FACTORS INFLUENCING THE CURRENT RESIDENTIAL ENERGY RELATED BUILDING PRACTICES IN NORTH DAKOTA

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

ABSTRACT

Pedersen, Carl Arne, M.S., Program of Natural Resources Management, College of Graduate and Interdisciplinary Studies, North Dakota State University, October 2010. Factors Influencing the Current Residential Energy Related Building Practices in North Dakota. Major Professor: Dr. Chris Biga.

The aim of the present study is twofold, develop a quantitative understanding of the current residential building practices related to energy efficiency in North Dakota and combine that understanding with an exploratory qualitative evaluation of the perceptions of those involved in the residential housing industry including homebuilders, realtors, and homebuyers of home energy efficiency.

A two part study was undertaken to begin to develop this understanding. A survey of professional home builders was conducted to assess the construction practices that are currently being utilized in North Dakota. Sixteen qualitative interviews with homebuilders, realtors, and homebuyers were conducted to explore how these stakeholders value energy related issues in the residential housing industry. The data from these interviews were analyzed to investigate how energy efficiency was perceived by these stakeholders.

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I would like to thank:

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The participants in the survey and detailed interviews. Their efforts will hopefully bring a better understanding of energy issues.

The North Dakota Association of Builders with Doreen Riedman and Sandy Ness were extremely helpful in providing information and ideas about the best way to work with the builders in the state. Rocky Schneider and the Fargo Moorhead Builders Association were instrumental in providing further assistance.

My wife Amy and my children Lily, Gus, Coop and Moose were very understanding throughout the process and without their sacrifice this project would never have been completed.

My parents for giving me the love of lifelong learning and a desire to make the world a better place. My brothers and sisters, and Dave and Denise for their support even if they didn't know they were giving it.

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CHAPTER 1. INTRODUCTION

The American Reinvestment and Recovery Act of 2009 (ARRA) provided North Dakota residents with the opportunity to stimulate the state economy while providing investment for the protection of the environment and long-term infrastructure improvements. As a condition of the receipt of ARRA funding, states were required to agree to the following:

> "The State or the applicable units of local government that have the authority to adopt building codes will implement the following: (A) A building energy code (or codes) for residential buildings that meets or exceeds the most recently published *International Energy Conservation Code (IECC)*, or achieves equivalent or greater energy savings" (ARRA, 2009).

In 2007, the North Dakota State Building Code Advisory Committee and voting jurisdictions deleted the chapters from the currently adopted International Residential Code (IRC) and International Building Code (IBC) (2006) concerning energy efficiency. While the 1995 Model Energy Code (MEC) was still part of state statute from 2007 to 2010, North Dakota effectively had no building codes referencing energy efficiency. This provided a major obstacle for receiving ARRA monies.

As a result, North Dakota Governor John Hoeven provided assurances to U.S. Secretary of Energy Steven Chu, that North Dakota was "committed to a robust improvement in energy efficiency and renewable energy" and gave assurances that the State "will move forward in these critical areas" requesting that the North Dakota Legislature would update building energy codes in the State (Appendix A) (Hoeven, 2009).

According to ARRA, the state must demonstrate a plan to provide 90 percent compliance with the most recent IECC building code standards in new residential and commercial buildings by 2016. The plan must demonstrate progress by outlining the level of training, enforcement, and yearly compliance rates (ARRA, 2009).

North Dakota Senate Bill 2352 (Appendix B) signed by Governor Hoeven, was the first step in updating North Dakota's energy efficiency building codes. This bill requires that energy conservation standards must be included in the state building code, and cannot be omitted. The North Dakota State Building Code Advisory Committee met in June 2009 to begin work on updating energy efficiency codes. Because the 2009 International Code Council (ICC) series of codes were being published following the committee's meeting, the committee felt it was prudent to hold off on implementing the energy efficiency provisions in the 2006 ICC codes considering the 2009 codes would become the state building code in the near future. The Department of Commerce requested and was granted an extension by the Administrative Rules Committee. Voting on amendments to the 2009 version of the IRC and IBC, which included energy conservation standards for the North Dakota State Building Code were completed in September of 2010. The adoption of North Dakota State building energy efficiency codes would wait until the next full adoption cycle of the ICC codes that were scheduled to take effect January 1, 2011.

This thesis is divided into two major sections. The first section describes a quantitative effort to evaluate how current construction techniques in North Dakota meet nationally recognized building codes and identify areas on which to focus educational efforts to enable builders to meet building codes as they are updated. The second section

describes an investigation of the perceptions of important stakeholders on issues of energy efficiency in residential buildings; primarily homebuilders, homebuyers and realtors. This qualitative component of the thesis is vital because future efforts are to be made to meet energy efficiency benchmarks and cooperation from these stakeholders will need to be ascertained. Because ARRA funding requires a state to be 90 percent compliant with the most recent IECC building code standards in new residential buildings by 2016, North Dakota must identify benchmarks for present compliance.

Following this introductory chapter, Chapter 2 will provide a description of the quantitative portion of the study. It begins with a more detailed description of the history of building codes in North Dakota, with special emphasis on energy codes. Then it outlines the survey of energy efficiency related practices of professional homebuilders. Chapter 3 will cover the qualitative portion of the study by delving into the history of energy related research and then describing the detailed interview portion of the thesis. Chapter 4 ties both efforts together with a final discussion.

The aim of the present study is twofold, develop a quantitative understanding of the current residential building practices related to energy efficiency in North Dakota and combine that understanding with an exploratory qualitative evaluation of the perspective of energy efficiency of those involved in the residential housing industry including homebuilders, realtors, and homebuyers.

CHAPTER 2. HOMEBUILDER SURVEY

North Dakota Building Code Background

The history of energy efficiency standards in North Dakota is not simple. A brief discussion of the complex history and evolving process for implementing building codes in North Dakota is provided.

The North Dakota State Building Code was created by the 46th North Dakota Legislative Assembly in 1979. In lieu of writing a code specific for the state, the Legislature adopted the International Conference of Building Officials' Uniform Building Code. The addition of the Uniform Mechanical Code was passed in 1985. The Legislature held the responsibility of updating the code until 1991, when it chose to have regularly updated versions of the Uniform Building Code and Uniform Mechanical Code act as the state building code. This was done to provide continuously updated building codes, which previously was not possible, without Legislative approval. Soon after, this process was deemed unconstitutional, so the responsibility of updating the state building code was transferred to the Office of Management and Budget (OMB). In 1993, the OMB selected the Office of Intergovernmental Assistance, which is now the Division of Community Service within the Department of Commerce, to periodically update the code, provide amendments and maintain code rules. The Department of Commerce does not enforce the codes. That responsibility is left up to the jurisdictions that decide to implement the state building code. Adherence to the building codes is ultimately up to the individual builder as enforcement is varied throughout the state. Larger jurisdictions have building inspections departments and personnel that ensure building codes are adhered to, in smaller

communities where resources are limited; adherence to the code is simply up to the professionalism and standards of the builder.

In 1993, the North Dakota Legislature passed a law requiring that if a jurisdiction (city, township or county) in North Dakota chooses to implement a building code, it must be the state building code; they are not required to have a building code. Jurisdictions also were given the ability to modify the state building code to fit particular needs in local areas. In 2010, according to the North Dakota Department of Commerce, there are 115 code enforcement jurisdictions in North Dakota, six of which are counties (Department of Commerce, 2010). Concerning energy codes, the Legislature made the state energy code the Model Energy Code, 1989 version. This was the first foray into addressing energy efficiency in residential buildings of North Dakota via building codes.

The State energy code was updated in 1995 to the 1993 version of the Model Energy Code, and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 – 1989 was included in reference to commercial buildings (DSIRE, 2010).

The last year for publication of the Uniform Building Code and the Uniform Mechanical Code was 1997; As a result, in 2001 the International Code Council's (ICC) 2000 suite of building codes was designated as the state building code. The ICC codes adopted in North Dakota consist of the International Residential Code (IRC), International Building Code (IBC), International Fuel Gas Code (IFGC) and International Mechanical Code (IMC).

Additionally in 2001, the Building Code Advisory Committee was created in North Dakota to provide recommendations on proposed code amendments. The jurisdictions and

the Building Code Advisory Committee are responsible for regularly updating the North Dakota State Building Code. The Building Code Advisory Committee prepares recommendations on recent versions of ICC codes to adopt and specific code revisions that have been submitted by interested parties. The participating jurisdictions and one representative each, from the North Dakota Chapter of the American Institute of Architects, North Dakota Society of Professional Engineers, North Dakota Association of Builders, North Dakota Association of Mechanical Contractors, and Associated General Contractors then vote whether or not to include the code revisions in the North Dakota State Building Code. As of December 2008 the ICC codes that have been adopted as the state building code are the 2006 edition of the IRC, IBC, IFGC and IMC. The 2009 versions with revisions are slated to become the North Dakota State Building code January 1, 2011.

The Model Energy Code, which has not been published or updated since 1995, still was part of the North Dakota Century Code until 2009, when the 61st Legislative Assembly amended section 54-21.2-03, removing reference to it and replacing it with a statement that simply required that energy codes must be included in the state building code, making no reference to a specific code (Appendix B). Individual chapters in the IRC and IBC deal with energy efficiency issues. A separate series of codes based on the Model Energy Code was developed in 1998, this being the IECC. This code combines the commercial and residential energy codes into one volume. Table 1 provides a synopsis of the events that have occurred in the development of North Dakota building codes.

Table 1. North Dakota building code timeline.

North Dakota Building Code Event	Year
Creation of North Dakota State Building Code	1979
Adoption of Uniform Building Code (UBC) as state building code	1979
Addition of Uniform Mechanical Code (UMC) to state building code	1985
Office of OMB assumes responsibility to update code	1991
North Dakota Department of Commerce -Division of Community Service assumes responsibility for code updating process	1993
Legislature creates requirement to adopt North Dakota State Building Code if a code is implemented by a particular jurisdiction	1993
State Energy Code updated to the *Model Energy Code,* 1993 version, for residential buildings	1995
Creation of the *International Energy Conservation Code* (IECC)	1998
ICC 2000 editions (IRC, IBC, IFGC, IMC) of building codes replace UBC and UMC as the North Dakota State Building code	2001
Creation of Building Code Advisory Committee	2001
Removal of reference to *Model Energy Code in* North Dakota State Century Code	2009
Legislative requirement to include energy code in state building code	2009

There is currently no statewide building code requirement in place for buildings except for state and local government-owned buildings in North Dakota. Individual jurisdictions can elect to implement and enforce the North Dakota State Building Code if they choose, but it is not required. In the matter of energy-related building codes, no statewide standards are required for any buildings, either public or private. Energy provisions will be included in the state building code beginning in 2011 if the enforcing jurisdictions accept them. What this means is that it is at the discretion of a particular jurisdiction to accept any building codes and previously a builder could construct a single family home with no insulation if they so choose. With receipt of the ARRA monies the State has to demonstrate compliance to a given code. The energy efficiency practices

portion of the current study will provide an understanding of how far current construction practices currently are from the given standard.

Energy Efficiency Practices of North Dakota Builders

To provide a benchmark for present compliance of energy efficiency codes in the state of North Dakota, a survey of North Dakota professional builders was developed in cooperation with the North Dakota Association of Builders (NDAB) and North Dakota Department of Commerce. The survey was designed to describe the building practices being used in North Dakota today. A questionnaire was sent to over 300 builders across the state. It included questions on the use/nonuse of specific building techniques, amount of insulation installed and the frequency that each technique was used for ceiling, wall, foundation and floor construction. Responses were compared with prescriptive minimums for insulation R-values[1], U-values [2]and air sealing requirements defined in the 2009 edition of the IECC. From this comparison, areas were determined where increased awareness would have the greatest potential for improvement in current practices.

The 2009 version of the IECC provides two methods for meeting energy efficiency compliance. The IECC outlines specific requirements that are mandatory in all residential structures, for example all ducts and air handlers must be sealed in a home. On the other hand, the IECC makes provisions for builders to have some flexibility in their construction techniques while still reaching a desired energy efficiency performance level. A builder may choose to meet the code by one of two ways: they either can meet all the 'prescriptive' requirements outlined in the IECC or they can have the house evaluated on a 'performance'

[1] R-value is a measure of the resistance to heat flow of a material, the higher the R-value the greater the effectiveness of the insulation.
[2] U-value is the inverse of R-value and is a measure of heat transfer through a material. U-value is used in reference to the energy efficiency of doors and windows. The lower the U-value the more efficient the window or door.

basis and use that determination to pass code. This study will focused on whether builders met the prescriptive measures of the IECC, given the degree of variation associated with the 'performance' basis of efficiency, The majority of the questions on the survey relate to the prescriptive requirements in the 2009 IECC. A determination of whether a measure does not meet, meets or exceeds code only indicates whether that particular measure compares with the individual component in the code and not the overall performance of the home. Builders can construct homes that far exceed the overall energy performance levels provided in the performance alternative section of the IECC but are below prescriptive code in a singular component.

Survey Questionnaire Development

The builder survey questionnaire (Appendix C) was designed to explore the present building practices being used in North Dakota. The questions were developed using a combination of checklists from the U.S. Department of Energy's RESCheck version 4.3.0 software and from the 2009 IECC. REScheck is a software program developed by the Pacific Northwest National Laboratory under direction of the U.S. Department of Energy. The software can be used to test a home for compliance to various energy codes. Additional questions were created using a prescriptive list of insulation and air sealing techniques listed in Table 402.4.2 in the 2009 IECC (p. 31).

Sample

To get the maximum number of surveys returned with the available funding and time permitted, a mixed-modes method of survey delivery was chosen. No definitive list of active professional builders in North Dakota exists, so ascertaining the actual number of builders and developing participation percentages would require considerable added effort.

The state of North Dakota does not track active builders. The North Dakota Association of Builders has a membership list that includes builders but is not broken out into specific trades. Their membership includes a variety of members including organizations such as banks, insurance companies and even governmental agencies. Therefore, statistical conclusions about the overall construction of residential structures in North Dakota are not possible from this survey design. The survey results provide a window into current energy efficiency practices for residential construction techniques.

