Consumer Federation of America
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TESTIMONY OF DR. MARK COOPER
DIRECTOR OF RESEARCH

ON

APPLIANCE EFFICIENCY STANDARDS LEGISLATION

BEFORE THE SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

March 10, 2011

Mr. Chairman and Members of the Committee,

My name is Dr. Mark Cooper. I am Director of Research at the Consumer Federation of America (CFA). Formed in 1968, CFA is an association of some 300 non-profit organizations, working to advance the consumer interest through research, education, and advocacy. We greatly appreciate the opportunity to appear before you today to let you know of our support for S. 398, the Implementation of National Consensus Appliance Agreements Act of 2011 (INCAAA) and to urge Congress to reject efforts to repeal appliance efficiency standards already on the books, and in this instance, S. 395, the Better Use of Light Bulbs (BULB) Act. We also think it is useful to share our overall consumer perspective on energy efficiency standards for home appliances and other consumer products.

We vigorously support the enactment of S. 398, the Implementation of National Consensus Appliance Agreements Act of 2011, to speed the adoption of appliance efficiency standards that were agreed to last year by manufacturers, efficiency, environmental and consumer groups, including CFA. We regret that the Senate failed to act on this non-controversial legislation at the end of the last Congress. And, we urge Congress to reject efforts to repeal efficiency standards that are already on the books. We support cost-effective energy efficiency standards for all appliances and consumer products that consume energy in the home.

It is noteworthy that in 2009, household expenditures on home energy, for electricity and natural gas, and other heating fuels, were $2,000, equal to household expenditures on gasoline for the first time ever. This cries out for decisive action by policymakers to support and promote increased energy efficiency standards on all fronts. Consumers and our economy will benefit.

There are four primary reasons that we have long supported energy efficiency standards for home appliances and other consumer products.

First, the energy efficiency standards are consumer-friendly. They will produce direct pocketbook savings for consumers. The reduction in the monthly bills for electricity and natural gas exceed the increase in the cost of the technologies needed to lower energy consumption. The homes in which consumers live will command higher resale because they are more energy efficient.

Second, the energy efficiency standards are technology neutral and procompetitive. The approach to minimum efficiency standards in the INCAAA bill, as well as the earlier standards adopted by the Congress for lighting, establish a performance standard, but do not dictate how those standards are met. Private sector firms compete around those standards in the marketplace, developing the technologies they think will meet the standard at the lowest price. This competition produces new goods and keeps the cost down. Declining out of pocket energy expenditures allows consumers to spend more resources on other goods and services, which grows the economy.

Third, energy efficiency standards are the most effective way to correct the undervaluation of energy efficiency in the residential market. The U.S. needs to lower its energy consumption and consumers need to reduce home energy expenditures, but numerous imperfections in the marketplace prevent consumers and the nation from getting to the optimum

level of energy efficiency. Raising minimum efficiency standards lowers the supply-side risk of investing in more efficient technologies for appliance manufacturers and helps new products get to scale more quickly. They address critical gaps in the valuation of, information about, and motivation to adopt energy saving technologies.

Finally, minimum standards for home energy consumption enjoy widespread public support, which makes an even more compelling case for S. 398, which includes several consensus agreements that are the product of a collaborative consensus building policy process. The public wants policy makers in Washington to work together to solve the nation's problems. When the representatives of the industry that produces the goods and proponents of energy efficiency including consumer groups, hammer out agreement on an important product attribute like energy efficiency, it would be foolhardy for Congress to turn its back on such a historic consensus.

The industry and technical experts at today's hearing will testify to the sound economic and technological basis for these standards, with which we whole heartedly agree. So in my testimony, I will focus on the last two points above, beginning with public support and then turning to the analysis of the need for standards to correct market imperfections that lead to market failure. I have attached two appendices that contain detailed analysis of these two issues.

PUBLIC SUPPORT

Appliance Energy Efficiency and Standards

The Consumer Federation of America has recently conducted a national random sample public opinion poll on home energy consumption and minimum efficiency standards for appliances. My analysis of the results is attached to this testimony as Appendix A. We find that the public overwhelmingly recognizes the benefits of energy efficiency in the home and supports energy efficiency standards.

Specifically, we found:

- Nearly all Americans (95%) think it "beneficial for appliances like refrigerators, clothes washers, and air conditioners to become more energy efficient," with 78% believing this increased efficiency to be "very beneficial."
- Nearly all Americans (96%) think improved appliance efficiency is important for personal financial reasons – "lowering your electric bills" – with 80% considering this to be very important. However, large majorities also believe improved appliance efficiency to be important for environmental reasons – because it reduces the nation's consumption of electricity "to reduce air pollution" (92% important, 77% very important) and "to reduce greenhouse gas emissions" (84% important, 66% very important).
- Substantial majorities also favor improved energy efficiency of appliances even when this increases the purchase price of appliances. This support predictably varies with the payback period: 3 years (79% favor, 35% favor strongly), 5 years (73% favor, 32% favor strongly), and 10 years (60% favor, 29% favor strongly).

- Only about two-thirds of Americans (68%) are aware that the "government requires new appliances like refrigerators, clothes washers, and air conditioners to meet minimum energy standards."
- Respondents who are aware of the minimum standards are more likely to support them (74% to 64%).
- But nearly three-quarters of Americans (72%) support "the government setting minimum energy efficiency standards for appliances," with strong support from 28%.

We believe this is very compelling data that demonstrate clearly consumer desire and support for cost-effective energy efficient products.

Other Surveys on Efficiency

Our recent survey focused on appliance efficiency and minimum energy efficiency standards. There are other products that consume electricity in the home – lighting in particular – and other programs that provide incentives for energy efficient purchases. Recent public opinion polls by others have addressed these products and policies, and they yield similar results, which are worthy of mention.

Two recent polls address the issue of lighting. A USA poll found that 61 percent of respondents thought the law that raised efficiency standards was a good law. These parallel the findings of our appliance efficiency survey. A study by Sylvania found that when respondents were asked about the transition to more efficient light bulbs, twice as many said they are "excited… because Americans will use more efficient light bulbs," as said they are "worried… because I prefer using traditional light bulbs. Younger respondents and those who had heard about compact florescent lights were more likely to say they were excited. This parallels our demographic and awareness finding.

