SCREENING MARKET TRANSFORMATION OPPORTUNITIES: LESSONS FROM THE LAST DECADE, PROMISING TARGETS FOR THE NEXT DECADE

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ABSTRACT

From 1996 to 1998, several studies sought to identify the most promising targets for market transformation programs based on such factors as potential energy savings, measure cost-effectiveness, and likelihood of initiative success. As a result of that work, regional and national programs pursued many of the most promising opportunities. We begin this report by reviewing the results of the past studies and assessing how highly ranked initiatives have since fared in the market, and then we identify factors associated with success.

Markets and market transformation thinking have both evolved since the earlier studies were conducted. In order to update this work, we conducted a new screening study to identify promising market transformation targets for the next decade. The next steps in this report include summarizing this analysis, identifying the most promising initiatives, and offering recommendations for program planners and implementers.

INTRODUCTION

During the 1996–1998 period when many market transformation initiatives were first starting, several studies were conducted to identify the most promising targets for market transformation programs based on such factors as potential energy savings, measure cost-effectiveness, and likelihood of initiative success (Nadel and Suozzo 1998a). Based on this work, regional and national initiatives were developed to pursue many of the most promising program opportunities. Since this time, there have been a number of changes in the market transformation field, such as the success and ramping down of some initiatives and a trend towards greater packaging of initiatives (e.g., residential appliance initiatives instead of separate initiatives for refrigerators, clothes washers, etc.). In addition, new technologies and practices continue to be developed and the market situation for some of the previously known measures has changed. In this report, we briefly review the results of some of these previous studies and what has happened regarding high-ranked measures over the past 5 years. We then examine recent trends in the market transformation field since the last major screening studies were conducted. Next, in the bulk of this report we present an updated screening analysis and categorize the most promising opportunities. We conclude with recommendations for program planners and implementers.

THE 1990S ANALYSES

Results

A paper presented at the ACEEE 1998 Summer Study summarized the results of five screening studies conducted during the 1996–1998 period (Nadel and Suozzo 1998a). Comparative results of these five studies are presented in Table 1.

Status of High-Ranked Measures from the Analyses from the 1990s

Of the top-ranked measures across these different studies, most have been incorporated into national and/or regional market transformation initiatives, including quite a few that have made substantial progress in the market and some that have made more limited progress. Table 2 summarizes the current market status of each of the twenty measures from Table 1 that were in the top twenty in at least two of the studies from the 1990s.

Table 1. Summary of Screening Results from Five Studies from the 1990s

Measure	CEE	PG&E	NEEA	BECo	NEEP	Summary
Commissioning existing buildings	A	A	A	A	A	5A
Residential dishwashers	A	A	A	A	A	5A
Residential clothes washers	A	NI	A	A	A	4A
Packaged commercial refrigeration	B	A	A	B	A	3A, 2B
Commercial clothes washers	A	A	NI	NI	A	3A
Home electronics	A	NI	NI	A	A	3A
Residential CFLs & fixtures	B	A	A&B	B	NI	2A, 3B
Commercial new construction (integrated design)	B	B	B	A	B	lA, 4B
Traffic lights (LEDs)	B	A	B	B	NI	1A, 3B
Commercial packaged air conditioning	B	A	NI	B	B	1A, 3B
Residential central air conditioning	A	B	NI	NI	A	2A, lB
Chiller systems		A		A	B	2A, lB
Distribution transformers (dry type)		B		A	A	2A, lB
Exit signs (LEDs)	A	NI	A	NI	NI	2A
Residential electric water heaters	A	NI	A	NI	NI	2A
Residential gas storage water heaters	A	A	NI	NI	NI	2A
Building code implementation & upgrades				A	A	2A
Duct sealing	B	B	A	NI	NI	1A, 2B
Industrial air compressors			B	NI	A	1A, 1B
Residential a/c installation & maintenance	B		NI	NI	A	1A, lB
ENERGY STAR® Homes	B	NI		A	NI	1A, lB
Motor repair					A	1A
Commercial lighting (T8 lamps & electronic ballasts)	A	NI	NI	NI	NI	1A
Microelectronics HVAC optimization			A	NI	NI	1A
Industrial fans & pumps			A	NI	NI	1A
Evaporative indirect-cooler for residential a/c	NI	A	NI	NI	NI	1A