Following Institutional Review Board (IRB) approval (Appendix F), questionnaires were distributed at builder continuing education workshops, and North Dakota builders were encouraged to participate. The workshops included:

- Minnkota Power Cooperative-sponsored builder workshop, Fargo, N.D., Feb. 2, 2010.
- Minnkota Power Cooperative-sponsored builder workshop, Grand Forks, N.D., Feb. 11, 2010.
- North Dakota Association of Builders training session, Fargo, N.D., Feb. 10, 2010.

The North Dakota Association of Builders (NDAB) provided input during the survey's development, as well as contact information for member builders, which was critical for the successful completion of the builder survey. With this help, the builder survey also was distributed via e-mail to 296 builders identified from a provided NDAB membership list. The initial contact list provided by NDAB included organization members not directly involved in building or remodeling of houses, such as banks. This list was extensively sorted and edited to include only NDAB members directly participating in the building of new residential homes and involved in the energy efficiency component of that process. NDAB members judged to not be an actual homebuilder were removed from the

contact list. In the contact e-mail, builders were asked to go to a URL address to complete a questionnaire online. The online version of the survey was created by the Group Decision Center (GDC) at North Dakota State University, Fargo, N.D.

A paper version of the survey was sent through the U.S. Postal Service to those builders who did not complete a survey following a builder workshop or respond to the email solicitation. The questionnaire included a postage-paid return label to encourage builder participation and was sent to 329 individuals and organizations identified as potential builders. These included builders who already had received e-mail notification of the survey.

The final method of delivery was through building inspection departments of select jurisdictions in North Dakota, which were chosen based on the number of building permits they supply, geographic location in the state and the willingness to participate. The departments that agreed to provide the survey to builders were in Grand Forks, Fargo, West Fargo, Minot, Bismarck and Dickinson. When homebuilders or remodelers arrived to obtain building permits for projects, the inspections departments provided them the survey and asked for their participation.

Survey Methodological Issues

Compliance with the provisions of the 2009 IECC can be reached either by following a simplified prescriptive list or demonstrated performance. This survey made all comparisons to the simplified prescriptive list's individual building component values. Any comparisons to meeting or exceeding code are for that particular measure only and do not indicate whether the structure would achieve code limits based on the overall energy performance of the home.

A wide variety of building techniques are possible for residential construction. To keep the survey to a manageable size, each individual aspect of construction could not be investigated. Since, the goal was to develop a general understanding of the building practices for those individuals and organizations that completed the survey, assessing all practices was not necessary.

Any results or conclusions drawn are based on the data collected and can be attributed only to the builders who responded and not to all North Dakota homes being constructed. Finally, there is potential for the results to be skewed to builders that are observing quality building practices, those that are not would most likely be reluctant to complete the survey.

Response Rates

Total number of returned surveys is provided in table 2. The percent of return rates from the list of active builders for this survey could not be determined, considering the number of and variation of survey delivery methods used.

Table 2. Response numbers per delivery method.

Delivery Method	Returned Responses
Minnkota Power Cooperative workshop, Fargo, N.D., Feb. 2, 2010.	3
Minnkota Power Cooperative workshop, Grand Forks, N.D., Feb. 11, 2010.	4
North Dakota Association of Builders-training session, Fargo, N.D., Feb. 10, 2010.	13
Online survey	19
Returned by mail	25
Total	64

Data Analysis

Data were compiled using the online survey form provided by the GDC. Responses from paper copies of the survey were entered into the online survey form. Analysis was done in cooperation with the North Dakota State University, Statistical Consulting Services using SAS version 9.2 to create correlative information. If applicable, the installation techniques indicated for each question were compared with code levels necessary to meet the 2009 IECC prescriptive requirements for North Dakota. The 2009 IECC was used because it was the residential code referred to in the requirements of the American Reinvestment and Recovery Act. Analysis was done to identify areas where focused educational efforts would provide the most benefit, not to determine how closely builders in the state are building homes to a specific code.

If a response of "not sure" is indicated, that does not indicate that it was unsure if the measure met the code based on the analysis. Not sure indicates a builder's response. If they were not sure of the insulation level of the measure they were installing they should have checked the unsure box on the questionnaire, those responses are included in the analysis.

In the ICC series of codes, North Dakota is split into two different zones based on climatic factors (Appendix D). The requirements for each climate zone are basically the same except for slight differences in the insulation levels required in wood-framed walls, mass walls and floor insulation values. Those differences are addressed during the comparison of each construction technique to the code levels.

Results

Ceiling Construction

The 2009 IECC requires R-49 insulation for ceiling construction for the two climate zones in North Dakota. Additionally, an R-38 will satisfy the R-49 requirements if it extends over the wall top plate. Of the Structural Insulated Panel (SIP) ceilings installed 100% would meet or exceed code. For flat or scissor truss ceilings 94.6% of respondents installations would meet or exceed code, 94% of installations meet or exceed code on energy truss homes. Only 62% of cathedral ceilings meet or exceed code. One builder reported installing polystyrene spray at a level that was above the prescribed code. Table 3 and Figure 1 show that the majority of the builders surveyed were installing ceilings to the IECC code levels. Lower levels of insulation are generally standard in cathedral ceilings due to the available space to install insulation. In an attic with truss supports there is more open space for insulation installation versus a cathedral ceiling.

Table 3. Ceiling insulation comparison to 2009 IECC.

Construction Technique	Below Code	Meet Code	Exceed Code	Not Sure	Total % (n)
Flat or scissor truss	5.2% (3)	54.3% (31)	40.3% (23)	0% (0)	99.8% (57)
Cathedral	32.0% (8)	52.0% (13)	12.0% (3)	4.0% (1)	100% (25)
Energy truss	6.0% (3)	56.0% (28)	38.0% (19)	0% (0)	100% (50)
SIP	0% (0)	60.0% (3)	20.0% (1)	20.0% (1)	100% (5)
Other			100.0% (1)		100.0% (1)
Total	(14)	(75)	(47)	(2)	(138)

(n) = number of responses in each category

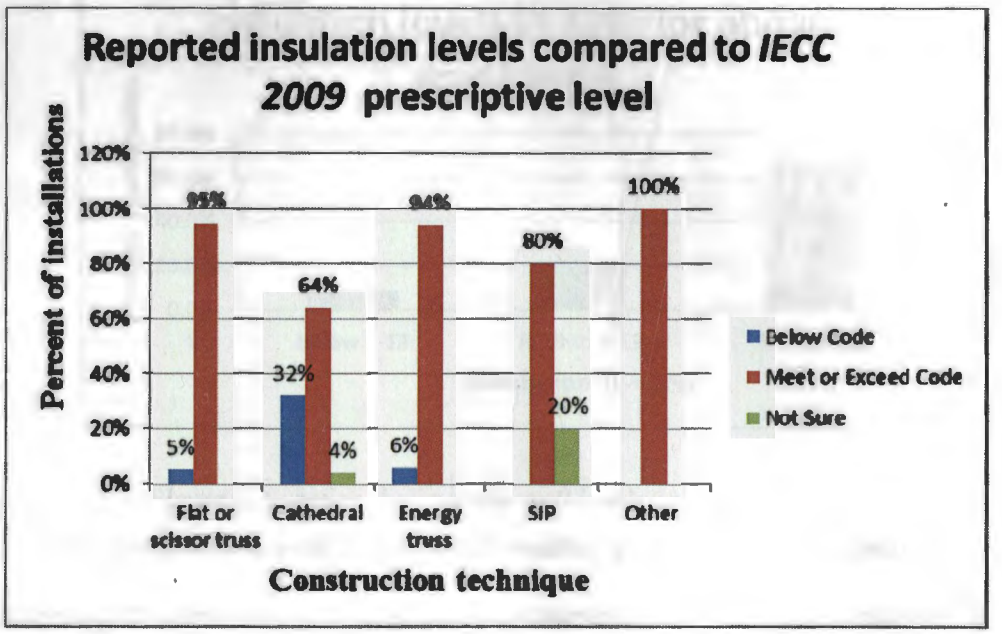

Figure 1. Ceiling insulation levels compared to IECC 2009 prescriptive level.

Above-Grade Exterior Walls

Three code levels are prescribed in the 2009 IECC for above-grade wall construction depending on the climate zone, wall construction type and insulating technique. For the southern North Dakota climate zone (zone 6) (Appendix D), the IECC levels call for an R-18, with at least an R-13 in the cavity between the framing members and an R-5 of continuous insulation covering the entire surface of the wall or an R-20; the northern climate zone (zone 7) has a requirement of R-21. Of the builders who responded, 98% are constructing walls using 2-inch by 6-inch (2"x6") studs spaced 16 inches on center in the vast majority of their housing projects, and 65% indicted they installed insulation levels from R-19 or above and 26% installed insulation levels from an R13 to R19 (Figure 2).

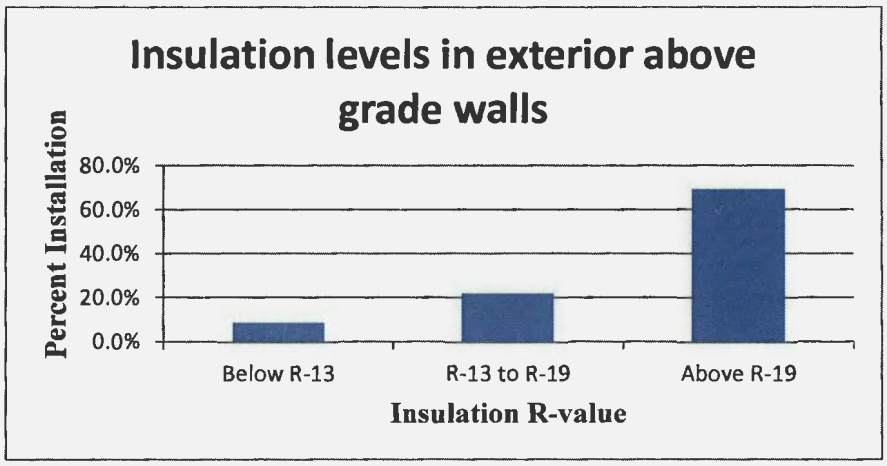

Figure 2. Exterior above grade wall insulation.

For this question, a determination of meeting or exceeding code is not feasible considering the various ways to meet the recommended code level and question design. Some minimal tradeoffs in data collection were necessary to keep the survey to a manageable size. While the data do not allow a specific determination if a builder would meet a specific code, some valuable inferences can be made. If a builder is installing 2"x 6" exterior walls and insulating those walls, it is very likely they are installing insulation to at the least the minimum level. The standard fiberglass insulation that is sold in North Dakota that will fit a 6 inch wall cavity has an R-value of R-19. To reach the maximum level in the state the builder would have to install an R-21 batt which few are doing as a result of the extra cost and local availability of R-21 insulation. Since 98% of builders indicate they use 2" x 6" construction it is easy to assume they are at least meeting the recommended code level. Even if they are not at present, if the IECC codes are implemented, without modifications, R-21 fiberglass insulation will most likely become more available and it would be simple for the builders to install this insulation level.

Foundation Construction

A determination of meeting/exceeding code or not meeting code for foundation walls was determined by using the IECC prescriptive value of R15/19, in which 15 equals continuous insulation with an R-value of 15. The 19 would be an R-19 insulation level either continuous or R-19 in the basement framing cavity (between the studs). An additional way to meet the level would be an R-13 in the framing cavity plus at least an R-5 continuous insulation on the basement wall. A typical batt of insulation that will fit in a 2"x6" framed-wall cavity would have an R-value of R-19, and 1 inch of rigid foam board insulation typically is rated at R-5, so 3 inches of continuous rigid board insulation would meet the continuous insulation requirement.

For poured-concrete foundations, if the respondent indicated an insulation level of R-11 to R-15, the builder was considered to have met code if he or she also indicated he or she installed continuous insulation; if he or she indicated a cavity or combination of cavity and continuous insulation, the builder was given a rating of not meeting the code. This is making the assumption that continuous insulation in this case is rigid foam, with an R-5 per inch. If they were above an R-10, they most likely would have met the code value of R-15. There is a potential for error with this assumption. If the continuous insulation was a draped blanket of insulation that did not meet the R-15 prescriptive value, there would be an overestimation of builders who were meeting the code. Given the available data and overall purpose of this study, this was a suitable assumption. Of the builders who indicated they installed a poured concrete foundation, 78.7% installed insulation levels that were below the IECC levels, 19.1% installed insulation levels at or above the IECC requirements and 2.1% of builders were unsure of the insulation levels they were installing on

foundation walls (Figure 3).

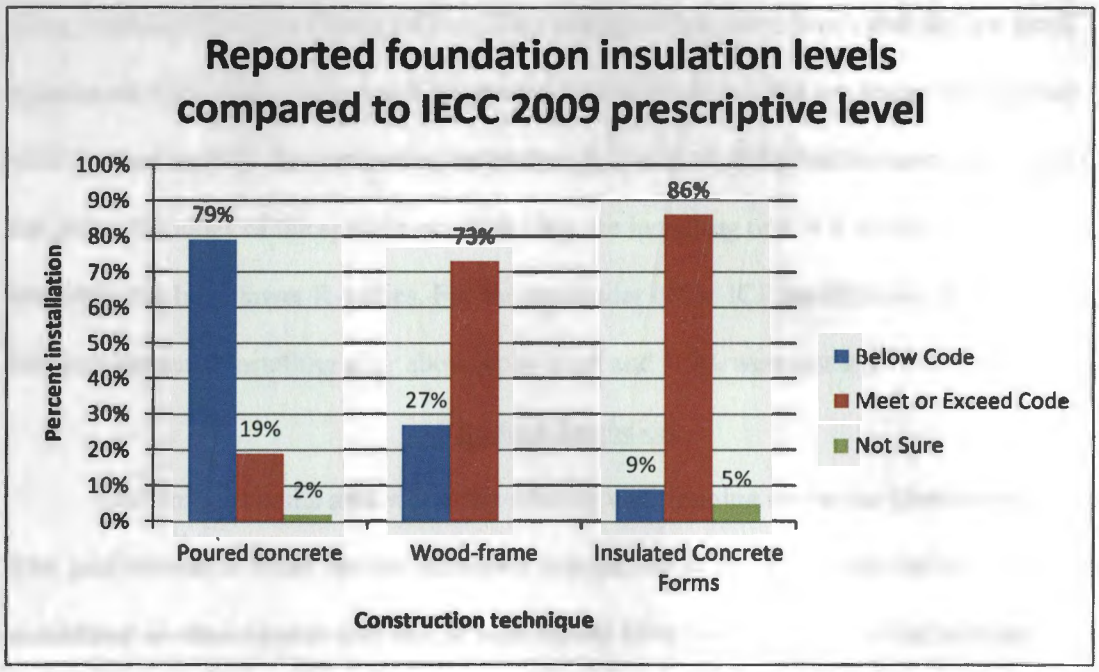

Figure 3. Reported foundation insulation levels compared with IECC 2009.