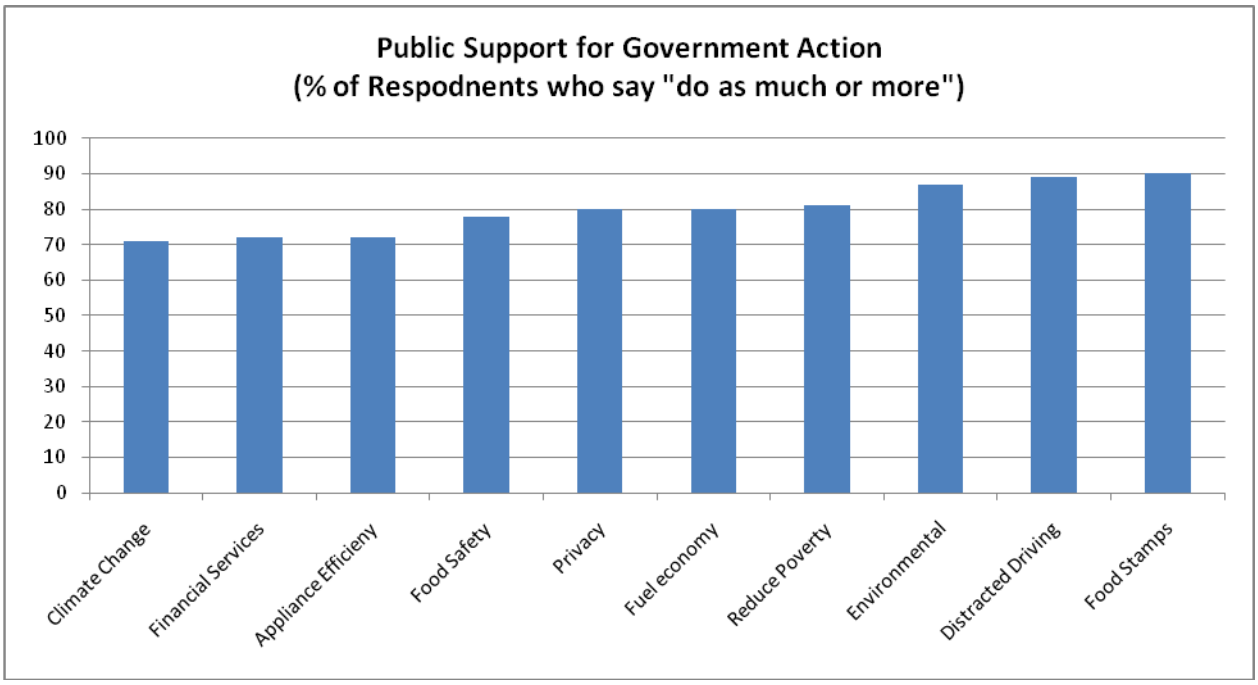
A study by Consumers Union asked people who had purchased a more efficient appliance what motivated them: 74% said saving money, while 49% said the environment. This parallels our findings on the perceived benefits of appliance standards. Awareness of utility rebates for energy efficient appliances and for retiring inefficient appliances was 67%, which is quite close to the 68% awareness of appliance efficiency standards in our survey.

CFA has conducted extensive polling and analysis of fuel economy standards that yields similar results. Levels of support for the general concept of fuel economy standards are in the range of 60% to 70% and in the most recent survey, 59% of respondents supported a fuel economy standard of 60 miles per gallon for 2025. Payback periods are consistently the greatest concern, as is the case in the appliance survey. Payback periods for fuel economy investments of five years are viewed favorably by a large majority of respondents (73%) as they are for appliances (73%).

Broader Public Opinion

Some may feel that these findings fly in the face of broad public sentiment about the role of government. That is not the case at all. When the public is asked about specific actions that protect consumers or promote the public interest, they are quite supportive across a surprisingly

large number of areas of economic activity. Public opinion polls show that 70 percent or more of the public wants the government to do as much or more with respect to distracted driving, food safety, fuel economy, privacy, oil drilling, the environment, and financial services, as well as energy efficiency.



Washington Post/ABS, December 2010; Henry J. Kaiser Family Foundation, October, 2010; Americans Reject Tailored Advertising, September 2009, Hart Research Associates, July 2009, Pew Food Safety Survey; Consumer Federation of America, Financial Service Protection, April 2010; Americans Want Consumer Agency for Financial Products and Services, September 2009.

In general, we find that the more deeply we delve into the specific areas, the higher the public support becomes. Our research shows that there is a consistent, significant positive correlation between perceived benefits and support for standards. We find that the more people know about energy consumption, the more they support the standards. When we explore the relationship between industry performance and standards, we find that support grows where respondents think the industry has not done a good job.

Standards are an Effective Response to Market Imperfections

Our analysis of the "energy efficiency gap" shows that the public perception of energy efficiency and the support for efficiency and standards is well-grounded in market reality. Our analysis of the energy efficiency gap identifies a number of market imperfections that cause the market to undersupply energy efficiency. Appendix B, which was prepared for a proceeding on motor vehicle fuel economy standards, provides a detailed analysis of the causes of this market failure and why minimum performance standards are an ideal policy to address these market imperfections and ameliorate the market failure. The public attitudes and perceptions we find in

surveys reflect the reality that consumers face in the marketplace. They understand that the marketplace does not produce the optimum level of investment in energy efficiency.

As described in great detail in Appendix B, economists and policy analysts with very different perspectives have identified a couple dozen causes of market failure when it comes to energy efficiency. In our analysis, we have grouped these into five broad areas –

- **Societal issues where important values are not well reflected in market transactions:** e.g. consumption and production externalities, national security values and environmental impacts.
- **Structural conditions that result in inefficient outcomes:** scale problems, bundling of multi-attribute products, product cycles, lack of availability, lack of experience with new products.
- **Endemic tendencies of economic relationships that undermine key market functions:** e.g. agency issues (e.g. landlord-tenant, builder-buyer), asymmetric information, first cost sensitivity.
- **Transaction costs create frictions that impose costs and constrain exchange:** e.g. sunk costs, new product risk & uncertainty, imperfect information.
- **Behavioral, psychological and other human traits that bound "maximizing" actions,** e.g. motivation, difficulty of calculation and discounting (projecting future energy consumption and prices).

These imperfections drive the market to an equilibrium at which the nation consumes far more energy than is economically efficient or socially desirable. Some analysts blame the market outcome on consumers and interpret it to mean that consumers apply an irrationally high discount rate to energy efficiency investments. We reject that claim.

The discount rate implicit in consumer purchases reflects the full range of market conditions on both the supply-side and the demand side. In fact, there is frequently a separation between the builder or purchaser of buildings and appliances and the user. Demand is most directly determined by producers (landlords and builders) not consumers. Even when they do consider efficiency investments, consumers may not find the more efficient appliances to be available in the marketplace. Purchasers may prefer less efficient products because they have lower first costs and are more familiar. Suppliers may not stock efficient appliances and may not install them properly, as it requires different skills or considerations. Thus, the marketplace may offer an inadequate range of options to consumers in many instances. Consumers and producers both exhibit a first cost bias. Individual firms have little incentive to invest in basic research or to deploy enabling technologies because they have difficulty capturing the gains. To be sure, there are imperfections on the consumer side as well. Consumers are not well-informed and are unprepared to conduct the appropriate analysis. They lack the information necessary to make informed choices and perceive differences in quality and the availability of options that may be based on inertia more than reality.

