Moving Architects and Engineers Beyond Typical Practice

Mark Eggers, Craig Kneeland, Chris Reohr, New York State Energy Research and Development Authority, Albany, NY

ABSTRACT

Architects and Engineers (A/E's) are in a position to influence the energy efficiency of building projects they design. A/E's, however, need reliable information and quantified cost/benefit data to convince building owners to make any incremental investment in better buildings. The New York State Energy Research and Development Authority (NYSERDA) launched a New Construction Program in the fall of 1999, seeking to influence and educate the A/E community through the early identification of project opportunities, and through delivery of technical assistance services providing quantified comparisons between standard practice and more energy efficient practices.

To reach market transformation goals set for the New Construction Program, NYSERDA set up a statewide network of Outreach Project Managers. With a strong local presence, they present the program to designers and building owners, identify candidate projects and to guide the design team through the process. Under NYSERDA direction, technical assistance providers who have been pre-selected based upon their expertise work in parallel with the design team and engineering consultants. This third-party value-added technical assistance is offered on a cost-shared basis and often includes DOE2.1 energy modeling. This technical assistance provides for timely delivery of services, keeps projects on schedule, identifies green building opportunities and allows the A/E team to stay focused on the building design. The outcome is a growing network of A/E firms with the knowledge and tools to design more energy-efficient and "green" buildings.

This paper will present the design of this service delivery approach, the mechanics of scoping out project needs and obtaining approvals from customers, and the advantages of this strategy in reaching market transformation goals in the A/E community.

Introduction

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation established pursuant to Title 9 of Article 8 of the Public Authorities Law of the State of New York. NYSERDA is governed by a 13-member Board of Directors, composed of State officials and other individuals who represent a broad range of interests in energy affairs.

In Opinion No. 98-3, the New York State Public Service Commission (PSC) established a system for funding public benefit programs of energy efficiency, research and development, low-income services and environmental protection. NYSERDA's proposed plan for System Benefits Charge programs, submitted to the PSC on May 8, 1998 and approved July 2, 1998, includes a New Construction Program as one of its key elements. The goal of the New

Construction Program is to affect long-term market transformation in the way that buildings are designed and built in New York. Key objectives to meet this goal include providing capital cost incentives to building owners and design assistance to A/E teams.

Program Description

Potential Energy Savings

New Yorkers spend nearly $30 billion annually on energy. Nearly $19 billion of this is spent in commercial, institutional and residential buildings. The construction marketplace in New York state is substantial - NYSERDA estimates that over $3 billion in new commercial construction activity, $3 billion in new residential construction involving 25,000 homes, and $4 billion in energy-related substantial renovation and upgrading occurs annually in New York State. A NYSERDA-funded study conducted by Steven Winter Associates entitled "Analysis of Alternate Commercial Energy Code Standards for New York State, March 1999" identified a number of key areas where advanced technologies were not being deployed in the commercial building marketplace. These technologies included more efficient lighting designs, controls, day lighting, use of low-e glazing, variable frequency drives in smaller motor applications, high efficiency chillers, and gas-cooling.

NYSERDA's assessment of current design practice found that current practice exceeds the minimum requirements of the New York State Energy Conservation Construction Code by 4-6% on an overall basis. This assessment was predicated upon the fact the Energy Code has not been updated for nearly 10 years, and that advances in lighting technology within that time period allow designers to achieve quality lighting designs at power levels (watts/sf) well below those allowed by the Energy Code. This assessment also concluded that achieving a building design that performed 15-20% above the Energy Code was very feasible using existing technology and at a minimal incremental cost. This level was set as the basic target level for the New Construction Program, which represents a *net* improvement over standard practice of approximately 15%.

This study further concluded that advances in lighting technologic and in awareness among larger A/E firms resulted in T-8 fluorescent lamps with electronic ballasts being standard practice in buildings over 10,000 square feet. Occupancy sensors, LED exit signs and compact fluorescents were also regarded as standard practice in buildings over 50,000 square feet.

