Review of Issues Associated with Mandating the Model National Energy Code for Houses

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1. Background to the Model National Energy Code for Houses

The Model National Energy Codes for Buildings and for Houses was developed for the Canadian Commission on Building and Fire Codes (CCBFC), the senior committee in a national structure responsible for writing model National Building Codes under the auspices of the National Research Council of Canada (NRC). The Model National Energy Codes were developed in response to renewed interest in the early 1990s in energy conservation and in regulating building energy efficiency. The federal Department of Energy, Mines and Resources (now Natural Resources Canada) and Canadian electrical utilities provided funding for research that progressed towards what became known as the Model National Energy Codes. The work to develop these codes was endorsed by the Provincial/Territorial Committee on Building Standards (PTCBS), which also requested that the National Building Code include a mandatory cross-reference to the Model National Energy Codes. In 1995, the CCBFC decided against the proposed cross-reference and presented the new Model National Energy Codes as independent documents that provincial authorities could decide to adopt or not. For the purposes of the Model National Energy Codes, houses were defined as residential buildings of three stories or less with an area of not more than 600 square metres.

The Model National Energy Codes for Houses (MNECH) was published in 1997. The MNECH incorporates four main types of variables: 1) energy use, including climatic and degree-day variations as well as gains and losses through the building envelope; 2) energy sources and costs; 3) construction costs; and, 4) economic factors, including macroeconomic variables such as interest and inflation rates as well as other variables such as the economic life of building components. An "environmental cost multiplier" was also included in the model to take into account the environmental costs associated with energy generation, transportation and use. This multiplier was given a neutral value in the model in the absence of adequate data to justify regional variations.

The Canadian Codes Centre has described the following process for identifying the optimum building assembly using the MNECH.[1]

> "A large number of typical construction assemblies for building envelope components (roofs, exterior walls, windows, foundation walls) have been identified and their construction costs carefully estimated. Taking the lowest estimated cost assembly as the base case for each envelope component, the cost increments for assemblies with higher thermal resistance were combined with the present value of the decrement in energy loss through each assembly over an estimated useful life. …The assembly with the lowest combination of first cost increment and life cycle energy loss decrement is the optimum choice."

[1] "Background and Main Features of Canada's New Model National Energy Codes for Buildings and for Houses", Haysom, John C., and Lacroix, Michel, Canadian Codes Centre, Institute for Research in Construction, National Research Council of Canada, September, 1997, p. 6.

The MNECH specifies three paths to achieve compliance.

1. Prescriptive requirements – Tables in the MNECH specify the characteristics of different assemblies required to meet specific thermal objectives.

2. Trade-offs – Trade-offs can be made to reduce thermal resistance in one portion of the envelope provided that thermal resistance in other areas is increased so that the overall heat loss of the building is not increased.

3. Performance path – A building can be designed with any thermal characteristics desired provided that its energy consumption will not be greater than if it had been built in strict conformity with the prescriptive requirements. Proof of conformity requires two energy analyses: one for the "target" performance and one for the actual design for which a permit is requested.

Prototype computer software programs have been developed for use with the codes. It is expected that further development of such software would be the responsibility of private sector developers and vendors.

No provinces or territories have adopted the Model National Energy Code for Houses. In a recent announcement from Environment Canada, the Minister stated that the MNECH will be part of Canada's action plan to deal with climate change. There has been no recent activity by federal departments or agencies to update the Model Energy Codes.

2. Review of Issues and Questions about the Model National Energy Code for Houses

There are several issues and questions that require serious consideration with respect to the Model National Energy Code for Houses. These issues and questions fall into three broad categories:

1. the underlying logic, rationale and assumptions of the MNECH;
2. technical, scientific and economic factors; and,
3. implementation issues and the practicality of the MNECH.

Logic, Rationale and Assumptions of the MNECH

1. **The validity of the MNECH conclusions about optimal assemblies has not been tested** – The conclusions of the MNECH about optimal building assemblies in different geographic zones have not been tested in real world situations. These conclusions are formulated using complex calculations that take into account various factors such as energy costs, material costs, thermal resistance of assemblies, and expected payback over 30 years for spending to achieve energy efficiencies. Although the software used in the MNECH has been tested, there has not been any kind of formal testing in real world situations to assess if the

recommendations/specifications of the MNECH conform to the reality on the ground. Without such testing, it is not possible to be sure that the MNECH works or if it can be made to work. There may be inherent weaknesses in the code or flaws in the assumptions upon which the code is based that are unknown. The effects of the MNECH in provinces with energy-related requirements not in the National Building Code (e.g. Québec, Ontario, Manitoba, Alberta and British Columbia) also are unknown and untested.