Performance standards that are technology neutral and procompetitive are an ideal way to address all of these imperfections, as long as the level chosen is well within the frontier of what

is economically practicable and technologically feasible. The fact that industry and efficiency, environmental and consumer advocates have agreed on the level of the standards in the consensus agreements contained in S. 398, the INCAAA bill, is a good indication that the standards meet this basic criteria.

The following market imperfections that cause the appliance market to provide less efficiency than it should are addressed by performance standards:

SOCIETAL FAILURES	ENDEMIC FLAWS	TRANSACTION COSTS
Externalities	Agency	Sunk Costs, Risk
Information as a public good	Asymmetric Information	Risk & Uncertainty
	Moral Hazard	Imperfect Information

STRUCTURAL PROBLEMS	BEHAVIORAL FACTORS
Scale issues	Motivation
Bundling	Calculation/Discounting
Cost Structure	
Product Cycle	
Availability	

We hope you can appreciate the numerous reasons why the Consumer Federation of American supports appliance energy efficiency standards and their benefits to consumers. We believe S. 398, the INCAAA bill, should be adopted, and can't see any reason why it shouldn't be. The legislation will strengthen and improve energy efficiency for a wide range of consumer products. We also believe that the current standard for lighting products should be kept in place and that S. 395, the BULB Act, should be rejected. Our analyses have shown that consumers will be better off, and public opinion polls have found that this is what they want.

Thank you for this opportunity to share our views on appliance energy efficiency standards and legislation.

APPENDIX A

PUBLIC ATTITUDES TOWARD ENERGY EFFICIENCY AND APPLIANCE EFFICIENCY STANDARDS:
CONSUMERS SEE THE BENEFITS AND SUPPORT THE STANDARDS

EXECUTIVE SUMMARY

The consumption of energy by household appliances, which we refer to as home energy, does not receive the same level of attention as the fuel economy of vehicles. This is surprising since in 2009, home energy consumption for heating, cooling, lighting, cooking and hot water, took just as large a bite out of household budgets as does expenditures for gasoline. The 2009 Bureau of Labor Statistics consumer expenditure survey puts total expenditures for home energy (electricity, natural gas and fuel oil and other fuels) at $2,000 per year, exactly the same as gasoline expenditures. This observation and the commitment to energy policy that benefits consumers led the Consumer Federation of America (CFA) to conduct a nationwide survey in January 2011, to learn about the public's knowledge and opinions about appliance energy efficiency. The survey results revealed that the consumer attitudes toward home energy consumption and efficiency are quite similar to the attitudes that consumers had expressed about vehicle fuel economy in prior CFA studies of that issue.

The data revealed the following:

- Nearly all Americans (95%) think it "beneficial for appliances like refrigerators, clothes washers, and air conditioners to become more energy efficient," with 78% believing this increased efficiency to be "very beneficial."

- Nearly all Americans (96%) think improved appliance efficiency is important for personal financial reasons – "lowering your electric bills" – with 80% considering this to be very important. However, large majorities also believe improved appliance efficiency to be important for environmental reasons – because it reduces the nation's consumption of electricity "to reduce air pollution" (92% important, 77% very important) and "to reduce greenhouse gas emissions" (84% important, 66% very important).

- Substantial majorities also favor improved energy efficiency of appliances even when this increases the purchase price of appliances. This support predictably varies with the payback period: 3 years (79% favor, 35% favor strongly), 5 years (73% favor, 32% favor strongly), and 10 years (60% favor, 29% favor strongly).

- Only about two-thirds of Americans (68%) are aware that the "government requires new appliances like refrigerators, clothes washers, and air conditioners to meet minimum energy standards." Awareness is highly correlated with income (53% below $25k, 81% $100k and above) and education (50% no high school degree, 84% college degree).

- But nearly three-quarters of Americans (72%) support "the government setting minimum energy efficiency standards for appliances," with strong support from 28%.

- Respondents who are aware of the minimum standards are more likely to support then (74% to 64%).

The conclusion is clear: The public overwhelmingly believes that improving appliance energy efficiency is beneficial and strongly supports appliance efficiency standards. Those people who are aware of minimum efficiency standards set by the government support them. They are willing to pay more for the product knowing that the additional cost will be made up over time in lower energy bills, and in fact, that they will ultimately save money.

BACKGROUND

Although the fuel economy of the vehicle fleet receives a great deal of attention, the consumption of energy by households appliances, which we refer to as home energy, does not. This is surprising since in 2009 home energy consumption for heating, cooling, lighting, cooking and hot water, took just as large a bite out of household budgets as does expenditures for gasoline. The 2009 Bureau of Labor Statistics consumer expenditure survey put total expenditures for home energy (electricity, natural gas and fuel oil and other fuels) at $2,000 per year, exactly the same as expenditures on gasoline.

Over the past six years, the Consumer Federation of America has conducted a dozen surveys that examine public knowledge about and attitudes toward the fuel economy of cars and trucks. We have found that the public: is concerned about oil consumption for several reasons, including cost and dependence on imported oil; believes that lowering consumption is good for consumers and the nation; is willing to spend more on more efficient vehicles as long as the investment has a reasonable payback period; supports minimum fuel economy standards, and the better informed they are about fuel economy, the more they support minimum standards.

Since home energy consumption deserves as much attention as gasoline consumption from the point of view of the impact of energy policy on the consumer pocketbook,[1] it should come as no surprise that a recent survey we conducted found that consumer attitudes toward home energy consumption and efficiency are quite similar to the attitudes about vehicle fuel economy. A large majority believe it is beneficial for appliances to become more energy efficient for several different reasons, among them is lowering electric bills as well as reducing pollution; they are willing to pay more for the product with a reasonable payback period, and they support the government setting minimum efficiency standards for appliances.

The remainder of this report examines the underlying pattern of attitudes toward appliance energy efficiency and minimum energy efficiency standards to gain further insight into public opinion about this important area of consumer spending and energy policy. A key goal is to provide policy makers with a deeper understanding of the nature of support for minimum appliance efficiency standards.

[1] Home energy consumption and appliances efficiency standards have acquired another link to gasoline consumption. As concern about gasoline expenditures and Mideast oil vulnerability grows in the wake of recent turmoil in the region, electric vehicles have become a focal point for efforts to reduce oil consumption. Reducing electricity consumption in the home could free up electricity for use in the vehicle fleet, thereby allowing the U.S. to meet its national energy policy goals without putting excess pressure on the electricity sector.

METHODOLOGY

In January 2011, the Consumer Federation of America commissioned a survey of public attitudes toward energy consumption of household appliances and support for government standards that set minimum levels of energy efficiency for appliances like refrigerators, clothes washers, and air conditioners. The national random sample survey of 1,006 people was conducted January 13-16 2011 by Opinion Research Corporation (ORC) with a margin of error of plus or minus three percentage points.

