislature resulted in the absence of energy efficient law which would have been responsible for the introduction of White Certificates. There is also a lack of energy efficient action and awareness from various organizations and companies which is compounded by the fact that there is no national energy agency with the purpose of supporting the government in energy efficient policies (Egger, 2012). Also, the experts verified that the energy performance certificates impact was much lower than anticipated. Another improvement to be discussed is financial aid and funding in energy efficient policies as that is also viewed as significant barrier to success (Egger, 2012).

In the 2013 NZEB report, it was stated that Poland still contained a problem with the calculation method. There were certificates with substantial errors and legal issues regarding certification validity (Hermelink, 2013). Further, it was reported that there were 20 errors in the energy certification methodology, in which 3 can be corrected by various experts but still causes legal invalidity. So there was no quality control procedures or no regulations pertaining to the number of nationally issued energy certificates (Hermelink, 2013). Also, no requirements exist for organizations that offer training courses that qualify experts that issue energy certificates for buildings (Hermelink, 2013).

Lastly, Poland has not yet defined NZEB performance standard. The research centre is currently discussing the national definition. And the NZEB road map to meet the requirements of 2019 and 2021 is not available (Hermelink, 2013).

- **Poland likely failed to proceed in the transposition of the recast EPBD due to lack of progress in energy certificate processes and no definition and planned goals for reaching the NZEB objective in the recast EPBD.**

Summary:

Both Poland and Austria failed to fully transpose the recast EPBD and in turn are financially penalized and referred to court. Both member states did not progress sufficiently with the NZEB objectives.

4.1.4 Lessons from Progressive EU

This section explains various lessons attributed from the successes and failures from various MS on the EU recast EPBD directive.

4.1.4.1. Country Collaboration

Energy Cities

Energy Cities is a initiative created by the EU that's purpose is to support local governments through supporting sustainable energy plans, provide a forum that allows for the exchange of ideas for energy efficiency and sustainability, and to influence policy making (EnEffect, n.d).Brussels BatEx financial subsidy program was instrumental for the successful implementation of the Passive House standard and was a direct result of the exchanging best practices cross regionally, through Energy Cities. Energy Cities displays various methods and

practices for sharing and learning from member cities and member states to support energy transition (EnEffect, n.d).

Concerted Action Plan for EPBD

In addition to the Energy Cities, the EU implemented a concerted action plan for the EPBD (CA EPBD). The major objective of the CA EPBD is to assist the member states in transposing and implementing the legislation by encouraging dialogue and the exchanging and sharing of information and experiences including best practices. In addition, the CA EPBD aims to help member states with meeting the goals and objectives outlined in the EPBD by providing annual results, including strengths and weaknesses of various approaches, and lessons learned (CA EPBD, 2013). Articles 11, 12, and 13 of the recast EPBD deal with energy performance certificates(EPC) and the CA EPBD states that database centered systems are needed to manage EPC. The databases for EPC's contain information that will contribute in preventing fraud while allowing data transparency by demonstrating improvement processes and monitoring implementation of recommendations, which provide feedback on monitoring procedures as well as implementation measures to improve building performance. This will help in supporting the consumer trust in EPC's (CA EPBD, 2013). Article 14, 15, and 16 of the recast EPBD are related to the inspection of heating and air conditioning systems and the CA EPBD identified actions and areas of investigation that could assist MS in developing a more successful and effective approach for inspection and advice. The CA EPBD suggested the check list methodology as a way to improve inspection, starting at a simple level and moving into more complex issues. Also, it is important to encourage building owners to investigate and take action on the various recommendations in the inspection reports. In addition, the CA EPBD states that it is necessary

to evaluate the different methods in order to understand and quantify the benefits of inspection especially with regards to cost effectiveness and value for money (CA EPBD, 2013).

Next, the CA EPBD discussed the issues of training experts which is closely related and tied into article 17 of the recast EPBD by organizing several meetings between representatives of the EU member states. The participants investigated the positives and negatives within the training of qualified experts(QE) for inspection reports and for issuing EPCs. It was identified that after completing university many students do not pass the test to become an official expert and so each MS should establish new requirements including education level, experience, and continual professional development for all QE (CA EPBD, 2013). In addition, the CA EPBD states that qualified experts must understand and become familiar with NZEB requirements and systems and include design appropriate courses for the training of qualified experts. It was agreed that there is substantial room for improvement for the training of QE and their skills and knowledge (CA EPBD, 2013).

The CA EPBD also brings MS together to discuss best practices for the move towards NZEB by 2020 outlined in Article 9 of the recast EPBD. The EPBD concerted action for NZEB revolves around supporting MS by sharing and exchanging experiences with already high performance buildings (ECEEE, 2014). These high performance buildings could range between passive houses to zero energy buildings to even energy positive buildings. The discussion topics include: common building system solutions, subsidies and incentives, and calculation methods (ECEEE, 2014). Also, the different MS definitions of NZEB, through national applications, are compared and evaluated in order to provide feedback and motivation. This information exchange allows MS to support each other in increasing the development and growth of NZEB (ECEEE, 2014).

Summary:

The CA EPBD and Energy Cities provides the EU MS with country collaboration which can be an essential tool for improving the success of energy efficient policy implementation in buildings in Europe.

4.1.4.2 Strong Political Leadership

Political support was essential to the success of the Passive House law and standard in Brussels. The regional government's political commitment to energy efficient policymaking is the reason for the rapid improvement. Regional governments can share responsibility with the federal governments on certain issues including environmental. 2004 signifies the first year that energy concerns were objectives on the region's policy agenda because a new government came into office (EnEffect, n.d). Evelyne Huytebroeck, is a environmental activist and has supported sustainability and a greener region for Brussels (Standen, 2013). Furthermore, she was the main political representative and catalyst responsible for the implementation of the passive house law and standard in Brussels and ensured that it remained a primary part of the political policies.

The political commitment level was extensive and without that level the passive house law might not have caught traction to become widespread (EnEffect, n.d). Evidently, due to lack of implemented policies in both Austria and Poland, it can be assumed that strong political leadership with regards to energy efficiency in buildings was not influential. Political leadership could have played an influential role in Austria and Poland for the implementation of the EPBD at it been prevalent. Political will could have been a significant element in ensuring success, as evidenced by the Brussels example of passivehouse law. Both MS failed to transpose the recast

EPBD even after the EU sent letters of reasoned opinion regarding lack of progress in transposing the directive.

4.1.4.3 Accountability:

As demonstrated in section 4.1.3, member states such as Poland and Austria that failed to fully transpose the recast EPBD were referred to court and financially penalized. This creates a level of accountability for all MS of the EU to fully commit to an aggressive energy efficient policy to execute low energy buildings. Further, there is an increase in the sense of urgency and importance for each member states to fully transpose the recast EPBD directive as those that fail to achieve that status are financially burdened. Without the financial accountability, there would likely be less importance placed on implementing policies and programs to improve energy efficiency in buildings.

4.1.4.4 Financial Subsides and Incentives:

The implementation of BatEx in Brussels was a significant financial subsidy program, previously explained in section 4.1.2. The duration of this program was planned from 2007-2014 with a budget of €45 million. This incentive program was heavily subsidized and was essential to transforming Brussels into a passive house nation. As demonstrated by Figure 4.3, financial subsidies continued to increase the number of passive houses in Brussels and by 2015 Brussels will be completely passive. This was one of the major reasons for Brussels success in the passive house law.

4.1.4.5 Existing Buildings:

Recast EPBD Article 9 Paragraph 2 declares that MS must develop policies and take appropriate measures for the purpose of transforming refurbished buildings into NZEB (EPC, 2010). As explained in Section 4.1.3, Austria did not sufficiently implement policies toward transforming refurbished buildings into NZEB and this could have likely been one of the major reasons for failure. However, Brussels did promote existing stock and statistics demonstrated that by 2010, 35% of the BatEx program funds were related to retrofits (EnEffect, n.d). The focus of the directive is not just on new buildings but also on existing buildings. EU considered existing buildings as an important component of the recast EPBD legislation.

5.1.4.6 Free Professional and Expert Advice:

Brussels benefitted from various programs that offered free communication and advice that would assist in the BatEx projects along with other programs aims to improve communication, education, and training. Refer to section 4.1.2.2 for a detailed description.

Summary:

The lessons from the EU can be used as a tool or guidance for the Ontario system for achieving more aggressive energy efficient RBCs. Although the EU was investigated in this policy analysis, North America has also had success with the implementation of zero net energy(ZNE) which could provide effective lessons for Ontario. However, this will not be further discussed in this study.

4.1.5 Application EU Success to Ontario:

Although not all the lessons from the EU can be effectively applied to the Ontario context and system, different variations of the examples above could be beneficial. For example, currently, as

demonstrated from Section 2.2, Ontario does not consider accountability from the building industry for the current performance level of the OBC. The widespread use of SB-12 prescriptive requirements does not guarantee that residential buildings performs to the EG 80 building code. Mandatory blower door test s however, would be one major step to ensuring the performance level was achieved and would hold builders accountable. Also, the OBC is not retroactive to existing buildings. The EU directive demonstrates that measures and policies shall be demonstrated in order to transform existing buildings into low energy buildings. Ontario's existing building stock could benefit from effective policies that strive to reduce the overall energy consumption and increase the performance level to the building code for new homes. Currently, there are not enough of these type of policies. Political support and leadership was critical in the adoption of Ontario's EG 80 building code. Political will is going to be necessary for Ontario in order to successfully implement more aggressive policies for residential building codes. Austria and Poland demonstrated to be examples of member states with a lack of political will to ensure the EPBD and NZEB policies were implemented successfully. As a result both were fined and must appear in court. Therefore, Ontario could learn the importance of political leadership through the failures of Poland and Austria. Ontario does have a number of various financial subsidies and incentives that are offered from utilities and the government for higher performance residential buildings. However, none have been even close to as successful as the BatEx program in Brussels. Ontario's priority towards funding energy efficiency in buildings is much less than that of the EU. However, Ontario could pilot a program that offers substantial subsidies and view the overall benefits to determine continuation. Therefore, Ontario could likely benefit from using different variations of the policies used in Brussels.

4.2 Method Section 2- Semi Structured Interviews:

The interview results in the following sections will be put into themes based on the questions in Appendix A. Full interviewee transcripts are attached in Appendix B.

4.2.1 Questions 1-3: Previous Implementation of EE Standards and Codes

Purpose:

Demonstrates the background of previous energy efficient standards: The first is the current BC standard as of 2012 and is EG80. The second is a voluntary program known as R-2000 and exemplifies a passive house or better than code built building. Understanding the successes and challenges to the implementation of these standards will contribute in knowing what has been done that is beneficial to implementation and what aspects have been challenging. It will also contribute in understanding possible policies that will/could help in allowing for more aggressive ee in RBC that can be implemented currently.

Michael Lio, of "buildABILITY", stated that all codes are reference to explicit objectives and that previous codes have been based on a least cost calculus that had to do with capital and operating cost. In addition, the Provincial government is in charge of creating building regulations and codes and this is done through: measuring operating costs, forecasting energy prices, and choosing a measure of least cost to build into the code. Energuide80(EG80) was adopted by the MMAH as part of the 2012 code (Lio, 2015). Heather Black from the MMAH, stated that the residential building code prior to 2006 contained little energy efficiency objectives and minimal insulation requirements. But the 2006 building code brought Ontario the SB-12, which was Ontario's first energy code (Black, 2015). Corey McBurney, President of Enerquality, stated that energy efficiency was not considered a core objective in the building code(BC) and therefore the goal was not to increase energy efficiency. But that changed in the 2006 BC and as of Jan 1/2012(2006 code that took effect Jan 2012), energy efficiency became a core objective through the EG80 building code for Part 9 housing. And Energuide is the rating scale designed by federal government NRCan. It is the Energuide rating system(ERS) that establishes the relative energy efficiency of homes and 80 by its own definition is considered an energy efficient home (McBurney, 2015). Mike Parkes, Policy Analyst of the Environmental Commissioner of

Ontario(ECO), claims that the GEA 2009 played an important role for EG80 and other energy standards because it amended the BCA(building code act) and made two major changes: the first being requiring the creation of the building code energy advisory council. The second was the requirement for the immediate review of the energy provisions in the code and then requirement for ongoing review of the energy provision that every 5 years (Parkes, 2015). Pauline Lip of Ontario's Home Builders Association(OHBA) states that the current EG80 derived from the R-2000 inception. R-2000 in 1980s, when it first launched, started the best in class high performance home. But it took approximately 30 years since the start of R-2000 to the adoption of the EG80 code (Lip, 2015). Peter Love, of Love Energy Consultants, states that the building code was designed for health and safety and it was not until Bob Rae's government in the early 1980's and the environment minister Ruth Grier that energy efficiency was considered in the OBC (Love, 2015). Greg Labbe of Blue Green Consulting Group Inc., declares that the r-2000 inception was EG80 until 2006 when it increased along with the building code and Energystar to EG85. Prior to 2012, Part 12 of BC, "resource energy conservation", was a voluntary standard but after it was no longer voluntary and the language from part 12 was used and added part 9, which states that a residential homes must be EG80 (Labbe, 2015). Stephen Pope of Pope Sustainability Consulting, stats each province develops it's own building regulations and codes and to assist with consistency, the federal government prepared a National Model Code(NBC) (Pope, 2015).

Voluntary Standards and Adequate Lead Time

Lip, Bob Bach, Labbe, and Pope (2015), all state that the inception of R-2000 was EG80 and is currently the regulated BC in Ontario. The R-2000 standard is an example of a voluntary program leading to a code because the current EG80 uses many of the same mechanical systems

and knowledge from r-2000. And Bach explains that one of the major changes that the r-2000 brought to the OBC and EG80 was the requirements for a vapour barrier (Bach, 2015). However, McBurney continues that the r-2000 program was a technical program and was a higher standard compared to prevailing BCs. It was not intended to be friendly for large scale builders and was always meant as a demonstration project (McBurney, 2015). Further, Bach claims that one of the major challenges is implementing aggressive energy efficient BCs from the time of demonstration. One example is the lack of training at that stage, especially with regards to the trades such as electricians and plumbing. At the time of r-2000's inception in the 1980's, electricians and plumbers were unknowingly damaging the vapour and air barrier. And when the vapour barrier became part of the 1991 BC, there were still issues ensuring it was completely sealed (Bach, 2015).

Black explains that there was a rushed implementation period for codifying NFHBI, which lead to the standard becoming implemented much later than anticipated. This standard was decided upon quickly and abruptly without adequate lead time and could not be implemented in time because there was not enough building and market capacity, technical background, or stakeholder consultation and as a result would likely lead to moisture in the walls and other structural issues. Therefore, in order to successfully implement aggressive codes, there should be adequate lead time. This was evident in the EG80 code implementation (Black, 2015). Lio agrees, to ensure that EG80 would enter the market as the new building code seamlessly, there had to be adequate lead time. Lio further states that providing adequate lead time was achieved through Energystar voluntary program that, during the time between 2006 and 2012, had builders constructing EG80 houses in anticipation of the new code requirement (Lio, 2015).

Frances Martin-DiGiuseppe, of Q4 Architects Inc, continues, mentioning that some builders prior to the EG80 code, were going above and beyond the OBC, such as Energystar (Martin-DiGiuseppe, 2015). And when EG80 became the new building code, it was effortless to gain acceptance because many builders already achieved it and trades were trained to understand that level, so there was wide acceptance in the industry. The adequate lead time was a major reason for the successful implementation of EG80 (Martin-DiGiuseppe, 2015).

Black, McBurney, Lip, and Love (2015), all agree the voluntary standards, such as Energystar and r-2000, are a major reason for the successful implementation of EG80 in 2012. McBurney claims that Enerquality creates voluntary programs such as Energystar and works with consultants, manufacturers, builders, technical firms, and gas utilities to voluntarily build better than code in order to understand the components of higher performance houses in anticipation of a new energy code (McBurney, 2015). Love states that required equipment and technology, such as a condensing gas boilers, for aggressive standards, such as the 1980's r-2000, was not readily available on the market and it was expensive and costly. But voluntary codes such as Energystar and progression of r-2000 contributed in reducing the costs of technology and materials because they were being more commonly used by builders. This is an example of how voluntary programs get new technologies into the market (Love, 2015).

Pope argues that although it took years for EG80 to become a regulated code, the delay was necessary in order to generate enough evidence to ensure builders could effectively reach that performance level (Pope, 2015).

SB-12 and Compliance

Black states that the development of the SB-12 lead to the successful implementation of EG80. Stakeholders argued that the costs and availability in Ontario of blower door tests, required in order to receive an EG rating, were causing issues and problems and did not want compliance of the standard to only be measured through performance, so the MMAH figured out prescriptive requirements for EG80 in Part 9 of the OBC and it resulted in SB-12 (Black, 2015). Labbe agrees that SB-12 played a major role in the successful implementation of EG80 (Labbe, 2015).

However, Peter Love and Mike Parkes (2015) insist that a major weakness in the EG80 standard is in the SB-12 prescriptive compliance packages. The issue is that without BDTs and performance tests, the prescriptive compliance packages do not guarantee that the home will be at the EG80 level(Parkes, 2015). One reason is that the building official cannot effectively ensure the house is performing at EG80 (Love, 2015). Matthew Brown, of Q4 Architects Inc., and Bach, 2015 agree and declare that builders following the prescriptive requirements are exempt from a BDT and therefore compliance is unknown. Labbe concurs and states that a vast majority of builders opted to use the SB-12 instead of the performance measuring and energy modeling. Therefore, compliance is a major issue in the OBC (Labbe, 2015).

Political Will and Leadership

Black believes that strong political leadership was a significant contributor. Minister John Gerretsen, of the Liberal Party, and the Ontario Government strived for increased energy efficiency and requested the MMAH produce a level that pushed the envelope, so EG80 was delivered to be the 2012 code (Black, 2015). Love continues that John Gerretsen announced EG80 as the new 2012 code even though his political staff heavily advised against such

aggressive action. One of the decisions that lead to the political support was that EG80 was being achieved voluntarily by many builders, through Energystar, and it was recognized that it was an attainable objective as an aggressive code (Love, 2015). Labbe also claims the success of the EG80 in the BC is in part due to the formation of the GEA through Dalton McGuinty's government and Kathleen Wynne of the MMAH (Labbe, 2015). However, Pope argues that politics is currently a weakness with regards to implementing aggressive building codes. And in the current political circumstance, there is no willingness to do that at any level (Pope, 2015).

Lobby Groups

Martin-DiGiuseppe states that the lobby groups such as home building organizations were able to resist the push towards more aggressive standards such as EG80. There are powerful lobby groups that support their members so they are able to slow down aggressive actions in the OBC (Martin-DiGiuseppe, 2015). The major issue with mandating aggressive codes is the resistance from these lobby groups, especially if there are additional costs. And the R-2000 program is an example of this as it struggled because of the mandatory BDT, which was a compulsory testing component of the program and was expensive (Martin-DiGiuseppe, 2015). Brown agrees adding that lobby groups were responsible for pushing the OBC from r-20 walls back down to r-12 and prevented a movement from 2x4 timber frames to 2x6 timber frames with added insulation (Brown, 2015). Furthermore, Pope states that there was a strong reaction from the CHBA to the introduction of the MNEC for residential homes. The Canadian Home Builders Association (CHBA) has a significant and influential lobby group that argued EG80 is aggressive enough. The CHBA is a national group and the federal government pays attention (Pope, 2015). Labbe explains that lobbying was detrimental to the Green Energy Act legislation requiring that every home sold in Ontario must have an energy audit that displays the EG rating.

It was never enacted due to the real estate lobby groups as the provincial government backed off in order to reassess the situation (Labbe, 2015).

Existing Buildings

Love and McBurney (2015), argue that a major deficiency of OBC is that there is no consideration for the existing building stock, which is an issue as new buildings only account for 1.5% of the stock each year. There is no code or policy forcing houses built in or prior to the 1970s or 1990s, to undergo a major energy retrofit. Brown ,also expresses that it is important to bring existing buildings up to code. It would be a significant accomplishment to mandate that all homes have to be brought up to the building code (Brown, 2015).

Training

Black states that there is no mandatory training for builders in energy efficiency. The requirement is a degree and certification but there is no other mandatory training required for higher performance buildings. Enerquality is a voluntary training program for builders and consists of 1-3 days of training for energy efficient buildings (Black, 2015). Parkes argues that although there is no mandatory training, Ontario was successful in getting the homebuilders association and the building officials association involved and collaborative, where both organizations had training for their members so builders knew how to build to meet the new standards and inspectors knew what to assess to determine compliance of the new EG80 code (Parkes, 2015). Brydon, of Cricket Energy Inc, claims that in carpenter trades and union, they have initial training requirements, and apprentice requirements, but no continuing education. There is no requirement to go back and learn the latest training advances especially in energy efficiency (Brydon, 2015). Bach previously mentioned the issue of trades such as electricians

and plumbers destroying the air and vapour barriers not understanding that it compromises the insulation and energy efficiency of the building (Bach, 2015).

Summary:

- Adequate lead time demonstrated to be an essential component to success of the EG80 implementation and should be provided to better ensure the success of future aggressive codes.
- SB-12 is used by a majority of builders but does not guarantee compliance as there is no requirement for a BDT.
- In the past, strong political will and leadership was critical to the implementation of aggressive codes. Currently, political willingness to implement aggressive energy efficient codes in Ontario is seen as relatively weak.
- Lobby groups have be able to slow down aggressive action and done that in the past. The government is influenced by these lobby groups.
- No policies to force the existing building stock into energy efficient renovations.
- There is no mandatory training programs or requirements for the building industry to learn the latest advances in energy efficiency for buildings. There have been issues as a result of lack of continuing education and training.

4.2.2 Question 4 and 8: What kinds of policies(procedures and protocols) could improve the implementation speed and success of more aggressive building codes in Ontario? AND How to encourage market speed?

Purpose:

This question will provide an analysis of what policies experts believe could be most important and substantial to implementing the most rapid and aggressive ee RBC while still being successful. Also, this question investigates what can be done to encourage the market to move

faster. Further it analyzes what policies/programs could contribute in making the market move faster with regards to implementing aggressive RBCs. This is currently one of the major barriers into speeding up the rate and success of implementing aggressive ee RBC and so policies that can be enhanced to help solve this would be a substantial improvement and major part of the solution.

Voluntary Code Alignment:

Lio described that the major development to improve the implementation speed and success of more aggressive BCs in Ontario is to ensure that voluntary programs align to the new code level because this will allow for a more seamless transition from voluntary programs to regulated codes. This is currently a problem as no voluntary program is considering this potential issue. For example, the 2017 building code is a 15% reduction in energy consumption, therefore if some current voluntary programs were 15% better than code level, this would allow builders get an opportunity to understand how to accomplish the reduction and get some recognition that they are able to achieve the future code level early and this has not happened. Instead, the training component for builders in voluntary standards is misaligned with the future edition of the code.

In 2006, when EG80 was signaled for 2012, there was a seamless transition because energy star's voluntary program was the same energy performance level as the upcoming code. The current Energystar is 25% better than code, but the new building code is only 15% better so there is more energy efficiency than required for the new code. When the 2017 building code comes into effect, Energystar homes will have been 25% better so there will be a misalignment because many builders now know how to build 25% better than code and not 15%. This will create a problem in the transition period of the new code instead of a seamless transition. The primary reason is that the goals of the provincial and federal governments differ. The federal government is responsible for the Energystar voluntary program and contributing in setting up the new

energy targets for these voluntary programs while the provincial government is responsible for establishing the building code. So there is currently a disconnect between the two governments (Lio, 2015).

Bach further argues that voluntary programs through Union Gas, Ontario Power Authority(OPA), and Enbridge, should be in sync with the building code in terms of timing. These programs used to be on 1 year cycles and now they are on 5 year cycles but still misaligned with the OBC (Bach, 2015). Currently, the programs commence January 1, 2016 and the code changes January 1, 2017. Aligning the two would create collaboration between the building code and the programs and so the programs and the new code would launch and the programs would move builders up to the next code, through their incentives (Bach, 2015).

In addition, Brydon claims that there should also be alignment with component efficiencies. This is because NRCan, for example, is able to change their window rating system mid-code and program cycle, which is difficult for builders (Brydon, 2015). Ideally, there should be the building code change aligned with the commencement of new programs released by the OEB through Enbridge and Union Gas , aligned with changes in energy efficient requirements of component efficiencies such as furnaces, windows, and water heaters (Brydon, 2015). Singleton, of Sustainable Buildings Canada, shares a similar view as Bach and Brydon. that alignment is necessary so that greater discussions between the code designers, code officials, and the utility programs from the OEB so that all parties understand what the code is trying to achieve, what the program is trying to achieve as a leadership program, and ensure that all the metrics line up (Singleton, 2015). More detailed response in Question 7.

Mandatory Home Energy Audits(prior to sale and resale):

McBurney claims another policy that could contribute to reduced emissions in buildings is mandatory home audits(MHA) and energy performance labeling (McBurney, 2015). Black, Brydon, Labbe, Lip, Love, Parkes, Pope (2015), agree that MHA would be beneficial. McBurney continues, stating that the GEA and minister George Smitherman has on books that all homes on resale would have to have a minimum energy performance audit, which would provide an Energuide rating. This was the plan, and was just never enacted. By enacting this objective it could also imply that every home within 2 years must undergo an energy retrofit, which would improve the existing building stock (McBurney, 2015). Labbe supports the claim that MHA were never enacted by the GEA (Labbe, 2015). Love agrees the GEA considered mandatory labeling for residential buildings, but it was never regulated because when the minister of energy(MOE) presented the idea, it was not well received by the public, especially real estate agents (Love, 2015). Bach claims that there was a cost of $200-$300 to receive a MHA, in which real estate agents opposed (Bach, 2015).

Parkes adds that although there was provincial interest in MHA, it has been delayed because the federal government has not yet updated the future labeling system so the province did not want to mandate this under the old EG rating system if it is going to be altered in upcoming years (Parkes, 2015). Black insists that requiring mandatory house audits could improve energy efficiency in RBCs. This would ensure that all new houses had energy display certificates, which could encourage owners of existing homes to get one before resale in order to stay competitive (Black, 2015).

Love also considers the possibility that MHA could contribute to the challenge of existing buildings in the OBC through encouraging the owners of existing inefficient homes to improve the efficiency in order to be competitive with new and efficient homes (Love, 2015). Parkes

concurs that mandatory home labeling, using an EG rating, would contribute in pushing higher energy efficient requirements for new and existing homes because consumers would be able to see the difference in performance that new code built houses would be compared to existing homes and evaluate the energy costs savings they would receive from lower utility bills (Parkes, 2015). So the consumer would be more informed. Because this is not happening, consumer education in this respect is weak and could be improved through mandatory energy labeling through buyers being able to compare energy ratings and values of the houses. In the case of existing buildings, a lower score would likely be a disincentive for a homebuyer and it could encourage the sellers to retrofit before resale (Parkes, 2015).

Brydon contributes that MHA will not only effect the existing building sector, it will force new construction to ensure a better performing and quality home as it would demonstrate to homebuyers that energy performance exists for homes. Therefore, consumer education could improve (Brydon, 2015). Lip further discusses the opinion of Parkes and Brydon and that mandatory home labeling could contribute in increasing energy literacy. There is education and training components on both the consumer and industry ends, and in the past 40 years, energy literacy has increased, but not to an optimal level (Lip, 2015). This is because the real-estate market is slowed and the consumer focus is not on energy consumption but instead the bidding wars and selling the house. Part of the introduction of the EG rating system was to increase energy literacy in Canada and it was not as successful as NRCan anticipated and there are plans to change the rating system to a G/J scale, which is an easily comparable metric in contrast to EG (Lip, 2015). Labbe also agrees that MHA at time or sale and resale could assist in the issue of energy literacy amongst Canadians. Mandatory energy audits could make homeowners more

aware of energy efficiency and the savings. Consumer education and awareness is poor in Ontario and energy audits could begin to get homebuyers interested (Labbe, 2015).

Love states the mandatory labeling program could be designed in 3 stages: one, all new homes, two, any home being sold, and three, all homes. This could contribute with the challenge of existing buildings in the OBC through encouraging the owners of existing inefficient homes to improve the efficiency in order to be competitive with new and efficient homes (Love, 2015). Pope insists mandatory energy audits and labeling could be a helpful program but was deleted from the GEA after there was provincial and municipal resistance, so it is a difficult achievement (Love, 2015).

Mandatory Blower Door Tests:

Love encourages the use of mandatory blower door test(BDT) to measure the performance of air tightness of the home and a thermography test to demonstrate the heat losses in the home in order to ensure effective insulation and identify significant air leakage paths. Both of these tests could contribute in measuring the performance and compliance of the home to the EG80 code and future editions (Love, 2015).

Labbe states there should be requirements for two mandatory BDT. One will be prior to installing the drywall and the other will be post drywall stage. The idea is to test the air barrier when it is exposed, so if there is a problem, it can be easily fixed. Then a test after the drywall. Pre dry wall will give builders the chance and time to understand the possible errors in the building methods (Labbe, 2015).

Parkes agrees that mandatory BDTs is important in ensuring compliance in the OBC and could contribute to more aggressive RBCs. A policy could be designed where initially the results of the

BDT would not be used to test the buildings performance and it wouldn't be used as a method of compliance, but it will after 5 years (Parkes, 2015). The code assumes that there are 2.5 air changes, so anything above that will demonstrate to builders what needs to be changed and altered to get 2.5 or better air changes. Builders today would be able to see their rank on that scale and whether they need training to reach the levels that the code will require (Parkes, 2015). Labbe adds that the code should gradually increase the requirements for the air leakage test. Therefore, if this was phased into the 2017 code, it might start as 2.5 air changes and then it should gradually decrease in each subsequent code cycle (Labbe, 2015). Brown further argues that air barrier tests and BDT should be made mandatory in the OBC and should be attended by personnel in building science and building inspectors to ensure effectiveness (Brown, 2015).

Carbon Pricing:

Parkes states another policy that could influence more aggressive RBC's is carbon pricing on consumers energy use. This would raise the price of natural gas and electricity consumption and therefore would increase the difference in operating costs between well built buildings and older more inefficient buildings. The more energy the house requires, the higher the cost (Parkes, 2015). Labbe agrees that an effective policy could be to inflict the true cost of energy on consumers utility bills. This would be the full cost of natural gas and electricity including the remediation of the affected fossil fuel. This could be achieved through a carbon tax. British Columbia and Quebec have a carbon tax but Ontario does not. Also implementing a carbon tax or pricing could increase consumer awareness in energy efficiency because well built homes will require less fossil fuel energy (Labbe, 2015). Brydon supports carbon pricing to ensure all consumers pay the full cost of energy from extraction to transmission through to demand side. There could be a policy in the area of increased fuel costs (Brydon, 2015). Love suggests that the

government could use the finances from this program, which would be the tax received for the emissions, to subsidize energy efficient programs for residential buildings and possibly start and better finance a new ZNE program (Love, 2015).

Financial Subsidies and Tax Breaks:

Love suggests financial subsidies for builders could be useful, especially for those builders going beyond the performance of the building code. Specifically, there should be larger financial subsidies for those builders that are building, not 5-10 ZNE homes per year, but 100's per year as that could significantly increase the time in which ZNE homes can be the new code and standard. The incentive program would need to offer builders 20% rebate to offset some of the capital costs (Love, 2015). Further, Brown indicates that because the government is pushing forward with more aggressive energy codes, there should be financial subsidies and breaks for builders that exceed them because there will be less fossil fuel and GHG emissions as a result of the buildings (Brown, 2015).

McBurney agrees and states another important policy piece is aiming to get the municipalities involved and supporting the building industry. This could be done through offering builders cash incentives, in the form of rebates on development charges, to build to a higher standard. Toronto is currently participating in a program that offers these rebates and the design is as follows: tier 1- normal no rebate, tier 2- voluntary and receives 20-25% rebate on your development charges. Providing incentives through DCs is something the government can do for the industry to show support for energy efficiency (McBurney, 2015). However, Brydon argues that there has not been significant reception of the program because there is not a lot of single family residential subdivisions in Toronto, which is the programs aim. If there could be an extension of the that

kind of program to the province, or if the province adopted it, there would be an increase in uptake (Brydon, 2015).

McBurney explains that one issue for trying to speed up aggressive RBCs is that there is no cash incentives for homebuyers of new homes, which means there is no incentive to consider energy efficiency and therefore, there should be a cash incentive for consumers that buy and ES or higher performance home (McBurney, 2015). Brown insists tax breaks could be beneficial in to motivating consumers to buy energy efficient homes and so at certain levels there would be a break on your taxes and the more energy efficient, the greater the tax break. This tax break could be done through the RSP(retirement savings plan) (Brown, 2015). Labbe states "The Home Energy Loan" (HEL) program in Toronto allows the homeowner to borrow money, which will then show up on the tax bill to make energy efficient retrofitting or re-insulation, but the program has only attracted 0.5% of the population (Labbe, 2015). Lip argues that a tax credit program could help the existing buildings match the current building code of EG80, but because there is no mandatory home labeling presently, there is no indication where existing buildings lie compared to newly constructed homes(Lip, 2015).

However, Bach believes the main issue for consumers with getting too aggressive in the OBC is affordability. Black agrees with this argument. This is an underlying issue in all major meeting surrounding zero net energy. Therefore, the implementation of a program that would allow a builder to offer a ZNE home to a consumer under a financing agreement with a payback period could be effective. This would be linked to the property and not the homeowner and would work similar to the hot water heater rental system in Ontario (Bach, 2015). Lip claims that another policy that would contribute to more rapid and aggressive RBCs is the use of pilot projects in order to demonstrate the degree of success in cash incentives for homebuyers and home builders.

The problem currently is that there is no time frame in which these financial subsidies and cash incentives will last. The Eco Energy for Existing Housing was successful during its implementation of 5 years, but did not get it renewed. One reason is governments and politics because as soon as there is a change of parties or changes within the government, objectives can change, which could lead to the programs being scrutinized (Lip, 2015).

Martin-DiGiuseppe adds that the residential building sector and the related industry is one of the top performers in the Ontario economy and therefore there should be efforts, such as more significant subsidies for higher performance builders, to make it function as best as possible (Martin-DiGiuseppe, 2015). Singleton believes there could be more leadership programs similar to the Union Gas and Enbridge programs, Savings by Design and Optimum Home, respectively. This could be done through the MOE directing the OEB, which regulates all the utilities, to provide more incentivized programs of better performing homes (Singleton, 2015). Further information in Question 5.

Training Programs and Consumer Education:

McBurney suggests that engaging with industry on sharing the lessons from the demonstration projects is an important aspect for implementing aggressive codes. For example, home builders sharing the methods, materials, and technologies for success and also the barriers and issues needed to overcome (McBurney, 2015).

Brown claims that there should be changes in the methods of building inspections because currently there are only inspections at the framing stage and to ensure vapour barrier continuity, but there is no inspection for the air barrier. The air barrier is critical to the moisture movement in and out of the house and, if it fails, everything within the system, including the insulation fails

(Brown, 2015). Bach and Brydon (2015), previously mentioned the importance of training the trades for air and vapour barrier continuity. Parkes agrees and declares that it is important to have dedicated training programs for builders that will help with special techniques for building to higher levels of efficiency (Parkes, 2015). This is further explained in Question 5.