Key: A = ranked in top 10, B = ranked 10–20th, Blank = ranked but not in top 20, NI = not included in study; CFL = compact fluorescent lamp, a/c = air conditioner, LED = light-emitting diode; CEE = Consortium for Energy Efficiency, PG&E = Pacific Gas and Electric Company, NEEA = National Energy Efficiency Alliance, BECo = Boston Edison Company, NEEP = Northeast Energy Efficiency Partnerships

Source: Table from Nadel and Suozzo (1998a) based on data in BECo (1997); Nadel and Suozzo (1998b); NEEP (1996), (1997); PG&E (1997); Suozzo, Nadel, Harris, and Eckman (1998); Suozzo, Nadel, Reed, and Shepard (1998)

Table 2 also includes an assessment of the progress made over the past 5 years on these twenty measures, using a 1 to 5 scale (where 1 = little progress, 2 = some progress, 3 = substantial progress, 4 = transformation likely, and 5 = largely transformed). Overall, of the twenty measures, six are well on the way to transformation (rated 4 or 5), nine have made substantial progress (rated 3 or 3.5), and five have made limited progress (rated 1 or 2). These results are discussed further below.

Table 2. Current Status of Top-Ranked Measures from the Studies from the 1990s

Measure	Current Status	Progress Rating	1997 Likeli-hood of Success Rating
1. Commissioning existing buildings	Several small programs underway that appear promising but activity is limited.	2	3
2. Residential dishwashers	Part of many appliance programs; ENERGY STAR market share 15% in 2001.	4	4
3. Residential clothes washers	Many programs underway; ENERGY STAR market share 12% in 2001; ENERGY STAR level will become minimum standard in 2007.	5	4
4. Packaged commercial refrigeration	Significant program efforts just beginning; several manufacturers have recently announced new efficient products. California adopted standards on vending machines and commercial refrigerators in Feb. 2002.	3	3.5
5. Commercial clothes washers	Promotion programs have met with limited success but California just adopted a minimum-efficiency standard; other states contemplating similar standards.	3.5	5
6. Home electronics	ENERGY STAR has achieved substantial market share for TVs and VCRs; other home electronic programs only recently started.	3.5	3.5
7. Residential CFLs and fixtures	Sales, stocking, and product availability all up substantially; lamp sizes and prices have decreased. California adopted a torchiere efficiency standard in Feb. 2002 and the U.S. Congress is likely to follow suit.	3	3
8. Commercial new construction	Several utilities and states have successful programs, primarily based on incentives. Some states revising building codes.	3	3
9. Traffic lights	Sales of red and green LED modules have grown dramatically. California just adopted a mandatory efficiency standard and the U.S. Congress may follow suit.	4	4
10. Commercial packaged a/c	CEE Tier 1 is now ASHRAE standard; availability of Tier 2 products up substantially and sales increasing.	3.5	4.5
11. Residential central a/c	Market share of ENERGY STAR units has been stagnant but some regions achieving high market share for SEER 13; new federal standard will take effect in 2006.	3.5	4.5
12. Chiller systems	The rated efficiency of new chillers has increased dramatically but few programs pay attention to system issues; manufacturers promoting system issues more.	2	3
13. Distribution transformers	Availability of efficient transformers has increased substantially and costs are down; mandatory codes/standards adopted in four states, national standards likely.	4	4
14. Exit signs	LED signs now dominate product sales; California adopted standards and the U.S. Congress likely to follow suit.	5	5
15. Residential electric & gas water heaters	Several programs have achieved significant market share for efficient units; new federal standards take effect in 2004.	4	5
16. Building code implementation & upgrades	Many states have adopted new codes; implementation issues receiving more attention.	3	3
17. Duct sealing	Just a few programs offered, with limited success.	1	3
18. Industrial air compressors	Compressed Air Challenge has increased knowledge about and skills to upgrade air system performance.	3	3
19. Residential a/c installation & maintenance	Programs in a few regions (e.g., New Jersey and southern California) have met some success, but efforts not widespread.	2	3
20. ENERGY STAR homes	Programs increasingly being offered around the country, with market share above 10% in some states in the Southwest; participation rates lower in the North.	3	3

Finally, Table 2 includes the "likelihood of success" score from one of the 1998 studies. For the most part, 1998 predictions and 2002 progress do not deviate substantially from each other (in all but two cases they are within one point of each other). However, on average, the 2002 progress score is half a point lower than the 1998 prediction.