The survey posed five questions about appliance energy efficiency and minimum standards.

Benefit: Do you think it is beneficial or harmful for appliances like refrigerators, clothes washers, and air conditioners to become more energy efficient, that is, to use less electricity?

Specific benefits: In your view, how important is each of the following reasons to improve the energy efficiency of appliances?

Lowering your electric bills
Reducing the nation's consumption of electricity to avoid building new power plants
Reducing the nation's consumption of electricity to reduce air pollution
Reducing the nation's consumption of electricity to reduce greenhouse gas emissions

Payback: Now, suppose improvements in the energy efficiency of appliances increased their purchase price but reduced the cost of using them. If these price increases were offset by reduced electricity costs over the following time periods, would you say you would strongly favor this, somewhat favor, somewhat oppose or strongly oppose?

Three years
Five years
Ten years

Awareness of Standards: Are you aware that the government requires new appliances like refrigerators, clothes washers, and air conditioners to meet minimum energy efficiency standards, that is, to use no more than a certain amount of electricity?

Support for minimum standards: In principle, do you support or oppose the idea that the government should set minimum energy efficiency standards for appliances?

The survey gathered data on the standard set of demographics that are typically included in survey research – gender, age, education, income, household tenure, region, – as well a question on summer electricity bills.

After examining the data, several summary indices were created for specific analyses.

Recoded variables:

Sum of benefits: All very important….. mixed… none very important.

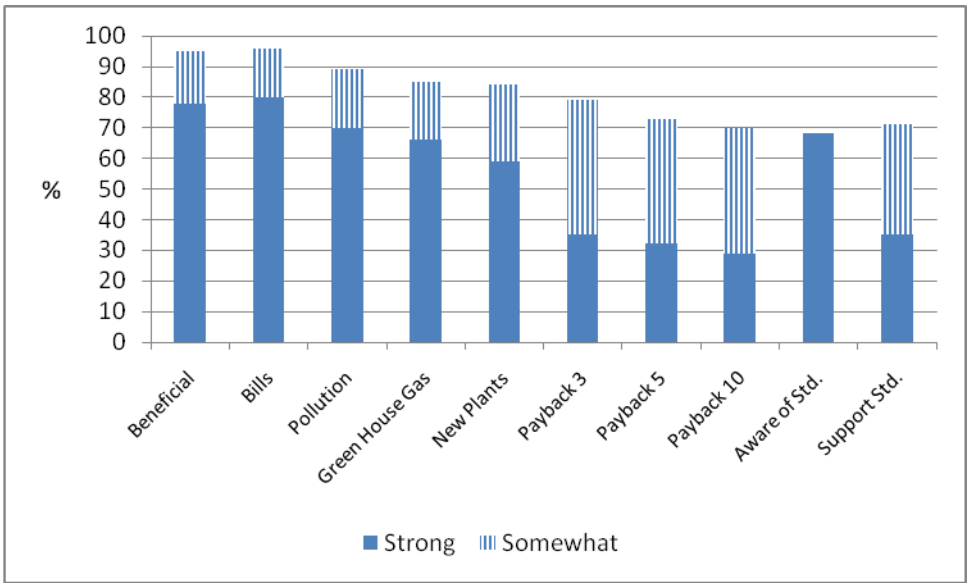
Payback sum: Strongly favors both 3-year and 10-year…. Mixed…. Strongly opposes both 1-year and 10-year

FINDINGS

Attitudes toward Appliance Efficiency and Standards

As shown in Figure 1, nearly all Americans (95%) think it "beneficial for appliances like refrigerators, clothes washers, and air conditioners to become more energy efficient," with 78% believing this increased efficiency to be "very beneficial."

Figure 1: Perception of Benefits of Efficiency, Awareness and Support for Standards



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But nearly three-quarters of Americans (72%) support "the government setting minimum energy efficiency standards for appliances," with strong support from 28%.

We next examine how these basic responses relate to each other and the demographic characteristics of respondents. In the following discussion, we examine all of the variables for which we have data that show a statistically significant relationship with support for minimum standards in both bivariate analyses and a multivariate analysis. All of the relationships discussed in this section are statistically significant by a Chi Square test with $p < .01$. The following analyses also exclude the respondents who refused to answer questions, or said they did not know. Therefore, the percentages vary slightly from the overall percentages cited above.

Perception of Benefits and Support for Minimum Standards

Table 1 shows that there is a statistically significant relationship between perceived benefits of energy efficiency and support for minimum standards. Those who perceive benefits are more likely to support minimum standards and the more benefits perceived to be very important, the greater the support. Thus, 83 percent of those who think that all four benefits are very important support minimum standards. This percentage declines steadily as the number of perceived benefits declines. Among those who find none of the benefits very important, only 44 percent support efficiency standards, the program, while 56 percent oppose it.

TABLE 1: PERCEIVED BENEFIT AND SUPPORT FOR MINIMUM STANDARDS

Efficiency Benefit	N	Support For Standards (% of Respondents)			
		Very Strong Support	Somewhat Support	Somewhat Oppose	Strongly Oppose
Sum of Benefits					
All 4 very Important	393	52	31	8	7
3 very Important	203	49	34	6	10
2 very Important	115	27	38	19	16
1 very important	133	16	32	16	37
0 very Important	110	8	36	14	42
Bills					
Very important	775	42	32	12	15
Somewhat important	189	28	37	12	23
Somewhat unimportant	19	21	21	15	48
Very unimportant	12	17	33	0	50
Plants					
Very important	548	51	31	8	10
Somewhat important	270	27	44	15	14
Somewhat unimportant	82	26	28	17	29
Very unimportant	79	8	18	11	63
Pollution					
Very important	680	50	32	10	8
Somewhat important	204	17	43	17	24
Somewhat unimportant	53	11	19	17	53
Very unimportant	51	4	16	10	71
Greenhouse Gases					
Very important	617	52	33	8	8
Somewhat important	201	24	40	14	21
Somewhat unimportant	61	11	30	33	26
Very unimportant	93	4	20	10	66

Attitudes toward Payback Periods and Minimum Standards

Results for the response to the payback questions parallel those for the perception of benefits question (see Table 2). We have observed a high level of support for energy efficiency, even with a ten year payback period, but there is stronger support with shorter payback periods. While the difference between the distribution of responses based on the three year payback and the five year payback is not statistically significant, the difference between the distribution of responses based on the three year payback and the ten year payback is statistically significant, as is the difference between the distribution of responses based on the five year payback and the ten year payback is statistically significant.