Pope suggests that in order to substantially benefit from training programs, there must be a major change, which is ZNE buildings. That is the next major step in aggressive energy efficiency codes and should be what new training programs are designed to support. And there should also be the integration of regional utilities and that would include the municipal local distribution companies as well as the provincial transmission companies. In the design of the ZNE training programs, utilities should participate and play a role. This would contribute in smoothing the road to the ability of large scale deployment of renewable energy on houses, which is a necessary element as codes get more aggressive towards ZNE. In addition, the utilities will likely be required to change their operational model from the current model, which is generating energy for the consumers to purchase. The ZNE scenario would indicate that the utility must restructure its rates to earning profit from renting out the transmission lines, rather than profiting from sending consumers electricity (Pope, 2015).

Love suggests that to improve consumer education, there should be a program or packages where a government representative, builder, or real estate agent explain to the homebuyer about the energy rating and how the home operates (Love, 2015). Lip explains that EG80 had a component of energy education through a summary sheet that is provided to homeowners upon purchase, but that is all. But there are not many consumer education or awareness programs in Ontario (Lip, 2015). Martin-DiGiuseppe expresses the necessity for consumer education because homeowners struggle to understand how to effectively operate energy efficient homes. The government

mandates through the OBC requirements of air tightness, but then homeowners turn off the HRV systems so the house does not function optimally, which creates an unhealthy environment. Homeowners do not know how to maintain a tightly built home (Martin-DiGiuseppe, 2015). Further explained in Question 5.

Mandatory Real Time Home Energy Displays:

Brydon claims there should also be mandatory, in real time, home energy displays off the smart meter. This would display to homeowners the cost of running the house per hour. This does not require technology and provides consumer awareness and education (Brydon, 2015).

Summary:

- Voluntary programs and codes along with component efficiency changes should be aligned with future editions of the OBC in regards to commencement dates.
- MHA should be implemented in Ontario and could improve energy efficiency, especially in the existing building stock. Also, there should be mandatory BDT implemented to ensure code compliance.
- Carbon pricing through inflicting the actual cost of carbon on the consumer is one method for more aggressive RBCs.
- Improved financial subsidies and training programs for builders could contribute in improved energy efficiency, in addition to increased consumer awareness.

4.2.3 Question 5: Brussels(EU) policy comparison

Purpose:

This question will spark debate as to whether the policies used in Brussels, Belgium to successfully implement the "passivhaus standard" could be partially used in the Ontario system to find success.

Lio, Black, McBurney, Lip, Bach, and Brown (2015), agree that the scale between Brussels and Ontario is vastly different therefore difficult to directly compare methods and policies for achieving aggressive building codes and standards. Lio proceeds to state that there are fewer buildings and immigrants in Brussels compared to Ontario as well as the notable difference in population size (Lio, 2015). Lip mentions that the European governments have prioritized energy efficiency as an area that required investment, which lead to high level of aggressive movements (Lip, 2015). Martin-DiGiuseppe adds that EU fuel costs are higher than Ontario due to the lack of fossil fuel energy and therefore, the political will for energy efficiency in buildings in EU is much higher (Martin-DiGiuseppe, 2015).

Bach and Black (2015), agree that the EU is heavily invested in energy efficiency due to the high costs of energy in addition to the energy security issues. Lip suggests that Ontario is not as aggressive in energy efficiency because energy is much cheaper Ontario compared to EU. Lip continues that Ontario currently has an aggressive standard in R-2000, but it is not being used by mainstream builders because the incremental cost of an R-2000 home is approximately $10,000, which homeowners will likely not pay (Lip, 2015).

The cost and lack of consumer demand for energy efficient homes are major market barriers in Ontario. Furthermore, education and training programs for both the consumer and industry would be helpful as not enough is being done and in order for this to change the government has to identify energy efficiency as a priority objective (Lip, 2015). Black argues that the EU has a much lower payback period on energy efficient upgrades for buildings in part due to the carbon tax and high fuel and energy prices. In Ontario, the price of natural gas is inexpensive so it will take a longer period of time before receiving the reduced utility bills from the energy efficient improvement. A carbon tax in Ontario could be used but it is a hard sell for Politian's because the

same fuel escalators used in the EU will not necessarily work in Ontario (Black, 2015). Parkes, Labbe, and Brydon previously discussed carbon pricing.

Bach believes there is also the issue of affordability. England recently backed out of the ZNE target, and it is suspected due to lack of affordability (Bach, 2015). In addition, consumer education and awareness in Ontario appears to be relatively weak because there has not been enough catastrophic events linked to climate change in Ontario to convince people that GHG emissions are detrimental to the environment. Therefore, there is not the desire to change or alter lifestyles, including residential homes (Bach, 2015).

McBurney insists that the Brussels concept can be applied to Ontario. This could be done through the government investing heavily in consumer awareness, consumer education, on the value of a recognized brand such as an Energystar house. The value of an Energystar quality home or better than code built home vs just a code built home. And they should provide cash incentive (for example $1000) for the consumer who buys an Energystar home or better than code home. the supply side, invest heavily in education and capacity building programs that work with builders to bring down the costs, overcome some of the resistance, because there is a lack of knowledge. Also provide incentives for home builders in the form of a rebate on their DCs (McBurney, 2015).

Parkes suggests there is an opportunity on the training side for air sealing, which can result in major energy savings which would not necessarily increase the capital cost of the house like adding layers of insulation. Ontario could focus more training programs on proper air sealing and prevention of issues that could arise from extra tightly built houses like moisture and mold. In addition, Ontario could support higher incentives for builders, especially those that target

extreme performance (Parkes, 2015). This is similar to Love's argument in Question 4. Currently, Ontario does have programs in Union Gas and Enbridge, but the OPA offers $500 for an EG83 and $1000 for an EG85 which is simply not enough to encourage the industry. Brydon insists that anytime there is a program that targets builders, there is generally uptake. Consumer education is an important tool because then the development community could actually extract the value back that is put in up front in the way of higher efficiency equipment. Currently, consumers do not understand the value of energy efficiency (Brydon, 2015).

Singleton claims that Brussels' passivehaus program is great example of a holistic program where there is understanding of all necessary features and put in place incentives and support mechanisms, which requires significant investment from the government. There was not just a single instrument used but instead it was a multi- pronged approach. However, in Toronto, passivehouse is more of a custom builder method and is especially requested by the homeowner. But there is an aim to make that into mainstream production buildings. The main problem is the incremental cost in building high performance houses. For most consumers and homebuyers, energy efficiency is not valued as high as overall cost of the home. The main method in demonstrating the importance of energy efficiency to homebuyers is consumer education (Singleton, 2015). Love does not believe that Brussels system of financial subsidies is sustainable and insists that 20-30% is sufficient so that the builder is encouraged to build efficiently.(Refer to Appendix B-7 Question 5). Although, a focus program for a set amount of years, similar to Brussels, with a large subsidy for builders to build ZNE could be helpful in creating consumer and industry awareness (Love, 2015). Lip shares a similar opinion that a focus program could contribute with increased awareness (Lip, 2015).

Labbe disagrees that Brussels cash incentives to the homebuyer and builder will be effective because in Ontario, there are speculative builders and many are not driven by home owners. The home owner receives the longevity, durability, and low utility bills and that should be incentive. There also should be a balance of carrot and stick approaches because a significantly aggressive action can result in lobbying from OHBA and CHBA so instead it is important to work together (Labbe, 2015).

Pope argues that although Brussels had a leading program, which featured low energy houses with substantial builder training, paying for an entire energy efficient program is a politically unpopular decision in Ontario and Canada. Municipalities, in order to keep taxes low, have starved the building departments especially methods and programs that would assist in the construction of better built homes (Pope, 2015). Therefore political unwillingness is a major limitation. Also occupant behaviour is an issue and the political attitude is not regulating homeowners behaviour in homes. In order to alter consumers behaviour there would have to be a set of objectives and goals that actually make a difference to a consumer. Money is the optimal system to leverage change but energy is inexpensive in Ontario (Pope, 2015).

Summary:

- Difficult to compare Ontario to EU due to the differences in population size and priority in energy efficiency for housing. In addition, the cost of energy is more expensive in EU.
- Carbon tax could be effective but is a 'hard sell' for a politicians as fuel escalators are different in Ontario than EU.
- Currently, political unwillingness is likely a major limitation in Ontario.

- Consumer awareness and improved training programs are methods of increasing energy efficiency in RBCs.
- A focus program could work in Ontario for a set number of years that would offer high financial incentives.

4.2.4 Question 6: Amanda Yip Thesis

Purpose:

This question investigates the plausibility of Amanda Yip's objective of an 80% reduction in space heating by 2030. It will further discuss whether or not it is realistic, what needs improvement and what policies could make it more successful for implementation as this is a relatively aggressive energy efficient policy by today's standards.

The general thought process from Lio is that Ontario is on the edge of economic feasibility and an 80% reduction in space heating by 2030 as outlined in the thesis is not plausible presently. A 50%-65% reduction in residential building energy consumption in 20 years is a doable goal. In order to achieve this goal earlier, the focus should be on demonstration projects during the 2017 code and technologies to achieve such levels(Lio, 2015). Lip and Martin-DiGuiseppe (2015), agree that an 80% reduction by 2030 is too high given current metrics. Singleton also emphasizes that that a 50% reduction by 2030 is more plausible.

One policy that would contribute to achieving the target is engaging municipalities and planning representatives in discussion regarding architectural designs. Currently, there are many architectural designs that contain thermal bridging, excess timber, and poorly insulated. These designs are established by the municipalities not the builders and should not be used in production building (Singleton, 2015). Black does not exactly know how far ahead it is possible to be without encountering issues such as market capacity. ZNE homes are approximately 10,000 dollars more than the code built homes and in order to gain market take up, the price must be

affordable so this is a reason why there is not widespread adoption of ZNE homes (Black, 2015). Parkes adds that an 80% reduction in space heating consumption by 2030 is an achievable goal but it is more a problem of capital cost and whether that is desirable from a policy perspective. Ontario is reaching the point where it is hard to justify too much more investment in residential energy efficiency, especially on the basis of homeowner costs. Bach substantiates this claim in Question 4 and 5. Black further states the CHBA is responsible for targeting higher energy efficiency in buildings and when a new target is decided upon along with a program in place to achieve the outcome, the MMAH will try and push the code up high enough so that the distance between minimum and the program is not massive. This has not happened yet for an 80% reduction in energy consumption outlined in Amanda Yip's thesis so it is difficult to determine if it is an achievable goal (Black, 2015). Lip agrees that one of the key indicators is the voluntary programs and what they are targeting because that will indicate the feasibility, so if it is possible to increase the voluntary codes, it could likely increase the energy efficiency in the building code.

Peter Love is convinced that an 80% reduction in heating energy consumption by 2030 is not only doable, but could be even more aggressive, close to ZNE. This can be achieved by providing adequate lead time and financial subsidies for builders going beyond the code. For example, in 2020, the requirement of passive house for 2025 is announced and a financial subsidy of 5,000-10,000 is awarded for each house built to that level and then the same for ZNE by 2030. Financial incentives will contribute in allowing builders to prove effective practices and decrease the cost of technology and manufacturing so that the end price substantially drops. Union Gas, Enbridge, and Toronto Hydro should be the source of funding and subsidies.(Refer to Appendix B-7 Question 6) (Love, 2015).

Parkes further states that framing the 80% reduction in terms of GHG emissions instead of only space heating consumption could align well with Ontario's climate objectives and approaching that as the overall goal could be an alternative (Parkes, 2015). However, Brown argues that this is a difficult target to achieve without introducing a passive system in addition to solar or geothermal sources (Brown, 2015). Parkes claims a subtle policy that could be used to help meet the 80% target is encouraging the passive solar design of houses to ensure that the windows are oriented in the right direction to capture the most sunlight. Although this cannot be mandated in the BC due to implausibility for every house, it could be considered in the planning act for subdivisions (Parkes, 2015). Labbe also claims that solar orientation is a passive policy that could contribute in more aggressive building codes (Labbe, 2015). Pope insists that the adoption of the passive house or ZNE by 2030 could be in the scope. In order to codify ZNE houses, there must be collaboration with land use policy and the planning act to remove barriers that prevent expansion of renewable energy. One of the past structures involved that the installation of PV panels worth 15,000 dollars, added value to the property and therefore there was an increase in property tax. There should be a revision that protects homeowners that make energy efficient upgrades from increased taxes (Pope, 2015). Brown states another method that could contribute would be better educating trades and builders to use materials and technologies more effectively. Examples would be ensuring tightness of air barriers and thermal bridging of building materials (Brown, 2015). Parkes discussed this in Question 5.

Larry Brydon discussed that the building code improved in 2012 by 25% better than the last BC in 1977 and now it is improving to 15% better than current. One policy that could ensure more aggressive energy efficient homes is to guarantee that every code cycle improves by at least 20% until ZNE. Or there could be regulations in the BC stating that every house is assigned an energy

intensity target (Brydon, 2015). Labbe insists that in order to meet the goal it will be critical to optimize the building envelope. To ensure that this target is met, there should be more significant incremental increases to Part 9 in every building code cycle. This could include the previously stated decrease in air changes every code cycle (Labbe, 2015).

Summary:

- The levels described in Amanda Yip thesis are generally seen as too high given Ontario's current policy and building code situation.
- Providing supportive financial subsidies could be a way to meet the 80% reduction .
- Guaranteeing that the code moves up by a minimum of 20% energy reduction each code cycle.
- There should be the use of passive measures and renewable technology in order to meet the reduction.

4.2.5 Question 7: Voluntary Standards

Are they important to aggressive energy efficient rbc and successful/rapid implementation. It will also evaluate whether they are perfectly aligned with the new upcoming BCs. Then there will be discussion on what needs to change to ensure more seamless transitions.

All the experts agreed that voluntary standards and codes are essential to the success of aggressive building code implementation and that it is also critical to ensure there is proper alignment with the voluntary codes and the future editions of the building code. The majority of experts also agreed that voluntary codes, standards, and programs are not currently aligned with the OBC. Lio, Bach, Brydon, and Singleton (2015), previously discussed the issues in Question 4. Furthermore, Parkes states that current financial incentive programs from the gas and electric utilities are only offered for building 25% better than code while no incentive exists to build 15%

better, which is going to be code in 2017 (Parkes, 2015). Lio argued this issue in Question 4. Love states that Ontario should have a long term energy goal. So by 2023 the code will be EG90 and in 2030 it will be EG100. And in order to support this there will be voluntary programs, like Energystar, that will contribute in ensuring 20% of the housing stock to be EG90 by 2018 and 40% by 2021 so the market will be able to support the change by the time the new code is official (Love, 2015).

Lip and Brydon (2015), argue that voluntary programs are a National level focus whereas the OBC is provincially focused. In addition, the National Building Code model is misaligned with the OBC in terms of revision cycles, which adds another layer. Therefore, because the National and Provincial codes are misaligned, a voluntary program or code which follows the National tool line will also be misaligned. Lip suggests the success of having them better aligned is with stakeholders and this includes the MMAH for the provincial codes, The Canadian Commission of Building and Fire Codes for the National Code, and NRCan for the voluntary standards or programs (Lip, 2015). Also, there is the Building Code Conservation Advisory Council(BCCAC) and it helps with alignment because there is a balanced representation from those in the industry to provide recommendations to the minister about a feasible target for code cycle purposes. But these committees do not make the decisions at the end of the day which is one reason why there is still misalignment. There may be political reasons for not making a change based on the committee's recommendations (Lip, 2015). Brown claims that there is a never seamless transition and lack of communication is the major problem. This takes form through the MMAH not having the proper documents ready in time or the focus groups of stakeholders and lobby groups are not in agreement (Brown, 2015). Further, Martin-DiGiuseppe adds that municipalities do not always completely understand all the code differences by the time the new code comes into

effect because they did not have all the recommended meetings with building departments and industries (Martin-DiGiuseppe, 2015).

Singleton, Brydon, and Bach (2015), support the need for integration and discussion between the code authority, natural gas companies, and electric companies in the BC process. Also, including appropriate stakeholders such as, a representative from Enercan appliances branch and from OEB, which sets the policies for the DSM and CDM programs is important. Currently, there is not much coordination between these parties and there is not support to have meetings and collaboration.

However, McBurney states that voluntary codes are aligned with future editions of the OBC because each year the building code moves up so does ES and so builders always know how to build better than code (McBurney, 2015).

Summary:

- Voluntary codes are essential for the success of aggressive BC implementation.
- Integration between code authority, natural gas and electric companies, and NRCan representatives is important.
- There should be a long term energy goal in Ontario and voluntary codes could contributing in optimizing the success.

4.2.6 Analysis of Interviews:

The interviews provided insight into previous energy code and standard implementation and policies that could be implemented in order to achieve more aggressive energy efficient RBCs. 13 interviews demonstrated enough overlap that it was deemed to be a sufficient amount.

The main conclusions from the interviews:

- Adequate lead time and voluntary standards are essential
- Exclusion of existing buildings, no official compliance testing, and no mandatory training programs are current limitations with more aggressive RBCs.
- Lobbying is another issue with getting too aggressive with building codes.
- Currently political will and leadership is viewed as relatively weak in Ontario.
- Voluntary program alignment, MHA's, carbon pricing, and improved financial subsidies are a several policies that could improve aggressive RBCs.
- Improving consumer awareness is a critical objective.

Voluntary standards demonstrate to be necessary in leading the way to implementing more aggressive energy efficient RBCs and are also a tool to indicate the feasibility of aggressive targets. They also allow adequate lead time for training and ensuring that the necessary energy efficient equipment and technology is readily available on the market. Voluntary codes such as R-2000 did not receive high enough uptake to convince the industry to push towards more widespread adoption. However, builders demonstrated that EG80 was achievable at a voluntary level, which, at the time was the 2006-2012 Energystar. Although that was a significant factor in EG80 implementation, strong political leadership was the key component in the successful implementation and without it, EG80 would likely never have been implemented in the OBC 2012. Furthermore, current voluntary codes including Energystar do not align with the future edition of the OBC, which could complicate the transition period between the previous and future versions of the OBC. In addition, no financial incentives exist currently to build 15% better than code and therefore builders do not have a clear understanding of the components and technologies required for 15% better, which will be the 2017 OBC. These alignment issues

support the argument that the transition between the 2012 and 2017 OBC will likely be complicated. Next, compliance was described as a major issue in the OBC as there are no requirements for performance testing or mandatory BDT. The SB-12(used by a vast majority of builders) allows for prescriptive measures to be taken in order to meet the current edition of the OBC, but without mandatory BDT or performance tests, compliance with the OBC is unknown. Mandating BDT will contribute in encouraging builders to participate in training programs as well as ensuring OBC compliance. Further discussed in Section 4.3. In addition, MHA will assist in that objective as part of the process will include a mandatory BDT in order to receive the performance evaluation. It was also stated that MHA's will likely increase energy literacy as homeowners can view and compare energy performances of houses on the market. And this could positively affect the existing building stock as now consumers will be able to compare the energy performances and metrics of each house and less efficient existing residential buildings might have to upgrade the overall energy performance in order to remain competitive with the newly constructed higher efficient residential buildings. Therefore, not only will MHA ensure mandatory BDT to guarantee compliance and increase energy literacy, but will also create retroactivity in the building code so that there is pressure on existing residential buildings to undergo performance upgrades. Policies for existing buildings are essentially nonexistent in improving the current OBC and implementing MHA could improve this current issue.

Lobby groups were also described as a method of limiting and preventing aggressive energy efficient upgrades and codes. Preventing lobbying is a critical goal in achieving aggressive energy efficient RBCs as previous experiences have demonstrated. Adequate lead time as established in the EG80 implementation is necessary and can be achieved through a long term energy plan detailing the aggressive energy efficient codes and when they will come into force.

This would be in addition to aggressive voluntary standards such as Energystar and the utility programs leading the way. Also improving communication between OBC representatives and the industry about contemplated changes ahead of time and discuss the changes that are possible and feasible (Martin-DiGiuseppe, 2015). This would be accomplished through alignment of voluntary codes, such as programs offered through the utilities and Energystar, with component efficiencies, and future editions of the OBC. Alignment will promote greater discussions between the code designers, code officials, and the utility programs so that all parties understand what the code and the voluntary programs are striving to achieve (Singleton, 2015). This will likely reduce lobbying because stakeholders and builders are generally frustrated with the fact that the code changes every 5 years, but there are still changes throughout the interim. For example, aside from voluntary programs operating on a different 5 year cycle than the OBC in terms of commencement dates, window and water heater performance upgrades take place throughout the interim. This causes stakeholders to push back against aggressive energy efficient action (Brydon, 2015). If all the elements were aligned, it would be easier for stakeholders to accept and encourage a continuous change and there would likely be less lobbying. Currently, stakeholders require a couple years to get the necessary processes in place after any one change occurs. Furthermore, MHA also aims to increase energy literacy and in turn could improve consumer demand for energy efficiency. Currently, consumers are not interested in spending more money to reduce energy consumption because energy related to higher performance housing, such as envelope and foundation is gas, which is cheaper than electricity. Instead, consumers are more interested in other features of a house and energy efficiency is not yet being requested. If consumers begin demanding energy efficiency, then builders and other stakeholders

will not lobby against increased performance, but instead provide support as it will be requested by consumers for residential buildings.

Amanda Yip's thesis for an 80% reduction in space heating consumption by 2030 received mixed views on the success given the current state on Ontario. The majority of experts insist that this is too high given current metrics in Ontario especially without introducing a passive and/or renewable energy system. However, with the implementation of several policies discussed in 4.2.2 could improve the current metrics enough to increase the success rate of an 80% reduction in the OBC.

Lio and McBurney (2015), discussed the research, development, demonstration, implementation, codification (RDDIC) cycle. As more research and development occur, there will be increased demonstration projects to test the success and feasibility. This is the method for transforming the market. And the only way to attain successful implementation of new aggressive codes is to go through the RDDIC cycle. There will not be codification until there is proven and demonstrated success as no government will adopt a new building code if not at least 25 percent of the market has demonstrated success. Therefore, increasing the speed and rate of implementation for aggressive energy efficient codes will require them to proceed through the continuum cycle at a more rapid rate. The data collected throughout the interviews, in specific, section 4.2.2 and section 4.3, suggest methods and policies that can contribute in moving aggressive energy efficient codes through the RDDIC cycle at a more rapid rate. This will contribute to successful implementation in the OBC.

4.3 Policy Recommendation Sets:

In order to achieve more successful implementation of aggressive energy efficient residential building codes, it is important to suggest recommendations that could significantly contribute. The recommendations are based on the results of the previous 13 interviewees that are experts in the fields of policy making, architecture, consulting, sustainable buildings, and high performance housing, in addition to methods used in the EU and Brussels that lead to the successful implementation of the Passivhaus standard. The recommendation set below consists of 5 policies that could be currently implemented in Ontario:

1. Mandatory Home Audits and Energy Labeling

2. Carbon Pricing and Taxing

3. Alignment of Voluntary Programs with OBC

4. Improved Financial Subsidies and Tax Breaks

5. Mandatory Training Programs and Improved Consumer Awareness

These policies, if carried out, could significantly benefit more aggressive action in RBCs. Each recommendation will outline the importance of why it should be mandated and how it can be successfully achieved. Some of the recommendations contain case studies of similar policies that were successful in their relative country in order to provide insight as to how Ontario could meet their goal.

4.3.1 Recommendation # 1- Mandatory Home Audits and Labeling

Importance:

The Ontario government, for the past few years, has explored the possibility of regulating mandatory home audits at the time of sale or lease of a property. In the original GEA, this was to be mandated, including information reports, or ratings pertaining to energy efficiency and consumption of the home(ECO, 2012). The purpose was to provide disclosure to the buyer or consumer about energy performance and efficiency (ECO, 2012). There was both public support and opposition for the MHA provision but amendments were made before the act was passed that: "Allowed home buyers to waive, in writing, the right to receive information, reports or ratings"(ECO, 2012). Therefore, the MHA provision still requires the proclamation in order to become mandated. In addition, this is the only provision in the GEA that requires proclamation and little has been done to bring MHA into force (ECO, 2012).One of the major issues is the resistance of the Ontario Real Estate Association(OREA) who proposed that there should be a voluntary homeowners audit program that would promote homeowners to voluntarily assess the energy performance of the home. OREA also believes that mandatory audits could make homeownership appear less attainable (OREA, 2013). An example is that when the energy rating is comparably lower than new houses, homeowners might feel obligated to make costly retrofits or even lower the cost of the house. Furthermore, OREA states that the proponents have argued that MHA will provide consumers the right to receive energy information about the home but this information could be received through utility bills (OREA, 2013). OREA's advocacy group was successful in preventing the MHA in 2009 when the GEA passed. The government now contains a new plan for implementing MHA, with the stipulation of a MHA prior to the time of listing (OREA, 2015). The plan will be carried out through the 2015 fall season with the intention to have a program that will be phased in over time until 2019 in which there will be full

implementation. OREA is actively planning a course of action to advocate against this regulation (OREA, 2015).

Benchmarking of Success:

Fuel Economy in the Automotive Industry:

History

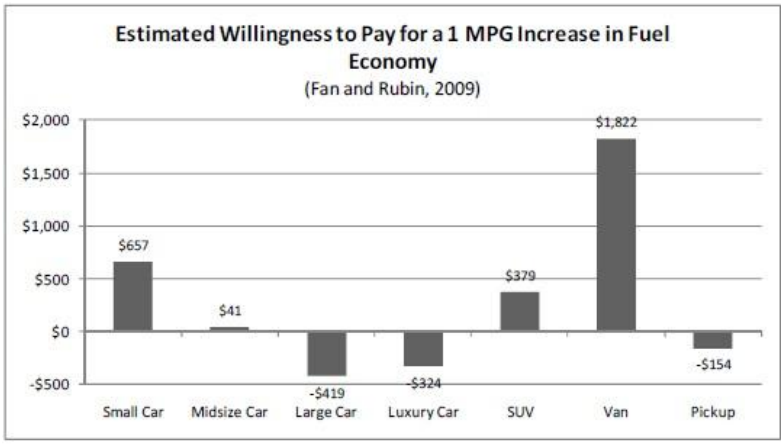
After the 1973-74 fuel shortages, Canada established the Company Average Fuel Consumption(CAFC) targets. In 1982, Canada approved the Motor Vehicle Fuel Consumption Standards Act(MVFCSA) in order to formally mandate CAFC targets but lawmakers did not proclaim this act because auto manufacturers agreed to abide to the targets on a voluntary level (ICCT, 2015). Canada fuel economy remained voluntary for 25 years and targets remained at 8.6L/100km from 1985-2010. In 2007, the MVFCSA was mandated and implemented by the federal government and in 2010, CAFC was replaced by Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations in 2010, which established standards for 2011-2016 model years (ICCT, 2015). The government has also instituted stringent requirements for fuel economy on model years of 2017-2025 (ICCT, 2015). The U.S. passed a similar standard in response to oil price increases in the early 1970s, referred to as Corporate Average Fuel Economy (CAFE). In 1985, the U.S. mandated a 27.5mpg(10.3L/100km) fuel economy which was double from the previous 13.5mpg (PEW, 2011). In 2007, U.S. congress passed the first fuel economy standard in approximately 20 years that raised the bar to 35mpg by 2020. However, in 2009, the Obama government accelerated the increase to 35.5mpg for model years between 2012-2016. The U.S. is currently aiming to increase fuel economy to a range between 47-62mpg by 2025 (PEW, 2011).

It appears that 2007 signified an important date as standards for fuel economy increased and long term goals begin to form. This was approximately 20 years after the first standard and target pertaining to fuel economy was established.

Consumer Demand:

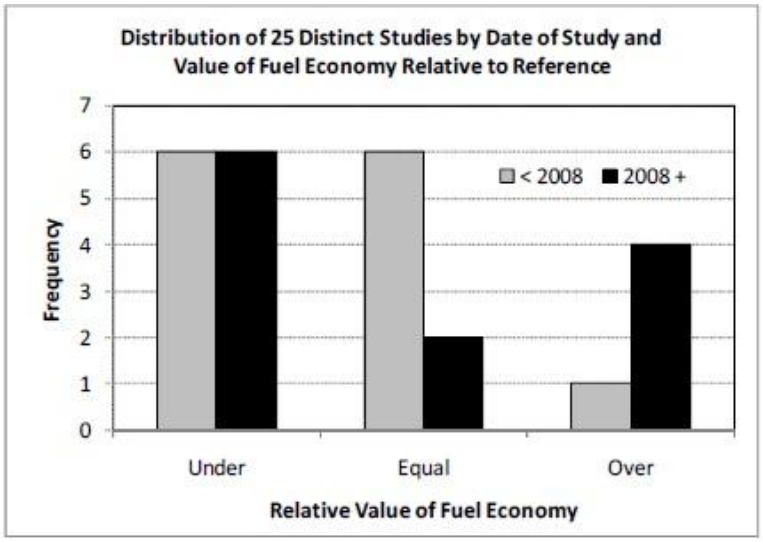
A literature review for the U.S EPA demonstrated that consumers are interested in and value fuel economy most notably when fuel prices increase. Mahadi conducted a study of the preferences of new vehicle owners between 2001 and 2008 and the results indicated that fuel economy becomes even more important, with regards to purchasing a vehicle, as the prices of oil and gas increase (Greene, 2010). Turrentine investigated 57 households in California in order to demonstrate consumer vehicle purchasing decisions. The results indicated that no consumers had a systematic approach to analyzing fuel costs when buying the vehicle or gasoline. Furthermore, consumers do not have the basic knowledge necessary in rational decision making regarding the purchasing of a vehicle (Greene, 2010). In addition, there are consistent errors when estimating savings from fuel economy and gas prices. Although, Turrentine evaluated that consumer knowledge could be relatively weak, Espey examined the marginal value of increased fuel economy and results demonstrate that automotive consumers fully internalize the savings received through increased fuel economy (Greene, 2010). Similarly, Fan illustrates the estimated willingness to pay for increased fuel economy in Figure 4.4.

Figure 4.4- estimated willingness to pay for FE source: (Greene, 2010)



It demonstrates, with the exception of large and luxury cars, that consumers value fuel economy (Greene, 2010). Through a 25 study literature review conducted by the EPA, it was concluded that in 13 of the studies, consumers equally valued or significantly overvalued fuel economy, while in the other 12, consumers significantly undervalued fuel economy (Greene, 2010). Figure 4.5 represents this claim. This also reveals that consumers, whether under or over value, are thinking and making assessments about fuel economy in vehicles.

Figure 4.5- 25 studies demonstrating value of FE source: (Greene, 2010)



Lastly in all studies, consumers anticipation of current trending and future oil and gas prices played an important role in fuel economy decisions (Greene, 2010).

Barriers/Resistance to Fuel Economy:

Currently, there have been more barriers and resistance with fuel economy, likely due to the more aggressive targets in recent years. With new targets for fuel economy in place that aims to exceed 50mpg by 2025, the automotive industry is pushing back against those efforts (Bartlett, 2011). In Washington and other states, The Alliance of Automobile Manufacturers(AAM) has already begun a campaigns to discourage these higher fuel economy targets. The AAM claim that this aggressive action will vastly increase the cost for consumers, likely compromise safety, and increase the risk of job loss. However, the consumers union believe that the proposed 56.2mpg can be achieved and that more aggressive and higher targets could be accomplished. Proponents against higher targets have argued that the additional costs of fuel efficient technology will deter consumers from purchasing the vehicle (Bartlett, 2011). Furthermore, a different article substantiates the claim and reports are inconclusive how much consumers would be willing to pay for technology that improves fuel economy (Bloomberg, 2015). And the more stringent the standards for fuel economy become, the higher the costs due to power train designs, advanced materials, and vehicle size (Bloomberg, 2015). However, one report and survey was conducted and results indicated that 62 percent of respondents expect that their future vehicle will contain a higher fuel economy, and 58 percent suggested that they would pay more for higher fuel efficiency (Bartlett, 2011). A similar issue is that consumers have demonstrated to buy less efficient cars if gas prices are low. A report demonstrates that while the U.S was experiencing gas prices at a 5 year low, the fuel economy of purchased cars in December 2014 compared to August 2014, usually seasonal highs for vehicle purchases, was 3 percent lower

(Young, 2015). This indicates that consumers tend to value the immediate financial situation compared to long term reflection of oil and gas prices (Young, 2015). This is a difficult barrier to overcome as consumers react to prices changing within the oil and gas industry but increased literacy with fuel economy could contribute in consumers understanding of long term benefits of fuel economy from savings to the environment. Also, it is evident that when gas prices are high, consumers significantly value fuel economy but the challenge is that oil and gas prices fluctuate.

New York City Energy Use Report:

New York City implemented a Local Law 84: Benchmarking(LL84), for the purpose of ensuring that owners of large buildings report energy use and consumption. The law has been in force for public buildings beginning in 2010 and large private sector buildings since 2011 (plaNYC, 2012). In the first three years of the standard, building owners were 84 percent compliant. This is an increase from the second year compliance rate of 75 percent and also 92 percent of the same building owners complying in year 2, complied in year 3. Overall compliance is expected in increase year by year (plaNYC, 2012). Also, after the first 3 years of the benchmarking standard, there has been reduced energy use per building.

Progress Examples of MHA and Energy Certificates:

Bull, 2012, explains that displaying energy performance certificates for buildings can act as a measure to increase behavioural change in consumers (Bull, 2012). Fuerst, 2015, demonstrates that there is a positive relationship between the dwelling price and energy performance rating. There are higher price premiums for dwellings that are highly energy efficient, while more inefficient dwellings have shown to have significant discounts (Fuerst, 2015). Davis, 2015, findings were similar in that there was a positive, although small, correlation between higher

selling prices and higher energy performances in residential buildings. The study compared the property values of various residential buildings and the respective energy performances (Davis, 2015). Therefore, the market for dwellings values energy efficient homes.

Barriers of MHA:

One of the major barriers to implementing MHA is lobbying from real estate organizations. These lobbying groups can have significant influence with the government and have been successful in the past with push back from standards that are viewed as too aggressive. In addition, the home audits suggested, will be mandatory and therefore will likely receive resistance. This is a challenging barrier to overcome and the original MHA , announced in the 2009 GEA , was rejected in part because of the lobbying.

It is assumed that consumers are not currently requesting the review of a houses energy performance that would be provided by the MHA. This would indicate that consumer awareness in energy efficiency in housing is lacking. Due to the lack of consumer awareness, real estate organizations resist standards that will increase the difficulty of selling a house. Improving consumer awareness could be a critical step in accelerating the adoption of MHA. There is reason to assume that if consumers request and insist on energy audits before buying a house, that there will be substantially less lobbying from the real estate organizations.

Even with the current energy efficient requirements, almost all new homes will be have much higher energy performance than existing buildings, but consumers are not widely aware. Therefore, in that aspect, consumer education and awareness is relatively weak but could be improved by MHA. MHA would have a straightforward score that consumers could compare and evaluate.

Method for Implementation:

MHA and labeling could be achieved through three stages:

Stage 1 would imply MHA for all newly built homes,

Stage 2 would apply to all homes being sold or leased, and

Stage 3 applies to all homes including existing stock.

