

Advancing Public Education and Awareness of Building Energy Use in Northfield

An evaluation of the Minnesota B3 database vs. the Oberlin,
Ohio energy & water online dashboard.

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Energy Working Group. Northfield, MN 55057

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Executive Summary

The Northfield Energy Working Group (NEWG)¹ included as Task #2 in its list of “quick start actions,” an assessment of the Minnesota B3 program as a tool to advance public awareness and education regarding building energy use in Northfield. This is a tool that is currently being used by the City of Northfield, as well as over 200 other Minnesota cities, to track energy consumption and efficiency in city-owned buildings. For purposes of this report, the MN B3 tool was compared to the Lucid Building OS energy and water dashboard from Oberlin, Ohio. Oberlin’s dashboard was chosen as a good example of what the NEWG perceives to be a particularly effective and engaging tool. It includes both city energy and water data as well as data from the public schools and Oberlin College. Lucid Building OS is also the same system used by Carleton College, which allowed the NEWG to gain access to some of its “behind the scenes” administrative tools and graphing capabilities.

After evaluating both systems on the basis of six criteria selected by the NEWG, this evaluation concluded that although the MN B3 program provides a basic level of city building energy use and benchmark comparison, its public interface is very minimal and not very engaging. Upon completion of this evaluation, we recommend moving forward with an evaluation of cost, feasibility and potential stakeholders interested in implementing a building energy and water dashboard system that incorporates a whole systems approach like Oberlin’s for all City of Northfield facilities, Northfield Public Schools, and the Northfield Public Library.

¹ The Northfield Energy Working Group was created in August 2016 to advise the Northfield Environmental Quality Commission on how to advance a subset of four specific “quick start” actions from the 2008 Northfield Energy Task Force report.

Background

The City of Northfield currently participates in the Minnesota B3 program (<https://mn.b3benchmarking.com>), which is a public record of energy consumption in city or state-owned buildings. Buildings in each city's portfolio are benchmarked against each other and buildings of similar use (e.g. office, classroom, arena, etc.) Cities are also ranked against each other based on their total energy efficiency score. Benchmarking is based not on total energy consumption but rather energy use intensity (BTUs per square foot per year). In Northfield's MN B3 portal, monthly utility bill data for six City owned buildings is manually entered by City staff into a password-protected portal. Northfield currently ranks 128th out of 227 participating cities. There are two views available on the Minnesota B3 website: a list ranking all participating cities by their overall performance against given benchmarks and an individual web page for each city with data from buildings in that city's portfolio. A screenshot of the public interface to Northfield's MN B3 energy data is below:

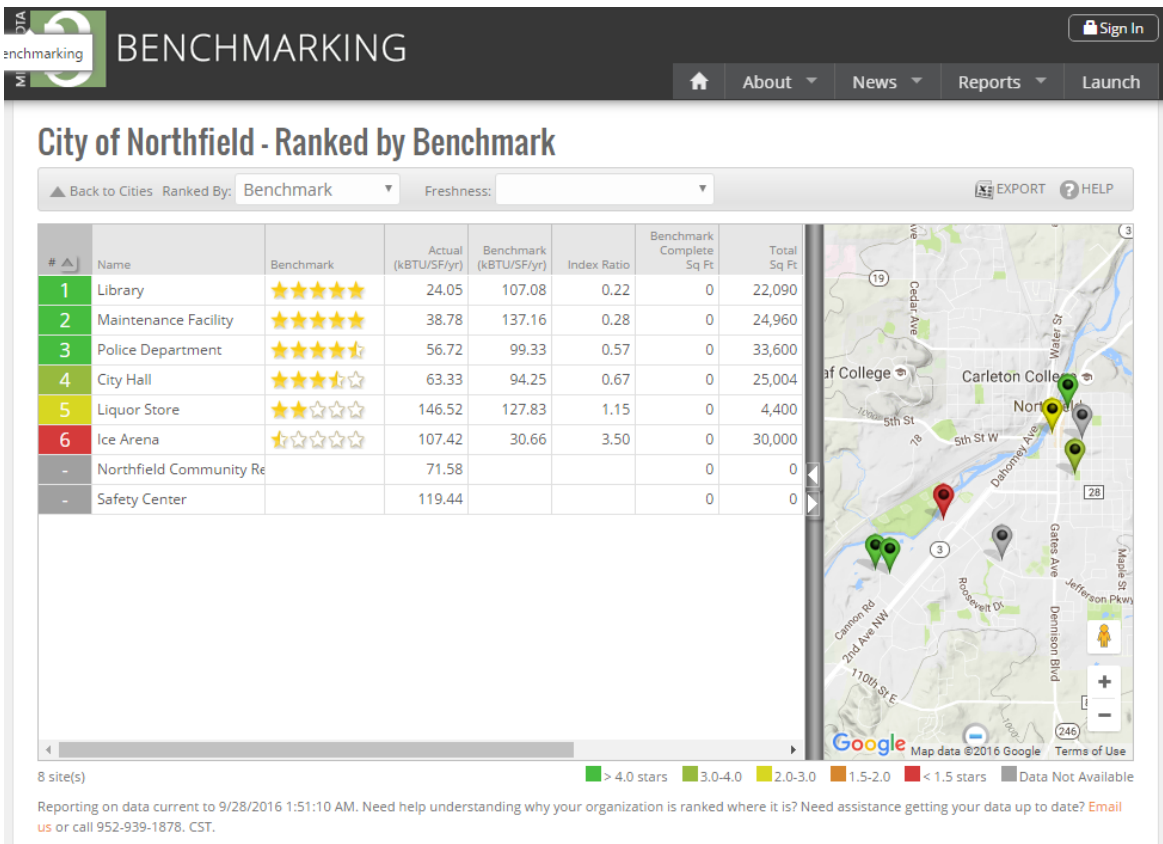


Figure 1: Northfield, MN detail page in the Minnesota B3 website:
<https://mn.b3benchmarking.com/Report?OrganizationID=621&ReturnTo=Cities>

The NEWG evaluation focused primarily on comparing the Minnesota B3 program to a city energy and water dashboard implemented by Oberlin, Ohio, a town of 8,000 citizens with a liberal arts college (Oberlin College) of approximately 3,000 students. Oberlin was selected for comparison because the town and college have worked extensively on community engagement in local water and energy issues and therefore offer a great deal of experience to the topic of engaging and educating citizens of all ages on community energy and water use. Members of the NEWG were also familiar with this system based on a 2015 evaluation of whether Northfield could participate in the Lucid Building Design Group Connected Cities program². It is also the same system currently in use by Carleton College, which allowed the NEWG to view additional graphics that are available to system administrators. The two following slides, provided by Oberlin College, summarize the concepts underlying their approach and the three “feedback elements” of their public, online dashboard system.