TABLE 2: PAYBACK AND SUPPORT FOR MINIMUM STANDARDS

	N	Support for Standards (% of Respondents)			
		Very Strong Support	Somewhat Support	Somewhat Oppose	Strongly Oppose
Payback Sum					
Support All		54	24	8	14
Mixed		35	39	13	13
Oppose All		9	27	9	55
3-Year					
Favor strongly	404	56	27	6	10
Favor somewhat	405	27	43	15	15
Oppose somewhat	109	25	22	20	33
Oppose strongly	65	21	23	5	17
5-years					
Favor strongly	327	57	26	5	11
Favor somewhat	408	32	42	14	12
Oppose somewhat	140	22	31	19	258
Oppose strongly	94	28	21	11	40
10-year					
Favor strongly	265	56	27	6	11
Favor somewhat	324	34	42	11	12
Oppose somewhat	175	31	31	19	18
Oppose strongly	285	29	33	11	38

The more favorable the respondent is to the payback period, the stronger the support for minimum standards. The response patterns are similar for each of the payback periods. Those who find any payback unacceptable are three times as likely to strongly oppose minimum standards. We have used the responses to the three and ten year payback questions to develop a general index of "willingness to pay." Respondents who strongly favor the three and ten year periods have the higher score of 8. Those who oppose both the one and 10 year periods have a score of 1. This captures the strong difference between the extremes. Sixty four percent of those who find any payback period unacceptable oppose both of the payback periods strongly oppose minimum standards; whereas 64% of those who strongly favor both the 3 and 10-year payback periods strongly support the standards.

Demographic Variables

Table 3 shows several background characteristics that exhibit significant relationships to support for minimum efficiency standards in addition to education. It starts with the data that show awareness of minimum standards is associated with support for them. Forty-two percent of those who are aware of the standards strongly support them, while only 31 percent of those who are not aware, do not support them.

Among the demographic variables, only education exhibits a statistically significant relationship to support for minimum standards in both the bivariate and multivariate analyses (income drops out in the multivariate analysis, since education is a stronger predictor). Education also exhibits a relationship to awareness that minimum efficiency standards exist. To be clear, gender, region, marital status, age and housing tenure (owner v. renter) do not exhibit significant relationships to support for minimum standards in either the bivariate or multivariate analysis.

TABLE 3: BACKGROUND CHARACTERISTICS AND SUPPORT FOR MINIMUM EFFICIENCY STANDARDS

	N	Support for Standards (% of Respondents)			
		Very Strong Support	Somewhat Support	Somewhat Oppose	Strongly Oppose
Awareness of Standard					
Unaware	284	31	34	11	20
Awareness	714	42	33	10	16
Education					
LT 8th Grade	35	27	27	20	27
8th Grade	55	40	29	13	18
High School	254	32	36	12	20
Associate Coll.	83	27	45	11	18
Some College	196	43	28	14	15
College Grad	213	42	34	9	15
Post Doc.	170	45	33	9	16

The multivariate model including five variables – education, political leaning, payback attitude, perceived benefit and awareness – explains about 15% of the variance, which is high for attitudinal variables such as these.

Appliance Efficiency Standards Compared to Fuel Economy Standards

The public attitudes toward appliance efficiency standards are quite similar to their attitudes toward fuel economy standards, as shown in Table 4. They perceive the importance of reducing energy consumption as both an important personal benefit and a benefit to the nation. There is strong majority support for standards and the better informed the respondents are, the stronger their support.

TABLE 4: COMPARISON OF ATTITUDES TOWARD APPLIANCE EFFICIENCY STANDARDS AND FUEL ECONOMY STANDARDS

	Appliances	Fuel Economy
Benefits/Concerns		
Overall benefit of Efficiency	78	79
Price	80	72
Greenhouse Gasses	66	57
Payback		
1-year	na	81
3-year	79	na
5-Year	78	72
10-year	60	na
Support for Standards		
General	71	na
27 to 35 mpg (current)	na	78
35 to 50 mpg by 2025	na	65
35 to 60 mpg by 2025	na	59
Awareness & Support for Standards		
Aware	74	72
Unaware	64	66

Fuel Economy Report:
http://www.consumerfed.org/elements/www.consumerfed.org/file/Gas_Oil_Survey_Oil_Spill_PR_5_18_10.pdf

Fuel Economy Press Release: http://www.consumerfed.org/pdfs/MVFE-Survey-PR092810.pdf

Conclusion

The conclusion is clear: The public overwhelmingly believes that improving appliance energy efficiency is beneficial and strongly supports appliance efficiency standards. Those people who are aware of minimum efficiency standards set by the government support them. They are willing to pay more for the product knowing that that the additional cost will be made up over time in lower energy bills, and in fact, that they will ultimately save money. The public recognition of the benefits of efficiency and support for performance standards is consistent across products and across time.

APPENDIX B

MARKET IMPERFECTIONS AND THE ENERGY EFFICIENCY GAP, WHY STANDARDS ARE THE RIGHT APPROACH

EXCERPT FROM COMMENTS OF THE CONSUMER FEDERATION OF AMERICA

Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Environmental Protection Agency Average Fuel Economy Standards, 40 CFR Parts 86 and 600, Department of Transportation, 49 CFR Parts 531,633, 537, et al., November 27, 2009