In addition, the there could be mandatory energy consumption reporting, beginning with large multifamily residential buildings and moving into single family residential buildings. A database would be created for reporting the energy use and consumption for the building owners.

This three stage implementation would not only contribute to newly constructed homes but also existing buildings. In addition, Lip suggested that the NRCan has plans to switch from ERS to a g/j scale, which is supposed to be an easily comparable metric (Lip, 2015). Therefore, MHA could increase energy literacy among consumers. The current ERS is difficult for consumers to understand. As mentioned in Section 2.2, consumers do not understand the differences in the current home energy ratings. Changing the metric and mandating home energy audits could allow for improved consumer awareness in energy efficiency in housing. This could work similar to that of fuel economy for automobiles. MHA should be regulated currently.

Summary:

The MHA has been deferred since GEA passed in 2009 and nothing further has been done to remedy the situation. It is important to enact and mandate the home energy audits now instead of waiting. The case study of fuel economy demonstrated that for 20-25 years there was no improvements made to increase fuel economy of a passenger car for both the U.S and Canada

until 2007 when it become officially regulated. There is also evidence that consumers are interested in and value fuel economy but mainly when the price of oil is increasing. Therefore this recommendation for MHA could be very successful in conjunction with carbon pricing (further discussed in recommendation #2). Just as fuel economy, MHA can increase energy literacy and in turn provide public support of the regulation. The resistance from the automotive industries is similar to that of the real estate associations that oppose and lobby against MHA. However, fuel economy standards are increasing and becoming more aggressive. MHA could increase consumer energy literacy just as fuel economy did for the automotive. Last, Lip, 2015, states that NRCan expects to change the rating system to a G/J scale, which is an easily comparable metric in contrast to EG, the current metric (Lip, 2015). This should allow for a comparable metric similar to fuel economy as it measures the amount of energy consumed. Now houses can be more effective at demonstrating energy consumption. And it will be easier to see and compare and know if there is a large efficient home and/or a small but inefficient home. Therefore, MHA should be regulated now.

4.3.2 Recommendation #2- Carbon Pricing

Importance

It can be argued that there should be a regulated carbon tax in Ontario in order to increase energy efficiency in residential building codes.

Carbon pricing and taxing is the system that assigns a cost to generated GHGs emitted through the burning of fossil fuels. Thus, it puts a price on emitted carbon. Agreed upon by many scientists, excess carbon in the atmosphere is responsible for raising the average temperatures that leads to various adverse climate and weather impacts (AMO, 2015). Fossil fuels including

oil, coal, and natural gas have been heavily relied on by production and transportation industries and CO_2 is the by-product that is being emitted, in which the environmental consequences are not reflected in the price. To improve this current situation, a carbon price could contribute in reducing GHGs in the atmosphere and also could lead to higher energy efficiency. British Columbia and Quebec currently regulate carbon pricing(AMO, 2015).

Benchmarking of Success:

Case Study: British Columbia's Carbon Tax

British Columbia announced a carbon tax in 2008, which became the centerpiece for the climate polices. The carbon tax was made possible by the leadership of the provinces liberal premier Gordon Campbell. Campbell strived to make mitigating climate change a top priority. The tax, when introduced in 2008, was 10 dollars per metric tonne of CO_2 equivalent emitted and increased by 5 dollars a year and by 2012 the carbon tax was 30 dollars. In addition, the price of gasoline increased by 2.4 cents in 2008 to 6.7 cents in 2012 (Smith, 2014). The tax is also revenue neutral, which indicates that there is no increase in new revenues but instead, the government returns every dollar of the tax collected back to the taxpayers and organizations through various tax cuts (Smith, 2014).

How BC Successfully Implemented the Carbon Tax:

One of the major components that lead to the successful implementation of BC's carbon tax was the strong political leadership of premier Gordon Campbell. Campbell made climate change policies the primary theme of BC's budget and top priority for the government. Furthermore, the design of the tax and the idea for revenue neutral were also created by Campbell (CEC, 2015). The public support for the carbon tax dropped by 40 percent when it was incepted in 2008, but

has since started trending upwards to approximately 64 percent by the end of 2012 (Horne, 2014). Another component that contributed to the implementation was the design was simple and contained minimal exemptions. The tax applies to all emissions generated from the burning of fossil fuels that can be measured, which has resulted in the coverage of approximately 75 percent of emissions (CEC, 2015). BC also began with a low price of the carbon tax and committed to set price increases every year. Starting low allowed the carbon tax to become more publicly accepted. The introductory cost of 10 dollars per tonne was a system that was in current use in other parts of the world (CEC, 2015). The increase in carbon tax per year allowed BC to move from the non threatening tax to a more stringent tax and this creates less opposition than introducing the tax at a high rate. Also, communicating early about the annual increases contributes in limiting resistance as the targets are publicly accepted. In addition, the gradual increases allow homeowners and businesses to make low carbon investments in anticipation of the new levels (CEC, 2015). In order to offset the financial burden of the carbon tax on low income households, BC announced a tax credit program known as the Low-Income Climate Action Tax Credit. An analysis demonstrated that in the first year of the carbon tax, it was slightly progressive towards low-income households, reporting that the bottom 20 percent, by income, received a moderate net benefit than the top 20 percent of households. This further establishes that the regressive impacts of the tax can be resolved and addressed (Sustainable Prosperity, 2012).

Barriers to Overcome in BC Carbon Pricing:

The Canadian Center for Policy Alternatives(CCPA) suggests key directions and important next steps in the BC carbon tax program. It is important to continually increase the carbon tax each year. Carbon taxes should be gradually phased in to allow households and organizations time to

alter behaviour (Lee, 2012). Also, over time there will be higher taxes and therefore more significant reductions in emissions which will require change through building retrofitting, new transportation, highly efficient appliances etc, so a phased in approach to a carbon tax program will allow for a smooth transition. Furthermore, BC's carbon tax should continue to increase 5 dollars per year and by 2016, there will be a 50 dollar per tonne carbon tax (Lee, 2012). Next, BC could expand the coverage of the carbon tax to include process emissions from cement, aluminum and the production of other metals that are currently excluded from the tax. In addition, applying the carbon tax to international trade would contribute to reduced emissions as currently BC's coal and natural gas exports are not counted in the GHG emission inventory (Lee, 2012). Furthermore, the carbon tax excludes non combustion sources and this includes the processing and transmission of natural gases, but there is debate whether these type of sources should be applied to the carbon tax (Horne, 2014). Also, there should be improved credits that ensure low income households are protected from the high carbon tax as they will likely have a small carbon footprint. A 2010 study demonstrated that low income households were better off with the tax credit as it was more than the cost of the carbon tax, but after 2010, the increases in the carbon tax were not matched by increases in the low income tax credit (Horne, 2014). It was evident through further analysis that BC was not keeping up with increases to the low income tax credit and therefore should be addressed in further expansions of the carbon tax policy (Sustainable Prosperity, 2012). Last, BC could part ways with revenue neutral carbon taxes and instead the government could use the revenue to reinforce climate change action. Part of the taxes should be used towards retrofits for energy efficient buildings and the associated education and training programs that aim to reduce emissions (Lee, 2012).

BC Carbon Tax GHG Reduction Levels:

BC has successfully reduced the overall levels of GHG emissions and the introduction of the carbon tax is likely the most significant reason. In 2008, total GHG emissions, measured in kilotonnes of CO_2e, related to the energy sector was 51, 199 and in 2013, it was 50,323 (British Columbia, 2015). In addition, the GHG emissions associated with the energy consumption in residential buildings was 4,784 in 2008 and 4, 374 in 2013 (British Columbia, 2015). This demonstrates that the carbon pricing has influenced a decrease in the amount of GHG emissions overall and those related to the energy sector, including residential buildings.

Switzerland 2000W Society:

Although this is not a method of carbon pricing, it is a method of carbon budgeting for buildings. Switzerland effort to drastically reduce energy consumption was a 2000 watts per capita per year (Morrow, 2008). This objective is currently being considered. This 2000 watt society is being encouraged at the federal level and will be pursued in the next couple decades. This is part of Switzerland's plan to reduce the demand of fossil fuels by 50 percent by 2050 (Morrow, 2008).

Barriers to Carbon Pricing:

One significant barrier for imposing carbon pricing is political will and leadership. Imposing taxes in general can be viewed as a politically unpopular decision. The carbon tax could be viewed by the public as negative which can have adverse effects on the current government therefore, governments could be hesitant to implement such a controversial tax. As previously discussed, in Ontario, political willingness for more aggressive energy efficient policies and standards is relatively weak.

Also, consumers might protest against another form of taxation. Because consumers are not demanding or requesting energy efficiency in housing, a tax could cause a protest and could even lead to a change in government parties, depending on the tax and provincial situation.

Methods for Implementation:

Several of the experts support the idea of a carbon tax in Ontario as it would increase the price of fossil fuel energy and increase the operating costs of less efficient homes compared to air-tight and energy efficient homes.

The method for implementing carbon pricing or taxing could be achieved through:

1. Setting a price for carbon on fossil fuel emissions for consumers and homeowners which imposes the true cost of the energy from extraction to transmission. This refers to the full cost of natural gas and electricity including remediation of the affected fossil fuel. Therefore, this would also cost consumers part of the negative externalities associated with burning fossil fuels.

2. The Ontario government could use a specified percent of the revenue generated from the carbon tax to incentivize programs for higher and more aggressive residential energy efficiency, such as ZNE home building programs. This could substantially finance builders to explore the proper methods and techniques to effectively pursue more mainstream ZNE residential building s.

3. Use similar strategies as BC has with regards to gradually increasing the tax and ensuring low income households will not have drastically increased financial burden.

4. An additional policy tool for carbon pricing is the government to consider could be to charge higher property taxes for less efficient residential buildings, specifically existing buildings that are not up to the current building code standard. Therefore, the more fossil fuels emitted to operate the home, results in increased property tax and would be regulated for the existing building stock. Or there could be a carbon tax that directly affects the homeowners utility bill therefore, the more fossil fuels required for operation, the higher the energy bill. This would encourage homeowners, specifically those in existing buildings, to make retrofits.

5. The introduction of a method of carbon budgeting. Control the amount of allowable energy consumption through the use of fossil fuels. Over use of fossil fuel energy results in a tax.

Summary:

This recommendation can be implemented in Ontario now. Currently, Ontario is in the process of implementing a cap and trade system, which will put a price on carbon emissions. The goal is to reduce GHG emissions by 15% lower than 1990 levels, by 2020 (The Canadian Press, 2015). But there is still many rules and issues that will have to be worked out before completely and successfully implemented (The Canadian Press, 2015). The tax should begin low and gradually increase annually. The four methods above could be implemented mutually or individually to regulate a carbon tax in Ontario. BC has demonstrated success with carbon pricing and has a system that both the majority of government and the public support. Strong political leadership is one attribute that is reliant on the premier and government's priorities. However, public support could indicate to governments what is important to the public. Previously mentioned, the public

in BC have supported to the carbon tax, although it did take a few years. Implementing a carbon tax could also improve the support for the MHA. As increases in energy prices, public will likely strive to reduce energy consumption. In addition, the savings that would result from a better built home could create more support for stronger and more aggressive building codes.

4.3.3 Recommendation # 3- Alignment of Voluntary Standards with Future Editions of the OBC

Importance:

All participants of the study agreed that voluntary codes are essential to the success of aggressive building codes and the future editions of the OBC. As previously mentioned in Section 4.1.1, between 2006 and 2012, the voluntary Energystar program had builders constructing houses to EG80 as that was announced as the new code level for the 2012 OBC (Lio, 2015). When EG80 was adopted in 2012, it was effortless to gain acceptance as builders and trades understood the required materials and techniques to achieve that level. However, Energystar is currently 25 percent higher than code, while the next edition of the OBC is only 15 percent higher (Lio, 2015). In addition, the financial incentive programs from the gas and electric utilities are only offered for building 25 percent better than code, while there is no incentive for building 15 percent better than code (Singleton, 2015). Therefore, when the 2017 OBC comes into force there will be misalignment because builders understand the mechanisms for 25 percent better than code but not 15 percent and this will create a problem with the transition period (Lio, 2015).

Current Situation in Ontario:

Currently, there is not a seamless transition from voluntary programs, codes, and standards to the new edition of the OBC. The primary reason that there is misalignment between the voluntary standards or programs and the future editions of the OBC is because voluntary standards, such as

Energystar are a National focus whereas the OBC is provincially focused. The federal government is responsible for the Energystar voluntary program and contributing in setting up the new energy targets for these voluntary programs, while the provincial government is responsible for establishing the building code (Lio, 2015). Furthermore, misalignment is present with the revision dates of the National Building Code and the OBC, which adds another layer. However, alignment between the National and Provincial governments is only part of the alignment predicament. The voluntary programs offered through Union Gas, Enbridge, and the OPA, should run simultaneously with the building code cycles (Bach, 2015). The programs are on a 5 year cycle but do not align with the revision dates of the OBC as the programs commence on January 1, 2016 and the new edition of the OBC is January 1,2017 (Bach 2015). Also, aligning component efficiencies, such as windows, furnaces, water heaters etc, with the new code and voluntary program cycle is important. Currently, Enercan is able to change, for example, window efficiencies mid code and program cycle, which is difficult for builders as now there is always changes in techniques and materials instead of once every 5 years, which would happen if all parties were properly aligned (Brydon, 2015).

Also, the alignment between building codes, component efficiencies, and voluntary programs could also contribute in preventing or limiting resistance and lobbying from stakeholders. Currently, without alignment, stakeholders are frustrated because the OBC updates energy performance every 5 years but other changes occur in the interim. For example, there may be changes to window efficiency 2 years after the BC and then a year later, changes to water heater efficiency. Stakeholders will be frustrated with that, so there is push back against the code change. If all elements were aligned then it would be easier for these stakeholders to accept and appreciate a continuous change, but currently they need a couple years just to get their processes

in place after any one of these changes occur (Brydon, 2015). Alignment can also lead to effective communication. This could lead to less lobbying because all stakeholders including BC personal and the industry will understand and discuss the contemplated changes ahead of time and discuss the changes that are possible and doable (DiGuiseppe Martin, 2015).

Barriers:

There are limited barriers to this recommendation of voluntary program, component efficiency, and building code alignment to commencement dates. This is an inexpensive recommendation.

Methods for Improving Alignment:

There is the Building Code Conservation Advisory Council (BCCAC), which aims to improve alignment as there is balanced representation from those in the industry to provide the minister with recommendations. But these committees do not make formal decisions, which is one reason there is still misalignment. There could also be political reasons for not making a change based on the BCCAC recommendation (Lip, 2015). Therefore, below are four methods to improve the current alignment issues and the future policy or program should contain some or all of these elements:

1. Ensure that there is at least one builder incentivized voluntary program that demonstrates the energy efficiency increase of the next OBC edition. This could be implemented after the 2017 code is official and the next energy reduction in the future OBC is firmly established. Improving the disconnect between the federal and provincial governments with regards to voluntary programs, such as Energystar and future voluntary targets, and the OBC is critical. Aligning the OBC and model NBC revision cycles is one possible method.

2. Modify the commencement and revision dates of the OBC with the electric and gas utility programs, and component efficiencies to be on the same date. The alignment would create collaboration and when the new code launches, the programs would move the builders up to the next code through the incentives. Ideally, there should be the building code change, aligned with the commencement of voluntary programs released by the OEB through Enbridge and Union Gas , aligned with changes in energy efficient requirements of component efficiencies such as furnaces, windows, and water heaters (Brydon, 2015).

3. Increase the integration and discussion between building code authority, natural gas companies, and electric companies in the OBC process. Also, including appropriate stakeholders such as, a representative from Enercan appliances branch and from OEB, which sets new standards for component efficiencies and the policies for the DSM and CDM voluntary programs, respectively, is important in ensuring the most suitable personal are present in the meetings (Singleton, 2015). Currently, this is not happening to that extent. This could be a way to improve the disconnect between the programs and the codes.

4. The creation of a long term energy plan for Ontario with regards to energy efficiency in RBCs could be beneficial. So by 2023 the code will be EG90 and in 2030 it will be EG100. And in order to support this there will be voluntary programs, like energystar, that will contribute in ensuring 20% of the housing stock to be EG90 by 2018 and 40% by 2021 so the market will be able to support the change by the time the new code is official. gives builders notice for what will be expected with the future so there can be the necessary training and education on achieving those levels (Love, 2015).

Summary:

These are four methods that could improve alignment issues in OBC and allow for a more seamless transition between revision cycles every 5 years. There should still be builders striving for more aggressive targets through higher efficiency targets as long as there is widespread understanding how to reach the next OBC level. It is also important to ensure alignment between component efficiencies, voluntary codes and programs, and the OBC in terms of commencement dates. Alignment could lead to reduced lobbying and effective communication between suitable personal discussed in method 3.

4.3.4 Recommendation #4- Improved Financial Subsidies

Importance:

What usually encourages a first thrust into more aggressive energy efficiency in RBCs would be financial incentives (Lip, 2015). However, Ontario's current financial incentives are relatively weak and are not receiving large enough uptake amongst the public.

Benchmarking of Success:

Brussels, Belgium

Brussels-Capital Region implemented the BatEx program in order to comply with the requirements of the Passivhaus standard, which was established in order to meet the EU energy directive. This was viewed as a major success. Brussels went from containing no passive houses constructed in 2006 to over 2,900 in 2015. By 2012, energy consumption per person decreased by 17 percent which, stated, was a direct impact of the BatEx program(Standen, 2013). Brussels BatEx program provided significant financial subsidies and stimulated the demand and supply of low energy buildings. Previously discussed in Section 5.1.

DSM and CDM Programs Leadership Programs

Demand Side Management(DSM) and Conservation Demand Management(CDM) programs exist the gas and electrical utilities, respectively. DSM is part of the Union Gas and Enbridge portfolio to have programs that reduce the consumption of gas and is a part of the conservation mandate. The programs have different models but essentially the programs incent buildings to provide and investigate various methods to achieve a reduction in gas consumption. Some models involve direct financial incentive to builder and other models put the money towards consultation and education and training component, so it enables the builder to build more efficiently. These DSM programs are critical in accelerating adoption. The same exists for electricity side, they call them CDMs but it is the same principles (Lip, 2015). So there are a couple of these type of programs in existence today. Below is an example of one of the programs.

In 2012, Enbridge presented the "Savings by Design"(SBD) program, designed for new residential and commercial buildings in Toronto. Residential homebuilders would apply for the program and if granted would receive financial incentives that would contribute in offsetting some of the costs associated with higher efficiency buildings (GBSS, 2012). SBD for residential builders offers 2,000 dollars for each house that is 25 percent better that the OBC 2012. However, the incentive maximum is 100,000 dollars which equivocates to 50 residential buildings per year (GBSS, 2012). In addition, the SBD program covers the costs associated with the integrated design process(IDP), which is a value of up to 20,000 dollars. The IDP identifies all the optimal technologies and various designs that will provide the maximum performance for the home. (GBSS, 2012). However, the SBD program is restricting the financial incentive to only 50 homes per year. This is not a substantial enough number given that Ontario builds close to

100,000 homes per year(CMHC, 2013). Currently, in Ontario, there is not many of these type of leadership programs. There is the "SBD" by Enbridge and the "Optimum Home" program offered by Union Gas. And the electric utilities also participate in a few programs run by the OPA (Singleton, 2015). The issue is that Ontario should incentivize more leadership programs, which could be achieved through mandating that the MOE direct the OEB, which regulates the utilities, to present more DSM leadership type programs (Singleton, 2015). Because ultimately voluntary programs lead to the regulation as more support in the voluntary side could lead to more rapid change (Lip, 2015).

Barriers:

Several of the current financial subsidies offered in Ontario for higher than code performing residential buildings are not receiving adequate uptake necessary to encourage more aggressive energy efficient residential building codes:

Toronto Home Energy Loan Program

The Home Energy Loan(HEL) program is a financial program offered through the city of Toronto with the aim to improve energy efficiency for homeowners. This is done through retrofits in components such as upgraded furnaces or insulation in order to reduce the energy bill (GNI, 2015). However, there are interest rates that vary from a 5 year term at 2.5 percent to 15 years at 4.25 percent (Spears, 2014). Homeowners apply to the city of Toronto with the agreement for the desired energy efficient improvements and the city will then impose the cost of those improvements on the property. The repayment installations are associated with the property and not the homeowner (GNI, 2015). Further, homeowners can get loans only up to 5 percent of the value of the participating property and the building must be evaluated through an

energy advisor before any action is taken(Spears, 2014). Labbe, a participant in the study states that thus far the HEL program has not had a significant uptake generating approximately 0.5 percent interest from the public (Labbe, 2015).

Toronto Green Standard(TGS)

Next, the Toronto Green Standard(TGS) is a two tier energy efficient measure for new low rise residential development. The first tier is mandatory while the second tier is voluntary and implemented by a third party review (City of Toronto, 2010). Tier 2 states that the residential building must be designed and constructed to EG 85. There are other categories with minimum requirements to meet in order to qualify for the Tier 2 DCs. Furthermore, there must be participation from a minimum of 5 dwellings, such as a sub section of town houses , detached, or semi detached, all Part 9 of the OBC (City of Toronto, 2010). The TGS also requires tier 1 to be achieved before consideration of DC rebates for meeting the objectives of tier 2. The incentive is a development charge(DC) rebate of 20 percent paid to the city for applications that meet both Tier 1 and Tier 2 (City of Toronto, 2010). Brydon, 2015, a study participant, argues that TGS is not receiving uptake because in Toronto there are not a vast amount of residential subdivisions. There are some single family residential buildings but the TGS stipulates a minimum of 5 buildings must participate in order to be eligible for the DC rebate. Toronto is aiming the program to production builders and not custom builders (Brydon, 2015).

CMHC

Another current incentive program is from the Canadian Mortgage and Housing Corporation (CMHC). The CMHC offers a 10 percent reduction on the full cost of the energy efficient premium for qualified new construction residential buildings. However, there are requirements

before the incentive is provided, which is that the building must be on the higher of 5 percent more efficient than the current edition of the OBC (CMHC, 2014). Aside from the relatively low incentive, Lip (2015), argues that this program was not well communicated to home owners that this is an available option to increase energy efficiency. This is a program that builders hesitate to discuss with home buyers as it should be communicated by the lender, CMHC. Also , not every home is eligible to as there are conditions of the loan (Lip, 2015).

OPA

Next, the OPA offers substantially low incentives, such as 500 and 1000 dollars, to builders that achieve EG83 and EG85, respectively. There is low uptake so far in these financial subsidies because it is not enough of an incentive for builders to go through various paperwork and demonstration at that level (Parkes, 2015).

Tax Breaks or Credits

Lastly, in Ontario, there are no current tax breaks or rebates for energy efficiency in residential buildings. There have been reports of advocating for tax credits both for energy efficient retrofits or renovations and possibly for purchasing a new energy efficient home. In the past, there was a federal tax credit program, but it was not reinstated, so it is possible to implement another(Lip, 2016).

Methods for Implementation:

It is important to consider improving and changing the strategies of implementing financial incentives and tax breaks for building or buying energy efficient residential buildings. Below are recommendations to improve the current financial incentive programs.

1. Development Charges(DC) are not insignificant and an incentive that governments can provide to builders that are striving for higher performance housing, which would support the industry (McBurney, 2015). Currently, Toronto does offer DC rebates through the TGS tier 2 but, as discussed previously, is not receiving high uptake because the target buildings are not prevalent in Toronto. Therefore, there could be an expansion of the program from a local region to province wide, which would likely lead to increased uptake because there will be more single family residential building subdivisions. Also, the expansion in DCs could reach Energystar certified buildings. So, provide every Energystar home a 20 percent rebate on DCs because energy efficient infrastructure will require less energy consumption to operate, but it is expensive for the builders (McBurney, 2015).

2. Also a significant issue with getting too aggressive in the OBC and financial subsidies is affordability. Therefore, the implementation of a program that would allow a builder to offer a ZNE home to a consumer under a financing agreement with a payback period. This would be linked to the property and not the homeowner and would work similar to the hot water heater rental system in Ontario (Bach, 2015). This is similar to the HEL program but does not have an interest rate or contain requirements.

3. It is important to value, through financial incentives those builders going farther beyond the performance of the building code. Specifically, there should be larger financial subsidies for those builders that are building, not 5-10 ZNE or passive homes per year, but 100's per year as that could significantly increase the time in which ZNE or passive homes can be the new code and standard. The incentive program would need to offer builders approximately 20% rebate to offset some of the substantial capital costs. This can be achieved by executing a focus program that states, annually for a total of 3 years, there will be high financial subsidies to build ZNE or

passive residential buildings but after that, the program ends. This is similar to the Brussels program (Love, 2015). In addition, pilot projects could be used to test how well this 3 year focus program contributes to increased ZNE or passive residential building.

4. Tax breaks could be beneficial in to motivating consumers to buy energy efficient homes and so at certain levels there would be a break on your taxes and the more energy efficient, the greater the tax break. This tax break could be done through the RSP(retirement savings plan) (Brown, 2015). Furthermore, a tax credit program could help the existing buildings match the current building code of EG80, but because there is no mandatory home labeling presently, there is no indication where existing buildings lie compared to newly constructed homes.

Summary:

Current programs aim at either relatively meaningless incentives or leave it up to the consumer to inquire and request upgrades, retrofits, or high performance buildings. However, Parkes and Singleton, 2015, state that utility bills for consumers are not high enough to incentivize costly retrofits and investments. Therefore, carbon pricing could be enough to encourage consumers to change. And applying carbon pricing along with MHA, which should increase energy literacy amongst consumers, these improved financial subsidy recommendations and possibly some of old programs should begin to receive interest and traction in the market. Also, if MHA were mandatory, tax breaks could contribute in improving existing homes to higher performance standards and even reach the current OBC. The high financial incentives from the focus program (3) and DCs(1) will contribute in allowing builders to prove effective practices and decrease the cost of technology and manufacturing so that the end price substantially drops. This should contribute in forming more affordable high performance housing.

4.3.5 Recommendation #5- Mandatory Training Programs and Consumer Awareness

Importance:

On the supply side there should be mandatory or increased use of training programs for those in the building industry and on the demand side there should be increased consumer awareness and education (McBurney, 2015). Considering and implementing the previous four recommendations will likely lead to more success and uptake in energy efficient training programs and an increased level of consumer awareness as previously explained. However, it is important to understand how to directly and independently improve building industry training and consumer awareness/education.

Benchmarking for Success:

Mandatory BDT and Improved Participation in Training Programs:

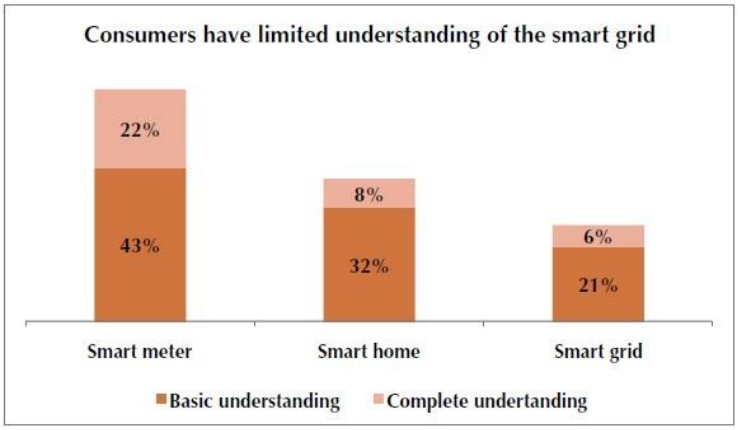
A BDT could be regulated in order to encourage builders and trades to complete energy efficient training programs. This would also contribute in ensuring compliance with current editions of the OBC in terms of energy efficient requirements, presently EG80. If the BDT was mandatory, then all components of the residential building industry would have to ensure that the end home met the requirements of the OBC and this would likely encourage the participation in training programs in order to succeed. Currently, in Ontario, there is no mandatory BDT and therefore, no push for the building industry to participate in higher performance building training programs as compliance is met by SB-12.). Further the code should gradually increase the requirements for the BDT or air leakage test. Therefore, if this was phased into the 2017 code, it might start as 2.5 air changes and then it should gradually decrease in each subsequent code cycle (Labbe, 2015). This would promote those in the building industry to remain current with participation in

more aggressive energy efficient building practices as the code is always increasing in air leakage rate. And given the previous issues with the sealed vapour barriers and air barrier continuity discussed previously, it is important for all components of the building industry to ensure the quality of higher performing residential buildings.

Smart Grid and Metering:

A global study in 2011 reported that nearly 60 percent of participants could not describe a smart meter (Rowlands, 2012). Further, North Americans have a narrow understanding of the terms, smart meter and smart grid. In a similar study in 2011, a survey demonstrated that in the U.S almost 50 percent reported that they could not define the smart meter term (IndEco Strategic Consulting Inc, 2013). The same study noted that over 50 percent of Americans had no understanding of a smart grid (Rowlands, 2012). The Canadian Consumers 2012 survey yielded similar results as the global trends, as only 27 percent reported understanding of the smart grid and 40 percent reported understanding of a smart home. However, in Canada, smart meter awareness was substantially higher, reporting 65 percent that contain a basic or complete understanding of smart meters (IndEco Strategic Consulting Inc, 2013). Canada has a significantly higher understanding of smart meters due to the extensive deployment, more widespread use, and experience, most notably in two of the Canadian provinces: Ontario and British Columbia (Rowlands, 2012). These levels of consumer education and understanding are depicted in Figure 4.6.

Figure 4.6- Consumers Level of Understanding of "Smart" Terminology Source: (IndEco Strategic Consulting Inc, 2013)



In the U.S, it was also established that increased levels of understanding was present in consumers that supported and participated in smart meter and smart grid programs. Furthermore, consumers that have increased knowledge are also likely to alter energy usage in order to meet energy goals. It appears evident that understanding of smart meters or grids is likely to increase upon participation and widespread use or deployment (IndEco Strategic Consulting Inc, 2013). Ontario has mandated smart meters(Brydon, 2015). It is clear that it has contributed and increased the consumer awareness and understanding. However, the current levels of consumer understanding of smart grids and meters is still relatively low and with that can increase the chances of confusion and opposition. If there is a lack of understanding, it will limit the extent to which they become active participants in the energy system (IndEco Strategic Consulting Inc, 2013).

Barriers:

Currently there is no mandatory training for any builders once they have obtained a degree and certification. So as the code increases in energy efficiency there is not additional required training for builders and (electricians, plumbers, etc) to ensure it is built to the highest

quality with minimal error (Black, 2015). Also, carpenter trades and union have initial training requirements and apprentice requirements, but no continuing education. There is no requirement to go back and learn the latest training advances in energy efficiency (Brydon, 2015). It is important to understand specific details such as piercing the air and vapour barriers in the wall when installing electrical boxes or water pipes will undermine the performance of the wall assembly and all professionals involved in the construction and operation of the residential home should have this knowledge (Singleton, 2015). In the building industry, there are personal from different component companies such as insulation, framing, windows, etc and so all parties must understand and have the necessary energy efficient training. As explained above, electricians, plumbers, and other trades are also part of the overall building team and therefore must understand the techniques of energy efficiency in buildings (Singleton, 2015). As discussed in Section 4.2.1 and 4.2.2, there were previous issues with electricians and plumbers destroying the vapor barrier while installing an electrical box or other component. There was no training to demonstrate that it was critical to have a completely sealed vapour barrier. This can compromise the performance of the insulation and overall efficiency of the residential home (Bach, 2015). One of the main issues with training is that the trades are paid per house and therefore try to accomplish that quickly and without difficulty and training courses and sessions will likely cost too much in lost wages and time. Enerquality is in the best position to train those in the building industry and still have issues. A problem is that although trades and others in the building industry are in a union, they are still piece workers and so the unions have not yet figured out how to instruct or execute the energy efficiency training programs (Bach, 2015). Mandating BDT could improve and increase builders and trades participation in energy efficient training programs.

In addition to improving the required training for energy efficiency in the building industry, the development and increase of consumer education is also important. Homeowners struggle to understand how to effectively operate energy efficient homes. The government mandates through the OBC requirements of air tightness, but then homeowners turn off the HRV systems so the house does not function optimally, which creates an unhealthy environment (MartinDiGuiespe, 2015). In addition, consumer education and awareness in Ontario is relatively weak because there has not been enough negative climate change events in Ontario to convince people that GHG emissions are detrimental to the environment. Therefore, there is not the desire to change or alter lifestyles, including residential homes (Bach, 2015). Also it was evident through Section 4.2.5 that fuel and energy costs in Canada and Ontario are relatively inexpensive. Consumers are not concerned about the gas and energy bills because it is a cheap expenditure, although electricity is more expensive (Singleton, 2015). But with higher performance houses, it is mostly energy efficient envelope and foundations, which are gas related savings and appliances and plug loads are electricity related (Singleton, 2015). Therefore, consumers are not largely concerned with education regarding energy efficiency. However, increased smart metering in Canada has increased consumer understanding and awareness.

Methods for Implementation:

The below methods explain various measures that can lead to improved training programs in addition to increased participation. The methods also outlines a possible option to improve the levels of consumer awareness.

1. There should be changes in the methods of building inspections because currently there are only inspections at the framing stage and to ensure vapour barrier continuity, but there is no

inspection for the air barrier (Brown, 2015). The air barrier is critical to the moisture movement in and out of the house and, if it fails, everything within the system, including the insulation fails. Therefore, inspection at multiple stages of construction is needed. It is important to have dedicated training programs for builders that will help with special techniques for building of higher levels of efficiency. Therefore, there is an opportunity on the training side for air sealing, which can result in major energy savings, which would not necessarily increase the capital cost of the house like adding layers of insulation. Ontario could focus more training programs on proper air sealing and prevention of issues that could arise from extra tightly built houses like moisture and mold (Brown, 2015).

2. In order to substantially benefit from training programs, there must be a major change, which is ZNE buildings. That is the next major step in aggressive energy efficiency codes and should be what new training programs are designed to support. And there should also be the integration of regional utilities and that would include the municipal local distribution companies as well as the provincial transmission companies. In the design of the ZNE training programs, utilities should participate and play a role. This would contribute in smoothing the road to the ability of large scale deployment of renewable energy on houses, which is a necessary element as codes get more aggressive towards ZNE. In addition, the utilities will likely be required to change their operational model from the current model, which is generating energy for the consumers to purchase. The ZNE scenario would indicate that the utility must restructure its rates to earning profit from renting out the transmission lines, rather than profiting from sending consumers electricity (Pope, 2015).

3. To benefit consumer education, a mandated real time home energy display off the smart meter could be effective. This would display to homeowners the cost of running the house per

hour and does not require any new advancements in technology. This could be an innovative method for developing and increasing consumer awareness of energy efficiency. This is an especially effective method as energy efficiency in homes becomes more aggressive.

