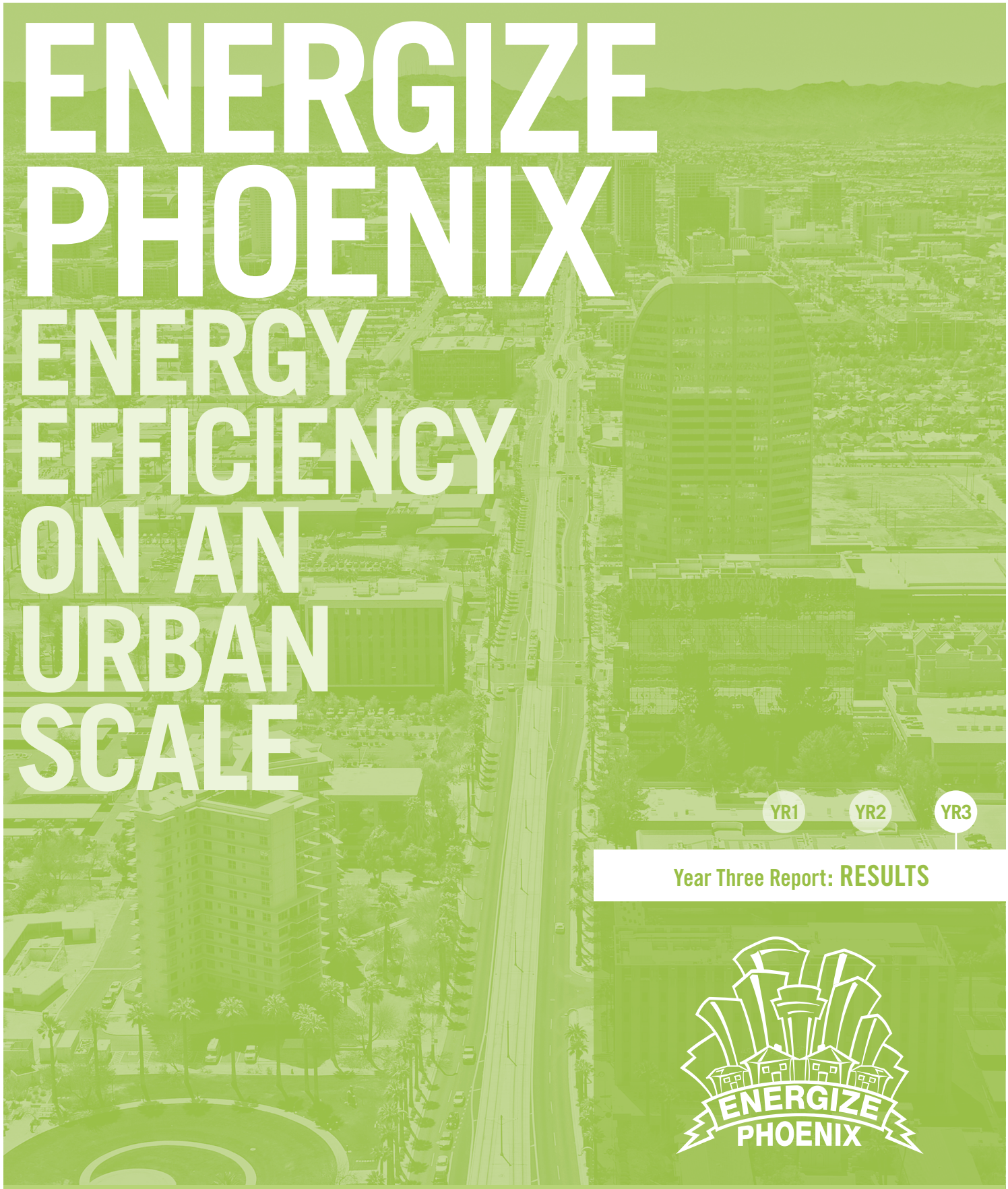
ENERGIZE PHOENIX

ENERGY EFFICIENCY ON AN URBAN SCALE



Year Three Report: **RESULTS**

ENERGIZE PHOENIX

Program funding:

BETTER BUILDINGS
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Lead agency:

City of Phoenix

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Report produced by:

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Executive Summary

Across the United States, cities are looking to energy efficiency as a means to reduce greenhouse gas emissions, increase energy security, create local jobs, and improve environmental, economic, and socio-political conditions for their communities. Stimulating energy savings through financial incentives and public policies can be relatively inexpensive compared to generating entirely new supplies of energy.

How can cities rapidly increase energy efficiency in their existing stock of buildings? This summative report provides fact-based scientific results, lessons learned, and recommendations garnered from an urban-scale project funded by the U.S. Department of Energy (USDOE). The report is intended to help communities improve energy efficiency savings from existing buildings at an urban scale.

ENERGIZE PHOENIX

Energize Phoenix was a three-year program designed to upgrade existing buildings for energy efficiency – part of a federal effort to stimulate jobs while simultaneously reducing the country's carbon footprint and promoting a shift to a green economy.

Managed by the City of Phoenix in partnership with Arizona State University (ASU) and Arizona Public Service (APS), the state's largest electricity provider, Energize Phoenix was funded by a 2010 award to the City of Phoenix from the U.S. Department of Energy's Better Buildings Neighborhood Program and the American Recovery and Reinvestment Act of 2009.

The Energize Phoenix award proposal included several targeted outcomes.

- Upgrading 1,700 residential units for 30% energy savings
- Upgrading 30 million square feet of office and industrial space for 18% energy savings
- Cutting carbon emissions by as much as 50,000 metric tons per year
- Creating 1,000 direct and indirect jobs
- Leveraging federal resources 5:1 with other investment
- Creating a sustainable revolving loan fund to perpetuate the program beyond the initial grant period

Some objectives were surpassed, while others came up short. Beyond the accomplishments associated with these targeted outcomes, major value was derived from lessons learned during the project's planning and implementation, and ultimately, the results achieved.

Metrics on Program Objectives	Result
Residential units upgraded*	2,014
Estimated average residential electricity savings – econometric analysis method	12%
Commercial square footage upgraded*	33,350,506
Average commercial electricity savings – individual building evaluation method	10%
Average commercial electricity savings – econometric analysis method	17%
Projected average annual CO_2e reduction (metric tons)	95,256
Projected job-years of employment created	414
Projected investment leverage ratio – including administrative, marketing, and research costs	1.32:1
Projected investment leverage ratio – excluding administrative, marketing, and research costs	1.85:1
Creation of a sustainable revolving loan fund	Discontinued due to low participation
Additional Key Metrics	**Result**
Projected annual energy savings (kWh)	135,009,120
Projected annual dollar savings	$12,632,863
Projected payback period for total investment by all parties (years)	4.5

** Updated figures as of end of program. Other metrics results were calculated using project data available at cut-off dates in spring or summer, 2013 and, where indicated, projected through the end of the program using project pipeline data available at the time of analysis.*

THE PARTNERSHIP NECESSITY

Creating energy efficiency on an urban scale requires multiple partners – key policy, financing, utility, implementation, and evaluation partners, as well as supporting community partners. Partnerships are a way of combining resources and skills to build a diverse base of expertise. This ultimately offers a better program than one partner might offer alone. With Energize Phoenix, each partnering organization naturally had its own expertise, mission, and mandates. The partnership best succeeded when partners communicated thoroughly, appreciated and accounted for each other's differences, and worked toward common goals.

Policy and financing partners are critical to encouraging urban-scale energy efficiency through policy support and financing incentives. Utility partners are key because of their customer relationships, energy usage data and, frequently, their experience implementing efficiency programs. Community partners play an important role in marketing. In addition to including all of these partners, Energize Phoenix incorporated an evaluation partner, Arizona State University.

ASU, the institutional author of this summative report, was designated in the award proposal as an objective third party to research and assess the results of USDOE's $25 million investment in the program and also to be a knowledge provider, adding value to program results so that future endeavors by communities and the federal government can benefit from the accomplishments and findings of Energize Phoenix.

Thus, by design, Energize Phoenix included a strong research component. The program used extensive analysis to strengthen confidence in findings and results, while also providing deeper insight into the forces driving those results. Throughout the award period, research findings were fed back to partners to inform and enable program modifications. Ultimately, much was learned – through analysis, experience, research, and relationships – that can inform efforts in other communities that are looking to save energy through increased efficiency upgrades.

KNOW AND BROADEN YOUR AUDIENCE

If the goal is urban-scale energy efficiency, more participants means more success. To accomplish this, Energize Phoenix worked to create a culture of energy efficiency in a 10-square-mile urban corridor of Phoenix along the Metro light rail. Businesses were more likely to participate when contractors approached them with dedicated sales representatives and a door-to-door marketing strategy. For large buildings with sophisticated property management arrangements, companies that chose to participate may have been driven by existing vendor relationships. Homeowners, meanwhile, were more likely to participate when they heard about the program from more sources. Grassroots relationships with trusted organizations –neighborhoods, community groups, churches – were very helpful in spreading the word.

To maximize energy savings, a program like Energize Phoenix must both generate prospects and convert them to upgrade participants. An efficient strategy to do this is to target the people and organizations that are most likely to pursue energy efficiency upgrades in the first place.

Energize Phoenix research results showed that people from smaller, more stable households with an intention to save energy were more likely to request a home energy checkup. These findings may be a reflection of the demographics within the Energize Phoenix corridor or a function of recession economics. When deciding whether to convert from a checkup to an actual upgrade, homeowners with higher income and those who were motivated to preserve national energy security or to keep up with others were more likely to upgrade. Ethnicity was not a factor in converting to an upgrade, nor were financial or environmental motivations.

Businesses that participated were more likely to own – rather than lease – their space, be structured as corporations – rather than partnerships or sole proprietorships – and either sell directly to the public or supply those companies

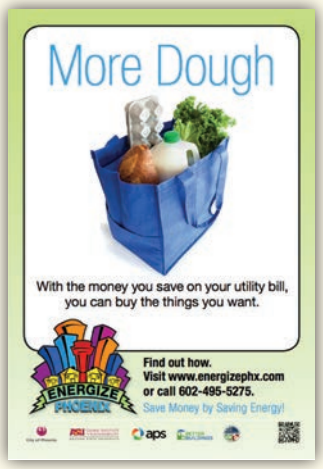
that do. They were more motivated to conserve energy for competitive business reasons and to present the company as being environmentally friendly, whereas actual environmental motivations and attitudes, as measured by surveys, were not a factor in getting an upgrade.

Consider, however, that targeting those who are most likely to participate may not achieve sufficient scale. This strategy also raises social equity issues. In order to broaden participation in a program like Energize Phoenix, then, it is just as important to know who does not participate as it is to know who does. Among homeowners, marketing efforts succeeded in generating prospects who had low incomes, but few of those prospects converted to upgrades, even though there were programs that provided additional assistance to these low-income residents.

Among business owners, professional service firms substantially under-participated compared to their numbers in the community, possibly because more professional service firms may rent their space. Professional services is a powerful business sector, and these companies are very capable of evaluating the financial benefits of energy efficiency upgrades and investments. One way to get building owners to upgrade their facilities may be to change lease structures in a way that generates market demand from their lessees.

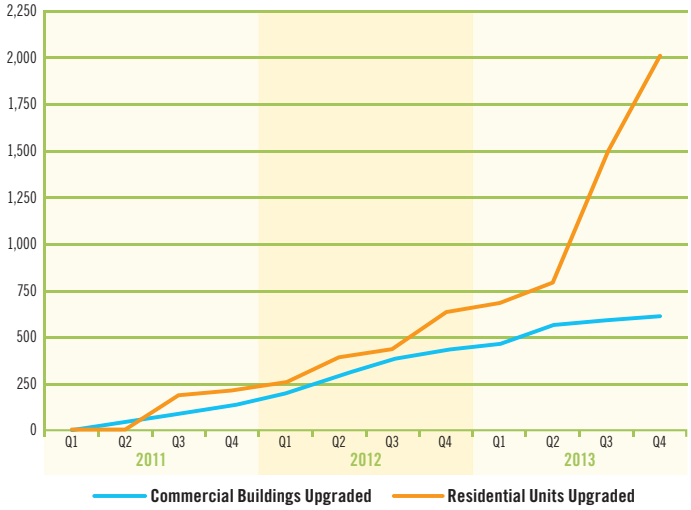
MINE MORE SAVINGS

To reach a broader audience of prospective participants, it is important to provide targeted marketing messages that are relevant, appealing, and understandable to segmented audiences. To retain and attract participants over the long term, a program must consistently provide accurate energy savings estimates. Many contractors substantially overestimated the energy savings that Energize Phoenix customers were likely to achieve. With very generous rebates based on predicted savings for certain upgrades, there was little incentive for some participants to police the accuracy of those savings estimates.



Energize Phoenix achieved abundant energy savings. However, business participants tended to pursue the lowest-cost upgrades (lighting), rather than expanding to the deep retrofits that are needed to achieve maximum energy savings and effect significant carbon reductions. To encourage customers to pursue these deeper retrofits, programs might create tiered incentive rates based upon incremental savings targets or set minimum savings targets to qualify for incentives.

ENERGIZE PHOENIX RUNNING TOTAL OF UPGRADED UNITS BY QUARTER



Note: Commercial buildings may have experienced multiple upgrades over time, though each upgraded building appears only once in the graph.
Source: ASU Global Institute of Sustainability

THE BROADER FRAMEWORK

It is also important to align business models with increased savings outcomes. The utility or third-party partner that administers efficiency programs should financially benefit from reduced energy use; to do otherwise is to misalign economic forces. Likewise, the home- and business owners or renters who invest in upgrades should reap the financial benefits of their investments. Achieving these goals falls within the policy environment. Policy improvements represent a significant and cost-efficient means to mine more savings by increasing awareness, aligning economic forces, and removing impediments to energy efficiency.

The energy efficiency program that appears most likely to succeed will be developed in partnership with stakeholders and structured to maximize savings through a portfolio of both policies and incentives. To be most effective, the program should also be part of a comprehensive energy strategy and sustainability plan for the community, and the community's plan should align with regional sustainability goals.

Introduction

Introduction

PARTNERSHIP FOR PROGRESS

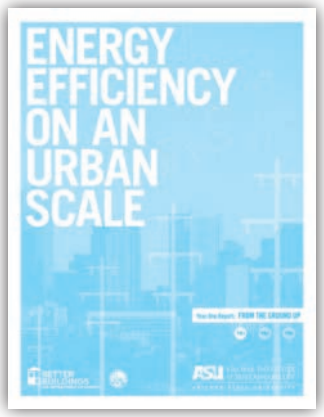
Energize Phoenix was an ambitious, large-scale, three-year program designed to upgrade energy efficiency in buildings – part of a federal effort to stimulate jobs while simultaneously reducing the country's carbon footprint and promoting the shift to a green economy.

The program was created through a 2010 competitive grant awarded to the City of Phoenix in partnership with Arizona State University (ASU) and Arizona Public Service (APS), the state's largest electricity provider. The U.S. Department of Energy's Better Buildings Neighborhood Program (BBNP) and the American Recovery and Reinvestment Act (ARRA) of 2009 provided the $25M in funding.

PROGRESS REPORTS

This report is the final in a series of three reports published annually by the Global Institute of Sustainability at ASU on behalf of the Energize Phoenix (EP) project. All three reports are available at energize.asu.edu. The first report covered the program design and implementation that took place during the first year of the award period. The second report covered preliminary results as early program data was collected and analyzed.

This third and final report shares the much greater aggregate program results through March 31, 2013. It also provides lessons learned, based on comprehensive inter-disciplinary analyses, as well as recommendations for local governments who might be considering developing energy efficiency programs and partnerships of their own.



TIMELINE OF KEY EVENTS

Energize Phoenix evolved over the course of the grant award period as key events unfolded and as progress on various goals warranted program modifications (Figure 1).

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Arizona State University

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Better Buildings
U.S. Department of Energy

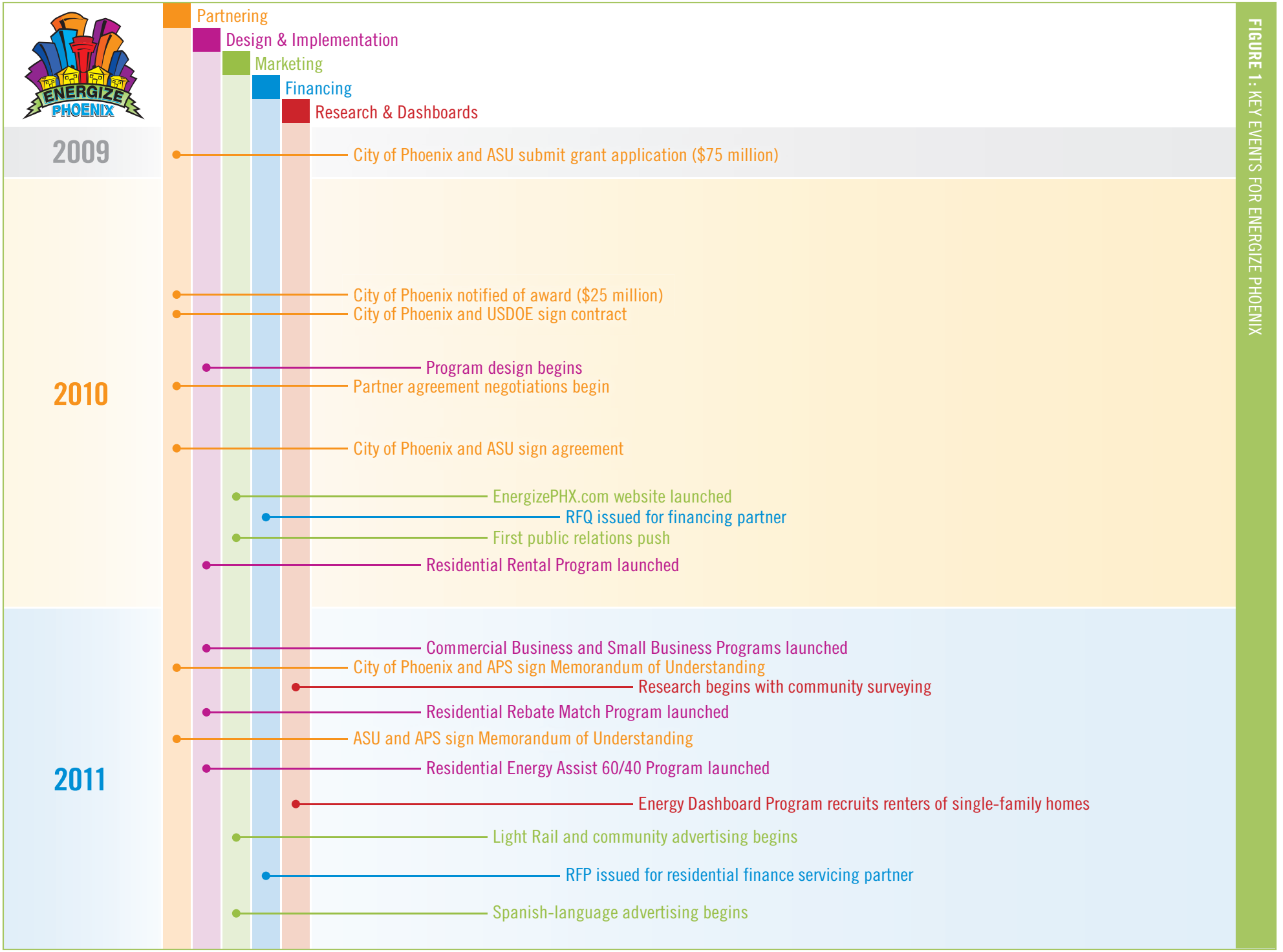
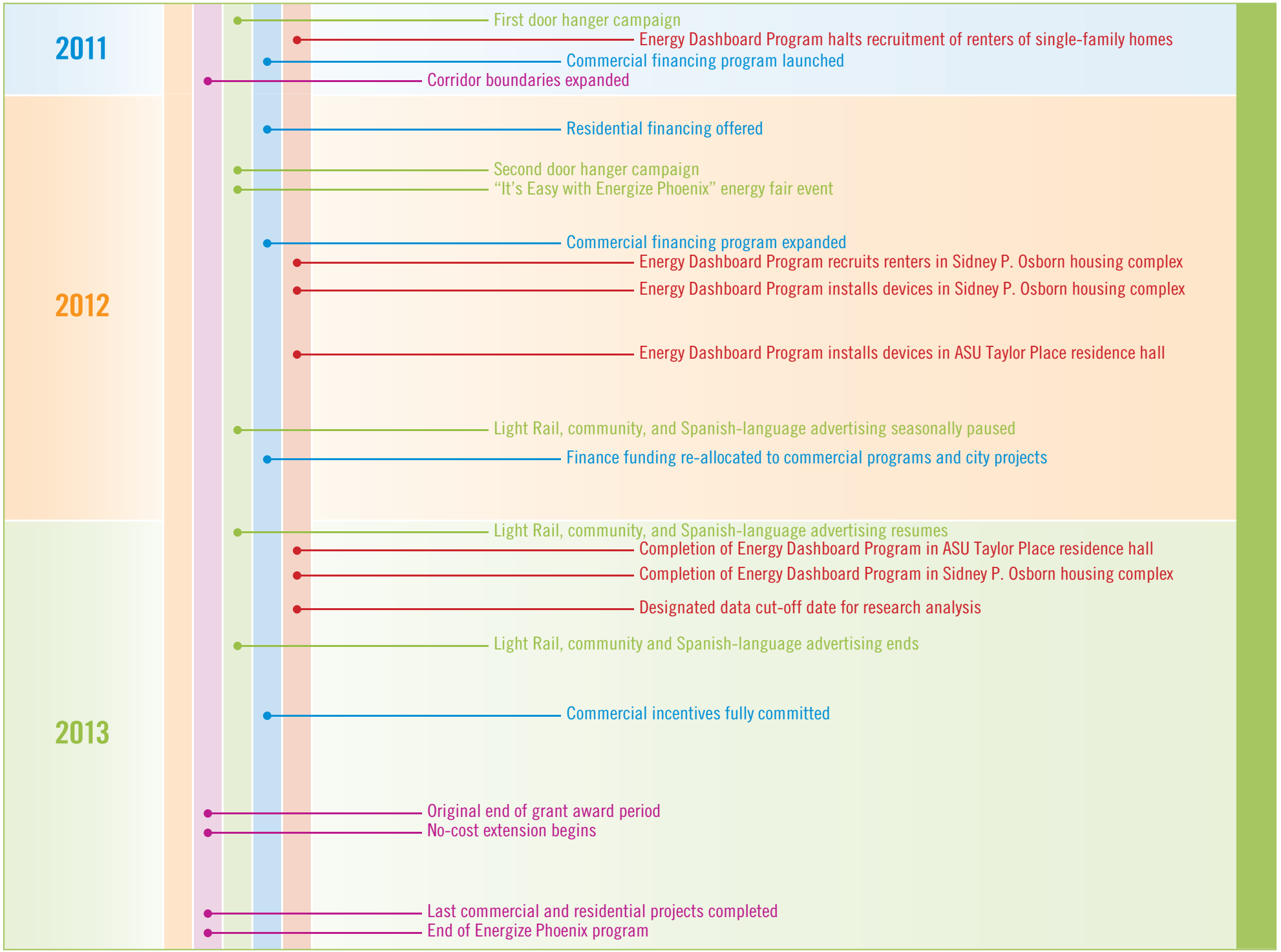


FIGURE 1: KEY EVENTS FOR ENERGIZE PHOENIX


2011
First door hanger campaign
Energy Dashboard Program halts recruitment of renters of single-family homes
Commercial financing program launched
Corridor boundaries expanded
2012
Residential financing offered
Second door hanger campaign
“It’s Easy with Energize Phoenix” energy fair event
Commercial financing program expanded
Energy Dashboard Program recruits renters in Sidney P. Osborn housing complex
Energy Dashboard Program installs devices in Sidney P. Osborn housing complex
Energy Dashboard Program installs devices in ASU Taylor Place residence hall
Light Rail, community, and Spanish-language advertising seasonally paused
Finance funding re-allocated to commercial programs and city projects
2013
Light Rail, community, and Spanish-language advertising resumes
Completion of Energy Dashboard Program in ASU Taylor Place residence hall
Completion of Energy Dashboard Program in Sidney P. Osborn housing complex
Designated data cut-off date for research analysis
Light Rail, community and Spanish-language advertising ends
Commercial incentives fully committed
Original end of grant award period
No-cost extension begins
Last commercial and residential projects completed
End of Energize Phoenix program

PROJECT LOCATIONS

The locations of Energize Phoenix projects as of April 14, 2013, are shown in Figure 2. Projects represent both commercial and residential sectors and include a wide range of vintages, building types, industries, and building sizes. Most commercial projects involved lighting, though a wide range of other upgrades were performed on some projects. Residential projects included measures typically addressed by a Home Performance with Energy Star program, such as duct sealing, air sealing, insulation upgrades, HVAC tune-up, and other measures.