In regard to initial first cost premiums for more energy efficient buildings, NYSERDA reviewed data on over 26 green buildings project studies conducted from 1997-2000. Table 1 provides a summary of this data, which indicates that for cost premiums of less than 1%, energy savings of 30% or more beyond code minimums were attained. The energy savings from just these projects alone is equal to the annual energy consumption of a 70-story office tower.

Identification of Barriers to Implementation

The rationale for developing and offering a New Construction Program as a component of market transformation activities was based upon the fact that the implementation of energy efficiency in buildings remains limited in New York, as it does throughout much of the country.

Table 1 Summary of NYSERDA Green Buildings Projects 1997-2000

						perct.	Incremental cost	
				Annual	Simple	above	percent	Additional
Building description	Size (SF)	Construction	Cost/	$ Savings	Pay Back	Energy	1st	1st
		Cost	SF	cf. Code	(years)	Code	Cost	Cost
Upstate public school (EPA $)	380,000	$30,000,000	$79	$16,626	3.4			
NYC public school (EPA $)	100,000	$4,000,000	$40	$22,426				
NYC transportation terminal	180,000	$76,500,000	$425	$108,906	5.4	40	0.93%	$712,198
State office building	450,000	$67,500,000	$150	$310,399	3.2	43	0.40%	$267,147
NYC healthcare/garage	117,500	$23,617,500	$201	$107,844	6.4		0.64%	$151,675
Upstate office building	291,000	$27,511,000	$95	$221,711	4.9		1.14%	$313,540
NYC apartment building	467,000	$116,750,000	$250	$326,710				
NYC public school	82,400	$12,360,000	$200	$38,452	3.6	34	1.88%	$231,852
NYC healthcare	41,000	$6,150,000	$175	$16,531	1.3	28	0.78%	$48,000
Park headquarters	9,050	$1,000,000	$110	$5,334		38		
NYC not for profit	15,509	$1,900,000	$123	$30,139	3.2	29	0.75%	$14,256
NYC social services	116,740	$40,000,000	$343	$99,527	6.5	33	0.81%	$323,185
NYC hospital	222,000	$60,000,000	$270	$166,667	3.0	27	0.26%	$156,157
Apartment complex	95,000	$12,900,000	$136	$45,829	9.5	23	2.19%	$282,838
NYC apartment building	340,000	$82,000,000	$241	$46,827	5.3	20	0.26%	$210,414
NYC office building	1,600,000	$400,000,000	$250	$1,760,000		40		
Upstate senior ctr.	47,000	$3,927,392	$84	$10,866	4.0	25	0.84%	$33,083
Downstate senior center	12,000	$2,400,000	$200	$18,985		44		
Conference center	11,000	$500,000	$45	$6,699		22		
Upstate cultural facility	20,000	$2,000,000	$100	NOT	FINISHED			
NYC court facility	750,000	$180,000,000	$240	NOT	FINISHED			
NYC cultural facility	22,000	$5,700,000	$259	NOT	FINISHED			
NYC library(EPA $)	10,000	$2,700,000	$270	NOT	FINISHED			
NYC cultural facility	200,000	$32,000,000	$160	NOT	FINISHED			
NYC correctional facility	167,000	$50,000,000	$299	NOT	FINISHED			
Upstate transportation terminal	86,330	$12,000,000	$139	NOT	FINISHED			
NYC office building	2,100,000	$500,000,000	$238	NOT	FINISHED			
Completed Total/Avg.	**4,597,199**	**$971,015,892**	**$176**	**$3,360,478**	**4.6**	**31.9**	**0.91%**	**$2,744,345**
Overall Total/Avg.	**7,932,529**	**$1,753,415,892**	**$190**	**$2,704,213**	**4.6**	**31.9**	**0.91%**	**$2,744,345**

As a result of developing and providing various energy efficiency deployment programs over the past decade, NYSERDA has a strong sense of the barriers to more widespread adoption of existing technology. First costs, lack of specific energy-saving information and unfamiliarity with newer technologies are the prime barriers. In addition, New England Electric Services (NEES) was retained by NYSERDA to assist in the design of the program and NEES confirmed these barriers based upon their experience in providing a new construction program to their customers in the Northeast over the past ten years.