4. Mandatory BDT could increase the level of participation in energy efficiency training programs of those involved in the residential building industry. This can be achieved by designing a policy where initially the results of the BDT would not be used to test the buildings performance and it wouldn't be used as a method of compliance, but it will after 5 years (Parkes, 2015). The code assumes that there are 2.5 air changes, so anything above that will demonstrate to builders what needs to be changed and altered to get 2.5 or better air changes. Builders today would be able to see their rank on that scale and whether they need training to reach the levels that the code will require. Same will be done for voluntary programs. The requirements in the OBC could gradually increase in each subsequent cycle, beginning at 2.5 air changes. There should also be two BDT: One will be prior to installing the drywall and the other will be post drywall stage. The idea is to test the air barrier when it is exposed, so if there is a problem, it can be easily fixed. Then a test after the drywall. Pre dry wall will give builders the chance and time to understand the possible errors in the building methods (Labbe, 2015). This could drastically improve participation in energy efficient training programs.

Summary:

Therefore , through mandatory BDT, it is possible to increase participation in energy efficient training programs thereby increasing the knowledge of the building industry, which will likely result in higher performing and quality residential buildings. If implemented, as the requirements increased in each new edition of the OBC, training would increase too and this

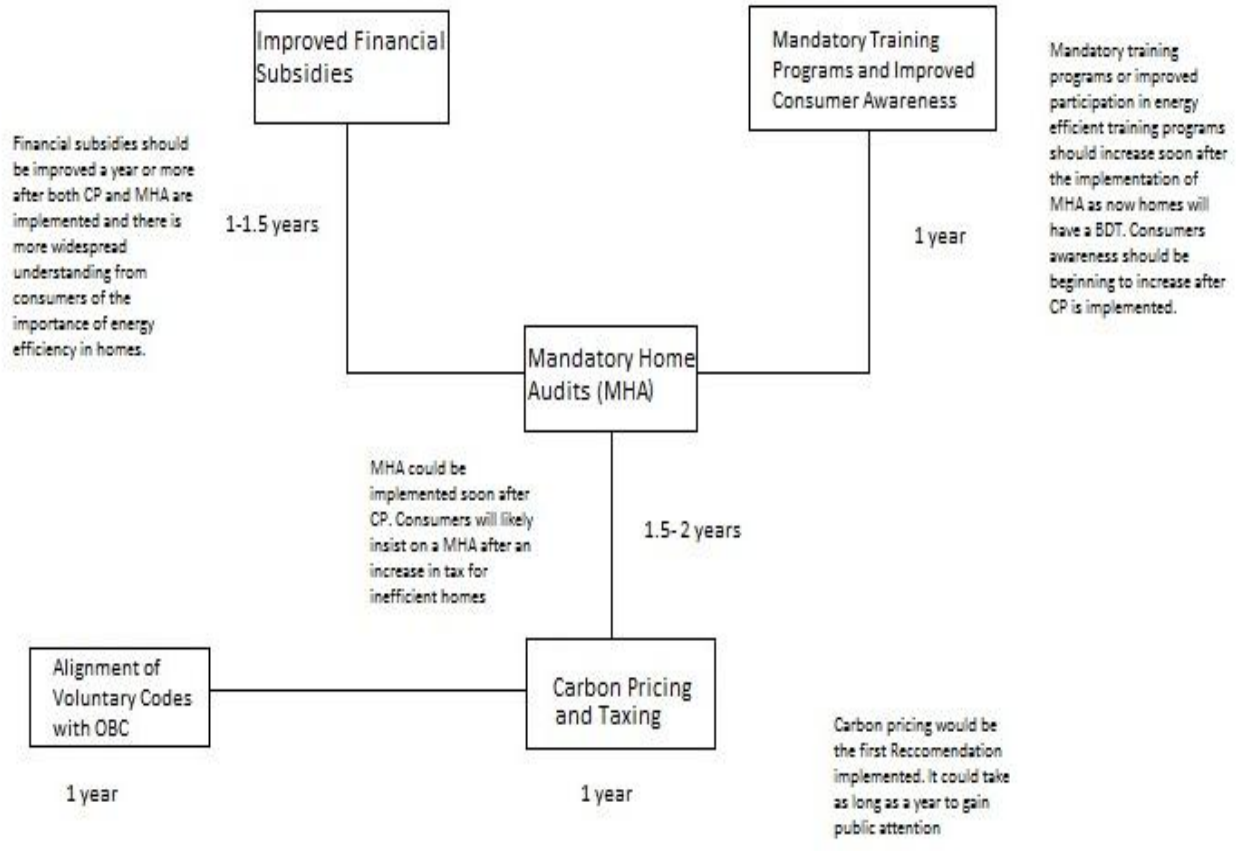
could allow for more aggressive residential building codes. Currently in Ontario, there is no requirement for a BDT and compliance is statistically unofficial. Consumer awareness has been discussed throughout the recommendation set and mandating IHD could increase consumer awareness and education in a similar way in which smart meters increased understanding amongst Canadians. As the implementation of one or more of the recommendations occur, building industry participation in training programs or mandatory training programs will likely become more prevalent.

4.3.6 Recommendation Set Summary and Conclusions:

Together, these 5 recommendations, if implemented in the form of policies or programs, could substantially improve energy efficiency in residential buildings and could lead to more aggressive residential building codes in the future.

In order for optimal implementation in terms of effectiveness and efficiency, the order of the recommendations is important. The implementation of one recommendation will likely lead to the support and implementation of the other recommendations and create a more effective and successful implementation rate. Figure 4.7 illustrates the optimal order of the recommendations (bottom-up).

Figure 4.7- Optimal Order of Recommendations(Bottom up) Source: (Moroz, Brian, 2015)



The recommendation set considers both new and existing residential buildings. All recommendations apply to new build residential buildings. However, there carbon pricing and MHA are two recommendations that are also geared specifically towards the existing building stock. Carbon pricing will be applied to existing buildings and illustrate to the homeowners the increased cost of utilities therefore, promoting renovation or retrofit. In addition, the MHA will demonstrate to homebuyers the difference in operating costs of a more energy efficient compared to an inefficient existing building, which could encourage existing buildings to improve in order to remain competitive in the housing market. The uptake in the energy efficiency for existing buildings is expected to increase with the implementation of the recommendation set.

4.4 Evaluation of Recommendation Set

In order to assess the successes and challenges of the recommendation set, an evaluation will be formed using 2 field experts with experience in high performance buildings. The intent is to understand, prior to a pilot, what is reasonable and manageable and what can be changed or altered to ensure the recommendations will be successful.

4.4.1 Expert #1- Richard White:

Richard White, lead architect at Harvey Architecture and practices in low energy housing, argued that one barrier is an ethical dilemma with MHA because it is difficult to determine and assess the actual energy use of a residential building. There is a theoretical performance and this applies to new homes even if compliance is demonstrated through the energy models and SB-12. Therefore, the challenge is between actual performance and model performance. It is difficult for consumers to rely on the reported performance of the building. The discrepancy could be in the execution in that there could be an effective design and energy model but the execution is poor. So energy models demonstrate the performance level that can be expected in the residential building but during the execution, there are errors and discrepancies that yield a lower than expected performance.

In terms of the carbon tax recommendation, there is agreement that a carbon tax based on the amount of CO2 emitted by the house is appropriate and should be implemented. And the tax generated from the carbon tax can be used to financially subsidize high performance building programs.

However, White does not agree that there should be alignment between commencement of component efficiencies, voluntary programs, and future editions of the OBC. Most recent and up to date advancements in technologies or materials to improve the energy efficiency of a

residential building should enter force when ready. The earlier the better so that innovation for energy efficient equipment and technology stays consistent. However, White mentioned one method for improving alignment. In Germany there is guidance provided on information regarding the next version of the building code. Germany's government releases the requirements for the current code and the next edition of the code along with methods that explain how to successfully achieve the criteria. Information provided to contribute in demonstrating methods for meeting some of the objectives of the future energy code. Therefore, the OBC could provide information regarding procedures for successfully meeting the 2022 code at the same time the requirements come into effect for the 2017 code.

In terms of financial subsidies , TGS expansion, as discussed in Section 4.3.4, could be effective. In addition, it would be valuable to offer rewards and incentives such as money for consumers that are purchasing higher performance buildings. Toyota offered rewards for consumers who purchased the Prius and this contributed in gaining traction. Therefore, incentives for home buyers could provide useful.

And White also agrees that introducing and implementing the mandatory BDT will contribute in increased participation in training programs.

Overall comment however, is that strong political leadership and support is a critical element for success as evidenced by the EU and certain policies and standards in Ontario, such as EG80.

4.4.2 Expert #2: Gerry Conway

Another expert, Gerry Conway, an architect in high end custom housing, insists that MHA is useful for comparing energy ratings and this should influence sellers and buyers. Labelling does exist in some places in the U.S.

In addition, consumer awareness is relatively weak. Consumers should be educated on the total cost of the house. There must be a way to demonstrate cost savings to the consumers as the public wants an inverse relationship. Also, there is not widespread acknowledgment on the possible rebate programs. And before implementing any policy that will have perceived additional costs, there must be an explanation demonstrating the value to the public. The provincial government should strive towards incentivizing home owners and consumers for reducing energy demand and it could be in the form of money for reduced usage. This method could be used as part of the carbon tax system.

Conway explains that carbon taxes should be measured in kwh usage, therefore the higher the kwh, the higher the carbon tax. And the basis of the cost of carbon is from extraction to transmission.

Conway further describes that the size of houses has an impact. Some houses now are upwards of 3600sqft. Therefore, incentives for compact buildings could be an effective strategy and could provide more exposure to those type of developers.

Last, Conway explains that in order for the recommendation set to be successfully implemented, it is important to involve manufacturers, architects, trades, and all stakeholders in the process.

4.4.3 Conclusions:

One of the issues with the recommendation set was presented by Richard White, arguing that there is an ethical dilemma with MHA as there is difficulty determining the actual energy use of the residential building. One method to addressing this roadblock could be through mandatory training, which was explained in section 4.3.5. Because White's theory is that there is discrepancy in the execution, improved training in the building industry could reduce and limit

the perceived issue and contribute in making MHA more effective and actual representation of building's performance. Improved training was discussed in section 4.3.5.

An additional method for aligning voluntary programs to future building codes(section 4.3.3) that would contribute in successfully implementation was described: Improving alignment in Ontario through ensuring that there is information and procedures for meeting the 2022 code during the commencement date of the 2017 code could be achieved. This could be part of Ontario's long term goals and would require governments, industries, and policy makers to understand all successful components for compliance of the future code cycle.

Another important financial piece to be included into section 4.3.4 is providing cash money rewards and incentives for consumers that upgrade or purchase a high performance residential building. Both White and Conway agree that this is important to include in Ontario. In the past, Toyota offered consumers money rewards for purchasing a Prius, which contributing in gaining traction. There could also be incentives for consumers reducing energy demand in their homes and could be part of the carbon tax system.

Also, recommended by Conway was designing a policy for compact residential buildings. Because the size of a house has an impact especially when a 2 persons are occupying a 3600sqft building. Incentives for compact buildings could be an effective strategy for more aggressive RBCs.

As White stated, political will and support is a crucial element to the success of the recommendations. Political support was evident in both EU and in the implementation of Ontario's first major energy code, EG80. However, the political support necessary to implement the recommendations is not known as different government's have different priorities. One

consideration is that implementing one of the recommendations, such as carbon pricing or MHA, could gain traction that results in public support, as demonstrated in section 4.3.1 and 4.3.2, and encourage the government to further support the energy efficient policy recommendations. Other than the requirement for political support, there were no major roadblocks identified in the expert evaluation of the recommendation sets. The next step would be to apply the advantageous suggestions to the current set of recommendations in order to increase the degree of success for implementation. Therefore, the recommendation set appears ready for implementation and if it is, should successfully lead to more aggressive RBCs. However, there could be additional efforts to validate in order to understand all possible roadblocks to the successful implementation of the recommendation sets. Testing the recommendation set in a pilot project is another future goal.

Chapter V Conclusions and Further Investigation:

5.1 Further Investigations

My study focuses on implementing energy efficient policies in residential building codes by using recommendation sets. I will be investigating how to successfully implement aggressive energy efficient policies while ensuring that the process is more rapid while still being achievable presently. However, my attention will not be aimed at cost effectiveness of the policy recommendations, which is one of the limitations of the study. Therefore, after complete my study, there should be follow up work examining how cost would factor into the potential energy efficient policy recommendations. Cross-studies could be performed to analyze the cost effectiveness. This way all the policy recommendations can be examined with realistic associated costs being factored into the equation. Therefore, a future study could evaluate which energy efficient policy recommendations would be most cost effective and achievable in Ontario.

Also, the next step could be launching pilot projects to demonstrate whether the policy recommendations are viable and successful in residential building codes in Ontario. Pilot projects will demonstrate the strengths and weaknesses of the energy efficient policy recommendation set. It will confirm whether or not these recommendations will lead to more successful implementation of aggressive energy efficient residential building codes in Ontario. If they demonstrate to be very effective and successful recommendations, then consideration about extending the scope to other provinces that are struggling with energy efficient building code implementation could be done. This could contribute in ensuring other provinces within Canada can, more easily and effectively, meet aggressive targets for energy consumption reduction in buildings within time frames or enforcement dates.

In addition, a future study could investigate North American jurisdictions and recommendations could be derived from those successful experiences.

Last, the role of renewable energy was not presented in the 5 recommendations. As standards become more aggressive, the role of renewable energy will increase. Therefore, future work could provide insight into what policies could make renewable energy uptake more effective.

5.2 Conclusion:

Global energy demand is expected to rise and fossil fuel energy, such as oil, coal, and natural gas are the dominant sources and represent a 50 percent increase from 2008 to 2030, based on 2008 policies (Pode, 2011). Further, residential energy consumption represents 17% of total secondary energy use while the related GHG emissions were 15% (NRC, 2011). Energy efficiency in residential building codes could reduce energy consumption and GHG emissions that contribute to global warming and climate change. The purpose of this report was to identify, enhance, and

support the implementation of policies that aim for more aggressive and stringent energy efficient building codes and regulations in Ontario. The literature demonstrated, through progressive EU, the opportunities and barriers to energy efficient policy implementation. The major challenge was compliance and lack of knowledge while the opportunities were in existing building stock and vocational training. The background of Ontario suggested that there are policies that must be improved in order to support more aggressive energy efficient RBCs. Further, the background demonstrates that there are not enough effective and stringent policies to promote aggressive energy efficient RBCs. This was evident through the GEA, SB-12, EG 80, Bill 124, and the continued use of timber frames in Part 9 of the OBC.

The methods used in the study were a EU policy analysis, semi-structured interviews, and a recommendation set. The EU policy analysis was an assessment of an energy efficient building directive that was to be implemented into all member states. Successes and failures within the MS was discussed with the analysis demonstrating possible lessons that can form a template for policy implementation that can lead to improved energy efficient codes in buildings. The second method was 13 semi structured interviews with experts of various backgrounds that have previous experience with energy efficiency in building codes. The results provided a background of to the success of previous energy efficient building codes and policies in addition to policies that could be implemented currently in Ontario which could lead to more aggressive RBCs. Both the results from the EU policy analysis and semi-structured interviews were instrumental in creating the recommendation set. The recommendation set explained effective policies to increase aggressive energy efficiency in aggressive RBCs along with the methods and procedures that will lead to the successful implementation. The recommendation set represents a holistic policy approach that can lead to more aggressive energy efficient standards in the OBC.

The recommendation set was then evaluated for validation and possible roadblocks to successful implementation. The major underlying barrier was that political will and support were essential to the success. However, the political support necessary to implement the recommendation set is not known as different government's have different priorities. It is difficult to implement energy efficient policies without political leadership. This was evident from the implementation of the EU directive and EG 80, as both had strong political will. Therefore, implementing one of the recommendations, carbon pricing, could contribute in gaining traction that results in public support MHA, as demonstrated in section 4.3.1 and 4.3.2, and encourage the government to further support the other energy efficient policy recommendations. The implementation of the carbon pricing recommendation could lead to the support of the others. For example, if carbon pricing was implemented using one of the various methods, it could encourage consumers to request energy audits because now the price of fossil fuel energy is increasing and therefore, would likely receive little opposition from MHA. This will also contribute in increasing energy literacy amongst the consumers. Because there is increased demand, more substantial financial subsidies could be offered to builders. And builders would likely invest time and effort in staying current with energy efficient buildings practices because there is now MHA and BDT. The voluntary program alignment and component efficiency with future building code editions will allow for a more seamless transition and understanding between those in the building industry. Each recommendation does not function in separation of one another but instead can function as a union. As previously stated, the implementation of one recommendation can support the implementation of another. Figure 4.7 represents the optimal implementation order of the recommendations. But this remains unknown. Other than the possible barrier of political leadership, results demonstrated that minor provisions could be made to certain

recommendations to better ensure success. Therefore, aside from unknown status of political support and will, the recommendations could be implemented, which would likely lead to more aggressive energy efficient RBCs. The final steps would be to either have more experts validate the recommendation set and state other potential barriers to successful implementation or create a pilot project to test one or combination of the recommendations to determine success and whether they do indeed lead to more aggressive RBCs.

APPENDIX:

A: Interview Questions

SAMPLE QUESTION LIST

Central Research Question: How can we enhance policies with the use of recommendation sets for more rapid change and aggressive energy efficient residential building codes in Ontario which can be successfully implemented presently?

1. What are some of Ontario's previous methods for implementing aggressive building codes in Part 9 residential building....Ontario (Energuide80)? Furthermore, what policies in this case procedures and protocols (contributed to/were responsible for) the implementation of previous aggressive energy efficient building codes?

2. What were some of their strengths and weaknesses towards successful and immediate implementation in the OBC?

3. In the case of the R-2000 voluntary building code standard, what policies(procedures and protocols) contributed to successful implementation? Also what were some of the challenges faced with its implementation?

4. What kinds of policies(procedures and protocols) could improve the implementation speed and success of more aggressive building codes in Ontario?

5. A look into Europe.....Brussels demonstrated that education and training programs, free professional advice, and special subsidy programs(BatEx) can lead to more rapid and successful implementation of aggressive energy efficient building codes. Can any of these policies for success be used in the Ontario System to speed up the implementation of aggressive energy efficient codes?

6. With regards to Amanda Yip's Thesis of an 80% reduction in residential heating energy consumption by 2030 using a tiered framework. Is this a realistic expectation in which policies should be designed to ensure success? OR

a) What should be changed or altered? And what policies could contribute in making this achievable?

b) How far do you think I could go to change things? How high, in terms of energy performance, can policies be designed and currently implemented into the Ontario System?

c) What type of policies are needed to achieve the most rapid change with the largest uptake?

d) Could Brussels' policies successfully contribute to Amanda Yip's idea of an aggressive 80% reduction of residential heating energy consumption by 2030?

7.

a) What are your thoughts on voluntary approaches as a policy towards more aggressive energy efficient building codes? In other words could voluntary approaches eventually lead to successfully implemented energy efficient building codes? Or maybe could voluntary approaches or leadership help achieve aggressive energy efficient building codes sooner? Have there been voluntary policies in Ontario that have contributed in doing this?

b) Are current voluntary policies and programs aligned perfectly with the future energy efficient building code?

c) IF NO, What can be done(policy/program-wise) to improve/correct the disconnect between the voluntary programs and the future level of the building code?

8.

a) How can we encourage the market to move faster with regards to energy efficiency in the residential building code? In other words the market and industry will need time to catch up to any type of highly aggressive energy efficient actions. How can we speed up that time and improve the success and rate of implementation?

B: Interviewee Transcripts

B-1: Michael Lio Interview Transcription and Summary

1/2.

All codes are reference to explicit objectives

- every code has specific objectives/performance objective

Previous codes have been based on a least cost calculus that had to do with capital and operating cost.

Ex. Looking at 3 different furnaces:

- how much each one costs
- operation costs in different locations
- Look at least cost for the purchaser

You cannot just look at the most EE equipment and not consider cost

Current Policy Framework is cost in dollars

How Regulations and codes are made: Provincial

- Measure operating cost
- Look at forecasting energy prices
- Do a survey on the cost of the actual measure
- Look at a number of measure and pick the one of least cost and build that one into the code

3.

Investigated whether this could be a part of the 2012 code

Decided this should be the level

Leap of faith that the economics would support it

Energuid80 was cost effective and the ministry adopted it

Told stakeholders this was the new level and started planning for it

The voluntary programs aligned up against energuid80:

- EnergyStar was energuid80 and builders started to adopt energystar as a voluntary measure in anticipation of the new code requirement.
- EnergyStar uptake started to rise as more and more builders said the code was coming decided to try energuid80 to see what it would look like
- The lead time allowed the market to seamlessly adopt this new level of EE so when the new code commenced, they would be ready.
- Now the OBC and MMAH have announced the 15% reduction by 2017 and so builders have began to experiment what that will look like through voluntary initiatives.

Challenges with Implementation of Energuid80

- New enclosure construction (improved air tightness, new types of windows)
- Higher levels of insulation
- new products (space heating and water heating is EG rating.) products refer to anything that can lower the energy rating of them. Appliances do not factor into the EG rating.

- new mechanical systems (higher levels of efficency furnaces..better furnaces.. new motors, mulitple stage firing systems,)HRV, water heaters..better energy factors.
- Almost entire switch out of old furnaces(entire class of furnace get dropped off)
  - They switched from a 90 to a 94 in energy rating of furnaces that came with an incremental cost of 800 per furnace but by the time this was implemented the cost was nearly 0 to switch.

4.

What could improve Implementation Speed and Success:

- Provide a signal
- Align voluntary programs like Energy Star, Union Gas Optimum Home etc. to the new code standard level because this will allow for a more seamless transition from voluntary programs to regulated codes. This is currently a problem and they are not doing this. So if all voluntary programs were 15% better than code level, this would allow builders get an opportunity to try them and get some recognition that they are getting the new code level early. Has not yet happened and needs to happen
- All the voluntary programs have a training component. Right now there are builders being trained for something that is misaligned with the code. WHAT IS THAT THEY ARE BEING TRAINED FOR????????? In 2006 when they signaled for EG80 for 2012 there was seamless transition. But the new ES is 25% better than code but the new BC is only going to be 15% better. Theres more ee than required. They dont know what to turn off. The provincial government is the one that sets the OBC and the federal looks at voluntary codes and obviously they are misaligned when looking at the example of EG80 in 2012 and ES voluntary standard. When they increase ee by 15% in 2017 ES homes will have been 25% better and now there will be a misalignment when the new code kicks in as many builders now know how to build 25% better than code and not 15% better. This will create a problem in the transition period of the new code instead of a seemless transition. One reason is because the goals of the provincial and federal governments differ.
- EnergyStar was the energy rating 80 voluntary program before the energuid80 code. Then energystar moved to a 83 rating for the next 15% reduction in 2017 but a 15% reduction is only about an 81 or 82 so there was a bit of a misalignment. The reason is that energystar is federal government and building code is provincial government so there is a bit of a disconnect.

  Theres a continuum: MARKET TRANSFORMATION OF EE
  - **Research(**idea of new technology) --> **Development** (develop idea to ensure it will work and fix and identify possible bugs) --> **Demonstration**(demonstration of idea with new houses) --> **Program**(Once you know it works you put it into a program. And these large based implementation programs like energystar. these type of programs are the pre codification voluntary programs) --> **Codifcation**

  - As more research and development take place, there will be more demonstration projects. ZNE is at the demonstration phase of the continuum. This is how to transform the market.
  - The only way to get successful implementation of new aggressive codes is to go through this process. No one will codify it if you dont have proven success. No one will adopt a new building code if not at least 25% of the market as tried it. The way to speed up the process is to move the aggressive code or standard through the continuum faster. HOW CAN WE DO THIS??? WHAT POLICIES COULD CONTRIBUTE IN ACCELERATING IT THROUGH THE STAGES OF THE CONTINUUM FASTER????
  - require a second thesis..
  -training, communications, demonstration Averit Rogers-Prof in US Written Books.

5.

Cannot really use Brussels as an example of what to do. Because there are many less buildings and families moving into Europe. The population size is too different to compare. Ontario and Canada have to accommodate many more people than European cities and states. CANT BE USED AT ALL TO SEE HOW TO IMPLEMENT A CODE AT A FAST RATE????? Principals are the same but you need to look at scale.

Subsidies: Enbridge does this, optimum home does this. Number of federal initiatives also do this.

Discovery process where you work with a builder where you actually work with builder to try it out on one house or multiple houses on a site. It also needs to be funded. Enerquality- service organization in Ontario. Building CANDA initiative mentors builders so that they could try energystar buildings. Worked with 400 builders. Work with them to adopt the new technology.

6.

Thinks were on the edge of economic feasibility. Amanda Yips thesis idea isnt plausible presently. Maybe hers was done mainly on the technical feasibility. Cant really go beyond current levels.

Technical Feasibility is the new R-2000 standard.

So a 50% reduction

How long it took energuide80 to go from demonstration to codification in 2012. 37 years. First demonstrated in Saskatoon in 1975.

Go to universities or whoever is doing energy efficiency research and state we need new technologies that are going to be technically feasible.

What are realistic aggressive codes that can be currently implemented:

Consider energuide80 took almost 40 years to be successfully implemented into the code. Also stated that mistakes were made. WHAT MISTAKES WERE MADE WHEN IMPLEMENTING THIS ENERGUIDE80? WHY DID IT TAKE 40 YEARS????????????? Not understanding market work. not adapting, not changing fast enough.

------>> 50% in 20 years could be doable. Something we could do.

- 50-60 maybe 65% reduction
- I should be looking at after 2017. Building codes work and update on a five year cycle.
- Focus on the demonstration projects for the 2017 code and technologies and speed them up.

Tools for Speeding up the Implementation Rate and Success.

Fiscal tools (tax incentive)

financial tools/subsides

education

regulatory incentive (dont do this and jail)

programming tools and builders can try it.

POLICIES have to have a program attached or a regulation or fiscal or financial initiative.

7.

Answered Throughout Interview.

8. LAST QUESTION HOW CAN WE ENCOURAGE THE MARKET TO MOVE FASTER WITH REGARDS TO EE IN RB Process to engage builders to adopt a standard, try before buying,...requires whoever owns the label or program to think about how the market works and whats important to builder over whats important to the consumer.

B-2: Heather Black Transcription and Summary

1-4.

No SB-12 before 2006. We have had insulation and other energy efficient objectives in BC but SB-12 was the first Ontario own Energy Code.

Minister Garretson and the Ontario Government said they wanted energy effciency and the Ministry(MMAH) came up with what they could and pushed the evelope as much as possible (consulted with people and came up with a list.) The ministry wanted something big so the branch(MMAH) delivered energuide80. enercan used this prior to the OBC. Follow up Recording Part1 EXPLAINS FURTHER....

Stat on how much more efficient a house was at energuide80 than prior to that code:.....(Ask Heather for this) ON EMAIL

Thats a big shift for a politician(nothing significant until 2006 energuide80) because it ties the hands of future governments and ministries in meeting the new energy codes. Discussed in 2006 and implemented in 2012 by code. You need time for industry and market to catch up to that type of aggressive action(energuide80).....**HOW CAN WE SPEED UP THAT TIME???? IMPROVE THE RATE OF IMPLEMENTATION AND SUCCESS**.

Energuide80 was the major benchmark for energy efficiency in buildings.

Full height basement insulation(an idea of previous government and code) was decided quite quickly and abruptly without adequate lead time. and the requirements went flying off the table after they were already in the code. So they couldn't be implemented in time because there wasn't enough capacity, there would be problems with moisture in walls and other things like that. And so that NFHBI requirement came into force

much later than anticipated and government must have felt foolish about it because they didnt leave enough time and it may not have had technical feasibility.

Rushed implementation period. Then there was fooling around with near full height basement insulation and by the time it came into force and successfully implemented, I believe you already had to do it for R-2000 requirement FHBS. Done too quickly, lead time too short, the technical background and stakeholder consultation was not adequate. Therefore it didnt happen when it was suppose to and thats a serious problem when you have something in a regulation and put a date in and it doesnt happen.

Ministry learned its lesson on rushing implementation of regulations. The ministry communicated early about the energuide80 standard and knew approximately what they wanted to do with it and what that kind of house looked like. Also builders could get on board with it(Ya I guess we could do that somehow) That early communication in advance of the energuide80 code of 2006 was important. But what was more important was the process for developing the SB-12 that went with energuide80 equivalent. Because it was stakeholders who said what if we dont want to have a blower door test? It costs a lot of money, there are places in Ontario that where blower door tests are not available, we need prescriptive requirements. Were not willing to just go along with performance paths here. In Part 9 your suppose to be able to prescribe what the requirements are. Hes got to be able to build anywhere in Ontario. Its not like a city like Brussels where you only have to worry about the city and its capacity but Ontario builders need to worry about an entire province and its capacity. So ANYWAYS they said we dont want blower door tests for every house(newly built) because of the above reasons and we want the prescriptive packages. So the ministry had a bunch of stakeholders in and they figured out what those(prescriptive requirements) were going to be and they got together with a consultant and developed so many options because those options need to have been created in 2008 for 2012 codification or implementation. You dont know how much the materials cost or where the capacity issues lie. So it was important to work together with the stakeholders and so the SB-12 kind of belonged to them.

At the same time there were all these different programs (WHAT ONES IN SPECIFIC) for better built houses, houses that were well above code and we depend on these programs to lead the way in the code because that really develops capacity. These are voluntary codes. Approximately 20% of the building industry is building above code. By the time the requirement comes into force, say in 2012, 20% of the building industry already knows how to complete that. So the trades know how, there in the market for that, by the time 2012 comes, they will also know whats coming next because their market relies on being ahead of the curve so they also want to know in advance of the implementation date whats the next thing going to be cause we want to go there.

Procedures of energuide80 adoption: Good answer from Jengis. energuide80 equivalent becasue no one eanted blower door tests/labelling.

procedure is a program for

Enerstar was used for 2012 code. lots of enerstar buildings, they were performing well, and it was popular in marketplace and that's why it was chosen in 2012 for the voluntary high performance standard.

Heather will find out why energuide80 was implemented as new standard for 2012 (ANSWERED THROUGH PHONE CALL) took big jump in 2006 due to garritson.did cost benefit anaylsis. enercan.

The enerstar being used in 2010 or 2011 is in the SB-12 for 2012. Its one of the ways to get to energuide80. These programs assist in reaching the codes----Programs: training for builders, developers, building officials, designers, trades, those training programs are critical. Now government does not have a training arm in building branch.....all training has been transferred to college university. Government/ MMAH still develops questions for the test but they dont administer them.

SB-12 was published in 2009 for the OBC 2012. SB-12 is a supplementary standard for the OBC 2012 regulation and was developed by the MMAH. It can be changed without going to cabinet. Energuide80 is part of the SB-12 and is currently the energy code in Ontario for buildings(residential). Only SB-12 can be tweaked without going to cabinet. If it had to go to cabinet for every minor change then the process would be more difficult. When they make the next edition of BC, they must go through cabinet.

2. Strengths and Weaknesses

It wasnt immediate implementation. There's a 5 year lead period. When energuide80 was iniated in 2006, you had until 2012 to comply. 2012 energuide80 was code but it was optional since 2006. The period in which a code is minimum standard is 5 years. Story of full basement insulation is a major huge part of success. There needs to be adequate lead time. That is a major weakness. Not giving enough lead time or doing something abruptly. Not reaching out to stakeholders enough. These things will lead to trouble when implementing codes. Lead time really helps companies/corporations develop the capacity to build and implement changes. 5 years is the acceptable lead time. Because you need those programs to start building better than code. Then they learn how to do that and after 2 years of them building better than code then we know what the house that is 10% or 15% better than previous code. How much it costs, market take up. Youve got to build it, market it, make sure it works so 5 years seems necessary. The ECO wants MMAH to reduce time period from 5 years to something under than maybe 2.5 years. Big energy efficient enhancement might take 5 years.

With full height basement insulation, it was going to be part of the code in 2012 and they tried to achieve it mid-cycle. Guide books could help with the process as well.

4. Policies to improve implementation:

Up to momentum and capacity in market and sector. And it happens with investment in the market. Government incentivises programs or helps with programs of higher performance buildings. Not really up to the policies BUT more up to the market. SO.....HOW CAN WE ENCOURAGE THE MARKET TO MOVE FASTER WITH REGARDS TO EE IN RB. There is no mandatory training for any builders right now nevermind ee builders. Once you have degree and are certified there is no other mandatory training needed currently. Enerquality is the training program and branch of ee buildings. Builders do take these 1-3 day training programs. Education and training is available. THERE ARE POLICIES OR THINGS THAT CAN BE PROBABLY BE DONE TO SPEED UP IMPLEMENTATION BUT SHE DOESNT KNOW WHAT THEY ARE YET. They listen to building officials because they enforce the code and home builders. How can you shorten period for Part 9?

SB-12 was tweaky: too many options was a problem, new reference standard, models.

IF YOU COMPLY WITH SB-12 YOU HAVE COMPLIED WITH ENERGUIDE80(SB-12 was a set of ways to meet energuide80)

5. Brussels:

No free advice. All happens in marketplace. Scale is much different than in Ontario. Europe put millions into programs where as Ontario does not. Also had billions/money from the EU to support programs and to know how to do it. They also have energy security and cost issues there. HOWEVER, THIS SHOULD NOT BE THE MAJOR ROADBLOCK FOR NOT ENCOURAGING AND INCREASING EE IN RBC. Ontario has pushed a lot for ee and is a province that takes GHG reduction seriously. Also need money for research. We are behind in R&D when comparing ee between Ontario and Brussels/EU. HOW CAN WE IMPROVE RESEARCH AND DEVELOPMENT....WHAT POLICIES COULD BE USED TO DO THIS? Also it cant be all done at a university level but more at a national level. Dont want to get Ontario too far ahead of other provinces because where will we get stuff such as the more efficient appliances or furnaces from. Issue to consider.

Pilot projects,ask

Furnace sizing has already been a problem in town houses. Americans make most of our furnaces and they didn't have a need for smaller furnaces at the time. Then we have a code required prohibited oversized furnaces. So then where do they get the furnaces. There was a gap there. So you pull too far ahead of your neighbours (states or other provinces) then you're in a bind. We wouldn't just need to improve the R&D in Ontario, but in all Canada and possibly the States.

Now there are high performance builders who make the furnaces in Canada. SO....HOW DO WE SPEED THIS PART UP...IS IT MOSTLY FROM IMPROVED R&D?

PROBLEM WITH GETTING TOO FAR AHEAD WITH EE IN RBC: SB-12 is criticized for having less efficient equipment/technology. But we have to allow it if you can buy it. How would equipment manufacturers react if we didnt allow their equipment in the RBC. If you were to just get rid of that equipment for more efficient ones you would need equipment regulation to catch up. Thats another problem if you get to far of everyone else.

Look in to HOME ENERGY AUDITS: this was written on your paper sheet.

Carbon Tax could be helpful.

Were pushing ahead with targets that are aggressive as they can be with the SB-12 but its going to be a hard sell to Politians when they see the payback period. Cant use the same fuel escaladers as we did.....ASK HEATHER ABOUT THIS.

Europe ee is a top priority. Payback period is much lower due to the carbon tax. And because of the fuel prices. So they can sell it in a marketplace more easily too.

Energy costs so much more there so the payback period is shorter. Were paying such a low price for natural gas in Ontario rught niw but it takes a long time before you start to relaize the improvements of energy efffieicny through your utility bills.

You mentioned a couple times about much shorter payback periods when referring to europe and ontario energy...could you just explain the difference in payback periods a bit. Not much detail necessary. I just wanted a bit more clarity.