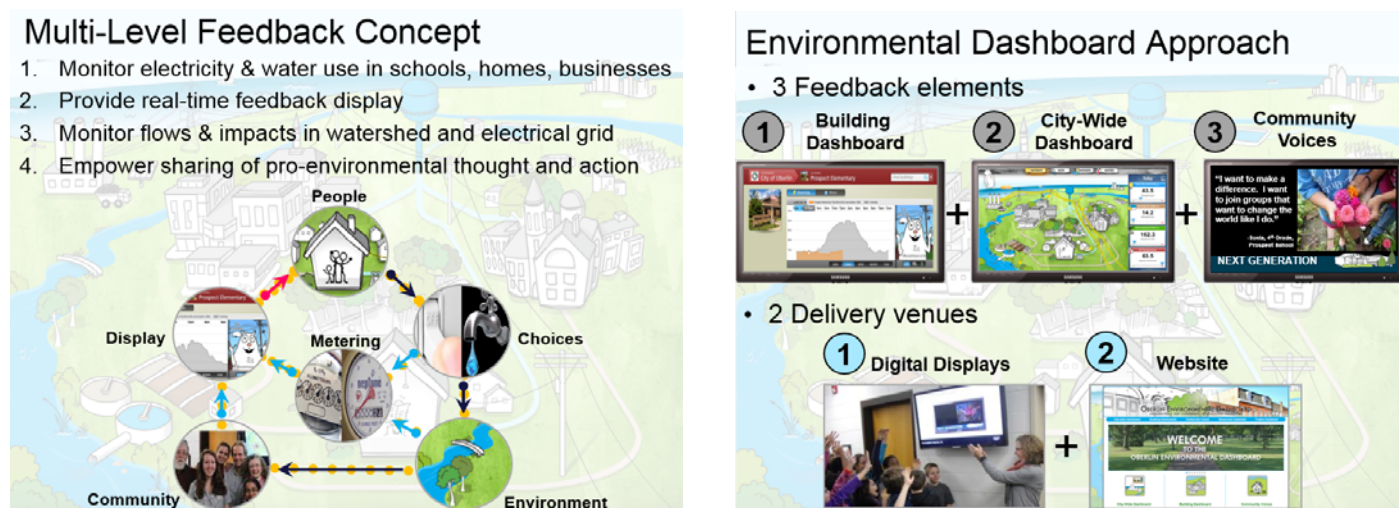


Figure 2: Slides provide by Oberlin, Ohio from a presentation highlighting their public energy and water dashboard. (2014.01.14EnvironmentalDashboardPresentation.pptx)

² Connected Cities is a program facilitated by Lucid Design Group and funded in partnership with the Clinton Foundation's Global Initiative. <https://lucidconnects.com/partners/cities>

Evaluation Criteria

The Northfield Energy Working Group selected the following set of criteria for evaluation:

1. Engaging graphics and public interface
2. Quality of data collection
3. Quality of data representation
4. Transparency for citizens interested in understanding and creating motivation for energy conservation and efficiency in Northfield's buildings
5. Ability to show results from - and build support for - City-funded energy conservation projects
6. Ease of integrating information into public school curriculum and community education

Below is a summary of the comparison between these two systems for each of the above criteria. The following pages include specific comments to further explain the basis for each rating.

Evaluation Criteria (1 = weak, 5 = strong)	Minnesota B3	Oberlin Dashboard
1. Engaging graphics and public interface	2	4
2. Quality of data collection	1	4
3. Quality of data representation	1	5
4. Transparency for citizens interested in understanding and creating motivation for energy conservation and efficiency in Northfield's buildings	3	4
5. Ability to show results from – and build support for - City-funded energy conservation projects	1	4
6. Ease of integrating information into public school curricula, colleges and community education	1	4
TOTAL	9 / 30	26 / 30

Criteria #1. Engaging graphics and public interface

Rating (5 = strong, 1 = weak):

MN B3 (2)

Oberlin Dashboard (4)

- The Oberlin dashboard home page (Figure 3) has an illustrated interface which shows city buildings and water sources in a **graphic format that is engaging to citizens of all ages**. Navigation is intuitive via using the top and side navigation panes or clicking on a specific building to drill into greater detail. MN B3 (see Figure 1 on page 2) provides a plain matrix of values which doesn't tell a captivating story of energy and water use. Many of the MN B3 values are not explained (e.g. "index rating") and some columns list zeros or no data.
- The Oberlin dashboard **includes both energy and water data**. Water data includes not only usage of fresh water and wastewater but also water quality and river levels. MN B3 only includes energy data and that data is in a normalized format (btu per sf) so it is not possible to see total building use or the split between electricity and gas. The Oberlin dashboard and public interface engages the entire community with a whole systems approach where individuals can recognize that their energy and water choices are taking place in the context of the community.



Figure 3: Front page of the City of Oberlin dashboard: <http://environmentaldashboard.org/brd/>

Criteria #2: Quality of data collection

Rating (5 = strong, 1 = weak): MN B3 (1) Oberlin Dashboard (4)

