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REPORT TO THE MINNESOTA LEGISLATURE

ON THE COST EFFECTIVENESS AND

PROGRESS OF THE SUSTAINABLE BUILDING 2030 STANDARDS

Pursuant to Minnesota Statute §216B.241, Subd. 9 (f)

January 15, 2013

Introduction

The Minnesota Department of Commerce (Commerce) submits this report pursuant to Minnesota Statutes, section 216B.241, subd. 9 (f), which provides that "the commissioner shall report to the legislature every three years, beginning January 15, 2010, on the cost-effectiveness and progress of implementing the *Sustainable Building 2030* (*SB 2030*) performance standards and shall make recommendations on the need to continue the program as described in this section." Pursuant to Minnesota Statutes, section 216B.241an implementation plan was submitted to the Legislature in July 2009 and the program was put in place and started in July 2010. The conclusion of the previous report in 2010 was that SB 2030 would be cost-effective when meeting the targets for projects starting between 2010 and 2015, which is the first phase of the SB 2030 program. This report will fulfill the 2013 reporting requirement and verifies that conclusion with data from actual projects.

1) History of the Sustainable Building 2030

In the spring of 2008, the Governor signed into law Chapter 278, which created the *Minnesota Sustainable Building 2030* (*SB 2030*) standards. The law designated the Center for Sustainable Research (CSBR) at the University of Minnesota as the lead to develop a Minnesota program reflecting the goals of the national *Architecture 2030* program. *Architecture 2030* outlines specific performance targets for energy use in buildings until 2030. Every five years, total carbon output due to energy use in buildings is to be reduced by an additional 10% compared to the average energy use of existing buildings in Minnesota in 2003. Carbon output was reduced by 60% from 2003 levels and by 2030 will have an 100% reduction In 2010 carbon output was to be reduced by 60% and in 2030 reach a 100% reduction (net zero carbon).

The *SB2030* legislation requires CSBR, in cooperation with Commerce, to "establish cost-effective energy-efficiency performance standards for new and substantially reconstructed commercial, industrial, and institutional buildings that can significantly reduce carbon dioxide emissions by lowering energy use in new and substantially reconstructed buildings." All program elements are to be based on scientific or real world experience in building energy conservation, and all buildings are to be scientifically benchmarked and real reduction in energy consumption measured.

The energy standards for all types of buildings are to be comprehensive, reliable and equitable and provide procedures for the ongoing monitoring of energy use in buildings that have adopted the performance standards. Minn. Stat. §216B.241 also requires that utilities develop and implement programs that help building owners achieve the energy savings goals through design assistance, incentives and verification.

Finally, continuing education and training programs for Minnesota designers, engineers and building operators are fundamental to the initiation of the *SB 2030* standards and the law made education and training a primary goal.

SB 2030 is paid out of Conservation Improvement Programs (CIP) funds that originate from the utilities' required CIP assessment for the applied research and development grant. Total project costs are $2.4 million through December 2012.

2) Expected Cost-Effectiveness of the Sustainable Building 2030

The significant improvements in building performance called for by the *SB 2030* energy performance standards must be achieved in a cost-effective manner. Projects and activities are generally considered cost-effective if the project or activity results in a net benefit to the consumer or society. In the case of utility-administered conservation programs, benefits are based on the energy savings over the assumed lifetime of a particular measure. The State of Minnesota established standards regulating utility energy savings programs in 1982.
In preparation for the *Minnesota Sustainable Building 2030* Phase One and Two/Year 1 Report that was submitted to the Legislature on July 15, 2009,[1] the Center for Energy and the Environment (CEE) performed a preliminary CIP-style cost-effectiveness analysis on a set of 115 buildings in the region. These buildings had participated in CIP design assistance programs and achieved savings similar to the expected with the soon-to-be established Sustainable Buildings 2030 energy performance standard.

Significant assumptions and conclusions from this effort are as follows:

- Energy savings, added costs and utility program rebates were based on the design alternative chosen by the design team.
- All other assumptions were chosen to be as representative as possible of current utility program analysis assumptions used in Minnesota.
- All of the building projects across a wide variety of building types were found to have a net benefit to society over an assumed 20-year life. When only the economics of the building owner were considered, 94% of the building projects were cost-effective over the same 20-year life-cycle analysis.

