Quantifying the "Real World" Impacts of Early Design Involvement and the Implications for New Construction Program Design, Implementation, and Evaluation

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ABSTRACT

Commercial new construction is a complex process that involves large, diverse teams where the only constant is the unique nature of each project. However, there are always strategies to improve a building's energy use, no matter what the design phase, the budget, or the project type. Although early design involvement is the ideal scenario for new construction programs, it is not always possible in the real world. In this paper, we investigate the implications for program design and delivery to accommodate projects at different design stages based on our experience delivering a non-residential new construction program in Wisconsin sponsored by We Energies.

From January 1, 2005 through June 30, 2007, fifty-eight buildings participated in We Energies' program, representing 6 million square feet across a range of building uses, size, ownership, and design process types. Our dissection of energy impact data from these projects shows that project design stage at the time of registration with the program is a primary factor for influencing the energy efficiency related decisions.

This paper focuses on quantification of "decision making ability" available during each design stage in terms of energy savings within the program. The relevance of early design involvement in the program will be quantified and analyzed in terms of energy savings as compared with projects later in the design process.

We will discuss features and modifications made to the program design and implementation to accommodate projects entering the program in any stage of the design process short of substantial completion. We offer program delivery recommendations for energy modeling and field implementation to apply program resources most efficiently for each project with an emphasis on design phase.

Introduction

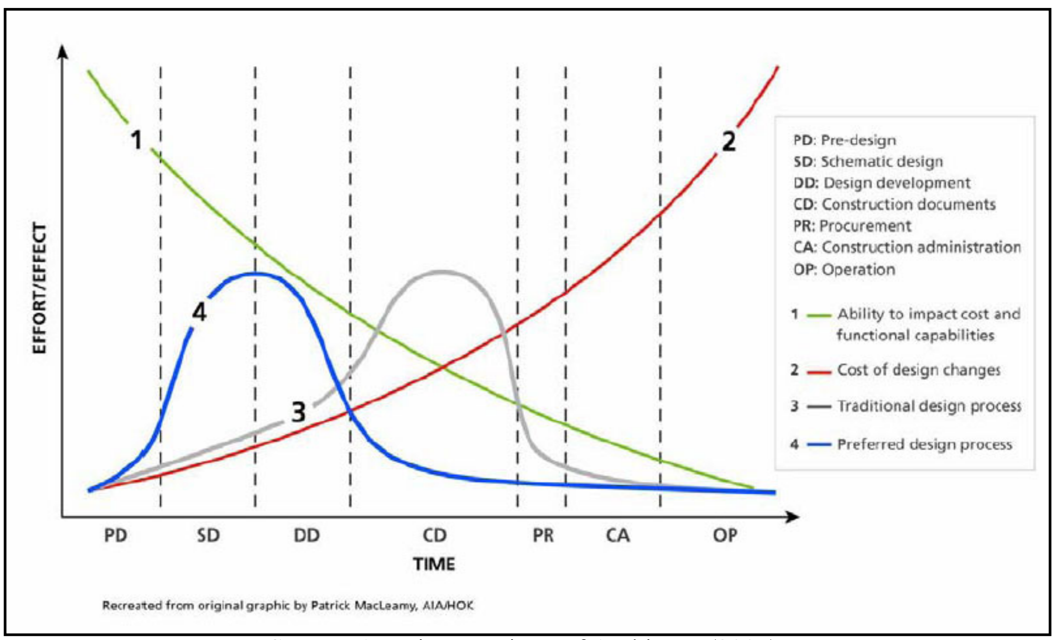
In 2004, Wisconsin regulators ordered We Energies to spend up to $43 million to procure 55 MW of gross summer peak demand reduction during the period of 2005 through 2008 as a supplement to the existing statewide public benefits programs delivered by Focus on Energy. We Energies included a Commercial and Industrial (C&I) New Construction program within the 55 MW resource acquisition portfolio because Focus on Energy was not targeting new construction, and to ensure lasting market impact on the design community after 2008. The budget allocated for the C&I New Construction program was approximately $3.3 million for the period of January 1, 2005 through December 31, 2008, to contribute 4.3 MW to the resource acquisition goal. All projects we required to be completed and paid by December 31, 2008.

We Energies selected the Energy Center of Wisconsin (Energy Center), a private nonprofit based in Madison, Wisconsin to design and implement the program on a turnkey basis, described previously (Vogen, Grabner, et al. 2006). The Energy Center approach to designing the program relied upon direct staff experience in the building design and construction process, established best practices for program design, new construction program theory, and local market research.

The Energy Center sought to design the program to maximize the electric demand and annual energy savings possible within the four-year window of program operations. To do so, the program would ideally influence buildings early in design, capturing synergistic energy savings by encouraging the design and construction of buildings as integrated systems. This has long been understood, and is the basis for *Integrated Project Delivery: A Guide* (American Institute of Architects, 2007), illustrated by Figure 1.

The relationship between the cost of both the design and construction, and the opportunities for improvement is inversely proportional. At the beginning of a project, costs are low and opportunities are high, at the end, the reverse is true. Ideally, projects participating in the program would track more closely to curve 4 to maximize resource efficiency and minimize cost for the life of the project. In reality, our experience is that most projects adhere to curve 3 for reasons that the program cannot influence once the project enters the program. Similarly, higher energy savings opportunities are available during early stages of the project.