Lessons Learned

In general, the measures that have made significant progress over the past 5 or so years share one or more of the following attributes.

- They have low incremental cost (e.g., ENERGY STAR TVs, VCRs, and dishwashers).
- They have rapid paybacks (e.g., LED exit signs and traffic lights, CFLs, compressed air upgrades).
- They have substantial other benefits besides energy savings (e.g., LED exit signs and traffic lights have long lives, ENERGY STAR clothes washers provide improved cleaning performance, and ENERGY STAR homes can be more comfortable).
- They are generally improvements in the efficiency of an existing technology rather than a totally new technology or changes in practices or design methods (i.e., none of the energy-saving practices have a progress rating higher than 3 on the 5-point scale and several have a rating of only 1 or 2).
- They are incorporated into new codes and standards (e.g., residential and commercial clothes washers, residential and commercial air conditioners, transformers, residential water heaters, torchiere lighting fixtures, LED traffic lights, vending machines, and commercial refrigerators).

Highly ranked measures with limited progress in the market often had limited promotion efforts, in large part due to the substantial market barriers the measures face. Falling in this category are commissioning of existing commercial buildings, commercial chiller systems, residential duct sealing, and residential air conditioner installation and maintenance practices.

A few measures that have achieved significant market success over the past 5 years were either not included in the screening studies at all (e.g., building operator certification) or were not ranked highly (e.g., efficient windows), indicating some of the limitations of screening studies. Also, the fact that average progress in the past 5 years has been more limited than the 1998 predictions indicates that forecasters should be more conservative in predicting success.

OTHER RECENT TRENDS WITH MARKET TRANSFORMATION INITIATIVES

Several other recent trends in the market transformation field will effect an updated measure screening analysis. First is a trend towards greater packaging of related technologies and practices into a single initiative. Examples include ENERGY STAR appliance programs (typically combining refrigerators, clothes washers, dishwashers, and room air conditioners),

motor/motor management programs, and programs for air conditioner equipment *and* installation.

Second, there is increased interest in initiatives that seek to change management, operational, and design practices in specific market segments. Examples include programs focused on offices, schools, and hotels/motels as well as efforts to change management practices in industrial market segments. These programs have the potential for large savings, but changing management practices in a significant share of the market will not be easy.

Third, new energy-saving opportunities continue to be identified, sometimes due to the introduction of new products but often due to new ways to apply existing technologies. For example, ideas now receiving attention that were not included in the screening studies from the 1990s are variable speed furnace fans; consumer electronics with reduced standby power draws; optimization of clean room and data center facilities; and more efficient power supplies for televisions, computers, and other electronic products.

NEW SCREENING EXERCISE

Progress of, and lessons from, past market transformation initiatives, along with other recent trends, call for a new screening analysis to help identify the most important targets for the next decade. ACEEE has recently undertaken such an exercise. The results of this analysis are presented in the sections below.

Methodology

The methodology used for this new screening analysis is very similar to what was used in many of the studies from the 1990s (Nadel and Suozzo 1998a). The first step in this new study was to select a variety of possible initiatives for screening based on (1) measures from the earlier studies that are not yet common practice, (2) current initiatives, (3) initiatives now in the planning stages, and (4) initiative ideas still in the conceptualization phase. This list of initiatives to screen was also based on discussions with leading market transformation program planners, implementers, and evaluators. Some of these measures overlap with each other and there are likely to be additional energy-saving opportunities that are not included. Relative to the earlier studies, this study includes many more groupings of measures (e.g., major appliances) rather than individual measures (e.g., refrigerators). The choice of which measures to group and which to leave separate is a question of judgement; there are alternative ways to group measures than the choices used in this analysis. This study also includes updated targets for many measures—for example, the analysis of residential water heating options takes the new 2004 federal minimum-efficiency standard as its base. The measures examined in this study are listed in Table 3.