To corroborate our interpretation of the marketplace barriers, NYSERDA conducted a survey among A/E teams in early 2000 and asked questions regarding the barriers to implementing energy efficiency improvements in building designs. A variety of reasons were listed as to why permanent improvements in the building envelope and performance of major

systems (*i.e.*, HVAC, lighting and controls) are not seized at the time of construction. These barriers are listed, in order of importance, in Table 2:

Table 2 Barriers to more energy efficient new construction practices

Percentage of respondents citing significant barrier	Barrier
70%	Additional first costs of more efficient equipment
65%	Lack of information on new technologies
61%	Resistance by the building owner
60%	Lack of information on energy savings
50%	Conflict with other design criteria
44%	Operation and maintenance uncertainties
35%	Reliability of performance concerns
22%	Lack of information on operating costs

Key Program Design Features

The New Construction Program was developed to overcome a number of these barriers. There was a concern that mitigating increased first costs with incentives would only result in a temporary transformation if several of the other barriers, such as lack of information on energy savings or performance issues, were also not addressed. Therefore, a key component focused on influencing the A/E team was integrated into the program design. NYSERDA sought a means to provide information and assistance to a large number of design teams across the state.

NYSERDA decided to select and retain a small core of expert energy consultants to provide technical assistance (TA), and a localized network of local outreach professionals was established to assist in the delivery of services. The ability to influence building designs is also very time-dependent, and so the ability to respond to opportunities quickly and decisively was another prime consideration in the program design.

The program provides technical assistance to many building partners, including: building owners, designers, contractors, design/build firms, construction companies, major equipment vendors and distributors. TA services are provided to A/E teams to assess the potential range of improvements available for a specific project. Financial incentives are provided to building owners to offset a portion of the additional incremental cost of approved measures. Assurance of optimal operation procedures is provided through commissioning. A total of $10.6 million is available for New Construction Program incentives over a three-year period.

Several participation approaches were developed. A small listing of pre-qualified incentives for lighting, motor and unitary HVAC replacements was developed. A Custom

Measure approach allows for a wide range of individually tailored measures. Finally, a Whole Building approach based upon computerized simulation of year-round energy performance of base case and improved designs is available for larger and more complex projects.

NYSERDA developed the program during 1999 and announced the availability of $10.6 million in incentives through a Program Opportunity Notice (PON) on September 6, 1999. An additional $4 million in program funds were earmarked to secure three Outreach Managers and five Technical Assistance Service providers who were competitively selected and began providing services in January, 2000. The annual New Construction Program budget represents about 6% of the annual Systems Benefits Charge effort.

Technical Assistance

Previous new construction programs have worked to provide incentives to the end-use customer (ie. the building owner) to reduce electric energy consumption. The NYSERDA New Construction Program focuses on the A/E team as a means to affect long term market transformation. The NYSERDA A/E survey indicated that these teams have a "significant" role in influencing the building owner's incorporation of energy efficiency. A/E teams also design many projects during the year for many different clients, (estimated by NYSERDA at 20 projects/yr.), so their reach and influence within the construction marketplace is significant.

To reach A/E teams, the NYSERDA New Construction Program is designed to provide value-added energy expertise to the customer's design team. Five expert energy consulting firms were competitively selected by NYSERDA to be available to provide technical assistance to A/E teams. This technical assistance (TA) provides for a review of proposed building HVAC systems and specifications and an examination and recommendation of the feasibility of more energy - efficient options. NYSERDA offers to pay for the first $10,000 of technical assistance provided to A/E teams, and to cost share, at 50/50, any assistance needs in excess of that amount. TA assistance thus far has ranged from $250 for a review of several pre-qualified measures to $87,000 studies (of which the customer pays $38,500) to conduct DOE2.1 energy modeling of large, complex buildings.