- The Oberlin dashboard scored high in this category because it **collects data in intervals down to 15 minutes**. This allows users to see changes in energy use associated with abrupt events such as building occupancy, energy efficiency projects or on/off status of building lighting systems or equipment. MN B3 data is only recorded monthly, so daily or hourly changes in energy use cannot be deciphered.
- The Oberlin dashboard uses real-time interval data, so the **dashboards are always up-to-date**. MN B3 data is entered manually upon receipt of the utility bills, which occurs only monthly and may be delayed if City staff have other, more pressing priorities.
- Oberlin dashboard data is logged automatically through internet-enabled meters or pulse outputs so it **does not require city staff to spend time on manual data entry**. MN B3 data is manually recorded, meaning it not only occupies staff time but it is also susceptible to human error.
- MN B3 data is recorded from utility bills so no additional equipment is required. Depending on the type of meters are currently in place in Northfield buildings, real-time interval data like that shown in the Oberlin dashboards (See Figure 3, Eastwood Elementary) **may require a different kind of meter or additional hardware**.



Figure 3: One day of electricity use at Eastwood Elementary compared to the prior day.
<http://buildingdashboard.net/oberlincity/#/oberlincity/cityelectricity/>

Criteria #3: Quality of data representation

Rating (5 = strong, 1 = weak):

MN B3 (1)

Oberlin Dashboard (5)

- The MN B3 dashboard offers only one way to view data (See Figure 1, page 2). In addition to being incomplete, the data table includes categories that are not explained. Other than the color-coded indication of relative energy efficiency, this data table is not useful to the average citizen nor City staff trying to evaluate the details of building energy use and energy conservation projects or opportunities.
- Oberlin dashboard provides **multiple ways to view data** using **graphic and color-coded data visualizations** that make it easy to understand what is being presented. The program has the ability to highlight the relationships between energy use and human behaviors or weather. It also offers the ability to monitor goals, successes and usage comparisons on several fronts like water and electricity.

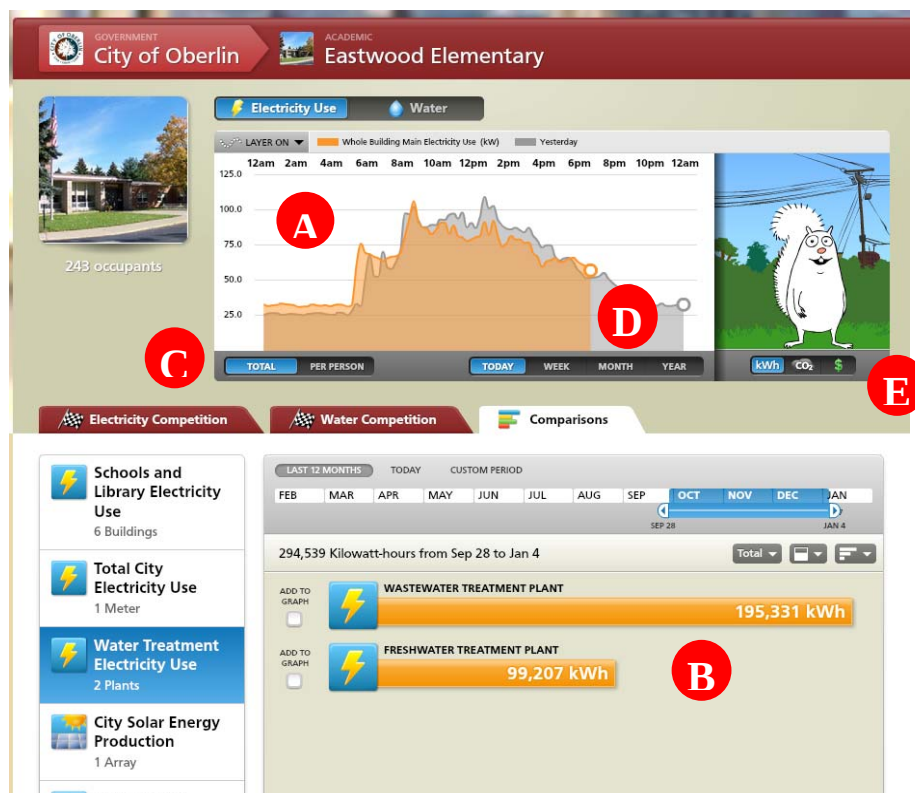


Figure 4: A single dashboard page shows electricity use for the day in one building (A) and a comparison of electricity use between multiple buildings (B). Data can also be viewed in total or per person (C) and in various time intervals (D). Graphs can be toggled from energy use to carbon emissions to dollars (E). <http://buildingdashboard.net/oberlincity/#/oberlincity/eastwoodelementary>

By referencing the administrative side of the Carleton College Lucid Building OS system (the same system used in Oberlin) the NEWG was able to see graphics in the administrative portal that would be **useful to more detailed data analysis and identification of energy conservation opportunities**. These “behind the scenes” administrative graphics could be used exclusively by City staff and/or shared with the community and integrated into school curricula.