Figure 1. Time and Effort/Effect Diagram



Source: American Institute of Architects (2007)

The Energy Center created a program offering to acquire near-term peak reduction and annual energy savings by stimulating incremental improvements in lighting, HVAC, and other building systems, while integrating market transformation activities into implementation to achieve long-term changes in design practices. The program services include:

- Targeted ***education, information, and outreach*** on integrated design practices and benefits.
- ***Technical assistance services*** provided at no cost to the customer primarily by Energy Center of Wisconsin architects and engineers, including facilitation in the design process, reviewing plans and construction documents, assisting with design strategies, analyzing energy savings, hourly energy modeling and verifying installation of measures.
- Financial ***measure incentives*** to owners and developers to help reduce cost barriers to adopting electric energy saving measures that have not yet been accepted as standard practice for construction, offering approximately $300 per gross summer peak kW reduced.
- Financial ***design incentives*** to the design team to help offset the costs of developing designs that provide as-built performance that is more energy efficient than their standard practice designs. Incentive levels are approximately 10% to 15% of measure incentives.

Energy savings in the program are relative to a researched "2005 standard practice" baseline defined as state energy code (based on IECC 2000) with specific baseline modifications to reflect improved building envelope, lower lighting power density (LPD), and improved unitary HVAC (ASHRAE 90.1-2001 standards) as seen in practice. Any size commercial, industrial, government or institutional non-residential new construction project is eligible to participate. The program also allows renovation projects in existing buildings that are required to comply with State energy code. Projects must be pre-approved for participation through a registration form.

In an effort to capitalize on all opportunities that would be available during the fixed 2005 to 2008 program window, the Energy Center defined three participation approaches for the new construction program to support any project type at any phase of design. Technical assistance, design incentives, and measure incentives are offered in varying degrees on individual projects to balance the program resources applied with the potential for saving energy and changing behavior. Incentives are paid to the owner by We Energies after a full site inspection by the Energy Center to verify the as-built conditions of the project. The program channels projects through one of three participation approaches:

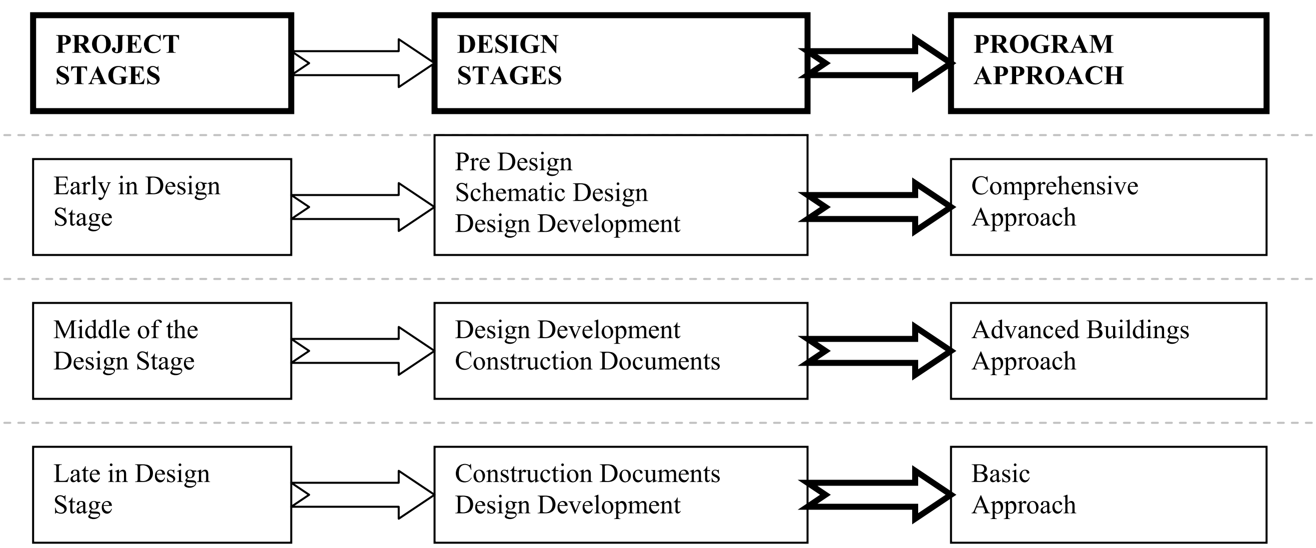
- ***Comprehensive approach*** offers the highest level of technical assistance and financial incentives for custom design solutions. This approach allows the design team the greatest flexibility to meet energy performance goals by adopting integrated design solutions analyzed through whole-building energy simulations.
- ***Advanced buildings™ approach*** provides a menu of financial incentives and technical assistance to encourage integrated design. Measure incentives are paid for meeting performance criteria described in the Benchmark™ technical reference manual for whole building, system and component performance (New Buildings Institute, 2005). Design incentives are available employing integrated design approaches. The Energy Center encouraged participants to adopt a comprehensive package of measures through technical assistance and incentives, but did not require comprehensiveness.
- ***Basic approach*** is a lower-assistance participation approach that offers a limited menu of financial incentives. This track provides measure incentives to meet Benchmark performance criteria for improvements in lighting power density and mechanical equipment efficiency.