2. **Issues and concerns raised during the development of the MNECH have yet to be addressed** – During the development of the MNECH some industry representatives expressed concerns about the code. For example, the Canadian Wood Council expressed concerns about the relative impacts of the model on different building materials, the model's inflexibility with respect to material cost variations, and the lack of consideration of embodied energy. The Canadian Manufactured Housing Institute argued that their products could not be subject to requirements that are specific to different geographic zones when the final point of installation is not under their control. These concerns were acknowledged and put on the table for discussion but they have yet to be addressed and answered. The current version of the MNECH is incomplete because there are no indications about where discussions on these issues will lead. CHBA does not have any information on the potential implications for end users of the outcomes of discussions on these issues.

3. **Liability is a major concern** – There are uncertainties about liability for non-compliance. What would be the respective responsibilities and liabilities for builders and municipal authorities?

4. **The model is a "black box"** – The model is not transparent. Assumptions and input values are presented in various appendices and the output values are presented in the tables to be used by builders and designers. However, the calculations used to derive the table values are not presented.

5. **There is a gap between presenting the MNECH as a guide and as a code** – There is a risk that the difficulties of adapting the MNECH to reflect provincial or regional differences will be underestimated. The Standing Committee on Energy Conservation in Buildings has stated that the life cycle costing (LCC) process is meant to be used only as a guide to the provinces and territories on the relative merits of various options. However, given the potential work and expertise required to modify the model for province-specific applications, it may not be practical or realistic to expect that all provinces and territories could use the values in the LCC process only as a guide. It is questionable that they would all have the capability, willingness and resources to test and evaluate the model using different LCC assumptions in order to customize the model to meet their needs.

6. **The MNECH conflicts with other public policy objectives** – The MNECH does not consider other important public policy objectives in the housing sector, for example, housing affordability.

7. **The logic of the MNECH is not clear** – For example, the differences between the MNECH and R-2000 are not clear.

8. **Estimating the payback over a 30 year period is very speculative** – It is impossible to estimate with any degree of confidence the expected payback from investments in energy efficiency over a 30 year period given the profound economic and technical changes that will occur over this length of time.

Technical, Scientific and Economic Issues

9. **The MNECH is already dated and dealing with further change will be difficult** – Many of the assumptions and values used in the calculations for the model code have changed since the MNECH was developed, with differences in relative energy costs being the most dramatic change. High efficiency furnaces are also becoming more common, while the MNECH assumes the use of mid-efficiency furnaces when comparing the costs of heating with oil or gas and electricity. The magnitude of the changes since the drafting of the MNECH brings into question the effectiveness with which the code can deal with change. For example, the numbers in the model for building materials and energy prices are based on "long term cost trends." The costing of assemblies also assumes that the prices of all materials used will be constant in relation to one another. Building materials are commodity products with independent cost cycles. When the inevitable market-wide changes in the relative costs of materials occur, application of the model may result in a false determination of the best assembly. Even if the values in the code are updated with some regularity – a major assumption – rapid changes in material costs can invalidate the conclusions/specifications of the model. Projections of economic factors and material and energy costs will almost certainly be inaccurate yet they are used as fundamental assumptions in the model. Is the MNECH flexible enough to allow the market to respond to changes or variations in the relative costs of building materials and construction of assemblies? In theory, the economic and cost numbers could be updated in the model on a regular basis to keep up with the inevitable changes. In practice however, it is unlikely that a formal code that regulates the industry, with all its implications for house design and construction, is a flexible enough tool to allow for these types of updates with anything close to the required frequency.

10. **There are questions about fairness and equity in the treatment of different building products** – Concerns about inequitable treatment of different building products have not been addressed. The costs of assemblies used in the model are based on average costs of construction at one location with regional multipliers applied. Even assuming that the regional multipliers are valid, this assumption does not take account of the fact that the relative costs of materials used in different assemblies can vary widely within a region. When the relative prices of different assemblies change because of local cost factors, application of the model can result in a false determination of the best assembly. This issue needs to be the subject of a rigorous assessment.

11. **The MNECH does not consider the embodied energy in different building materials** – The lack of consideration of embodied energy is the basis for one of the criticisms of the MNECH made by the Canadian Wood Council. For example, considering the embodied energy in foam sheathing would produce different ratings of the relative merits of wood with batt insulation and foam sheathing for wall assemblies.