The most notable finding of the review is that for 94 percent of the buildings analyzed, any additional up-front cost yielded enough energy cost savings to make it a cost-effective investment for the building owner. This initial review shows that the energy performance level

[1] This document is available online through the Minnesota Legislative Reference Library at http://www.leg.state.mn.us/docs/2009/mandated/090892.pdf.

called for by the *SB 2030* standards can be achieved cost-effectively for the overwhelming majority of building types and situations. The projects that did not achieve the energy savings cost-effectively tended to be buildings with special circumstances or limited operating schedules, such as religious buildings and sports facilities.

Anticipated increases in utility program incentives will improve the building owner cost-effectiveness, which is expected to result in an even higher percentage of projects that will be able to cost-effectively achieve the *SB 2030* energy performance standards.

3) State-Bonded Project Cost Effectiveness Actual Results

Based on the analysis noted above, the achievement of the *SB 2030* energy performance standards should be cost effective for the vast majority of state-bonded building projects.

From 2009 to 2012, 40 building projects have been involved in the *SB 2030* process. Of the 40 projects involved in the program, approximately 30 of the 33 state-required building projects and 7 of 8 volunteer building projects appear to be on track to meet the required SB 2030 Energy Standard. To date, 90% of all buildings project enrolled in the *SB 2030* program have met or exceeded the *SB 2030* Energy Standard.

When compared to buildings that just met the minimum energy code requirements, the buildings designed to the *SB 2030* Energy Standard are predicted to save approximately 250 million kBtus/year (thousands of British Thermal Units per year) or a saving of $3.25 million per year assuming an average cost of $0.013 per kBtu.[2] As new projects are added each year and standards increase in 2015, ongoing annual savings to the State and other building owners will increase. The total cost of the program using CIP funds is approximately $2.4 million through December 2012.

The four projects that initially failed to meet the *SB 2030* goal then used a "cost effective alternative path" to meet the guideline. This type of building is not expected to meet the Energy Standard from our analysis three years ago.

1) University of Minnesota Recreation Center Expansion-required
2) MN Army National Guard Jackson Armory Renovation-required
3) University of Minnesota Physics and Nanotechnology-required
4) Cossetta's Italian Market & Pizzeria-voluntary

[2] The average cost per kBtu from the B3 Benchmarking database is $0.013 (assuming a mix of electricity, gas, and other fuels).

Waivers will be granted for the small minority of projects that cannot meet the *SB 2030* standards cost-effectively. The waiver process will ensure that the *SB 2030* standards do not mandate upgrades that are not cost-effective for any state-bonded projects. Such waivers will be granted after a project team demonstrates that appropriate energy saving design options were investigated in an effort to achieve the *SB 2030* performance level but that the design options are not cost-effective for the particular project.

To date, there have been only four buildings that have used the cost-effective alternative path to meet the Sustainable Building Standard.

4) SB 2030 Program Progress

Initial efforts have focused on the development of the tool that will be used to establish customized Energy Standards, development of the administration of the program, case study development, research on types of education classes for designer and building operators, integration of *SB 2030* with the utilities' CIP programs (see below) and assisting design teams in the integration of the *SB 2030* Energy Standards into pilot projects.

The initial Energy Standards for all new building types were established in July 2009. These Energy Standards have been developed into a web-based tool so that designers and building owners can quickly determine their Energy Standard. This tool allows for setting a customized energy target based on the special circumstances of each project such as hours of operation, climate zones and space types.

Additional efforts have been made to develop the administrative portion of the program to make it intuitive and helpful for the designers and building operators. Minnesota is one of the national leaders in the implementation of the program based on the *Architecture 2030* program. Prior experience and close coordination with the *Minnesota Sustainable Design Guideline (MSBG)* program has been essential in developing the procedures. As the statute requires, the *Minnesota Sustainable Building 2030* program will mesh seamlessly with the MSBG. Additional tools were developed to assist designers with accurate energy modeling to ensure that the *SB 2030* Energy Standards are continuously met throughout design, construction, and operations.