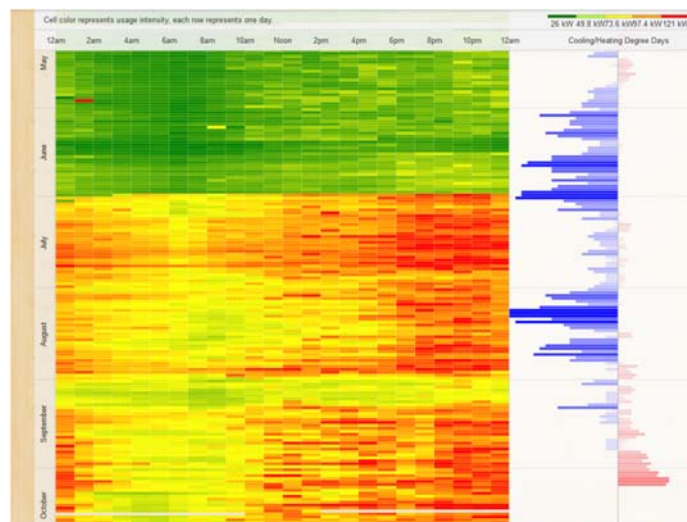


Figure 5: A “heat map” display shows energy use for all hours of the day throughout the year providing insight on how buildings are being used, when they are occupied, whether building equipment operating schedules match building open hours and identify at a glance potential energy conservation issues or opportunities.

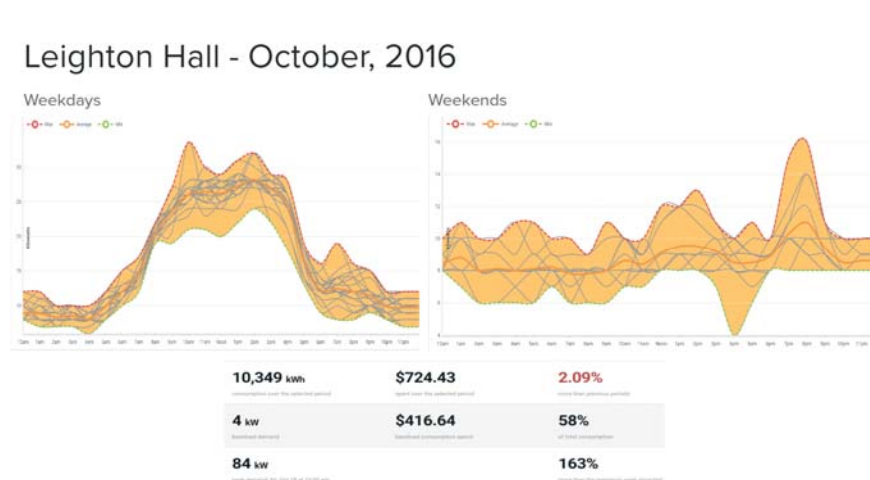


Figure 6: A “load profile analysis” shows differences between weekday and weekend consumption and how much of a building’s energy use is due to its base load (equipment) vs. occupant activities.