During the first two years of the program, the Energy Center used building size, project type, design stage, and project opportunities to guide the selection of participation approach offered on the project. The decision on offered approach was made by Energy Center program delivery staff that were given considerable flexibility to decide on a case-by-case basis.

The Basic approach was intended to be used on smaller projects, those where there was limited opportunity for integrated design and for those projects that were further along in the design process. The Advanced Buildings ("Advanced") approach was intended for use on projects when there was an opportunity to achieve greater energy savings through integrated design, but smaller project size or design schedule required a streamlined program delivery approach. The Comprehensive approach was intended to be utilized when larger project size, longer schedule, project complexity, and interest level justified a high level of program resources to achieve the full benefits of integrated building design. In a few instances, customers offered the Comprehensive or Advanced approaches were allowed to select the Basic approach if they preferred the simplicity, but projects offered the Basic approach could not "trade-up" to the higher assistance and incentive approaches.

By the end of 2006, building design phase was emerging as the most significant factor influencing the approach selection, even though the other factors – project type, size, budget, fixed decisions about the efficiency measures etc. were sometimes influential. Therefore, a relationship between the decision making abilities available during each design phases and the peak kW reduction using various program approaches was developed and is a focus in this paper. The integration of design stages with program approaches, in general, can be represented as shown in Figure 2.

Figure 2. Project Design Stages and Offered Program Approach Relationship



Using these three participation approaches, We Energies C&I New Construction Program completed recruitment, design assistance, and measure installation agreements on fifty-eight projects between January 1, 2005 and June 30, 2007, representing 6231 gross kW reduction from 6 million square feet across a range of building uses, size, ownership, and design process types. Thirteen additional projects comprising roughly 400 kW are likely to participate, but were excluded from this paper because technical assistance was ongoing and they have not committed to installing measures. The first project completed construction in November 2005. Of the 6231 kW, 3800 kW has been site verified as of February 29, 2008, while the remaining kW are engineering estimates. As of that date, the ratio of site verified savings to the engineering estimates for verified projects was greater than 90 percent.

The project summary data for the 58 committed projects including energy impacts and square footage area under each approach are shown in Tables 1, 2, and 3. The "other commercial" type comprised multiple-use local government buildings and community centers. There was high representation by industrial projects reflecting We Energies diverse and healthy industrial customer base. Industry types participating include printing, food processing, heavy equipment manufacturing, industrial equipment, consumer products, transportation, instruments, plastics, and chemicals.

Table 1. Committed Projects in We Energies C&I New Construction Program, 2005-2007

Approach	Committed Projects	Offices	Retail	Education	Healthcare	Other Comm.	Industrial
Basic	31	0	1	1	5	0	24
Advanced	7	2	3	1	0	1	0
Comprehensive	20	7	1	4	0	4	4
Total	**58**	**9**	**5**	**6**	**5**	**5**	**28**

Table 2. Project Areas in We Energies C&I New Construction Program, 2005-2007

Approach	Total Build Up Area, sq.ft.	% Area	Smallest sq.ft.	Largest sq.ft.	Average Area sq.ft.
Basic	2,487,300	42	4,000	502,000	80,235
Advanced	532,500	9	5,500	165,000	76,071
Comprehensive	2,956,000	49	12,000	550,000	147,800
Total	**5,975,800**	**100**	**4,000**	**550,000**	**103,031**

Table 3. Project Impacts in We Energies C&I New Construction Program, 2005-2007

Approach	kW	Annual kWh	kW per sq. ft.	kW per Project	Annual kWh per sq. ft.	Annual KWh per Project
Basic	1851.6	7,774,146	0.74	60	3.1	250,779
Advanced	768.9	2,799,933	1.44	110	5.3	399,990
Comprehensive	3610.4	6,976,007	1.22	181	2.4	348,800
Total	**6230.9**	**17,550,086**	**1.04**	**107**	**2.9**	**302,588**

Energy Savings Analysis and Discussion

This section analyzes the energy savings achieved by the different program approaches. The building design stage and its integration with program approaches for energy savings is of particular interest. The total peak demand reduction of 6230.9 kW was achieved under the program by all approaches, as shown in Table 4. The greatest quantity of peak demand reduction was achieved using the Comprehensive approach; followed by the Basic approach and then the Advanced Buildings approach, which had the fewest number of projects.

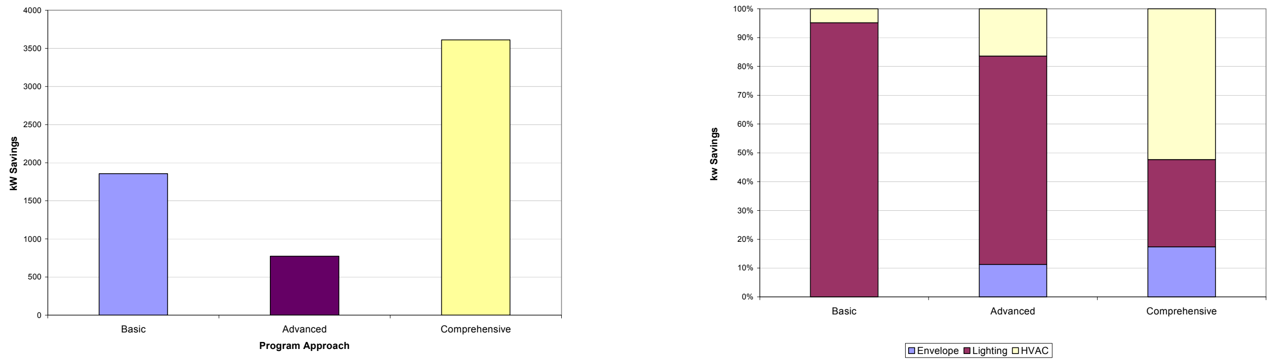
Table 4. Matrix of Energy Savings Measures Adopted for Each Program Approach and Savings Achieved