42mins.

6. Amanda Yip

How far ahead should we or could we be before we run into trouble. Where should we be if this thesis is not doable currently.

Believes in 5 year period. Could we have done better than 15%? Must find a sweet spot where the cost of the house isnt drastically more than the price of an existing house.

How to market net zero- you want to market this house, it must be approximately 10,000 more than a house that isnt net zero. To get market take up you need to be affordable.

Amanda yip is maybe energuide86-89.

When the CHBA committee gets going they will be targeting the higher efficiency and they just started meeting. So they would have a program ready by 2020-2025 that they could implement that would be near net zero. Probably work with other jurisdictions or just Ontario. BC and NS are caught up to Ontario in the energy front. But its the program that needs to lead the way. This is what CHBA is working on. This is where the protocols are made and designed to do the program. And they figure out how to implement it. HOW WERE PREVIOUS PROGRAMS FOR THIS IMPLEMENTED? WHAT WERE SOME OF THE STRENGTHS AND WEAKNESSES? AND IF WE IMPROVE THE PROGRAMS OR RATE AT WHICH PROGRAMS ARE IMPLEMENTED, WILL THIS CONTRIBUTE IN INCREASING THE SUCCESS AND RATE OF EE IN RBC?

For example: If CHBA wants to be somewhere by 2025, the MMAH will try and push the code up high enough so that the distance between minimum and the program is not massive. Methods for doing this: working with stakeholders, listen to them because they are the high performance builders. Make sure theres equipment to do this. HRAC, spray foam, furnace manufacturers, embridge and union gas all work together to get the new code working and so the new gap isnt so high that it isnt doable.

So for example, if the CHBA came to MMAH and stated the new 2025 code will be energuide86, they would aim for energuide83 in order to ensure that the gap is not too out of reach before the code is enforced and implemented as a standard.

7. Voluntary Standards:

Essential. They set the tone for the new codes. If those voluntary code designers(enerstar) dont know what the new code is going to be, they cant make standards that will be better than code. They also use voluntary standards ahead of the implementation of new energy codes so that builders know how to build to the new level and can see how it looks and how its done.

B-3: Corey McBurney Summary

1-3.

Corey McBurney, President of Enerquality, stated that energy efficiency(EE) was not considered a core objective in the building code(BC) and therefore the goal was not to increase EE. But that changed in 2006 BC and as of Jan 1/2012(2006 code that took effect Jan 2012), EE became a core objective through the Energuide80(EG80) building code for Part 9 housing. And EG is the rating scale designed by federal government NRCan. It is energuide rating system(ERS) that establishes the relative ee of homes and 80 by its own definition is considered an ee home. In the 2006 BC, it stated that all homes after Jan 1/2012, must be built to EG80. The Research-Development-Demonstration-Program-Codification(RDDIC) cycle is one of the elements that contributed to the successful implementation of EG80 in the BC. This is the same cycle that was mentioned previously by Michael Lio. Corey mentioned that one of the major strengths in the implementation of EG80 and other energy codes was ensuring that voluntary codes lead the way. Enerquality creates voluntary programs such as energystar and work with consultants, manufacturers, technical firms, and gas utilities to voluntarily build better than code in order to understand the components of higher performance houses in anticipation of a new energy code. This was done in 2006 and in 2012, and will likely be done again for the 2017 cycle. Another import aspect for implementing aggressive codes like EG80 is training. Engaging with the industry on sharing the lessons from the demonstration . So for example, homes sharing the methods, materials, and technologies for success and also the barriers and issues needed to overcome. As for the strengths and weaknesses of implementing R-2000, one weakness was that it was a technical program and that it was a higher standard compared to prevailing BCs. It was designed to and wasnt intended to be friendly for large scale builders, so it was always meant as a demonstration project. A strength of the R-2000 was that it introduced better ways of building through advanced air sealing practices and HRV technology.

4 and 8.

Corey McBurney classified many policies and programs that could contribute to increased implementation speed of more aggressive energy efficient RBCs. The first is aiming to make the BC retroactive. There is no code forcing houses built in or prior to the 1970s or 1990s, to undergo a major energy retrofit. It would be a significant accomplishment to mandate that all homes have to be brought up to the building code. Another policy that could contribute to reduced emissions in buildings is mandatory home audits and energy performance labeling. The GEA and minister George Smithermen has on books that all homes on resale would have to have a minimum energy performance audit, which would provide an energuide rating. This was the plan, and was just never enacted. By enacting this objective it could also imply that every home within 2 years must undergo an energy retrofit. Another important policy piece is aiming to get the municipalities involved and supporting the building industry. This could be done through offering builders money, in the form of rebates on development charges, to build to a higher standard. Toronto is currently participating in a program that offers these rebates and the design is as follows: tier 1- normal no rebate, tier 2- voluntary and receives

20-25% rebate on your development charges. Providing incentives through DCs is something the government can do for the industry to show support for energy efficiency. One issue for trying to speed up aggressive RBCs is that there is no cash incentives for homebuyers of new homes, which means there is no incentive to consider energy efficiency. A barrier is that there is not enough progressive proactive programs to positively engage the industry and homebuyers. Also, in terms of encouraging the market to speed up: Engage building industry for continuous improvement. Move slowly upwards. There must be consideration of occupant behaviour and culture of conservation. In addition, 2 types of programs are necessary. The first is demonstration focus, stretch targets, radical new way of building. Advanced housing with the aim to push the envelope. Second, is broad implementation and this is done through building capacity programs and certification programs. These types of programs can contribute in encouraging the market to move faster with regards to aggressive energy efficient BCs.

5.

Corey McBurney agrees that the scale between Ontario and Brussels is different but that the concept can be applied to Ontario. This could be done through the government investing heavily in consumer awareness, consumer education, on the value of a recognized brand such as an energystar house. The value of an ES quality home or better than code built home vs just a code built home. And they should provide cash incentive (for example $1000) for the consumer who buys an ES home or better than code home. Then on the supply side, invest heavily in education and capacity building programs that work with builders to bring down the costs, overcome some of the resistance, because theres lack of knowledge. And also provide a cash sweetener for home builders in the form of a rebate on their DCs.

7.

Corey McBurney states that voluntary codes are aligned with future editions of the OBC because each year the building code moves up so does ES and so builders always know how to build better than code

B-4: Mike Parkes Transcription and Summary

1-2.

The GEA 2009 is important because it amended the BCA(building code act) and made two major changes: the first being requiring the creation of the building code energy advisory council. The second was the requirement for the immediate review of the energy provisions in the code and then requirement for ongoing review of the energy provision that every 5 years. It built in the idea of continuous improvement in energy right into the code. And then also those legislative provisions had a major impact in ensuring that the ministry of municipal affairs and housing continued to devote staff attention and staff resources to ee in the code. Because the building code covers so many different areas that if its not specifically identified that ee is a priority that their focus could naturally turn to whatever other topics are hot at the moment. Ex would be that LA situation where a mall collapsed, and that dumped a big load on them, but by putting GEA into law the requirement for the energy council and the 5 year review ensures that they will keep a staff of people that specialize in ee in there and continue moving forward on that. For other provisions in the code theres not necessarily that same requirement that at every update cycle you look at whatever the future is but there is that with ee.

Problem with GEA implementation?

There were certainly problems with other aspects of the GEA. On the BC itself, there was concerns about the idea of performance standards for housing. Builders didnt want to get to the last stage of building their house and then find that it failed the test. So I think it was very important and necessary for that SB-12 that the ministry came up with so that builders could choose a set of specific technologies, put those in their house and have that guarantee it will meet the code requirements that wouldnt be subjected to a performance test. So I think that was pretty key in gaining support of the home builders and they could live with that moving forward. Conscriptive paths were the most popular way to meet ee requirements of the code to date. I think the majority of home builders use those packages outlined in SB-12.

EG80 challenges and successes with implementation?

One general concern is that by putting EG80(developed by federal government, EG rating system by NRcan) as a requirement in law is that the province can run into trouble if it tries to put EG as a way to meet the code because the update cycle for the federal EG standard might not match the provincial timeline. So, for example, EnerCan has been working on an updated version of the EG label for years now and its been continually delayed so if you look at the SB12 for 2012, it had the EG as a compliance path and at the moment, its not in there as a compliance path in 2017. This is the case because the province doesn't exactly know where that federal labelling program will end up. It was suppose to be in several years ago and hasnt yet been done. So what the province has done instead is commission their own energy modeling and build in these prescriptive requirements that essentially meet the same energy level as energuide but not putting the EG label itself in there as a code compliance path, at least for the next generation, 2017, BC. If the federal government does come out with an updated EG system that works and meets Ont needs, that they will change SB and put it back in by means of meeting the code.

Strength: The one thing the province did really well was getting the homebuilders association and the building officials association involved and collaborative and both organizations had training for their members so builders knew how to build to meet the new stadards and inspector knew what to look for when they were assessing whether the new homes were built to compliance so the ministry did a good job of that. Builders are

always concerned of first cost of a house and the province did a good job working with them and introducing them to the packages as a means of meeting it.

Weakness in implementation: It doesnt guarantee that every single home is a high performance or EG80 built home because there are assumptions made about how leaky a house is or the air change requirements(dealt with a lot in AY thesis). It makes an assumption that there is this much leakage and in reality, some will do quite a bit better and some will do worse.

The prescriptive compliance packages dont guarantee that it will be the level of EG80. This is because there is no requirement for a blower door test. That was an intentional choice and has its strengths and weaknesses in that it brought builders on side and it reduces their cost of complying with the energy standards in the code. BDT are approx. 300 per test. However, it does raise concern that not all houses are being built to EG80. It is recommended that the province do a review of sample houses after they were built to see how much variation exists. This is for informational purposes and to find out whether there is enough variation to raise concern or whether it is small enough not to worry and just keep moving forward. If you(the builder) chooses the prescriptive path, there us nothing done for actual compliance assessing and measuring/checking. There is no performance test to measure success if the builders choose one of the prescriptive packages in SB-12(AY thesis demonstrates most builders use Package J). To his knowledge there hasnt been any look at houses after they have been built to see what the energy rating range is like. Prescriptive paths are more popular among builders than the performance path because with the performance path it is more expensive because you need to do energy modelling, which will be an additional cost and usually farmed out to a consultant that knows how to use the software or has a license to use it. Also, another reason why prescriptive paths are more popular to builders is because they can all learn one package, usually J, and become effective and efficient at that method of building homes. It is more difficult to become an expert or effective at building performance path homes.

3. R-2000 question.....FOLLOW UP N/A

4. Policies Improving Implementation Speed and Success:

One thing would be more rapid review of the energy efficiency requirements than the 5 year code cycle. ECO has formally recommended that already in previous reports. So they set the 5 year time scale to match the update cycle for the model National Building Code so at the federal level, they make these model NBC's and then Ontario reviews them, adopts what is relevant to Ontario within their building code. But for low rise RB on ee side, the model NBC is not that important so theres not necessarily a need for the review of the energy side of the code to be tied in in that same way with the model NBC?????????????????????? so we just feel a 5 year cycle between those updates is too long so perhaps twice within the 5 year cycle a review should be done. And that would be enhanced if they actually changed the legislation. Currently in legislation, the energy requirements in the BC must be reviewed at least once every 5 years. Changing the law to twice every 5 years in legislation would give it more force and ensure that it would continue on and that staff would make that a priority.

Also mandatory home labeling would really help push higher ee requirements for new homes in that home builders who build homes are obviously worried about the increase in the intial captial cost so if you dump new ee requirements that add on 10,000 to the cost of the house then thats going to be a concern for home builders. But if you had some sort of mandatory home energy labeling in place for new and existing homes then customers would be able to see just how much better performing these new houses built to code would be compared to existing homes and what the energy costs savings they would see in terms of the lower utility bills would be, so the customer would be more informed to say its worth spending the additional 10,000 on this building because im going to be making back 1000 a year on the energy savings but you dont see that right now. Right now, even with the current energy requirements, pretty much any home you buy is going to be quite a bit more ee than the average older house but your average home buyers isnt aware of that. Consumer education in this respect is weak and could be improved through mandatory energy labeling. It would be helpful because it would have straight forward score that you could compare. **Brian**: *This could help increase the consumer education and knowledge in the importance and savings of an ee house. It could also encourage existing buildings to get retrofits in order to sell so they can stay competitive with newer houses. With these mandatory house labeling policy, it could encourage the market to move faster if it is successful in raising consumer awareness and education of ee in homes because then they will demand more*. Also for existing buildings it should be mandatory at time of sale. So if your putting your house up for sale then you must have your house audited and presented with a performance rating. A lower score would likely be a disincentive for a homebuyer to buy that house so it should encourage people to retrofit. The main point is thtat you want buyers to be able to compare energy ratings and values of the houses. Home Builders' Association are on board with this and in favor of this policy as well because it will certainly show off how much more ee new builds are. The home labeling will be represented by an EG rating. This is one initiative that has some interest in doing but has delayed because the federal government hasnt yet updated the future labeling system so the province doesnt want to go to the trouble of mandating this under the old EG rating system if its going to be changed around so they have been waiting around for that shoe to drop. **Brian**: *This is another indicator that provincial and federal goals are not properly aligned. Provincial government is wanting to go through with a policy that could encourage more aggressive ee in the RBC but is unable to due to the fact that the federal government has not figured out the new EG rating system or its replacement for the 2017 code. This puts a lag on aggressive ee initiatives. In fact, in this previous interview it was stated that EG isnt even an option in the prescriptive packages because the federal government hasnt figured out what the system will be*.

One other policy that could also help would be some kind of carbon pricing on our energy use. So basically that would raise the cost of natural gas or electricity consumption. This would be on any energy from fossil fuels so what that does is increase the difference in operating costs between good/well built buildings and older more inefficient buildings. So the more energy the house requires, the more you pay. The savings

you would see from a better built home would be much more significant. If thats the case then there would be more support for stronger building codes. **Brian**: *This policy could also encourage consumers to support more aggressive BC*. WOULD THIS BE ADMINISTERED AS A PROPERTY TAX??? IF NOT WHAT ARE YOUR THOUGHTS ON MANDATING A PROPERTY TAX ON EXISTING BUILDINGS?? IF THEY DONT MEET A CERTAIN PREDEFINED MINIMUM PERFORMANCE. *Property tax would be difficult to implement as it would not be a popular political choice. The carbon pricing would be more of an increase in the energy bill depending how energy efficient the house. Annually your energy bill might go from 2000-3000 with the addition of the carbon pricing implementation. And the energy retrofit would cost 10,000. You could compare cost of the carbon pricing to the cost of the retrofit. There would be a 10 year payback period it so it would make sense to get the retrofit in order to decrease your energy bills.*

5. Brussels Policy in Ontario System:

On the training side air sealing is a big opportunity (was identified in AY thesis). And that you can get big energy savings from good air sealing and that doesnt necessarily increase your houses capital cost the same way that adding more layers of insulation for walls does. So if the province was going to focus on training then proper air sealing would be the way to go. And some builders who are building good tight houses, that once you do build houses that have a very low air change rates, that it can introduce other problems like how moisture moves through walls and there can be mold so your training programs could look at both of those issues together. Mold issues and moisture level isnt an ee problem but it does stem from higher ee and something that the builders can be in legal trouble with. On the financial incentive side both the gas and electric utilities have small incentives right now for building above code. OPA will give you $500 if you reach EG83 and $1000 for EG85. These programs have had very little uptake so far among builders because incentives are simply not large enough to make it worth their while as they would have to go through paperwork and demonstration at those levels. The best thing to do is to look at higher incentives but really target the more extreme performance not just marginal improvements over the code.

Energy costs are a lot higher in Europe and they depend on Russia for natural gas at high prices.

Could go under Q4: Another policy that would be helpful in supporting is mandatory BDT. Requirement for BDT in the code. Initially that wouldn't be used to test your performance and it wouldn't be held against you. So for example, the code assumes there are 2.5 air changes under their testing so lets say you built the house and it turned out to be leaky and you got a 4. They wont pull, your permit BUT at the same time we introduce that requirement maybe the code also states that in 5 years the result of the test will be used to measure the performance and whether you meet code compliance. So builders today would be able to see where they are on that scale and whether they need training to reach the levels that the code will require. That will give them 5 years to enhance and perfect their air sealing through training and design. Start mandating that they do the test now with no penalties and then in 5 years down the road use it to access code compliance. Give them the signal that this is coming in 5 years and that there will be a requirement to reach such and such level. This is similar to the BC cycle in that builders today know that they will have to build 15% higher in 2017.

6. Amanda Yip Thesis

She showed that it was technically feasible but its the issue how much you are willing to pay and whether thats a desirable goal from a policy perspective because you start to see that you reach declining returns after a point like for every extra dollar spending your not getting the same amount of energy saved. The first bt of insulation you add on the house you make huge improvements than you start to see less when you build it up more and more. So the code requirements for ee were initially put it to protect people from higher operating costs from energy. They didnt want builders building cheap houses at minimum cost that would be very expensive for homeowners to maintain. But I think were close to reaching the point to where you couldnt justify too much more investment in ee. This is on the basis of homeowner costs. 60,000 capital cost and 30 year payback period. I find that tough to justify if the only goal is reducing homeowners bill.

What should be changed or altered:

Maybe it could be framed as trying to get that 80% reduction in GHGs that would align well with Ont climate objectives/targets. Looking at it with that as the overall goal. And you would still want to do a lot of the same things. It would also make you look at your space heating choices/options as right now we use almost exclusively natural gas for space heating. Whereas Ont has a very clean low carbon electricity system so if the goal was to get that reduction in GHG emissions then you would also look at solar thermal, air source heat pumps or geothermal heat pumps. You would use those technologies together with a lot of the same passivehaus designs and you might be able to reach that 80% reduction at a lower cost if your considering the space heating technology and the structural elements of the house together and that might be more acceptable from public policy standpoint. Certainly the 80% in heating energy consumption reduction is doable but is it politically desirable or not.

builders need to be taught how to build tighter houses that dont have these moisture management issues but that can be done through training The problem is the capital cost and whether we want to pay that.

Also we want to try to encourage good passive solar design of houses in ensuring that their windows are oriented in the right way to capture the sunlight(**Greg shares this thought**). It be tough to do that through the BC because it has to apply to every building but some buildings will be on poor sites where they dont have much choice. Might not have choice on orientation as they might be shaded and blocked from the sunlight or

another building. The question becomes whether you want to put requirements right into the code that kind of require that passive/solar design or the other way to do it is potentially through the planning act, when your doing plans of sub divisions for large lots, you might be able to introduce some requirements in that way. Another policy which could deal with the BC and could contribute in more aggressive ee in RBC.

d) Brussels methods to meet AY thesis: Nothing wrong with using financial subsidies and training to encourage consumers and builders towards more aggressive ee in RBC.

7. Voluntary Standards

Voluntary programs should pushing the leading edge and typically I guess being one code cycle ahead of where the code itself is going. Doesn't believe province would have passed the EG80 code if the energystar program wasn't out there and proving it can be done and could hit that and by production builders and not necessary people doing fancy one off showcases. It played a significant role. Ideally you would want the voluntary programs aligned with the financial incentives from the gas and electric utilities so that if you build whatever the new level of energystar is, your automatically eligible for incentives from them and the builder can then demonstrate to the homebuyer that they have this certificate and met the energystar label.

a) alignment

You would want a seamless transition and tight alignment so you might want incentives now for whats going to be a code requirement. Relies on the utilities and what they set as their requirement for getting their incentives. They have the freedom to set up their conservation programs the way they want. BUT why do gas/electric utilities set codes that aren't aligned with future BCs? Why cant they learn how to achieve the 15% better for 2017 while still going above and beyond? They think more can be done now so the 25% better than code that they made in the program, is more realistic and why should they reward someone for reaching what they think is a relatively low bar and we think they could easily do better.

b) Also a program administration could be useful because you want it to be as easy as possible for the homebuilder to get these incentives. The OPA program has not been successful and has not received much uptake from builders. This is because its a hassle for builders to go through. Even if they have built homes to those levels(LOOK INTO OPA PROGRAM LEVELS) its not worth their time to go through the paperwork to collect the relatively small incentives. The program administrator would have certain requirements of what you have to fill out and demonstrate before you can get the incentive check. Ideally that would be integrated in within the energystar or other voluntary program. To get your financial incentive from the OPA it would be the exact same requirements as you need to get energystar label. So its just one thing you go through instead of a number of processes. I dont think were quite there with alignment.

The OPA has a legalistic approach to the design of their energy conservation program and they might change because they were incorporated into the independent electricity system operator a few months prior so we might see change. The current problem could be that they are too onerous legal requirements or too onerous requirements for demonstrating the performance potentially. Theres a big difference in how the gas utilities and the OPA administer their programs and gas ones are typically a lot less paperwork and easier for customers to go through. Ideally there would be, for a house where your seeing both electric and gas savings, one program. To improve voluntary alignment, look into the financial incentives and use one program. That would be to use program administration to create one financial program to be more successful and widely used and give out more incentive.

8. Market moving faster.....FOLLOW UP/

Dedicated training programs for builders that will help with special techniques for building to higher levels of efficiency.

B-5: Pauline Lip Transcription and Summary

Pre Interview-

Could put more emphasis on R+D or early adopter side but that would be voluntary. Voluntary standards are where you begin to see marketed option. So if you increase market adoption at the voluntary level, that will help you speed up how does the regulatory side adopt it.(WHAT COULD CONTRIBUTE IN SPEEDING IT UP AT THE VOLUNTARY LEVEL?) *Utilities have a program for DSM and CDM which contain similar targets that overlap and are closely aligned to voluntarry standards. A participant in a voluntary program such as ES will likely also qualify for the incentivized utility program*. Because ultimately voluntary leads to the regulation. And we saw that historically through energystar for new homes in ontario and how it was launched in 2005. Its now the 2012 BC. More support in voluntary side could lead to more rapid change. We currently only have one ee housing program.es.

What can we do to increase market adoption at the voluntary level in order to speed up the time it takes the regulatory side to adopt it.

R-2000 in its inception was EG80

1-3.

Started from NRCan, they have a whole portfolio of voluntary programs and EG rating system is the backbone for Canadian housing. R-2000 in 1980s when it first launched started the best in class high performance home and thats when we tried to figure out the innovation in new home construction. We understand we need better air tightness, ventilation and all these things were done at the r and d level but one step past that and it was a custom home stage and not done by a production home builder. Then you have your more mainstream marketing programs which was energystar for new homes and LEED which is not managed by NRCan, it came from industry. These voluntary strategies contributed in the implementation of EG80 in 2012. And then there was, to back up the support of using the voluntary programs, there was federal eco energy for existing homes program which was federal incentive program and was quite successful and put money towards encouraging homeowners to select ee features to retrofit their houses and used the EG system to benchmark these homes both pre and post. The industry views the program as successful with a large amount of uptake. At the National level they achieved all their intended targets for how many people and how much money they wanted to put into investing in this. This is no study done on the return of the return on investment. It incented a lot of homeowners to make energy efficiency upgrades to their homes.

Successes and Challenges:

R-2000 in 1982 in Saskatchewan was our current EG80. Why it take so long to become code. Thats when they first built the house but they didnt understand what they built necessarily. There were all sorts unintended consequences and its as a result of having done all of these things, increased insulation, put in ventilation systems but we were still encountering issues following with moisture and humidity levels and now were slowly figuring through all of those pieces. Also code didnt and wasnt an objective until 2006 when we started to consider ee and conservation as a result of the GEA. So things take time. Its not just about being able to build it on a one off house. For example today building a NZE home is significantly higher than a code built home. Theres cost factors and market factors. We still havent dealt with the fact that consumers today are requesting from homes. Consumers are not asking for NZE today. **Brian: Maybe lack of consumer education**.... Theres a huge education and training component on both ends, industry and consumer, and so we finally in the past 40 years, have increased our energy literacy as referred to by NRCan and they are still on that path (WHY ISNT IT WORKING OPTIMALLY AND WHAT COULD BE DONE TO HELP IMPROVE IT). *One of the problems is the real estate market is slowed and theres no incentive to look at it. Focus isnt on energy consumption, its on bidding wars and selling the house. Mandatory labelling for existing homes could help this*. Part of the introduction of the EG rating system, their intent was to increase energy literacy in Canada and it wasnt until the past 5 years homeowners are finally getting used to the term EG and that we have a benchmarking system that exists. They might not even understand the concept of what EG means but were going to be changing the metrics of the energy system in the future(moving away from the EG rating system) so its a continuous education process there. (DO YOU THINK ITS A PROBLEM THAT ITS AS YOU SAY "A CONTINUOUS EDUCATION PROCESS"? WHY CANT CONSUMERS LEARN ONE TYPE OF ENERGY PERFORMANCE METRIC SUCH AS EG RATING SYSTEM? ITS HARD TO KEEP READJUSTING TO DIFFERENT METRICS WHEN HISTORY SHOWS ITS DIFFICULT ENOUGH ALREADY TO GET THE ATTENTION OF CONSUMERS TO ENCOURAGE EE?) *The current EG80 comparison metric isnt as objective in the minds of the gov. Its just a rating and its hard to compare to other homes. Thats why NRCan decided to move to a G/J scale so there can be comparisons. EX cars compare fuel economies. Now houses can be more effective at demonstrating energy consumption. Now it will be easier to see and compare and know if theres a large efficient home and/or a small but inefficient home*.

Strength: What always encourages a first thrust is financial incentives. There was a program in place that supported the construction of R-2000 homes (Whats the name of the program). It was federal program and provided money to incent builders to actually build R-2000 and as soon as the program ended you could see the drop in participation. So with any financial incentive, there are two positions there: telling people you cant incent change with money and others say thats the one way to get it started. So if you look the numbers of the history of R-2000, you can probably see theres a huge spike in the numbers when the program was in effect and as soon as it ended, participation dropped. I think part of the S and W is that you got money in it and that kept in going and as soon as the money stopped, there was nothing to help the builders continue with the process. And today we have, with the utilities, we got demand side management programs and also conservation demand programs both on electrical and gas sides. DSM is part of the union gas and Enbridge portfolio to have these programs that reduce the consumption of gas. Part of their conservation mandate. And part of this lends itself to then incenting builders to look at ways to achieve reduction in gas. The programs have different models. Some models involve direct financial incentive to builder and other models put the money towards consultation and education and training component so it enables the builder to build more efficiently but doesnt give them a kick back for every home. These DSM programs are critical in accelerating adoption. The same exists for electricity side, they call them CDMs but it is the same principles. So we do have a couple programs in existence today. (WHY ARE THERE NOT MORE AND SHOULD WE HAVE MORE OUT THERE LIKE THIS TO ENCOURAGE BUILDERS/CONSUMERS.....WOULD MORE PROGRAMS LEAD TO MORE RAPID ADOPTION?) OEB, who administers the funding for utilities has a clear set of rules and they are restrictive, so all the funding is not able to go into incentivizing better built homes.

4. Policies that will lead to more rapid aggressive ee in RBC:

The best way is those type of DSM programs. Should be done on a voluntary basis. Start there, as soon as you get pick up from the voluntary side. They are our industry leaders. Theres the subset of our association members that are the innovators and leaders and those are the ones that will pursue the aggressive model and by demonstrating they can build it others will follow. Cash Incentives for homebuyers??? There is one from the Canada Mortgage Housing Corporation have a 10% rebate on their premium. Look to see how successful it is. But one of the barriers was lack of communication. Its not being well communicated to home owners/buyers that this is available to them. And its a question that builders

dont want to ask so it really comes down to the lender. Its something they should be able to offer but they dont really talk about it. The builder can talk about it and they do but not every single homeowner qualifies for it because with CMHC you have to be eligible for it. If you put down less than 25% I believe, you would have to have mortgage insurance. There is conditions to this rebate. The other way would be through the banks and financial institutions. If the banks started to value ee in housing and that you would pay less for maintenance and operation and that starts to factor in on the mortgage side and insurance side of things than that would incent homeowners to start to view it as well as not paying as much on the mortgage. There are no tax rebates for ee in RB.

We have talked about on the existing building side; we have been advocating for tax credits both for having ee renovations done and isnt sure if one could exist for purchasing a new ee home. There use to be a federal tax credit program(NAME?) so it could be again, they are just trying to find the tools to justify that internal calculation. Building code is mainly for new buildings is not retroactive. Theres a small section for existing buildings but its predominantly new buildings. So that tax credit program would help the existing buildings match what were currently building. We dont have mandatory labeling so we dont know where on the rating system existing buildings lie so we cant compare them to new buildings in terms of ee. They have done studies on 100 house samples but until there is mandatory labeling we wont know what were looking against in the existing housing market but we know what were doing on the new house market because we started at EG80 and only going up from there.

Cash incentive for Homeowners and Builders: In the states they have a different model and that might help with how they achieved their goals on more of a large scale than Ont but relation seems to be that insurance companies and mortgage lenders are starting to value it. And both are outside the code. (HOW ARE INSURANCE AND MORTGAGE LENDERS IMPORTANT WITH REGARDS TO CASH INCENTIVES).

Pilot projects could be used to see how well cash incentives for home owners and builders would work and try it for a few years. Not sure if it will speed up more aggressive action because we are encroaching that last incremental stage of ee. We have gone from 90% afue on our furnaces which is bare minimum code to most builders are now putting in 94. Theres not a lot of space left. The discussion has been we have already taken the low hanging fruit and made it code. The last few steps to achieving ZNE, its a tough piece to achieve because now its harder and harder to get those percentage points. The increments we used see for example....when es first came out it was 25% better than code, now its 20% better than code...the next iteration could only be 15% because we are starting to find that threshold and so the incrementals of speeding it up is also under the condition of knowing it might not always be 10 or 15%, it might start to be 5% only because we are starting to reach the maximum level we can achieve.

In terms of financial subsidies, we dont know the length of time the subsidies will last for. Eco Energy for Existing Housing was successful during its implementation. The eco energy program last 5 years(2007-2012) but did not get it renewed. OHBA is currently advocating to get the program running again. They are advocating for the reinvigoration of an eco energy type program for existing houses. But as with all political pieces, as soon you change parties, objectives can change and we def are subject to that. Different governments and changes within might scrutinize the programs.

5. Brussels Program:

This is based on the fact that government had to prioritize this as an area they want to invest in order for it to bring about that level of aggressive movement. They have an entirely different focus than we do in NA. When you throw money at something, you can make it move faster but how long can you throw money at something. When money runs dry there will likely be drops on participation. Its also a matter of sustaining it too. Thats the kind of balance that needs to be achieved and that could also be why your hearing that the code is moving fast and aggressive. We are going at a rate of no financial incentive, and builders arent regressing. As soon as you start to push it up to a certain limit, you might find that the model may fail for pushing too hard. We do also have a Sam Rashkin from the department of energy, he used to be the lead on es for new homes in the US, and he is working the zero home which is NZE program in the US and he has interesting comments about reaching the ceiling in BCs and now that you have reached a certain point, you have to look at all of the other pieces that interconnect like safety. Backbone of BC is still health and safety so as soon as you start to implement things in the code that infringe on H+S such as ventilation, making sure the mechanical systems properly sized for the loads were creating in each new home. This is where states are at. Trying to achieve these very high targets but there are all these other barriers that have happened that we are only coming across now in building construction that we didnt know about before or that we knew about technically but werent actually being created in housing.

There needs to be time for change. The barrier might not be at the R+D stage but instead at the early adopters and mainstream adopters and the transition there. Your always going to get a one off builder, building a ZNE home but that doesnt necessarily translate to a mainstream builder doing it.

So I think it becomes telling where the voluntary programs can lead- ES is 20% better than code now and will be 5% better even after 2017 code. By then they will set a new voluntary standard that will be more than 10% better than code. R-2000 has targeted 50% better than 2012 code but no one is building it. The incremental cost is at least 10,000 more on a one off R-2000 house. Its not feasible for production builders. Market barriers are our reality....trying to sell that home is tough because you cannot sell it as an added cost as the homeowner would not want to pick up cost. Consumers do not ask for ee homes. That is one of our realities. Also theres the cost of energy. Its cheap here so its not top of mind. Consumer education is a helpful tool but is a tough one to crack. NRCan used EG rating system for energy literacy for consumers. They started making it about energy literacy since 2010. They are in the process of revamping EG. This was a big change because it was the first time they revamped it since its existence. This was a big policy change to change the whole EG system as we know it. As we currently understand it, it is a

0-100 scale and 80 was generally reviewed as a good number and where R-2000 was benchmarked at its inception. Now the criticism is as we evolve is when you start to compare it to vehicles and their fuel economy, EG80 didnt have a scale that was comparable and didnt have a metric of any kind. So they are looking to revamp the rating system to kilo joule scale. Now it will start to measure energy consumption (Is this done already and in the 2017 code?????). Now all the time it took them to educate homeowners on what EG80 meant and how good a home it was will be relatively useless because we will be working with the k/j. Now they will be spending time educating consumers on this metric and what it means to have a high energy performance/ the BC. EG80 was difficult for consumers to understand because an (80)A on a small house and an A on a big house arent the same. Your still consuming more energy in a big house.

Theres not many consumer education or awareness programs out there now. EG80, part of the revamp has a component for education and consumer awareness but it is built into the system so they are not going to have a program to support that up and above the system itself. It will have a summary sheet and the summary will tell you about the home. So after the home is built, they give a summary sheet to the consumers/homeowner that informs you about the house. That is it. Theres no training, and a lot of the responsibility is put on the builder if he tries to educate the homeowner of what the summary actually means to him.

The eco energy program recreated would have an educational component as well and it will include energy evaluators or auditors explaining to homeowner what this means and what measures they should consider going forward if they want more ee features in their home. Thats why the OHBA wants to get support to funding to run the program again. Hasnt happened yet.

Education and Training programs would be good. Its on both ends consumer and also industry. We want to make sure the builders who are selling it and the real estate agents know what their selling. (What kind of education and training programs would be helpful???????????). The government has to identify ee as a priority objective. *George Brown works as a agent to the MMAH and have programs/courses for the administration in the OBC. However, they are experiencing trouble and problems with low enrollment. Education programs that target younger audiences would be helpful such as highschool and university. Enerquality has provided and offered course material for highschools to provide for courses. We need a push. No one wants to take courses so we must establish a demand. Again mandatory labelling would help with encouraging education*.

6. AY Thesis:

Not realistic goal. Heating is a main driver in e consumption in a home but there are many other parts. Its hard enough to reduce e consumption in a home when considering all working parts let alone reducing e consumption while only focusing on heating. Now you you reduced policies and tools you could use drastically. As were moving and shifting in our housing types from large single family homes to smaller attached town homes that are more dense. So were talking about units that are significantly smaller in size and with that shift, it also shifts load in homes. Now space heating is still the primary source of energy consumption but you start to see water heating balance out and become almost equal to space heating in some scenerios of smaller homes with smaller loads. When we start to move forward into ZNE one of the biggest troubles into truly achieving net zero is the occupant behaviour. That electrical load and their usage and all those things were the factor in them not achieving true net zero. So with that in mind its difficult to narrow scope to space heating alone. Its a difficult expectation to have and if you look at the BC now, it addresses both space heating and water heating.