Criteria #4: Transparency for citizens interested in understanding and creating motivation for energy conservation and efficiency in Northfield's buildings

Rating (5 = strong, 1 = weak):

MN B3 (3)

Oberlin Dashboard (4)

- **The MN B3 program is primarily intended to be a benchmarking system.** Its strength is in ranking each building's efficiency against other buildings of similar type, comparing all buildings in a city's portfolio against each other, and ranking a city's overall scores against other Minnesota cities. To make the best use of this aspect of the MN B3 system, Northfield should include all City-owned buildings in its dashboard. Currently only six buildings are represented. (See page 2, Figure 1).
- The Oberlin dashboard allows users to see **building rankings given various ways of normalizing data.** Buildings can be compared by total energy use, energy use per square foot and energy use per building occupant. Oberlin uses their dashboard to raise awareness of energy use by engaging the community on many fronts with user-friendly data that encourages conservation and inspires behavioral change.
- The Oberlin dashboard allows users to selectively view buildings data **during different time intervals.** One can view data from the last week, last month, last year or a custom period (e.g. during a particular season or event). The MN B3 program records only monthly utility bill data.
- Unlike MN B3, the Oberlin dashboard does not provide benchmarking data against other cities. However, it does allow **benchmark comparisons against other buildings of similar type and use** through use of the Energy Star Portfolio system.

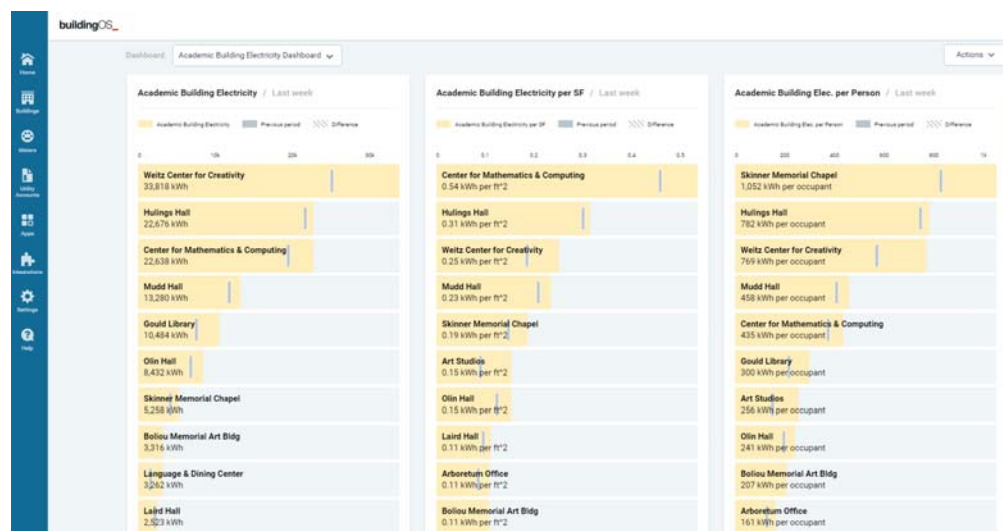
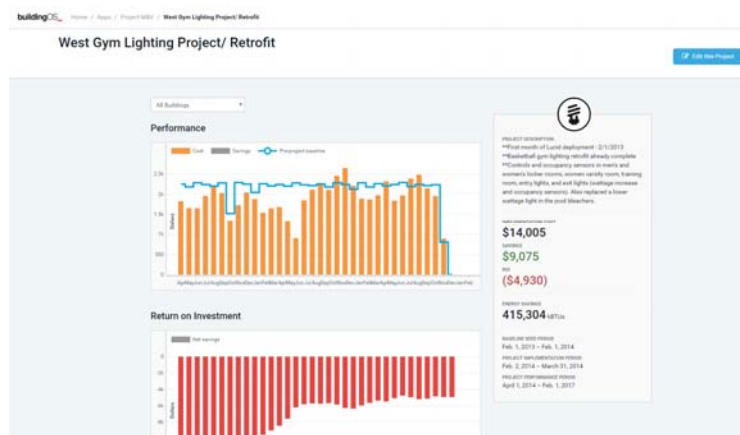


Figure 7: A single dashboard shows Carleton academic building electricity use during the previous week ranked by total electricity use, electricity use per square foot and electricity use per building occupant.