Table 3. Summary of Updated Screening Analysis—Market Transformation Targets for the Next Decade

				Savings in 2020			Cost of Saved Energy			
Measure	**Current Efficiency**	**Efficiency Target**	**Units**	**By Fuel (TBtu)**		**Total (TBtu)**	**By Fuel**	**Per Primary mBtu**	**Likely Success**	**Total Score**
Major res. appliances	federal standard	21%	savings	282	E	335	$0.014/kwh	$1.16	4.5	64
				53	G		0.859/therm			
Comm'l bldg. retrocommissioning	149	134	kBtu/sf	503	E	865	0.023/kwh	2.29	2.5	62
				362	G		0.229/therm			
Res. windows	0.64/0.65	0.33/0.44	U/SHGC	233	G	422	0.154/kwh	0.85	3.5	60
				189	E		0.015/therm			
Industrial mgmt. practices (e.g., 1-2-5)	typical plant	8%	savings	385	E	786	0.034/kwh	3.51	3	58
				402	G		0.531/therm			
Res. lighting	75	18	Watts	558	E	558	0.023/kwh	2.35	3.5	58
Res. furnace, heat pump, & a/c blowers	950	300	kWh	130	E	130	0.016/therm	1.60	5	58
Comm'l lighting	1.2	0.8	W/sf	639	E	639	0.022/kwh	2.27	3	57
Res. duct sealing/inflation reduction	avg. home	20%	H&C svgs	310	G	712	0.45/therm	1.96	2.5	57
				403	E		0.044/kWh			
Premium motors & motor mgmt.	EPAct	premium	efficiency	317	E	317	0.004/kwh	0.44	3.5	57
	typical	better	mgmt.							
Comm'l clothes washers (res. sizes)	vertical	horizontal	axis	5	G	7	0.288/therm	negative	4.5	55
				2	E		-0.012/kwh			
Comm'l furnaces and boilers	standard units	power burner		181	G	181	0.082/therm	0.82	4	54
Compressed air system improvements	typical system	30%	electric savings	473	E	473	0.015/kwh	1.53	3	54
Sector-based comm'l retrofit (e.g., offices)	15.8	13.4	kWh/sf	728	E	890	0.047/kwh	4.59	2.5	52
	0.5	0.4	therms/sf	162	G		0.361/therm			
Comm'l new construction	90.1-1999	30%	savings	330	E	470	0.043/kwh	4.01	4	51
				140	G		0.322/therm			
Power-supply efficiency	70%	80%	efficiency	79	E	79	0.006/kwh	0.62	4	50
Standby use of electronics	4	1	Watts	145	E	145	0.016/kwh	1.67	4	48
Bldg. operator training/certification	typical OM	better		62	E	113	0.006/kwh	0.63	3.5	47
				51	G		0.063/therm			
Industrial lighting	2,325	1,170	kWh	214	E	214	0.015/kwh	1.57	3.5	47
Fans & pump system optimization	typical system	20%	electric savings	543	E	543	0.027/kwh	2.80	2.5	45
Packaged comm'l refrigeration	typical equipment	43%	savings	83	E	83	0.007/kwh	0.66	3.5	45
Res. light roofs	0.2	0.55	reflectance	266	E	266	0.013/kwh	1.33	3	45
Cleanroom optimization	1.2	0.6	kW/ton	16	E	16	0.011/kwh	1.14	4	45
Comm'l pkgd. a/c (equip & install)	10.3	11.5	EER	125	E	125	0.023/kwh	2.29	4	44
Chiller systems	1	0.75	kW/ton	53	E	53	0.009/kwh	0.87	3.5	43
New homes	avg. home	30%	H&C svgs	125	E	303	0.039/kwh	4.01	4	43
				178	G		0.401/therm			
Advanced comm'l glazing	1.3/0.69	0.45/0.45	U/SHGC	122	E	267	0.03/kwh	3.01	3	42
				145	G		0.301/therm			
Res. central a/c, heat pump (equip & install)	12	16	SEER	386	E	386	0.044/kwh	4.50	3.5	40
Data center optimization	35	17.5	Watts/sf			11	0.018/kwh	1.84	3.5	36