An uninsulated foundation wall would be a significant area of heat loss in a residential building. Considering the majority of foundations in North Dakota are poured concrete walls and builders indicated they insulate these walls only 19% of the time, this would be an area where significant attention would need to be focused to meet 2009 IECC levels. Insulating basements needs to be done correctly to avoid issues with moisture, affecting building components. Simple heat loss calculations indicate that an insulated basement can reduce the heat loss from a structure by 20% if comparing an uninsulated concrete wall to a wall insulated to an R-19 (Pedersen and Hellevang, 2008).

A statistical difference was found between the amount of insulation installed on poured-concrete foundations and wood-frame foundations. Builders installing wood-frame foundations installed insulation meeting or exceeding the IECC level 73% of the time.

Another interesting fact was noticed for builders that were installing basements using Insulated Concrete Forms (ICFs). They indicated insulation levels that did not meet code levels 9.1% of the time, but ICFs generally have R-values that are above the required code level of an R-15 for continuous insulation. It is unclear if the builders are not aware of the actual R-values of the specific products they are installing or if ICF products are available that have lower R-values. For the remainder of the ICF installations, 86.3% of builders indicated installing at or above code level and 4.5% were unsure.

Rim Joist Insulation

The rim joist is the area where the exterior wall framing meets the foundation wall. Rim joist insulation levels are not addressed specifically in the IECC code but are considered an above-grade wall and as such should have insulation levels that meet any requirement prescribed for above-grade walls. This area was addressed separately in the survey since it is an area that can easily be overlooked. A comparison with current IECC levels was not done but rather an evaluation of builders who installed insulation levels above an R-15 level was prepared. Of those surveyed, 54.5% of builders insulate rim joists above an R-15 and 9% were unsure of the level of insulation used on rim joists. This information is important to consider when educating builders especially if an energy code is implemented, since these areas should be insulated to the same level as exterior above grade walls. Heat in a home will find the path of least resistance to exit the home and if one area is overlooked as far as air sealing and insulation levels it will reduce the efficiency of the whole house.

Floors Over Unheated Space

Floors over unheated spaces can be found in areas such as living spaces over garages, floors over unconditioned crawl spaces and cantilevers. The required R-value for floors in the IECC 2009 is either an R-30 in the southern North Dakota climate zone, an R-38 in the northern climate zone or enough insulation to fill the entire cavity as long as it exceeds an insulation value of at least an R-19. Forty-nine percent of respondents were insulating at or above the highest IECC requirements, 49% were at or near the lower requirement and only 2% were significantly below the required minimums.

Window and Door U-values

The IECC does not provide separate requirements for windows and doors but incorporates them all into fenestrations. According to the IECC 2009, a fenestration is a "skylight, roof window, vertical window, opaque door, glazed door, glazed block or combination opaque/glazed door" (IECC, p.6). For the purposes of this survey, the questions referred to window and door U-values. The required U-value of U=0.35 is the same for windows and doors in both North Dakota climate zones. Of the builders surveyed, 38% were unsure of the U-values of the windows and 59% were unsure of the U-value of doors they installed. An equal number, 31%, of windows installed were at or above code as well as below code requirements. The door U-values were below the IECC code level 25% of the time and at or above code levels 16% of the time (Figure 4).

While the energy savings are variable between windows that meet code and do not meet code, the effort to install windows that reach the prescribed U-values is fairly simple considering builders are already installing windows and they just need to order ones that meet the code. The high 'unsure' response rate was surprising. A few inquiries were

made with builders in North Dakota to ascertain the reason behind such high numbers. Responses varied from the fact that they were aware of the numbers but were not sure of the actual U-value when they completed the survey. Another builder responded that they typically ordered windows based on style and basic price ranges not on the specific U-values. For example, if they were building an entry level home they would install the lower tiered double glazed vinyl window that their supplier carried without concern for the U-value or energy efficiency of the window.

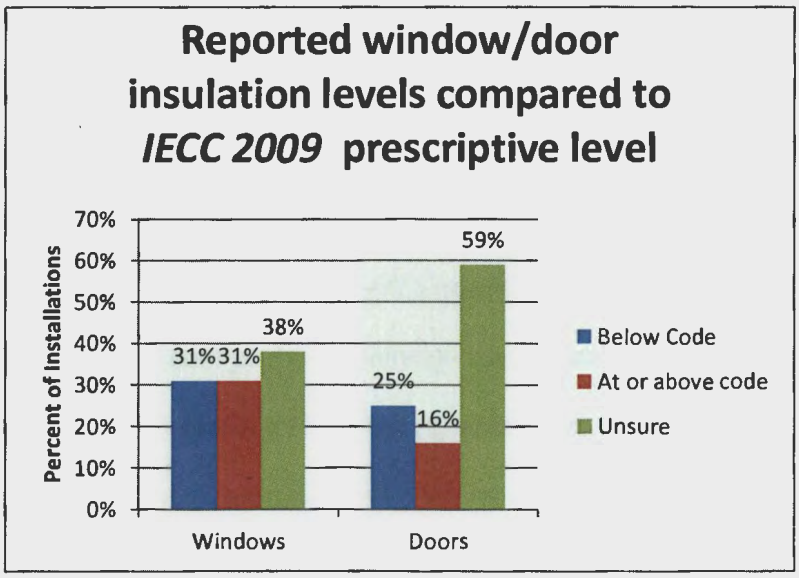

Figure 4. Window and door U-values compared to IECC 2009 prescriptive levels.

Air Sealing and Efficient Equipment Checklist

A variety of code requirements concerning air sealing and various energy-efficient equipment installations are in the IECC. For example, Section 402.4.2 of the IECC deals with the air sealing and insulation of homes. Two options are listed for ensuring a building is constructed to an adequate level of tightness. The first option is that the building can be

tested for air leaks at the "rough-in" using a blower door [3]. The second option is to have independent verification of the building's air sealing properties and insulation levels. Of the builders surveyed, 53% never have tested one of their buildings using a blower door and only 11% test all of their buildings.

Testing the ducts for leakage is another requirement in the IECC unless all the ducts and the air handling equipment are located within the conditioned space in a home. Eighty-six percent of builders surveyed rarely or never install ducts outside the conditioned portion of the home, so duct leakage testing would not be a substantial issue for North Dakota builders.

The majority of questions dealing with air sealing techniques were answered favorably by builders: 95% always seal between the foundation and sill plate, 90% are not using unfaced insulation as an air barrier, 90% are always sealing the space between the window jamb, 88% seal door jambs, 80% always use IC (Insulation Contact) rated recessed lights and 83% are always sealing HVAC and plumbing penetrations to the outside.

Proper air sealing techniques are vital for the energy efficiency of a home. If insulation is installed to recommended levels but the gaps around building components are not sealed there can be considerable heat losses. Some areas that could use attention according to the surveyed builders are air sealing techniques around attic access areas and recessed lights. Only 35% of builders always install an air seal around the attic access and only 15% seal attic drop down stairs. Twenty eight percent of builders indicated they are never sealing recessed lights to the drywall. While these may seem like minor areas, the more opportunities air has to leak into or out of a home, the higher the homeowners' utility bills.

[3] A blower door is a tool used to pressurize a structure in order to test for air tightness.

Discussion

The survey indicates that the North Dakota builders who participated in the study are building residential structures that meet the IECC required prescriptive values in the majority of the areas of their residential housing projects. However, builders have an opportunity for improvement concerning energy-related measures in portions of residential structures that could result in energy savings, greater comfort and compliance with the IECC. Those areas include foundation insulation, air sealing measures, and window and door U-values.

While building to recommended code levels is important for the energy performance of residential structures, understanding the reasons for the recommended insulation and air sealing measures is vital. Performing blower door tests on an increased number of houses would provide builders valuable information on areas where attention to air sealing would have the greatest impact. Heat loss through an uninsulated foundation accounts for up to 20% of heat loss from a house in North Dakota. The proper installation of foundation insulation can add some cost at the time of construction, it can also add to the comfort level and energy performance of the home significantly.

Considering the number of builders who are using 2"x6" construction for exterior walls, an addition of the IECC requirements would have little impact to the actual construction of housing projects for the majority of builders surveyed. If using a fiberglass batt insulation to insulate wall cavities, it is relatively simple going from an R-19 batt to an R-21 batt as long as local suppliers stock the R-21 batts.

Only minor differences were found between current building practices surveyed in North Dakota and the 2009 IECC. In most instances, the surveyed measures meet or exceed

the latest code requirements. Only a small percentage would require significant efforts or additions to reach the code requirements.

CHAPTER 3. STAKEHOLDER PERCEPTIONS OF ENERGY EFFICIENCY AND RESIDENTIAL HOMES

Literature Review

This literature review will provide a basic description of the benefits of using energy resources in residential settings more efficiently as well as offer examples of various approaches to reducing energy consumption. Evidence is presented on the economic, social and environmental impacts of energy related regulations. A review of past research on energy efficiency is included to illustrate where energy related research has primarily been aimed and provides evidence of where it should be focused in the future. The hope is that this will set the stage for an understanding of the significance of not only evaluating what decisions are made concerning energy efficiency but also to appraise why those decisions are made.

Benefits of Energy Savings

The impacts of energy related consumption can be broken down into three main areas: economic, social and environmental. While these impacts overlap, the goal is to make decisions that have the least detrimental impact on each category. If we use economic impacts as the sole determining factor in energy use, we do so possibly at the expense of the social and environmental aspects of a particular community. The scale of the impact depends on the scale of the energy use. Decisions made in one particular home might only affect a small number but decisions made at the state or federal level can have serious implications on the economy, society and the environment. In order for a community to be sustained, all three need to be balanced (Adams, 2006) (Bruntland, 1987) (Figure 5).

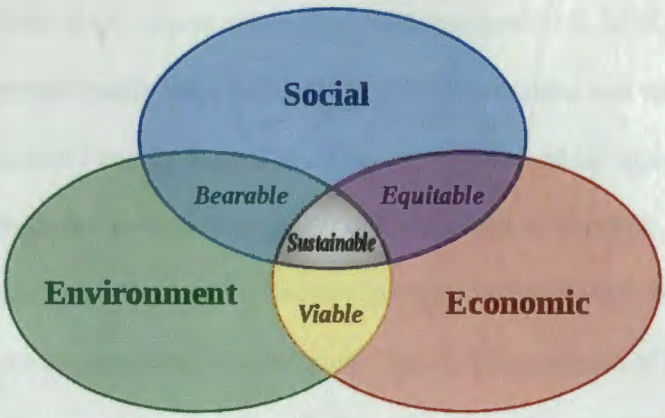

Figure 5. Three facets of energy use **(Source: Dreo, 2006)**.

Continued attention to a reduction in energy consumption by using resources more wisely can have a number of benefits.

While there are many factors that contribute to energy use, there are some indicators that attention to energy consumption and energy efficiency related policies might affect considerable economic impacts. North Dakota customers have some of the lowest utility rates in the nation, based on retail price per kilowatt hour (Energy Information Administration, 2010a), the average North Dakotan pays higher average monthly utility bills than customers in Minnesota (EIA, 2010b). Minnesota consistently scores in the top ten ranking of energy efficient states based on energy efficiency policy issues, while North Dakota consistently ranks as one of the lowest on the state ranking according to the American Council for an Energy Efficient Economy (ACEEE, 2009).

States that have implemented policies and energy related building codes are reporting significant reductions in energy use. Building standards in California have reportedly saved more than $15.8 billion in electricity and natural gas use since 1975 (CEC, 2003). Yearly estimates provided from the United States Department of Energy are for North Dakota residents to save between $273 and $413 per year for an average new

home built to 2009 IECC versus current building practices (U.S. DOE, 2009). These estimates have traditionally been based on simulation programs and are not always based on actual documented energy reductions. There is evidence of savings although they may be less than simulation programs would predict (Jacobson & Kotchen, 2009, p.23).

The social impacts of energy savings in residential buildings depend on the extent to which they are accepted and implemented. The U.S Department of Energy predicts that by 2030, if implemented, the Buildings Technologies practices currently being promoted have the potential to create 446,000 jobs with wage increases of $7.8 billion (Scott et .al, 2007).

Environmental benefits can be realized by a reduction in fossil fuel consumption. According to the EIA (2010c) North Dakota electric power industry emissions included 32,917,730 metric tons of Carbon Dioxide, 123,801 metric tons of Sulfur Dioxide and 63,840 metric tons of Nitrogen Oxide. These emissions are from the generation of electricity. There are not readily available figures for emissions as a result of home heating. North Dakota ranks among the highest in per capita energy consumption with the majority of this consumption resulting from high heating loads that can be reduced by building more efficient homes (American Council for an Energy-Efficient Economy [ACEEE], 2010).

The social and economic impacts felt as a result of the oil embargo of the 1970s, combined with the growing environmental movement increased the attention paid on ways to reduce American energy consumption. This included research on how to reduce energy use. A look at the history of energy related research with specific studies highlighted will provide a basis for the approach taken in the present study to evaluate ways to encourage wise energy use.

Energy Related Research

This section will describe how energy related research has changed over time. *The American Energy Consumer* by Newman and Day (1975) is considered by some to be one of the first studies on energy efficiency (Ritchie et. al, 1981). The study by Newman and Day attempted to provide a picture of household energy use and provide recommendations for ways to reduce that use. The majority of their recommendations were policy related. In the middle 1970s, the amount of energy that could be saved by consumers was limited, a result of the choices available to consumers in amenities such as water heaters, domestic heating equipment and construction techniques (Newman & Day, 1975). Consumers obviously have more options now concerning energy related equipment in their homes but they do not always choose items based on wise energy use.