FIGURE 2: LOCATIONS OF ENERGIZE PHOENIX COMPLETED PROJECTS

OPPORTUNITIES AND CHALLENGES

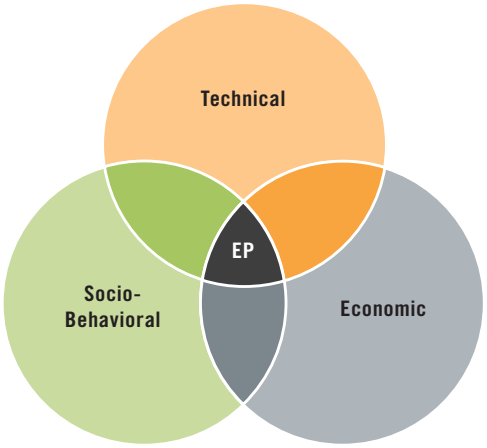
More and more cities across the U.S. are setting carbon reduction goals, and budgets for utility ratepayer-funded energy efficiency programs have blossomed. As a result, the opportunity exists for partnerships between local government and utilities to achieve mutual goals[1]. Lessons from Energize Phoenix can help partnerships and programs overcome challenges and increase success.

During much of the award period, Phoenix faced a severe housing crisis and ongoing economic uncertainty that inhibited many home- and business owners from investing in improvements. Additionally, the Energize Phoenix program faced many of the same intertwined barriers that plague most energy efficiency programs, as discussed in detail in the second year report. These challenges can be roughly characterized as follows:

- Technical: Current technology and building science can tell us how much energy buildings can potentially save through efficiency upgrades. However, it does not tell us how that potential will play out in diverse, imperfect, real-world settings.
- Economic: A self-sustaining energy efficiency industry requires private sector investment, but uncertainty in predicting energy savings impacts investor analysis of returns and increases risk premiums.
- Socio-Behavioral: Program managers need to understand the factors influencing the behaviors of increasingly diverse groups of energy users and to communicate in ways that motivate them to act. They also need assistance in removing legal and policy impediments to action.

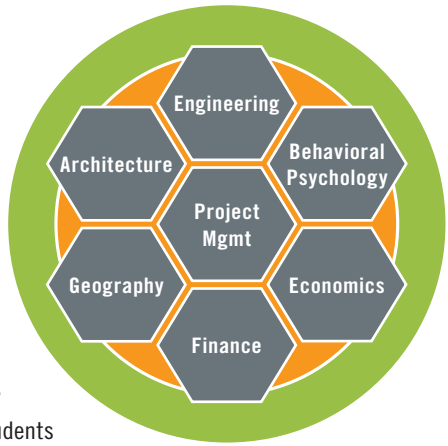
ASU formed an interdisciplinary research team, which was structured to address all three of these challenge areas. The team's research targeted and informed many aspects of the program, including program design, implementation, and impact.

ENERGY EFFICIENCY BARRIERS



Source: ASU Global Institute of Sustainability

INTEGRATED ASU TEAM APPROACH



- Faculty Disciplines
- Graduate Students
- Undergraduate Students

Source: ASU Global Institute of Sustainability

Objectives and Goals

Objectives and Goals

OBJECTIVES

Energize Phoenix was proposed by the City of Phoenix, ASU, and APS in response to a U.S. Department of Energy (USDOE) funding opportunity announcement for what was then called the Retrofit Ramp-up Program[2]. Now known as the Better Buildings Neighborhood Program, the funding offered was intended to stimulate:

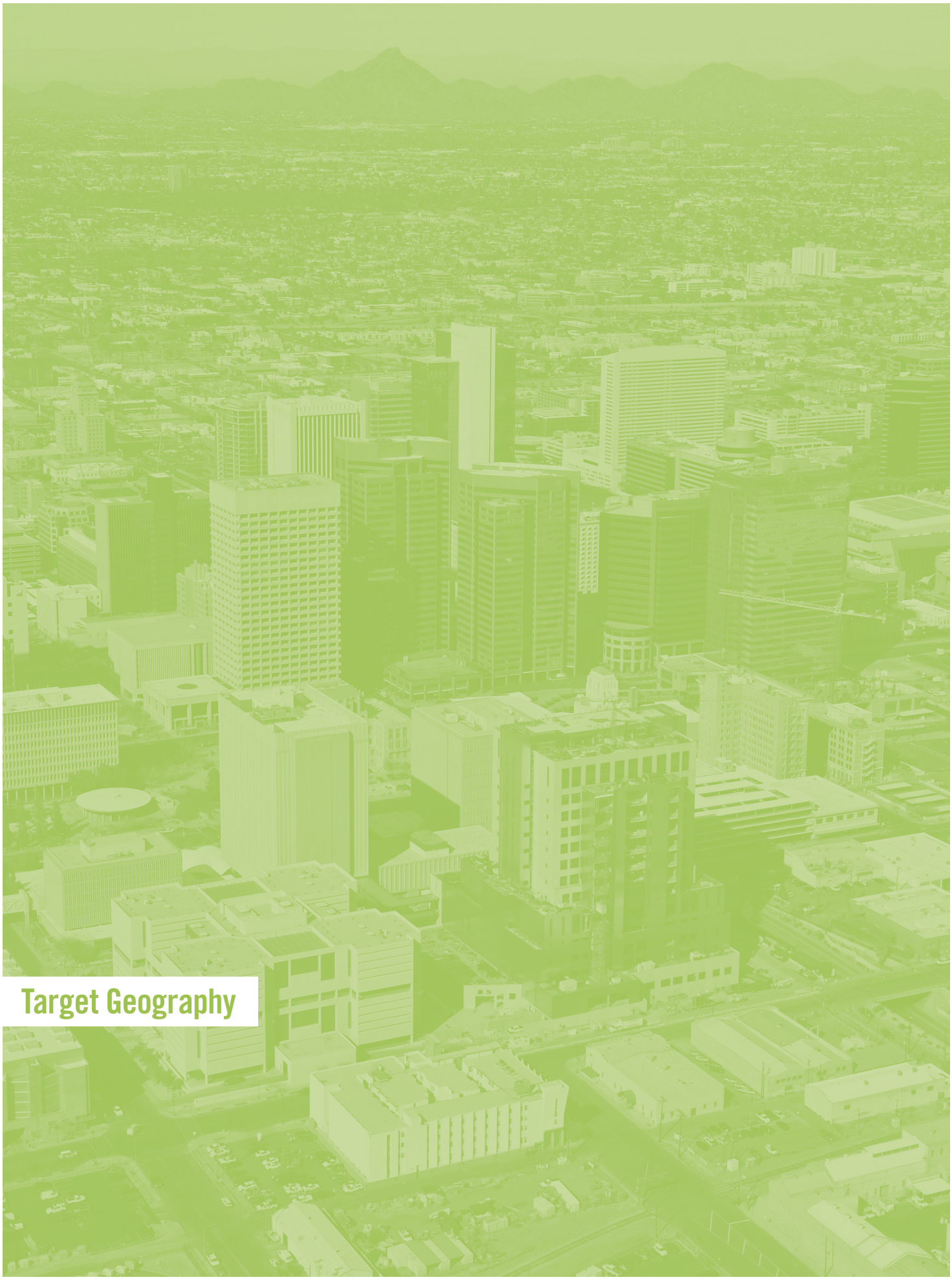
- Energy savings: Deliver verified energy savings through energy efficiency retrofit projects
- Increased participation: Achieve broad market participation from a variety of residential, commercial, industrial, and public customers
- Economies of scale: Demonstrate the benefits of gaining economies of scale
- Enhanced resources: Enhance the resources available to support energy efficiency upgrades by effectively leveraging grant funding
- Financial sustainability: Design a viable strategy for program sustainability beyond the award period
- Replicable pilot programs: Exemplify comprehensive community-scale energy efficiency approaches that could be replicated in other communities across the country

GOALS

In response to the funding opportunity announcement, the City of Phoenix, ASU, and APS submitted a $75 million proposal for Energize Phoenix. The program was originally designed to create a sustainable large-scale model for urban energy efficiency in a portion of the Phoenix urban core over the course of three years. In negotiations with USDOE, a $25 million program that addressed a smaller geographical area was created with the following goals:

- Upgrade 1,700 residential units for greater energy efficiency and reduce energy consumption for residential participants by 30%
- Upgrade 30 million square feet of office and industrial space for greater energy efficiency and reduce energy use for commercial participants by 18%
- Cut carbon emissions by as much as 50,000 metric tons per year
- Leverage federal funds 5:1 with other investment
- Create 1,000 direct and indirect jobs (originally 1,900 – 2,700[3] by federal formula for national job impact)
- Create a sustainable revolving loan fund to perpetuate the program beyond the three-year award period

The original vision of Energize Phoenix was to create a sustainable, critical mass of energy efficient culture in the city's diverse urban core that would eventually spill over into the broader Phoenix community.



Target Geography

Target Geography

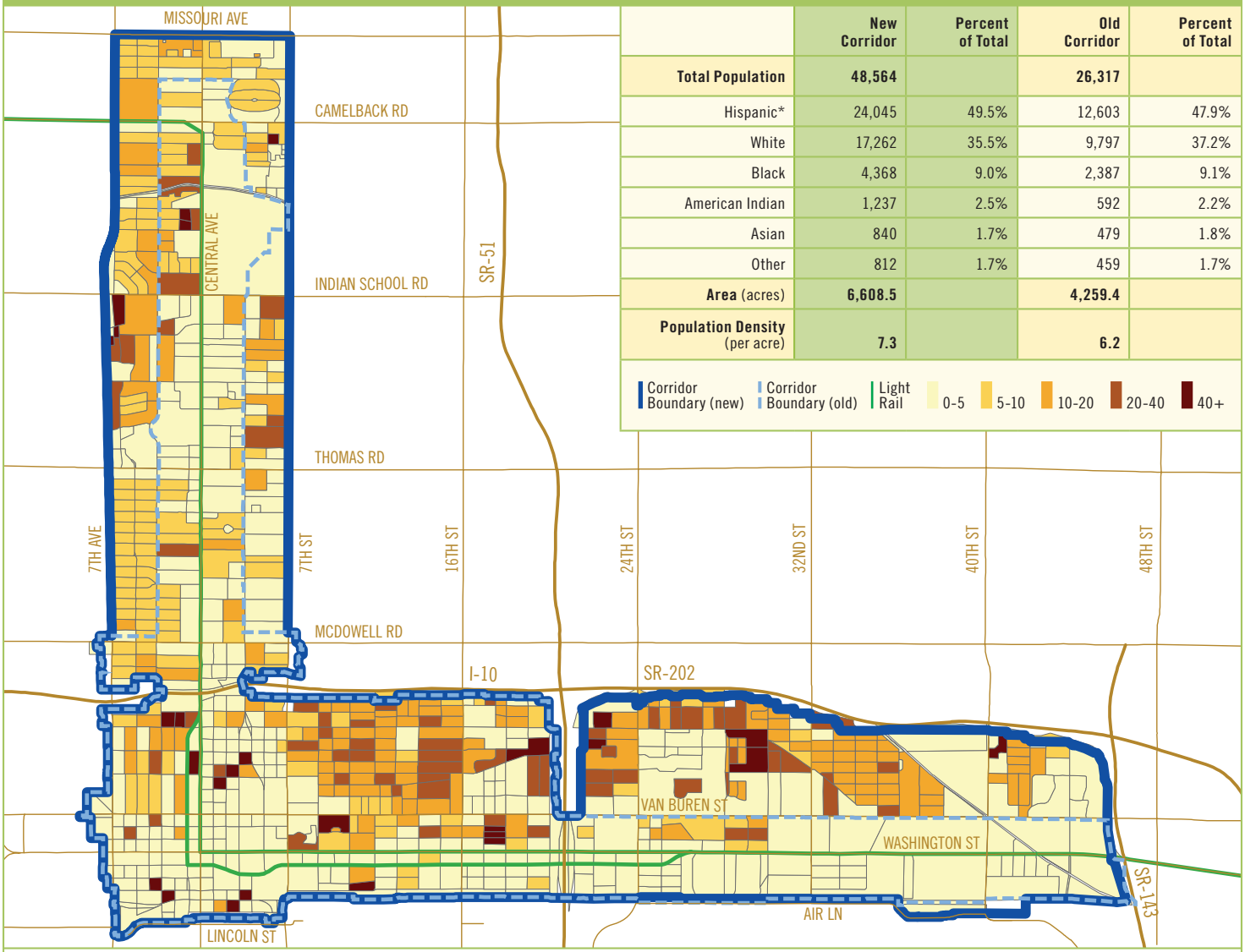
THE ENERGIZE PHOENIX CORRIDOR

The Energize Phoenix program targeted the area surrounding a ten-mile stretch of the Valley Metro light rail starter line, dubbed the Energize Phoenix Corridor. The Corridor is a highly diverse, mixed-use, L-shaped region centered on the Phoenix central business district. Fifteen of the light rail's 27 stations lie within the EP Corridor. Both the commercial and residential populations, as well as the building stock of the Corridor are a study in diversity. See the Year One Report – Appendix C: Characteristics of the Energize Phoenix Corridor – for more details on characteristics of the original Corridor.

EXPANDING THE CORRIDOR

To boost residential participation, the Corridor was expanded significantly in 2011. The goals of the mid-program adjustment were to increase the number of homeowners eligible for upgrades and unite neighborhoods that the previous boundaries had unintentionally split (Figure 3).

FIGURE 3: BOUNDARY AND POPULATION COMPARISON OF NEW AND OLD ENERGIZE PHOENIX CORRIDORS



	New Corridor	Percent of Total	Old Corridor	Percent of Total
Total Population	**48,564**		**26,317**	
Hispanic*	24,045	49.5%	12,603	47.9%
White	17,262	35.5%	9,797	37.2%
Black	4,368	9.0%	2,387	9.1%
American Indian	1,237	2.5%	592	2.2%
Asian	840	1.7%	479	1.8%
Other	812	1.7%	459	1.7%
Area (acres)	**6,608.5**		**4,259.4**	
Population Density (per acre)	**7.3**		**6.2**	

Corridor Boundary (new) | Corridor Boundary (old) | Light Rail | 0-5 | 5-10 | 10-20 | 20-40 | 40+

**The Census Bureau treats Hispanic ethnicity and race as separate, cross-cutting categories. In other words, a person can claim both Hispanic ethnicity and whatever racial category desired. Here, the category "Hispanic" includes all people who claimed Hispanic ethnicity, regardless of race. For the race categories, tabulations are for non-Hispanic respondents in that category.*

Source: Census 2010 Redistricting Data

TABLE 1: SIZE COMPARISON OF NEW AND OLD ENERGIZE PHOENIX CORRIDORS

Use Category	Statistic	New Corridor	Old Corridor	Added Area	Percent Change
	Area (square miles)	10.33	6.66	3.67	55%
Residential	Parcels	9,370	5,289	4,081	77%
Commercial	Parcels	4,538	3,218	1,320	41%
	Employers	6,256	4,888	1,368	28%

Number of parcels according to Maricopa County Assessor's office, 2011.Number of employers according to Infogroup, 2009. Source: ASU Global Institute of Sustainability

The expansion increased Corridor size by 55% (Table 1), including a 77% increase in the number of eligible residential parcels and a 41% increase in eligible commercial parcels. The total target population increased by 85% and added a relatively high proportion of Hispanic and American Indian/ Alaska Native residents in comparison to the original Corridor. For more details, see the Year Two Report – Appendix A: Energize Phoenix Corridor Expansion.

CORRIDOR CHARACTERISTICS

The Corridor, served by a single, investor-owned electric utility company (APS) and a separate investor-owned gas utility, is electricity-dominated and heavily cooling-driven. The building stock is relatively young by national standards, generally ranging in vintage from the 1920s to the 2000s, with a high percentage of residential rental properties.

The very diverse residential and commercial make-up of the Corridor provided a rich environment in which to pilot many different programs, strategies, and studies. Further, the presence of the light rail as a backbone provided an easy visual cue for communicating the location of the program area.

LESSONS LEARNED

Social networks trump physical boundaries.

- When the size of the Corridor was scaled down during pre-award negotiations with USDOE, some close-knit neighborhoods were split by the revised Corridor boundaries. This created discord that hindered marketing efforts, until the mid-program boundary expansion reunited those neighborhoods.

Program boundary decisions affect the ability to target messaging through media.

- The boundaries of the Energize Phoenix Corridor did not align with traditional media market boundaries, confounding media buys. It was a challenge to reach the target audience without also reaching residents and businesses that were geographically ineligible.

Partners and Partnering

Partners and Partnering

CITY OF PHOENIX

Phoenix is the sixth largest city in the U.S. and its city government has received several awards for management excellence. As the grant awardee and government lead on the Energize Phoenix program, the City of Phoenix had responsibility for managing the program.

Phoenix staff members' ultimate accountability is to elected officials who report to voters, as well as to the U.S. Department of Energy, which funded the program.

ARIZONA STATE UNIVERSITY

Arizona State University, a Tier 1 public research university, is the largest university in the state; its Tempe campus is the largest by enrollment in the country. ASU's Global Institute of Sustainability subcontracted to the City in the role of program evaluator, while also handling marketing and data management. (Marketing was subsequently subcontracted to DRA Strategic Communications, a Phoenix-based firm.)

ASU's Global Institute of Sustainability has a mix of accountability to students, administration, the Arizona Board of Regents, legislators, and grant funders.

ARIZONA PUBLIC SERVICE

Arizona Public Service is the state's largest utility, providing electricity to 1.1 million customers. APS brought to the team energy efficiency program implementation expertise and infrastructure, monetary incentives, and a qualified contractor base, as well as energy data and program data.

Arizona Public Service's accountability, as an investor-owned utility, is to its shareholders, the Arizona Corporation Commission, and its customers.

PARTNERING

The three partners are all locally dominant institutions and have a long history of collaboration on large-scale projects, though mostly in two-way partnerships. Through this three-way partnership, Energize Phoenix broke significant new ground.

Major programs involving multiple large institutions necessarily require time and effort to establish solid foundations. Throughout the first year of the program,

the Energize Phoenix partners painstakingly and successfully developed the critical infrastructure of the formal partnerships – three two-way agreements as opposed to one three-way agreement. They also reached decisions on the program design, incentive levels, contractor collaboration, financing structures, data collection, and marketing necessary to enable the success and sustainability of the program over the following two years.

LESSONS LEARNED

Creating multi-partner project infrastructure is complex and time-intensive.

- Among the three primary partners, it was necessary to negotiate liability and manage narrow divisions of labor; the circular process of revising program documents was complicated and time-consuming.
- A critical challenge was understanding how cultures and accountability differed among the partners, and integrating those institutional differences into the program structure. For the program to succeed, it was necessary to work within the capacity of management for whom Energize Phoenix was just one of their organizational obligations.
- The decision early in the process to have three bi-lateral agreements to regulate the partnership (versus the alternative of having one master agreement) probably minimized governance complexity and maximized flexibility to revise agreements as the program evolved.

Partnerships can accomplish otherwise insurmountable tasks.