NYSERDA arranges for a scoping visit with the customer and their A/E team. This meeting is provided at no cost to the customer or to NYSERDA. Meetings generally last 2 hours, during which time the current plans, specifications, system and equipment information contemplated by the A/E team is discussed with the TA providers, and a listing of potential upgrades is developed. A scope of work is then prepared by the TA providers, reviewed by NYSERDA and presented to the building owner for approval and acceptance. The customer completes a one-page agreement which allows NYSERDA to authorize TA services.

Outreach

NYSERDA recognized that a local presence would be necessary to successfully market the New Construction Program to A/E firms and to follow up on current projects. Based upon a similar model utilized by the NEES New Construction Program, three qualified individuals were competitively selected to act as local Outreach Project Managers (OPMs) across New York State. Each of these individuals is a registered P.E. with extensive building energy experience, and therefore has credibility within the A/E community. OPMs market the program within their

designated regional area to AIA and ASHRAE members, utilities, local planning and development boards, BOMA chapters and various professional associations. In addition, the OPMs act as local project managers and coordinate the provision of TA services on each project.

The capabilities of providing direct, localized assistance to prospective applicants and for ongoing projects has proven to be a key program component. This has helped in the early identification of potential projects, and allowed NYSERDA to operate the program with only two professional staff.

NYSERDA and the OPMs generally intake program applications directly from customers. If the project comes into NYSERDA first, generally as the result of program mailing or presentation, it is initially screened for eligibility and status. Then is referred to the local OPM for management. The OPM will coordinate with NYSERDA and the TA provider, and arrange a time for the initial scoping meeting. The OPM acts as a facilitator among the TA provider, A/E team, owner and NYSERDA. Table 3 provides a flow chart of these activities.

OPM's generally have a caseload of 10 -20 projects. In addition, they are expected to conduct presentations to A/E teams and product vendors/subcontractors within their region on a scheduled basis. OPMs are provided a weekly project status report by NYSERDA describing activities on all active projects. OPMs provide NYSERDA with a weekly progress report listing covering currently assigned projects, upcoming presentations, planned contact activities and a discussion of any issues that arise. NYSERDA staff and the OPM's are usually in telephone or e-mail contact several times each week.

Incentive Levels

Defining standard practice as the baseline from which to provide capital cost incentives is a critical component. As previously discussed, NYS standard practice was determined to exceed energy code minimums *on an overall basis* by roughly 4-6%. While explaining to potential customers that building design would need to exceed "standard practice" in order to qualify for incentives, defining standard practice in each instance became difficult. Therefore, NYSERDA developed a document outlining "standard practice" for a variety of HVAC, building envelope and equipment measures[1] . This document established consistent baseline practices from which all potential improvements could be compared and incentive offers developed.

The program provides capital cost incentives to cover a portion of the incremental costs of more efficient measures, up to a maximum of 70% available through Custom Measure and Whole Building Design approaches. The customer is expected to contribute a portion of the incremental cost as well, and no measures will be bought down to less than a one-year simple payback. Maximum incentives are $250,000 per building projects, with a cap of no more than three projects per building owner.

Pre-set incentives were developed for more common applications, to include a range of lighting technologies, motors and smaller unitary HVAC equipment. Generally, these incentives cover 50% of the incremental cost. This list of measures may be expanded to include transformers and smaller variable speed drive applications.