How far could we go to change things: We are close to as far as we can push it with the current policies in place. It is possible with policies regarding education training, subsidies etc to push code further but one of the key indicators would be the voluntary programs and what their targeting because thats going to tell you how feasible it is. (BUT WE HAVE VP THAT ARE 20% AND 25% BETTER THAN CODE AND ITS 2015....WHY COULDNT WE ACHIEVE MUCH BETTER CODES IF THOSE PROGRAMS LIKE YOU SAID WERE INDICATIVE OF FEASIBLE TARGETS????). Voluntary codes are the test drivers so if you can increase what the voluntary codes are you could likely increase the code. *EG80 and our energy efficiency systems are algorithms and its now about fine tuning. Its harder and harder to guess what 100% looks like.*

It would be more difficult to have more permanent voluntary programs like ES because right now theres market recognition with their brand so designing more like that would dilute the industry and consumers.

7. Voluntary Programs:

a) No they are not perfectly aligned with the code. There is a lot of difficulty, if you understand, we have a National model BC that governs buildings, and then the provincial ones. Ontario set their own provincial code while many others can adopt the national one in lieu of making their own provincial code. That adds another level of alignment because ideally you would want the national and provincial to be the same. In Ontario there is already misalignment as it is. Then voluntary programs tend to be a National focus, so its pretty rare that a program would be provincial unless your talking about a utility such as union gas or Enbridge, so now you've got a voluntary program that is also national which then looks to the national tool line so if theres a misalignment happening between a national novel code and the provincial code then the voluntary national code will also be misaligned. Its a very common problem. The success of having them better aligned is with stakeholders. With programs like energstar we have stakeholders who are able to help with the provincial specific issues. Its a long process because theres different levels/layers of government involved; provincial code you have MMAH and national code is The Canadian Commission of Building and Fire Codes. And then you have voluntary programs that are usually managed by NRCan. Different ministries at different levels of Gov. trying to work together.

Currently there is a difficulty in code cycle transitions. Every 5 years when the code change levels, its not doing it at the same time the National code is doing their cycle revisions and its not doing it at the same time the voluntary programs are doing their revisions. So their all happening in different stages in time and industry is doing its best to ensure the transition. Transition is always sticky.

b) There is the beginning of the Building Code Conservation Advisory Council. That council helps with alignment. It has balance representation in the industry and those are the people that get to provide recommendations to the minister on what they think is a feasible target for code cycle purposes. And some of these members are involved in the voluntary program side so they can make sure the alignment continue.

Its more or less these types of committees that are helpful and thats one example. NRCan has a technical advisory committee so all of these committees with their stakeholder members is where we have to have due diligence. But they dont make the decisions at the end of the day which is one reason why the there is still misalignment. Could be a political reason for not making a change based in the committees recommendations.

B-6: Peter Love Transcription and Summary

1-3.

The BC designed for health and safety to make sure people building the home wouldnt have accidents and people living in the house would be safe.

It was really the Bob Ray's government in the early 80's, and the environment minister was a lady named Ruth Grier. They began to put ee into the OBC. In addition to health and safety the OBC should also look at ee in new homes. So thats when it started as an environmental initiative and then there was a government that came in and his name was Mike Harris and he was a conservative and he came in in late 90's and his theme was common sense revolution. He was going to reduce red tape, and make it easier for business. One of the things he and his minister announced was take out ee from BC and that it should go back to basics and they had a report titled back to basics and the BC was going to go back to focusing on health and safety and if people wanted ee than they should pay for it and of course the builders loved that. Peter and Michael Lio fought that through an advocacy organization saying it is wrong and poor policy to have this go through. It was a difficult debate and they convinced a few cabinet ministers that it is not something to be left up to consumers and it should be code and they finally prevailed. During that administration, at least the code continued and at that point the code was primarily prescriptive; r12 in the walls, r30 on ceiling, r12 in basement. It was all, this is what you have to do. It was in the most recent code cycle and Peter was with Ontario government and pushed very hard his first report with the government agency that pushed for EG80 to be the Ontario BC. And that was brought in by MMAH minister and MP John Garritson. He announced it in 06 and became effective in 2012. That was the first time they went to a performance based code. He actually implemented that and made it a requirement. It was an interesting political move by him because his staff (both civil servants and political staff) were saying you didnt have to go this far. You could have done something but it didnt have to be this aggressive. (This is an example of what strong political will can achieve). ASK PETER FOR MORE INSIGHT AS TO HOW HE GOT IT DONE AND WHY HE CHOOSE TO DO THIS? *A new government(liberals) and they wanted to be different. Much more interested in ENS issues. They saw benefits in ENV. hey closed down all coal fire generation plants and they knew they would have to make up for that so they set targets and made positive policy decisions in order to achieve it. They came up with 5 options in ascending order of energy efficient targets with option 5 being EG80. It came down to the leadership of one guy(John Garritson). He wanted option 5 while policy makers and his bureaucrats wanted 2 or 3. One of the decisions that lead to the political support was that EG80 was being achieved voluntarily by many builders and they knew they could build it. A lessons learned is that we should show the way with aggressive voluntary standards. So we need to should successes in building ZNE homes. How we do this is get 500 built in a year then 1000..and so on until builders are confident they can achieve that goal. Previous conservative gov let free market system go, less red tape, BC was about health and safety*. He took the bold move to go to EG80 and he did it because a meeting Peter had with him and was able to tell him about the voluntary programs going on in Ontario for homes including R-2000, and I encouraged him, I knew he was from Kingston and that he would know the builders there, and encouraged him to call some of the builders from Kingston who are building R-2000 homes, EG80 homes and he did and they told him it was not that difficult and this should be more of a requirement in BC. And code that is been built now is not sufficient. It was a real leadership role that he played. Going forward, theres an advisory committee (MMAH) there able to make more frequent recommendations. The code used to be reviewed every 5 years and now it CAN be reviewed on a more regular basis and updated on a more regular basis. They are on record as saying they want to move towards ZNE homes as soon as possible.

Implementation successes and strengths:

Its a very conservative industry and its mainly small, family owned companies who dont like to be told what to do by the governments. Its a very independent industry, and cautious industry. Back in '82, it was really difficult to do; the equipment and technology wasnt there so it was really expensive and very few people could do it but by the time Peter became involved in the R-2000 program in '98 we know had one of the big developments, condensing gas furnace, which was a high efficiency gas furnace 92%. That really began to have an impact and so initially to build and EG80 house in the 80's was probably going to be 10-20,000 by the 90's, it came down to 5-10,000, and by 2005 it came down to 3-5,000. So the price of what you needed to do has come down significantly so I think it was really driven by price. You can see that with the example of is the condensing gas furnace. So the technology was around but back in the 80's manufacturers of it would spend 364 a year mid efficiency units and 1 day a year, they would have to change. They would have to change, make this part and that part for the high efficiency units. So they would make them but its really expensive so its special; we dont make them often and not entirely sure how to do it. But a few people want them, so instead of selling the furnace for 3,000, they sell it for 6,000. And for you guys that want that furnace you pay a lot for it. As more and more

builders began to see this furnace and try it, and Mattamy became an early user/builder of the EG80 houses. All of a sudden , im doing one a month, then one a week, then prices decrease from 6-5-3. Now EG80 is code and you cant even build a house without an ee furnace and you cant use a mid efficiency furnace. Part of that cost reduction was just volume and efficiencies; same with triple glaze windows; they use to be very expensive and then as people began to use more of them, they became cheaper and more commonly used. This is also an example of how voluntary program like R-2000 or ES can get these technologies into the market so people get used to using them. Some builders like Mattamy begin to make large orders for these things and then the price comes down. It will come to a point where the OBC and the MMAH can say were just going to go this higher standard because the price isn't 20,000 anymore its 4.(HOW CAN WE GET THIS TO HAPPEN FASTER???HOW CAN WE GET BUILDERS TO TRY HIGHER EFFICIENT TECHNOLIGIES MORE OFTEN IN ORDER TO BE ABLE TO ACHIEVE HIGHER EE IN RBC).

Strengths Weaknesses:

Without voluntary standards or programs more aggressive action would have been very difficult. Technology development; better walls, windows, ceiling products, furnaces etc. more efficient HRV. These were certainly benefits. One of the challenges of a performance based code EG80 house, is that how does the municipal building official, the guy that goes in and signs off on the building permit, know that its efficient. How does that guy know its EG80. They overcame the challenge of a performance based code by having prescriptive requirements aka SB-12. The other challenge is compliance levels and if houses are actually compliant with EG80. How well inspected are these houses and what is the compliance levels. The BO goes in and looks at the house; how much time are they really here can he really tell if insulation is installed correctly/perfect, if the air barrier is actually complete. They cant be really accurate if there is no air tightness test or performance calculator after house is complete. It tough for them to know if products were installed correctly and they do their best efforts; wall looks like 8inches, I think its full of foam etc. You dont know if theres something thats been missed. So one of the issues still is compliance. California has about a 30-40% non compliance rate. Its something similar to that in Ontario.

Mandatory BDT would help to measure performance of air tightness but not insulation values. However a Thermography(heat image) test to see heat losses throughout the house would demonstrate this. Both of these together would help with testing the houses performance and compliance and give you a good idea if you were at EG80. (HOW WOULD YOU DO THE THERMOGRAPHY TEST??WHAT WOULD IT CONSIST OF FOR MANDATORY ADOPTION???). Thermograhy test would be for existing buildings.

One of the major challenges with ee is consumer awareness. Its hard when you look at houses to tell which ones efficient and which ones are not.

Provincial/Ontario government is going to require that all commercial buildings have energy labels. TD center, sick kids hospital etc will have energy labels. So that people going in there will know how efficient the building is. So TD bank might be an 82 and notice that telus is 85. There might be pressure to do that to the residential buildings. Its been thought of in the GEA but not regulated. So the Ontario government does have the ability to label all houses but hasnt done it..(WHY HASNT IT BEEN DONE WHATS THE ISSUE AND WHAT CAN I DO TO MAKE IT HAPPEN NOW??? WHAT DO WE DO ABOUT REALESTATE AGENTS COMPLAINTS??). *When the minister of energy went to various regions to talk about mandatory energy labeling in homes, it wasnt well received especially by real-estate agents who thought it would make their jobs much more difficult. What can be done is that we can get more trained auditors to do this work and test houses. Require it for all new houses so experts know excatly how to do it efficiently. Then mandate it for all homes being sold. Once this is more of a practice it will bring cost down be more of a new initiative*. It will likely start off at the point of resale, so when you sell your house you have to have a label.

Another one of the deficiencies of the code is existing housing. The BC is primarily for new buildings and major renovations. Concern is that we have a majority of the housing stock(existing buildings) being untouched by the BC. We need to find some way to encourage people with energy inefficient homes to improve their effiency. One way to do this is mandatory label at time of resale. They will have to compete with more efficient houses. That will force people to upgrade their house in order to sell and compete in the housing market with newer homes. Right now consumers and other people wouldnt know the difference between a 62 and 82. Building labeling for existing housing is important. (HOW CAN WE MAKE EXISTING HOUSES MORE EE... PEOPLE ALREADY BOUGHT HOUSES SO HOW CAN WE MAKE THEM CHANGE PROPERTIES OF THEIR HOUSE FOR MORE EE? HOW CAN WE MANDATE THIS INTO THE BC?) Pretty much what we talked about earlier. Have energy labeling in 3 stages. 1- all new homes, 2. any home being sold, 3. all homes. We only add about 1.5% of housing stock per year. So in 10 years 85% of housing is existing.

It would also help to have someone/government rep/real estate/ builder...explain to the new homebuyer how to live in and run the house. Make sure they understand the rating and how their house operates. Some of the better builders already do this. There are homeowner packages. It should be required. So as part of buying a house, you must learn how to operate it. (WHAT WOULD A PROGRAM THAT REQUIRES THIS LOOK LIKE?)

4. Policies to improve implementation speed and success:

More incentives available for people that are going beyond the code. Big believer in voluntary initiatives. I think we should financially incent in someway pushing the code. Right now there should be financial incentives for builders that are building ZNE homes. And there are some now but they should be larger. If we really want to have ZNE homes as a target in 20 years, lets provide incentives for people that will build not 5-10 but 100's a year. And that would really speed up the time in which we could implement it into our building code. We would need a bigger program

with more incentives to offset some of the capital costs.(GIVE EX OF WHAT TYPE OF PROGRAM AND INCENTIVE WOULD WORK AND FOR HOW LONG...How would this program look and operate?) OPA gives you a few hundred for the builder. ZNE house is probably around 30,000- 50,000. With a ZNE energy home you will probably have a solar collector so youll qualify for the microfit program. For the ZNE envelope you are looking at 10,000 or 15,000 so I think a 20% incentive is reasonable which is 2000. If builders received a check for 2500-5000, that would get a lot more built and even possible to codify sooner.

5.

Incentive program covers almost entire cost of the ee upgrades, and so it is not sustainable. And when they run out of money, they cant build it anymore. He is more in favor of a smaller subsidy like 20-25%-30% maybe so you make sure they have skin in the game. If you give them the exact cost (Brussels) theyll take it because they say it costs this much gov gives me this much....fine il do it. Brussels isnt sustainable. Are the benefits to society sufficient enough to justify that very large grant. What we can do with that is do a **focus program**.....3 years we will give you a large amount of money to build ZNE houses but after that its over so signup quick. (WHAT WOULD THIS TYPE OF PROGRAM CONSIST OF). Theres a few programs for training programs. For consumers, energy is a pretty small thing.....when buying a house for 300-400,000, they are looking at neighbourhood, schools, etc. not energy(its pretty far down the line).

6.

80% reduction is doable and could be even more aggressive. I mean architecture 2030 in the US and I think some advisory committee in ONT is calling for ZNE by 2030 and shes only asking for 80% reduction in space heating by then. I think our target by 2030 should be 100 and by 2025 PH code. Her thesis is possible and doable...whats her EG rating? code is 80, ES is 82, R-2000 84.

b) you want to provide some financial incentive to all parties for building higher than code, and then; give builders 5 years. Builders had 5 years to prepare and get used to building EG80. And thats why Coreys business took off; is that all the builders, that he was doing energystar homes. So if were going to have PH(EG90) the code by 2025, then well need to let builders/people know by 2020. And by 2030 ZNE. Give them at least 5 years and although it seems like a lot the EG rating system is algorithm going from 70-80 is much easier than going from 80-90. It gets more and more difficult as you get closer to 100. So providing incentives and a 5 year period to get use to the changes. In that 5 years you will have to do the necessary RD, demonstration. So in 2020 you say by 2025 it will be PH(EG90) and in the meantime heres 5-10,000 for each house you build at that level and by 2030, its going to be ZNE. Financial incentives so that people begin and are able to prove practices, cost of technology comes down (because of gas furnace ex above) as people buy more and require more, price significantly drops. Financial subsidies should come from gas and electric utilities. Union Gas, Enbridge, Toronto Hydro should be the source of funding and subsidies. All of the electric utilities(OPA) are allotted 300 million a year for incentives for the last 5 years. It goes to coupon programs, home depot, demand response programs, incentives for building new commercial buildings. Enbridge and Union have 120 million to encourage and give out to people to be more energy efficient. these are coming off our electricity bills and gas bills. Its these utilities that should be putting the funding towards programs for ee in buildings and they should reassess where all the money is going and spend less somewhere else. Maybe spend some on new buildings but a lot more on existing (HOW WOULD THIS PROGRAM OPERATE and HOW IS IT DIFFERENT THAN HOW ITS WORKING NOW). Someone needs to make the decision about wheres the best place to spend that money. Argument for spending money on new buildings and not existing is that its always much less expensive to build it right the first time than to build it crappy and go back in fix it. Thats why the BC is important, even though its only 1.5% of the stock.

7.

Essential. Cant just state you want to change the BC to EG90, you need to have a ramp up and thats the success of the BC is been is that weve had the voluntary programs that build up the experience with the technology, brought the price down so that you can bring it into code.

a) Not aligned. Its not always clear what future BC is going to be.(I dont Understand??) Take a longer term view....by 2023 were EG90 and by 2030 were EG100. And in order to support this we will have a voluntary program, provide money to energystar to encourage it and we want 20% of the housing stock to be EG90 by 2018 and 40% by 2021 so by the time the code is brought in, were ready to go. And then we take the next step to 2030.

Also next step is, not stopping at EG100, but increase to houses that can send energy back to the grid. Then they become a power source and they can help with the existing stock.

Ontario could benefit from a long term energy plan for the BC. ES design a program that help us get there, and heres some money that can help builders and homeowners with the process.

B-7: Frances DiGuiseppe Martin and Matthew Brown

M: Matthew Brown

F: Frances DiGuiseppe Martin

1. How(policies and procedures) for implementing previous aggressive BCs such as Energuide80:

F: People had a great deal of time to get used to it and understand what it meant. People were using it in the industry or aiming towards it. It was already in use in the industry and people saw it as a good thing. Some builders were using it as a selling point. The trades and builders knew how to deal with it. It became a common building practice before it was actually more mandated. There was a lot of information out there about it. Doesnt know who was doing the selling of it???? Before it was a mandated code, it was a policy and something good to do. They demonstrated it and taught it and people started using it as a desirable thing. And builders were selling it as we do energuide80 so buy from us as it is a good thing.

Why did energuide80 take so long to implement? Failures and Successes

M: The code is becoming more proactive now as of late but in the past like in 1980s, it was more reactive. There was a movement to go to 2x6 with more insulation before the 1990 and then all the builders said no. Builders said it was too expensive and that they didnt need 2x6. Builders were kind of holding it back. **F**: Its lobby groups like the home building organizations and other lobby groups....research and find some of the other lobby groups that were involved in the EG80 or EE code initiatives. They were able to resist. **M**: And they actually pushed it back down. Because it went up to R-20 (walls) and then it went back down to R-12 again. **F**: Building Organizations are very powerful lobby groups and they are backing their members and they are able to slow down changes in the OBC. They didnt want to move on a major ee BC due to the increased costs. (ASK A BUILDER IN OHBA ABOUT THIS Can ask if they lobbied to slow down that or if they didnt why did groups like that lobby). **M**: A lot of it is perception too, we have always done it this way, why should we do it a new way. There was alot of old generation builders that were working that said Ive been building homes using 2x4 all my life, why now do I have to change to 2x6. And back then 2x6 was the only way to achieve the higher ee insulation where as now have better options. Now we have options like 2x4 with rigid insulation, 2x4 with all these new blankets that there coming out with. New blankets with reflector on the outside. The market is being flooded with guys like DOWL and Owens Corning. **F**: So they have to now train their trades to do new and the smaller builders have their guys how to build this way and so theres resistance to it. Even the Unions have been resisting it. (WHAT DO U MEAN UNIONS). They could have said were wasting lumber 2x4 moving to 2x6. **M**: There was something similar with dimensional lumber. We came out with i joist and they were all the rage for a few years and then all the guys that the lumber companys supplied 2x10 and 2x8 said, wait a minute were not selling as much as we used to. So they dropped price of all conventional lumber in order to compete. And now its just started to come around again where i joist are starting to become cheaper than conventional lumber again. Its an example of how much push the lumber companys have. If lumber companys want to sell a certain size of lumber, they are capable of manipulating the market as seen with the example above. And the insulation guys can do the same; they can manipulate the market. **F**: Like wood counsel and all sorts of people can get involved in these type of things. There is a lot of lobbying.

How do you push back the resistance? **M**: Well they have the right to push back but now the governments are getting a backbone and they are actually holding their ground better. Where as before they werent as much. **F**: The BC is actually moving faster then we saw it move for years so I think they are. We have serious issues if we dont do something. I did the OAA 2030 challenge along with other architects and went once a year to learning about what the 2030 challenge was and if people and governments arent taking it serious, they better start soon. **M**: And the new BC is more flexible(ex all the different compliance packages) so its become less mandated and more open to choice(they have more choice)and they dont even have to follow those compliance packages if they do the energystar. **F**: So a guy whos doing r-2000 and has been doing it awhile, can still do his r-2000 house as long as he proves it through the required blower-door test. **M**: They must have a blower door test and prove how air tight the house is. Blower door test are much more common now and have come down in price to approximately $300-400CDN. It doesnt take very long to set up either. They will be mandated as it is moving that way. Every house, not in this energstar maybe next or in the future, must have a blower door test. It is unknown if all houses are compliant with the BC due to lack of blower door tests and so some house could be energuide80 or 73 or 76 etc. They can follow the paths but still be incorrect. Some builders such as Mattamy are doing blower door tests on their houses but that is because they are building to energystar(and within that system there is a required BDT). **F**: Greg Labbe does blower door tests. Some builders are actually going above and beyond BC. This is another method how EG80 came into force, builders were already doing it like mattamy so they werent lobbying against it because they were doing higher. So there were people always going beyond. So then when BC brought it EG80, no big deal as people that want to go beyond will now go to next level. So thats why when it came, some builders arent happy, but a lot of builders like I said (you asked me how did it get accepted). When it finally came in it was fine because so many builders had done it, so many trades were trained in it, it was easy to gain acceptance. By the time it came in it had wide acceptance in the industry because it took so long. **M**: There were some really good builders that were fighting for it too. For instance whenever you would go to one of these things at build, where all the builders get together and talk about LEED and ENERGYSTAR. There were a few builders that stood out and actually said were already doing that why are you finding it so difficult. We can do that and we think its only costing us an extra 3,000 per house and were educating the sales staff to teach homebuyers. I think it was an education to the homebuyers too because they didnt understand why builder "x" was charging more for a house than builder "y" for the same sqft. So this had to be taught because if they see it, they dont see the value in it. Therefore consumer education plays an important role.

2. Strengths and weaknesses with implementation.

F: Theres always people that work against or lobby against it because it does increase costs in delivery. So you will find having it mandated, there is a desire to control, Not to have things mandated. And youll find that in any industry when something is mandated. Especially when the change adds additional cost. Theres part of the industry that will say, let the market dictate it. The market wants it, the market will pay for it. This could increase our costs and the market is not asking for it. There was a bit of this type of resistance towards adopting EG80. Or the industry stated that

they are doing this, its not EG80 but we believe its better. So why are you telling us we have to do this. We have our own EE program and we want to deliver this instead. We spent time developing this and spent time and money on it as well. No names of the energy programs used instead of EG80 but builders did have their own programs. Their ee house did this this and this. This will likely cause a delay in adopting and codifying EG80 cause there will be lobbying and resistance and this will cause a delay.

3. R-2000 Home, How was this successfully adopting (challenges and success)

F: Some builders embraced it but the blower door test is expensive. Anything that has a compulsory testing component is expensive and I think the r-2000 program which was very good, it was an expensive delivery program and the testing was expensive and people had trouble passing. They would do everything or believe they were doing everything and then had trouble passing the blower door test. Then its like retrofit trying to get that blower door test to pass because thats an integral part of the r-2000 program.

F: It got a lot of great press but never really caught fire. The believers really swear by it. It builds a good home and certainly a tight one. Then theres people that say is it costly. A lot of it comes down to cost and delivery of cost and does the market in general want to, because were talking about the home building industry now rather than individual consumers because when you talk about an individual consumer whos buying a and building a house for themselves and you work, as an architect, directly with a home owner unless their budget is extremely limited, they dont likely come to you. ????? NO IDEA... Maybe question this.

M: it was really hard to measure and do all the metrics. It was accepted that much. It was certification and qualifications based and people didnt want to pay for that part of process. Its difficult for builders t We took what we learned from that into EG80 and es such as air tightness, BDT, insulation, etc.

4. Policies used to Speed up Implementation Process:

M: Inspections- Change the way building inspections are carried out. They are currently carried out right now- they go out and inspect at the framing stage and they inspect the vapour barrier continuity but they dont inspect the air barrier and they should be inspecting the air barrier continuity. So they do a framing, vapor, and insulation barrier and thats it. From this experts opinion(all the courses/training programs) the air barrier is the most important. The air barrier is critical to the moisture movement in and out of the house. So if the air barrier fails, everything within the system including the insulation fails. The studs and everything else fail. An air barrier and BD tests that should be attended by building science guy, a few guys certified to perform BDT, but also by inspectors. The guys doing the BDT are third party employee. Its an external employee. Its a neutral third party building science person who was trained in how to operate the test but it should be attended by the inspectors. So the inspectors can either do the test themselves(which means in the future, they must be trained how to operate them) or they can regulate it because there is a lot of variables on how it is done. Theres a manual on how to set up the house to do it, the basement door must be closed and theres certain things that must happen but ti make sure the playing field is leveled and that its getting done right there should be somebody in there looking at it because a lot of times you hear about that one homeowner thats not happy with their house and the way its performing. Building science guys will go in and say everything is fine with your house and then home inspectors will go in and say no you need like 30,000 worth of repairs. So theres some people that are getting a bad home for some reason and therefore arent happy with it. Theres no knowledge to whether that is home owner perception or education or its cutting corners during different stages of the build. I think more government or inspector driven inspections of the home. **F**: But consumer education, as far as why its important for conservation of energy, but also people dont know how to live in their own homes and dont know how to take care of their homes. Clueless to how the government can help but who else can. This is evident through the facts that people turn off their HRV systems. So the government is mandated through the BC, how energy tight your home has to be but then people dont know how to live in them. EX of this is people turn off their HRV systems and the house cant function properly without it or they are afraid to open their windows. And this is contributing in creating unhealthy homes. So there are a lot of things people dont understand that they have to run their fans(HRV Fans) or how to actually maintain a tightly built home that doesnt have all this air. This fits in with what im doing because im looking at what types of policies we need to increase ee.(So when we talk about homeowners not knowing how to live in their own homes and that it is related to my study because im looking at what policies we need....IS IT THAT CONSUMER EDUCATION AS A POLICY TOOL WOULD BE USEFUL IN SPEEDING UP AGGRESSIVE EE IN RBC THROUGH....WHAT...AND HOW WOULD IT DO THIS....MAYBE CREATE MORE CONSUMER DEMAND THUS ENCOURAGING THE MARKET TI MOVE FASTER OR INDUSTRY TO MOVE FASTER? **M**: There are a lot of people that hear the fan from the furnace running all the time from the HRV and they think its wasting energy. We cant pay these bills because were wasting money but then they turn it off and their whole system breaks down and now they are living in an unhealthy home. This is because there will be more moisture, pouring down windows, because the houses are too tight for the amount of ventilation. The ventilation is coming and going when they turn on and off the fan. The fan must always be on. All the old houses, your plugs, windows, and caulking around windows leaked and everything leaked. Good builders are delivering that type of education process. Some builders educate the homebuyer about the building and how it operates. Mattamy has a thing called mattamy university its called with all your systems and features of your house. Isnt sure exactly how much time they spend on this explanation to new homebuyers. When they deliver the house to the homebuyer, they spend a little bit of time with them but they dont get through to everyone.(Look and email Mattamy about this....HOW MUCH TIME TO THEY SPEND EDUCATING THE HOMEBUYER ON THE FEATURES AND OPERATIONS?). Now would adults that are becoming homeowners actually go to ee house information sessions that are offered? **M**: I think they should go because a house is your largest investment and you should take care of it. **F**: So what kind of policies could help this. Because you cant mandate....well you mandate through the building code that you must have certain performance levels but then it stops right there, so theres some consumer education maybe that the government needs to do. **M**: The systems within have to be fail safe because

were delivering such a tight home that its going to be huge mold issues down the road. **F**: And mold causes health problems and health problems cause further costs that the government cant bear. What can we do about this as it is a bit of a concern.....consumers need to know this type of information when buying/owning a ee home. And as the code increases ee, this becomes even more important.

What about Cash Incentives(Homebuyers)

M: There are tax breaks to do renovations or retrofits your home if you raise the ee up. F: There are some for upgrading/retrofit homes but there is not method to prove they were done correctly...(ARE THERE NO INSPECTIONS AFTER THE UPGRADE/RETROFIT IS COMPLETE) there are weaknesses to these type of programs that exist today. The problem lies in...do they go back and test how well the money was spent. They are no sure of if they could do that. Also bringing existing homes up to code is important too(COREY MC also shares the same belief.) Bringing them up to energy efficiency is important too. So should there be something to buy an ee home that is more ee than is on the market. Doesnt know.....Will the builders just roll that into the price or they would want to charge you the standard and then charge extra for delivering whats better (I DONT UNDERSTAND). Thinks that a tax break would be beneficial. Maybe a tax break that shows up on your RSP it would be enough to motivate consumers to buy ee homes. At certain levels you get a break on your taxes. Better the ee the greater the tax break.

What about a rebate for home builders?

M: Maybe a rebate on some of it such as the extra insulation parts. The homebuilders would welcome that and it could significantly speed along the process. **F**: Their organization, Q4 Architects, would support that kind of policy. Would like anything thats going to deliver better built homes. EU have gone much further ahead of us because of need, so they have gone much further than Ont. They are moving in the direction of PH.

Doesnt know the cost difference between the current EG80 and PH but states that it is also in the design (designing smart) and not all about the materials.

Is there anyway to speed up the RDDIC cycle:

F: You need industry and public acceptance. While they are doing this the research must be done because you cant go around spending other peoples money including the governments without demonstrating that the research is sound. The research and the demonstration must be done so I dont know how to speed that up. Gaining acceptance could move quicker because as it stands the government moves slowly. But how much quicker is hard to quantify. **M**: According to the NZE housing program in Calgary, they would like to put it through 4 seasons of testing to make sure it will succeed. They are all over the place across the country to prove NZE can be done. **F**: We are behind compared to EU. They have more political will and more need. Dont have fossil fuels so they need it. **M**: Their fuel costs are higher. Even the scale of their buildings.. Apartments...everything is so small so they have to make small sized appliances, furnaces. They also have higher density living so you dont have that sprawl. Think about their mechanical systems; they were the first to have tankless hot water, which is just starting to catch on here. But they had to have it because the price of their fuels is so high and where would they put a tank in those smaller houses(most EU houses like previously stated are small). We have it now because of the efficiency and because they realized it is a lot cheaper not to keep this much water hot all day long. COULD BE ANOTHER REASON FOR CONSUMER EDUCATION. **F**: Increasing political will could be helpful. Look at all the time were spending in the tar sands, oil pipelines. Theres got to be money in using less.

5. Brussels, Belgium Program Implementation

M: If the governments trying push these codes through, eventually they should put their money where their mouth is and start giving people a break that want to exceed them. For the builder that wants to exceed it and really explore it and want to get off the grid. Why not give him a break because hes using a lot less FF and GHG in the buildings and down the road. This goes for builders and homebuyers. **F**: If you think about the money and other subsidies in the energy sector, so why not subsidize this(more aggressive ee in RBC). You should look at the amount of money residential construction puts into the economy because the RB sector and its related industries is probably one of the top performers in the Ont economy. So why not try and make that function better and to its best. It fuels the Ontario economy so if theres a way to making it perform to a better standard or to its best standard than why not subsidize. **M**: And when the government builds buildings for itself lately, new rec centers and other new buildings they are all gold and platinum and so they are building to a real high standard for themselves. So why not help out the little guy out (residential buildings/homebuyers) even through tax breaks and get them there also. And in the end, were paying for all those government buildings through taxes and stuff. **F**: Not stating that people should be building houses to LEED accredited standards but there are standards that they can follow because we cant be going around doing LEED testing and certification on housing because the certification standards are very expensive. But they can follow LEED goals or objectives or similar sets of goals to achieve. The government is setting the example, help individual tax payers achieve those and have more comfortable and healthy homes because there is no question that a more ee home is a healthier and more comfy home. So it is a honourable goal to push towards(Brussels) and why not do it through tax rebates or similar.

8. Encourage market to speed up along with aggressive action in ee in RBC

a) **M**: When we have a new code change coming into effect, we have so many houses sold based on the old code and the old pricing so that permit phase really takes a long time to roll out because if we have house "a" over here and its been paid for, budget is done, and builders have

priced it out and so they wont get anymore money for it when the new code takes effect. So whenever the code changes, it is a loss on that house. Builders need a lot of notice before these things change and roll out. Just like all the suppliers do to, like the insulation company. There still making the old blankets to be R19. Before they move to the R22 they need to sell the old stuff and roll it out of the system. Reality is everyone needs to make a buck. **F**: There are contemplated changes and they give you warning that there coming. Theres got to be this contemplated changes in this roll over period have to be seriously considered. So notification contemplated changes and roll over period and proper dates for when the changes are going to take place. **M**: They move back because all the builders lobby against it..... like you cant make us do this by this date,...our supplies wont even be ready. The rules cant keep flopping around. So contemplated changes..talk to the industry some more. There isnt enough talking and communication between those responsible for code changes and the industry and builders. What kind of policy would help this?

F: If the BC personnel talked to the industry beforehand with their contemplated changes, have lots of consultation with the industry. And the industry isnt just the builders, but its union gas, Lennox etc, carrier, Owen corning, windows guys...all major stakeholders have to be brought in with all contemplated changes ahead of time and discuss the changes that are possible and doable. Give them enough warning and they will respond. **M**: They will figure out a way to make it economical too. They probably already have a furnace that they can sell that is high end but its just about bringing that cost down for the masses. Its like trying to sell everyone a caddy, once your making one for everyone, cost will drop. Communication is a big problem. Obviously with more aggressive BC there will be greater costs but it doesnt have to be the scale that it is. When you put more insulation in walls, it will cost more because the materials have to come from somewhere, but more scale will make it cheaper.

6. Amanda Yip Thesis:

M: definitely education because the stuff were putting out there now can be used much more effectively. Like tightness of air barriers, thermal bridging of building materials. Just using what we have more effectively. F: Blower door tests after full completion of air barrier.

Is this a possible goal?

M: 80%? without introducing some kind of passive, I dont think so. Need to use some kind of solar or geothermal to get and make up for what your losing. The amount of insulation in the walls, the more you add the less returns you get. If you have R20 and double it, you only receive half the benefit. You receive diminished returns. So if we go to R40 we will only reduce or save half of the bill. Ditto when you go to R80. The more you put in, it decreases you maximum return. Are furnaces are already at 94% efficient and our hot water is already 60-70% efficient. **F**: Will probably have to use triple pane windows. Lower amount of windows too. You would also have to dramatically reduce the amount of glazing. **M**: Current EG80 is the stats above for furnaces and water. Also air conditioning is not regulated but uses a lot of energy. Could use geothermal for cooling as well. It would be tough to get to 80% by 2030 with regards o reducing heating energy consumption. Likely would need renewable energy to achieve this. Likely couldnt be achieved through policies and their enhancement. Needs a significant contribution from renewable given the situation that presently exists. There is also drain recovery system. Theres a lot of ways to recover heat. **F**: Cooling is the major problem.