II. EFFICIENCY GAPS IN THE MARKET AND STANDARDS

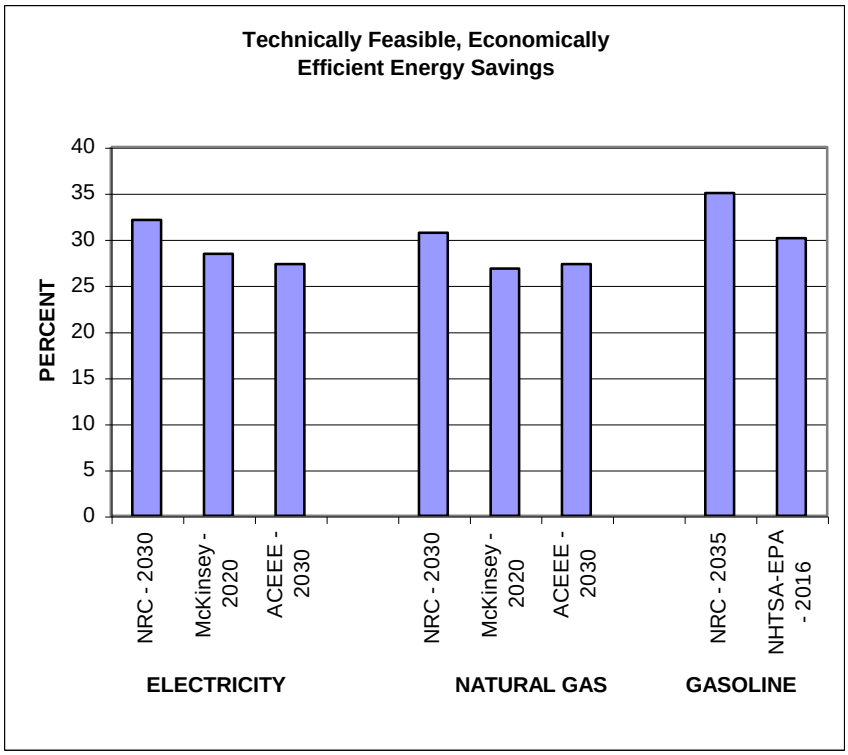
A. MARKET FAILURE AND THE RESPONSE

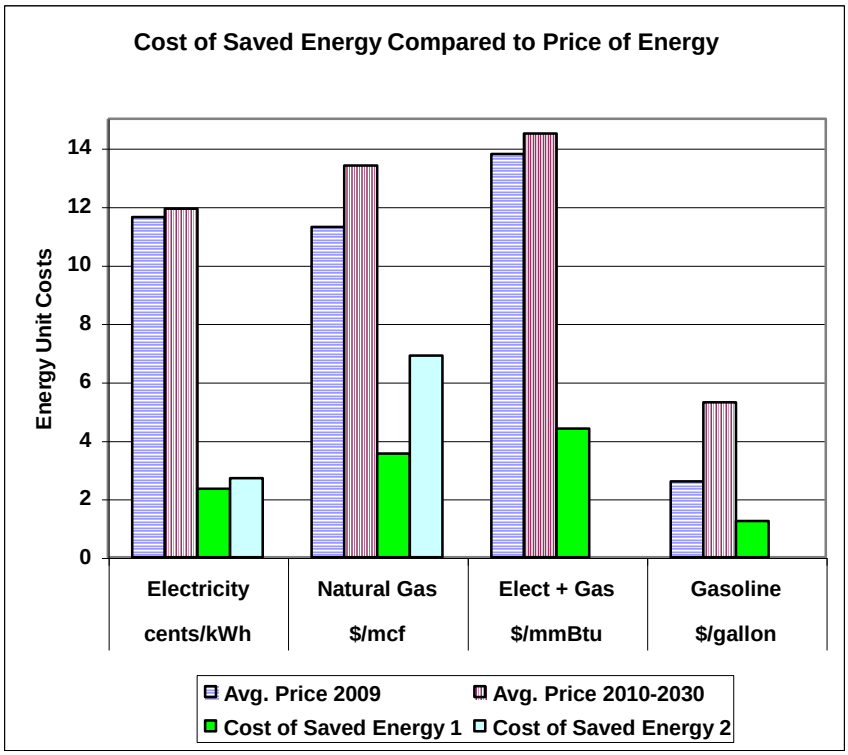
The very large potential efficiency gains estimated by the engineering/economic analysis conducted by NHTSA/EPA, which can be most easily summarized by nothing that, even at the highest and most expensive level, the cost of saved energy is about one-third of the price to consume energy, are at the core of a decade's long debate over fuel economy standards. In a capitalist economy, when problems are serious, like rising energy prices and imports, and a solution is inexpensive and potentially widely available, one would expect people to seize it. The existence of the "efficiency gap" immediately raises the question:

"Why don't people buy more of it?

The efficiency gap is not new, nor is it confined to the transportation sector. A similar efficiency gap is found in building sector energy consumption. As Exhibit I-1 shows, the magnitude of the problem is similar across sectors. In the past few months, four major national research institutions have released reports that document the huge potential for investments in energy efficiency to lower consumers' bills and greenhouse gas emissions, creating a win-win for consumers and the environment. The National Research Council of the National Academy of Sciences has estimated the potential reduction in electricity, natural gas and gasoline at approximately 30 percent, similar to the estimates of NHTSA/EPA. McKinsey and Company and the American Council for Energy Efficient Economy have reached a similar conclusion on electricity and natural gas. Across these three sectors, saving energy costs about one third of the price of consuming it.

EXHIBIT II-1:
THE EFFICIENCY GAP ACROSS ENERGY MARKETS





Sources and Notes:

Gold, Rachel, Laura, et. al., *Energy Efficiency in the American Clean Energy and Security Act of 2009: Impact of Current Provisions and Opportunities to Enhance the Legislation*, American Council for an Energy Efficient Economy, September 2009),

McKinsey Global Energy and Material, *Unlocking Energy Efficiency in the U.S. Economy* (McKinsey & Company, 2009).

National Highway Traffic Safety Administration, *Corporate Average Fuel Economy for MY2012-MY 2016 Passenger Cars and Light Trucks, Preliminary Regulatory Impact Analysis*, Tables 1b, and 10. The 7 percent discount rate scenario is used for the total benefit = total cost scenario.

National Research Council of the National Academies, *America's Energy Future: Technology and Transformation, Summary Edition* (Washington, D.C.: 2009). The NRC relies on a study by Lawrence Berkeley Laboratory for its assessment (Richard Brow, Sam Borgeson, Jon Koomey and Peter Biermayer, *U.S. Building-Sector Energy Efficiency Potential* (Lawrence Berkeley National Laboratory, September 2008).

2009 average prices are from the Energy Information Administration, Short-Term Outlook, while 2010-2030 Prices are from the *Annual Energy Outlook: 2009. Adjusted.*

III. ENERGY EFFICIENCY MARKET FAILURE

A. INTRODUCTION

To establish a framework for explaining the existence and magnitude of the market failure, as well as why fuel economy standards are an effective solution to the problem, this section reviews several literatures.

First, we review the discussion of the issue in the Notice of Proposed Rulemaking and its supporting documents. The agencies have invited comment on this issue.

Second, we briefly establish the basis for market failure analysis in the general economic literature. We start from traditional economic discussions and then move to more recent challenges to the traditional model in transaction cost and behavioral economics.

Third, we review the general "efficiency gap" literature. This literature was cited in the Notice and supporting documents.

Fourth, we review the "efficiency gap" literature as it relates directly to fuel economy and the importance of supply-side causes of market failure. This literature was also cited in the Notice and supporting documents.

Exhibit III-1 summarizes the conclusion of the literature review in the remainder of this section. It identifies all the market failures that the NPRM did as well as those it did not mention. We have highlighted the factors we believe affect the auto market that are addressed by standards.

- Neoclassical economics recognizes societal flaws – primarily in the form of externalities and public goods.
- Traditional analysis of industrial organization and market structure, conduct and performance, recognizes that there are structural problems that affect market performance.
- Some of the problems that have long been recognized rise to the level of endemic imperfections – imperfections that are repeatedly found in market structures.
- The analysis of transaction costs has given rise to new institutional economics, which offers another major challenge to the assumption that markets work perfectly.
- In addition to the behavioral causes of market failure that the NPRM identified, there are additional important behavioral problems that cause market failure by looking at the friction in economic transactions and the institutions that develop to deal with it.