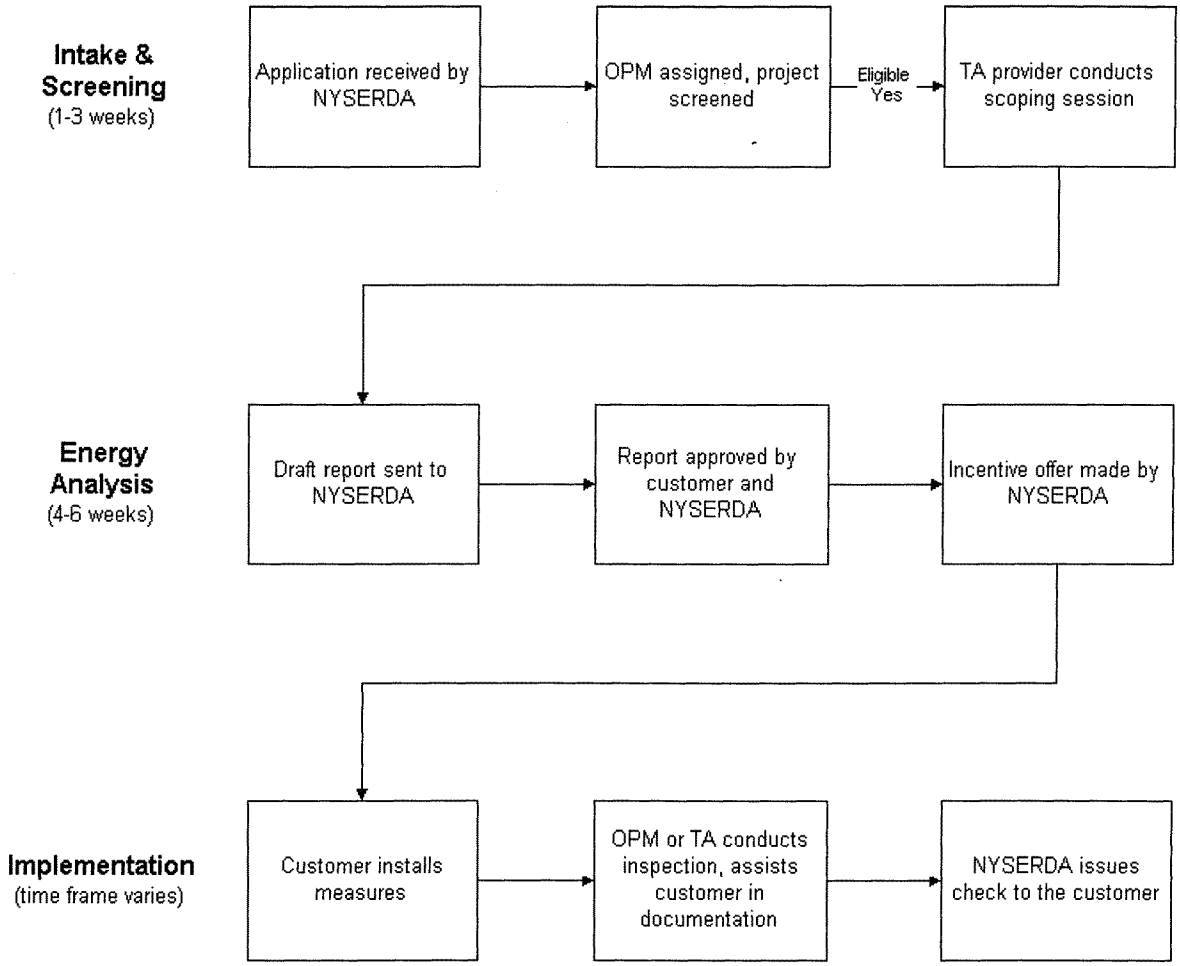
Additional incentives of 10% are offered under the Whole Building Design approach for

---

[1]NCP Form SP-01, Standard Practice and Energy Efficiency Upgrades.

projects that meet the minimum certification requirements set forth by the U.S. Green Buildings Council or by the EPA's ENERGY STAR® Buildings Program.

Table 3 New Construction Flow Chart



Results/ Benefits

Currently, there are over 127 project applications. This represents over 5.6 million square feet of new or renovated floor space and projected capital cost incentives total $4.8 million. The mix of project applications has been weighted towards Custom Measure and Whole Building applications, with 75 Custom Measure and 27 Whole Building design applications. Thus far, the majority of the energy efficiency upgrades have focused on motor and drive systems, controls, variable air volume systems and attendant control strategies, geothermal heat pumps, and alternate DHW systems.