Criteria #5: Ability to show results from – and build support for - City-funded energy conservation projects

Rating (5 = strong, 1 = weak): MN B3 (1) Oberlin Dashboard (4)

- The City has a lot to be proud of given the many energy conservation projects that have already been implemented in City owned buildings. The NEWG recommends finding ways to communicate those successes to the community so these projects can be congratulated, supported and encouraged.
- The graph below from the system used at Carleton College (the same type employed in Oberlin, OH) provides a **specific graphing tool to measure and verify energy conservation projects**. It allows users to set a specific “before and after” time period so monthly energy savings can be tracked against the up-front project cost. MN B3 has no ready-made visual interface specifically focused on communicating energy project paybacks. Monthly B3 data would need to be manipulated quite a bit (exported, sorted, weather normalized, graphed, etc.) in order to perform similar comparisons.
- The Lucid Building OS System also provides **weather-normalized data** so energy savings shown in the graphics are more likely attributable to the project itself and not, for example, a warmer winter which would lower overall heating or electrical demand.
- With either system, **additional sub-metering or site measurements may be required** to truly parse out the effect of a single energy conservation project which affects only one part of a building or one particular building system.



- **Figure 8:** This graph shows weather normalized “before and after” data (top) for an energy efficient lighting retrofit at Carleton College. The Return on Investment graph (bottom) shows each month’s energy savings offsetting the initial project cost. The bars will turn green after the break-even point.

Criteria #6: Ease of integrating information into public school curriculum, colleges, and community education

Rating (5 = strong, 1 = weak):

MN B3 (1)

Oberlin Dashboard (4)

- The Oberlin dashboard was developed in partnership with Oberlin College and Lucid Design Group with **a specific focus on community, college and classroom engagement, and the goal of creating a whole systems approach to energy and water use.**
- The Oberlin Dashboard model incorporates digital touch screen kiosks in public places like libraries and schools to monitor energy use, provide instantaneous feedback, and inspire strategies to conserve energy or develop energy efficiency incentives. The environmental feedback system that is generally hidden from sight in pipes and tanks can now be re-introduced through a visual connection to our natural resources which, in turn, promotes sustainable thought and action.
- The Oberlin dashboard offers **specific tools for engaging both public school and college students** in energy and water awareness. This includes energy and water conservation competitions and animated characters intended to encourage students to engage, learn and make changes based on their relationship with the site.
- Lucid Design Group has an extensive library of online white papers and cases studies, including **ready-made curricula** devoted to use of the energy and water data in schools at a variety of grades and ages.

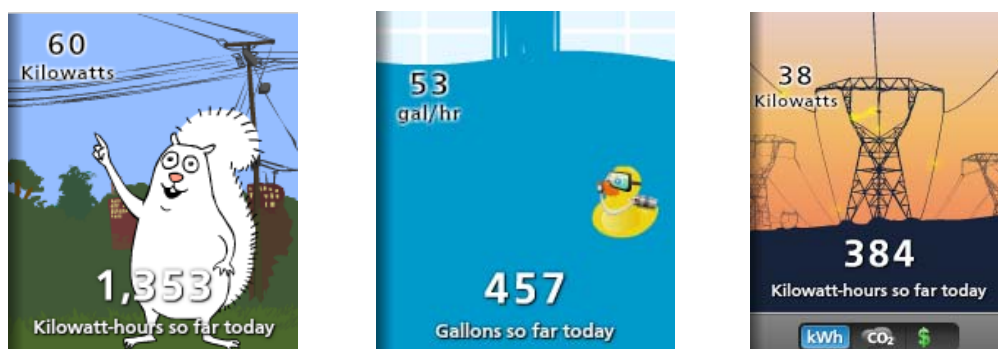


Figure 9: Animated energy and water conscious cartoon characters indicate the effectiveness of the day's energy and water efficiency efforts.



Figure 10: A dashboard declaring Prospect Elementary the winner of a fun energy conservation competition.