All projects following the above-mentioned MSBG program are tracked at each stage of their design to ensure compliance with the Energy Standard. Project teams must report anticipated energy consumption results from energy modeling in the Schematic Design Phase, Design Development Phase and at the full Construction Documents Phase. Due to the vagueness of the building program at the early design phase, the requirements for meeting the SB Energy Standard are bracketed to account for this. In the Schematic Design phase, anticipated building energy consumption can be within 15% of the Energy Standard. At the end of the Design

Development Stage, the anticipated building energy consumption can be within 10% of the Energy Standard. At the end of the Construction Documents phase, the anticipated building energy consumption can be within 5% of the Energy Standard. The design team has to meet these requirements at each stage of design to continue the *SB 2030* process. If they cannot meet the Energy Standard at any design phase, they must reevaluate their design and create alternative plans that will meet the standard (or demonstrate the need for a waiver). At the end of the Construction Documents phase, a third party expert reviews the design team energy model to ensure that all of the assumptions (e.g., occupancy schedules and plug load equipment) match the assumptions used to set the SB Energy Standard, and that the proposed anticipated building energy consumption is within the *SB 2030* Energy Standard.

As part of the program, the predicted energy use, carbon emissions and construction costs have been documented for thirty case studies between 2006 and 2012. While these case studies are in various stages of the design process (from pre-design to occupancy), each design team has calculated both the 2030 Energy Standard for the project and the anticipated building energy consumption. On average, the thirty projects are designed to use less energy than the 2030 Energy Standard, indicating that the Energy Standards are feasible to attain for the design and building industry. The construction cost per square foot for a similar non-SB 2030 building was independently calculated and compared to the estimated construction cost for 19 of the 30 case studies. The average *SB 2030* construction cost estimate was 3% less than the non-SB 2030 building cost. These projects have not yet been operating long enough to determine actual annual energy use; however, the conclusions drawn are supported by a set of 12 non-SB 2030 case studies designed between 1997 and 2006, which show an average actual energy use within 5% of the 2030 Energy Standard and an average construction cost within 2% of a typical building.

5) SB 2030 Utility Programs

As the *SB 2030* energy performance standard has been implemented, the project team has worked cooperatively with utilities to develop and/or modify CIP programs to encourage new buildings to meet the *SB 2030* standards. As noted previously, the language of the legislation requires that utilities address these standards with their programs. Research during the first phases of this project led to the identification of three priority areas for working with utilities to develop and/or support CIP program features. The project team has encouraged and supported CIP program development and refinement through a combination of individual meetings, large group meetings and other communications. Each of the three CIP program priority items is listed below, along with a summary of developments over the last three years.

A) <u>Comprehensive design assistance services.</u> This priority item involves helping to optimize the energy performance of a building's design by providing the design

team with detailed results of the energy performance implications of a large number of design options. This service is considered by the project team to be much more critical than other CIP program aspects. The largest electric investor-owned utility (IOU) in Minnesota had a comprehensive design assistance service prior to the implementation of *SB 2030* standards. The *SB 2030* team worked with the IOU to refine the program to give all participating projects feedback on building energy performance relative to the *SB 2030* standard. Also provided are services to generate and submit the documentation necessary to demonstrate compliance with the *SB 2030* standard for projects that commit to achieving a specific high energy performance goal early in the design process (at no extra cost to the building owner). The State's second largest electric IOU has stated the willingness to consider funding services to support the achievement of the *SB 2030* energy standard for individual projects on a case-by-case basis, but has not developed any standard program in support of *SB 2030* standards. In contrast, the State's third largest electric IOU has committed to, and developed, a comprehensive design-assistance program that is very similar to the largest utility's program (in direct response to the legislation and project team efforts).

B) Bonus incentives (per unit of savings) for achieving *SB 2030* standards. While no utilities have yet committed to increased direct financial incentives, two utilities have a commitment to achieve *SB 2030* energy standards (or another similar goal of exemplary energy performance) as a prerequisite for funding of specific design assistance services.

C) Comprehensive whole-building performance program for small buildings. There have been two key developments in this area. First of all, the State's largest IOU has dramatically lowered the minimum building size that is eligible for its design assistance program and associated performance-based design incentives. Secondly, a comprehensive set of design requirements has been established as an *SB 2030* Energy Standard option for buildings that are too small to be cost-effectively served by comprehensive, project-specific energy simulation analysis. Besides implementing this item within the application of the *SB 2030* energy standards to specific projects, it was also presented to a large group of utility representatives for consideration in future CIP program development.