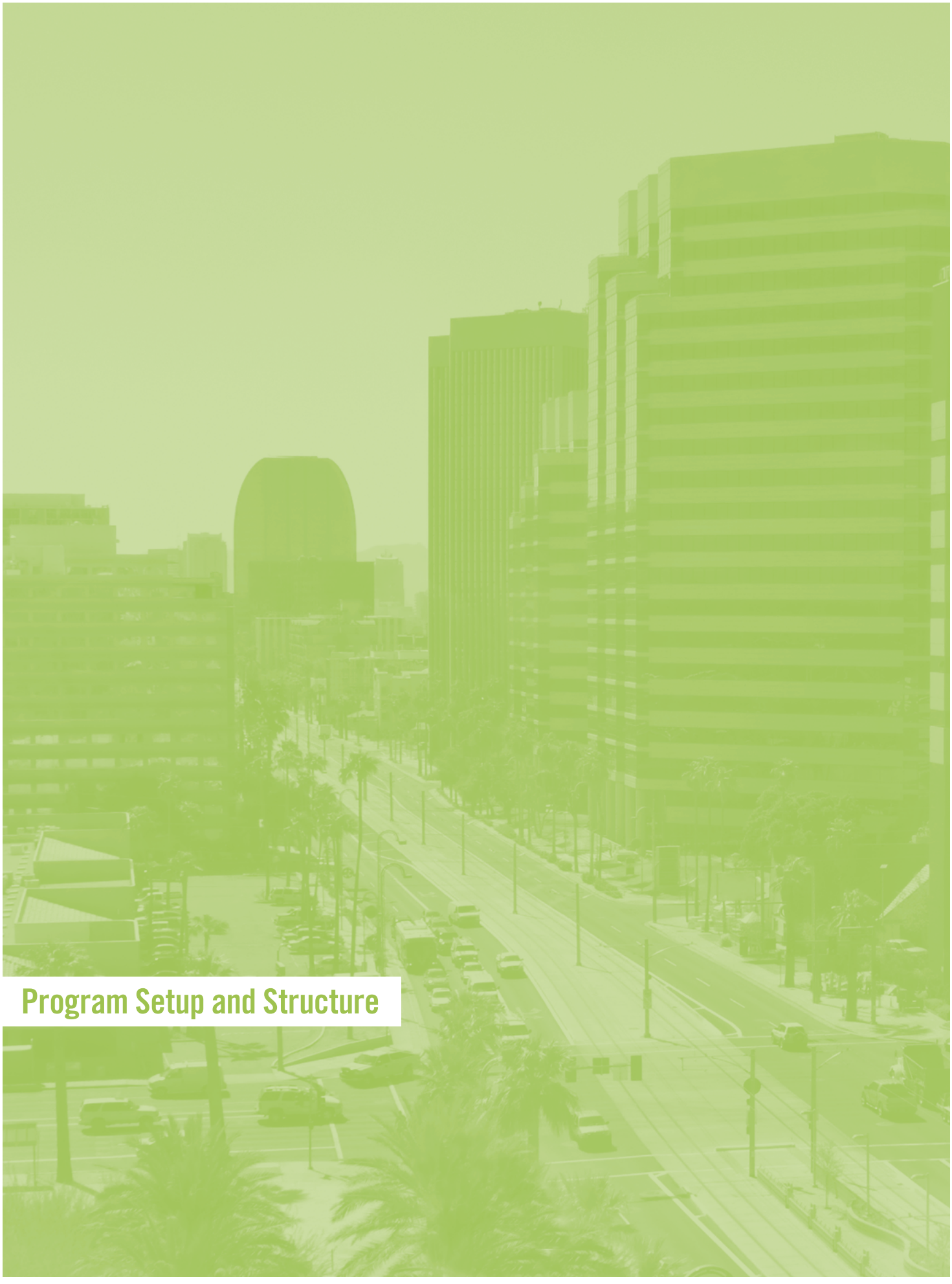
- Energize Phoenix was most successful when all of the partners were working toward a common, over-arching goal – with support and commitment from both leadership and team members – and when the goals of the partnership closely aligned with the goals of the individual institutions.

- Diverse partners contribute invaluable skills, experience, and infrastructure to a project. Partners that are relatively similar in terms of power and influence can collaborate toward better overall decisions.

A program like Energize Phoenix involves more than just the primary partners.

- Even three major institutions cannot tackle an energy efficiency challenge without consultation of and participation by vendors, contractors, community groups, residents, businesses, lenders, and other stakeholders.
- Understanding that web of relationships and the needs and perspectives of the many departments, organizations, and individuals involved was critical to empowering the program to save residents and businesses on their energy costs.

For more partnership and organizational lessons learned, see Energy Efficiency on an Urban Scale – Year One Report: From the Ground Up.



Program Setup and Structure

Program Setup and Structure

EARLY DECISIONS

Energize Phoenix offered several rebate, grant, and financing options to help residential and commercial customers make energy efficiency upgrades to their properties. Because APS already offered an incentive program infrastructure, Energize Phoenix incentives were structured to work with and layer on top of those existing programs. The City developed additional incentive programs for specific target audiences not directly addressed by APS programs. All programs targeted electricity savings only (not natural gas or other fuels).

An early APS decision to not receive any federal dollars (nor the accompanying and uncertain conditions and reporting requirements) created some boundaries around the possible structures of the program, such as precluding the City from contracting APS to administer incentives on its behalf. For this and other reasons, the City of Phoenix administered its own application, incentive, and some upgrade processes.

Because the Energize Phoenix application process ran in parallel to existing APS application processes, managing applicant flow through the process required close collaboration among City of Phoenix and APS staff.

PROGRAM DEVELOPMENT

As the program was developed, APS program staff served as the technical experts. APS programs are voluntary and flexible in nature, driven by an established private sector contractor base. Those contractors were also consulted about program design during multiple sessions early on, and their feedback resulted in some significant modifications to anticipated program processes.

Energize Phoenix faced several complexities, including the geographical and other limitations on who was eligible to participate in the program and the need to fulfill historic preservation requirements.[4] Meanwhile, the City of Phoenix had to combine its own accounting and regulatory procedures with federal compliance and reporting requirements related to hazardous waste management, historic preservation, Davis-Bacon Act[5], buy-American provisions, not conducting business with prohibited countries, and so on.

APPLICATION PROCESS

Energize Phoenix commercial participants were particularly subject to the timeline of APS project flows, as upgrade projects had to receive APS program approval before processing for approval by EP. At times, there was a high degree of uncertainty as to when the Arizona Corporation Commission would approve APS' annual energy efficiency implementation plan and at what funding level. That uncertainty, as well as delays and project volume waves created by it, flowed through to Energize Phoenix and its participants, particularly for commercial projects.

LESSONS LEARNED

A complicated application process limits program participation.

- Incentives that are subject to both federal and local government compliance and reporting requirements create an amount of application paperwork that can seem daunting to an average resident or small business owner. Applying for financing increases documentation even more.
- Complying with regulations and reporting created paperwork challenges to program administration, as well.

Continuous input from experienced contractors was invaluable.

- The continuous involvement of experienced contractors improves program design, time-to-launch, and impact. Soliciting input at multiple stages takes time and effort but is more efficient than restructuring after the fact to deal with an unintended consequence.

Financing and Incentives

Financing and Incentives

PROGRAMS FOR RESIDENTIAL CUSTOMERS

Rebate Match

This program was available to any owner-occupied, single-family homeowners in the Corridor. The program matched rebates (with limitations) provided by the Arizona Home Performance with Energy Star whole home upgrade program. Projects were managed by contractors working directly with homeowners.

Participants were required to obtain a home energy checkup that included combustion appliance safety testing. Typical efficiency measures obtained through this program included duct sealing, attic insulation repair and enhancement, air sealing, window shade screens, solar water heating, and HVAC replacement. The performance of these improvements was then verified through a test-out procedure.

A mid-program adjustment broadened accessibility to residentially-metered condominium owners by providing them opportunities for individual measures such as HVAC tune-up, solar water heating, or HVAC replacement. Another mid-program adjustment allowed single-family rental homes to participate in Rebate Match opportunities, up to two total properties per landlord.

FACING MOUNTING UTILITY BILLS, THE RESIDENTS OF REGENCY HOUSE VOTE FOR EFFICIENCY

Built in 1964, the 22-story condominium Regency House was saddled with a nearly 50-year-old mechanical system that was economically inefficient and unreliable. The residents voted to replace their cooling towers, chillers, and boilers, as well as upgrade lighting in their common parking garage.

Their timing could not have been better. As they prepared bid documents for the project, their contractor alerted the Homeowners Association about Energize Phoenix. With $65,000 in combined incentives available from APS and Energize Phoenix, they upgraded to a more efficient replacement chiller than initially planned. The incentives and HVAC energy savings also helped with the lighting upgrade, which they could not afford otherwise.

Regency House representatives say the results are fantastic and EP data analysis shows savings are even higher than the contractor predicted (22% vs. 15%). Not only do residents have better quality lighting in their underground parking garage, they have reduced their energy bills, increased the reliability of their mechanical systems, and improved the comfort in 118 condominiums in central Phoenix.

Energy Assist 60/40

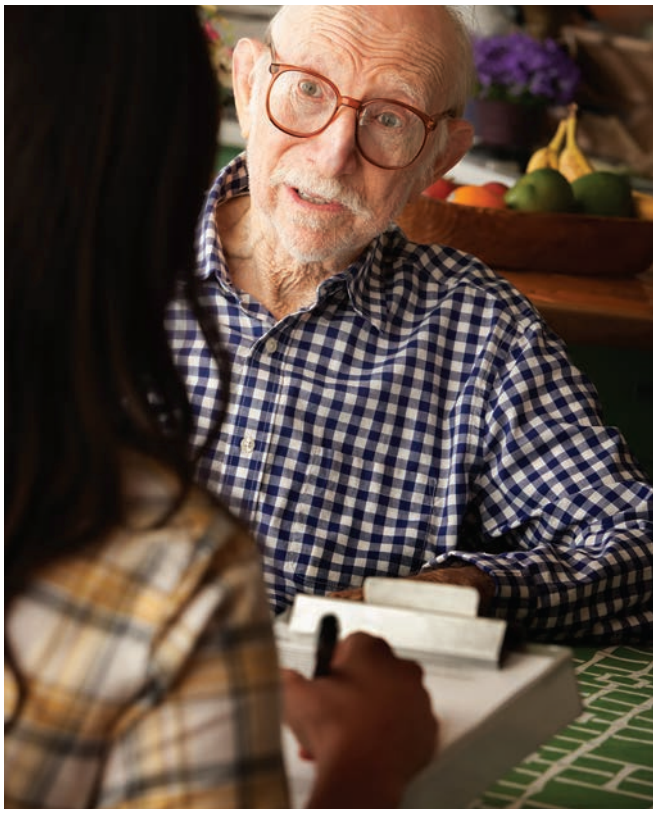
This program was available to homeowners with an annual income of 400% of federal poverty level or less. The program provided a grant to cover 60% of upgrade costs, after APS rebates. The homeowner was responsible for covering the remaining 40% plus taxes through personal sources of funds, and/or through financing provided by the City of Phoenix. The City approved funding for each project before construction. The homeowner selected the contractor to perform the work.

The process for participating in this program mirrored that of the Rebate Match program, with similar requirements, upgrade measures, and performance verification procedures.

Energy Assist 100%

This program, formulated to target low-income residents, was available to homeowners with an annual income less than 200% of federal poverty level. The program paid for 100% of upgrade costs and helped alleviate a waiting list for the City-administered federal Weatherization Assistance Program. Projects were managed by the City.

The process for participating in this program mirrored that of the Rebate Match program, with similar requirements, upgrade measures, and performance verification procedures.



Rental Program

This program was available to owners of multi-family apartment complexes serving mostly low-to-moderate income residents, meaning 67% or more of the rental units were reserved for this demographic.

The program covered upgrades costing up to $3,000 per unit or the amount needed to achieve a 15% predicted energy savings; the incentive ceiling was raised mid-program to $3,500 per unit. The funds were provided in the form of a 10-year, zero-interest loan, with 10% forgiven for each year of continued ownership. Projects were managed by the City in collaboration with the building owner.

Participants were required to meet accessibility, crime prevention, historic preservation, and housing quality standards. The program provided grants for the same set of efficiency measures offered through the other residential incentive programs.

Energy Dashboards

This program placed real-time energy usage feedback devices into a City-owned low-income housing complex and an ASU Downtown Phoenix campus residence hall to better understand how energy usage feedback might potentially increase energy savings.

PROGRAMS FOR COMMERCIAL CUSTOMERS

The City of Phoenix set a cap of $125,000 per owner at the beginning of the program to ensure wide distribution of resources in the community. Through a mid-program adjustment, the cap was raised to $200,000. The City made an early program decision that it would limit aggregate program incentives on its own facilities to the same aggregate cap as all other participants.

Small Business Program

This program was available to businesses, governments, and non-profits with an average monthly utility cost of approximately $14,000 or less, as well as to all schools. The program matched APS rebates up to 100% of the cost of individual energy conservation measures.

Built upon the APS Express Solutions™ program and often referred to in the industry as a contractor “direct-install” program, this program focused on common lighting, pump, and food refrigeration upgrades for small businesses. Customers paid contractors for the work, less the APS incentive. The contractor received the APS incentive after APS verified their work, and the customer received a rebate directly from Energize Phoenix.

Business Program

This program was available to nonresidential customers with monthly electricity demand of any amount. Built upon APS’ classic business program, Energize Phoenix matched rebates for assistance with the incremental costs of a wide range of prescriptive and custom energy conservation measures in existing buildings.

PROGRAMS FOR CITY OF PHOENIX FACILITIES

At various points throughout the award period, the City contracted for work on City-owned properties that were either occupied by city operations or leased to tenants. Some projects

were undertaken with energy efficiency upgrades as the primary or sole purpose, while other renovations were more comprehensive, integrating energy efficiency upgrades into planned, broader adaptive re-use projects. Most City projects did not involve APS rebates or incentives. The aggregate EP funding allocated was approximately $4 million. Many of these projects were under planning or construction as of March 31, 2013.

RESIDENTIAL AND COMMERCIAL FINANCING

Residential Financing Program

This program provided financing to Energy Assist 60/40 participants. The City served as the lender; Neighborhood Housing Services of Phoenix, a non-profit community revitalization organization, serviced the loans.

Commercial Financing Program

This revolving loan fund was available to nonresidential customers wanting to finance energy efficiency projects. The minimum project size was $50,000, after APS and Energize Phoenix incentives. The revolving loan fund was made available through a partnership with National Bank of Arizona.

Participants could obtain low, fixed-interest rate loans for 12 months to 120 months. Collateral was generally required, depending upon loan size, term, and underwriting requirements of the bank.

Financing as a Solution

Many leaders in the energy efficiency industry and in federal policy circles have believed that financing is a silver bullet for scaling energy efficiency in the built environment, with the success of financing seen in the solar industry as an example. In theory, energy efficiency loans can be bundled and sold as securities on the secondary market, if the risk premium can be minimized with the help of accurate savings estimates. Solar photovoltaics have an advantage in this regard in that the calculation of their energy production is a standardized procedure involving predictable variables.

Finance mechanisms such as Property Assessed Clean Energy (PACE) loans can also bridge some of the economic barriers to participation created by the split incentive issue – making sure the energy savings accrue to the party who pays for the upgrade. Indeed, several Better Buildings Neighborhood Program grantees have developed innovative and successful loan programs.

Evaluation of the Energize Phoenix finance program was not within the scope of this assessment. However, ASU partnered with the City of Phoenix near the end of the award period to conduct an analysis, which will be available as an appendix online.

For information, see Appendix J: Energize Phoenix Finance Program Evaluation.

LESSONS LEARNED

Broad program offerings create reach and complexity.

- More variety in program offerings expanded participation options to a broader audience. However, it also added management, data, and marketing complexity.
- Layering on top of existing utility programs was more efficient than creating expertise and programs from scratch. However, it also added parallel application processes and uncertainty for participants.

For examples and more details on processes for most of the individual programs, see Energy Efficiency on an Urban Scale - Year One Report: From the Ground Up.

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ENERGIZE PHOENIX

Program Marketing

PLANNING

The brand strategy for Energize Phoenix was to build an approachable, inviting, and fun identity that promoted energy conservation as a social norm in the EP Corridor, with the intention of creating a spillover effect in how the greater community behaves. The brand was created early in anticipation of a fast program launch, with a small window for creating brand awareness (Figure 4).

DRA Strategic Communications, a Phoenix-based marketing and communications firm, developed and managed the marketing and communications strategy for the program. The team developed a phased approach based on brand development, outreach, and high-touch community initiatives.

FIGURE 4: ENERGIZE PHOENIX LOGO

IMPLEMENTATION

The brand was launched and supported with a layered, multi-channel communications strategy that included media relations, print and light rail station advertising, informational collateral, a website, social media, community events, contractor meetings, point of purchase collateral, and door hangers. It was augmented by personal contact through ASU community surveyors and a Phoenix Neighborhood Services Department community worker.

Marketing messages focused on the financial benefits of energy efficiency and on the ease of use of the process. After an initial media relations effort for program launch, most program marketing efforts focused on promoting the residential programs rather than the commercial programs, the latter of which were deemed to generate sufficient demand to match program targets. This decision helped to extend marketing resources for residential programs, but, in turn, increased the dependency of commercial contractors on their own marketing efforts and the budget flows of APS commercial programs.

It is difficult to convince homeowners to invest in their homes when economic and housing crises decimate home equity and income confidence. Under these conditions, residential participation in Energize Phoenix initially lagged and required additional marketing efforts. One of the most effective marketing activities of the program was "It's Easy with Energize Phoenix," a heavily-marketed community event that brought approximately 20 contractors to one location and offered double rebates for homeowners who signed up for a free home energy checkup at the event. Held in March 2012, the event attracted approximately 500 residents and led to more than 130 homeowners signing up for checkups with contractors. Advertising for the event consisted of marketing via door hangers to all 7,000 single-family residences in the Corridor and ad placement in targeted community newsletters and on the light rail.

Many other marketing initiatives were successful in influencing customers. Advertising in community and neighborhood newsletters built awareness and goodwill with neighborhood associations. Template marketing materials allowed contractors to print their own co-branded collateral. Strategic alliances with community groups whose missions aligned with the goals of the program – such as the Sierra Club, Rogue Green, Phoenix Green Chamber of Commerce, Downtown Voices, Local First, Discovery Triangle, and the U.S. Green Building Council Arizona Chapter – added legitimacy to the program.

FROM HOLIDAY DECORATIONS TO SUMMER SAVINGS AND COMFORT

Phoenix resident Sandy J. remembers the day her husband was rearranging some holiday items in their attic. "I was worried about him (it was a really hot day) and he kept saying 'it's fine up here.'" He realized the fact that the attic was a reasonable temperature might be a problem, which their first summer utility bills soon confirmed; twice as high as their previous house, which was 1,100 square feet larger.

Sandy remembered the three consecutive Energize Phoenix door hangers that she had discarded, visited the website and chose an approved contractor. "They were extremely professional and spent half the day conducting an audit. They came back with an entire workbook of graphs and photos. We chose to have the duct work sealed, sunscreens on the west side of our house, and sealing the building envelope."

Another contractor upgraded the insulation in their attic. "The biggest difference we have noticed is that our home feels more comfortable. Our utility bills have come down, and we are not wasting energy. If I had to do it again, I would only say 'I would not have waited so long.'"

LESSONS LEARNED

A multi-channel marketing strategy reinforces awareness and builds legitimacy.

- This strategy was recommended by APS from its own energy efficiency marketing experiences and was reinforced by residential survey findings that homeowners were more likely to participate when they heard about the program from multiple marketing sources.
- Engaging with neighborhoods and community groups whose interests aligned with Energize Phoenix leveraged trusted sources and social networks.
- While most commercial participants learned about the program through a contractor, contractors felt it would have helped them to have City personnel either mail information to or directly meet with potential customers to explain the program and its benefits.
- Financial savings messages are critical but could be more effective when combined with messages that address other attitudes and motivations.

Personal outreach and call to action events are critical marketing opportunities.

- Custom, well-marketed community events with a call to action are resource-intensive but critical to designing and operating better programs, gaining timely awareness on emerging trends or issues, and building or maintaining strong relationships with stakeholders.
- The potential benefits of an energy concierge program, where advocates would provide residents with energy education and guidance through the entire checkup and upgrade process, were discussed several times. Though resource-intensive, such a program has proven effective elsewhere. Budget limitations precluded this strategy for Energize Phoenix.

For details of the marketing plan for Energize Phoenix, see Year One Report – Appendix G: Energize Phoenix Strategic Communications Plan. For details of marketing results, see Appendix A: Marketing and Communications Final Program Detail of this final report.

Marketing Research: Residential Participation

Marketing Research: Residential Participation

Who participates in energy efficiency programs and why? ASU's interdisciplinary research team studied how advertising and sales strategies affected participation, as well as the characteristics, attitudes, and motivations of program participants. The team analyzed data from each project and census tract within the Energize Phoenix Corridor, as well as several surveys completed before and throughout the course of the program. The team employed a statistical analysis method called logistical regression ("logit") to isolate the effects of individual characteristics, attitudes, and motivations from one another.

INCOME AND EMPLOYMENT STATUS

Energize Phoenix researchers found that having a higher household income did not predict whether a resident received a home energy checkup, but once having received a checkup, participants with a higher income (relative to other Corridor residents) were more likely to follow through with an energy efficiency upgrade. Those low-income residents who did move forward with an upgrade lived in middle- or high-income neighborhoods; no households in low-income neighborhoods participated.

Interestingly, income level and demographic characteristics, in general, did not predict how much energy households were using before the program began.

ETHNICITY AND OTHER DEMOGRAPHICS

Residents who completed a home energy checkup were more likely to be of non-Hispanic, white origin than any other ethnicity. However, when ethnicity was analyzed alongside other household characteristics, attitudes, and motivations, ethnicity was no longer a statistically significant factor in participation. Additionally, ethnicity was not a factor in following through from checkup to upgrade.

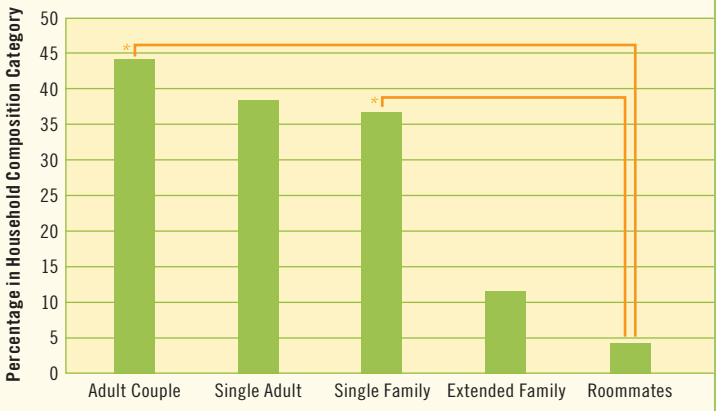
Sex, age, political affiliation, and the survey respondent's education level were not significant in predicting participation.

HOUSEHOLD COMPOSITION

Household composition, broadly speaking, was an important predictor of residential participation in Energize Phoenix. As the number of adults or children within a household increased, the likelihood of participating decreased. Households consisting of adult couples or single families were more likely both to get a checkup and to invest in upgrades relative to households comprised of roommates.

These findings may reflect differences in stability of the family unit; it is reasonable to assume that a stable adult couple, single adult, or small family might be more willing to consider making a substantial investment of money and time in their home. This may indicate challenges or opportunities in targeting participation by households with more children and/or extended families. Marketing messages emphasizing the benefits of having lower and more consistent utility expenses, or a healthier home, might resonate with these audiences.