Program Approach	Energy Savings Measures Adopted			Energy Saved				Design Phase
	Envelope	Lighting	HVAC	kW	%	kWh	%	
Basic	None	Reduced LPD	Equipment Efficiency	1851.6	30	7,774,146	44	CD, DD, SD
Advanced	Cool Roof	Reduced LPD, Daylight Controls	Reduced Load, System Selection, Equipment Efficiency	768.9	12	2,799,933	16	PD, SD
Compre-hensive	Envelope Thermal Performance, Glazing Selection (SC)	Reduced LPD, Daylight Controls	Reduced Load, System Selection, Equipment Efficiency	3610.4	58	6,976,007	40	PD, SD, DD, CD
				6230.9	100	**17,550,086**	100	

The Basic approach yielded 1852 kW savings which accounts for 30% of the total reduction, as shown in Table 4. The annual kWh savings of 7.77 million by the Basic approach is highest amongst all approaches (44%), owing in part to the popularity of this track by industrial design-build projects with long operating hours for lighting power reduction. The kW and annual kWh savings under the Basic approach was possible mainly by reduction in lighting power density. Another energy saving strategy used under this approach was improving air conditioning efficiency. The kW reduction for cooling equipment efficiency was 5% and the lighting strategy was 95% of the total kW reduction under the Basic approach (Figure 3). A similar breakout is provided for annual kWh in Figure 4. Overall, the kW impacts for the Basic approach were 0.74 watts per square foot.

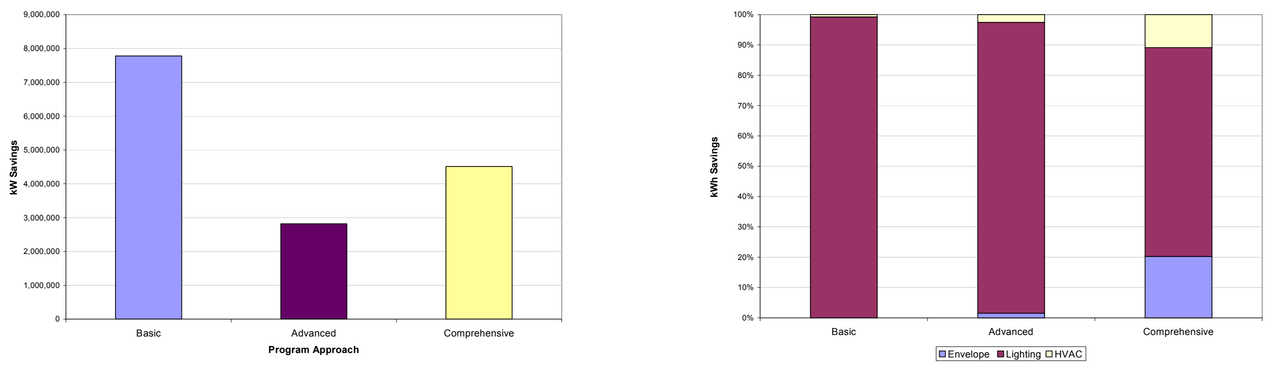
The Advanced Buildings approach reduced peak kW demand by 769 kW which is 12% of the total kW reduction (Table 4). The annual kWh savings by the Advanced Buildings approach is 2.80 million (16% of the total). The energy savings under the Advanced Buildings approach was possible mainly by lighting strategies: reduction in lighting power density and side daylighting. The improvements in building envelope properties (cool roof), ventilation heat recovery, and cooling equipment efficiency were other energy saving strategies used under this approach. Although a more comprehensive set of measures was considered by these participants, these other measures were dropped during design or construction. The peak kW reduction contribution of HVAC, lighting, and envelope strategies are 14%, 74%, and 12% of the total kW reduction by the Advanced Buildings approach, as shown by Figure 3. The kW impacts for the Advanced Buildings approach were 1.44 watts per square foot. This was boosted by three large retail projects comprising 465,000 square feet (87% of the Advanced Buildings participation) that achieved lighting power density reductions of approximately 0.9 watts per square foot. Excluding these large retail, the remaining Advanced Buildings projects achieved 0.84 watts per square foot reduction.

Figure 3. (a) kW Reduction by Basic, Advanced and Comprehensive Approach (b) kW Reduction by Envelope, Lighting and HVAC Energy Saving Strategies Adopted Under Program Approaches



kW- All Projects kW- Breakout

Figure 4. (a) kWh Reduction by Basic, Advanced and Comprehensive Approach (b) kWh Reduction by Energy Saving Strategies Adopted Under Each Approach



Annual kWh – All Projects Annual kWh - Breakout

The peak demand reduction of 3610.4 kW by the Comprehensive approach is the highest among all the approaches. It accounts for 58% of program-wide kW reductions. The kWh savings from the Comprehensive approach is 6.97 million and accounts for 40% of the total kWh savings (Figure 4). The energy savings under the Comprehensive approach were due to three strategies; HVAC, lighting, and envelope. The peak kW reduction contributions from HVAC, lighting, HVAC, and envelope strategies are 52%, 30%, and 18% of the total kW reduction from the Comprehensive approach (Figure 3). The HVAC strategies were more dominant than lighting strategies under this approach. The kW impacts for the Comprehensive approach were 1.22 watts per square foot.