In the few years following the release of the book by Newman and Day an increasing number of studies on energy consumption and conservation in homes were published (Ritchie et al, 1981). This dramatic increase can be seen by looking at the number of studies published. From the initial study by Newman and Day in 1975, to 1977, when Cunningham and Lopreato summarized 50 studies on household energy and conservation and in 1979 Joerges provided a list of over 500 such works.

Since that time many more studies and volumes on residential energy use and conservation have been published. Some deal with policy issues (Hamblin, Johnson and Killen, 1990), (Gillingham, Newell & Palmer, 2006) others concentrate on the social issues related to energy use (Hackett & Lutzenhiser, 1991), (Lutzenhiser, 1993), (Rosa, Machlis, & Keating, 1988), while others concentrate more on the environmental aspects of energy consumption (Dincer, 1999), (IPCC, 2007), (Rosen & Dincer, 1998).

What are some of the issues with the energy efficiency research? Many of these studies deal with data related to energy use in residential buildings and not on the decision making process (Hirst, 1980). Hirst (1980) provided a review of data that was related to residential buildings and energy use. In his paper he discussed the determinants of energy use and evidence for why he believes the data on energy use was inadequate for determining how effective energy conservation measures were. In his paper he refers to the "rough and spotty" picture painted by the lack of complete information from all sectors in the United States. He uses the example of Congress passing the National Energy Conservation Policy Act (NECPA, 1978) requiring utilities to provide onsite audits at a cost of billions to customers, as opposed to computerized home audit services, without having any actual data to show that onsite audits were more effective at saving energy.

Hirst provided additional insight into US energy use in 1990 by giving recommendations as to why the federal government should strive to improve energy efficiency. His arguments include the fact that certain aspects of the energy conversion process for residential and commercial applications are not reflected in the pricing structure. Environmental degradation and dependence on foreign sources of oil are two of the examples of the social costs of not using energy resources as efficiently as possible (Hirst, 1990). More recent attempts have been made to include the social and environmental costs of energy use into the equations (IPCC, 2007).

In addition, there is what Hirst refers to as a payback gap (1990:97). This gap creates a situation where energy production investments are far more likely to be made than energy efficiency investments even though the public overwhelmingly supports federal efforts to improve energy efficiency (Hirst, 1990),(The Analysis Group,1988). In the study

reported by the Analysis Group (1988) the majority of people responding indicated the government should spend more money on energy efficiency and renewables versus spending on traditional energy sources such as oil and natural gas. These findings are similar to a 2006 study done in North Dakota where 80 percent of those surveyed would choose to have additional energy demand in this country met by renewable energy, conservation and efficiency while only 13 percent indicated fossil fuels (Bureau of Governmental Affairs, UND, 2006). There is a gap in opinion polls concerning energy use as a result of low gasoline prices and utility costs that had stabilized in the 1980s (Farhar,1994). In 1988, gasoline prices began to rise and questions began to be included in national surveys once again. The question then needs to be asked; if the majority of Americans and North Dakotans believe being efficient with energy resources is important why does it not show in their actions?

Heiskanen and Lovio (2010) believe the problem of converting knowledge about energy efficiency into action is the lack of interactions between disciplines described as "stickiness" of information. This is where information is shared freely within a discipline but not between them. The economists are not talking with the social scientists and so on. Factors such as low utility costs and the volume of low energy strategies available also add to the problem. The authors believe that building codes provide guidance for construction companies and residents as to the best strategies once they are implemented. The efforts need to be made to make connections across disciplines to build the body of evidence to use energy resources more efficiently.

Making a connection between respondents saying they support energy efficiency and actually making decisions based on wise energy use can be a difficulty. Hackett and

Lutzenhiser (1991) address this issue in a study that evaluated energy consumption in an apartment complex. They point out that the majority of research on energy efficiency had been based on engineering concepts. For example, if you build a home that has no insulation and compare it to a similar home that is properly insulated, the insulated home will require less energy, if heated or cooled similarly. The savings can be modeled and as the authors point out, the idea is a "rational" one. At the time, the research was based on building test houses to compare actual differences. The dilemma comes when you try to tie this type of research into a real world example. It is feasible to compare one house to the next but one does not know how the residents in a particular home will utilize energy. As Hackett and Lutzenhiser show from their research, energy use is a social action and that energy use is greater when the measure of its use or costs are shared as opposed to individually calculated, even though the actual expenditures may be the same (Hackett and Lutzenhiser,1991).

The task of creating an understanding or consciousness of energy and eliciting a reaction to its use is a difficult one. Energy is in essence invisible to consumers; it is simply there when needed. Recent attempts by global warming advocates have put a face on energy use by using the image of polar bears and shrinking ice sheets caused by greenhouse gas emissions. While the success of these efforts is debatable, the core of the problem is how to create an understanding of energy use that will encourage builders and homeowners to take action. The amount of energy that is saved by the implementation of building codes is variable. Builders may report they are building energy efficient homes but actually have limited knowledge of energy efficient practices and feel energy codes

have no true value (Yang, 2005). If building code implementation is done with increased education of the value to builders, contractors and homeowners the savings can be greater.

In Depth Interview Procedure

It is the purpose of this study to develop an exploratory investigation into the perceptions of stakeholders (builders, realtors, and homebuyers) concerning energy efficiency when building and buying single family homes. A series of interview questions specific for professional homebuilders, real estate agents and homebuyers were developed in order to elicit the respondents' beliefs concerning residential energy related items (Appendix E). Prior to any interviews being conducted, North Dakota State University Institutional Review Board approval was obtained (Appendix F). Considering the purpose of this study was to begin to develop an understanding of the decision making process and not form detailed descriptions of specific populations, sample sizes were relatively small.

Builder Interview Subjects

An effort was made to identify 5 professional builders to participate in the interview portion of the study from a range of builder type (custom, production, 'spec') and average housing project cost. In cooperation with the Fargo Moorhead Builders Association a list of the housing projects that were completed in 2009 was obtained. The list provided the number of single family homes built by professional builders in Fargo, North Dakota in 2009. In addition, information on the number of homes, as well as the average price indicated during the permitting process of the homes sold for each builder was included. The list was divided into three main sections based on the average price per home. The average price for a single family home in Fargo in 2009 was roughly $164,000. Builders were put into general categories based on that figure. If the average home for a particular

builder was between $0 and $150,000 they were considered an entry level builder, builders from $150,001 to $250,000 were considered mid-level, and builders that averaged over $250,000 were considered high-end. In addition, one builder that was identified as a "green" builder was included in the study.

Real Estate Agent Interview Subjects

Real estate agents were identified using a snowball subject contact method. Contact was made with an initial agent and that agent was asked for any suggestions for others to contact. A list was made of possible interview subjects from various realty companies and phone contacts were made to illicit interest in participating in the interview process.

Homebuyer Interview Subjects

The intent was to identify prospective homebuyers from names provided by the participating real estate agents. When initially asked, the agents were reluctant to provide contact information or pass along the researchers contact information. The next attempt to identify potential subjects was done by contacting an realty company mortgage broker. They agreed to email a cover letter to their current list of active clients. This again resulted in no interested individuals. Inquiries were then made using snowball sampling of NDSU faculty members in the process of looking for a home. This was successful in identifying two prospective homebuyers. An IRB amendment to the procedure was done to include minimal compensation for participation that consisted of a $25 gift certificate to a local grocery or home improvement store (Appendix F). The real estate agents that participated in the study were again contacted and asked to provide contact information for interested homebuyers, this time the effort was successful in recruiting study participants. The term

homebuyer is used to refer to an individual involved in the process of purchasing a home. The interview subjects included individuals that had very recently purchased homes, were in various stages of purchasing homes and also those looking to build a home.

Methods

Interviews were conducted during August 2010, with 5 professional homebuilders, 6 real estate agents and 5 homebuyers. Interviews were conducted at locations that were convenient to interviewees. The majority of interviews were conducted in offices or conference rooms and one was conducted in a coffee shop. The interviews were recorded and later transcribed. Coding was done to develop themes in the data in reference to energy aspects of residential construction. The purpose of coding is to take text and systematically break large groups of text into segments and eventually themes that can then be analyzed based on decided criteria (Creswell, 2008). Initial readings were done of the interviews and general response categories were developed based on their relation to aspects of energy use and decisions that are made. The categories that were initially identified include:

- **Economics** – refers to a response that included reference to the financial aspects of energy use or efficiency either positive or negative.
- **Education** – refers to the level of knowledge the interviewee had concerning home issues and more specifically home energy issues.
- **Building codes** – refers to building codes.
- **Belief system/core values** – This category was used if the interviewee made reference to their attitudes or actions concerning residential construction based on their personal belief system or their core values.

- **Keeping current** –This category refers to wanting to keep current with recent trends.
- **Bling** - Bling was a term used in one of the initial homebuilder interviews and in this situation was used to refer to an attention to the outward appearances of the home, what a realtor referred to as "curb appeal".
- **Change in value** – This is a reference to a recent change in core values.
- **Indication of performance versus energy efficiency** – This refers to an interviewee that was willing to sacrifice some aspect of energy efficiency for another performance aspect of the home.

After development of the initial categories, the interview recordings were listened to while reading the transcriptions and responses that fit into one of the major categories were noted on the transcriptions.

After the second round of transcript review, the categories were reevaluated for pertinence to the study. It was decided at the time that 'feel for the house' and 'bling' were close enough that those categories would be combined. While there are varying degrees of what the 'true feel' for the house are, they are still outward appearances that do not have to do with the actual performance of the home. The themes were then grouped into the main impact categories of energy related decisions: economic, social, and environmental. The findings were evaluated based on the interactions between the themes and the connection between responses. For example, did the respondent make decisions concerning energy use based on strictly one impact such as, environmental decisions or a combination of impacts such as social and environmental concerns? Quotes from the actual interviews are provided to emphasize descriptions.

Findings

The findings from the detailed interviews are initially broken out into the economic, social and environmental facets of energy related decisions, and then an examination is provided that looks into interactions within certain facets and how decisions related to one can influence others.

Economics

When asked to give their priorities for choosing a home, economic impacts were by far the greatest area of interest from all groups of respondents. Upon evaluation of the economic aspects related to the housing industry, some interesting observations were made. First of all there are basically three economic related issues concerning homes; 1) the initial purchase price of the home, 2) the costs to provide upkeep on a home and 3) the monthly costs of living in a home.

The initial purchase price was listed as one of the priorities when looking at homes. Real estate agents listed it as one of the first things they ask potential clients.

> "Well we start with price, you know, and so price dictates what you're going to find"

The builders are also concerned with the purchase price, but they have the added concern of building a house that will sell for a profit.

> "what we looked at first would be the price point"

Purchase price was not regarded as much of an issue for some of the homebuyers

> "More times than not, people will just say, well, we'll just see where it comes in at, and then you design it"

but certainly for the entry level buyers.

> "we were going for a price point so if we found the perfect house next to a factory we probably would have bought it"

The builders expressed some concerns with the initial purchase price of the home and the expectations of their prospective clients. A number of builders indicated the housing market in the Fargo area is getting considerably more competitive and so they needed to be more competitive with their pricing:

> "you can't find a better time to buy one right now. The rates low and I'd say a lot of the builders' pricing is very competitive so, especially in our market, but then again, like-in this Fargo market that, if we're talking mostly about that, it would be, there's way to many builders for the amount of work that's going on, so it's easy for the pricing to be lower"

> "it seems like now more and more people are just price shopping and trying to get as much as they can"

They expressed concern with being able to offer some of the housing options they felt were important and still remain competitive;

> "You know, and so it's all these little things, and yeah, I would love to do this to the house and do these little things and we'd get there at some point, but if I start throwing all this, that's a couple more grand we're putting onto there, and we're trying to keep the house affordable."

While a 'buyers' market is not ideal for a homebuilder, two of the homebuyers indicated that was an added incentive to get them into the housing market.

> "It definitely is a buyer's market and I guess the interest rates definitely helps"

> "I kinda think the housing market is so good now and with the rates being what my realtor described as silly it seemed like it couldn't hurt to at least start looking"

Purchase price is a major issue but it is not the only economic concern. The cost of providing regular maintenance on a house was also mentioned. A number of homebuyers indicated they were looking at houses that they would not need to make major improvements to once the purchase was complete.

> "So if it's going to have to be gutted in some places and have huge things, I can't deal with that so yah a high priority is a house that is in pretty good shape."

> "so we wanted to get the most house like house that was stable that we wouldn't have to fix the roof or the basement"

The final economic issue is the monthly cost, not all the homebuyers were concerned with the average monthly cost to live in the house. Two of the buyers were moving from apartments and would be making their first home purchases so had not put considerable thought into the monthly costs. When one particular homebuyer was asked if they thought about how much a home would cost to live in, they responded this way:

> "I guess I'm, I haven't really thought about that very much other than wanting the house to have decent windows and how much that would cost and um ah I guess I'm not, the houses I'm interested in are of kinda like a similar certain size I'm looking for so I guess I don't think I haven't thought about that very much no, because I just I don't know they're all of the same size so it would be a big difference at least the size of the space you would be heating or cooling. So no I haven't thought about that"

Homebuyers that had previously purchased homes and were looking to move up from the entry level home had learned from their experiences and responded differently.

> "Yah, they're pretty efficient for the maintenance costs and heating and stuff. So that kinda attracts me I guess"

> "when I first bought my first twin home right out of college. You know I was house broke at one time and I know the feeling and so I'm always very cautious on something like that too to make sure that all our parameters and think of your bills and your future bills that you're gonna have"

All but one of the real estate agents indicated they requested utility bills before an offer on a house was made, so clients would have an idea of the monthly energy costs.

> "I'll say look at the energy bill because if the energy bill's efficient, it's efficient. If it's not, it's not. You know, it's one of those things where, you know, that's the easiest way to tell if- is get the energy bill"

But clients do not always ask about the monthly utility costs. When asked if clients inquire how much it will cost to heat and cool the homes he builds one builder responded this way:

> "I haven't been asked that question, see how it equates to actual operating cost, so no I don't get the question"

Certain economic exchanges are obvious when considering the residential housing industry. The professional homebuilder builds a house and the homebuyer gives them money in exchange for that service. The real estate agent is also given money in the transaction in exchange for assisting with the process and protecting the rights of their client.