FIGURE 5: HOME ENERGY CHECKUP-LEVEL PARTICIPATION BY HOUSEHOLD COMPOSITION



**p < .05. Denotes a significant difference between these two Household Composition categories in terms of percentage of respondents that received a home energy checkup.*

Source: ASU Global Institute of Sustainability

SWIMMING POOLS

Households with swimming pools were more likely to get a home energy checkup than those without, perhaps because pools require so much energy to operate. However, pool owners were less likely to pursue an energy efficiency upgrade through Energize Phoenix.

The Energize Phoenix residential program – based on the Arizona Home Performance with Energy Star program – does not include rebates for pool motor replacements per USDOE Better Buildings Neighborhood Program guidelines. APS does offer separate rebates to incentivize this high-savings measure, but the process generally involves tapping into a separate workforce of pool contractors. Since the Energize Phoenix program does not include savings from pool motor replacement, pool owners who may have been

highly interested in receiving a checkup may have been correspondingly under-impressed by the total predicted savings offered through Energize Phoenix.

ATTITUDES AND MOTIVATIONS

Residents with a stronger intention to conserve energy were significantly more likely to receive a home energy checkup. Participants who were motivated to preserve national energy security or to keep up with others were more likely to make the leap from checkup to home energy upgrade. Financial and environmental motives – common targets of most energy efficiency marketing campaigns – did not influence making the leap from checkup to upgrade.

Residents who reported more pro-environmental attitudes, as well as those who were socially motivated to appear environmental, were actually less likely to get a home energy checkup, although these effects did not remain statistically significant when considered together with other factors.

What was significant was that residents who were more motivated to preserve the environment also used less baseline energy, whereas residents who were more financially motivated used more. ASU researchers postulate that highly pro-environment residents may have believed that they had already taken all reasonable steps to improve their energy efficiency, and thus did not see a need for a checkup to identify more. Another possibility is that Energize Phoenix

FIGURE 6: RESULTS OF RESIDENTIAL CLUSTERING ANALYSIS

High-income areas (in red) account for 49.3% of upgrade projects, while 50.7% of the projects are located in middle-income (in pale yellow) areas. The white area had no residences.
Source: ASU Global Institute of Sustainability

marketing messaging, with its emphasis on financial rather than environmental benefits, may have resonated particularly well with individuals for whom potential cost savings were more motivating, and environmental preservation less so.

GEOGRAPHIC SIGNATURE

Among residents in the Energize Phoenix Corridor, those living in areas with relatively higher average income were more likely to participate than those living in areas with relatively lower income. In the lowest-income areas of the Corridor – neighborhoods with an average household income of less than $12,905 as determined by the 2010 American Community Survey – no residents (of any income level) chose to receive energy efficiency upgrades through the Energize Phoenix program.

These geographic clusters of participation, shown in Figure 6, may have been influenced by contractor marketing strategies and methods. Some contractors used Energize Phoenix as a way to fill gaps in demand for their services, promoting the program in higher-income areas to generate revenue during their slow season.

One residential contractor successfully capitalized on a word of mouth strategy by working to complete a single home upgrade project on each street block in a close-knit, high-income neighborhood. This strategy demonstrated a well-known behavioral principle that people are influenced by trusted sources in decision-making, and it could suggest a high marketing potential for customer referral programs by residential contractors. However, paying for referrals may reduce the perceived legitimacy of the trusted source referral in the eyes of the person being influenced.

For clustering analysis details, see Appendix B: Spatial and Spatio-Temporal Clustering Analysis of Project Locations. For contractor survey results, see Appendix C: Results of the Residential Contractor Survey.

MARKETING CHANNELS

Not surprisingly, the more ways a resident heard about the program, the more likely they were to get a checkup. However, the number of ways they heard did not impact the decision to upgrade, and no particular marketing channel influenced the decision to get an upgrade. At various times, marketing messaging was complicated by telemarketers, unrelated to the EP program, who called residents to market solar and other efficiency measures under a generic federal program funding message.

For complete methods and analysis of residential participation rates and factors, see Appendix E: Behavioral Elements of Energy Use and Participation in Energize Phoenix, and Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings. Also, for more insight on residential contractors and marketing, see Appendix C: Results of the Residential Contractor Survey.

LESSONS LEARNED

Residential customers are best reached by targeted messaging.

- An education campaign touching on building science and the surprising realities of home energy loss may engage pro-environment residents to participate at a higher rate and save more energy than they are already doing. Baseline energy use may help identify these potential customers.
- For those motivated by national energy security, targeted appeals could be incorporated by contractors into their delivery of checkup results and proposals for upgrades. This approach should be used with caution and focus group testing, as the San Diego BBNP grantee experienced a negative reaction to such appeals with military family audiences. It is also possible that there is a difference in response between active and retired military audiences.
- For those motivated by keeping up with others, comparisons to local average energy use or case studies of neighbors may help convert.
- Swimming pool owners who show interest in whole home performance programs represent a highly qualified cross-marketing opportunity for pool pump replacement programs.

More needs to be understood about converting low-income participants into upgrade customers.

- Household income did not prove to play a role in receiving checkups. However, the $99 EP rebate, which made the checkups zero net cost, eliminated all financial hurdles except for the $99 out-of-pocket cost until the rebate arrived.
- Either the low-income programs did not sufficiently match their needs, they were not marketed effectively during the sales process, or the application process was too challenging for residents to follow through with upgrades. Additional analysis of final program data may reveal more insights.

Marketing Research: Commercial Participation

Marketing Research: Commercial Participation

The commercial programs differed from the residential in that there was no distinct checkup level of participation; organizations either upgraded or did not. To uncover participation trends, the research team analyzed commercial participation and energy usage data against survey responses and business data from the National Establishment Times Series (NETS) database[6].

As with residential participation patterns, many of the factors analyzed by the research team had overlapping effects; participation patterns may be explained by a combination of these factors, rather than by one independent variable. Energize Phoenix used multivariate statistical analyses to better understand companies' decisions to upgrade.

BUILDING OWNERSHIP

Building ownership was the biggest factor influencing commercial participation in Energize Phoenix, according to analysis of survey responses. Building ownership increased participation rates by almost twelve times over leasing. Low participation among lessees is likely due to limits on decision-making authority and to the issue of split incentives (who invests and who benefits), which continues to hinder the energy efficiency upgrade market. For instance, a building owner may have little motivation to install or upgrade to a high efficiency air conditioning system if tenants pay for the utility bills. The building owner does not directly benefit from the investment.

NUMBER OF EMPLOYEES

Over 77% of organizations within the Energize Phoenix Corridor have five or fewer employees. However, organizations that participated in Energize Phoenix had slightly more employees than organizations that did not participate, according to NETS data. With each additional employee, the probability of upgrading increased by 0.001%.

MINORITY- AND WOMAN-OWNERSHIP

A larger percentage of participating (vs. non-participating) organizations were minority-owned (7.7% vs. 2.1%), and a larger percentage were woman-owned (8.3% vs. 5.0%), according to NETS data (Figure 7). When considered alongside all other characteristics studied, minority-ownership doubled the probability of upgrading. However, there is not enough statistical confidence to say woman-ownership significantly increased the probability of upgrading.

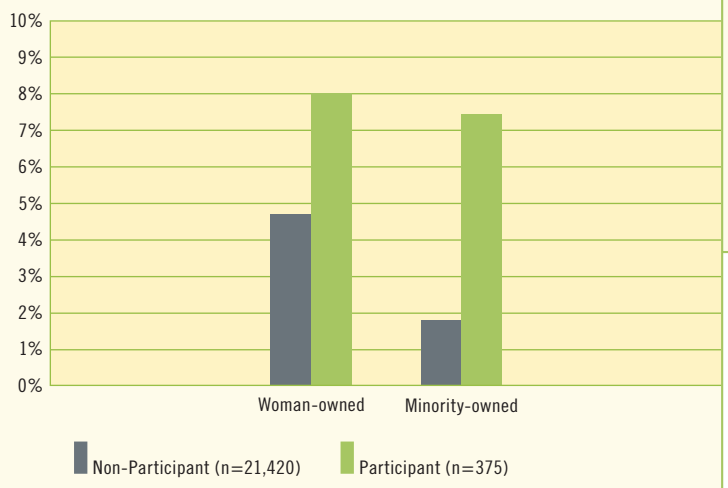
Neither group of businesses was targeted specifically by Energize Phoenix program marketing. English- and Spanish-speaking surveyors from ASU canvassed the Corridor in bilingual teams. It is not known whether any contractors specifically targeted either group of businesses.

It should be noted that analyses using Energize Phoenix primary survey data rather than NETS data found woman-owned businesses to have under-participated in the commercial programs. However, the NETS database contains a vastly larger data set, and the researchers believe it to be less likely to have respondent bias on this topic.

A combination of other factors could explain why woman-owned establishments might participate at a higher rate than non-woman-owned businesses. For instance, in the Energize Phoenix Corridor, women own disproportionately more businesses in industry sectors that had a higher propensity to get upgrades, and their companies are also more often minority-owned. As a counter-balance, woman-owned

businesses are less likely to be structured as corporations or non-profits, yet corporations and non-profits had a higher propensity to get upgrades.

FIGURE 7: COMMERCIAL PARTICIPATION AND CORRIDOR PRESENCE BY WOMAN-OWNED AND MINORITY-OWNED STATUS



Source: ASU Global Institute of Sustainability

LEGAL STRUCTURE OF ORGANIZATION

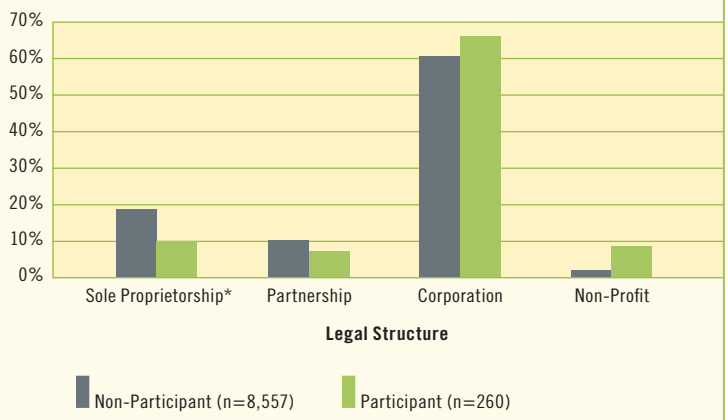
A larger percentage of participating organizations were corporations or non-profit organizations; non-participating organizations were more likely to be sole proprietorships and partnerships, according to NETS data (Figure 8). Being a corporation increased the likelihood of upgrading by 2.1 times, while non-profit status did so by 3.5 times, relative to a sole proprietorship structure.

Corporations and non-profits are legally more separated from individual owners, relative to sole proprietors and partnerships, for which taxes and other liabilities flow to the individual owners. It is possible that corporate or non-profit ownership provides a greater degree of protection to decision-makers against any risks (including responsibility for borrowed capital) associated with upgrade investments. Non-profit organizations may be more attuned to upgrading for societal reasons. Corporations may also have more experienced and sophisticated management to evaluate upgrade offers than partnerships and sole proprietorships.

BUSINESS SECTOR

More than half of commercial participants (54%) were drawn from four business sectors – retail, real estate, other services (excluding public administration), and lodging and food services, according to NETS data. Researchers grouped

FIGURE 8: COMMERCIAL PARTICIPATION AND CORRIDOR PRESENCE BY LEGAL STRUCTURE

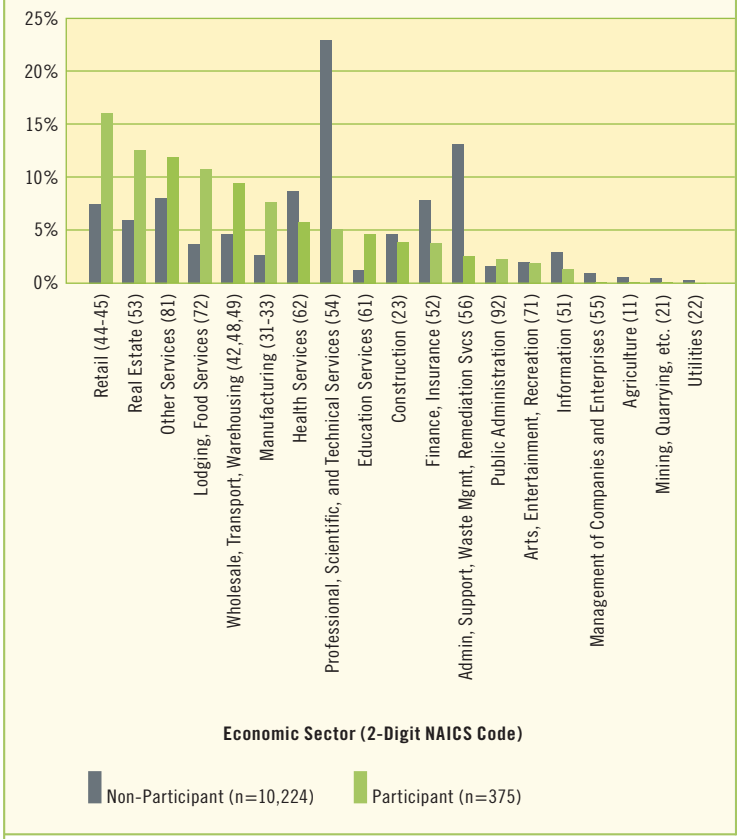


Source: ASU Global Institute of Sustainability

organizations into these sectors (Figure 9) by using codes established by the U.S. Census Bureau's North American Industry Classification System (NAICS).

Several blue-collar industries such as manufacturing, wholesale, transport, and warehousing signed up for upgrades at a disproportionately high rate, as did some customer-oriented sectors such as retail, real estate, education services,

FIGURE 9: COMMERCIAL PARTICIPATION AND CORRIDOR PRESENCE BY ECONOMIC SECTOR



Source: ASU Global Institute of Sustainability

lodging and food services, and miscellaneous other services (including many non-profit or religious organizations).

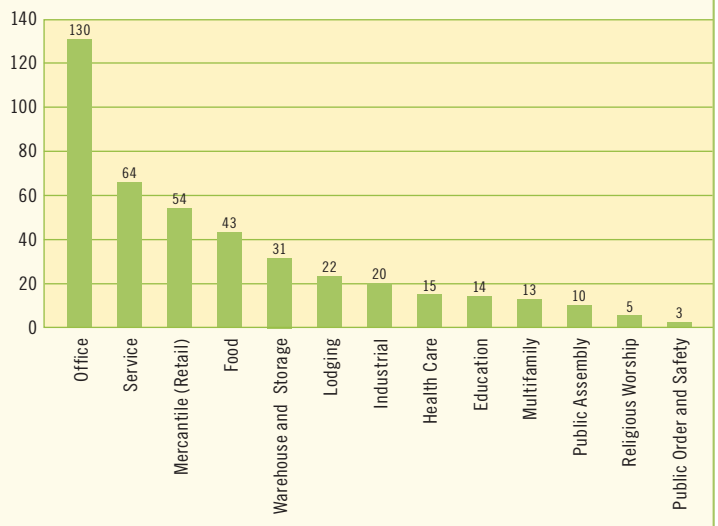
In contrast, business services and information companies upgraded at a disproportionately lower rate than their population would indicate, with the exception of real estate companies. This low participation rate is somewhat surprising given the technical expertise available in these kinds of information, scientific, and management companies.

Construction businesses participated at about the same rate as the corridor as a whole, and so provided a reasonable gauge by which to measure other business sectors. Relative to the construction industry, wholesaling businesses were 140% more likely to upgrade, retail and manufacturing were about 90% more likely to upgrade, and real estate and lodging/food services were about 60% more likely to upgrade.

Other economic sectors were less likely to participate relative to construction. Information businesses were 70% less likely to participate; finance, insurance, professional, scientific, and technical services were 80% less likely to participate; and administrative, support, waste management, remediation, and health services were about 55-60% less likely to participate.

Generally speaking, businesses that sell goods or services to the public and the manufacturers and wholesalers that supply them participated at higher rates than their percentage of the population would suggest. Meanwhile, businesses that provide more professional, financial, and technical services under-participated.

FIGURE 10: NUMBER OF COMMERCIAL PARTICIPANTS BY CBECS BUILDING TYPE



Source: ASU Global Institute of Sustainability

This could be related to a higher motivation of retailers and manufacturers to market their business as green. Or it could be related to previous upgrade activities, the amount of access contractors have to businesses in different industries, or to variations in building ownership between industries. For instance, it is possible that the high percentage of professional, scientific, and technical services firms in the Corridor predominantly occupy office space as tenants in high-rises in the downtown core. Such tenants are often subject to upgrade decisions controlled by property management firms faced with split incentive challenges.

Because businesses in these professional services are a significant portion of the economy, understanding and overcoming their low rates of participation should be a focus of programs and further research.

BUILDING TYPE

Of all participating building types, over 30% are categorized as office buildings, according to the national classification system, Commercial Buildings Energy Consumption Survey (CBECS) (Figure 10). Approximately 40% of participants are based in service, mercantile, or food premises.

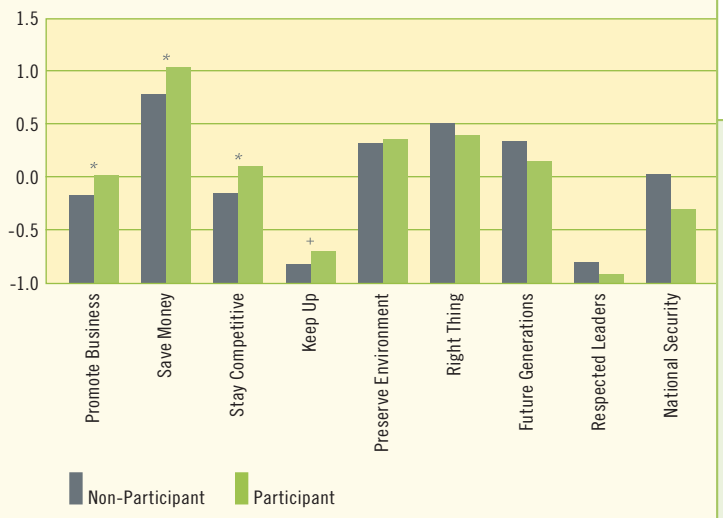
TYPE OF ESTABLISHMENT

A higher percentage of participating businesses were located in organizational headquarters or branch locations; non-participating organizations were more likely to be stand-alone establishments that were the company's only place of business, according to NETS data. This finding was not statistically significant when analyzed together with other characteristics.

BUSINESS MOTIVATIONS

Business reasons appear to have trumped environmental reasons for getting upgrades, according to survey responses. Participants were more likely than non-participants to report saving money on electricity bills, making the business more competitive, promoting the business as environmentally responsible, and keeping up with what other businesses are doing as important motivations for saving energy. Organizations with stronger business motivations also used more energy pre-upgrade. Explicit environmental motivations and attitudes were not associated with participation or energy use (Figure 11).

FIGURE 11: RELATIVE MOTIVATIONS TO CONSERVE BY COMMERCIAL PARTICIPATION STATUS



**p < 05, +p < .10. Denotes a significant or marginally significant effect of this relative motivation in predicting commercial participation status, in the logistic regression model with all relative motivations entered as predictors.*

Source: ASU Global Institute of Sustainability.

GEOGRAPHIC SIGNATURE

The research team found geographic clusters of commercial participants. When those clusters were broken down by individual contractor, two things became clear. First, many contractors appear to have successfully competed or cooperated in many of the same service areas. Second, one contractor – a contractor specializing in large-building upgrades – had the most success alone in the downtown Phoenix core.

For clustering analysis details, see Appendix B: Spatial and Spatio-Temporal Clustering Analysis of Project Locations. For contractor survey results, see Appendix D: Results of the Year Three Commercial Contractor Survey.

MARKETING CHANNELS AND SALES STRATEGIES

Businesses that participated were much more likely to have heard about EP from a contractor than from other marketing sources, consistent with the program design of having contractors lead the commercial marketing.

A door-to-door sales strategy played a key role in the success of commercial contractors, according to surveys of participants and contractors. Additionally, spatio-temporal analysis and contractor survey data demonstrates that a dedicated sales representative was an important competitive advantage for the most prolific contractors, playing more of a role in commercial customer participation than did word of mouth.

However, many of the most prolific contractors sold only small lighting upgrade projects. The sales strategies they employed may not have translated successfully to projects with large clients or to selling deeper retrofits.

SUPERMARKET SAVES A BUNDLE THROUGH UPGRADES

A local upscale Asian supermarket decided to take advantage of Energize Phoenix when the store's manager first heard he could save his store a lot of money through the upgrade program. Two contractors had stopped by the store to discuss energy savings opportunities.

After an evaluation of the facility by one of the contractors, the store manager went with upgraded motors, controls, and lighting in all the walk-in and open-air coolers, predicted by the contractor to save 282,183 kWh a year – about $25,000 in electricity costs. The upgrades cost $76,604, but APS rebates of $54,718 and Energize Phoenix rebates of $18,293 brought the final cost down to only $3,593, implying a simple payback of less than two months.

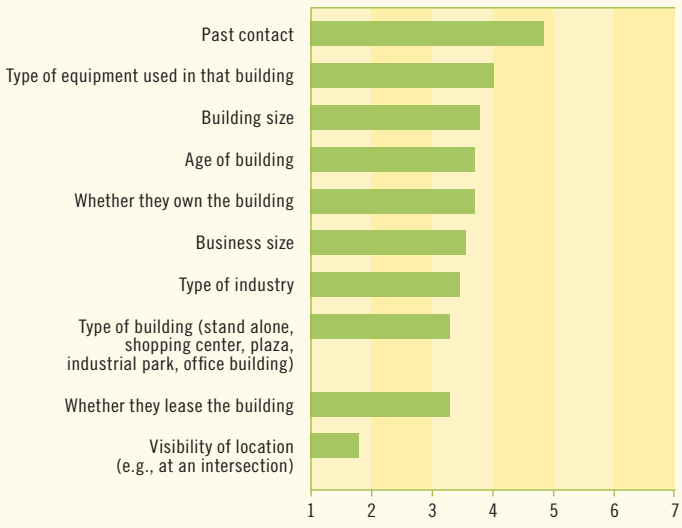
While evaluated savings calculated by ASU have not matched pre-upgrade estimates, the store manager is more than satisfied. He has noticed not only lower bills but also that he no longer spends money on labor and materials to replace lights in the food cabinets, which now have long-lasting LED bulbs. Participating in Energize Phoenix really paid off for this small business.

Indeed, commercial contractors indicated that having past contact was the most important factor in assessing prospective clients (Figure 12). One contractor commented that, "many large (>50,000 sq. ft.) buildings are managed by a few facilities management companies who do not really cooperate." In large buildings, relationships with existing facilities management or energy service companies may be more important than door-to-door sales.