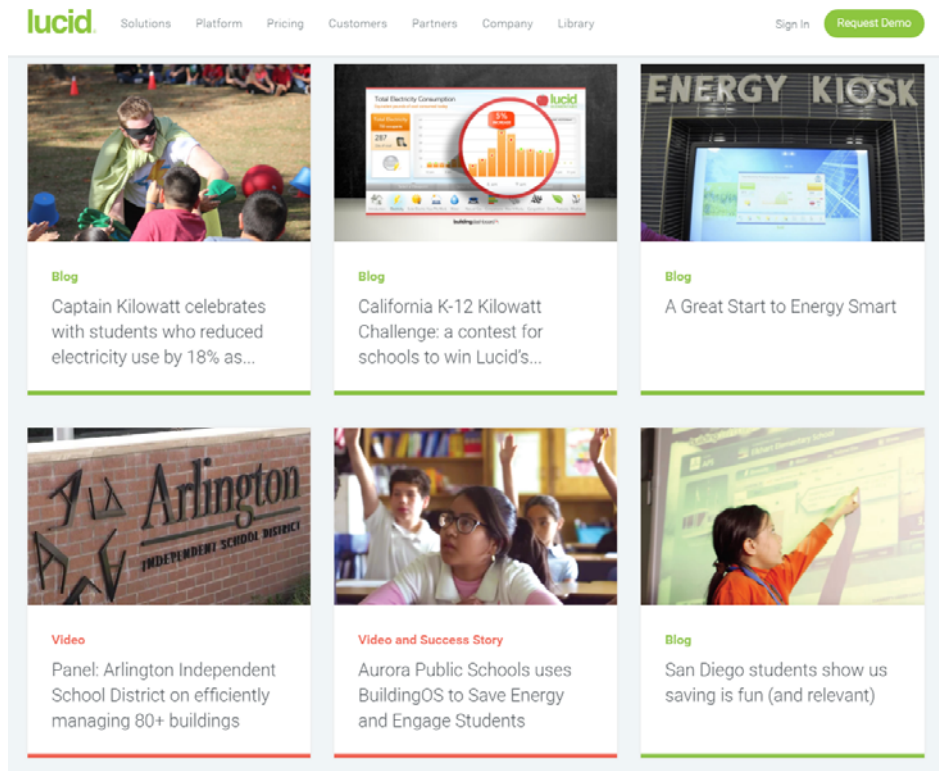


Figure 11: An online library of white papers and case studies provides inspiration and connects Oberlin's local energy and water conservation efforts to similar initiatives in other communities.

Conclusion

Although it provides an overview of building energy use intensity and a basic comparison structure, the MN B3 public dashboard is not broad enough, applicable enough, or engaging enough to be considered a useful public outreach tool. By comparison, the Oberlin site – using the Lucid Building OS system – was created with a focus on community connectedness, education and awareness. It not only provides a more plentiful amount of data, but also provides a multi-layered interface through which to understand and engage with the data. It transforms mere numbers into an interactive platform for teaching, analysis, story-telling, and observation of energy and water consumption and conservation issues and practices. It encourages responsible use of those resources by reminding viewers of the interconnected nature of our energy and water systems, by providing a user-friendly format for teaching and learning, and by turning the data into graphics that provide “at a glance” understanding and application. The ability to compile and compare energy and water use in city buildings, schools, library and colleges could open up many opportunities for collaborative teaching and projects. It could also enhance the City’s ability to connect to the community through collective feedback on how we use our natural resources and by viewing that usage with a whole systems approach. The dashboard can be made available online and via touchscreen kiosks in public locations such as a school lobby or library. A system like Oberlin’s appears to have endless possibilities, inspired by the collective imagination of the community.

Next Steps

The NEWG recommends that the NEQC charge one or more task forces to complete the following next steps:

1. Explore potential stakeholders who would be eager to engage with a whole system, community-focused energy and water dashboard. This could include teachers in the public school system, college faculty, City staff, library staff, senior facilities and citizens of various ages.
2. Evaluate the existing metering systems in-City of Northfield facilities and Northfield Public School buildings to further understand their existing meter hardware and capabilities.
3. Contact the Lucid Design Group to explore the cost of an energy and water dashboard system similar to that of Oberlin. This evaluation should include the cost of any additional metering or hardware requirements, system start-up, and ongoing hosting or maintenance fees.
4. Contact Lucid Design Group to explore the possibility of doing a webinar presentation with interested parties such as the city and the public schools to gain a better understanding of the management, optimal applications and shared operational responses that are possible.