Responses from one homebuilder demonstrate this economic exchange:

> " I don't like to do stuff I'm not getting paid for..."

How do housing decisions include social decisions?

Social

The second most mentioned theme was the outward appearance of the home. This is where the social aspects of home related decision are noticed. Broken down to the most basic of ideas, the home's main function is to provide shelter to its inhabitants.

> "They realize that yes, they could put $3000 into having a, say double the insulation level someplace and save the money in the long run, but today I need to get in out of the rain and out of the cold"

The outward appearance of the home provides them a feeling of comfort, self-worth or status. Homebuyers indicated paying attention to details that do not add to the functionality of a home but they found value in them.

> "the yard was pristine, nicely landscaped, nicely groomed, green fertilized you know and you could kinda tell that when you walked into the home too after taking an exterior view of it that the home was in very good shape."

> "Umm what else, I really like hardwood floors. I don't particularly care for carpet so if the place has nice hardwood floors I find that very attractive"

When asked to list the details in the homes that were important only one homeowner and one builder even mentioned the energy aspects or how the home would perform without being prompted. The priorities list included the following things in various orders: number of bedrooms, bathrooms, garage stalls, location, and style of home. Upon further questioning other things were mentioned such as the size of the yard, whether the yard was fenced, proximity to schools, and even central air conditioning.

A number of buyers and real estate agents made mention of the feel of the house and how sometimes buyers can be concentrating on the visual aspects of the home, the ones that make them feel good or impress others and fail to see the important structural aspects in homes.

> "if you're looking to buy a home, your eyes are big, you see everything great about the home. You walk in and you see the granite countertops, you see the cool built-ins, you see all this, you don't see the crack in the ceiling, you don't see the crack in the basement"

While granite counter tops may add economic value to a home it is only because they are socially accepted as a display of wealth or opulence which is a social value.

<u>Environmental</u>

The environmental aspects of housing decisions received by far the least attention. Only one prospective homebuyer truly stressed the importance of the environmental aspects of housing related decisions, in fact environmental factors related to energy use was the main reason this particular homebuyer was looking for a home. On a whim he had completed an online evaluation of his carbon footprint:

> "I did a little survey online and kinda figured out my carbon imprint for a single person. And I was consuming, I'm consuming more energy than a four person family. And I'm only one person"

This is what motivated him to find a residence that was more environmentally friendly.

Another homebuyer mentioned environmental aspects in home related decisions but tied them to water consumption and low flow toilets.

> "..its good for the environment which is the most important thing, like for example I mean something that I never see in Fargo, I never see in the United States in general are toilets where you have a choice of the size of the amount of water you're gonna use right.."

Similar to the homebuyers there was just one builder that mentioned environmental aspects of building related decisions.

> "but it's all about energy, and products that people like, building, gobbling up resources, and when you build a house that's going to use resources, energy, electricity, gas, whatever for many, many, many, many years, and to me building an energy efficient house should be one of the most, the highest priority"

This particular homebuilder and the homebuyer that held the energy consumption in a house as a priority both stressed the need to reduce the size of the homes people are building and purchasing. The homebuilder had this to say referring to his clients:

> "They all come in with way too big a house"

While his clients all want larger houses than they need according to him, the national trend toward larger and larger houses looks to be slowing. The average size of homes in the United States had been steadily increasing for 30 years until it peaked in 2007, since then the average size has slowly decreased (National Association of Home Builders, 2010). When the environmentally conscious homebuyer was asked to list his priorities for a home, the first thing was a smaller dwelling that would result in the consumption of less energy, he indicated he was having trouble finding a smaller house.

So how do the economic, social and environmental decisions tie into each other and the energy consumption in residences? The following sections will provide those answers.

Short Term Versus Long Term Economics

The difference in the economic decisions homebuyers make can affect the overall energy performance of the home. It all centers on whether they are simply looking at the purchase price or combining purchase price with the monthly utility bills. For example, properly insulating basements will have higher initial costs but will save considerable energy and financial resources over time. The payback period ranges from 2.3 to 7.2 years, depending on the construction and insulating technique used in a climate similar to North Dakota's (Carmody, Christian and Labs, 1991). So if the homeowner is looking at the initial cost of added insulation in a home they might view it as unfavorable, but if they consider that the added cost of increased insulation will be recouped in a short time, increased insulation is actually a financial benefit.

"Um the more money I save is more money in my pocket."

One homebuyer was interested in the energy efficiency of a home but indicated they wanted to be sure it would save money:

> "I'm okay with some of it but if it ends up not being cost effective that's what it ultimately comes down to for me. So it would be fine but if I have to pay twice as much for it then no thanks. It would depend on the cost benefit ratio"

A real estate agent had this to say:

> "the builders try to put out there a decent product for their money so people will buy it... It's just- the consumers have to perceive a good value,... it comes down to how much money you're [going] to put down, what's my monthly cost, you know, and if you can save yourself some money on a payment or on an energy bill, your payment can be as good or a little bit better on- you can spend- buy a little bit more home, but I think it's the two working together."

That is one advantage of nationally accepted building codes. The research has been done on what will be the most cost effective insulation levels and energy related additions for each climate zone, bringing monthly payments down so buyers can afford more.

Economic and Environmental

A few homebuyers indicated they were interested in protecting the environment to a certain extent but put in the caveat that decisions also needed to make financial sense.

> "The impact on the environment we haven't taken as big of a evaluation of that as compared to what it would be to our finances"

> "I'd be a fan of more people doing research on that so this is you know really having a negative impact on the environment so if we can demonstrate the cost benefit ratios"

While another buyer indicated they were willing to pay a little extra for what they referred to as green amenities.

> "I mean if its all tied into the price I mean if there was a house that had you know green energy amenities I would definitely like that um that would I would be willing to pay some more to have those features"

A question in the interview process did ask interviewees if they were interested in homes that carried a certain energy rating or were considered "green". While the definition of green was not established, the majority of homebuyers were interested but it was not a major concern. One homebuyer responded this way when asked that question:

> "Absolutely, if we were looking at homes like that. Absolutely, and we actually did contemplate one home that was an ENERGY STAR but it was out of our price range"

Another responded this way when asked the same question:

> "sure because it could save me money in the end and also its good for the environment which is the most important thing"

Economic and Social

Considering the majority of study participants indicated that economics were the main deciding factor in their housing purchases, it is interesting to note that if the decision truly was all about the economics they would be buying smaller houses that were well insulated. So there must be something more to it than that. As indicated, a number of builders mentioned homebuyers are coming in wanting more than they can afford and need. They are more interested in the 'bling' factor of a home than the way it performs. A number of builder comments related to the desire of homebuyers for larger houses, superficial things and the portions of a home that would give the homeowner instant gratification as opposed to insulation levels that are rarely, if ever, seen.

> "..and they have to realign their priorities, and maybe even size, so, I mean, because it's like the consumer {muffled} they want it all, and sometimes energy efficiency, for too many again it's a superficial world"
>
> "they just all want bling, they're all about the bling"
>
> "Yep, they want the floofy things right off the bat, the fireplace, the Jacuzzi tub, kind of those things that they're going to enjoy instantly, instant gratification, and you know, some will come in and they'll have their energy built but rarely, it's very rare"
>
> "Unfortunately a lot of them are more concerned about what their house is going to look like [than] what it may cost them to live in it later"

The challenge for the person interested in convincing homebuyers of the social and economic value of wise energy use is to be able to tie the two together. One builder described a particular client that was interested in the 'bling' of energy efficiency.

> "he wanted to be at a higher level of, almost bragging rights to see how low his heating bill is"

While these types of buyers may be rare in North Dakota, things such as Smart Grid technologies (United State Department of Energy, 2010) and instant access to home energy consumption rates just beginning to be offered by some utilities may bring residential energy issues more into the public eye and provide an incentive to reduce energy use for economic and social reason.

While reduced consumption of energy sources can have financial and social implications, what are the environmental and social connections?

Environmental and Social

The tie between the social and environmental aspects of energy was described by the prospective homebuyer that was most interested in the environment. He indicated an awareness and began thinking about his carbon footprint and the foreign use of energy as a result of serving in the armed services for the United States during the gulf war. He was looking for a smaller house to reduce his impact on the environment and help with national security.

> "But I do believe we have a responsibility too as a citizen."
>
> "..and just coming back from the middle east not long ago. Made me more aware of it I guess. You know so that definitely made a huge, what's the word I'm looking for, huge weight for my decision I guess"

There are obvious and direct ties to reduction in uses of foreign energy sources and the related social implications. Sustainable communities should have a proper balance of all three; the economic, social and environmental.

Economic, Social and Environmental

There are ties between the three that are inherent when reducing energy use in residential structures. The less energy a person uses, the less they will have to pay on their

utility or home heating fuel bills. Utility companies and home heating fuel suppliers in North Dakota are mainly using fossil fuels so the less energy a consumer uses the fewer fossil fuels are being consumed. The challenge comes when you try to balance all three. Fossil fuels are great for society because they provide a cheap, readily available source of energy but trying to limit their use will adversely impact prices. There are environmental impacts that are realized from their use that can be minimized by using energy wisely.

CHAPTER 4: CONCLUSION

The efforts surrounding American energy consumption have seen dramatic changes in the past 30 years. People can still remember President Carter asking citizens to turn down the heat and put on a sweater. Those attempts at energy conservation have evolved into a more direct and hopefully more successful effort to use energy resources more wisely. The challenge of encouraging builders and homebuyers to include energy related decisions into their home construction and buying process can be a difficult one especially considering the low utility rates experienced in North Dakota. Efforts need to be concentrated on the consumer by including the active participants in the process; the builders and realtors. It is the builders that are the experts in the construction of homes and they are the ones that homeowners rely on to be the guides to show them the best way to utilize their resources. While it may be an uphill battle to convince homeowners of the longer-term benefits of constructing homes that are energy efficient it is an effort worth undertaking.

So how do policy makers, city officials and educators facilitate that change? Start by identifying the areas that will have the most impact. The quantitative portion of this study indicated that participating builders were constructing homes to a relatively high energy standard in the majority of the aspects of their projects but there is room for improvement. The two areas that could see the most improvement are in added attention to basic air sealing techniques and foundation insulation. That is where training programs should be focused. It is crucial that the information be provided in a positive light to encourage builder buy-in and not be construed as telling the builders what to do, presenting the competitive advantage for builders to construct homes that cost less to live in and are

more comfortable. It is important to encourage builders to utilize that information to promote a better quality product that they are producing for their customers.

Identify what is important to the typical consumer. The qualitative portion of the study identified that while homebuyers in the Fargo area are not overly concerned with their monthly utility costs they are certainly interested in the economic aspects of energy consumption and the feel for a house. Letting homeowners know they have a quality home will hopefully create a pride of ownership. There is little attention paid to environmental issues in the area so promotional efforts would be better served to not concentrate in that area unless a connection between the economic aspects and the environmental aspects can be made.

As with any good campaign looking to make a change the more an individual hears the message the more apt they are to make a purchase or with the case of energy efficiency a change. The more people that come in contact with messages touting the benefits of energy efficiency the greater the chance they will make decisions that reflect sensible energy use. The list of people that should be involved includes all the actors in the residential housing industry. Real estate agents are important as they are often the first point of contact for prospective homebuyers. Bankers and home loan professionals are concerned with return on investment, the lower the monthly utility costs the more money homeowners have for mortgage payments. Increased awareness of energy efficiency aspects of homes can be shared by providing information to financial professionals. Some areas provide for homebuyers to qualify for a higher loan principle for homes that are proven to be energy efficient. Building inspectors, as indicated by the homebuyer interviews are the individuals trusted to evaluate each home for purchases of existing

homes. They should be encouraged to provide information to homeowners for ways to reduce energy use in homes.

For homebuyers it is critical to create a social value in the energy aspects of the home as well as an economic value. It is important to provide education to homeowners concerning the energy aspects of the homes they are purchasing as well as attempt to create a social value in using energy more wisely. The example from Hackett and Lutzenhiser demonstrates this, when homeowners are aware of energy costs they will take measures to reduce their use.

REFERENCES

ACEEE. 2010. *The 2010 State Energy Efficiency Scorecard.* Report No E107. American Council for an Energy-Efficient Economy: Washington, D.C. Retrieved October 28, 2010 (http://www.aceee.org/sites/default/files/publications/researchreports/e107.pdf).

Adams, W. 2006. *The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century.* Report of the IUCN Renowned Thinkers Meeting, January 29-31, 2006. Retrieved October 28, 2010 http://cmsdata.iucn.org/downloads/iucn_future_of_sustanability.pdf).

American Recovery and Reinvestment Act of 2009. H.R.1. 111th Congress. 2009.

The Analysis Group. 1988. *Waste Not, Want Not: A National Opinion Survey on Energy Policy.* New Haven, CT.

Bruntland, G (ed). 1987. *Our Common Future*: The World Commission on Environment and Development, Oxford: Oxford University Press.

Bureau of Governmental Affairs, University of North Dakota. 2006. *Energy Survey.* Grand Forks, ND, July 2006.

California Energy Commission, (CEC). 2003. *Initial Study/proposed Negative Declaration for the 2005 Building Energy Efficiency Standards for Residential and Nonresidential Buildings.* Retrieved October 4, 2010 (http://www.energy.ca.gov/reports/2003-09-12_400-03-018.PDF).

Carmody, John, Jeffrey Christian and Kenneth Labs. 1991. *Builder's Foundation Handbook.* Report prepared for Oak Ridge National Laboratory, May 1991.

Council of American Building Code Officials. 1993. *Model Energy Code; 1993 Edition.* Falls Church, Va.

Creswell, J. 2008. *Educational Research: Planning conducting, and Evaluating Quantitative and Qualitative Research.* Third Edition. Upper Saddle River, NY. Person Prentice Hall.

Cunningham, William. and Sally Lopreato. 1977. *Energy Use and Conservation Incentives*, New York: Praeger Publishing.

Dincer, Ibrahim. 1999. "Environmental Impacts of Energy." *Energy Policy* 27(14): 845-854.

Dreo, Johann. 2006. Image from Wikimedia Commons. Retrieved October 12, 2010 (http://en.wikipedia.org/wiki/File:Sustainable_development.svg).