There was a wide discrepancy in how accurately contractors predicted energy savings, which could have played as much or more of a role in their sales success than door-to-door sales or dedicated sales representatives. As described in the Energy and Emissions Savings section, several of the most prolific contractors dramatically over-predicted energy savings as compared to evaluated savings using billing analysis on an individual building level.

For complete methods and analysis of commercial participation rates and factors, see Appendix F: Commercial Participation Factors, Appendix E: Behavioral Elements of Energy Use and Participation in Energize Phoenix, and Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings. Also, for more insight on commercial contractors and marketing, see Appendix D: Results of the Year Three Commercial Contractor Survey.

FIGURE 12: CONTRACTOR ASSESSMENT OF PROSPECTIVE CUSTOMERS



Question 10 from Commercial Contractor Year Three Survey: In assessing prospective customers, how important are each of the following attributes to you? N=55 (7.7.5). X axis = Ranking score (1 = no value, 7 = high value).

Source: ASU Global Institute of Sustainability.

LESSONS LEARNED

Commercial customers are best reached by relationship-building.

- Corporations were more likely to participate than other organizations. Motivations of keeping up with industry leaders, competition, and promoting a business as green joined financial motivations as reasons to conserve energy. Combined, these findings hint at a possible strategy for marketing to smaller sole proprietors and partnerships: Create associations between energy efficiency upgrades and business success on multiple dimensions (financial growth, business sophistication, leadership, and green image).
- With minority ownership doubling the chance of participation, energy efficiency may be viewed as a viable economic development tool for strengthening minority-owned businesses.
- Non-profit organizations, which may be attuned to upgrading for societal reasons, demonstrated themselves as a natural and reliable audience for efficiency upgrades.
- Environmental and other moral motivations for conserving energy, though professed as important by businesses, did not predict actual participation. The broader implication is that businesses act in their business interests, and so increasing participation in energy efficiency or other behaviors of societal interest can either be framed to businesses in terms of how they advance their business interests, or be mandated.

Marketing Research: Behavioral Intervention

Marketing Research: Behavioral Intervention

ENERGY DASHBOARDS

Studies have shown that when people receive feedback about how much energy they use, they tend to reduce their energy consumption. To capitalize on this phenomenon, Energize Phoenix created a home energy information Dashboards program intended to help local residents save energy, while also providing valuable industry research to address a known gap between potential and actual energy savings obtained through efficiency upgrades.

The Dashboards program was originally envisioned as a straightforward opportunity to employ an off-the-shelf technical solution to an understudied population – renters of single-family homes. (Energy use behavior has been studied in owner-occupied homes and other populations.) Studying this renter population was also viewed as an opportunity to isolate energy savings garnered through feedback mechanisms from savings gained through upgrades, because renters of single-family homes were originally ineligible to participate in the upgrade programs. As the program was rolled out during Year Two of Energize Phoenix, though, complex factors converged to make the Dashboard strategy unwieldy. These factors are discussed in detail in the Year Two report.

As an alternative, the Dashboards program was modified during Year Three to examine two different participant groups: low-income renters in a City-owned apartment complex, and students housed within an ASU residence hall. In these two environments, EP avoided the primary technical issue that had plagued the Dashboards program in Year Two – needing to place equipment into the locked side of the electrical panel reserved for utility use.

Unfortunately, the Dashboards program was not as successful as hoped. Challenges included illiteracy, new technical hurdles, partial or zero participant financial responsibility for energy usage, and minimal participant historical knowledge of energy consumption patterns, among others. Results were generally inconclusive as to the overall impact of feedback devices for reducing energy usage in these two environments. However, some more specific insights were gained.

SIDNEY P. OSBORN LOW-INCOME HOUSING COMPLEX

In this cinder-block construction, City-owned, low-income housing, air conditioning dominates electricity usage during the summer. During the heaviest cooling months, researchers found no measurable impact from the Dashboards feedback devices. One reasonable explanation is that feedback on energy use has less impact during the intense heat of Phoenix summers, when air conditioning is necessary for physical comfort (cinder block provides minimal insulation value).

In contrast, energy usage feedback did have significant impact during heating months. Heat for the Sidney P. Osborn apartments is provided by gas, so heating-month electricity bills more likely reflect just lighting and plug load usage (or "baseload" usage). The feedback devices may have had a greater impact on the use of non-space conditioning electrical devices, which may have been viewed as luxuries or discretionary rather than necessities. Additionally, feedback devices may be more relevant for appliances that residents turn on and off manually, such as a lamp. Because air conditioning turns on and off automatically once the thermostat is set, the feedback provided by the Dashboard device is separate in time from the behavior of adjusting the thermostat.

The type of feedback offered by the device proved important in this study. When feedback devices were set to provide real-time cost-per-hour information, residents saved 17% of their energy usage in heating months relative to the same time period the previous year. Alternatively, displaying energy feedback in other formats (e.g., aggregated over time or real-time voltage rather than kWh), did not result in a significant impact on energy usage.

TAYLOR PLACE RESIDENCE HALL

Taylor Place is a two-tower, 352,000 square foot residence hall located on the Arizona State University Downtown Phoenix campus. Its amenities include retail areas, a fitness center, and a dining hall, as well as common areas on each floor. Energy use was measured in terms of plug-loads and lighting in individual dorm rooms, and did not include climate control or usage in common areas.

Students with more electrical devices used more electricity. Though logical, this implies that behavior change programs may draw success from focusing on ways to convince people to buy fewer electrical devices and/or buy the most efficient equipment on the market.

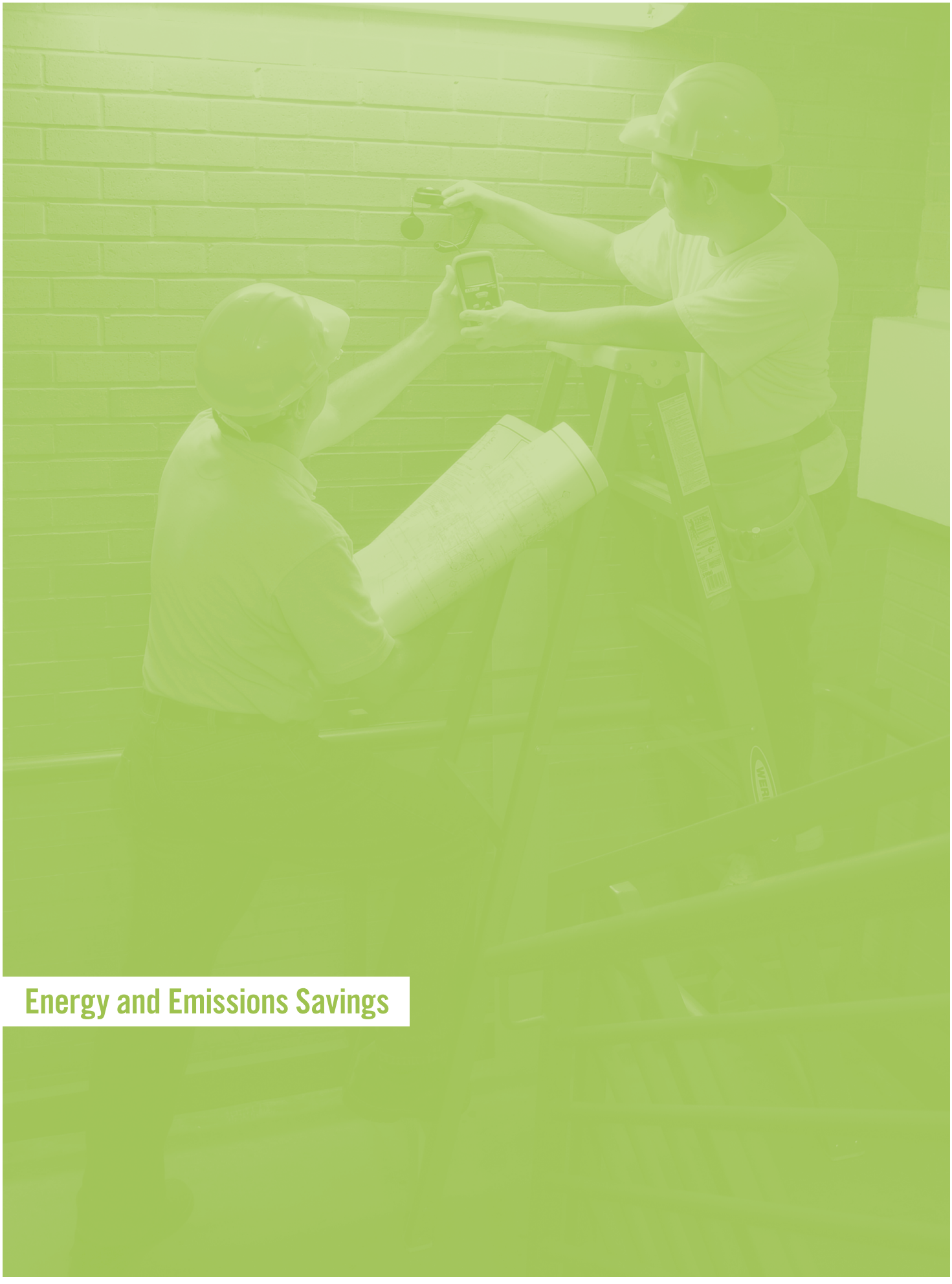
From a motivations standpoint, students who more strongly felt a broad responsibility to others tended to use less energy. Meanwhile, specific pro-environment attitudes did not predict energy consumption.

For more detail on the Dashboards studies, see Appendix G: Implementing Two Home Energy Information (HEI) Dashboard Experiments and Appendix E: Behavioral Elements of Energy Use and Participation in Energize Phoenix.

LESSONS LEARNED

Feedback is more effective when it is immediate and specific.

- Feedback is more effective when presented immediately after behavior rather than later, and in an easily understood metric. Other studies also indicate it is more effective when it incorporates known behavior change strategies such as social norms, goal setting, high social status, competitions, and community-based social marketing.
- While the value of real-time feedback is substantial, implementation will be difficult until feedback functionality becomes integrated into the home or appliances, rather than provided by bolt-on technology.
- As more “smart” appliances generate data that can be utilized to provide energy use feedback, working through standardization, inter-operability, and customer access to that data will empower behavior change programs to enable greater savings.



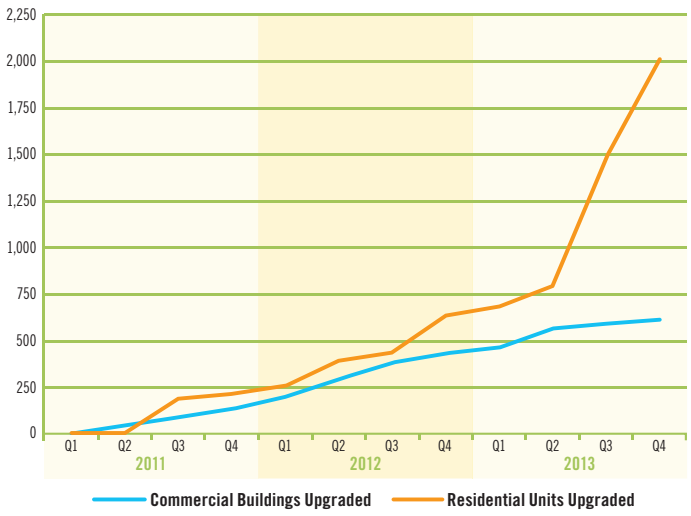
Energy and Emissions Savings

Energy and Emissions Savings

According to City of Phoenix pipeline projections, Energize Phoenix is on track to exceed its goals of upgrading 1,700 residential units and 30 million square feet of commercial, industrial, and institutional space. The program is also on track to significantly exceed its target of cutting carbon emissions by 50,000 metric tons per year, according to projections based upon econometric estimates applied to both completed projects and City of Phoenix pipeline projections.

Year Three of the Energize Phoenix program (2012-2013) produced a significant increase in completed project activity compared with previous years (Figure 13).

FIGURE 13: ENERGIZE PHOENIX RUNNING TOTAL OF UPGRADED UNITS BY QUARTER



Note: Commercial buildings may have experienced multiple upgrades over time, though each upgraded building appears only once in the graph.

Source: ASU Global Institute of Sustainability

It is certain that the Energize Phoenix program saved, and will continue to save, significant energy. What is less clear is what to include and not include in counting those savings, how best to count the savings, how to secure all the needed data, how to deal with incomplete and/or inaccurate data and, ultimately, how much energy was saved.

METHODS FOR EVALUATING SAVINGS

ASU researchers looked at the topic of program energy savings from three perspectives, each borrowing from, but distinct from, methods commonly used to evaluate utility efficiency programs including APS programs.

- Residential Team: The original objective of the residential research team was to quantify the energy savings achieved in individual residential projects and then compare them to the savings predicted by the contractors during the upgrade sales process.
- Commercial Team: Like the residential team, the primary objective of the commercial team was to quantify contractor-predicted versus evaluated savings attained through individual commercial energy efficiency upgrade projects. The commercial team analyzed projects completed by April 30, 2013.
- Economics Team: The primary goal of the economics team was to determine how much of participants' change in energy use could be explained by undertaking an upgrade using purely statistical methods of assessment. The team conducted this and other analyses for the single-family residential programs and, separately, for the commercial programs. The economics team analyzed projects completed by March 31, 2013.

In this report, savings calculations made by the commercial team are referred to as "evaluated savings." Calculations by contractors are referred to as "contractor-predicted savings." Those made by the economics team are referred to as "estimated savings," and any calculations that involve forecasts based upon a combination of actual historical data analysis and projected future data is referred to as "projected savings."

It should be noted that the claimed savings from APS programs reported to the Arizona Corporation Commission (ACC) are based on estimated savings from end-use metering on a sample of customers as well as on-site inspections and walk-throughs done by independent third-party evaluation contractors.

Due to budget requirements that reporting be completed by the end of the grant award period, researchers were limited to analyzing only projects completed through spring 2013, rather than all projects slated for completion by the September 30, 2013, program deadline. Where noted, analyses were applied to City of Phoenix pipeline projections to forecast final results.

RESIDENTIAL ENERGY SAVINGS

Compared with participation in the commercial programs, which started quickly at the end of Year One, residential participation took time to ramp up. As of March 31, 2013,

Energize Phoenix contractors had completed upgrades on 219 single-family homes (as compared to 7 during all of Year Two), and 246 multi-family residential units (vs. 182). Additionally, 140 single-family homes had completed energy checkups, and 1,391 multi-family units were in the upgrade or application process. Many of these upgrades were expected to be completed before the end of the program on September 30, 2013.

Each residence that received a home energy checkup was provided 10 free CFL bulbs and two low-flow showerheads, though installation could not be confirmed. Residents who chose to upgrade selected various combinations of air sealing, duct sealing, insulation repair and enhancement, water heater replacement, solar water heater installation, window shade screens installation, and HVAC tune-up or replacement.

Residential Energy Savings Calculations – Econometric Approach

Econometric research indicates that the long-term impact of an average upgrade on a single-family residential property is a reduction in energy usage of 4.72 kWh/day (a savings of 12%), although the full impact is not evident immediately. Savings tend to grow quickly during the first two months post-upgrade then level out, perhaps as residents modify thermostat settings and adjust behavior.

For more detail, see Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings.

Residential Savings Calculations – Project Level Approach

There were insufficient single-family residential projects with a full year of post-upgrade data from which to draw many insights through project-level analysis.

As an alternative, researchers compared evaluated savings of residential participants against both program-estimated savings and savings based on various energy-software-modeled combinations of upgrade options. Unfortunately, sample sizes were still too small to draw statistically significant conclusions; the team is planning to re-run the analysis in a year when more data is available.

Energize Phoenix program estimates for upgrade savings are comparable to those found from similar programs using industry standard methods, including Building America program estimates. Still, better energy saving estimation methods are desirable, particularly for the problem of predicting energy savings in upgrades of inefficient and older pre-code housing.

COMMERCIAL ENERGY SAVINGS

As of March 31, 2013, Energize Phoenix contractors had completed upgrades on 424 commercial buildings (vs. 154 during all of Year Two). Additionally, 152 commercial buildings were in the upgrade or application process. Most of these upgrade projects were slated for completion before the end of the program on September 30, 2013.

The commercial projects outlined in this section include governmental projects, which will be examined more closely, below.

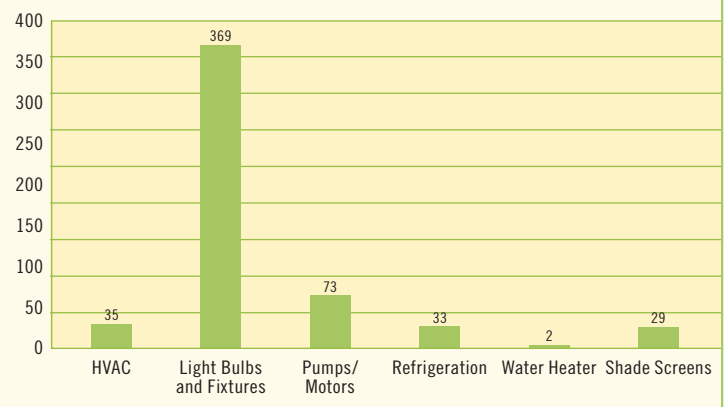
Commercial Project Characteristics

By a wide margin, lighting-only upgrades dominated the commercial programs (Figure 14). Lighting upgrades are relatively less intrusive than other upgrades and cost less per kWh saved. Since APS incentives are based upon predicted kWh saved, lighting upgrades produced a greater return on investment for participants. When Energize Phoenix rebates were added, participants' costs frequently approached sales tax only on lighting projects.

Commercial Energy Savings Calculations – Econometric Research

Econometric research indicates that commercial customers experienced an average initial reduction of 3.24 watt-hours per square foot per day (5% of average baseline energy use) after

FIGURE 14: TYPES OF COMMERCIAL ENERGY CONSERVATION MEASURES IMPLEMENTED



Source: Seidman Research Institute analysis

an upgrade. That savings grew incrementally post-upgrade, with most of the savings growth achieved in approximately the first 8 months, perhaps as customers fine-tuned equipment and modified behavior. The savings then leveled out at a long-term rate of 10.79 watt-hours per square foot per day – a savings of 17% (Figure 15).

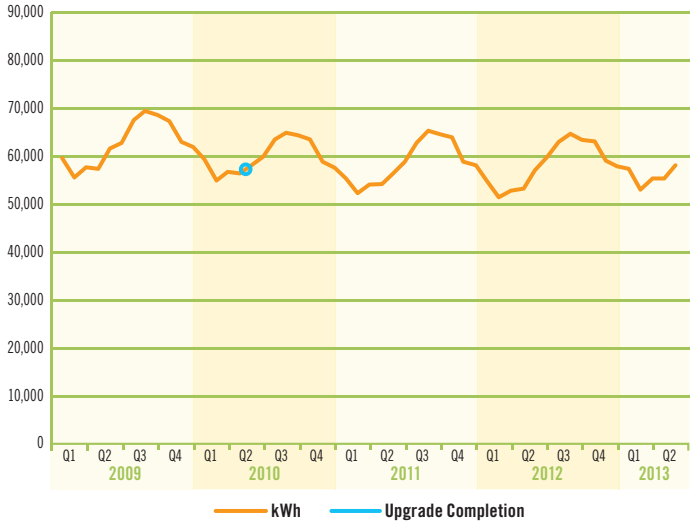
FIGURE 15: ENERGY SAVINGS EFFECT OF A COMMERCIAL UPGRADE OVER TIME

Source: ASU Global Institute of Sustainability using Seidman Research Institute analysis

How this savings dynamic might play out in an average building is illustrated in Figure 16.

It is easy to understand why an HVAC upgrade might require an average of 8 months before maximum savings are attained, as fine-tuning of new equipment can continue for a year or more. How the savings growth pattern relates to lighting-only upgrades (the overwhelming majority of projects) is not well understood.

FIGURE 16: MODELED ENERGY USAGE OF A HYPOTHETICAL AVERAGE BUILDING



Note: Model reflects historical weather data and a median 28,000 sq. ft. hypothetical building.
Source: ASU Global Institute of Sustainability using Seidman Research Institute analysis

Commercial Savings Calculations – Project Level Research

Researchers also analyzed commercial projects individually and sorted each into bins according to critical analysis characteristics. Projects were excluded from the final analysis pool if:

- The contractor predicted energy savings from the upgrade that were less than 1% or greater than 100% of the building's pre-upgrade energy use
- Less than 12 months of pre-upgrade or less than six months of post-upgrade energy data was available
- Observed discrepancies in energy data could not be resolved, including unexplained changes in patterns of use or increases in post-upgrade use

Of the 557 projects completed by April 30, 2013, 236 satisfied the analysis criteria. Energy savings were calculated two ways using weather-corrected electricity bills. Average energy savings per project amounted to 10.0%. When the energy data of all projects were combined to account for the difference in sizes of projects, the total energy savings for the 236 projects was calculated at 7.2%.

Commercial Savings Calculations – Contractor Predictions

As part of the Energize Phoenix process, commercial contractors predicted customers' potential savings using custom audits and/or other proprietary tools, including tools provided by third-party consultants to the utility. Most of these

assessments relied on equipment counts (such as lights) and called for contractor-estimated or customer-supplied information such as operating hours. Small Business program participants were required to sign off on operating hour estimates.

Contractors presented these energy savings predictions to participants on program application forms for the Small Business and custom Business programs. Because prescriptive Business program incentives were not explicitly tied to savings predictions and predictions did not appear on customer-signed program application forms, it is not certain that contractors presented their savings predictions to these customers.

Researchers compared contractor predictions to savings evaluated using the above project-level approach. Of the 236 analyzed projects, a data audit revealed that 201 had usable data regarding final contractor savings predictions. Using the 201 projects, researchers recalculated average and aggregate evaluated energy savings and found a major discrepancy between the evaluated and contractor-predicted energy savings for those projects (Table 2). This discrepancy was present whether calculated for all projects or lighting-only projects, though it was slightly greater for lighting-only projects.

Important Considerations for Predicting Savings

Some contractors generated significant energy savings and did so fairly accurately with a limited number of projects.