Many of the market imperfections identified in the literature afflict the market for fuel economy in light duty vehicles.

EXHIBIT III-1: CAUSES OF ENERGY MARKET FAILURE AND THE ROLE OF STANDARDS IN CLOSING THE "EFFICIENCY GAP"
(Bold and Underlined Factors are Addressed by Efficiency Standards)

Neo-classical and Traditional Industrial Organization

Challenges from Keynesian, New Institutional and Behavioral Economics

SOCIETAL FLAWS
Externalities:
Environmental
Energy Security
Public Goods
Basic research
Information
Learning by doing
Learning-by-using
Other

INDUSTRY STRUCTURAL PROBLEMS

Imperfect Competition
Concentration
Barriers to Entry
Scale
Vertical Leverage
Collusion
Marketing
Bundling: Multi-attribute
Gold Plating
Inseparability
Purchase Method
Advertising
Regulation & Policy
Price Distortion Avg-cost
Permitting
Other Distortions
Cost Structure
Product cycle
Disaggregated/ fragmented Mkt.
Elasticity
Own-price
Cross-price
Income
Availability
Lack
Emergency replacement
Quality
Improper installation
Lack of enforcement

ENDEMIC IMPERFECTIONS

Ownership
Agency
Transfer
Limited payback
Lack of premium
Capital
Illiquidity
Asymmetric Information
Perverse Incentives/ Conflict of Interest
Moral Hazard

TRANSACTION COST/ NEW INSTITUTIONAL ECONOMICS

Friction
Sunk costs
Lifetime
Risk & Uncertainty
Technology
Marketplace
Policy
Financial
Liability
Imperfect Info.
Availability
Accuracy
Search Cost
Organizational Structure

BEHAVIORAL FACTORS

Motivation
Preference
Custom
Values & Commitment
Social group & status
Perception
Prospect
Framing
Loss Avoidance
Status Quo
Salience
Social Influence
Awareness
Attention
Low priority
Calculation
Bounded rationality
Ability to process info
Limited understanding
Heuristic Decision Making
Rules of thumb
Information
Discounting
Low Probability Events
Long-Term
Small Outcomes
Implementation
Improper use & maintenance

- The recent financial meltdown has resulted in the thorough repudiation of the efficient market hypothesis.[i]

B. MARKET FAILURE IN THE GENERAL ECONOMIC LITERATURE

The Traditional Approach

Market failure is a sufficiently widespread phenomenon to be recognized as an important analytic issue even for introductory economic texts. In one widely used text, John Taylor states that "in certain circumstances – called market failure – the market economy does not provide good enough answers to the "what, how and for whom" questions, and the government has a role to play in improving on the market"[ii] Taylor defines market failure as "any situation in which the market does not lead to an efficient economic outcome in which there is a potential role for government."[iii] Taylor identifies the "major sources of market failure as "public goods, externalities, and monopoly power."[iv]

An advanced text on antitrust and regulation offers the following observation on the importance of market failure in economic analysis:

> If we existed in a world that functioned in accordance with the perfect competition paradigm, there would be little need for antitrust policies and other regulatory efforts. All markets would consist of a large number of sellers of a product and consumers would be fully informed of the product's implications. Moreover, there would be no externalities present in this idealized economy, as all effects would be internalized by the buyers and sellers of a particular product.
>
> Unfortunately, economic reality seldom adheres closely to the textbook model of perfect competition. Many industries are dominated by a small number of large firms. In some instances, principally the public utilities, there may be a monopoly. Consumers who use hazardous products and workers who accept risky employment may not fully understand the consequences of their actions. There are also widespread externalities that affect the air we breathe, the water we drink, and the future viability of the planet.[v]

The difference between framing the issue as "economic reality seldom adheres closely to the textbook model of perfect competition" and "in certain circumstances… the market economy does not provide good enough answers" may have a substantial impact on a broad view of policy because the challenge of finding the instances where markets have failed and intervention is justified may be substantial. However, where the evidence of market failure is strong, as in the case of energy efficiency, a debate over the extent of the problem is no longer necessary.

These two citations identify three broad areas of analysis that are common in the literature:

- structural conditions of supply, e.g. lack of competition (small numbers or monopoly);
- consumer behavior, e.g. ill-informed or unaware, and

- societal, e.g. externalities and characteristics of products (public goods) that undermine supply;

Imperfect competition, which is mentioned in the above quotes in the form of the small number of competitors or, in the extreme, the "monopoly" problem, actually receives a good deal of attention in traditional economics, especially in the literature on industrial organization. The dominant paradigm is the structure conduct performance (SCP) approach (see Exhibit III-2).

The analysis commences from the bottom of the figure, with performance and works its way up through the model. The central concern is with market performance. The concept of performance is multifaceted. It includes, among other factors, productive and allocative efficiency, progress, and fairness.[vi] The measures of performance to which we traditionally look are pricing and profits. They are the most direct measure of how society's wealth is being allocated and distributed. [vii]

The performance of industries is determined by a number of factors, most directly, the conduct of market participants. [viii] Do they compete? What legal (or illegal) tactics do they employ? How do they advertise and price their products? The fact that conduct is only part of the overall analytic paradigm is important to keep in mind.

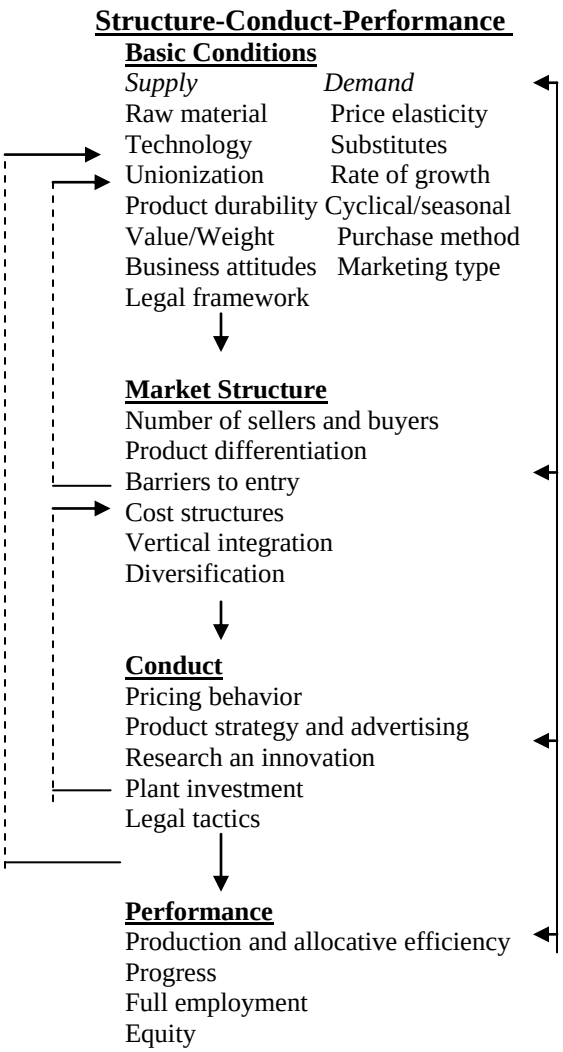
Conduct is primarily a product of other factors.[ix] Conduct is affected and circumscribed by market structure. Here we look at the number and size of the firms in the industry, their cost characteristics and barriers to entry, as well as the basic conditions of supply and demand.