DSIRE (Database for State Incentives for Renewables and Efficiency). 2010. "North Dakota Incentives/Policies for Energy Efficiency." North Carolina State University. Retrieved March 24, 2010 (www.dsireusa.org/incentives/incentive.cfm?Incentive_ Code =ND03R&re=0&ee=1).

Energy Information Administration. 2010a. "Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State." Retrieved October 4, 2010 (http://www.eia.doe.gov/electricity/epm/table5_6_b.html).

Energy Information Administration. 2010b. "Table 5. Average Monthly Bill by Census Division, and State 2008." Retrieved October 4, 2010 (http://www.eia.doe.gov /cneaf/electricity/esr/table5.html).

Energy Information Administration. 2010c. "State Energy Profiles: North Dakota." Retrieved October 8, 2010 (http://www.eia.gov/state/state_energy_profiles .cfm?sid=ND).

Farhar, B. 1993. "Trends: Public Opinion About Energy". *Public Opinion Quarterly, Winter Issue* 58(4): 603-632.

Gillingham, K. Newell, R. and Palmer, K. 2006. "Energy Efficiency Policies: A Retrospective Examination." *Annual Review of Environment and Resources* 31: 161-92.

Hackett, B. and Loren Lutzenhiser. 1991. "Social Structure and Economic Conduct: Interpreting Variations in Household Energy Consumption." *Sociological Forum* 6(3): 449-470.

Hamblin, Daniel, Jeannie Johnson and Judith Killen. "Optimizing Simulation for Policy Analysis in a Residential Energy End-Use Model." *Operations Research.* 38(3): 397-411 Retrieved October 12, 2010 (http://www.jstor.org/stable/171354).

Hirst, E. 1980. "Review of Data Related to Energy Use in Residential and Commercial Buildings." *Management Science* 26(9): 857-870.

Hirst, E. 1990. "Why the Federal Government Should Help Improve US Energy Efficiency." *Ambio*, 19(2): 96-98.

Hoeven, John. 2009. "State Energy Program Assurance." Letter to Secretary Steven Chu, U.S. Department of Energy. Feb. 27, 2009.

Homans, George C., 1961. "Social Behavior: Its Elementary Forms." New York: Harcourt Brace and World.

International Code Council, ICC. 2009. *International Energy Conservation Code, IECC 2009 Edition.* Falls Church, Va.

International Code Council, ICC. 2009. *International Residential Code, IRC 2009 Edition.* Falls Church, Va.

IPCC. 2007. Climate Change 2007: Synthesis Report. Retrieved June 2, 2008 (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf)

Jacobsen, Grant and Kotchen, Matthew J. 2010. "Are Building Codes Effective at Saving Energy? Evidence from Residential Billing Data in Florida." NBER Working Paper Series, Draft prepared for discussion at the Conference on Green Building, the Economy, and Public Policy held at the University of California, Berkley. December 2-3, 2009. Retrieved October 6, 2010 (http://urbanpolicy.berkeley.edu/greenbuilding/kotchen.pdf).

James, C., Takahashi, K., and Steinhurst, W. 2009. *North Dakota Energy Efficiency Potential Study Report.* Prepared by Synapse Energy on behalf of Plains Justice.

Joerges, B. (1979). *Consumer Energy Research: An International Bibliography.* Internationalen Institut fur Umwelt and Geselschaft, des Wissenschaftszentrums, Berlin.

Lutzenhiser, Loren. 1993. "Social and Behavioral Aspects of Energy Use." *Annual Review of Energy and the Environment* 18: 247-89

Molm, Linda. 2001. "Theories of Social Exchange and Exchange Networks." Pp. 260-272 in *The Handbook Social Theory*, edited by G. F. Ritzer and B. Smart. Thousand Oaks, CA: Sage Publications

National Association of Home Builders. 2010. "Home Size Continues to Decline; Buyers Increasingly Opt for Single-Story Homes." Retrieved October 12, 2010 (http://www.nahb.org/news_details.aspx?newsID=10898)

National Energy Conservation Policy Act of 1978. 95th Congress. PL 95-619. 1978.

Newman, Dorothy and Dawn Day. (1975) *The American Energy Consumer.* Cambridge, MA: Ballinger Publishing Company.

North Dakota Department of Commerce, Division of Community Services. *North Dakota State Building Code. 2008.* Retrieved March 10, 2010 (www.communityservices.nd.gov/uploads/resources/601/2008-state-building-code-book.pdf)

North Dakota Department of Commerce. 2010. "Code Enforcing Jurisdiction as of 2010." Retrieved October 11, 2010 (http://www.communityservices.nd.gov/government/state-building-code/).

Pedersen, Carl and Kenneth Hellevang. 2008. AE-1373 *Determining Insulation and Air Infiltration Levels Using an Infrared Thermometer.* NDSU Extension Service Publication. Fargo, ND.

Ritchie, J., McDougall, G. & Claxton, J. 1981. "Complexities of Household Energy Consumption and Conservation." *Journal of Consumer Research* 8: 223-242.

Rosa, Eugene , Gary Machlis and Kenneth Keating. 1988. "Energy and Society." *Annual Review of Sociology* 14: 149-172.

Rosen, Marc and Ibrahim Dincer. 1998. "On Exergy and Environmental Impact." *International Journal of Energy Research* 21(7): 643-654.

Schor, Juliet. 1998. *The Overspent American: Why We Want What We Don't Need.* New York, NY: HarperCollins.

Scott, Michael, Joseph Roop, Robert Schultz, David Anderson, and Katherine Cort. 2007. "The Impact of DOE Building Technology Energy Efficiency Programs on U.S. Employment, Income, and Investment." *Energy Economics* 30(2008): 2283-2301.

United States Department of Energy (U.S. DoE). 2009. *Impacts of the 2009 IECC for Residential Buildings at State Level.* Retrieved October 4, 2010 (http://www.energycodes.gov/implement/state_codes/reports/IECC2009_Residential_Nationwide_Analysis.pdf).

United States Department of Energy. *The Smart Grid: An Introduction.* Prepared by Litos Strategic Communication for the U.S. DoE under contract No. DE-AC26-04NT41817 Retrieved October 13, 2010 (http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf

APPENDIX A. GOVERNOR HOEVEN ASSURANCE LETTER

State of
North Dakota
Office of the Governor

John Hoeven
Governor

February 27, 2009

The Honorable Steven Chu
Secretary
US Department of Energy
1000 Independence Ave SW
Washington, D.C. 20585

Re: State Energy Program Assurances

Dear Secretary Chu:

As a condition of receiving our State's share of the $3.1 billion funding for the State Energy Program (SEP) under the American Recovery and Renewal Act of 2009 (H.R. 1)(ARRA), I am providing the following assurances. I have written to our public utility commission and requested that they consider additional actions to promote energy efficiency, consistent with the Federal statutory language contained in H.R. 1 and their obligations to maintain just and reasonable rates, while protecting the public. I have also written to the State Legislature and requested that they consider actions to improve building energy codes, consistent with State law and State Constitutional requirements, and to consider the statutory language contained in ARRA.

We are prioritizing our energy investments to take advantage of existing programs and expand programs where appropriate.

Our State is committed to a robust improvement in energy efficiency and renewable energy, as well as a balanced State energy policy. I want to assure you that, within the limits of my authority, we will move forward in these critical areas.

We look forward to immediate distribution of the Federal SEP funds to permit my State to make progress in energy efficiency and renewable energy.

John Hoeven
Governor

38:34:58

C: Gil Sperling
Director, Office of Weatherization and Intergovernmental Programs
U.S. Department of Energy
Jim Boyd, ND Dept. of Commerce
David Terry, Executive Director
National Association of State Energy Officials

600 E Boulevard Ave.
Bismarck, ND 58505-0001
Phone: 701.328.2200
Fax: 701.328.2205
www.nd.gov

APPENDIX B. NORTH DAKOTA SENATE BILL 2352

Sixty-first Legislative Assembly of North Dakota
In Regular Session Commencing Tuesday, January 6, 2009

SENATE BILL NO. 2352
(Senators Wardner, Holmberg, Horne)
(Representatives Carlson, Klein, S. Meyer)

AN ACT to amend and reenact section 54-21.2-03 of the North Dakota Century Code, relating to energy conservation standards for new buildings.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:

SECTION 1. AMENDMENT. Section 54-21.2-03 of the North Dakota Century Code is amended and reenacted as follows:

54-21.2-03. Energy conservation standards. ~~The standards~~ Standards for energy conservation in new building construction, for thermal design conditions and criteria for buildings, and for adequate thermal resistance in regard to the design and selection of mechanical, electrical service, and illumination systems and equipment which will enable the effective use of energy in new buildings, must ~~at least equal the Energy Conservation Code based on the Council of American Building Officials Model Energy Code, 1989 Edition. The department of commerce shall adopt rules to implement, update, and amend the Model Energy Code~~ be included in the state building code.

President of the Senate

Speaker of the House

Secretary of the Senate

Chief Clerk of the House

This certifies that the within bill originated in the Senate of the Sixty-first Legislative Assembly of North Dakota and is known on the records of that body as Senate Bill No. 2352.

Senate Vote:	Yeas	46	Nays	0	Absent	1
House Vote:	Yeas	93	Nays	0	Absent	1

Secretary of the Senate

Received by the Governor at _____ M. on _____, 2009.

Approved at _____ M. on _____, 2009.

Governor

Filed in this office this _____ day of _____, 2009,

at _____ o'clock _____ M.

Secretary of State

APPENDIX C. BUILDER QUESTIONARE

The NDSU Extension Service, in cooperation with the North Dakota Department of Commerce, is asking for your help.

We are conducting a research survey of builders in North Dakota to understand current building practices.

This information can be used by individuals and organizations (builders, building officials, architects/designers, building trades organizations, etc.) as they evaluate North Dakota building codes and by educators to tailor programs specifically to fit the needs of North Dakota builders.

In addition, a few questions relate to personal preferences about building projects and will be used in conjunction with a survey of Realtors and prospective homebuyers to develop an understanding of homeowners' desires for home purchases. This information will be made available so builders can better determine how to concentrate their marketing efforts.

The survey is completely voluntary and should take less than 10 minutes to complete. Individual responses will be kept confidential. If you have any questions, please call Carl Pedersen, NDSU Extension Service, at (701) 231-5833 or send an e-mail to carl.pedersen@ndsu.edu.

North Dakota
DEPARTMENT OF COMMERCE
Office of Renewable Energy & Energy Efficiency

When answering the following questions, provide information on the building components in each section of what you are installing or having installed in new construction and/or remodeling projects. Include the percentages of each installation for your jobs. If you use the technique described, check the "Used" column and provide the rest of the information in that row. If you do not use a technique listed, simply check the "Not Used" box and move to the next line.

NORTH DAKOTA ASSOCIATION OF BUILDERS

Example

If the question is asking what color and type of roofing material you or your contractors install and you install green asphalt shingles on 40% and gray asphalt shingles on 60% of your homes, your answer would look like this:

			Color					Type			Percentage of Installations
Roofing Material	Not Used	Used	Brown	Gray	Black	Green	Not sure	Asphalt	Slate	Steel	
6/12 roof pitch	○	●	○	○	○	●	○	●	○	○	40%
9/12 roof pitch	○	●	○	●	○	○	○	●	○	○	60%
Flat roof	●	○	○	○	○	○	○	○	○	○	

If a question does not provide answer possibilities for a specific type of construction that you utilize, please describe that in the comments section after each question or at the end of the survey.

NDSU
Extension Service
North Dakota State University
Fargo, North Dakota 58108
February 2010

For questions about the rights of research participants or to report a problem, please contact the NDSU Human Research Protection Program at (701) 231-8908

1. **For ceiling construction, please provide the amount of insulation and the insulation technique used. Of all the ceilings installed in new and remodeling projects, what percentage of each ceiling construction type do you use?** (Continuous insulation refers to insulation that is not interrupted by framing members. For example, if you blow cellulose between ceiling joists, that would be considered a cavity installation, but if it extends above the framing, that would count as combination. If you add an inch of rigid board on the outside of the house, that would be continuous.)

Ceiling Construction	Not Used	Used	Amount of Insulation Installed					Insulating Technique			Percentage of ceilings installed
			None to R-13	R-14 to R-37	R-38 to R-49	R-49+	Not sure	Continuous	Cavity, in-between framing	Combination (continuous and cavity)	
Flat ceiling or scissor truss	○	○	○	○	○	○	○	○	○	○	_____
Cathedral with no attic	○	○	○	○	○	○	○	○	○	○	_____
Raised or energy truss	○	○	○	○	○	○	○	○	○	○	_____
Structural Insulated Panels (SIPs)	○	○	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	_____

COMMENTS

2. **For <u>exterior</u> above-grade wall construction, please provide the amount of insulation, the insulation technique used and the percent of time each type was used in your housing projects.**

Wall Construction (more than 50% above grade)	Not Used	Used	Amount of Insulation Installed							Insulating Technique			Percentage of walls installed
			None	R-1 to R-6	R-7 to R-13	R-13 to R-19	R-19 to R-21	Above R-21	Not sure	Continuous	Cavity, in-between framing	Combination (continuous and cavity)	
2" x 4" – 16" o.c. (on center) wood	○	○	○	○	○	○	○	○	○	○	○	○	_____
2" x 4" – 24" o.c. wood	○	○	○	○	○	○	○	○	○	○	○	○	_____
2" x 6" – 16" o.c. wood	○	○	○	○	○	○	○	○	○	○	○	○	_____
2" x 6" – 24" o.c. wood	○	○	○	○	○	○	○	○	○	○	○	○	_____
Structural Insulated Panels (SIP)	○	○	○	○	○	○	○	○	○	○	○	○	_____
Insulated Concrete Forms (ICF)	○	○	○	○	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	○	○	_____

COMMENTS

3. For walls with more than 50% below grade (foundation), please provide the amount of insulation, the insulation technique used and the percent of time each construction type was used in your housing projects.