University at Albany, Building 28

One of the more significant successful projects involved the substantial renovation of an existing administration building at the University at Albany campus. This building is served by a central plant and used older constant volume, dual-duct HVAC distribution system. Most of the buildings on the central campus podium, nearly 2 million square feet, are similar in construction and served by the central plant and distribution system. Any changes implemented in Building 28 will likely set the standard for successive projects which are planned across the podium.

The TA study prepared by Steven Winter Associates recommended a variable air volume reheat system with supply air temperature rest and night shut off controls, resulting in annual energy savings of $70,011 for a 57% reduction over a standard practice renovation. In addition to a $250,000 incentive to offset incremental costs to install these measures, University at Albany has agreed to commission these improvements and introduced detailed commissioning specifications in the project. As it is very likely that future renovations will include a VAV system and building commissioning, the transformation potential of this single project across the remaining 2 million square feet of campus floor space is tremendous.

CDTA Rail Station

The Capital District Rail Station in Rensselaer will be the local terminal for Amtrak trains heading west to Chicago, north to Montreal, east to Boston, and south to New York City. The 80,000 square foot building designed by Stracher Roth Gilmore, the local architect for the Albany International Airport, is expected to be operational in the first quarter of 2001. The Capital District Transportation Authority (CDTA) was especially interested in the New Construction Program because of CDTA's concern about the long-term costs of operating and maintaining the terminal.

The electrical energy efficiency measures analyzed include high intensity discharge lamps, daylight dimming controls, direct digital controls for the heating, ventilating, and air conditioning system, premium efficiency motors, variable speed drives on pumps and fans, and reflective glazing. The estimated incentive for these measures is $115,569, which represents 70% of the incremental cost of their implementation. As compared to a building designed according to standard practice, this facility will use 20% (359,247 kWh) less electricity per year, which represents an annual electricity cost savings of 18% ($23,678). Without the New Construction Program incentive, the simple pay back for the recommended measures is 8 years; the incentive reduces the simple pay back to 2.4 years.

Program Metrics

To track the market transformation impacts of the program, NYSERDA has developed a comprehensive plan to track the following metrics, among others:

- Number of projects for which incentives are provided; incentives provided,
- Construction costs of measures and projects; square footage of projects,

- Projected energy savings in KW and KWH (from base case to actual construction),
- Contacts with Architectural and Engineering (A/E) firms,
- Standard design practices among A/E firms, both program participants and non-participants,
- Base case projected energy usage for comprehensive projects.

Oak Ridge National Laboratories (ORNL) will also be preparing case studies on several successful New Construction Program projects. These stories best present the program's impacts on decision-making and market transformation of the owner and design team.

Lessons Learned

New Construction programs are transaction oriented

There are many transaction points, with a variety of players, in the building design and construction process. NYSERDA also has multiple transaction points in the New Construction Program, particularly in the Custom and Whole Building approaches. While some of these steps are unique to NYSERDA, those outlined in bold below are the anticipated minimum actions that would be required in a similar program:

Completion of these steps in a timely manner requires strong management and communication. Under the NYSERDA New Construction Program, once a project has been assigned to an OPM, they have the responsibility to manage each project through these steps:

Before Construction

1. Initial contact
2.Customers submission of an application form,
3. Project screening
4. Scoping visit with the customer and the project A/E team
5. Preparation of a technical assistance study
6. Exchange of information among the A/E team
7. Review of the Technical Assistance study recommendations
8. Presentation of a formal incentive offer to the customer.

After Construction

1. Review of receipts and documentation of measures
2. **Measure Inspections**
3. Commissioning on large projects
4. Sign -off and approvals
5. Presentation of an incentive payment

(Bold text signifies a required action)

Customer commitment is critical

In the early phases of the program, much of the communication was between the OPM's, TA providers and the customers A/E team, with a lesser focus on the customer. It became apparent that the customer in some cases was not consulted on go/no go decisions on potential measures, and because of this lack of involvement, not in a position to encourage or direct their design team to aggressively pursue all incentive opportunities. Developing and maintaining an active working relationship with the building owner (or their representative) creates a strong advocacy for participation in the program.