Measure	Current Efficiency	Efficiency Target	Units	By Fuel (TBtu)		Total (TBtu)	By Fuel	Per Primary mBtu	Likely Success	Total Score
Res. gas water heating (stand-alone units)	0.59	0.62	EF	52	G	52	0.370/therm	3.70	4	34
Res. heat pump water heaters	0.9	2.4	EF	315	E	315	0.027/kwh	2.74	2	30
Built-up comm'l refrigeration	typical market	12%	savings	24	E	24	0.037/kwh	3.78	3.5	27
Res. furnaces/boilers (equip & install)	82%	90%+9%	AFUE+	162	G	162	0.479/therm	4.79	3	23
Comm'l heat pump water heaters	<100%	~225%	efficiency	17	E	17	0.021/kwh	2.13	2	20
Comm'l cooking and ventilation	typical equipment	improved		76	G	76	0.3/therm	3.00	2	18
Ground- & dual-source heat pumps	2.2	4	COP	8	E	8	0.025/kwh	2.54	2	17
Comm'l light roofs	0.2	0.55	reflectance	29	E	29	0.059/kwh	6.03	3.5	16
Transformers (dry and liquid)	98%	99%	efficiency	55	E	55	0.056/kwh	5.66	3	14
Res. combo gas space/water heating unit	82/59	90/90	AFUE/EF	85	G	85	0.543/therm	5.43	2	6

Notes: E= electricity, G = gas, comm'l = commercial, res. = residential, bldg. = building, avg. = average, pkgd. = packaged, mgmt. = management

Second, data were collected on each of the measures including current energy use and efficiency, targeted efficiency levels, the incremental cost to reach these targets, quantified non-energy costs and benefits (e.g., operations and maintenance), and measure life. The specific data collected and the sources for each data point are provided in the appendix.

Third, three key metrics were calculated for each measure—potential energy savings in 2020, cost of saved energy, and likelihood of success. Potential energy savings were calculated for the year 2020, based on energy use projections by sector and end-use from the Energy Information Administration (EIA 2000). In calculating energy savings we took into account the following:

- measure life (what proportion of the stock will turn over by 2020);
- whether the measure is appropriate and cost-effective as a retrofit measure in existing applications or whether it is more appropriate for the new construction or replacement equipment markets;
- program participation rates (we assumed 10% participation in appropriate markets in 2003, 20% in 2004, etc., up to 100% participation in 2012–2020); and
- the percent of end-use applications for which a particular measure is likely to be technically feasible and cost-effective to the end-user on a life-cycle cost basis.

Cost of saved energy is the levelized cost per kilowatt-hour of electricity saved (or per therm of natural gas) over the measure lifetime. Cost of saved energy was calculated by annualizing the cost of each measure over its life, assuming a 5% real discount rate (i.e., 5% over the rate of inflation), and then dividing by annual energy savings.[1] The cost of saved energy calculation also includes other quantifiable annual costs and benefits where these

[1] To annualize the cost of a measure, we assumed it was financed with a loan, with the loan term equal to the measure life and the interest rate equal to the discount rate.

differ between the base case and the more efficient measure case. The cost of saved energy can be compared to average consumer energy costs to determine approximate cost-effectiveness from the consumer perspective, or can be compared to the societal avoided cost of energy in order to determine approximate cost-effectiveness from the societal perspective.

Likelihood of success is a subjective measure that accounts for how likely an initiative is to be successful. It was estimated on a 1–5 scale, using a decision matrix developed by the Northwest Energy Efficiency Alliance for a 1998 screening study (Suozzo, Nadel, Harris, and Eckman 1998). Likelihood of success is high where market barriers can be overcome, progress to date is significant, benefits (energy and non-energy) are substantial, and there is a clear exit strategy. As each of these factors becomes less certain, likelihood of success declines.