Foundation Construction	Not Used	Used	Amount of Insulation Installed: None	R-1 to R-5	R-6 to R-10	R-11 to R-15	R-16 to R-18	Above R-18	Not sure	Insulating Technique: Continuous outside/ outdoors	Continuous inside/ indoors	Cavity, in-between framing	Combination (continuous and cavity)	Percentage of basements installed
Poured concrete	○	○	○	○	○	○	○	○	○	○	○	○	○	.....
Masonry block with empty cells	○	○	○	○	○	○	○	○	○	○	○	○	○	.....
Masonry block with integral insulation	○	○	○	○	○	○	○	○	○	○	○	○	○	.....
Wood frame	○	○	○	○	○	○	○	○	○	○	○	○	○	.....
Insulated Concrete Forms (ICF)	○	○	○	○	○	○	○	○	○	○	○	○	○	.....
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	○	○	○	.....
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	○	○	○	.....

COMMENTS

4. For rim joists, please provide the amount of insulation, the insulation technique used and the percent of time each construction type was used in your housing projects.

Rim Joist Installation	Not Used	Used	Amount of Insulation Installed: R-1 to R-5	R-6 to R-10	R-11 to R-15	Above R-15	Not sure	Insulating Technique: Continuous	Cavity, in-between framing	Combination (continuous and cavity)	Percentage of rim joist
Spray foam	○	○	○	○	○	○	○	○	○	○	.....
Fiberglass batts	○	○	○	○	○	○	○	○	○	○	.....
Rigid board insulation	○	○	○	○	○	○	○	○	○	○	.....
None	○	○	○	○	○	○	○	○	○	○	.....
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	.....
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	.....

COMMENTS

5. For floors installed over unheated space, please provide the amount of insulation, the insulation technique used and the percent of time each construction type was used in your housing projects.

Floor Over Unheated Space	Not Used	Used	Amount of Insulation Installed: None to R-13	R-14 to R-37	R-38 to R-49	Above R-49	Fill the framing cavity	Not sure	Insulating Technique: Continuous	Cavity, in-between framing	Combination (continuous and cavity)	Percentage of installations
Living space over garage	○	○	○	○	○	○	○	○	○	○	○	_____
Crawl space	○	○	○	○	○	○	○	○	○	○	○	_____
Cantilever floor	○	○	○	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	○	○	○	_____

COMMENTS

6. For the majority of windows and doors, please provide the U-value installed in your housing projects.

U-values	U-value: U-1.2 or higher	U-.65 to U-1.1	U-.50 to U-.64	U-.36 to U-.49	U-.35 and lower	Not sure	Double pane	Triple pane	Percentage of installations
Windows	○	○	○	○	○	○	○	○	_____
Windows	○	○	○	○	○	○	○	○	_____
Doors	○	○	○	○	○	○	○	○	_____
Doors	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	_____

COMMENTS

7. **For the heating systems you or your contractors install, please provide the efficiency ratings and percent of installations for equipment utilized in your housing projects.**

Heating Systems	Efficiency Rating								Percentage of Installations
	78% to 85%	86% to 90%	91% to 95%	Above 95%	HSPF 7.7 to 8.1	HSPF 8.2 to 8.6	HSPF above 8.6	Not sure	
Natural gas furnace	○	○	○	○				○	_____
Natural gas boiler	○	○	○	○				○	_____
Propane furnace	○	○	○	○				○	_____
Propane boiler	○	○	○	○				○	_____
Heat pump					○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	_____
Other (specify) _____	○	○	○	○	○	○	○	○	_____

COMMENTS

8. **Please indicate how often either you or your contractors are performing the following air sealing measures or installing the following pieces of equipment on your housing projects. If you do not use the construction technique, indicate "Not applicable." For example, if you do not build homes with knee walls, indicate "Not applicable" for that question.**

Air Sealing Measures	Percent of Homes						
	Not sure	Never	25% of homes	50% of homes	About 75% of homes	Always	Not applicable
1. Conduct duct leakage testing	○	○	○	○	○	○	○
2. Conduct blower door test for air infiltration levels	○	○	○	○	○	○	○
3. Seal between foundation and sill plate	○	○	○	○	○	○	○
4. Unfaced insulation is only used in conjunction with an air barrier, not as an air barrier	○	○	○	○	○	○	○
5. Install air barrier in rim joist	○	○	○	○	○	○	○
6. Install air sealing gasket in attic access	○	○	○	○	○	○	○
7. Install air seal in knee wall door	○	○	○	○	○	○	○
8. Install air seal in attic drop-down stair	○	○	○	○	○	○	○
9. Space between window jamb is air sealed	○	○	○	○	○	○	○
10. Space in door jamb is air sealed	○	○	○	○	○	○	○
11. Recessed lights are IC rated	○	○	○	○	○	○	○
12. Recessed lights are airtight	○	○	○	○	○	○	○
13. Recessed lights are sealed to drywall with gasket or caulk	○	○	○	○	○	○	○
14. Air barrier extends behind electrical boxes or sealed boxes are used	○	○	○	○	○	○	○
15. Seal plumbing and HVAC penetrations to outside with expanding foam or other proper air sealing	○	○	○	○	○	○	○
16. Install heating systems with ducts outside the conditioned portion of the home	○	○	○	○	○	○	○
17. Install high-efficiency/efficacy light fixtures	○	○	○	○	○	○	○
18. Install programmable thermostats	○	○	○	○	○	○	○
19. How often do homeowners ask for upgraded energy-related items	○	○	○	○	○	○	○

COMMENTS

The following questions refer to personal beliefs and not specific building code requirements. The answers to these questions will be used in conjunction with similar surveys of Realtors and homebuyers to establish views about energy use in residential structures. Please answer to the best of your ability.

1. Who is responsible for decisions related to building quality? Rate in order of responsibility, with 5 being the most responsible and 1 the least responsible.

_____ State regulators/legislators
_____ Builders
_____ Designers/architect
_____ Homeowner/homebuyer
_____ Building code official
_____ Other _____

2. Who is responsible for informing the homebuyer/homeowner about energy-related issues? (Check all that apply.)

❑ Realtors
❑ Builders
❑ Designers/architect
❑ Public officials
❑ Homeowner/homebuyer themselves
❑ Other _____

3. How concerned are you with energy efficiency aspects of homes you construct?

❑ Not concerned
❑ Slightly concerned
❑ Neutral
❑ Somewhat concerned
❑ Very concerned

4. How concerned are homeowners/homebuyers with energy efficiency aspects of homes they buy?

❑ Not concerned
❑ Slightly concerned
❑ Neutral
❑ Somewhat concerned
❑ Very concerned

5. What reason would cause you to consider energy issues when building/retrofitting a home? Rank in order of importance from 1 to 7.

_____ Comfort
_____ Energy cost
_____ Consumption of natural resources
_____ Not want to spend more than comparable homes
_____ Carbon footprint
_____ Quality of product I am selling
_____ Code
_____ Other _____

6. Based on your observations, please answer the following statements.

■ If given the option, the majority of homeowners would rather spend money on granite countertops than on additional insulation.

❑ Always True
❑ Sometimes True
❑ Rarely True
❑ Never True

■ Homeowners generally only consider the initial cost of installed appliances and not the cost to operate them through time.

❑ Always True
❑ Sometimes True
❑ Rarely True
❑ Never True

■ I am often asked to build a "green home."

❑ Always True
❑ Sometimes True
❑ Rarely True
❑ Never True

7. Where would you go to find more information on energy-related issues in buildings? (Check all that apply.)

❑ Building trade organizations
❑ Internet
❑ Other builders
❑ Workshops
❑ Trade schools
❑ Trade shows
❑ Already know all I need to know
❑ Other _____

8. Please give an estimate of the percentage of each type of home you build in a year.

_____ Starter spec homes
_____ Middle price range spec homes
_____ High-end spec homes
_____ Starter custom homes
_____ Middle price range custom homes
_____ High-end custom homes
_____ Other _____

100%

9. Which North Dakota city is closest to where you build the majority of your homes?

❑ Williston ❑ Minot ❑ Grand Forks
❑ Dickinson ❑ Bismarck ❑ Fargo

For tracking purposes only, please provide your name and/or the name of the construction company for which you work. Identification will not be tied to any provided answers and is simply used for tracking purposes to ensure the survey is completed only once.

Name _____

APPENDIX D. NORTH DAKOTA CLIMATE ZONES MAP

APPENDIX E. DETAILED INTERVIEW QUESTIONS

Interview Questions: Builders

There are many dimensions to designing and building a home. Could you talk with me about the process you go through when designing and building a home?

1. Can you provide some basic information about the types of homes you typically build?
    a. Spec/custom
    b. Entry level/ mid-range/ high end.

2. Please describe the process of designing a home for a customer?
    a. What input does the customer have, if any?
    b. Who makes the decisions as to the structure and components of the home being designed (size, bedrooms, type of construction, etc.)?
    c. How do you decide what features are included in the design of a home?
    d. How do you decide which features are going to be offered?
    e. Are there certain features that you try to encourage that homeowners often overlook?
    f. Are there certain features that you discourage?

3. Are you interested in building a green or energy certified home?
    a. Yes/no
    b. What would encourage you to build one of these homes?

4. How do energy related decisions fit into the process of designing a home?
    a. Heating systems
    b. Structural
    c. Insulation
    d. Air sealing

5. Where do energy efficiency provisions fit into the overall building plan?
    a. Do they fit?
    b. How?

6. When discussing energy related decisions, do you provide information to perspective homebuyers on the expected costs for utilities in the home?
    a. How much will the heating/cooling system cost to run?
    b. How much energy will appliances use?
    c. How much reduction in heating/cooling costs could be avoided by added insulation?

7. What are some of the struggles you face when making energy related decisions in the design of a home?
    a. Balancing cost with diverse features
    b. Price of materials
    c. Energy price
    d. Price point of home being sold

8. When you design a home, what would it take to make energy related decisions a principal feature in the design process?

9. What are your thoughts and concerns about energy provisions being included in the North Dakota state building code?
    a. What do you think will be some of the positive outcomes of including energy provisions in the state building code?
    b. What do you think will be some of the negatives outcomes of including energy provisions in the state building code?

10. The most current version of accepted building codes are the 2009 series of ICC codes. Do you currently build to those codes?
    a. In what areas of homes you design and build do you exceed the codes?
    b. In what areas of the homes you design and build would you need to improve to reach the standards prescribed in the 2009 International Residential Code or International Energy Conservation Code

11. Who is responsible for the energy related decisions concerning the home you are building?
    a. Building officials
    b. Builder
    c. Realtor
    d. Buyer

Interview Questions: Realtors.

Many Realtors use different methods when finding the right home for their clients.

1. Please describe the process you follow when helping a client find a home?
    a. How do you determine what features in a home are important to your clients? (size, bedrooms, new construction/existing, etc.)
    b. Do you provide education or information about what homebuyers should be looking for in buying or building a home or provide information about issues/items in a home that might reduce buyer satisfaction?
    c. How do you help homebuyers prioritize the list of features they feel they would like in the home?

2. Can you provide some basic information about the types of homes your clients are generally looking for?
    a. New/Used
    b. Spec/custom
    c. Entry level/ mid range/ high end.

3. When showing a home do you point out areas of the home that might require improvement to a future homebuyer?
    a. Examples, (Old furnaces, cracked foundations, etc.)

4. Do energy related decisions fit into the process? For example, do you provide prompting questions such as how important are the energy related features in the home to you?
    a. Heating systems
    b. Design of the home to reduce energy use, (excess glass, landscaping, etc)
    c. Insulation
    d. Air sealing

5. Do you provide information on the expected monthly or yearly expenditures for utilities in the home?
    a. How much will the heating/cooling system cost to run?
    b. How much energy will appliances use?
    c. How much reduction in heating/cooling costs could be avoided by added insulation?

6. In your experience, how concerned are prospective homebuyers with energy related issues in a home?
    a. Do they ask to see utility bills?
    b. How often do clients mention they would like to see homes that are considered to be built to a specific "green" standard or energy rating standard?

7. How knowledgeable are you concerning energy related features in homes?

a. Do you know how to identify an outdated heating system?
b. Are you aware of the recommended insulation levels for homes in North Dakota?
c. Have you received any training about energy efficiency or related issues?

8. Who is responsible for the energy related decisions concerning the home you are selling?
    a. Building officials
    b. Builder
    c. Realtor
    d. Buyer

Interview Questions: Homebuyers.

Finding the right home can be a daunting task, we are trying to understand the process that homeowners go through when attempting to choose the right home for their needs.

1. You have been looking to buy/build a home. What made you want to buy/build a home? Could you walk through the processes that lead you to this decision?
    a. How did you develop the list of the important features you would like in your new home? (size, bedrooms, new construction/existing, etc.)

2. Can you describe the process you used to prioritize the list of features you feel are important in your new home?
    a. What are the "deal breakers"?
    b. What are priorities
    c. What are important items/features in a home that you would like but are willing to live without?

3. Can you provide some basic information about the type of home you are looking for?
    a. New/Used
    b. Spec/custom
    c. Entry level/ mid range/ high end.

4. Did you have help in deciding what might be some important but overlooked items to look for in a home that might reduce your satisfaction with the home you purchase?
    a. Yes/no
    b. Who provided information, or where did you obtain that knowledge?

5. Are you interested in having a "green" or energy rated home?
    a. Are you aware of what makes a home a "green" home?
    b. Are you familiar with the various energy rating certifications?

6. How much input or concern do you have over the energy related items in your new home?
    a. Heating systems
    b. Structural
    c. Insulation
    d. Air sealing

7. Where do energy efficiency provisions fit into the overall vision for your home?
    a. Do they fit?
    b. How?

8. Are you concerned with the expected costs for utilities in the home?
    a. How much will the heating/cooling system cost to run?
    b. How much energy will appliances use?

c. How much reduction in heating/cooling costs could be avoided by added insulation?