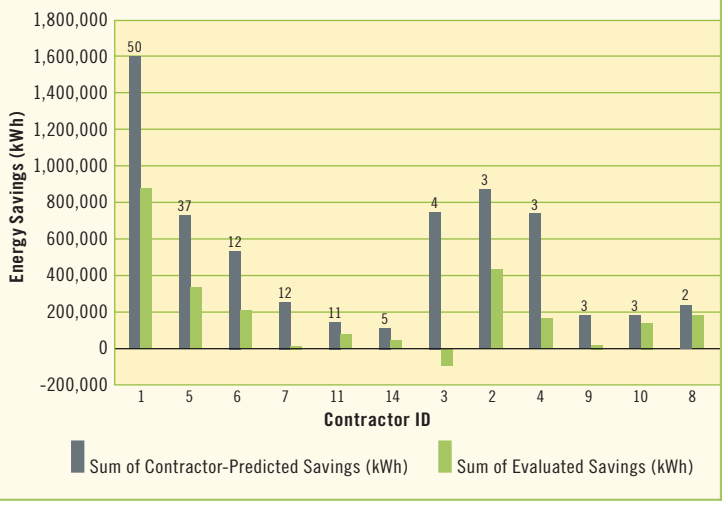
TABLE 2: SUMMARY RESULTS OF ENERGY SAVINGS PERCENTAGES

		Savings as Percentage of Aggregate Energy Use of All Buildings	Average of Individual Building Savings Percentage
Projects of all types with sufficient usable data (n=201)	Contractor-Predicted Savings	9.8	22.4
	Evaluated Savings (Weather-Normalized)	5.5	10.4
Lighting-only projects with sufficient usable data (n=161)	Contractor-Predicted Savings	11.1	23.4
	Evaluated Savings (Weather-Normalized)	4.2	10.7

Unfortunately, some contractors had large discrepancies between predicted and evaluated savings. An examination of projects completed by 12 contractors who performed the greatest number of projects – or projects with large energy savings – reveals that those with the highest number of projects also had the largest discrepancies between predicted and evaluated savings, masking the success of their more accurate but less prolific counterparts.

On-site measurements at 11 projects indicated that one significant contributing factor to over-predicted energy savings was likely overestimated operating hours in lighting projects. Eight of the 11 projects exhibited overestimates in operating hours of greater than 10%, including 2 cases with overestimates greater than 100%. These estimates could have been generated by the owner or the contractor,

FIGURE 17: DIFFERENCES BETWEEN PREDICTED AND EVALUATED SAVINGS FOR 12 PROLIFIC COMMERCIAL CONTRACTORS SORTED BY THE NUMBER OF PROJECTS COMPLETED



Note: The number of projects are indicated above the individual bars.
Source: ASU Global Institute of Sustainability

but the owner signed off on them when approving their application for submission. Owners and contractors both had a financial incentive to overestimate operating hours on their rebate applications for the Small Business and the custom Business programs.

As contractors predicted savings from lighting-only projects, several other potential sources for inaccuracies emerged. Predictions generally presumed that pre-upgrade lighting equipment was fully operational unless a burnout rate of 20% or greater was observed by the contractor or during the mandatory pre-upgrade visual inspection by the utility program staff.

Additionally, savings may have been predicted based on faulty assumptions about the type of lighting equipment in use. In some cases, differences between equipment types are not discoverable upon a visual inspection. In other cases, estimates may have been made based on a single type of equipment through sampling, when in fact a mix of equipment types was in use. In at least one case, incomplete data – data from only one of the four meters at a facility – was provided to the researchers to calculate baseline energy usage, thereby invalidating the percentage savings calculations for that project.

Finally, the data audit also revealed several instances in which contractors made incomplete calculations, basic math or spreadsheet errors, or read data from the wrong cell on a spreadsheet (such as kW savings rather than kWh savings).

The tools used to generate savings predictions (and their sophistication) varied widely.

Approaches to Calculating Energy Savings

The two very different research approaches to calculating energy savings each have their strengths and weaknesses.

The econometric approach, which indicated long-term savings of 17%, has the benefit of being able to use data from many more projects. It can also statistically isolate the effects of different variables that influence energy use.

Of all the variables tracked on each project, only weather changes, previous energy usage, and receiving an upgrade were found to be statistically impactful on energy usage per square foot per day. A larger pool of projects may have revealed effects from other variables, such as what kind of upgrade was undertaken.

The econometric approach does not attempt to provide physical world insight into why energy savings increased over time following an upgrade. It also does not provide insight into contractor estimation accuracy or possible ways to increase savings or improve processes.

The project-level individual building analysis approach, which indicated savings of 10%, utilizes one of four methods widely followed by the measurement and verification industry. Its multiple levels of analysis provide insight into nuances

TABLE 3: RESULTS OF ALL COMPLETED UPGRADES

	Contractor-Predicted kWh Saved	EP Rebate Amount	Final Project Cost	Number of Buildings	Number of Units	Square Feet	Rebate $ per sq ft	Rebate $ per kWh saved	Leverage Ratio
All Single-Family Homes *	647,245	$491,345	$1,008,977	219	N/A	N/A	N/A	$0.76	1.05
All Multi-Family Dwellings *	820,014	$960,710	$1,208,014	11	246	N/A	N/A	$1.17	0.26
All Commercial Buildings *	45,237,935	$5,948,477	$23,159,510	424	N/A	26,797,092	$0.22	$0.13	2.89
City of Phoenix Multi-Family Dwellings **	569,207	$654,100	$718,257	2	N/A	140,832	$4.64	$1.15	0.10
City of Phoenix Commercial Buildings **	201,151	$915,323	$1,776,253	2	N/A	14,300	$64.01	$4.55	0.94
Other Government Commercial Buildings **	5,930,702	$519,895	$6,253,273	21	N/A	4,093,260	$0.13	$0.09	11.03

Note: City of Phoenix multi-family dwellings represent a portion of all multi-family dwellings, while City of Phoenix and other government commercial buildings represent a portion of all commercial buildings. Other government buildings include properties owned by Maricopa County, State of Arizona, Arizona State University, and Maricopa County Community College District, but do not include K-12 schools. Leverage ratio, calculated as (cost-rebate)/rebate, is the amount of investment in a project by other sources of funds relative to the amount of investment of program dollars.
** Projects completed through March 31, 2013*
*** Projects completed through July 26, 2013*
Source: ASU Global Institute of Sustainability.

and factors that impact results. This approach is useful for analysis of contractor estimation accuracy.

Because the usable pool of projects is a subset of all participants, the evaluated savings may differ from those that could be generated were more projects usable. If more projects had had sufficient post-upgrade data, researchers may have discovered, for example, differences in the savings achieved by later projects – a finding that could reflect differing project characteristics.

When the pool of 236 projects dropped to 201 in order to assess contractor savings predictions, a bias could have been introduced because the dropped projects consisted of multiple-upgrades or large-building upgrades, and all of them were from the prescriptive Business program. This potential bias would not impact the 10% average evaluated savings figure, as it was calculated on the larger pool of 236 projects.

While the econometric approach isolates the effects of different factors, the project-level analysis approach relies on the portfolio effect, in which individual, non-systemic variations between projects cancel each other out over a large pool of buildings; for example, one building experiences an increase in the number of occupants while another experiences a decrease. Potential systemic variations that may impact the entire portfolio over time, such as weather, energy creep, and changes in the economy, are examined individually for potential bias and accounted for as necessary. Weather is the only systemic variation that was found by the econometric approach to have an effect on energy use and was corrected for in the individual project approach.

Both approaches differ from the method APS uses to generate savings estimates for reporting purposes to the ACC. APS' approach consists of using "deemed" savings estimates based on savings of prior similar projects and verified by field data collection and research to modify the initial estimates.

More inter-disciplinary research and analysis are needed to understand the reasons behind the difference in results of the two approaches (10.0% and 17% average savings per project). It is possible that the 10% correlates to some averaging of the initial 5% effect and long-run 17% effect indicated by the econometric model. To this point, using the formula derived from the econometric model, an average building would have captured 11% annualized savings by the six-month mark post-upgrade and 13% annualized savings by the twelve-month mark. In any case, it is clear that more savings are practicably achievable through deeper retrofits and are needed to achieve international carbon reduction goals.

For more information on the energy analysis of nonresidential buildings, see Appendix H: Energy Savings Evaluation of Commercial Upgrade Measures through Individual Project Analysis and Utility Bill Modeling and Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings.

GOVERNMENTAL ENERGY SAVINGS

City of Phoenix and other government entities, as well as K-12 schools, also participated in Energize Phoenix. Their project numbers through March 31, 2013 are included within the Commercial and Multi-Family Residential results. However, since City of Phoenix projects during Year Three represent a significant change in cost per kWh of energy savings due to additional federal requirements, it is helpful to view government projects separately.

Governmental Project Calculations

Investment in City of Phoenix facilities improvement projects in the last year of the program will reduce final cost-effectiveness metrics for the commercial program substantially.

For all non-governmental commercial projects completed by March 31, 2013, Energize Phoenix rebates averaged $0.21 per square foot upgraded and $0.12 per kWh saved annually. For these projects, each program incentive dollar invested in a project leveraged $2.40 in customer and utility investment. The two City of Phoenix projects completed by July 26, 2013 averaged $64.01 in incentives per square foot upgraded, $4.55 per kWh saved annually, and leveraged $0.94 per program dollar.

Completed City of Phoenix projects represented lower contractor-predicted energy savings return on federal dollars than non-governmental buildings by a factor of 37. (This drops to a projected factor of 7 when seven additional City of Phoenix pipeline projects are included.) However, there is wide variation among City of Phoenix projects, with one utilizing $4.83 in EP rebates per contractor-predicted annual kWh, another at $8.30/kWh and, on the other end of the scale, one at $0.04/kWh. Investing federal program dollars directly in City of Phoenix facilities linked those projects to Davis-Bacon Act higher wage rate requirements, not just for the energy efficiency work but for the entire renovation project, raising project costs significantly. Those additional costs were covered by program funding.

Timing issues played a role in investment decisions. Two cultural facilities were undergoing major adaptive re-use renovations during the program, representing a unique

opportunity and a limited window of time to embed energy efficiency into the cultural facilities and reduce the operating costs of the associated non-profit tenants. Without EP funding, the energy efficiency upgrades would not have been accomplished. Similarly, as additional funds were transferred from the commercial financing program near the end of the grant award period and earlier decisions were made to not proactively market the commercial programs, City-owned facilities represented an opportunity to apply those resources to improvement projects that could be completed within the remaining grant award period. Finally, EP funding allowed the City to fulfill an inter-governmental commitment to upgrade a historic building for energy efficiency during a period of reduced city budgets.

The decisions and events that resulted in investment in more resource-intensive city projects substantially reduced the ultimate leveraging of program dollars with private sector sources of funds for energy efficiency purposes. In a classic trade-off, while reducing the potential private sector reach of the program, the projects appear to also be of substantial benefit to Phoenix residents, taxpayers, and the construction tradespeople involved.

EMISSIONS SAVINGS

Econometric researchers were also tasked with calculating additional program level costs and benefits. Energize Phoenix is projected to nearly double its goal to cut 50,000 metric tons of carbon emissions annually, using the econometric energy savings calculations applied to completed projects plus pipeline project estimates. Residential greenhouse gas emissions reduced through the Energize Phoenix program are projected at 486 metric tons; commercial greenhouse gas emission reductions are projected at 94,769 metric tons – a total of 95,256 metric tons. Estimates are based upon APS-specific emissions for coal and natural gas, as well as industry average lifecycle greenhouse gas emissions for nuclear and renewables.

95,256 metric tons of CO_2 is equivalent to:

- Annual greenhouse gas emissions from 19,845 passenger vehicles
- CO_2 emissions from 1,256 tanker truckloads of gasoline
- CO_2 emissions from the electricity use of 14,260 homes for one year

For more information, see Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings.

LESSONS LEARNED

Program structure is a key factor in achieving savings goals.

- The goal to reduce residential energy consumption by 30% was overly ambitious, given that EP was built upon existing utility programs that do not have that explicit goal. The Arizona Corporation Commission approves utility energy conservation measures by calculating the cost-effectiveness of each individual measure, rather than the portfolio of measures. There is no savings goal per home. Since homeowners were free to select whichever measures they desired, a la carte, they selected those measures that most appealed to them. Also, because of the ACC's cost effectiveness test method, some measures that can contribute to additional energy savings but do not pass the test are not incentivized in Arizona.
- Based upon the experience of Clean Energy Works Oregon (another BBNP grantee), if programs offer a structure of tiered incentives with higher incentive rates for customers who achieve higher overall percentage energy savings, it appears that contractors and homeowners are likely to seek greater savings[7]. Additionally, tiered incentives could support cross-marketing of pool pump or other upgrades.
- Commercial program energy savings dwarfed residential multi-family and single-family energy savings, both in

terms of overall kWh savings and kWh savings per EP rebate dollar invested. This raises questions as to how to get more residential savings more efficiently in a time when greater savings are needed from all sectors in order to reach carbon reduction targets required to avoid dangerous climate change. Should programs identify and target the worst performing existing homes? In regions with housing growth, what is the best and most cost-effective means to ensure homes are built to use the least energy? Adoption and enforcement of newer energy-related building codes? Builder incentives? Contractor education? Proper valuation of energy efficiency in the real estate transaction process? Energy use transparency tools and ordinances? Support of Zero Net Energy (ZNE) efforts?

- With ever-changing costs for solar photovoltaics and energy efficient technologies, it is also important to monitor the moving cost balance between incremental energy efficiency savings versus renewable generation of the same amount of energy.

Contractor predictions of energy savings vary widely.

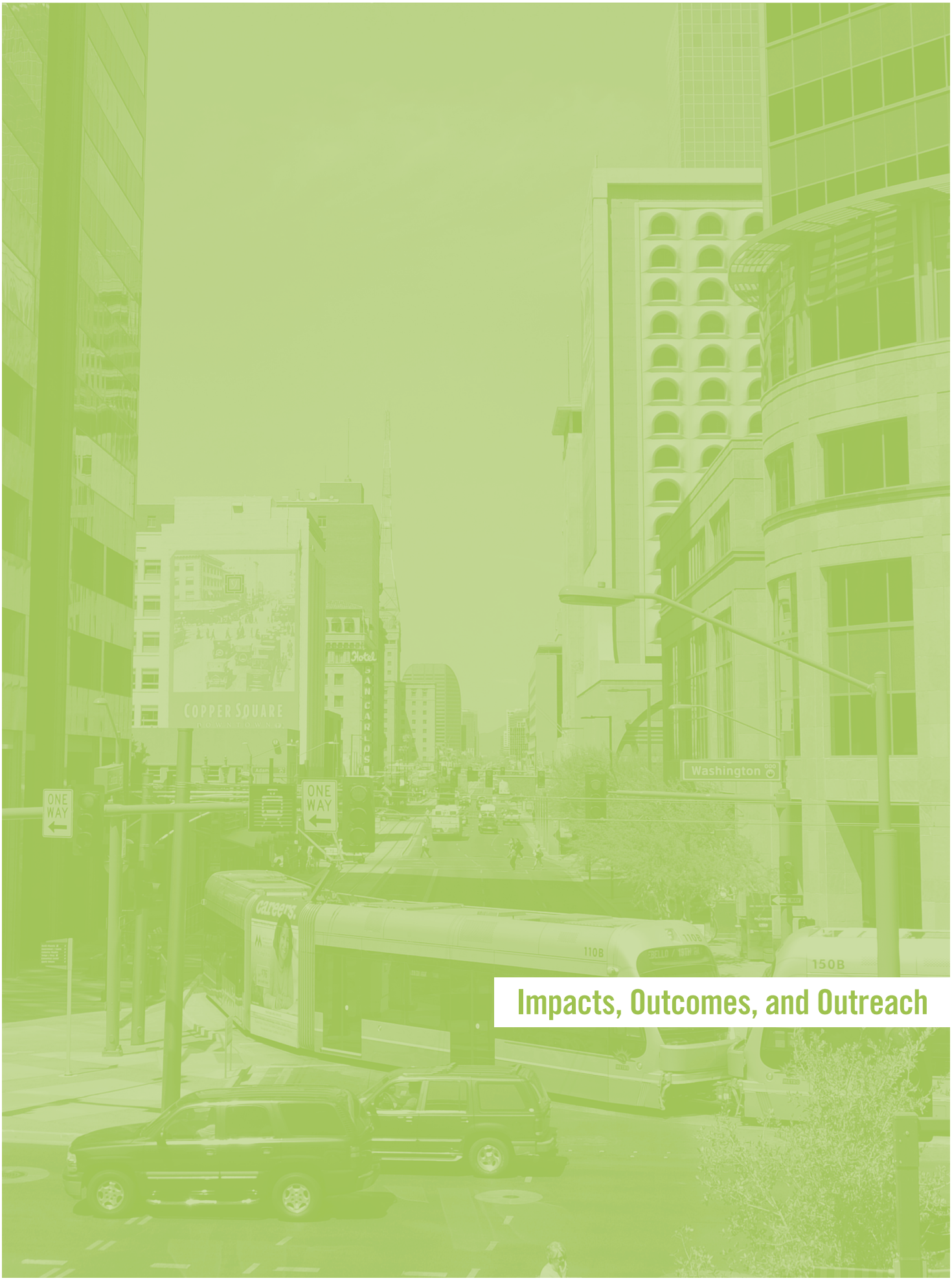
- Of the top 12 contractors in terms of quantity of projects completed, those contractors who performed larger energy upgrades did a much better aggregate job of predicting savings. This could be due to the professional level of expertise employed on these projects and/or due to the tools used for estimation. It may also relate to a higher level of review applied by clients and/or the utility to larger investments.
- Some contractors, particularly ones performing a large number of smaller lighting upgrades, did a very poor job of estimating savings, some of which appears to be attributable to overestimation of operating hours.
- The tools used by contractors to predict savings varied widely in sophistication, usability, and utility. The contractor savings reporting spreadsheet provided by EP for prescriptive projects would have benefitted from having formula-driven calculations and cross-checks to minimize math errors.
- Better methods are needed for the challenge of predicting energy savings in upgrades of inefficient and older pre-code housing. One way to improve estimates may be to mine large amounts of historical utility data on efficiency program participants, together with accurate home characteristics, vintage, construction methods, test values, and other information.

Overestimation is a known issue that hinders contractor reputations and the industry as a whole.

- Overestimation is a commonly known issue among industry stakeholders and is addressed in utility reporting of program savings to public utility commissions, but it impacts the front end of programs, the phase in which incentive payments are determined.
- Corrective and preventive actions are available. One behavioral-policing tool involves publishing contractor performance ratings, including customer ratings of the contractors, among other metrics. APS has plans to implement additional preventive measures in 2014 by eliminating contractor and building owner estimation of operating hours, instead using average operating hours by building type and sector.
- If participants have a more substantial investment in the projects and do not financially benefit from savings overestimation, they are likely to serve a stronger role as a diligent check on contractor predictions. Very high incentive levels promote undesirable behavior among those who benefit.
- Energy savings estimates will likely benefit from capturing and processing more data – through smart meters combined with energy use disaggregation software and a greater number of projects. However, more data and analysis requires more resources.

Investing in City of Phoenix buildings substantially increased program cost per unit of energy saved while also increasing wages, providing other community benefits, and reducing private sector reach.

- Investing program dollars in City of Phoenix facilities, coupled with marketing decisions, reduced the potential to leverage non-program dollars. While the City projects provided substantial benefits to Phoenix residents and taxpayers, those benefits were achieved through a trade-off regarding one of the primary Better Buildings objectives of increased participation.
- Investing program dollars in City of Phoenix facilities substantially increased cost per unit of energy saved as a result of Davis-Bacon wage requirements extending beyond the energy efficiency work and onto the entire renovation scope of some projects. The additional costs translated directly as income benefits to the workers involved on those projects during a time of economic recession.



Impacts, Outcomes, and Outreach

Impacts, Outcomes, and Outreach

OVERALL COSTS AND BENEFITS

Energize Phoenix saved its customers $12.63 million in energy costs annually, according to econometric calculations of program energy savings. Table 4 highlights various cost and benefit metrics for the Energize Phoenix program.

Researchers calculated investment payback using multiple methods. Including EP incentive payments only (excluding program administration costs, utility incentives, and customer payments), the single-family residential program (including Rebate Match, Energy Assist 60/40, and Energy Assist 100%) is projected to experience a 13.2 year payback. Adding in the contributions of all parties results in a projected payback of 29.6 years. The same calculations for the commercial programs results in projected paybacks of 1.3 and 3.8 years, respectively.

These calculations, however, do not include what the industry refers to as Non-Energy Benefits (NEBS), such as carbon reduction, increased property valuations, and environmental benefits. Other NEBS, such as comfort, durability, indoor air quality, and safety – and their resulting impacts on health and productivity – may alter the financial payback equation substantially. As an extreme but actual anecdotal example, if low-income family members avoid even occupying their home until well after sundown because they cannot afford the energy needed to make the indoor temperature tolerable, then substantial and complex losses – such as lost safety, productivity, and family cohesion –might dwarf an investment in upgrading the home.

Additionally, equipment such as HVAC systems or water heaters may need replacement because they are at end of useful life. In such cases, the incremental costs of purchasing equipment that is more efficient than code minimum is appropriate to use in calculating financial metrics, rather than total equipment cost. That level of data specificity was not available for this assessment and so total cost was used, inflating the payback timeframe estimates. Also, "free-riders" (participants who would have made the same upgrade regardless of the availability of EP incentives) and "spillover" (individuals or organizations that were influenced by the existence of the EP program to make upgrades but who did not participate in the incentives) were not tracked.

For more information, see Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings and Appendix H: Energy Savings Evaluation of

TABLE 4: ENERGIZE PHOENIX PROGRAM PROJECTED ANNUAL ENERGY SAVINGS, COST PER KWH SAVED AND CO_2e EMISSIONS

	Single-Family Residential	Commercial	Admin, Commodities & Training	Total
Program Payments	$978,765	$16,415,287	$6,994,626	$24,388,678
Local Finance		$437,806		$437,806
Utility/Customer Payments	$1,211,813	$30,603,099		$31,814,912
Total Payments	$2,190,578	$47,456,192	$6,994,626	$56,641,396
Annual Energy Savings (kWh)	689,120	134,320,000		135,009,120
Total Cost per First Year kWh Saved	$3.18	$0.35		$0.42
EP Program Cost per First Year kWh Saved	$1.42	$0.12		$0.18
Annual Dollar Savings	$73,943	$12,558,920		$12,632,863
Total Cost Payback Period (Years)	29.6	3.8		4.5
EP Incentive Cost Payback Period (Years)	13.2	1.3		1.9
Projected Average CO_2e Annual Reduction (Metric Tons)	486	94,769		95,256

Note: Multi-family projects are included in the Commercial column. Admin, Commodities & Training includes office supplies, BPI training costs, and legal expenses. Total Cost per First Year kWh Saved is calculated rather than the more common levelized cost per kWh (cost per lifetime kWh saved) because only first year savings were evaluated and the expected lifetimes of individual improvements were not tracked or evaluated. While Energy Conservation Measure (ECM) lifetimes of 15-20 years are commonly used in evaluations, many variables come into play in evaluating savings persistence.[8] APS uses a 7.5-year average life for residential ECMs and 13.6 years for commercial ECMs. Annual Dollar Savings is assessed using energy prices of 9.35¢ per kWh for the commercial sector and 10.73¢ per kWh for the residential sector.[9] Total Cost Payback Period assumes a discount rate of 0%, is based on total payments by all parties for upgrade projects, and excludes EP program administration costs, except for far right column. EP Incentive Cost Payback Period assumes a discount rate of 0%, is based on Energize Phoenix incentives alone, and does not include APS rebates. "CO_2e" is carbon dioxide equivalent – all greenhouse gas emissions are converted to the amount of CO_2 that would generate the same amount of climate change impacts.