The building envelope related energy saving strategies include improving/increasing wall insulation, roof insulation, green or cool roof, reflective roof surfaces, window U-value, window solar heat gain coefficient and providing shading devices. The lighting strategies mainly include reduction in lighting power density and side daylighting. North facing skylights were used in a few projects. The HVAC strategies include many measures: demand controlled ventilation

Figure 5. kW Reduction by Energy Savings Strategies Adopted Under Comprehensive Approach

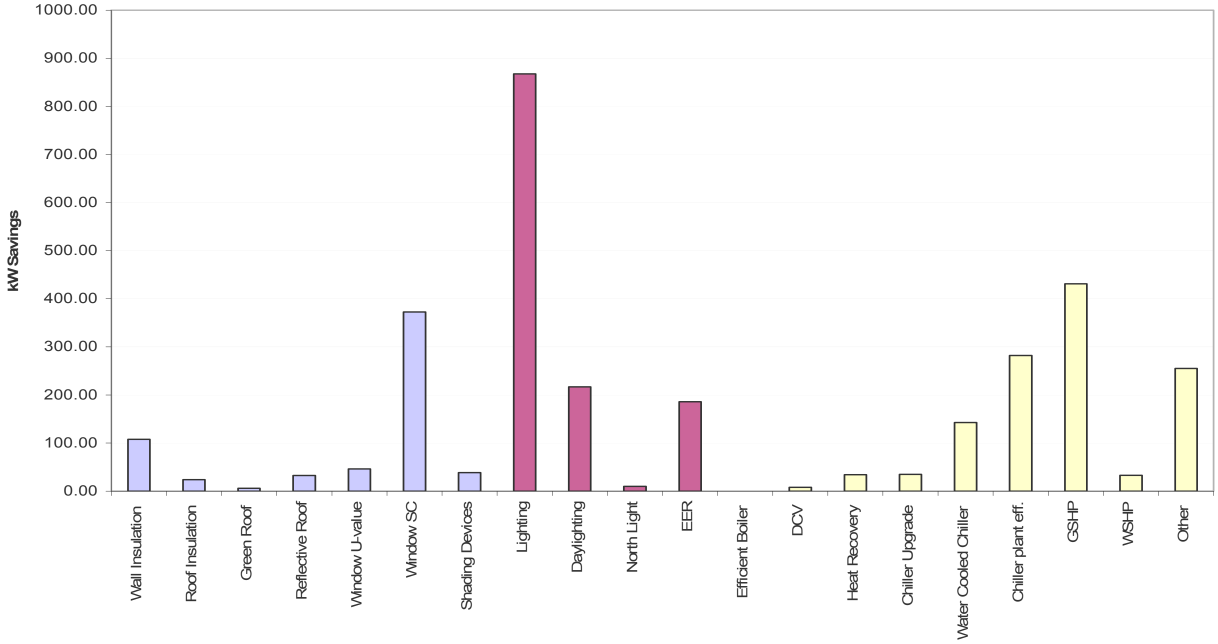
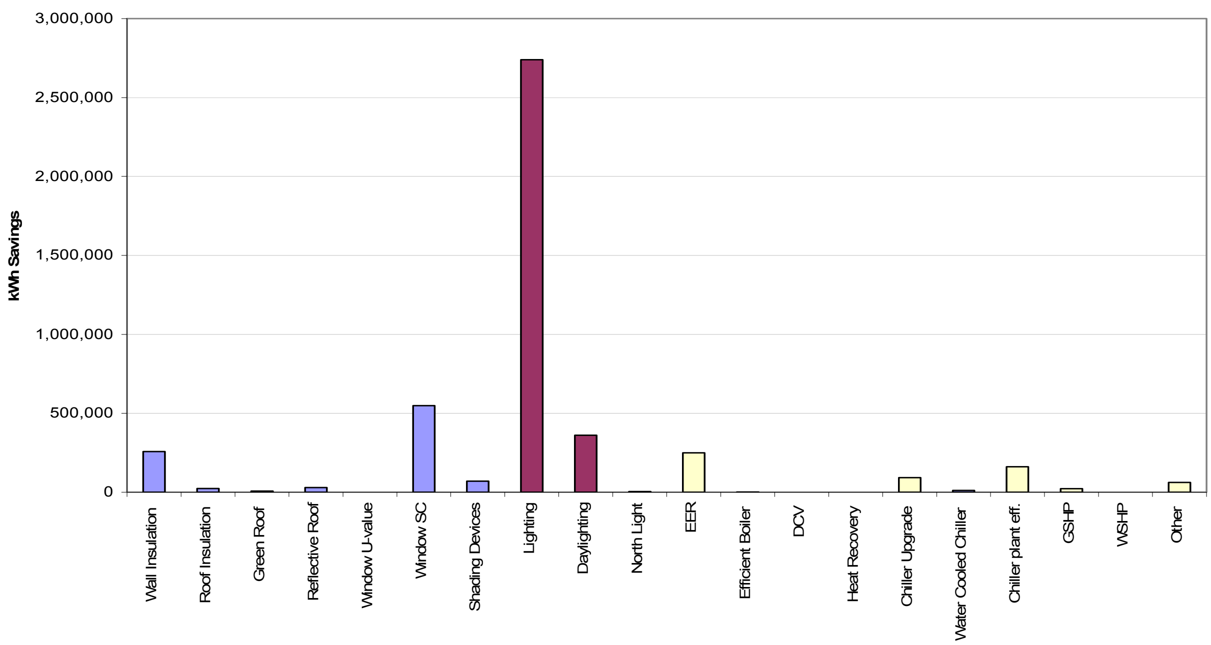