M: Cooling is homeowner installed or aftermarket. The only regulation is then noise regulation. However, AC is a significant energy consumer and there are no regulations towards that in the BC . Could this play a role in consumer education/market demand? If you know about ee in RB than you might want to have higher efficiency AC units and could demand that from the market. *Should be regulated. It could be part of the prescriptive tables. If a building contains an ac unit, it must meet a certain minimum efficiency rating. It could be easily regulated.....how to get there. public awareness.*

7. Voluntary Standards?

a) **F**: They are one thing that adds to improving the entire field of ee. Voluntary works for some people and not for others. A lot builders participating in Voluntary programs and doing very well and delivering some high performance houses as a result. R-2000 existed solely on voluntary initiatives. And there are still builders producing and delivering R-2000. And ES is also voluntary. Some municipalities have mandated ES homes. In some municipalities, in order to get your building permit, must be ES. So they have mandated ES as part of site approval. Under the planning act they are allowed to require that. People are doing great things with voluntary programs. Passive House, ZNE etc.

b) Is there going to be a seamless transition from voluntary standards to the level of the new BC for Part 9 residential? **M**: Its never seamless but they will get there. It stumbles a little bit. Lack of effective communication is a problem in the transition. Code personal will say new code begins this day and then there are hiccups and the day moves to March 1. Builders not being able to get their hands on the materials they need. Sometimes the Ministry dont put out the documents in time. New code comes into effect Jan 1 but the documents arent ready and they havent been printed. They might be in focus groups with the stakeholders and lobby groups and not getting as far as they think they should get. **F**: And sometimes the municipalities dont have a thorough understanding, havent had all their meetings yet with all the building departments and industries(BBO building officials etc). and sometimes they dont even understand all the code differences by the time the code is planned to come into effect.

B-8: Mike Singleton, Larry Brydon, Bob Bach Interview Transcription and Summary

1-3.

Part 9 residential.

BOB: 1979 was approximately the time of the R-2000 program from NRCan. and it took 10 years before it started to have an impact and Ontario picked up some of the R-2000 requirements in about 1990-91 building code that first picked up some of the design and construction methods that the R-2000 program had. The R-2000 program that ran separately by enercan and was a very high efficiency residential approach, particularity reducing infiltration and thats the beginning of the vapor barrier on the inside of the studs. Ontario picked that up in '91 as one of the items. The BDT came through r-2000 and r-2000 was a game changer but it did take 10 years before it started to filter into the BCs. Why did it take so long? **It was under development in the early stages. People had to figure out and those builders who wanted to build advanced houses had to figure out exactly how to do it and there was a lot to learn and it takes time for the knowledge to from the research level through to the construction of houses. And there was only a small number of R-2000 houses...at the end of 10 years there were maybe 4000 houses**. Theres the NBC which is a model code and has no authority and there are provincial codes. Some provinces just adopt the national code as their provincial code. Ontario does not. In '91 there are some housing technologies from the r-2000 program picked up by Ontario. EG80 was first identified in the 2006 BC in the code as the standard that would be required by the next BC in 2012. The reason why this cycle was a longer than the 5 years was because the NBC shifted towards objective based codes so there was delays in the process. EG80 was an option in the code and now were into the era of CSMs and DSM programs and

In order to make a major change in the code, the MMAH's building development branch has a series of consultation meetings with a technical advisory council/group. These consist of people and experts from a broad base of interests who request to be involved in this committee and are selected to ensure that there is a broad matrix of representation. **In 2005-06, julie mcnaley from the OPA came into a TAC and put in a strong pitch to have EG80 as a standard BC for 2006. 2006 was also the proposed time for NFHBI to come back into the code. TAC rejected EG80 for 2006 but thought it could be accomplished for the next code cycle. But they did approve the NFHBI. The industry was also at the TAC and the industry independently, after the TAC met and made recommendations , the industry seperatly went to the ministry and said that NFHBI is a real problem and that measure was then delayed 2 years but was eventually implemented.** PROBLEMS WITH NFHBI: when the concrete was poured while constructing the building foundation, it did not get enough of a chance to dry. Several builders put industrial humidifiers in the basements of the homes to dry them out before they did the final finish. Theres a lot of moisture and if it gets trapped behind the insulation, then you have mold. Thats a big problem. Some builders have had to tear the insulation from the walls. People think its leaking but its really just condensation. The code has been moving forward reasonably quickly over last 10 years to implement more ee measures but the builders live with it and therefore their voices must be heard. And so its a process and it takes quite a bit of time.

Strengths and weaknesses:

There was NFHBI in approx. 97' and then the conservatives came into power and NFHBI was removed from code. The real problem now is whats called building science. And when we do these design shreds, we have building science experts in attendance. And if the proponent brings their architect and also their site and construction supervisors we get into an interesting debate about what were calling durability but its mostly moisture. **As soon as the code picked up the r-2000 requirement for an vapor barrier underneath the drywall, the moisture problems began to increase and the key issue which took builders awhile to figure out is that it has to be sealed**. (SO WHEN CODE REQUIRED A VAPOR BARRIER, THE PROBLEM WAS THEY DIDNT KNOW TO USE A AIR BARRIER TO PREVENT AIR LEAKAGE.....So this was a problem because when you require a vapor barrier you also to an air barrier) **There were stories in the 80's about how electricians who would go into a r-2000 home where the vapor barrier was already installed and took a knife and cut it to put their electrical box in. You cant do that because then you let in moisture air from inside the house**(inside of house is at much higher relative humidity than air outside). Theres more moisture in the house than outside due to showering, washing dishes(normal daily living) than there is outside the house. So moisture in the house moves through the breaks in the vapor barrier and finds the point where the temperature is cold enough that it condenses in the insulation or against the sheathing and then that leads to mold. **So it was the implementation of having a vapor barrier that was the significant change and that took some years for industry to figure out that it had to be tight and now we know that the industry is very aware of that and so they are building houses better now. The vapor barrier has been in the 91' code. Thats the major change that r-2000 brought to the OBC. OBC has adopted this from the r-2000 standard. If you want the house to be airtight, you have to have vapor barriers and you cant pierce it in a major way.** The code ramped up the insulation requirements somewhat but its the combination of air sealing the house and increasing the insulation which tends to move the condensation point farther out. But there is a condensation point and if theres any air leakage that moisture air condenses and you get mold. The industry had to learn this and had to know that you cant have anything except a very well sealed vapor barrier.

WEAKNESS: In Ontario BC if you follow the prescriptive paths in the SB-12 you do not need to have a blower door test. If you build to the certified EG80 then you need one.

Policies that helped s:

BOB: The push from the DSM and CDM programs utilities. Enbridge and Union Gas. The development of the ethic of energy conservation.

LARRY: There were organizations who were advocating for more ee. The CEEA who took a strong position for the codes. You had some of the insulation manufacturers and their association and they took a strong position. You also have a combination of things happening: Advocacy

happening from associations and non profits, certain parts of building industries advocating for it, and you have programs from the utilities happening. Everything came together and produced noise for the ministry and they take notice and respond.

BOB: As soon as you put in a vapor barrier, you have cut down the natural infiltration and the house must be ventilated mechanically. And that was the other major change. CHBA took on responsibility for moving r-2000 forward as a program, and heating refrigerating and ac institute(HRAI) took responsibility for training in how we install mechanical ventilation in r-2000 homes. Bob ran this program for the HRAI. If you're going to make a change you have to be pretty sure the connections are there so that your not changing one thing and its effecting everything else in a detrimental way. Enercan r-2000 program pioneered a whole bunch of stuff mainly air sealing of envelope but also mechanical ventilation because that became necessary and also mechanical ventilation with heat recovery.

The r-2000 was an example of how a program(voluntary) can lead a code. Especially because EG80 used knowledge and mechanical systems from the r-2000 program.

MIKE: Ultimately we talk about market transformation and this is one of the keys. Its understand the code, look at it when next code changes, understand connections as bob described, and then design a program that integrates with those connections and with that code change. And thats what the savings by design program does. It understands those connections, it has perspective for the next code changes, it chose a 25% aggressive target(a target that is aware of these other issues and builders perspective, design communities perspective, and availability of equipment that allows you to reach higher goals).

Weaknesses of R-2000:

BOB: It was a very advanced housing program and wheres the market. You get few custom builders who wan to build something better and they were the pioneers in the program but from a marketing point of view r-2000 has never really made a big impact. **LARRY**: It wasnt until ES came along that you saw that kind of massive market transformation. And that was more about brand and marketing and consumer awareness programs that went out there.BOB:.....LARRY: From the industry perspective they look theres codes and then theres leadership programs. So leadership programs are for leaders, people who are out to lead and set example and code is for everyone else. Thats how industry looks at it. So when enercan and the province looked at bringing ES to canada, they partnered with the OHBA, so it was brought in by the CEEA. They got the OHBA to buy into this company enerquality, which was the first one to bring ES here. But I think the reason they have uptake is because 30% of homes are being labelled under ES. It was industry ownership of that that drove major change. As compared to old r-2000 program and OHBA was involved in that and they saw that as a research vehicle, a technology adoption vehicle. Early adopters have the ability to try out technology and then the code brings up that level. The r-2000 program proved a bunch of technologies,(problem with basements was that the technology for insulating basements was blankets...quick and easy...polybag with insulation....). This is how it was being perceived at the national level. It wasnt until there was profit interest in it for the OBHA, and it was now a business of certifying and labelling homes. **BOB**: And all the support was there led by enerquality...so there had to be an independent party evaluating and reviewing and testing the house to make sure it met this advanced program ES. But r-2000 there had to be the same but its time wasnt right because by the time it matured enough, they understood what had to be done, and thats why ONT adopted some of the provisions(mainly vapour barrier) and not all. (SO IF THEY USED THE VAPOUR BARRIER PROVISION FROM R-2000, WHY DID THEY DO THIS AS BEFORE YOU HAD MENTIONED THAT IT CAUSED A LOT OF PROBLEMS.....DID THEY FIGURE THOSE OUT AND THEN USED IT?????)

EG80 Challenges and Successes:

BOB: the challenges in implementing it right away from the time of demonstration is that everybody has to be brought along. Training is an issue. One of the groups are the trades building the houses. They get paid a set amount for each house so all they want to do is get in and out of there. And when are you going to train them. You announce that there will be a training session and they say oh no cant make it we got houses to build. Costs us too much in lost time. Enerquality are in the best position to train trades and others and they still have issues with it. The trouble is that they are in a union but they are piece workers. The unions havent figured out how to do the training programs. **LARRY: In carpenter trades and union, they have initial training requirements, and apprentice requirements but no continuing education. Theres no requirement for every year to go back and learn the latest training advances.** 6 week training program followed by 2 years apprentice shadowing.

BOB: Best idea we heard, on the air sealing side, is those builders who set up competition and they do blower door testing. The trades compete to have the lowest air leakage number and that works. The trades want to learn the techniques, figure out how to learn them, and they produce good quality. (WHAT IS IT THAT MAKES THEM WANT TO COMPETE...WHY LEARN ALL THESE TECHNIQUES JUST TO COMPETE.....IS THERE MOTIVATION LIKE MONEY FOR WINNERS).

Why is it important for trades to know all these building techniques? Doesnt the builder tell them what to do at the time? MIKE: Its about knowing the specific details....when building a wall, you put a hole in it for an electrical box or whatever, you can undermine the performance of that wall assembly. And it could be something as simple as not doing the windows right so that youll leaky windows etc. So everyone needs to know these things. LARRY: There were changes recently around your delivery date. It use to be that you could push back closings without any kind of penalties. Now theres penalties for pushing back closings to the industries. This is another example of people making laws without understanding the impacts of the laws they make(??????????????????????). So now theres a penalty if you dont close on the day your suppose to close on. The builder is like a manager. Its not as if the builder has a level of control that says im the builder and I say do it so do it because in the

building industry there is staff from different companies(windows, framing etc) with different personal all the time. And also they cant be everywhere all the time so the trades and things that work with the builder have to be part of that team. So they need to know how to build and the techniques because their part of the overall team of builders. You cant say the builders just do it because theres a lot of working parts and components as described above.

BOB: They are also doing panelized construction where the walls are already intact and they arrive on a truck and just stand them up and connect them. For efficiency aspects they can build a house in 2 weeks. Different methods like advanced framing(fewer studs) thats 2-3 years old and is moving in more and more. And many builders in their better built homes are building 9-10ft ceilings on the main floor and thats another structural issue they have to deal with. Overall its a complex issue because everyone's(described above) voices must be heard.

How to bring about more aggressive change?

MIKE: Code cycle change is pretty much set at 5 years: LARRY: Thats a substantial change that has brought about these most recent developments. 2006 was the beginning of this every 5 years were going to review the energy component of the code. BOB: SB-12 was a major change. The fact that SB-12 is the only document dealing with energy efficiency is simply cited in Part 12 of the code. And the beauty of it is that SB-12 can operate on a 5 year cycle. It doenst matter what the code does anymore. LARRY: It doesnt require regulatory change. The province can change SB-12 without going to parliament to change the code. Thats another substantial piece because it takes a degree of the political intervention that was part of the problem with the code, out of it. Now the ministry itself can make changes without going to parliament. BOB: Seen 2-3 elections called and everything stops for the 4 months beginning from the election call to having the election, and seen 6-7 ministers of the MMAH since 2010. The building and development branch in the MMAH and other building industries think weve got it and we can move forward and another election occurs and can delay the BC. It delayed the 2012 BC for two years.

BOB: Its unlikely that your going to get faster and more aggressive code revisions than we have now. (1 every 5 years). MIKE: In the past it wasnt once every 5 years, it was once every whenever. LARRY: The Part 9 construction industry: Were building homes and theres an affordability component that comes with building homes and one of the most expensive things to homebuilders is change because like any other product, you get efficiencies, and you get better at things over time. So your able to negotiate in bulk for 3 or 4 years of production, your able to establish trade relationships, and then along comes a code change and you have to do everything differently. So the biggest change ive seen in this last iteration is the movement from interior air barrier and insulation to exterior. But now with that they had to do a lot of things differently. On top of that the manufacturers who manufacturer foam or board insulation have to ramp up to meet that new production demand that comes from that. We could get a 25-30% increase in ee by changing substantially the way that they currently build but along with that comes a price tag to the end product and when we talk about affordability in single family attached, or attached, thats where the largest price increases have come and its land cost, other provincial legislation around green belts and access to land, and municipal capacity to build infrastructure ultimately play into that cost. Builders still need to make money and consumers still want it affordable. The talk about increasing ee always comes back to how much does it cost to do that and can the market bare that burden.

4. Policies to Improve Implementation Speed and Success:

MIKE: What the gas and electric utilities do and what the government has put out in the past is programs designed to engage the marketplace but its all voluntary. And so I think you cant really change the code cycle much. Not sure what the appetite will be for more aggressive than what were doing now which is the 15% by 2017. But if you have programs like what the utilities offer, this can lead us to how we can achieve this 25%-40% improvement then that puts in place all the pieces(BOB talked about the connections) and then you can have a policy or some sort of code or government intervention that seals that off. LARRY: The policy piece to that is the OEB mandating programs and then its the programs that will move it along. LIC is an example of a policy that could be established that could then create a program. BOB: If you want an idea you can use, I would argue that programs should be in sync with the code in terms of timing. There was a meeting in 2011 that brought various utilities representatives(gas, electric,)OEB and OPA representatives together and at that time programs were on 1 year cycle. Now they are on 5 year cycles and code is 5 year cycle but they dont align. Because the programs have a huge benefit in terms of the ramping up the industries knowledge and understanding of what they have to do bcause the programs set a higher standard in order to get incentive funding and thus the builders over 5 years, have a chance to learn what they will have to do, but, they dont align. If they were to align, and there was collaboration between the code and the programs(people who offer programs) so that they were to designed to ramp up to the new target which comes up 5 years after the code implementation, then to me thats ideal. We dont have that currently. Right now the programs commence january 1/2016 and the code changes january 1 2017. Theres not strong communication between the two groups and if the 2 were aligned, and they collaborated then the programs and the new code would launch and the programs would move everybody up to the next code, through their incentives. LARRY: Part of the code change that happens now is in this code cycle they tell us what the next change is going to be. So today I know what I have to do in 2017 and I have from now until 2017 to figure that out as opposed to someone telling me out of the blue that in 6 months you need to be here. We see that a lot in the ES program in that they make change. In the middle of a code cycle and in the middle of a program cycle, Enercan announces their changing the window rating system. So now the windows that builders have been using for the first half of this code, in the middle of it they are saying now you have to use this instead. So now with that different window, maybe the price point is the same but generally if theres a change in that window standard, theres testing costs that have to be met and all those get ruled into the end consumer price of that product. So thats another challenge. If you could get those to sync as well then. So overall there should be a building code change aligned with a program commencement period aligned with changes in component efficiencies(windows, furnaces, are regulated). Those things are fairly disruptive and from a policy standpoint, if there was some way brining policy into place, that caused all of those to be aligned. Believes we will

see a drop in new homes being ES certified. Currently theres approx 30% being certified but there could be a drop this year. And part of that is becasue the builders who are building that get frustrated with the middle of cycle changes so they just say im not going to do this because it just screws me up to much half way through my site. Im just going to go back to building code. That misalignment is frustrating the objectives of these programs.

BOB: ON LARRY'S POINT OF OUTDOOR INSULATION: Once the need is there, the suppliers of those products innovate. they come out with better products and that allows the builde to meet the requirements more effectively. But when those products first come out on the market they are relatively high priced and volume has to occur in order for them to come down in price to something more competitive. Windows are the same and they have been on a fast track for quite awhile. We keep getting better and better products but it takes time for the need to be defined and the industry to do the research and testing necessary to produce the better products and then for them to be applied on a broader base so that the price can come down to where its competitive.

Larry Brydon:

1-3: R-2000 didn't have a strong consumer brand attached to it. Because of that it carried out mostly as a research project. Where as ES had a strong consumer brand so it was easier to move that.

4.

Aligning equipment standard changes with program standard changes with code changes. As for the moving the code approval process, thats pretty tough to do.

If we were able to say January 1/2017 the code changes. Also on Jan 1 2017 the new programs being released by OEB through Enbridge and were going to change the ee requirements of furnaces or windows or water heaters, we do that all on the same day. That would be policy but it would be difficult to know but it would be very beneficial or ideal. Essentially within the process you have the industry stakeholders , and they advise the gov on where the ee level should be. Right now there is a lot of frustration with these changes because they dont happen every 5 years. Code changes every 5 years but all the rest of it occurs interim. So you might be able to do something for 2 years but then you have to change. You might have to do different types of windows for example. And then for another year your going to be able to and then water heater manufacturers want to up their game. You will have stakeholders that will be frustrated with that, so that push back against the code change and they say well ya you changed the code 5 years ago but two years ago we had to change everything because you changed the windows. If everything was aligned then it would be easier for these stakeholders to accept and appreciate a continuous change but they need a couple years just to get their processes in place after any one of these changes occur.

The other piece of building to ZNE other than cost/consumers paying it, is grid connectivity. And we just dont have open grid connectivity access right now. The ability to connect the electrical grid and backfeed power. It is available in some areas but in many areas its not available.

Given that cost is a factor in this, whats the most rapid change we can make with the greatest uptake?

From a policy directive side:

- Mandatory home energy use labeling: So although that does have an impact on existing houses, it would force new construction to up its game. Because it would make people aware that there is such thing as energy performance labeling and its not all in your bills. The bills dont tell you how much the house uses. The bills tell you how much the people in the houses use. If there are different people living in the house, the bills will be different. So mandatory home labelling takes away that and instils this.

- In home energy display off the smart meter. You would probably see it as a display board near the entrance of the house. So when you walking by(entering or exiting house) and as you walk by you look at it and see right now its costing me 3.75c an hour to run my house. That would cause you to change. And then add to that an "all off" switch technology where you hit one switch and you can shut off all the lights in the house.

From a policy standpoint those are the 2 major things we could do. We have already mandated smart meters and now we need to mandate in home "real" time energy displays. After display is useless because its just regret. You look at it and go shit, yesterday I should have reduced my hydro. So it would be displayed in real time so you can save energy or make changes to your house to reduce the energy consumption. These are 2 significant policy changes that can be done. And neither require technology and both of them are consumer awareness. Then you would have consumers asking the builders for it in the showroom and as a result you would have builders believing that thats what the consumers want. Right now if no one asks for it, their(builders) argument is no one is asking for it so why should I do it. They want granite counters or big ensuite. Nobody is saying I want more insulation or a higher efficiency furnace.

Also with mandatory labeling, when homebuyers can see it at time of purchase, and seeing the energy rating, they would be comfortable knowing that they will have a higher resale value. Just telling people that goes in one ear out other. These would also contribute in creating demand and create a pull in the market rather than a push in the market.

5.

- I think anytime you have an incentive program that targets builders, then theres generally uptake. In his experience with the savings by design program,.....? Consumer education and being able to educate consumers, thats another piece that would add a lot of value because then the development community could actually extract the value back that they are putting in up front in the way of higher efficiency equipment or better windows or doors (I dont really understand this comment???????). Consumers dont understabd the value of ee. .....Then Toronto has the LIC charge program so if they would extend that to builders of new homes. So if they agree to build 25% better than code, then they might get a direct rebate. Also the city of Toronto has tier 2 TGS incentives, that provide a DC charge reduction so those are the kind of things we expect would help. Has there been good reception or just ok.....and why hasnt there been? Theres not enough single family residential housing, you dont have to do it for 1 house, you have to do it for 5 houses and more. Theres not a lot of single family residential subdivisions going on in Toronto. So if they were to extend that kind of program to the province or if the province adopted it, then you would see more uptake.

You mentioned property tax? SO would this be a property tax on existing buildings that were inefficient or did not meet an identified minimum performance rating by a certain date....So making the BC kind of retroactive. ?????

Why is the program limiting itself to SFH in Toronto where there arent many? Their limiting it to provide incentives for production builders. They have a similar incentive program for other residential buildings and commercial buildings but they dont want to have to get those 1 person building their own home or a custom builder dealing with it. (I dont understand this statement.????).

6.

Its a realistic goal to achieve by 2030. Theres one major step change that would have to happen between now and then and getting more insulation in the houses. Including exterior insulation. This could effect the types of windows required. But if you look at a typical passive home, your generally looking at 12-16 inch walls (without the exterior cladding, so you still have to add that in) . Right now our walls are somewhere in the neighbourhood of 8 inches. 2x6, half inch OSB, 1 inch of air space, 3 inch brick.

Theres nothing on the technology side that would prevent this from happening but its all tied to the cost.

a) I think were on the right track to getting there now and there are things that have happened that indicate that. The indicator of this is that as soon as the new bc came out, manufacturers released r-24 batt insulation. So before that the highest we had was an r-22 batt. So as soon as the code changed they came out with the r-24 batt. That batt was 80% more expensive when they released it and within 2 years its only 5-6% or the same more expensive r-22 batt. So this is an example of how the industry is already starting to align with this continuous improvement notion. Weve seen 3 new insulating products hit the market that never existed in the market before within the last 12 months. So the industry is responding but you also have to remember the last time we had a major change to the ee in the code was 1977 in housing. And then the next change happened in 2006 but wasnt implemented until 2012. So we havent really had to change the way we have been building for years and years and years. So were in the first cycle of that change right now.

c) Right now on the low rise (RBC) its going to be 15% better than the current code. The current code is 25% better than it used to be. We used to have the 1977 code so in 2006 that code became 25% better. And now in 2017 its going to go up by another 15%. So were on this continuous path but whats scary is that we went from 25% -15% better. The reason why could be because of stakeholder intervention. So the stakeholders may come back and say well we can only do 5% better this year..on the next iteration of the bc. And if theres sufficient people on the technical committee that are on that mindset then that is what well get in the end. One way from a policy standpoint would be to fix those increases. So to say every code cycle that it has to be 20%. Another way is to start to look at assigning energy intensity targets to different types of buildings. So lets say that a 2 bedroom house, the maximum energy intensity you could be is 200gjoules/year/sqm. That would then establish a budget and bigger houses would have to meet that budget as would smaller houses. Its more of the stick approach than the carrot. Right now governments and the industry favor the carrot approach (SO THEIR IN FAVOR OF THE CARROT APPROACH YET THEY OFFER JUST MEDIOCRE INCENTIVES. AND THEY COME WITH CONDITIONS AND TERMS???.). So prov. gov prefers incentives for political reasons. So your LICs, incentive programs, DC charge reductions.

d) I think we can do better. I think we could get up into the 35%-50% range. That would involve, mostly at the 50 range, your changing and making substantial technology changes that have larger cost implications. We could most likely build to ZNE today if we had an unlimited budget and consumers are paying for it. BUT 1) most consumers assume that the OBC guarantees them the most ee house available but common misnomer out there..(.....????).

7.

a) They are not aligned with the future iterations of the bc. Its a federal/provincial matter.

b) Getting the appropriate stakeholders together at the time would help that. So when were sitting down to talk about OBCs, it would be nice to have someone from the ENERcan appliances branch which deals with ee of furnaces, water heaters, dishwashers etc, as well as having representation from OEB which sets policy or conservation demand management programs, and the gas companys and electrical utilities that are responsible for delivering those programs. So when we were looking at code cycles those people should be at the table. Currently they are but the right people arent. They would have a marketing rep attending the meetings. So get the right people there that know about the topics(appliances

experts, set policy, and people that will complain about the changes later). This could be a way to improve the disconnect between the programs and the codes.

8. How to encourage market to move faster?

a)- Goes back to 2 major policy drivers.

- Only other policy would be around fuel cost. And ensuring that purchasers pay the full cost from extraction through to transmission through to demand side. Because right now thats all heavily subsidized. So if we had to pay the true cost of our utilities we would more likely be more conservation minded.

b) The market will not move without consumer demand. Aside from regulations. And your not going to get the aggressive regulation because the stakeholder involvement is in the process now and no gov is going to do something that the stakeholders tell them not to do.

Mike Singleton:

4. Policies Improving speed and success of implementation

I dont think you can improve the speed of the cycle anymore than once every 5 years. Thats the fastest it can go for the reasons we talked about before. Such as the complexity of the building sectors, how long it takes for the industry to engage the builders and due process, and the rate of technologies going into the marketplace. So the 5 year cycle(thats a lot faster than it used to be) and although it sounds slow, its actually pretty good and it probably cant do much better. The policies would be more about the alignment of other initiatives with the BC. So for instance direction to the OEB from the MOE that the electric utlities and gas utilities that offer programs, get them aligned with the BC and in sync with the code in terms of timing and in terms of outcome. So we talked about Enbridge SBD, thats an example of a program that can lead the code but it doesnt line up with the timing of the code. The program cycle is different than the code cycle. Thats an example of a policy direction which would be linked to code. Enbridge program is currently 25% better than code but in 2017 will only be 10% better so they will have to decide (and it is a leadership program) whether or not to ratchet that up and line it up with the 2022 code. So thats how far forward they have to look and its up to them how they want to proceed but theres the feeling that they will increase their requirements as part of the program design and they wont just leave it at 25. The increment that they will increase is unknown and it might be 15 but could be anything. But as the code gets stricter and stricter it gets harder and harder to increase ee above code.

PROBLEM THAT POLICY COULD FIX: Right now programs are 3 year cycles(and seeking approval for 5 years) but still that would be 2016-2020 and BCs are 5 year cycles 2017-2022. So Enbridge will have to re-design their program half way through their program cycle(if program is approved for 5 years). If the program cycle was on the same cycle as the BC that would be ideal. What could help is greater discussion between the code designers and code officials and the program people at the utilities and OEB so that everyone understands what the code is trying to achieve, what the program is trying to achieve as a leadership program, and make sure that all the metrics line up. Its a bit complicated due to the prescriptive requirements in the code and performance etc. so that gets a bit confusing so clarity there would help. Im not sure how that would be written as a piece of policy but thats what you would want to happen: THESE TYPES OF DISCUSSIONs.

Is there any policies that could be used so we could achieve more aggressive codes????: While they are eliminating incandescent bulbs in as a code change. Theres specific prescriptive codes for technologies like that that are working on their own cycle and arent in the BC. I dont know if theres much to do with the policies and BC but to go back to what Bob said: You have to understand the building cycle and how quickly they can adapt to changes and you cant make these BCs totally unreasonable. They have relationships with suppliers and so on and technology plays out in the marketplace. And so you cant go in there and completely upset the balance. I think its important for programs that are leadership programs to advance the speed and pick up of some of these new ideas and technologies. So when you implement a code that has really aggressive ee performance targets, you run the risk of backlash from the building industry. Now there always going to be some push back and they will always tell you that new target is too hard but you want to find a balance. I dont know how far is optimum but what we are doing now is not unreasonable. We have a pretty good energy code component in the OBC.

Are there a lot of the leadership programs out there now??? No there isnt. So Enbridge has one, Union Gas has one, Electric utilities like Toronto Hydro they have access to a program run by the OPA. The OPA program is more of a prescriptive design where as SBD is all about performance and what is good about that is you give a performance target and the industry figures it out. And the industry likes that, they dont like being told to use this lightbulb. They like being told your energy performance for lighting is "x" kwh. Then they figure out the mix of technologies and designs to achieve that. The industry is much more in favor of this.(THEN WHY DID THEY REQUEST PRESCRIPTIVE PACKAGES IN THE BC SO THEY DIDNT HAVE TO DO PERFORMANCE TESTING/ENERGY MODELING). *Not related to BC in this instance. Its more to do with builders not wanting to be told what type of technology or equipment to use. They prefer to have the flexibility to choose how they do it.*

Could there be more leadership programs in ONT? Yes there could be. Either they could be utilities or gov (NRCAN), provincial ministries of energy could have programs. Often its utilities that offer the programs though. I dont know about what other provinces do but theres not a national effort. Maybe Ont gov could incentivize more programs like SBD. The way they would probably do that in practice is through the MOE

they would direct the OEB who regulates all the utilities to tell them you have to do more of this. Its the OEB that is the regulator of both the gas and electric utilities and so they tell them what activities broadly they have to do, not specifically like you have to do a leadership program, but they can say you have to spend a certain amount of money on market transformation type programs. A good example would be one that integrates with the BC and leave it at that.

5. Brussels examples used in Ontario

Yes they could. Whats great is there wasnt just a single instrument used because we see how complicated the building sectors are with all the stakeholders and players and all these different points of contact with the marketplace: theres trades, builders, developers, designers, customers etc. Its hugely complicated and so you must have a multi-prong approach and you cant have just one incentive. So you got to be doing training, you got to be engaging unions and trades, you got to be giving an incentive to the builders because it will cost more to build higher ee homes, you got to be teaching awareness to homebuyers as the homebuyer will have to want to buy it. So you have to work on the demand and supply side. **So Brussels is a great example of a holistic program where they understand all these various features and they put in place, incentives and support mechanisms for everything but that requires a significant investment and the gov has to stick to it.** You have to stay with it for an extended period like 5 years or so and then at some point you can have a code at the end of that. Once we get to 50% of our new homes being built this way, were going to seal off a certain level of energy performance with a code so you raise the bar and the code finalizes that.

Mike is currently working with the passivehaus in Toronto and its completely a custom builder thing. We are building them but their one offs. Or its one customer that really wants it done. We have to aim that into mainstream production building. But Passive houses will cost more: thicker walls, more efficient and expensive windows. They can have smaller mechanical systems and they probably will. But the savings there is probably not going to offset the extra costs for the thermal envelope improvement. Builders are hugely price driven they know their margins down to a penny. And builders advertise price....its the biggest thing you see on the billboard. Its the most important aspect to show the marketplace is the price. You if you tell them were going to build passive house and it will be way more efficient but cost 15,000 more per unit they are going to go no or wait we have to think about it. Thats their reality. These market transformation programs usually work on the supply side so they engage builders to make things more efficient and then customers just get them as part of that but when your looking at potentially large incremental cost, that has to be offset ands usually that is done through higher price and the way you would get people to buy and pay for it is through education and making them understand its worth it to be in one of these houses (SO THIS ISNT OFFSET THROUGH THE PROGRAM INCENTIVES???? HOW MUCH MORE DOES IT COST WHEN FACTERING IN THE PROGRAMS FINANCIAL INCENTIVE????). *Programs could offset the extra cost. It might cost more than the program incentive though. Program incentives might not(they could but they could not) offset the entire cost so someone, either the builder or consumer, will have to pay the premium.* Most homeowners/homebuyers particularity first home buyers, its all about the price and then some of the interior finish.(kitchen counters are more important that water heater). Thats the reality of that sector. This is more true with smaller houses. Some bigger houses will attract more interest in passive elements but those buyers are already spending 1mill or 2 on the house. Theres not a simple solution because the issue is complex. Some people want these features and some people dont. If you can marry the idea of a passive house as a healthier home thats important to the marketing message. Better homes better indoor air quality, cleaner all that stuff.

6.

80% heating consumption reduction by 2030 is a lot. But I think in new houses a 25%-50% reduction by 2030 would be doable. Were demonstrating 25% all the time. So I think 50% by 2030 is doable. 80% thats getting really low and its not so much about the technologies anymore, its about the design and the willingness to embrace some of these ideas. Example: Thicker walls, it sounds so simple but then all a sudden you need thicker foundation. Well that brings in all sorts of complexities and higher costs. You cant put a 12inch wall assembly on a 8 inch foundation it doesnt work. So builders they love building 8 inch foundations they know exactly how to do it and how much it costs even an extra inch is a cost. To achieve that kind of energy performance(AY thesis) you must have a better thermal envelope. The marketplace (the buyer) have to accept that they will probably smaller windows. A lot of/most people want these huge windows overlooking ravines or grass or whatever. You cant evenly put in triple pane windows as its still the least efficient part of the envelope. People have to be taught they might have to give up that kind of thing. So if you got a window facing south and you want floor and ceiling windows, theres going to be impact on the heating and cooling loads. With regards to AY thesis, its one thing to talk about technical feasibility, its another thing when you talk about market potential. They are usually different outcomes.

a) If we were to achieve a 50%(or 80) reduction by 2030 we would need to see thicker walls, thicker foundations, triple pane windows(higher performance windows), different designs in homes. So all these architectural designs that arent good on energy performance so we could get rid of those (EXPLAIN A BIT FURTHER*). This is referring to the architectural designs that would be less ee and contain losts of thermal bridging, not well insulated, contains lots of wood.* **So architectural designs are often established by municipalities not the builder. So you need to engage the municipality and their planning people in these discussions. Thats a policy that could be useful**. ENGAGING MUNICPALITIES IN DISCUSSIONS AND DECISIONS IS A GOOD POLICY. And engaging municipal planners and the people who are responsible for the architectural requirements. Also there could be more consumer awareness and you need to get people asking for these homes. And you could also use something like branding, like what ES has done. Maybe a brand called 2030. If your going to have a 2030 objective, you need to stay on it and have constant reinforcement and that requires political will to do that.

b) The policy stated previously regarding engaging the municipalities is one of the ways to gain the most aggressive ee codes with the largest uptake. And for municipalities, they have a huge role to play, they set the tone for a lot of this stuff and its the municipalities up in the greenbelt, there the ones where all these homes are being built. No new homes arent being built by production builders in Toronto anymore, its all out there in the Whitby and Oshawa.

7.

a) No they arent as explained before.

b) Correcting the timing like we talked about previously is important and the other thing that is important is greater integration and alignment between the fuel sources. So we got natural gas, electricity(the main ones). There is very little discussion between Enbridge and Toronto Hydro or Powerstream or whatever. That program is a very much a gas financed program even though it has metric energy performance including electricity so your saving electricity in these homes. The electricity utilities are not participating in the program so I think that would be a huge thing to get them at the same table as part of the program design discussion. WHY ARENT THEY NOW? They have different mandates and theres history to that. Its a legacy more than anything and there directed differently by the OEB and its complicated because theres so many of them(like 80 electricity utilities in the province and like 2 gas) so its a lot easier on the gas side. If someone could figure that out that would be a huge benefit. And then as part of that you would have discussions with the code authority and whoever to talk about integrated with codes. So talk about getting natural gas companies and electricity companies in the BC process. Or at least so they are all aware of what each entity is doing. They dont necessarily have to participate in the design of these things, but just so they know hey this is an important date, we better prepare, make sure we understand it, this is how its going to work etc. So make sure they are aware of whats going on in code and what kinds of programs are out there and cycles and stuff.