Source: Seidman Research Institute analysis

Commercial Upgrade Measures through Individual Project Analysis and Utility Bill Modeling.

ECONOMIC IMPACT

The American Reinvestment and Recovery Act of 2009 was intended "to stimulate the economy and to create and retain jobs."[2] The USDOE Better Buildings Neighborhood Program, which funded Energize Phoenix, was fundamentally about accomplishing this goal while simultaneously reducing emissions from fossil fuels and continuing on the pathway to a clean, secure, and sustainable energy future.

Energize Phoenix is projected by City of Phoenix to ultimately process $24,388,679 in total federal payments in Arizona between 2010 and 2013. It was conservatively assumed that, if this program did not exist, all leveraged funds from the private sector (that is, the expenditures made by the participants and the utility) would have been deployed on some non-Energize Phoenix economic activity. Based on this assumption, the program created a number of economic impacts through direct program payments and the resulting indirect and induced ripples created by those funds circulating through the Arizona economy (Table 5). Almost all of these impacts were generated in Maricopa County.

It is possible that at least some private sector customer and utility payments would not have been spent on other economic activity in Arizona if the program had not existed. Total final (including completed and pipeline projects) customer and utility payments are projected by the City at $31,814,912 (Table 4), and any amount that in the absence of EP would have sat on the sidelines as savings in uncertain economic times further increased EP's economic impact. However, private sector payments were not included in the economic impact calculations, which were exclusively based on federal program payments.

Local Spending and Savings

A distinct economic impact results from customers' direct utility bill savings. The residential participant pool can be expected to save $73,943 annually on energy bills (at $0.1073/kWh) to put to use in other economic activity. More financially stable families also provide economic benefits to the housing market.

All commercial participants combined are expected to save $12.56 million per year (at $0.0935/kWh) that can be used for other purchases or passed on to customers (or taxpayers, in the case of government projects) through price-competitiveness and expanded service offerings.

TABLE 5: STATE OF ARIZONA ECONOMIC IMPACTS OF ENERGIZE PHOENIX PROGRAM EXPENDITURES

Total Employment (Job Years)	2010	2011	2012	2013
Arizona	12	55	128	219
Maricopa County	12	54	126	215
Host County as Percentage of Total	100%	98%	98%	98%

Total Private Non-Farm Employment (Job Years)	2010	2011	2012	2013
Arizona	9	43	109	198
Maricopa County	9	42	107	194
Host County as Percentage of Total	100%	98%	98%	98%

Gross State Product (Millions 2012$)	Cumulative Impact 2010-2013
Arizona	$30.92M
Maricopa County	$30.38M
Host County as Percentage of Total	98%

Real Disposable Personal Income (Millions 2012$)	Cumulative Impact 2010-2013
Arizona	$18.17M
Maricopa County	$17.43M
Host County as Percentage of Total	96%

Jobs Created

The original goal of the program was to create 1,900 - 2,700 jobs. However, this goal was calculated using a uniform federal dollar-to-job projection formula (where $92,500 of investment equals one job) that proved for grantees to be inadequate and did not distinguish between local and non-local jobs. The goal was revised mid-program to 1,000 jobs. The State of Arizona uses a more robust and dynamic economic impact model, REMI, which is widely recognized by economists to be one of the leading economic impact models in the nation.

Ultimately, Energize Phoenix was projected to create 414 job years of employment in Arizona directly through project labor, indirectly through inter-industry transactions and supplier purchases, and induced through the personal spending of employees or upstream supplier demands. This total projection encompassed every sector and industry, including public (government) employees and farm workers. The "job years" distinction is important. A "job year" is defined as one person holding a full-time job for exactly one year. This means, for example, that a City of Phoenix employee working on the Energize Phoenix program from October 1, 2010 through September 30, 2013 accounted for 3 job years, but represented only 1 job.

The private, non-farm sectors and industries estimated to benefit most from the Energize Phoenix program were:

- Construction: 38.65%
- Educational Services: 14.16%
- Retail Trade: 8.34%
- Health Care: 6.40%
- Professional and Technical Services: 6.05%

It is possible that additional employment was created via the leveraging of private sector funding that would have otherwise sat on the sidelines in a period of economic uncertainty.

EXPANDING THE GREEN JOBS WORKFORCE

The Energize Phoenix program was almost too good to be true for the energy services manager for a Phoenix area commercial contractor specializing in lighting installation, maintenance, and energy management services.

"It was not only a huge success for us, but for our customers as well. With over $1,000,000 dollars in contracts, $400,000 dollars in Energize Phoenix rebates and a combined annual energy savings well over $700,000 dollars, it made participating in the program a no-brainer," according to the manager.

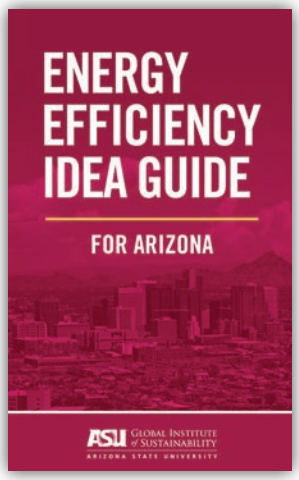
The program not only helped the contractor sign more contracts, it helped create and employ more skilled workers. "We estimate 10 additional employees were hired to get these projects completed. We actually found it difficult to find skilled labor during this time so we had to hire and train several people so we could get the work done. Now we have a larger skilled labor pool out there to pull from when we hit our busy season."

For more information on program economic impacts, see Appendix K: An Economic Impact Analysis of Energize Phoenix and Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings.

EDUCATION AND OUTREACH ACTIVITIES

Energy Efficiency Idea Guide

Above and beyond the statement of work for Energize Phoenix, ASU researched and created an Energy Efficiency Idea Guide to share great ideas with Arizona decision-makers. The Idea Guide is a collection of 46 of the best ideas from around the country to accelerate the energy efficiency market. The guide is available online at energize.asu.edu. It is searchable by stakeholder, market, or category and includes full briefs to provide the details.



The Idea Guide is as much a communication device as it is a well-researched policy resource, and at least four communities in Arizona are already evaluating

specific ideas from it. As well, other states and the USDOE have requested the raw content files so that it can be adapted to other geographic regions. While not linked to Energize Phoenix, the Idea Guide benefitted from real world experiences of utility and BBNP programs such as Energize Phoenix and many others across the country.

Multi-Family Audit Improvements

The market for multi-family weatherization in Arizona has been hampered by a scarcity of local experience in auditing multi-family dwellings and by the lack of a protocol appropriate for testing buildings in the Southwest with more than four units. The City of Phoenix EP staff took the challenge head-on by bringing an East Coast training group to Phoenix to work with local contractors and City staff. The group jointly adapted a national testing protocol to local architecture, while simultaneously training contractors in the testing process and enabling the multi-family rental program to succeed.

Saving Energy through Better Roofs

ASU EP researchers have tested eight alternative residential roof assemblies to identify the best balance between energy savings and construction costs for upgrading roofs during the regular roof-replacement cycle. By attempting to tap into the cycle of normal replacement expenditures, team members hope to grow energy efficiency organically over time while reducing the incremental costs of energy efficiency upgrades.

Roofs receive the brunt of heat gain in a hot, arid climate. Researchers have tested prototypes, and data indicates several opportunities to significantly reduce attic temperatures. Regional construction cost analysis is underway.

Contractor and Community Education and Training

Energize Phoenix also provided numerous scholarships for residential contractors at the Excellence in Building national conference held by the Energy & Environmental Building Alliance in Phoenix in September, 2013. Participants learned the most current residential building science knowledge. In partnership with other stakeholder organizations, the Energize Phoenix partners also helped organize and present a pre-conference Energy @ Home homeowner education event, as well as education sessions for industry stakeholders in Selling Green Homes and Valuing Green Homes.

The partners also participated in a Green Home Valuation Summit to chart a state roadmap for accurately valuing energy efficiency in real estate transactions. Finally, ASU, City of Phoenix, and the Southwest Building Science Training Center produced online videos to educate homeowners on common energy efficiency issues, improvements they can do on their own, what to expect from a professional, and how to select one. The videos are available publicly at energize.asu.edu and can be freely embedded in other websites.

Student Education and Training

Energize Phoenix provided an opportunity for direct education, training, and employment for 23 undergraduate students and 13 graduate students, several of whom have gone on to post-graduation career employment related to the field.

In addition, an ASU School of Sustainability capstone course, SOS 494: Energy Efficiency in Policy and Practice, was developed based on the Energize Phoenix experience. The course provided students with a broad range of exposure to energy efficiency in the built environment, from the principles of building science to industry stakeholders to policy and program design. Many of the key EP team leaders from all three major partner institutions served as guest expert lecturers, providing the full range of perspectives on the industry.

THE HUMAN FACTOR IN GREEN JOBS SUCCESS

Regina A. is a green jobs training success story. Today, she is a process engineer for a multinational chemical manufacturer and food processor in Mexico. In 2011, she was a senior at Arizona State University, working with Energize Phoenix as one of 11 undergraduate community surveyors.

She took the Energize Phoenix job to apply her research skills and learn more about energy efficiency. She didn't expect to learn about human behavior and decision-making, or how to adjust her communication strategy based on feedback.

"I expected most people to embrace a 'win-win' sustainability initiative such as Energize Phoenix, but I quickly realized that people have a variety of incentives, pre-conceptions, and cultural influences in deciding to get involved (or not). To be a successful surveyor, I learned to adjust quickly based on their feedback."

Regina uses the knowledge she gained to help her employer optimize energy use and reduce costs. She incorporates human factors and feedback into her engineering process, and her experience with Energize Phoenix gives her added credibility in energy efficiency and survey tools and methods.

Community Outreach

ASU EP team members participated in 38 educational events in 15 cities, reaching more than 1,450 residents, business owners, researchers, and industry leaders in order to share results and lessons learned. Several more educational presentations will share final program results.

LESSONS LEARNED

Energize Phoenix produced significant economic impacts with varying cost effectiveness.

- 414 job years of employment were created; less than was expected from a simplistic tool for forecasting national impacts, yet substantial for the local economy.
- The local economic impact trade-off between energy efficiency expenditures and utility expenditures from energy sales needs to be examined in more depth.
- Cost effectiveness varies according to the perspective of each stakeholder, but EP commercial energy efficiency programs were much more cost-effective and produced much greater savings than EP residential programs, based upon the results of the econometric models.
- Program resources would have produced greater savings impacts if City of Phoenix projects had been substituted with additional private sector projects enabled by additional Year 2 marketing – the trade-off being lower wage rates for the contractors' workforce.

More savings are practically achievable and needed to achieve international carbon reduction goals.

- Additional sources of energy savings in existing homes must be found (such as plug load reductions, emerging cost-effective LED lighting, behavior programs, energy transparency, and other policy changes).
- Deeper energy savings in existing homes are not likely to be achieved unless programs complement strict individual measure cost-effectiveness tests with

whole-house cost effectiveness tests and whole-program portfolio cost effectiveness tests that take into account the interactions between measures and programs. This is a research challenge, made even more difficult by the general absence of Non-Energy Benefits in most cost-effectiveness calculations.

Energize Phoenix had impacts outside the scope of the project.

- Education is a prerequisite to progress. Energize Phoenix engaged with home- and business owners, community members, contractors, students, and county and municipal policy-makers, giving them valuable knowledge about energy efficiency to permanently change the marketplace.
- As incentives are a transitional and likely not a sustainable long-term strategy, a greater role for alternatives such as policy changes, real estate transaction process changes, education, and piggybacking onto additional regular retrofit cycles represents an opportunity for continued growth in energy savings.

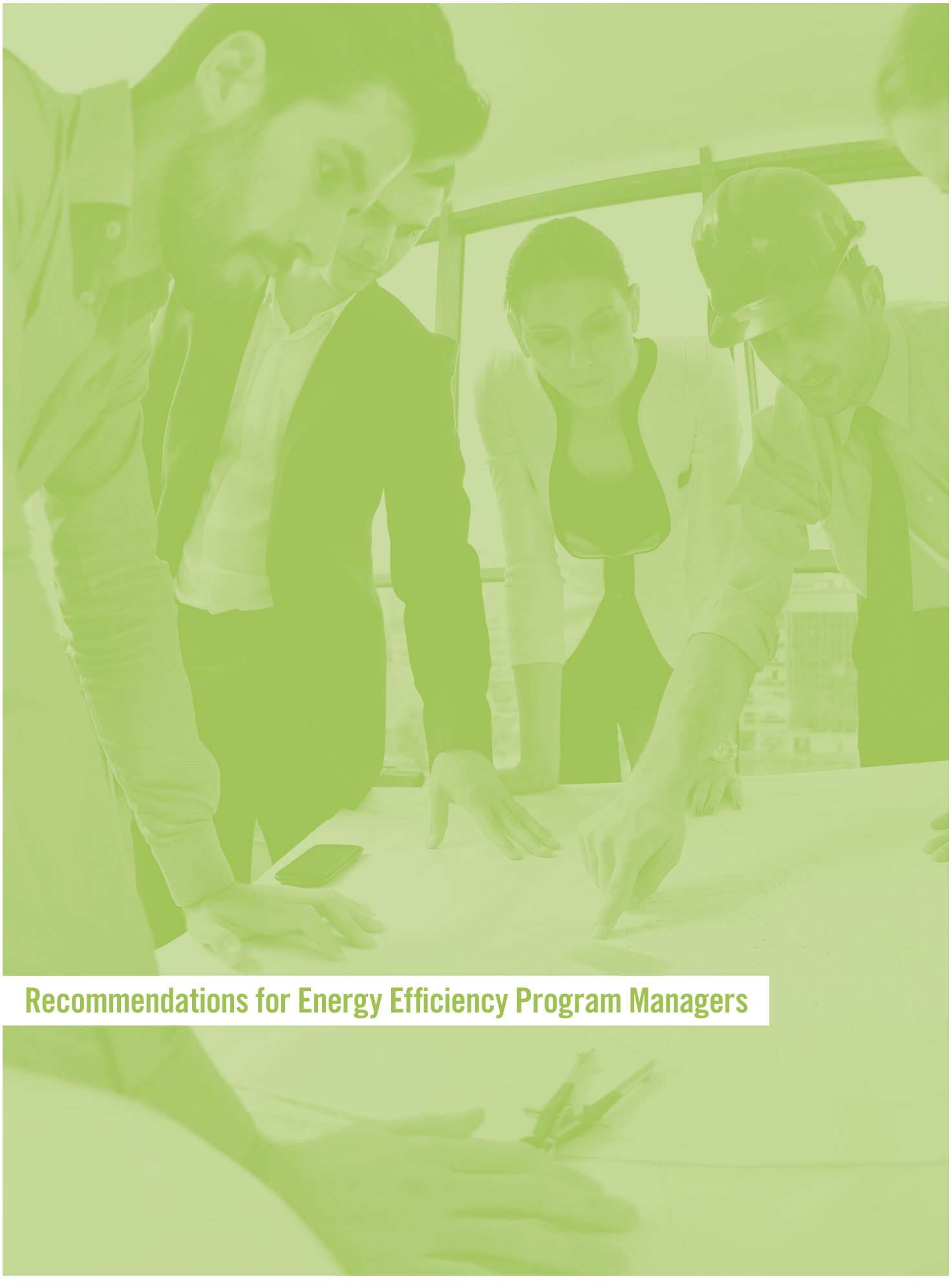
Dynamics of Stakeholder Impacts

A major goal of the federal administration was to stimulate the "green economy." Therefore, it is worth discussing some of the interactive and dynamic impacts at play in the local energy economy. Energy efficiency project labor represents local jobs – an important bonus for regions like Arizona that import almost all the fuel used to power their homes and buildings. As an economic development consideration, that labor is also highly mobile, though the buildings generating the economic opportunity are not. Energy efficiency product manufacturing represents an economic development opportunity that could be pursued with the proper tools and intention to make those jobs permanent.

Redirecting money from imported fuel purchases to energy efficiency project labor has significant local economic benefits. These benefits would become more apparent if externalities such as long-term health and environmental effects were factored into the price of imported and fossil fuels, highlighting the true costs of those fuels relative to local labor. What's more, energy efficiency projects are capital investments with additional Non-Energy Benefits, whereas fuel purchases are an ongoing expense.

Energy efficiency also saves customers money by reducing energy bills – money that would otherwise have gone to a local utility to pay for fuel purchases, generation, maintenance, overhead, shareholder profits, and/or construction of new power plants. In what is termed the "rebound effect," customers may actually spend some or all of the money they save to pay for increased comfort or additional energy-using equipment. They may also recirculate utility savings locally through deposits in a local bank or local purchases, or invest it or spend it in other parts of the country or world through financial markets or non-local purchases. Ultimately, when you compare how customers spend their energy savings with how the utility would have distributed those same dollars, local economic activity may or may not increase.

There is a real potential that utility companies will lose profits (or even not fully recover costs) from successfully implementing energy efficiency programs. For this reason, the Arizona Corporation Commission has established a lost revenue recovery mechanism for APS. However, this and other dynamics between energy efficiency goals and utility business models underscores the importance of fully de-coupling utility profits from higher energy sales.



Recommendations for Energy Efficiency Program Managers

Recommendations for Energy Efficiency Program Managers

If a policy decision has been made to promote energy efficiency, key design and implementation decisions follow. The recommendations below are primarily targeted toward local or regional government program designers and managers, but many also apply to utility efficiency program managers.

PARTNERING

Partner with affected utility companies to get the data you need.

- Secure cooperation agreements before starting energy efficiency programs; baseline data on energy usage is critical to measuring success.
- Understand the data provided – what it measures, its quality, and its limitations.
- Recognize utility companies' legitimate and serious concerns and regulatory requirements with regard to sharing private customer data.

Partner with organizations that add value to your program.

- Tap into expertise and services that your organization cannot provide alone.
- Geographically aggregate markets to gain administrative efficiencies of scale. Recognize that fewer scaling benefits may be realized when expanding into additional climate zones, jurisdictions, or fuel types.
- Partners that are relatively similar in terms of power and influence can collaborate toward better overall decisions.
- Partners' cultures and staffing capacities are as important as the function they fulfill in the energy efficiency value chain.
- Find partners who are flexible and innovative. Energy efficiency is fundamentally about changing the status quo, and the industry is in a highly evolutionary state.

Keep formal authority vested with a few key partners.

- The greater the number of partners, the more complex decision-making becomes, and the more time it takes to reach a decision.
- Understand that different institutions have different regulatory responsibilities, operating procedures, and reporting requirements.
- Consider adding an advisory board comprised of industry and customer stakeholders.

PROGRAM DESIGN

Set clear, realistic, multi-criteria, measurable goals.

- Base your goals on comprehensive research and evaluation of your market; identify opportunities for greatest energy savings and participant benefits.
- Understand the market-specific barriers that may reduce program participation and energy savings.
- Monitor results and glean actionable information from your data.
- Too many metrics can create unnecessary complexity or overburden tracking and reporting efforts; too few may create an incentive to achieve "metric compliance" rather than achieving broader desired goals.

Create measurement and tracking mechanisms before program launch.

- Programs that cannot measure success have uncertain funding futures; invest in data structure, collection, and analysis.
- Data that is not captured at the point of generation is very challenging to capture after the fact.
- Automate as much as possible so as to not overwhelm program staff with manual data processing activities.
- Consider a graphical dashboard of a half-dozen key metrics with the availability of additional drill-down metrics to provide deeper context.

Leverage existing energy efficiency-related programs and data collection processes.

- Understand that existing programs and processes may not align perfectly with your goals; consider the trade-offs of creating from scratch and adjust accordingly.

Create a sufficiently comprehensive suite of program offerings and incentives.

- Tailoring specific programs toward each target market's needs can broaden participation.
- Financial incentives result in participation, but only for as long as the incentive is offered.
- Augment with non-financial incentives – such as public recognition and social norms – to motivate individuals and businesses to participate.

- Overly generous incentives promote non-productive, counter-productive, or unethical behavior. In one case, a contractor reported that their business model was to follow incentive programs and provide the services required to access those incentives.
- Be mindful of fairness criteria to ensure all taxpayers or ratepayers have opportunities to benefit from programs.

Make the process simple for the customer.

- Shift as much of the process from the participant onto the contractor as is practical.
- Communicate only the program offerings relevant to a particular customer segment's specific needs.
- Recognize that when processes are simplified too much, they can reduce administration costs but also create loopholes that become open to abuse.
- Consider an energy concierge service to provide neutral-party information and advice.

Make the process simple for contractors and partner organizations.

- Automate application processes and capture the data for marketing analysis.
  - Consider using home performance software that is emerging on the market.
- Provide tools to allow contractors to efficiently enter checkup data from the field in order to get higher quality and more timely data, and to reduce contractor costs.
  - Support the HPXML effort to standardize data capture for analysis.
- Develop mechanisms to allow building owners and homeowners to easily provide contractors with actual energy use data during the sales/estimation process.
- Provide feedback to contractors on actual energy performance and customer satisfaction.

MARKETING

Utilize multiple marketing channels to increase reach and legitimacy.

- Provide audience-friendly educational and marketing materials on the benefits of energy upgrades as well as what to expect from a contractor.
- Get trusted sources on board early – community and religious leaders, family, friends, neighbors, colleagues, and fellow business owners – and provide incentives for customer referrals.
- Attend neighborhood association meetings, present at non-profit groups, join community events, and visit residents door-to-door.
- Visit businesses door-to-door, and capitalize on established customer relationships through dedicated sales representatives.
- Create goodwill with community leaders and influencers, and keep more dollars in the community by advertising in neighborhood newsletters.
- Include case studies and home tours early in program marketing to quickly put a human face on an abstract subject, whether for residents or businesses.
- Create community events that link target audiences with a range of contractors.

Segment your market to best customize your message.

- Utilize utility and other data to conduct your market research.
- Conduct baseline demographic, attitudinal, and behavioral surveying to inform program design and marketing messaging and to build awareness of programs.
- Target your message toward businesses and residents that represent the greatest opportunity for energy savings and related benefits while being mindful of any regulatory or political fairness criteria.