Figure 6. kWh Reduction by Energy Savings Strategies Adopted Under Comprehensive Approach *(energy penalty is not shown in the chart)*



ventilation heat recovery, chiller upgrades, water cooled chiller, improving chiller efficiency, geothermal systems and high efficiency HVAC equipment. These individual strategies are considered as potential measures, and the selection of final measures was done on a case by case basis using hourly energy modeling. Figures 5 and 6 show the savings for measures adopted under this approach (savings shown are additive).

Here it is important to note that the kW reductions are affected by the order in which the measures are applied. In the Comprehensive approach, the application of envelope strategies reduced building envelope heating and cooling loads and the lighting strategy further reduces internal loads. This allows for smaller HVAC systems and the program takes credit for the kW reductions associated with smaller systems. Thus, these early design opportunities influence HVAC system selection and the potential for kW reduction from HVAC strategies. Taking advantage of the early energy savings opportunities available during the early design stages combined with whole building energy analysis is a key to higher savings.

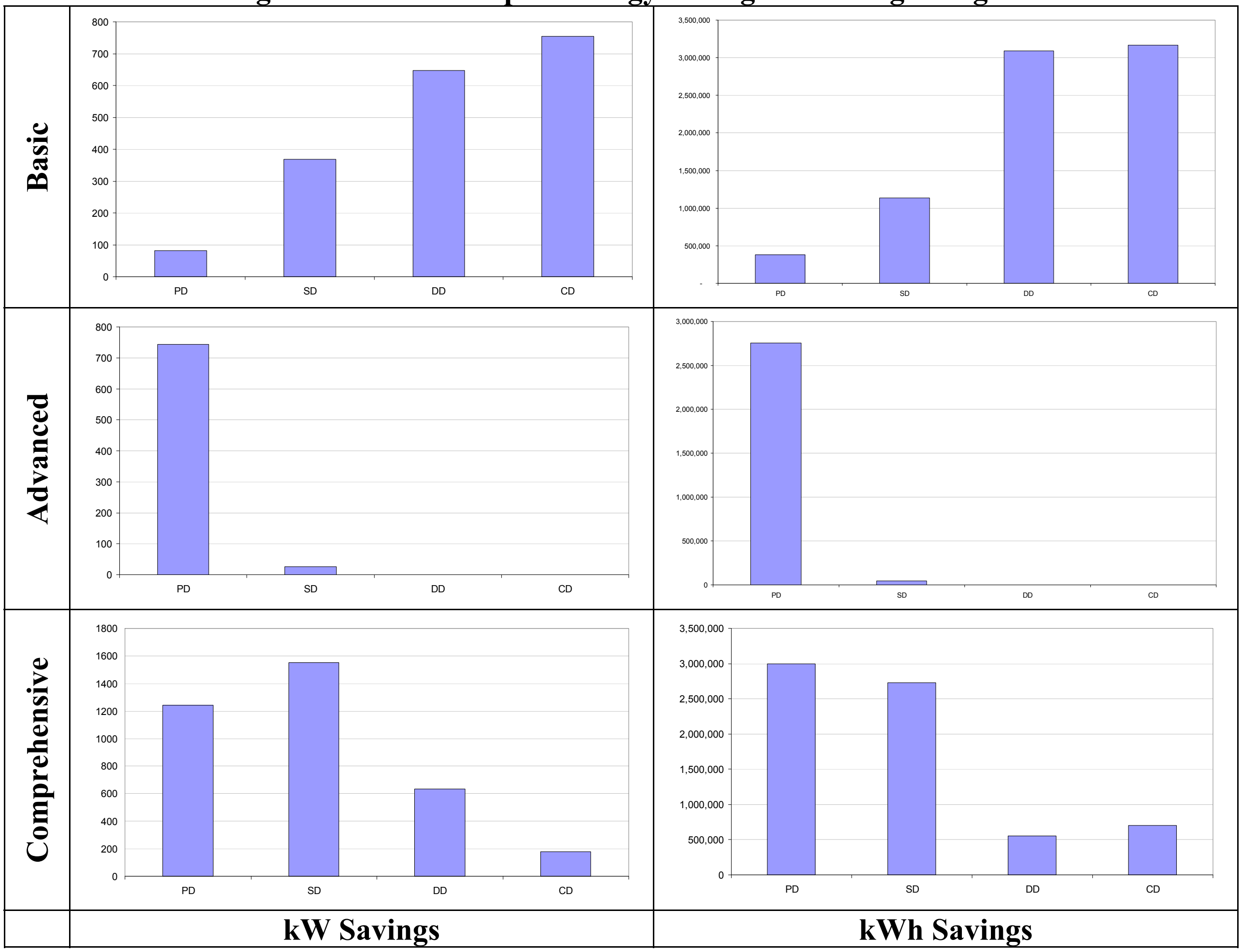
Implications for Program Design and Implementation