12. **The complexity of MNECH increases the scope for error** – The MNECH attempts to integrate complex technical and economic factors into a single model. The high degree of complexity increases the scope for error in the model specifications and the risks that the code is impractical.

13. **The overall energy efficiency impacts of implementing the MNECH may be negative** – Over the last decade the housing industry has made significant progress in improving the energy efficiency of new homes built in Canada with a voluntary, market-driven approach. It is highly uncertain that new regulation will improve the energy efficiency of new Canadian homes. The objective of the MNECH is to improve the energy efficiency of houses currently built to lower standards by raising the bar for the poorer performers. An unintended impact may be to lower the bar for the builders who currently exceed the targets set by the MNECH. It will be difficult for high performance builders to market homes built to a higher standard (e.g. the R-2000 standard promoted by the industry) when facing competition from competitors building to lower but government-regulated standards. The net effect may well be to lower the overall energy efficiency of new homes built in Canada or to significantly delay improvements that the industry would make in the absence of regulation.

Implementation Issues and Practicality

14. **There is no consideration for implementation requirements** – The MNECH makes no reference to the implementation requirements for either builders or building officials. Implementation of the code will require an infrastructure for training, compliance monitoring and enforcement. Developing and maintaining this infrastructure will entail a significant administrative burden and cost to municipalities.

15. **Implementing the MNECH could involve significant problems with enforcement** – There is no acknowledgement in the code that enforcement would have to be stepped up. There is no indication of a process in which the product would have to be tested and signed-off (like R-2000). The question of whether there will be new liability issues raised by implementation is unanswered.

16. **There is no reference to technical support for the software required** – Specialized computer software is required to calculate trade-offs or performance compliance with the code. The MNECH includes a spreadsheet "prototypical model" called Life Cycle Costing for Houses. There are no indications about how the software would be further developed or maintained or what kinds of technical support would be required or provided to users, beyond a mention that this would be the role of the private sector.

17. **The MNECH could be a deterrent to innovation and the use of new building products** – Implementing the MNECH could make builders reluctant to use new products because of uncertainty about the effects of their use on compliance with the energy code. The costs associated with a new product or process could also deter innovation and use. In practice, the MNECH could put pressure on builders either to build every house as a custom home or to build all of their houses the same.

18. **The MNECH could limit consumer choice –** The MNECH could limit consumer choice in two ways: 1) by acting as a deterrent to the use of new building products and technologies; and, 2) by limiting design choices offered by builders who want to avoid having to meet the more demanding performance requirements of the code (which require the builder to undertake testing and demonstrate that the results comply with the code).

19. **Builders will bear the burden of proof for the performance requirements of the code –** The MNECH says that builders who find the prescriptive approach too limiting may design a building with any desired thermal characteristics if the energy consumption of the building under standardized conditions is not greater than if the building was designed in accordance with prescriptive requirements. A builder who chooses to meet performance rather than prescriptive requirements must prove conformity through two energy use analyses: "one on the building as it would meet the prescriptive requirements, giving the 'target' performance, the other on the actual design for which a building permit is requested." These analytical requirements place an additional burden of proof on the builder, one that is not demanded of a builder choosing the meet the prescriptive requirements. With the performance option, the onus is placed on the builder to prove compliance. With the prescriptive option, the onus is on the agencies responsible for enforcing the regulations to prove non-compliance. This difference will act as a deterrent to use of the performance option, even though the performance option provides a means of overcoming some of the inefficiencies that could result from the use of fixed values for energy and material costs in the code.

20. Summary and Conclusions

Given the many unanswered questions about the Model National Energy Code for Houses, there is a need for an objective review of its underlying assumptions and expected outcomes.

- The MNECH is based on a complex model that is untested and unproven in the field.
- There are some serious questions about soundness of the technical, scientific and economic assumptions used in the MNECH and the conclusions made about optimal assemblies.
- Important questions about the practicality of implementing the MNECH remain unanswered.

The residential sector has achieved more improvement in energy efficiency than any other sector of the Canadian economy. It is the only sector that has actually reduced green-house gas emissions since 1990 and this despite a significant increase in the total number of housing units and reduced energy costs during much of this period. The use of voluntary, market-driven initiatives, such as the R-2000 HOME Program, has been a major factor in this achievement. It would be perverse to undermine this success by imposing a new, untested, intrusive, complex and administratively expensive regulation on the housing industry and its customers.

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