Appeal to financial motivations, but don't focus solely on them.

- For businesses, add messaging related to competitiveness, leadership, and opportunities for recognition with customers as being eco-friendly.
- For residents, conduct focus groups and/or test marketing of a variety of messages to understand which messages both resonate with and trigger residents to act.

WORKFORCE DEVELOPMENT

Create local energy efficiency jobs.

- Measure economic impact in job-years – one full year of workdays, completed by any number of workers – rather than individual jobs created.
- Use regional economic impact modeling and other tools to create a more sophisticated assessment of the number of jobs you will create.
- Consider an economic development strategy that encourages local energy efficiency equipment or materials manufacturing.

Provide contractors and their employees (or potential employees) with educational opportunities.

- Require or publicly recognize certifications and continuing education earned by participating contractors that may cover program processes, technical topics, and/or sales.
- Expand energy efficiency educational opportunities to facility managers, architects, design consultants, general contractors, and trades workers, as budgets permit.
- Consider seeding and supporting an industry stakeholder group that focuses on professional development, developing and disseminating best practices, and advocating for a policy environment that supports energy efficiency.

Implement a robust quality assurance and accountability program.

- Publicly disclose compliance requirements, consequences, and corrective actions.
- Use pre- and post-upgrade inspections through a sampling protocol to measure actual savings on a contractor-by-contractor basis.

- Educate target audiences on myths and how to spot energy efficiency scams.
- Create a publicly available system for reporting contractor performance and customer satisfaction, along with a contractor mechanism to respond.

MAXIMIZING SAVINGS

Give customers the opportunity to achieve maximum energy savings.

- Promote lighting retrofits, but think bigger; deeper upgrades are needed to reach most savings targets.
- Promote cross-marketing between contractors with different specialties (lighting, HVAC, insulation) to facilitate more comprehensive, deep energy retrofits.
- Provide referral bonuses to contractors whose projects lead to follow-on projects by other contractors with different specializations.
- Get customers in the door with low-cost or loss leader energy conservation measures, then expose them to higher energy savings opportunities.

Prevent overestimation of savings.

- Minimize or remove any financial incentive for overestimating savings: Implement prescriptive programs that are based upon average savings. Do not tie incentives to owner or contractor-provided operating hour estimates. Explore claw-back provisions or contractor penalties for systemic overestimation.
- Verify operating hour estimates with remote profiling of energy usage through new software packages.
- Allow contractors to accurately represent burned-out fixtures in savings estimations, minimizing or eliminating any penalty to customer incentive amounts.
- Provide diligent pre-upgrade spot checks to verify the type of equipment to be removed.
- Work with contractors to develop a suite of standardized commercial estimation tools that are accurate, consistent, flexible, and provide a streamlined output for easy analysis by program administrators.
- Develop an enforcement mechanism to take corrective action if abuse is taking place.

Inform customers about their energy use through feedback.

- Provide energy use data specifically, immediately, and in small increments of time. Present the information in graphical, relatable terms.

- As emerging enabling software comes to market, allow customers to opt in to services that generate appliance-specific energy usage information from whole-house energy usage patterns.
- Provide comparisons to community and neighborhood averages.
- Incorporate goal setting, teamwork, public commitments, and rewards into feedback.
- Leverage or implement the U.S. Department of Commerce-supported Green Button data initiative to increase energy use transparency and to spur the market for energy-related software innovation.

MEASURING SUCCESS

Improve measurement of cost-effectiveness.

- Measure program success on the cost-effectiveness of the portfolio of savings, rather than on the cost-effectiveness of individual measures.
- Use incremental costs to calculate cost-effectiveness, and allocate program administration costs appropriately across the portfolio of programs.
- Define and attempt to measure additional impacts beyond energy use reduction (NEBS), as well as spillover, free rider, and rebound effects.
- Focus on creating the right suite of policies to get greater energy savings with less focus on incentives. See the Energy Efficiency Idea Guide at energize.asu.edu.

Evaluate economic impact.

- Prudent energy efficiency investments reduce operating costs for businesses and families, contributing to their competitiveness and stability, respectively.
- Energy efficiency projects are labor-intensive, creating economic development opportunity.
- Energy efficiency jobs generally represent local jobs, though technology and materials may not be local.
- When evaluating economic goals and impacts, consider whether the energy use that will be displaced by your program is generated using local or imported fuel sources.

Calculate energy savings.

- There is not a single definitive way to calculate energy savings. Multiple approaches are good and provide additional insights into the factors that impact those savings. It is particularly beneficial if multiple methods converge around one number that provides more certainty to financial markets, but the other benefits of having a more comprehensive view should not be undervalued.
- Investigate the recently developed voluntary framework for evaluation, measurement, and verification created through the USDOE's Uniform Methods Project.
- Energy savings calculations methods and results depend heavily on the availability and quality of various data, labor availability to conduct evaluation, and the level of automation that is possible.

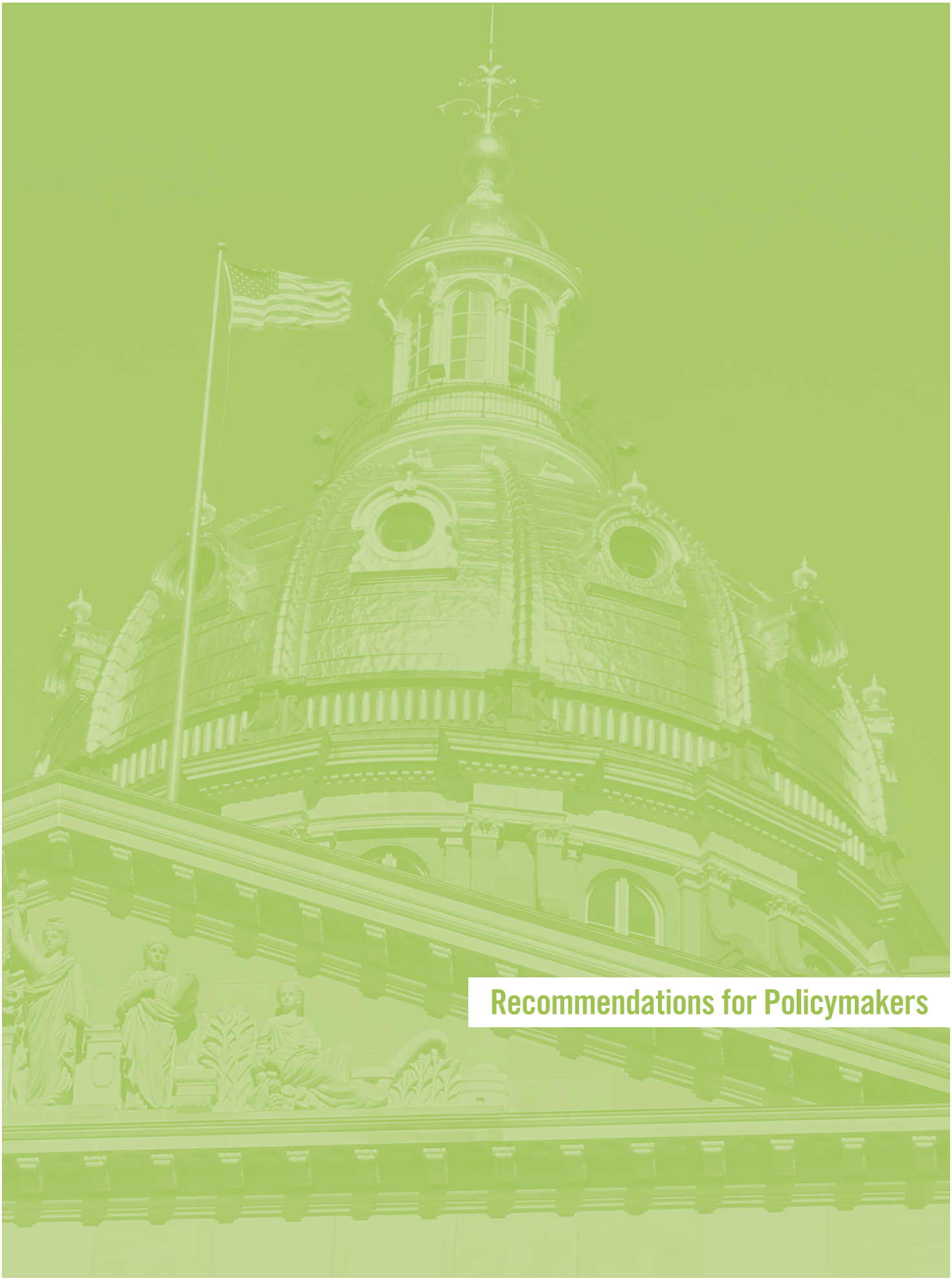
TAKING IT TO THE STREETS

Arizona State University student Bryan O. took his sustainability knowledge to the streets – or rather the buildings – of Pittsburgh. He landed an internship with the Pittsburgh 2030 District program, developing policy options to help them achieve their green building goals.

Pittsburgh's Green Building Alliance (GBA) is working to cut half of the district's energy consumption, water consumption, and transportation emissions from existing buildings and infrastructure by 2030. The program involves over 100 properties in downtown Pittsburgh.

Bryan credits his School of Sustainability capstone class, Energy Efficiency in Policy and Practice, with preparing him for a future in the green building community. The course, developed out of the Energize Phoenix experience, covered not only policy formation and implementation, but also many aspects of green building, utility operations, incentives, financing, and even human behavior.

"The capstone allowed me to identify barriers and obstacles affecting the 2030 District," Bryan recounts. "I hope my work will help Pittsburgh GBA meet or exceed their goals for this project."



Recommendations for Policymakers

Recommendations for Policymakers

The importance of the role of policymakers in creating an environment where energy is used productively instead of going to waste cannot be overestimated. Below are a few key recommendations for state and local policymakers, informed by the Energize Phoenix experience. Many more opportunities for leadership have been gathered from around the country and are available in the Energy Efficiency Idea Guide, published separately by ASU.

PLANNING

Create a comprehensive sustainability plan.

- Include energy efficiency as an ongoing initiative to develop continuity of efforts.
- Address both local government operations and the community as a whole.
- Embed the sustainability plan into the community's general plan.
- Get input and buy-in from both the community and its leadership.

Work toward a regional plan for sustainability that includes energy efficiency.

- Align with other municipalities in the region toward common goals.
- Recognize that resources flow freely across community boundaries.
- Collaborate and aggregate resources to maximize influence and impact.

IMPLEMENTATION

Select or create a program administrator who has the capacity to massively scale energy efficiency.

- Many large utilities have established energy efficiency programs and can achieve scale and consistency across a large geography.
- A third-party agency, such as a non-profit or government, can aggregate service areas and obtain funding from a wide array of sources. This may provide efficiencies of scale and consistency in processes for contractors and customers across wide geographies that cross utility service areas. It may be beneficial for small, rural utilities without the administrative capacity to run programs on their own.

Decouple utility profits from increased energy sales to create a system that promotes or is at least neutral to scaling energy efficiency.

- Traditional utility companies whose energy sales are diminished by efficiency programs face an inability to adequately recover their fixed costs and may not be able to provide an approved return on investment. A mechanism to decouple the recovery of fixed costs from the level of sales is necessary to remove this disincentive for utilities to reduce sales.
- Consider providing financial incentives to the program administrator for maximizing customer benefits from energy efficiency sales reductions in order to accelerate scaling.
- A third-party administrator that has not made large investments in energy-generation equipment and whose success is tied to energy savings rather

than energy sales does not face the same fixed cost loss recovery dilemma as utilities. However, if decoupling is not in place, that administrator's level of scaling success is still influenced by the ongoing cooperation of utilities, who continue to face the loss recovery dilemma.

Make quality assurance and accurate energy savings estimates a priority.

- Inaccurate estimates reduce investor confidence and increase the risk premiums that financiers may charge.
- Affordable financing makes upgrades more attractive, but only if potential customers believe they can actually achieve the predicted energy savings.

Make sure that incentives benefit the person who will pay for energy efficiency upgrades.

- Even with affordable financing of projects with accurate savings estimates, participation may be hindered by split incentives (who pays versus who benefits).
- Solutions such as PACE (Property Assessed Clean Energy), green leases, and On-utility Bill Financing (OBF) help to address this issue.[10]

ONGOING SUCCESS

Avoid duplication of program administration.

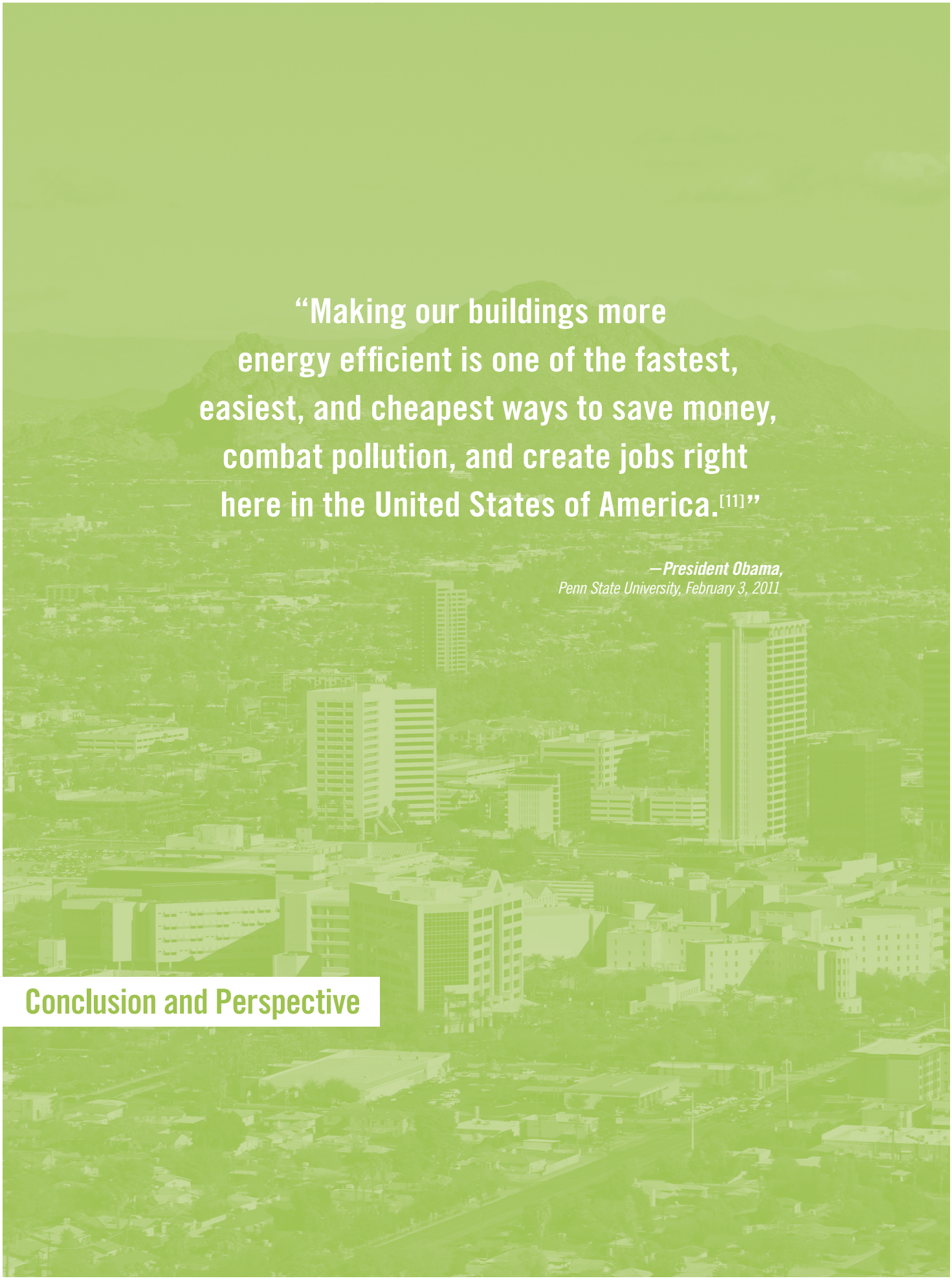
- Capitalize on existing energy efficiency incentive programs; contract with the provider for program administration.
- Drive participation to these existing programs through community education and marketing efforts. This avoids replication of processes while achieving goals for all parties.

Provide consistent and predictable funding and policies.

- Provide adequate time to build a program and recruit a qualified contractor base.
- Prevent program approval delays and funding gaps that break trust with contractors and can lead to a diminished pool of qualified contractors; workers move on to other opportunities and companies go out of business.
- Avoid lost institutional knowledge that may not be recoverable if program staff are re-assigned or leave as a result of unpredictable program interruptions.

Use both policy and education to increase energy efficiency.

- Policies such as energy use information transparency and up-to-date energy codes can have very significant impacts on energy usage while using relatively minimal government and private sector resources.
  - The Energy Efficiency Idea Guide, published by ASU, contains 46 policy and program ideas, many of which can be implemented by local governments.



"Making our buildings more energy efficient is one of the fastest, easiest, and cheapest ways to save money, combat pollution, and create jobs right here in the United States of America.[11]"

—President Obama,
Penn State University, February 3, 2011

Conclusion and Perspective

Conclusion and Perspective

Energize Phoenix experiences generated a tremendous amount of insight into what works and, more valuable, what can be done better. Hopefully, reporting on these findings will help other local governments, utilities, non-governmental organizations, and policymakers to design the most effective partnerships and programs for energy efficiency.

This report summarizes results, lessons learned, and recommendations through the final year of the Energize Phoenix award period. Readers can gather insight from additional findings and much more detail in the extensive appendices and in previous years' reports.

Efforts are underway to make subsets of the data available to other researchers, resources and privacy permitting. Additionally, ASU research teams will continue to analyze data, as APS plans to continue providing billing data for three years post-program.

The Energize Phoenix program, while ambitious and complex, was fundamentally executed as an implementation program. The revolving loan funds, the sole strategy to perpetuate the program beyond the initial grant award period, did not attract sufficient participants, and there is no plan to leverage the Energize Phoenix brand for future energy efficiency activities or policies. The program is wrapping up major operations, having saved significant energy, created some jobs, and lowered the ongoing utility bills of many local businesses and residents.

APS continues to offer its incentive programs for now, although the Arizona Corporation Commission has plans to re-examine its statewide energy efficiency policy. There is a risk that energy efficiency programs may be scaled back substantially. With the very significant achievements of utility programs and the continuous improvements made through lessons learned, this would be a serious loss to utility customers and industry jobs.

In this climate of financial uncertainty, informed policy options and effective behavior change programs become vitally important, as does detailed data analysis to identify the opportunities for maximum return on every dollar invested.

Now is the time for cities and individuals to reduce carbon emissions. The lessons and recommendations of Energize Phoenix can help inform the path forward.

Endnotes

[1] Cooper, A. 2012. Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets and Expenditures. Institute for Electric Efficiency. *http://www.edisonfoundation.net/iee/Documents/IEE_CEE2011_FINAL_update.pdf*

[2] U.S. Department of Energy. 2009. Recovery Act: Energy Efficiency and Conservation Block Grants: Competitive Solicitation: Retrofit Ramp-up and General Innovation Fund Programs. Funding Opportunity Announcement Number: DE-FOA-0000148.

[3] Per Q3, 2010 City of Phoenix Energize Phoenix Quarterly Progress Report to USDOE.

[4] Most residents and organizations were eligible. However, initially, single-family homes were required to be homeowner-occupied. Also, as APS had not launched a multi-family program, Phoenix needed to create programs to address that constituency.

[5] USDOE determined that if Phoenix issued a rebate for a completed project contracted by a private individual or other entity, Davis-Bacon Act wage rates and reporting requirements did not apply. However, if Phoenix contracted for the work, the requirements did apply.

[6] The National Establishment Times Series (NETS) database is a proprietary longitudinal database of business, job and economic data derived from Dun & Bradstreet reports.

[7] Spotlight on Portland, Oregon: Use Incentives to Get Attention and Encourage Deep Savings. *http://www1.eere.energy.gov/buildings/betterbuildings/neighborhoods/pdfs/cewo_incentives_case_study.pdf*

[8] Jayaweera, T., & Haeri, H. (2013). Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures; January 2012 - March 2013. doi:10.2172/1076653

[9] Source: U.S. Energy Information Administration, Form EIA-861, "Annual Electric Power Industry Report."

[10] PACE ties energy efficiency loan payments to the property taxes on a property and, in owner-occupied situations, ensures that both the benefits and costs of an upgrade transfer to the new owner in the event of a property sale. Green leases include provisions to allow owners and tenants to share in utility savings. On-utility Bill Financing (OBF) provides upfront capital to perform upgrades and utilizes monthly utility bills as a mechanism to collect loan payments.

[11] *Blueprint for a Secure Energy Future*. March 30, 2011. *http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf*

PRINCIPAL AUTHORS OF APPENDICES (All from ASU except where noted)

Appendix A: Marketing and Communications Final Program Detail (Michelle McGinty, Denise Resnik – DRA Strategic Communications)

Appendix B: Spatial and Spatio-Temporal Clustering Analysis of Project Locations (Elizabeth Mack, Scott Kelley, Michael Kuby)

Appendix C: Results of the Residential Contractor Survey (Will Heasley, Michelle Schwartz, Mara DeFilippis, Mick Dalrymple)

Appendix D: Results of the Year Three Commercial Contractor Survey (Will Heasley, Mick Dalrymple, Michelle Schwartz, Mara DeFilippis)

Appendix E: Behavioral Elements of Energy Use and Participation in Energize Phoenix (Michelle Shiota, Anna Berlin, Samantha Neufeld)

Appendix F: Commercial Participation Factors (Michael Kuby, Elizabeth Mack, Scott Kelley)

Appendix G: Implementing Two Home Energy Information (HEI) Dashboard Field Experiments (Harvey Bryan, Aleksasha Webster, Karla Grijalva, Shaily Rungta)

Appendix H: Energy Savings Evaluation of Commercial Upgrade Measures through Individual Project Analysis and Utility Bill Modeling (T. Agami Reddy, Karthik Thalappully, Marcus Myers, Oscar Solache Nishizaki)

Appendix I: Descriptive, Inferential and Econometric Analysis of Energize Phoenix Participation and Savings (Tim James, Alex Castelazo, Anthony Evans)

Appendix J: Energize Phoenix Finance Program Evaluation (Andrew Conlin)

Appendix K: Energize Phoenix 2010-2013, an Economic Impact Analysis (Anthony Evans, Alex Castelazo, Tim James)

All appendices and main report are available online at energize.asu.edu

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