9. What would encourage you to include more energy efficiency based practices/materials in the homes you are looking to build/buy?
    a. Price of materials
    b. Energy price
    c. Price point of home being sold

10. Who is responsible for the energy related decisions concerning the home you are purchasing?
    a. Building officials
    b. Builder
    c. Realtor
    d. Buyer

11. What is your awareness level of the current ways to reduce energy consumption in homes?
    a. High efficiency heating systems
    b. Insulation
    c. Air sealing
    d. Fenestrations

APPENDIX F. IRB PROTOCOL DOCUMENTS

Institutional Review Board ...for the protection of human participants in research

North Dakota State University
Sponsored Programs Administration
1735 NDSU Research Park Drive
NDSU Dept #4000
PO Box 6050
Fargo, ND 58108-6050 231-8995(ph) 231-8098(fax)

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REVIEW BOARD

Protocol Amendment Request Form

Changes to approved research may not be initiated without prior IRB review and approval, except where necessary to eliminate apparent immediate hazards to participants. Reference: SOP 7.5 Protocol Amendments

Examples of changes requiring IRB review include, but are not limited to changes in: investigators or research team members, purpose/scope of research, recruitment procedures, compensation scheme, participant population, research setting, interventions involving participants, data collection procedures, or surveys, measures or other data forms.

Protocol Information:

Protocol #: **HS10171** Title: **North Dakota State Energy Code Survey of Current Practices**

Review category: ☒ Exempt ☐ Expedited ☐ Full board

Principal investigator: **Dr. Chris Biga** Email address: **chris.biga@ndsu.edu**
Dept: **Sociology**

Co-investigator: **Carl Pedersen** Email address: **carl.pedersen@ndsu.edu**
Dept: **Ag and Biosystems Engineering**

Principal investigator signature, Date:

Description of proposed changes:

1. Date of proposed implementation of change(s)*: **2-20-2010**
   ** Cannot be implemented prior to IRB approval unless the IRB Chair has determined that the change is necessary to eliminate apparent immediate hazards to participants*

2. Describe proposed change(s), including justification:
   In order to increase return rate and put the survey directly into the hands of builders, propose to provide survey with a return address at designated city building permitting departments. Survey will be supplied to builders as they apply for building permits.

3 Will the change involve a change in principal or co- investigator?
   ☒ No
   ☐ Yes: *Include an Investigator's Assurance (last page of protocol form), signed by the new PI or co-investigator.*

Note: If the change is limited to addition/change in research team members, skip the rest of this form.

4 Will the change(s) increase any risks, or present new risks *(physical, economic, psychological, or sociological)* to participants?
☒ No
☐ Yes: *In the appropriate section of the protocol form, describe new or altered risks and how they will be minimized*

5. Does the proposed change involve the addition of a vulnerable group of participants?
Children: ☒ no ☐ yes – include the *Children in Research* attachment form
Prisoners: ☒ no ☐ yes – include the *Prisoners in Research* attachment form
Cognitively impaired individuals: ☒ no ☐ yes*
Economically or educationally disadvantaged individuals: ☒ no ☐ yes*

**Provide additional information where applicable in the revised protocol form.*

6. Does the proposed change involve a request to waive some or all the elements of informed consent or documentation of consent?
☒ no
☐ yes – include the *Informed Consent Waiver or Alteration Request* attachment form

7. Does the proposed change involve a new research site?
☒ no
☐ yes – include a letter of permission/cooperation, IRB approval, or grant application or contract

Attach a copy of the approved protocol, with highlighted change(s) incorporated within the relevant section(s).

Impact for Participants (future, current, or prior):

1 Will the change(s) alter information on previously approved versions of the recruitment materials, informed consent, or other documents, or require new documents?
☒ No
☐ Yes - attach revised/new document(s)

2 Could the change(s) affect the willingness of *currently* enrolled participants to continue in the research?
☒ No
☐ Yes - describe procedures that will be used to inform current participants, and re-consent, if necessary:

3 Will the change(s) have any impact to *previously* enrolled participants?
☒ No
☐ Yes - describe impact, and any procedures that will be taken to protect the rights and welfare of participants

Request is: ☒ Approved ☐ Not Approved	
Review: ☒ Exempt, category#: 2 ☐ Expedited method, category # ____ ☐ Convened meeting, date: ____	
IRB Signature: [redacted]	Date: 2/23/2010
Comments:	

Protocols previously declared exempt: (Allow 5 working days) If the proposed change does not alter the exemption status, the change may be administratively reviewed by qualified IRB staff, chair, or designee. If the change(s) would alter this status, Expedited or Full Board review will be required

Protocols previously reviewed by the expedited method: (Allow 10 working days) Most changes may also be reviewed by the expedited method, unless the change would increase risks to more than minimal, and/or alter the eligibility of the project for expedited review.

Protocols previously reviewed by the full board. Minor changes (not involving more than minimal risks, or not significantly altering the research goals or design) may be reviewed by the expedited method (allow 10 working days). Those changes determined by the IRB to be more than minor will require review by the full board (due 10 working days prior to next scheduled meeting)

NDSU NORTH DAKOTA STATE UNIVERSITY

Institutional Review Board
Office of the Vice President for Research, Creative Activities and Technology Transfer
NDSU Dept. 4000
1735 NDSU Research Park Drive
Research 1, PO Box 6050
Fargo, ND 58108-6050

701.231.8995
Fax: 701.231.8098

Federalwide Assurance #FWA00002439
Expires April 24, 2013

July 30, 2010

Chris Biga
Department of Sociology, Anthropology, and Emergency Management
342 Barry Hall

IRB Expedited Review of: **"North Dakota State Evaluation of Current Residential Building Practices"**, Protocol **#HS11008**
Co-investigator(s) and research team: **Carl Pedersen**

Research site(s): **varied** Funding: **ND Dept of Commerce**

The protocol referenced above was reviewed under the expedited review process (category # 7) on **7/28/2010**, and the IRB voted for: ☐ approval ☒ approval, contingent on minor modifications. These modifications have now been accepted. IRB approval is based on the original submission, with revised: protocol and funding information (received 7/29/2010).

Approval expires: 7/27/2011 **Continuing Review Report Due: 6/1/2011**

Please note your responsibilities in this research:

- All changes to the protocol require approval from the IRB prior to implementation, unless the change is necessary to eliminate apparent immediate hazard to participants. Submit proposed changes using the *Protocol Amendment Request Form*.
- All research-related injuries, adverse events, or other unanticipated problems involving risks to participants or others must be reported in writing to the IRB Office within 72 hours of knowledge of the occurrence. All significant new findings that may affect risks to participation should be reported in writing to subjects and the IRB.
- If the project will continue beyond the approval period, a continuing review report must be submitted by the due date indicated above in order to allow time for IRB review and approval prior to the expiration date. The IRB Office will typically send a reminder letter approximately one month before the report due date; however, timely submission of the report is your responsibility. Should IRB approval for the project lapse, recruitment of subjects and data collection must stop.
- When the project is complete, a final project report is required so that IRB records can be inactivated. Federal regulations require that IRB records on a protocol be retained for three years following project completion. Both the continuing review report and the final report should be submitted according to instructions on the *Continuing Review/Completion Report Form*.
- Research records may be subject to a random or directed audit at any time to verify compliance with IRB regulations.

Thank you for cooperating with NDSU IRB policies, and best wishes for a successful study.

Sincerely,

Kristy Shirley, CIP
Research Compliance Administrator

Last printed 07/30/2010 1:39:00 PM

NDSU is an equal opportunity institution.

NDSU NORTH DAKOTA STATE UNIVERSITY

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Fargo, ND 58105-6050

701.231.7261
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www.ndsu.edu/aben
www.ag.ndsu.nodak.edu/abeng

Title of Research Study: North Dakota State Evaluation of Current Residential Building Practices

This study is being conducted by:

Dr. Chris Biga. Phone: (701) 231-5887 Email: chris.biga@ndsu.edu

Carl Pedersen. Phone: (701) 231-5833 Email: carl.pedersen@ndsu.edu

Why am I being asked to take part in this research study?
You are being asked to participate based on your recent activity concerning the residential housing market.

What is the reason for doing the study?
In conjunction with North Dakota State University, NDSU Extension Service and the North Dakota Department of Commerce, we are interviewing several persons of interest in our attempt to explore current residential building practices and the choices builders, Realtors, and home buyers make when building, selling or buying a home.

What will I be asked to do?
We are asking for your participation in an interview that will take approximately 30 minutes to complete. The questions aim to widen our understanding of the decisions that are made concerning the building or purchasing of homes, with a specific emphasis towards residential energy use. All interviews will be audio recorded and transcribed for future analysis. Participation is completely voluntary. You are free not to answer any questions you may find objectionable, and may withdraw from the interview at anytime without penalty. All interviews will kept confidential and only researchers at NDSU will have access to the completed interviews. Data from the interviews will be compiled and summarized with responses from other interviewees in a final report to the Department of Commerce and subsequent academic publications. No personal information or identifiers will be used in the data analysis, project reports or published results.

While there is no direct financial compensation for participating in this research project, you may find the interview enlightening and informative. You will be offered a copy of "The House Handbook" that provides guidelines for building and remodeling homes. You should feel free to ask questions now or at the any time during the interview. In the future, if you have any questions about this study, you can contact Carl Pedersen, NDSU Extension Service, at (701) 231-5833 or send an e-mail to carl.pedersen@ndsu.edu. If you have any question about rights of human research participants.

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www.ag.ndsu.nodak.edu/abeng

or wish to report a research-related problem, please contact the NDSU IRB office at 701-231-8908 or ndsu.irb@ndsu.edu.

Findings from this study will be prepared in Fall 2010 and a copy of this report will be available upon request.

Thank you in advance for agreeing to help with this project

Documentation of Informed Consent:
You are freely making a decision whether to be in this research study. Signing this form means that

1. you have read and understood this consent form
2. you have had your questions answered, and
3. you have decided to be in the study.

You will be given a copy of this consent form to keep.

_____ _____
Your signature Date

_____
Your printed name

_____ _____
Signature of researcher explaining study Date

_____
Printed name of researcher explaining study

Institutional Review Board ...for the protection of human participants in research

North Dakota State University
Sponsored Programs Administration
1735 NDSU Research Park Drive
NDSU Dept #4000
PO Box 6050
Fargo, ND 58108-6050 231-8995(ph) 231-8098(fax)

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Protocol Amendment Request Form

Changes to approved research may not be initiated without prior IRB review and approval, except where necessary to eliminate apparent immediate hazards to participants. Reference: SOP 7.5 Protocol Amendments

Examples of changes requiring IRB review include, but are not limited to changes in: investigators or research team members, purpose/scope of research, recruitment procedures, compensation scheme, participant population, research setting, interventions involving participants, data collection procedures, or surveys, measures or other data forms.

Section I: Principal Investigator Information

Protocol #: **HS11008** Title: **North dakota State Evaluation of Current Residential Building Practices**

Review category: ☐ Exempt ☒ Expedited ☐ Full board

Principal Investigator: **Dr. Chris Biga** Email address: **chris.biga@ndsu.edu**
Dept: **Soc., Anthro., and Emergency Mgmt.**

Co-Investigator: **Carl Pedersen** Email address: **carl.pedersen@ndsu.edu**
Dept: **Ag and Biosystems Engineering**

Principal Investigator signature, Date: [redacted]

Section II: Description of proposed changes

1. Date of proposed implementation of change(s)*: **Upon IRB approval**
   ** Cannot be implemented prior to IRB approval unless the IRB Chair has determined that the change is necessary to eliminate apparent immediate hazards to participants.*

2. Describe proposed change(s), including justification:
   Homebuyers have been reluctant to participate in the research process. We feel offering a small incentive for participation would encourage participation

   Inclusion of the option for a $25 gift card to Menards Home Improvement, Hornbachers Grocery store or providing a copy of "The House Handbook" to participants in the study as compensation for participation.

3. Will the change involve a change in principal or co- investigator?
   ☒ No

☐ Yes: *Include an Investigator's Assurance (last page of protocol form), signed by the new PI or co-investigator.*

Note: If the change is limited to addition/change in research team members, skip the rest of this form.

4. Will the change(s) increase any risks, or present new risks *(physical, economic, psychological, or sociological)* to participants?
   ☒ No
   ☐ Yes: *In the appropriate section of the protocol form, describe new or altered risks and how they will be minimized.*

5. Does the proposed change involve the addition of a vulnerable group of participants?
   Children: ☒ no ☐ yes – include the *Children in Research* attachment form
   Prisoners: ☒ no ☐ yes – include the *Prisoners in Research* attachment form
   Cognitively impaired individuals. ☒ no ☐ yes*
   Economically or educationally disadvantaged individuals: ☒ no ☐ yes*

   **Provide additional information where applicable in the revised protocol form.*

6. Does the proposed change involve a request to waive some or all the elements of informed consent or documentation of consent?
   ☒ no
   ☐ yes – include the *Informed Consent Waiver or Alteration Request* attachment form

7. Does the proposed change involve a new research site?
   ☒ no
   ☐ yes – include a letter of permission/cooperation, IRB approval, or grant application or contract

Attach a copy of the approved protocol, with highlighted change(s) incorporated within the relevant section(s).

Impact for Participants (future, current, or prior):

1. Will the change(s) alter information on previously approved versions of the recruitment materials, informed consent, or other documents, or require new documents?
   ☒ No
   ☐ Yes - attach revised/new document(s)

2. Could the change(s) affect the willingness of *currently* enrolled participants to continue in the research?
   ☒ No
   ☐ Yes - describe procedures that will be used to inform current participants and re-consent, if necessary:

3. Will the change(s) have any impact to *previously* enrolled participants?
   ☒ No

☐ Yes - describe impact, and any procedures that will be taken to protect the rights and welfare of participants:

FOR IRB OFFICE USE ONLY

Request is: ☒ **Approved** ☐ **Not Approved**	
Review: ☐ **Exempt, category#:** ___ ☒ **Expedited method, category #** 6 ☐ **Convened meeting, date:**	Review of minor change
IRB Signature:	**Date:** 9/21/2010
Comments:	

Protocols previously declared exempt: (Allow 5 working days) If the proposed change does not alter the exemption status, the change may be administratively reviewed by qualified IRB staff, chair, or designee. If the change(s) would alter this status, Expedited or Full Board review will be required.

Protocols previously reviewed by the expedited method: (Allow 10 working days) Most changes may also be reviewed by the expedited method, unless the change would increase risks to more than minimal, and/or alter the eligibility of the project for expedited review.

Protocols previously reviewed by the full board: Minor changes (not involving more than minimal risks, or not significantly altering the research goals or design) may be reviewed by the expedited method (allow 10 working days). Those changes determined by the IRB to be more than minor will require review by the full board (due 10 working days prior to next scheduled meeting).