The Comprehensive and Advanced Buildings approaches adopted for those projects early in design showed higher peak demand reduction when compared with the Basic approach. On a per square foot basis, the kW savings are 70% higher than the savings from the Basic approach. The wide range of energy related design decisions available during early design stages and the ability to tap the potential using integrated building analysis is a key to higher peak demand reduction. Although some projects entered the program early in design with pre-existing intentions to be comprehensive, early program engagement caused most of the project teams to consider and ultimately adopt a more comprehensive set of measures, including a large speculative office project that achieved LEED Silver, the first LEED project by the developer.

The projects registered in the program during early and mid design stages adopted the Comprehensive or Advanced Buildings approaches and resulted in the greatest kW reduction for the program, as shown by Figure 7. The available decision making flexibility for the projects early in the design allowed for an integrated design process, where early energy analysis helped in selecting the most appropriate energy saving measures. This flexibility is high during the Pre-Design, Schematic-Design and Design-Development phases of a project. The main advantages of such flexibility are the estimation of annual energy savings by integrated design and achievable incentives from the program. It takes time to develop a holistic understanding of a building's energy use, and since profit and performance are at stake, design teams often settle for a 'systems' approach, where the operation of each separate system is well understood, but not in relation to the whole building.

The availability of measure savings information during early stages of the project helps decide the future course of energy savings actions and the financial feasibility. To ensure that actionable energy impact data was in the hands of the project team as early as possible in the design process, Energy Center staff developed a "rapid modeling protocol for early design decision-making." This approach applied hourly modeling techniques that rely upon a simplified building description, and dispensed with time-consuming measure-by-measure life cycle costing (measure-by-measure cost effectiveness screening is not required by the program).

Figure 7. Relationship of Energy Savings and Design Stages



Left to Right: PD-Pre Design, SD-Schematic Design, DD-Design Development, CD-Construction Document

The Energy Center gathered the critical energy impact results drawn from hourly models and summarized them in a single-page spreadsheet format to give to the clients during the early stages to expedite the energy related decision making process. An example is provided by Figure 8. The report was well received. In the Energy Center's experience, a single page report that clearly quantifies the complex interaction between the baseline and proposed building systems was found to be more useful to the design team than a 10-40 page report that provides in depth commentary on the same interactions. One consultant provided an example of a 40 page report that looked very professional, but failed to include a baseline for the measures proposed.

Very limited decision making opportunities are available for projects late in the design stage. These projects were dealt with under the Basic approach which primarily employed lighting strategies for peak kW reduction. Therefore lighting strategies emerged as a major kW reduction measure. Although Comprehensive and Advanced Buildings projects achieve greater savings than Basic approach projects, the impact attributed to the Basic approach were significant – thirty percent of the total program kW.

Figure 8. The Energy Center's "*Early Design Analysis Summary Report*™"

Project Name

New Construction Program

Summary of Results

$81,648	Annual Energy Savings [$]
$75,200	Measure Incentives [$]
331	Peak Demand Reduction [kW]
796,726	Annual Electricity Saved [kWh]
10,264	Annual Natural Gas Saved [therms]

Incentives and Annual Energy Savings

Measure	Incentive	Annual Savings
Wall Insulation	$5,381	$13,284
Roof Insulation	$1,887	$2,186
Reflective Roof	$6,005	$2,706
Windows	$9,159	$5,652
Shading	$7,818	$5,983
Lighting	$34,702	$38,213
Daylighting	$4,952	$3,600
Northlight	$828	-$2,272
Northlight (w/d)	-$68	-$920
WSHP	$7,448	$5,473
EER	$3,536	$1,295
Total	$81,648	$75,200

Energy Savings Measures

1) Wall Insulation: improve wall assembly U-value from 0.136 and 0.157 to 0.078
2) Roof Insulation: improve roof assembly U-value from 0.04 to 0.032
3) Reflective Roof: increase roof reflectivity from 0.18 to 0.8
4) Windows: Improve solar heat gain coefficient from 0.8 to 0.45.
5) Shading for windows
6) Efficient Lighting: decrease Office lighting power density from 1.4 to 0.9 w/sf, Manufacturing-assembly power density from 1.7 to 1.68 w/sf, Manufacturing-staging and shipping power density from 1.7 to 0.92 w/sf and Molding power density from 2.0 to 1.
7) Daylighting: sidelighting-continuous dim lights based on photosensors within 15 feet of perimeter windows
8) North facing skylights for office and manufacturing area, without dimming controls.
8a) North facing skylights for office and manufacturing area with dimming controls.
9) WSHP for office area,Using available hot water (from manufacturing area) for weekday heating needs, High efficiency condensing modulating boiler for weekend heating needs.
10) Improving EER values for RTUs of manufacturing area from 9.5 to 10.5.
11) Ventilation heat recovery