Fourth, scores were calculated for each measure on a 0–100 scale, with energy savings accounting for 40% of the available points and cost of saved energy and likelihood of success each accounting for 30%. Slightly less points were allocated to the last two factors since measure economics strongly influence both of these metrics and we didn't want to overweight economic considerations. The choice of weights to apply to each measure is subjective—the choice used here is similar to those used in many of the studies from the 1990s. However, the studies also found that changes to the weighting factors generally only resulted in modest changes to measure ranks, and thus the exact choice of weighting factors is not of critical importance (Nadel and Suozzo 1998a).

Of course, there are other ways the different measures can be scored and limitations to virtually any scoring method. For example, one reviewer of a draft of this analysis noted that aggregation of related measures would increase energy savings, causing the energy savings score to increase. This is of course true, but as programs become larger and more complicated, likelihood of success will sometimes decline (in fact, several likelihood of success scores were adjusted down for exactly this reason). Also, by assigning only 40% of the maximum score to energy savings, measures with high scores on the other two measures can (and sometimes do) score highly. This same reviewer also suggested that rather than scoring energy savings and likelihood of success separately, the two figures should be multiplied (with likelihood of success recast as "probability of success") and then the results should be divided by measure cost, yielding a single score that is roughly the probability-weighted savings per dollar invested. We employed this approach as an alternative scoring scheme.

Screening Results

Results of the screening exercise are summarized in Table 3. For each measure this table includes a brief measure characterization, the value of each of the three ranking metrics, and the total score. Additional details on the data used and the sources of these assumptions are documented in the appendix to this report.

The results in Table 3 indicate a large variation in scores between the top- and bottom-ranked measures, but differences in scores between adjacent measures are generally slight. Thus, exact ranks are not especially meaningful but instead we urge readers to pay more attention to relative position in the rankings (i.e., top, middle, or bottom quartile.). Also, these rankings are based on limited data—additional investigation will be needed before deciding whether to sponsor any of these initiatives. Furthermore, these rankings are all based on national average data; at the regional level, rankings will change somewhat due to differences in climate, energy prices, sector and sub-sector energy use, and market development.

Table 4 compares measure rankings from the primary scoring method with scores and ranks from the alternative scoring method. As can be seen, results from the two scoring methods are generally similar (i.e., measures in the top, middle, and bottom quartiles are generally similar). For most measures, the ranks from the two scoring methods are within five places of each other. Only seven measures vary by more than five ranks and these measures generally have either low savings or high costs (which score lower on the alternative ranking) or low costs or high savings (which score higher on the alternative ranking).

INITIATIVES FOR THE NEXT DECADE

Based on this screening analysis, quite a few market transformation initiatives look promising for the next decade. These include continuations of many existing initiatives as well as some new areas that have not received much attention to date. Of the initiatives ranked in the top ten under the primary scoring method, four (ENERGY STAR appliances, ENERGY STAR windows, residential lighting, and premium-efficiency motors and motor management) have received extensive attention in many regions of the country over the past 5 years. The other top-ranked measures (commissioning of existing buildings, industrial energy management practices, residential furnace blowers, commercial lighting, residential ducts and infiltration reduction, and commercial clothes washers) have generally received limited or no attention of late. A similar pattern occurs for the next ten measures. Five of these measures (compressed air system improvements, commercial sector-based retrofits, commercial new construction, building operator certification, and commercial packaged air conditioning) have received significant attention in recent years, while the others (commercial furnaces and boilers, consumer electronics [standby power and power supply efficiency], industrial lighting, commercial and industrial fan and pump system optimization, and commercial packaged refrigeration systems) have received limited attention

Another way to examine the top-ranked measures is in terms of possible exit strategy, considering some of the lessons learned from successful initiatives over the past 5 years (as discussed above). Considering these success factors and exit strategies, the initiatives for the next decade fall into the following four primary categories.