The project team will continue to support existing utility programs that aid in the accomplishment of *SB 2030* Energy Standard performance and encourage further cost-effective program development to achieve optimal services and financial support for building owners and design teams. Previously identified priorities will continue with an expected focus on 1) getting more utilities to develop or support a standard program offering of comprehensive design

assistance, and 2) the development of additional incentives for buildings that achieve the *SB 2030* energy standard or similar levels of energy savings (as opposed to the peak demand savings that some programs emphasize)—especially for smaller buildings.

6) Sustainable Building 2030 Education

Educational programs for the designers have been developed and conducted. There has been a series of three different education programs implemented in the last three years. First, an early building design energy modeling education program was conducted to simply introduce building energy strategies that are available early in the design process. These strategies include building orientation, massing, height, window to wall ratio and building wall insulation. Each of these strategies were demonstrated and modeled in an energy modeling program to determine their effect on the building energy consumption. Over 50 building designers participated in this three-day workshop.

Second, in 2012 a more intense 40-hour seminar was conducted to introduce best practices when creating low energy buildings. The subjects covered in these sessions were:

- Session 1: Setting and achieving energy goals with integrated design
- Session 2: Getting to 60: The power of targets & load reduction
- Session 3: Accentuate the positive- climate responsive design
- Session 4: Skins - the importance of the thermal envelope
- Session 5: Passively-Aggressive -- employing passive systems for load reduction
- Session 6: Illuminating savings: daylighting and integrated lighting strategies
- Session 7: Right-sized - equipment and controls for super-efficient building systems
- Session 8: Site power- renewable energy opportunities
- Session 9: The handoff and staying in shape
- Session 10: Achieving 2030 goals on the project and at the office

Over 50 building designers participated in this educational event. This education opportunity will be available again in 2013.

Lastly, an introductory four-hour education session was created and conducted for design firm leaders to expose them to the variety of tools and strategies available to create low energy building design. Over 50 participants attended this session in November 2012.

It is anticipated that, by the end of 2013, over 200 building designers will have been through some type of training program that addresses the Sustainable Building 2030 Energy Standards and strategies to attain them. Other presentations on the program are made annually to professional architects and engineers at the Minnesota AIA and ASHRAE/AEE Conferences. In

addition to the formal education sessions, more informal education sessions are conducted for individual firms and building designers on an ad hoc basis.

An innovative building operator training system is being developed to provide project-specific guidance for sustaining optimal energy performance over the life of the building's energy systems. It is essential that *SB 2030* designed buildings are operated at the Energy Standards that they were designed to be capable of achieving. Prototypes of this building operator training system have been completed, and a tool is being developed that can provide notifications and tracking of periodic operator checks. This tool will be web based so that each organization can have the project-specific operator checks and tracking notifications customized to fit the needs of the individual buildings' equipment and their organizational structures.

Conclusion

Progress is being made on all tasks required to implement the *SB 2030* program that was in place as of July 2010. All work on the standards completed to-date shows that it is cost effective to meet the 2010 target. Ninety percent of all buildings involved in the program were able to meet the *SB 2030* Energy Standard with little additional cost to the overall project.

The 40 buildings designed to the *SB 2030* Energy Standard so far are predicted to save approximately 250 million kBtus/year–a savings of $3.25 million per year. When new projects are added each year and standards rise in 2015, recurring annual savings to the State and other building owners will grow significantly.

The Sustainable Building 2030 Standards program should continue. More educational opportunities are needed for architects and engineers to facilitate more *SB 2030* designs. The building operator training program being developed but is not fully launched. While the *SB 2030* statute requires utilities to develop or modify CIP program to encourage new buildings to meet the *SB2030* Standards, two of the three largest electric investor owned utilities have developed comprehensive design assistance services, but not all utilities have fully integrated *SB 2030* programs into their CIP. Finally, work must continue on the next stages of the *SB 2030* program so that the tools will be in place when the next goal – 70% reduction – is required in 2015.

Finally, as required by Minnesota Statute, section216B.241, subd. 9 (f), an additional report regarding the cost effectiveness of the standards and the progress of the program will be made to the legislature in 2016.