NYSERDA elected to develop measure incentive levels that require a financial commitment from the building owner. Experience in offering cost-shared engineering assistance through over 200 "FlexTech" studies over the past years demonstrates that customers are much more likely to commit to implementation if they made a financial commitment to either the technical assistance or implementation costs. Therefore, measure incentives were limited to 70% of the calculated incremental costs, up to a maximum buy down to a one-year simple payback. Customers are expected to contribute the remaining 30% of the incremental cost. This simple limitation helped reduce free riders.

Provide Flexible Program Guidelines

Program guidelines prepared by NYSERDA and with the assistance of NEES were made as specific as possible while retaining a measure of simplicity. Forms were kept brief, and terms and conditions condensed. Most of the project applications, however, have not been for new buildings - many are for renovations or additions to existing space, with various levels of complication due to building ownership and leasing/tenant issues. As program eligibility interpretations are constantly required, to be successful the guidelines need to be consistent and yet remain flexible.

Develop an early intervention network

Identification of potential projects at the planning stages provides the maximum opportunity for energy efficiency opportunities. To reach these types of projects, an early detection network needs to be developed. This network could include realtors, developers, local economic development organizations, school boards, utility staff and large organizations such as the State University Construction Fund, state and local agencies and large A/E firms.

Define standard practice

It is important to describe as specifically as possible what is meant by "standard practice". In areas with up-to-date codes, standard practice may be the code. In New York's case, standard practice was found to exceed code. The Standard Practice Document developed for the New Construction Program also served to the level the playing field, by allowing building owners with good base design standards to still participate in incentive awards.

Summary

The New Construction Program is still in the early stages of implementation. It has been available for customers for less than a year, and many projects have not been fully constructed as of this date. It will be several years before all incentive awards are processed. It is too early to fully gauge program impacts and the measure market transformation. Early indications, however, point towards success. Over 80 A/E firms have been involved in the program and provided some level of technical assistance and education, over 20 DOE2.1 energy simulations have been performed, and a growing support network has been established.

The TA and OPM network has been invaluable to NYSERDA in delivering the program to customers. Most A/E firms have been very receptive to the inclusion of additional energy expertise, as it allows the A/E team to stay focused on completing the building design and provides new information and independent assurance on measures. The OPM model has also provided NYSERDA with good local representation and the ability to respond quickly to project opportunities. As the OPMs market in their designated region, they have also been able to cross-market other NYSERDA programs and services to businesses across the state.

Case studies of successful projects such as the University at Albany project and the Amtrak train station will be developed to highlight the benefits of better energy design standards and how customers and design teams have adopted these standards for their subsequent building designs. Project participants will be contacted with the next year to determine if any of their design practices have been revised to consider energy efficiency, and if they are now employing these features as part of their "standard practice."

Acknowledgments

The NYSERDA New Construction Program was developed with contracted assistance from the New England Electric System (NEES), and staff members David Jacobsen, Mike McAteer and Mark Siegal, and consultants Doug Baston of North by Northwest and Ron Slosberg of Science Applications, Inc.

References

Millington, Errol. 2000. Personal communication. Albany, N.Y. University at Albany Finance and Administration Office.

Nadel, Steve and Tress, Harvey. 1990. *The Achievable Conservation Potential in New York State From Utility Demand-Side Management Programs*. Albany, N.Y. New York State Energy Research and Development Authority.

New York State Energy Office. 1991. *New York State Energy Conservation Construction Code*. Albany, N.Y. New York State Energy Office.

New York State Energy Research and Development Authority. 1998. *Proposed Plan for Public Benefit Programs Funded by Systems Benefits Charge*. Albany, N.Y. New York State Energy Research and Development Authority.

Science Applications Incorporated. 1999. *Analysis of Alternate Residential Energy Code Standards for New York State*. Albany, N.Y. New York State Energy Research and Development Authority

Steven Winter Associates. 1999. *Technical Assistance in Analysis of Alternate Commercial Energy Code Standards for New York State*. Albany, N.Y. New York State Energy Research and Development Authority.