Table 4. Comparison of Measure Ranks for the Two Scoring Methods

Measure	Alternative Method		Primary Method Rank	Measure	Alternative Method		Primary Method Rank
	Score	Rank			Score	Rank	
Premium motors/ management	511	1	9	Residential furnace blowers	82	20	6
Residential windows	347	2	3	Standby use–electronics	69	21	16
Major residential appliances	260	3	1	New homes	60	22	24
Commercial retrocommissioning	189	4	2	Residential central a/c & heat pump	60	23	27
Compressed air systems	186	5	12	Advanced commercial glazing	53	24	25
Residential ducts & infiltration	182	6	8	Residential heat pump water heater	46	25	30
Commercial furnaces/boilers	176	7	11	Commercial packaged a/c	44	26	23
Commercial lighting	169	8	7	Chiller systems	42	27	25
Residential lighting	166	9	5	Residential furnaces & boilers	20	28	32
Industrial management practices	135	10	4	Residential gas water heating	11	29	29
Commercial clothes washers	132	11	10	Cleanroom optimization	11	30	22
Building operator training/certification	126	12	17	Commercial cooking/ventilation	10	31	34
Residential light roofs	120	13	21	Residential combo heating units	6	32	38
Power supply efficiency	102	14	15	Transformers	6	33	37
Fan/pump system optimization	97	15	19	Built-up refrigeration	4	34	31
Sector commercial retrofits	97	16	13	Data center optimization	4	35	28
Industrial lighting	95	17	18	Commercial light roofs	3	36	36
Commercial new construction	94	18	14	Commercial heat pump water heaters	3	37	33
Packaged commercial refrigeration	88	19	20	Ground/dual source heat pumps	1	38	35

1. Measures with good likelihood of success because mandatory standards could be adopted in the next few years. For these measures, voluntary programs to promote efficient products can significantly increase the probability that strong standards will be adopted.
2. Measures with reasonable likelihood of success because they provide substantial benefits to customers (including non-energy benefits), and customers are sophisticated and relatively small in number.
3. Measures with reasonable likelihood of success because they can potentially be incorporated into building codes, but substantial market development is required before this can happen.

4. Measures for which success will be more difficult, but which have large energy savings and hence deserve increased attention.

The first and second categories hold the potential for success in the relatively short term and thus are likely to be a priority for many program operators. The third category holds promise over the medium term (building support for code changes commonly requires on the order of 3–8 years) and thus will also often be a priority. The fourth category contains higher-risk initiatives, but ones with potentially very large payoffs in terms of cost-effective energy savings. There are substantial barriers to the measures in this category and not a clear exit strategy, and thus these initiatives are likely to be long-term efforts that seek to gradually build market share. Table 5 classifies the top-ranked measures into these four categories (in parentheses are the primary ranks among all screened measures). For some measures the choice of category is clear; for other measures the choice may be subject to debate. And some measures may fall into more than one category. For example, sector-based commercial retrofits could fall into the "substantial benefits, sophisticated customer" category for some sub-sectors such as real estate investment trusts.

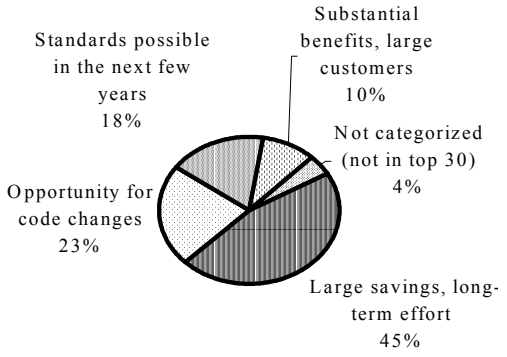
Table 5. Top-Ranked Measure by Implementation Category

Standards Possible in the Next Few Years	Substantial Benefits, Limited Number of Sophisticated Customers	Opportunity for Code Changes	Large Savings, Long-Term Effort
Major residential appliances (1)	Premium motors and motor management (9)	Residential windows (3)	Commercial building retrocommissioning (2)
Residential furnace, heat pump, & a/c blowers (6)	Compressed air system improvements (12)	Commercial lighting (7)	Residential lighting (4)
Commercial clothes washers (10)	Building operator training & certification (17)	Commercial new construction (14)	Industrial management practices (5)
Commercial furnaces & boilers (11)	Cleanroom optimization (22)	Industrial lighting (18)	Residential duct sealing & infiltration reduction (8)
Power supply efficiency (15)	Chiller systems (25)	Residential light roofs (21)	Sector-based commercial retrofits (13)
Standby use of electronics (16)	Data center optimization (28)	New homes (24)	Fan & pump system optimization (19)
Packaged commercial refrigeration systems (20)		Advanced commercial glazing (26)	Residential heat pump water heaters (30)
Commercial packaged a/c (23)			
Residential central a/c (27)			
Residential gas water heating (29)			

Note: Includes the top thirty measures from Table 3.