8. How to encourage market to move faster through more aggressive action:

a)I think the main way is by offering incentives. Money talks. So if you want to implement a step change, you can do it through messaging, awareness, education, but the fastest way to do it is payup. One of the things with the Enbridge SBD program, it has a 2000 incentive per house and thats when builders sit up and take notice. Oh 2000...how do I get that. Like what was previously mentioned, builders know their margins and they know the costs of building costs. So you have to do all the other things but if you want to do it quickly then you need incentives.

b) Yes consumer demand is an important part of the equation. Im less convinced that it could really speed it up but its certainly important and if no one is willing to buy the home, that means your out of the game. So there definitely should be an awareness program and the builders wont do it themselves so it needs to be done on behalf of them(Clarify this why does it need to be on their behalf??? Why would they do it then??). *Builders will more likely market ee features of their own product(ex, Mattamy and ES). General awareness falls onto the government or the utility and is not up to the builder(ex. Federal Gov and ES). General consumer awareness for ES comes from the Federal Gov*. And theres a big debate in the industry about the value of green, the value proposition. And a lot of builders will tell you its not really there for their customers. There still more interested in other features of the home. Your talking about saving energy. Most people spend more money on their cell phone in a year than they do on gas bill. Energy is still fairly cheap.(electricity is more expensive.).....SO DOESNT THIS FACTOR INTO ENERGY SAVINGS STILL). *With higher performance houses, it is mostly a more efficient envelope and foundation and so energy savings there are gas related. Electricity deals with plug loads and appliances which is a smaller part. So the cheaper energy gas, is more what your saving with more ee houses.* But from a gas bill perspective(gas bills are likely less than 100 a month), thats around the same or less than a cell phone bill. So this is the other element: yes we want to save energy but its not the biggest part of the wallet. The houses now are fairly efficient, much more than houses built 40 years ago. If you put in a piece of equipment like an ee water heater, but it comes with a 50 rental, that is more of a barrier than then any advantage they would get from the gas savings. So this is the other thing that happens if the ee equipment is rented can be expensive(I dont understand this rental????). *Many homes have rental water heaters and higher efficiency is higher costs. With the 80-90% efficient heaters, consumer gets the bill and complains. This is because gas is cheap so paying more for gas with a less efficient water heater isnt a problem but paying higher rental costs with a more efficient water heater is a problem*. And people wont know what their saving because they dont have a baseline. They just have to take your word for it that they are saving gas. Theres not a baseline because its a new house.

B-9: Greg Labbe Interview Transcription and Summary

Question 1-3:

So R-2000 was EG80 for a long time up until 2006. So if you built an R-2000 home, it was at EG80 level using the EnerCan Software. So part 12 of BC "resource energy conservation", prior to 2012 that was a voluntary standard. Currently Energystar is at 83. And R-2000 is 85. These are the three tiers. Came 2012, it was no longer voluntary and they took the language from part 12 and put it in part 9. So now Part 9 states the house needs to be EG80. Started in 2012 and then ES went up 82 and R-2000 to 84. So they will constantly go up. At the same time though the federal government has planned for the last 7 years this version 3 of HOT 2000 software. And that version 3 has been like watching paint dry. Come 2012, what happened was the language changed in the BC and now Part 9 said your house must meet EG80 or if thats too stringent for you, you can follow SB-12. Theres 3 options in SB-12: you can build ES or R-2000(which beats eg80), you can follow the tables in the compliance packages, or you can do the performance compliance where you build two energy models. So you take the same bones of the house, mechanical systems etc. The only reason people go to performance compliance is if they have more than 22% window to wall ratio. Typically these are richer

people building cottages with 30% glazing facing a lake. And it doesnt matter if its facing N,W,S,E they want glazing facing lake. So the government says we will build 2 energy models. Were going to build the as built house. So the 30% glazing, we know mechanical systems going into it, we energy model everything going into the house. It spits out x number of kWh a year. And we take the exact same file and save it as a different name and then reduce the window to wall ratio to 22%. Now this house has less window. And if all the window was south facing and it was optimized for solar gain, you might be penalizing. But what ends up happening is its not and the glazing is North facing and now we have a better r value of windows so this house performs better. Lets say it requires 50,000btu furnace where as this one requires a 60,000btu furnace so this one requires more energy. Now the existing house performs more poorly than this house by 10,000btu per hour so what you have to is you have to tweak the ee of this house(as built house) add insulation, recommend more air tightness. So you have to make it perform as good or better than the reference house. Sometimes it doesnt have to be tested because the default air leakage rate is 2.5 air changes in the as built house and this house. If you want to make it better such as 0.5 air changes(passive house) so now its more ee and now the performance is better. If you model anything tighter than 2.5 air changes in this house than you must get tested otherwise theres no testing. ??????????????????????.

Air cooling is important to look for policies and into becoming part of the code. Cooling is what were interested in in Ontario. Because it is important to manage summer peaks. Its not mandated because there is no real software for it. But if you took all the homes in Ont to see how many have air cooling systems installed, it would likely be around 50%. Also, traditionally house didnt have air cooling systems. Would it be helpful if there was a policy to encourage/mandate ee in air cooling units? Could this contribute in being more aggressive?

SB-12 is an example of a successful policy to improve energy efficiency in the BC. This worked good but there was a lot of grumbling. Builders really grumbled but they got over it. How???? Now the province and the MMAH should keep reiterating that same pattern for new houses. Every code cycle just keep increasing the demands on builders. In part 9 ok guys now its 82. Then es and r-2000 move up.

Challenges:

The big challenge with EG80 is that nobody went with it in terms of performance measuring. Everyone went with SB-12. Maybe 1% of them took advantage of energy modeling and did an actual energy model of the house. Many people went es. And a lot of track builders are going to energy star. The problem with es is you dont need to test all the houses. You can get away with prescriptive measures. You dont have to do the blower door test. This is wrong/travesty. Every house needs to be tested. They all need a building inspector to go through it. And they must all be physically tested. Without a performance test to ensure compliance, there is no way to know if the houses are compliant with the code. I think thats the last little bit before Ont really starts to close the noose. Because were starting to see in most houses, the biggest load in some of the most efficient houses today is no longer the heating system, but its the hot water tanks. So to him were getting better on the envelope so when it comes to the envelope I think that one of the last little bits is making sure that every house meets a certain minimum air leakage rate. And the best time to do it is before the dry wall is on not after. So you test the air barrier when the air barrier is exposed and then you can fix it. Because once the dry wall is on its over. So Ont should have mandatory air leakage tests prior to dry wall installment???. It must be done before the dry wall so if there was one mandatory test thats when it should be done. And then I would phase it in. So the entire air barrier is installed and the windows are sealed along with the walls. Then you test it and once the dry wall is assembled, typically the air leakage drops a bit from the pre dry wall test. So things usually get better after dry wall not worse. If you were to phase it in, make the air tightness test for every house mandatory pre drywall and then in the following code cycle make a test for post dry wall. Pre dry wall will give builders the chance/time to see where they are screwing up. Builders havent made the connection. Neither have electricians or plumbers. Plumbers and electricians come in and they just plow through the air barrier, brick layers do this too. They make huge holes in the air barrier of a house.

Successes and Challenges in EG80 implementation:

So this was in a large part the GEA that was Dalton Mcginty, and it brought in a bunch of measures and Kathleen Wynn was at the MMAH and helped bring in some of the changes. This was a key document. With it came in the microfit and fit programs. We had grants for solar hot water heaters. There is one piece of legislation that requires every house that is sold in Ont to be EG rated and audited. It is the case right now but it hasnt been enacted. Its still sitting on the books(mandatory audited houses). It just needs to ne enacted and then it becomes law. The main issue is the real estate lobby is very strong. And so the government backed off a bit on this one. It affects the realtors because they want to sell houses as quickly as possible and if you have anything in there that could slow down the process, or make them lose the sale. In Toronto, due to high amounts of people wanting homes and overbidding, it might not be as big a problem. But in other markets that might not be the case, where your struggling to sell a house for 100,000. And your asked to spend 300 on an energy audit. The last thing you need is the buyer to say well it says here your furnace is 15 years old and thats the maximum lifetime, you should give me a 2000 break on the house. When your paying 100,000 for a home 2000 is 2%. What kind be done to get the auditing mandated??? Its been on the books for years and next term it should just be mandated. Theres a lot of talk on the world stage about climate change is building to a crescendo. They always say carrot and stick.

3. R-2000 Success and Challenges:

R-2000 was never really successful. They also got ES off on the wrong foot. ES started off and as soon as it started it got a huge black eye because of mold ventilation issues. They didnt get it right in the first set of houses. They have rectified it though. R-2000 homes are in the maritime provinces but you wont really find them in Ont aside from in and around Ottawa. Its climate driven in those provinces and people are ok with spending a little bit more and benefitting in energy savings; they see the value in it.

4. What policies could improve more aggressive ee codes in Ont:

Energy literacy is a big one. I think if you bring energy performance into the fore and you make people think about it everytime they make a transaction; first of all people flip houses all the time using houses as an investment. And you dont want to tell people what they can and cant do with their property or how they make money, but what you can do with the bulk of canadians is make them more aware of ee through having them do an energy audit of their houses and I think at the time of sale is a good time. Mandatory house audits(at time of sale or resale). BC it is the law. It was implemented through a provincial mandate. Its what we almost did here with the GEA house audits. Ont has followed BC on a few ee policies. BC had energy modelling and BDT before Ont did. DO YOU HAVE ANY MORE INFO FROM YOUR FRIEND PAT FROM BC???????? The energy audits will lead to more energy literacy among Canadians.

Cash Incentives????? With builders there has to be a carrot and stick. They have to be closely monitored. Right now theres already a carrot and stick. If you build to EG83 you get 500. Nothing for consumers. The incentive to save energy isnt high. This is due to the fact that energy is very inexpensive in this province. Electricity is starting to go up and could keep going up. So if energy prices werent so low then I think homeowners would be more aware of it. So I think a carbon tax and the pricing is very key because right now. (Could it be trending towards less efficient cars because gas prices are low).

Consumer education could play a role. He believes in global education starting from grade school and high school so the energy literacy needs to be increased. It starts at knowing how much carbon is emitted from coal, oil etc, whats a kWh, how do we manage the energy curve so we are using less energy. Is there many programs and initiatives for consumer education??? there isnt. and right now were kind of in a vaccuum and there are some low income programs like utilities are mandated to do conservation for low imcome people. The idea is you dont want to tax the poor more with having very high energy prices so the government is basically telling utilities that look, you dont want to saddle low income people who are already having a hard time with higher energy bills. Utiliities like toronto hydro and Enbridge will have programs that will do some minor measures on houses. And minor is really minor, very basic. Like adding in a new freezer, increasing r value slightly, very basic measures. They make a difference but not a major one. Brian: What about general public education programs? There isnt any broad based energy auditing services going on or programs going on provincially. So there is the Hel program in Toronto. It is an innovative program but unfortunately they put the cap at 40,000(more likely 25,000) which doesnt allow you to do much. For retrofitting/re-insulation it can easily cost 100,000 and go up to 4. The 40,000 is something but the problem is that the city of Toronto is so timid in their approach that it wont get widespread adoption of the program. So this program wont go far. So the Hel(Home energy loan) program where the home owner borrows money on their tax bill. So if you have a house you get an energy audit and the results show you need to insulate attic basement better, and if you do that youll bring it up to eg70 and so you do the work to get it there and get it re-audited. So then the city gives me money towards the money that was spent on it up to a maximum amount. Now because you borrowed money on your tax bill, so now everytime you pay your taxes theres an amount that will be there from the home improvement charge. Its in the section where your municipality taxes are paid. Also its interesting because if you sell the house, it becomes the responsibility of the new homebuyer to pick up the bill. It can help with education and energy awareness but the problem is that this program was picked up enough. 0.5% percentage of the population takes advantage of this program. BRIAN: So are you really even educating people. Thats the question about programs like these. Theres not enough people taking advantage of them and learning about the benefits of ee. You need something that appeals to the mass. And these are carrot programs. And the stick programs like the GEA coming out with mandatory house audits could work. All of a sudden everyone will get the home inspection report and you get a home energy audit on top of that and now you have these two documents. So you carry that with your portfolio and mortgage. And they might not look at it after they buy the house but at the time of sale or resale they most certainly will. Because if they are negotiating for a better price and the audit shows a flaw or energy inefficient expenditures, you can ask that it be replaced or upgraded before buying. This could improve energy literacy if the auditing was mandatory. Also the GEA did mandate that all home must be audited prior to resale but in the housing contract it stipulates that buyer waves the right to request it. So its there but theres language in the contract that allows them not to get it done. ASK HIM IF THE GEA MANDATES THE AUDITING?????

5. Brussels programs being used in the Ontario system:

The problem with offering cash subsidies to home buyers and builders is that there is a lot of spec builds in the province and a lot arent driven by the home owners and when you build on spec(you building a house with no owner in mind) as opposed to a home owner saying heres the plan for my house so build it.

The home owner gets the longevity and durability and low utility bills and that should be incentive enough. I think right now builders are not building good enough homes. If you can do a continuos loop and phase it in over years where you say ok builders were going to ask you to spend an extra 40hrs on detailing the air barriers and an extra 80 in special tapes and then you say it has to be performance tested as well. So its a cyclical thing where the trades learn and then they do the test and you fail(you didnt do this gap etc etc) come back and redo it. So when they learn they see they get better and its continuous improvement. Then next code cycle they pick it up again. So cash incentive should be given to home builders . Utility prices have to come up or nobody will care. Unless there is an incentive for builder occupants to save money, then giving them money probably wont work. The optics are bad for any government that gives money to homeowners because its going to the rich people. Whos building houses, rich people.

You need to balance the carrot and stick approaches with home builders. You have to work with the associations like build in toronto, OHBA, CHBA etc,(These groups lobby on behalf of the builders for status quo. These are very powerful lobby groups so if you made something too aggressive they would be on you. First one to knock GEA)

6. Amanda Yip Thesis:

a) I think its the only way your going to do it. Its the stick approach and the stick really brings about massive changes. SB-12 was the first massive change. It brought about the common use of outside exterior sheathing. So were talking about reducing the thermal bridging that happens at each studs. Still a lot of houses that have 2x6's with 3/8 inch plywood on them.

So yes this is a realistic goal and that it should be done. 2030 is not that far off but look at the Saskatchewan conservation house: It was built in 1974,5,6. And the passive house in Germany, the insights all came from that house built in the 70's and in other words we had the technology to build super efficient houses back in the 90's. Its all about optimizing the building envelope, theres no moving parts(except hinges on the doors, windows, so theres some) but they are all static things that are part of the building. If we were to bring in panelized houses like they do in Europe, we can assemble things quickly and get higher tolerances from things in terms of more consistency. Feasibility by 2030:right now there are houses being built to that already so of course its possible. Make more serious rachets in each code cycle. SO NOT BY 15 AND THEN 10 ETC ETC BUT MAYBE BUY 25,20?????????. And probably the biggest thorn in builders sides is going to be when every house needs to be air tightness tested. And will probably be phased in where you say every house needs to meet 2.5 air changes per hour for 2017 code cycle. Totally doable. Next code cycle you can change it to a normalized leakage area. So make it an ela based as opposed to an hch based. Just start rachettting in up. Once you test for 2.5 air changes and they know they will be tested, they're going to pay attention and get matter. And theres no mandatory air tightness test. And so gradually every code cycle make it a more aggressive att. Start off with 2.5 and then make it more demanding each year.

c) How high in terms of energy efficiency can policies be designed: Right now the code should be moving towards a double wall system to eliminate thermal bridging. Or we need to move towards massive exterior insulating sheathing. The codes wall systems are slightly more complicated. This is the next big obstacle. To get this achieved faster and successfully ratchet up part 9 of the bc in every code cycle.

7. Voluntary Approaches:

a) Ive tested a lot of ES houses and not all of them are tested. The moment you allow builders to build houses prescriptively, its not guaranteed performance and it has more of a chance in not being built to code/above code requirement. ES houses do not all have to get BDT or performance tested being there is two paths in ES homes for builders to choose: performance and prescriptive.

b) Yes it can work really well. There is no reason that if builders are building better than code homes before the new requirement in the new BC, that there shouldnt be a seamless transition to the next code level.

RE QUESTION THESE BEING MORE CLEAR ON OBJECTIVE OF QUESTION.....

8. How can we encourage market to move faster?

a) It might be good to try shorter code cycles. Because right now 2012 is our code and that was awhile ago. I think 3 years is a long time to make change.

b) I think actually letting the cost of utilities help make consumers cautious of ee. This can be done if we include in the cost of energy: remediation from whatever ff emitted are harming the env. This would be the full cost of utilities from natural gas and electricity. So the externalities of the resources. People and consumers will understand that language when they have to pay for it. And so we talked about education, if people had to pay for natural gas, what it actually costs including remediation after its released, they would start to get a little bit smarter in the way they use energy. Brian- How would you go about mandating this? It only happens when we all work together and have the same tax system and right now we dont have that. The problem is we dont have that: BC has enacted a carbon tax, Quebec has one but Ontario does not have that.(ONT DOESNT HAVE A CARBON TAX ON ENERGY USE????). So I think that it is coming but were missing the framework nationally. If we had a carbon tax it might start to trickle down through the economy and people would start to see prices go up but at least they would have money to do remediation work as well. Maybe we would start to invest in planning and infrastructure like bigger sewers and better planning instead of short term planning. If all people are paying similar ubills then it seems fair. Im ok eating a bad sandwich if everyone else does. Brian: What about the people with high efficiency houses do they pay too? - Well they will pay less because they arent consuming as much. Or maybe they have pvs on the roof so they can sell back or be more of a net zero. There is the energy poverty issue. People working at low paying jobs because thats all they can get. And yet there being asked to pay ubills just as high as the rich guy next door.(SO WHAT CAN BE DONE ABOUT THIS???)

B-10: Stephen Pope Interview Transcription and Summary

Question 1-3-

Part 9 residential- Each province develops its own building regulations. Now to assist with consistency for the provinces themselves, the federal government prepares a national model code and thats the NBC. So NRC code setter produces a model code and then that is adopted or adopted with provisions by the provinces. Then from the provinces, the implementation of that code is delegated to a municipality or some kind of local government. So it falls on the individual city or region to administer the provincial adaptation of the national model. Thats the authority string because it many cases the municipalities dont have the ability to develop their own codes. Only Toronto and Vancouver have developed their own codes and even then they are adaptations of the model code. Thats the regulatory chain of command. Then theres the cultural idea that says any Canadian citizen has the right to build their own home as long as it falls within the scope of part 9 because part 9 has been developed in a strong prescriptive form to show exactly what to do. The municipalities spend an inordinate amount of time on the housing of a relatively small number of people especially compared to the commercial side. Thats(Whats been talked about so far) the regulatory structure. And the voluntary programs like r-2000 come out of social policy, which has gone through a major transformation in the last 40 years. R-2000 was implemented in 1982 and it was a continuing effort to deal with the oil crisis in the 70's and the concern about building better quality houses in canada. R-2000 was developed and implemented by NRCan because they have the jurisdiction over energy and energy use either wood for heating or oil for cars etc., that whole 9 yards. So as the voluntary program developed and a lot of extra effort was put into developing training and at a certain point the government decided that they did their bit and they handed off r-2000 to the CHBA. And CHBA kept r-2000 in a box essentially. They had it available as an option for builders who wanted to diferenciant themselves by doing something special but they made sure it didnt actually leak into the general trade of their members. Notwithstanding that strangulation of the r-2000 program, it did very quickly demonstrate that you could build houses that were a lot more energy efficient. And the quality of the r-2000 documentation is a builders guide and a training courses were quite solid so very quickly, within 20 years the r-2000 program had a significant influence on part 9 of the building code. And that went right through the National models and provincial adaptations. Thats the r-2000 side. Because r-2000 required extra specialists and pushed the home builder industry more toward the professionalized commercial building model, there was always a search for something more easy. The r-2000 file manager costs 500 and for 500 you got BDT and HOT-2000 model. Also the HRV systems for houses are now required in part 9 all houses are now following the r-2000 "build tight ventilate right". That is a Canadian invention and is only about 20 years old so in the house building community there was initial resistance and a lot of the bad press that came out about r-2000 was a rsult of people that said they were building r-2000 but didnt and then built tight heavily insulated houses with no ventilation which quickly developed moisture problems. So in the vacuum that was created by the industries had difficulty with the technical requirements for r-2000.

But for es, early on there was certification recognition but there was no requirement for the blowerdoor test. And it didnt mandate ventilation either. It had to keep up with the changes in canadian code but it was an american certification based on patterns of equipment certification rather than the whole building certification, but it was a recognizable name. The Canadian version of es was eg and it was recognized from equipment sales like refrigerators and appliances(laundry) all had eg labels so you could get a eg label for your house and that was the way enercan and r-2000 tried to capture back some of the market by producing the r-2000 certification with the bdt r-2000 had but giving the house a simpler label which was an eg rating. And eg80 was the entry level for r-2000 and it really very rapidly(within 10 years) went from being a rating system to actually the definition of code performance.

More often there is political reasons why things happen rather than technical reasons: the change in attitude about codes. Perhaps it was the case of home builders, there was a strong reaction to the introduction of the Model NEC for houses. It was rejected and the CHBA had a very vigorous campaign to get people to leave them alone because housing was improving anyways and then they make the point to say what used to be an r-2000 level of house is now a code level house and that was good enough. It was a very large lobby group that the CHBA had. They are also very powerful with the code setter in NRCAN. The lobby group is a large coordinated national group so the government pays attention. This is unique because everywhere else buildings are provincial concern and the federal government doesn't pay attention at all. In the housing department, there is a strong national organization which therefore has a strong presence with the national government even though the jurisdictional lines are a little separate.

*****r-2000 showed prescriptive requirements which is what the eg80 rating describes. But eg80n was a performance approach to allow people to deviate from what was written out in the code and demonstrate that they had equal performance.******

eg80 late adoption:

The delay was generating enough evidence that the builders could do it. The people interested in building performance and serve as advisors to committees that write these code are a small number of people. And they looked around them and said ok im seeing a lot of behaviour that looked a lot like an unregulated r-2000 so clearly the industry is comfortable with that. So modelling studies were worked on to demonstrate the energy savings and GHG savings and the arguments were made that the industry was already doing it so we could easily put this into the code. Thats the way that the r-2000 program influenced the BC because there was enough training and enough people were doing it that the authorities having jurisdiction had comfort in saying well set the bar here.

Anything notable that really pushed for eg80 as code(strength): NO but there is the growing concern about emissions is one thing and the governments responding to the climate change arguments and this is one vehicle. Recently in Ontario there is growing concern in peak electricity demand because we got a hundred year old electricity transmission infrastructure that is going to need an upgrade sooner than later and thats very expensive so if the government can put it off by making people more efficient than they wont have to upgrade it and thats a large potential savings. And those are the social drivers- which are, how can the government avoid spending money on energy or infrastructure is the large part of it and the smaller part is climate change hysteria.

Same for r-2000 S+W: Depends on the local builder whether or not they believe in high performance buildings or not. Some companies build/built nothing but r-2000 houses. This is a better quality house(easier to maintain, more comfort, less expensive on energy).

4. Policies to improve more aggressive ee BCs

No because the codes are extremely conservative. And so you need to have demonstration before the model code will be adjusted. Then the BCs will be adjusted in response to the model code. The only option is for government mandated programs with a very widespread approach for training. In the current political circumstance there is no willingness to do that at any level.

The training program previously mentioned would look something like the r-2000 builders course. There are currently course in community colleges. The CHBA will have some r-2000 training programs but r-2000 has been captured by code so what it used to be is now code. In order to have major training programs, you need to make a major change. And the next big jump is really net zero houses and so we need to get there. It will be something similar to what training programs were done in the 80's for r-2000. And there are training programs for net zero now as well??.....

One new thing for any aggressive ee program in Canada would be the integration of the regional utilities and that would have to be the municipal local distribution companies as well as the provincial transmission companies. so when making zero net energy training programs, utilities would have to play a role and participate in this.....why??? what would they need to do??? and what about programs like union gas optimum home etc?? .....Because its still voluntary and because there arent so many and the major utility that is challenged in this case is the electric utility. Because there going to lose sales as everyone will likely do the microfit program and on a sunny june day, the utility actually change its purchasing habits on the stock market because it would have more electricity than it needed and the local guys arent use to doing that. The bigger guys are but the local guys are not.

Brian- Why wouldnt we have training for middle ground instead of just going from eg80 to zne training? One of the reasons is because were on a declining returns curve so compared to 1970s code house, the r-2000 certification was a huge jump but the thing is you get close to a concept sift when you start pushing beyond eg80. In the early CMHC the two rounds of the CHMC zne house competitions the starting point you had to have was eg90 in the building shell/envelope. You hit the point where its hard to squeeze anymore energy savings out of the shell. Go from eg80-eg90 which is an exponential scale but its doesnt sound like much.

The eg system is changing from a single number rating which is difficult to explain to an energy utilization intensity number. So for example it would read a building uses ...kw per sqm.

Brian- why use utilities in the training programs? Well one thing is you would be smoothing the road to the ability of large scale deployment of renewable energy on houses. The whole thing about the house is that the individual house is insignificant but all of them is a huge number and all of them is a dominant energy use in a country. There is no class of buildings that use more energy on an absolute scale than houses. It just because theres so many of them. The individual house doesnt mean much at all. To get the utilities involved will require them to change their operational model. So they must be involved or nothing will be moved forward. Their current model is they generate the electricity or they buy it from another licensed generator and then they sell it to you so there either the producer or broker but there is a one way supply of energy. If we went to regions and communities of nze houses and we go to micro grids that could theoretically be self sustaining, so they wouldnt require the purchase of electricity. Then the utility which has been given its monopoly structure by the municipality or the province is suddenly having to cover its costs with significantly decreased revenues. This is because people are producing their own energy. And then furthermore they are looking for somewhere to send it in the middle of the day. That scenario means that the utility has to restructure its rates to maybe getting money from renting out the lines rather than getting money from sending people electricity. This is a topic that hasnt been discussed at a large scale yet.

There is lots of talk about the smart grid but the people who are proposing it and promoting it are the people that make control systems and their not the utilities. Its going to require a complete overhaul of the grid control to make some of these scenarios feasible.

5. Brussels policies in Ont. system:

There are things you need to influence regulation and one is a clear system tthat describes how people are suppose to do things and the other is a target that has some attraction to it. So adopting passive house in a technical sense satisfies both of those criteria. Being a very low energy houses strong program with good builder training. Thats a potential and then theres a very short step from passive to zne. Paying for almost the entire ee costs is politically unpopular now in Canada certainly the municipalities, in trying to keep taxes down, have starved their building departments and starved anything that would be useful to assist the construction of a better quality house. So thats a political limitation.

Occupant behaviour is something that is just starting to show up in NA. Its showing up commercial office and in managed resources like low income housing but at the apartment scale. The general political feeling is that you dont want to try regulate someones behaviour in their own house. That shows up in the approach towards the electrical lightning where in the commercial buildings, they dont have any trouble limiting the amount electrical light being used in the office building but theres no credit for cutting lighting in a house.

Brian- Programs to implement to teach people how to live in high performance houses: You would have to first make a set of objectives and goals that actually make a difference to somebody. The problem there is a house with fairly low energy consumption to start with so if somebody

actually has to change their behaviour, the benefit they get is $5 a week, $20 a month. So you have to create an end goal that is really appealing and then introduce a set of tools that will help people achieve that end goal and then roll out the program. You need a program that will make consumers care. You have to look at design, the sizzle of people with equipment, and you have to really leverage convenience. And these are difficult and what you really want to do is give people a limited budget so they have to live with it.

Brian-If we cant leverage with money for consumers to change behaviour / care about an ee home then what?- Their comfort and their status. So the pure marketing approach is to find something obscure and tell everyone they are left behind if they dont have one. There was some success with the microfit program. Well the success of microfit has been that you got these shiney things on your roof that can help reduce or get rid of your energy bill. Your generated electricity and getting paid at the preferred rate. That gets close but in reality you have to become a little utility so you have to have a little business on the side. So most people arent interested in running a business, then the microfit program isnt that great for them, they are better off renting roof space to someone else and they dont involve themselves with the electricity and so they get rent from a company using their roof. That kind of thing has had some success. Not a lot here because of connectivity issues.

(should go into 4)In the GEA, the mandatory home audits was the first thing to be deleted after it was apparent that it would be adopted, specifically for houses. They proposed it and the people didnt like it so they took it out. The question becomes, you failed already once so, how are you going to bring new information to get it implemented. But the idea about your house performance being your proprietary information. Privacy advocates are very strong on that data being controlled.

6. Amanda Yip Thesis:

a) realistic for 2030? - Thats all doable. You could probably go further. If you decided the adoption of passive house you could exceed that. That 80% residential space heating reduction is simple. Its trickier when you start looking into retrofits but for new construction, its easy.

b) How far can we go 2030- If we have to pick a target that makes people stretch , think and is inspiring, then were talking about zne communities. So you do two things: You would have to move off indivdual building sites, you could do things on the individual building site but your thinking about bigger picture already....why do we have to think about moving off individual building sites????. .....And then you need to introduce the means and the demonstrating success, so you need a whole series of metrics like the declaration of the energy consumption of the house (Can this only be obtained if the GEA mandates the home energy audits????)..... You need instructions about how things will be controlled from the municipalities and utilities and system operator perspective.

c) You would need to look at Land use policy, planning act, directions given by OEB which is large scale energy policy. Policies have to touch on the planning acts, they have to remove the barriers in other policies to allow things to be assembled in different ways. EX- from the GEA was wind turbines being reclassified as designated facilities or structures. In the planning act there is certain attitudes about industrial equipment and industrial equipment has to be kept separate from other sensitive objects. So thats an issue of zoning. Where you put what kind of equipment so thats why its in the land use side and thats why its in the planning act.

In the past structure, one of the things is that if your buying a solar system for 15,000 then you have added to the value of the house so therefore your tax will go up and in many cases the increased property tax based on the value house was more than the value of electricity your saving. Maybe the planning act could be revised or mandated that this would not go against you to be more ee. Just like the wind turbine example is planning act, the solar example is municipal property tax. There are these things all around that are setup based on the argument that we do everything in this way. That utilities are a one way trip, they generate you buy, that communities and community grids infrastructure is municipal property and is given to the tax payer to encourage the community. There are a whole bunch of attitudes in the laws around infrastructure that would have to be adjusted to describe a different kind of behaviour sort of a its now a community behaviour and by giving energy into the community grid, your supporting community energy picture therefore there is a rebalancing of policy to encourage that behaviour.

Also if you can subsidize the manufacturers, you can have a much more aggressive impact on the sale price. If your in a new market, the government does have to support people who propose to make the things they want. But the word subsidy will get you thrown out of a room so you need to develop an argument for building manufacturing base based on local manufacturing, local profits, local business development.

7. Voluntary Programs and alignment to future editions of BC:

They arent perfectly aligned. There also things that are in regular matenance mode so I mean the new eg system should be well introduced soon if not this year and that will completely change the way eg rating is viewed and read. It will be an energy utilization number not a arbitrary comparative number.

Brian- Voluntary at fed and codes prov. anything we can here:- To date the alignment has become federal and the province responds and its usually a year and a half or so between the federal announcement and the provincial response. The idea of a seamless transition is strictly because the industry is still not a tighten integrated thing, it takes generations of teaching to make sure everyone can do the same thing so thats why the r-2000 program was so remarkable because in 10 years or so it jacked up the building code quite a bit which is an extremely fast time.

Some local builders are still using 2x6 for exterior walls it could be the 70's.

b) Voluntary programs can always be more aggressive because people are doing it because they are interested. But you really need aggressive voluntary programs. More aggressive than es. And you have to look for and find step changes and behaviour. Incremental improvement is the kind of thing that governments and code do. Voluntary programs must be exciting so they have to engage dramatic changes and scare people. Voluntary programs will always be fairly small and cannot get large scale adoption. But if you have an exciting voluntary program, people will copy it. One of the tricky things about houses is going to be that nze houses doesnt have to look a lot different than a current code built house. Thats the problem. Its getting to the point where differeienciating the look of something is no longer the flag. In the end the house can look like anything and perform to the target. With the exception of all glass houses.

Brian- If were looking to be exciting with the aggressive voluntary programs should we have more(higher number) of programs rather than just a few like es:- The kind of direction that it is going now is they is still having to move off site and the business of engaging other values like if someone is handling all of their rain water on site, they dont need to connect with storm drain. Then they are taking load of the municipal system and this is the argument with green roofs that were delaying the peak and flattening the peak so that the storm drain doesnt have the same tough time when you get a big rain. So thats a municipal benefit that an individual building owner is doing so were starting to look at getting beyond the building site so you might look at the arguments around the 2030 districts which are the neighbourhoods that are suppose to be low energy rather than individual buildings. And you could look at the scale jumpings discussions in the living building challenge certification. And the argument now has to be developed about bigger targets being achieved by participation in larger groups and to participate in that group youve got this kind of entry level behaviour on your building site. These are municipal level programs and so if you can get the provinces to earmark money from municipalities to fund aggressive building programs. Then your voluntary approach could do something remarkable.

Overall: **Theres no one silver bullet. You have to sew together a whole array of different chains and approach the question from different areas. You can tag the cost of the building on materials or labour because the differences arent that great. The costs arent that much but there is a knowledge difference. ****

8: Policies to encourage market to speed up:

Were approaching a fairly large shift so if we can make the market faster by looking at subsidizing materials or not willing to change the payroll so you encourage builders to higher more tradesmen.

Because the building stock is good enough now that if you pay a little attention you can live very comfortably in a complete shithole.

How to make it faster: Either make a step change where comfort is delivered with no extra equipment which points you towards the passive house approach or you look at the a municipally subsidized mass deployment of renewable energy like sort of like a municipally administered micro-fit programs which would be a lot of work on the part of the local utility(Toronto/Ottawa hydro) but would actually be achievable.

Would training like we talked about before help? Training to get utilities involved is two fold: Theres the actual utility operation model which is eye level discussion and then theres the building training model and those are two different discussions but both are needed.

Its tricky because were having to go beyond the r-2000 builders course.....Is this the main training guide for builders even up to todays code of eg80????

Also some of the arguments go to all trades have to be licensed, they have to go through professionalization as a trades kind of thing. Anybody, if he wants to be a carpenter has to take the r-2000 builders course. That is tough to administer and it hasnt been discovered yet how to do it because you would teach it differently than you taught academically. So you have to figure out a way to teach people that isnt sitting in a classroom. This dilemma would arise if we said that all trades had to be licensed for r-2000 building. How to deliver the education without being in a classroom. They are builders and want to be outside and like problem solving thinking on feet and may not be good in a classroom. That was classic problem of the r-2000 builders course is that all a sudden these guys had to sit inside for a week and memorize stuff. But legislating things like this is not the easiest route. Voluntary programs are much more easier to manage.

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