Summary of Model Results by Savings Measure *(Additive)*

Model + Savings Measures	Peak Electric Demand [kW]	Annual Electric Consumption [kWh]	Annual Natural Gas Consumption [therms]	Annual Energy Cost	Peak Cooling [tons]	Peak Heating [Mbtu/hr]	Peak kW Saved	Peak kW Reduction Incentive	Annual kWh Saved	kWh Reduction Incentive	Total Incentive	Annual Energy Savings
Baseline	792.2	2,648,769	29,977	$254,560	270.9	2,971	-	-	-	-	-	-
Baseline+1	772.7	2,575,318	22,682	$241,276	262.5	2,674	20	$3,912	73,451	$1,469	$5,381	$13,284
Baseline+1,2	764.5	2,562,050	21,611	$239,090	257.6	2,620	28	$5,534	86,719	$1,734	$7,268	$15,470
Baseline+1,2,3	737.2	2,535,723	22,024	$236,384	241.5	2,616	55	$11,012	113,046	$2,261	$13,273	$18,176
Baseline+1,2,3,4	698.3	2,466,573	23,888	$230,732	224.1	2,581	94	$18,788	182,196	$3,644	$22,432	$23,828
Baseline+1,2,3,4,5	664.6	2,412,058	23,808	$224,749	212.3	2,535	128	$25,516	236,711	$4,734	$30,250	$29,811
Baseline+1,2,3,4,5,6	542.4	1,899,041	28,793	$186,536	189.0	2,580	250	$49,958	749,728	$14,995	$64,953	$68,024
Baseline+1,2,3,4,5,6,7	522.4	1,852,043	29,204	$182,936	184.3	2,576	270	$53,970	796,726	$15,935	$69,905	$71,624
Baseline+1,2,3,4,5,6,7,8	516.4	1,870,553	31,061	$185,208	185.2	2,648	276	$55,168	778,216	$15,564	$70,732	$69,352
Baseline+1,2,3,4,5,6,7,8a	516.4	1,873,974	31,709	$186,128	186.2	2,668	276	$55,168	774,795	$15,496	$70,664	$68,432
Baseline+1,2,3,4,5,6,7,8,9	483.1	1,834,451	27,778	$180,655	187.1	2,787	309	$61,826	814,318	$16,286	$78,112	$73,905
Baseline+1,2,3,4,5,6,7,8,9,10	466.4	1,824,959	27,778	$179,360	187.1	2,787	326	$65,172	823,810	$16,476	$81,648	$75,200
The following results are not part of the incentives program. It is provided for informational purpose only.												
Baseline+1,2,3,4,5,6,7,8,9,10,11	460.9	1,958,150	19,713	$179,832	166.2	2,261	331	$66,260	690,619	$13,812	$80,072	$74,728

To ensure that Basic approach projects participated, the Energy Center developed a one person, one face-to-face meeting delivery approach tailored to meet the needs of the late stage construction process. Some commercial projects and most industrial projects are design-build, coordinated in the field with minimal drawings, and built on a fast track. The program assigns a single professional architect or engineer from the Energy Center to handle the initial contact between program and project team; and the same architect/engineer will meet with the designers and customer to discuss efficiency options, review resulting design drawings, and complete all the savings and incentive paperwork. This allows fast-track projects to participate with minimal communications, and a very low time commitment for customers and their design team to participate in the program. This low hassle delivery approach has implications for program evaluation, as customers and the design team can have difficulty remembering the role the program played in influencing design decisions – it was a single meeting in a comparatively long and complex design and construction process.

Conclusions

The Comprehensive and Advanced Buildings approaches adopted for those projects early in design stage showed higher peak demand reduction compared with the Basic approach. On a per square foot basis, the kW savings are higher by 70% over the savings from the Basic approach. The wide range of energy related design decisions available during early design stages and the ability to tap the potential using integrated building analysis is a key to higher peak demand reduction. However, it is not enough to find a project early in the design process, the program must provide actionable recommendations and energy impact data to the project team as early as possible in the design process. The Energy Center developed a "rapid modeling protocol for early design decision-making" to meet this need. Applied to three Comprehensive industrial projects, early modeling resulted in multiple measures adopted, rather than just the "lights and rooftops" typical of industrial Basic projects. The Advanced Buildings approach goes one step further by using pre-modeled comprehensive measure sets that may applied with confidence of savings on small-to-medium sized common commercial building types (NBI, 2005).

Comprehensive and Advanced Buildings projects achieve greater savings than Basic approach projects, but the impacts attributed to the Basic approach were significant – thirty percent of the total program kW. To ensure that Basic approach projects participated, the Energy Center developed a one person, one face-to-face meeting delivery approach tailored to meet the needs of the late stage construction process.

Although the Comprehensive and Advanced Buildings approaches yield greater impacts, it would be a mistake to force projects into those paths in the expectation of greater savings. For successful program approach implementation, it is critical that the program representative listen to the details of the project and recommend the appropriate path. Selecting the appropriate approach for them reduces the amount of hassle they must endure to participate. If the project comes in late and must follow a Basic approach, the program representative can follow up with the design team afterwards and estimate what a Comprehensive approach might have yielded if they had qualified, and what it would take to qualify. Four of the seven projects in the Advanced Buildings approach are examples of this phenomenon, and several Comprehensive projects registered in 2007 were brought in by design firms. A program manager should have flexibility with the project placement guidelines as every project is unique. In some cases, early stage projects were placed in the Basic approach when it was clear that lighting power density and cooling efficiency were the only measures that would be adopted.

Our next iteration of program design will be even more closely tailored to the needs and opportunities of the design stage.

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