In the past 5 years or so, measures in the last category have received limited attention (with the exception of residential lighting), quite likely because these initiatives require long-term strategies and their success is far from assured. However, the seven measures in this category account for nearly half of the total possible energy savings from the 38 measures considered in this analysis. Thus, while these initiatives may be high risk, they also have high payoffs that may well justify the risks. This trend is illustrated in Figure 1, which analyzes the total savings potential in 2020 by implementation strategy.

Figure 1. Distribution of Potential Energy Savings by Implementation Category



While this study examines 38 possible initiatives from a program planner's perspective, when offering programs to customers it is often advisable to combine initiatives into a coherent overall marketing strategy. For example, the Northwest Energy Efficiency Alliance is now developing an overall commercial sector strategy that combines aspects of several of the measures analyzed here including the sector-based commercial strategy, retrocommissioning, and commercial lighting (Hewett 2002).

CONCLUSIONS AND RECOMMENDATIONS

A review of past screening studies of potential market transformation initiatives and the progress of these initiatives over the past 5 years indicates that many of these initiatives have made substantial progress in the market. Successful initiatives tend to promote energy-saving technologies and practices that fall into the following four categories: those with low incremental cost; those with rapid paybacks; those with substantial other benefits besides energy savings; and those that have been incorporated into new codes and standards. Of the measures that were ranked highly in past screening studies but that have made more limited progress in the market, many involve energy-saving practices. Often there have been only limited efforts to promote these measures, but where they have been promoted, market barriers have been substantial, permitting some progress but not rapid market gains.

It has been approximately 5 years since the last major screening study for new market transformation initiatives was prepared. This report summarizes a new screening study that updates the older studies with new data, new measures, and regrouping of measures based on recent trends. This new screening study indicates that there remain many opportunities for substantial energy and economic savings from market transformation initiatives. The most promising initiatives for further investigation are identified. These tend to be for technologies and practices that fall into four categories: (1) those for which mandatory standards could be adopted in the next few years, with voluntary programs helping to ease adoption of these new standards; (2) those that provide substantial benefits to customers, and which target

customers that are sophisticated and relatively small in number; (3) those which can potentially be incorporated into building codes over the medium term, but which will require substantial market development before this can happen; and (4) those with large energy savings but for which long-term efforts will be needed to overcome barriers and gradually build market share.

Technologies and practices in the first and second categories tend to be attractive to program implementers because of the potential to achieve success in a relatively short period of time. The third category also provides good chances for success over the medium term. The fourth category is higher risk, but offers potentially higher rewards, as the seven initiatives in this category account for nearly half of the potential energy savings of all 38 measures examined in this screening analysis.

We recommend that program implementers pursue the top-ranked measures in all four categories and not just concentrate on the first and second categories that have been the "bread and butter" of many market transformation initiatives. Category one (measures lending themselves to standards) is still very important because standards are only set every 5 years or so for each product—by paying attention to these measures now, program implementers can influence the next round of standards rather than having to wait an additional 5 or so years until the next standard revision. Category three and four measures (those with large savings but significant risks and those that could perhaps be incorporated into building codes in the medium term) deserve increased attention, since these measures can provide substantial savings but require time to achieve success—the sooner work on these initiatives can be started, the sooner their substantial benefits can be achieved. However, the path toward achieving these benefits is not clear, meaning that numerous pilot programmatic approaches should be tried in order to maximize chances of success.

Screening analyses, including this one, rely on many estimates and assumptions and by nature simplify complex situations. These analyses indicate promising technologies and practices that merit further investigation, particularly consideration of local market conditions. We recommend that these investigations now take place for at least the high-ranked measures from this study. We also recommend that a study of this type be repeated every few years in order to continue providing up-to-date recommendations based on the latest market data.

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