Basic conditions of supply and demand are also important. Some of the key conditions that are important in the energy sector are elasticities of supply and demand, technology, the growth and cyclical nature of demand, and the type of marketing.

Regardless of how much weight one gives to the causal assumptions of the paradigm, the list of variables is important. These are the factors that taken together determine whether markets work or fail. Also note that the paradigm contemplates the possibility that structure and behaviors affect basic conditions.[x] There are feedback effects in the model. The important role of policy is recognized.

The theoretical concepts in the framework are challenging empirically. Pure and perfect competition is rare, but the competitive goal is important.[xi] Therefore, a great deal of attention has been focused on the relative competitiveness of markets and conditions that make markets more competitive or workably competitive. Summarizing an "explosion of articles on workable competition", Scherer and Ross developed a list of "the criteria of workability suggested especially frequently by diverse writers [that] can be divided into structural, conduct and performance categories.[xii] The list presented in Exhibit III-2, is verbatim from the text.[xiii] These are the characteristics of a workably competitive market. Sometimes the market exhibits these characteristics and is workably competitive, sometimes it does not and can be said to exhibit market failure.

EXHIBIT III-2: THE STRUCTURE CONDUCT PERFORMANCE PARADIGM



Sources: The figure is a primarily based on F. M Scherer and David Ross, *Industrial Market Structure and Economic Performance* (Houghton Mifling: Boston, 1990) (hereafter Scherer and Ross), pp. 5, 53-54; with additional factors from W. Kip Viscusi, John M. Vernon and Joseph E. Harrington, Jr., *Economics of Regulation and Antitrust,* Cambridge: MIT Press, 2001), p. 5 and William G. Shepherd, *The Economics of Industrial Organization* (Englewood Cliffs, NJ: Prentice Hall, 1985), p. 5

Measures of Workable Competition

STRUCTURAL CRITERIA

The number of traders should be at least as large as scale economies permit.

There should be no artificial inhibitions on mobility and entry.

There should be moderate and price-sensitive quality differentials in products offered.

CONDUCT CRITERIA

Some uncertainty should exist in minds of rivals as to whether price initiatives will be followed.

Firms should strive to attain their goals independently, without collusion.

There should be no unfair, exclusionary, predatory, or coercive tactics.

Inefficient suppliers and customers should not be shielded permanently.

Sales promotions should be informative, or at least not misleading.

There should be no persistent, harmful price discrimination.

PERFORMANCE CRITERIA

Firms' production and distribution operations should be efficient and not wasteful of resources.

Output levels and product quality (that is variety, durability, safety, reliability, and so forth) should be responsive to consumer demands.

Profits should be at levels just sufficient to reward investment, efficiency, and innovation.

Prices should encourage rational choice, guide markets toward equilibrium, and not intensify cyclical instability.

Opportunities for introducing technically superior new products and processes should be exploited.

Promotional expenses should not be excessive.

Success should accrue to sellers who best serve consumer wants.

Transaction Costs and the New Institutional Economics

Transaction cost economics is framed as a critique of neoclassical economics.

> The costliness of economic exchange distinguishes the transaction cost approach from the traditional theory economists have inherited from Adam Smith… An exchange process involving transaction costs suggests significant modifications in economic theory and very different implications for economic performance.[xiv]

Transaction costs analysis launches from the observation that there is friction in human activity that is not accounted for in the neoclassical models of economic behavior. Failing to take transaction costs into account misrepresents the cost of action and therefore the pattern of activity that occurs. Noting the difference from neoclassical assumptions, Douglass North, one of the first to receive a Nobel Prize in this school of economics, argued as follows.

> If political and economic markets were efficient (i.e., there were zero transaction costs) then the choices made would always be efficient. That is, actors would always possess true models or if they initially possessed incorrect models the information feedback would correct them. But that version of the rational actor model has imply led us astray. The actors frequently must act on incomplete information and process the information they do receive through mental constructs that can result in persistently inefficient paths….
>
> The theory is based on the fundamental assumption of scarcity and hence competition; its harmonious implications come from its assumptions about a frictionless exchange process in which property rights are perfectly and costlessly specified and information is likewise costless to acquire. Although the scarcity and hence competition assumption has been robust and has provided key underpinnings of neoclassical theory, the other assumptions have not survived nearly so well.
>
> For the past thirty years, other economists and other social scientists have been attempting to modify and refine the issue to see just what have been missing from the explanation. Put simply, what has been missing is an understanding of the nature of human cooperation and coordination.[xv]

Information is the resource at the center of transaction cost and institutional economics because "the costliness of information is the key to the costs of transacting, which consists of the costs of measuring the valuable attributes of what is being exchanged and the costs of protecting rights and policing and enforcing agreements.[xvi]

Institutions are formed to manage and reduce transaction costs.

> Institutions provide the structure for exchange that (together with the technology employed) determines the cost of transacting and the cost of transformation. How well institutions solve the problems of coordination and production is determined by the motivation of the players (their utility function), the complexity of the

environment, and the ability of players to decipher and order the environment (measurement and enforcement).[xvii]

Although their existence of institutions stems from the transaction cost problem that constitutes a deviation from the frictionless efficiency claim, their function is to reduce and control the extent of the deviation. However, there is a gap between the broad institutions of society and the organizations within the institutional environment. The creation of organizations may create inertia, lock in on inefficient solutions, or conflicts of interest that result in wide from the second best solution that the institutions are intended to achieve[xviii] The deviation of the institutions from their ideal is the result of the difficulty of enforcement, "there are two reasons why enforcement is typically imperfect… the cost of measuring the multiple margins that constitute contract performance [and] the fact that enforcement is undertaken by agents whose own utility functions influence outcomes."[xix] Central to the challenge of monitoring, is the agency issue. "The agency issue is ubiquitous in hierarchical organizations. The problem of monitoring and metering the various attributes that constitutes the performance of agents in contrast to the standard neoclassical frictionless model.[xx] Thus, agency, asymmetric information and conflicts of interests are the barriers and imperfections in that drive organizations farther from the goal of efficiency.

Behavioral Economics

Over the past couple of decades, behavioral economics has mounted a second major challenge to the dominant economic paradigm.[xxi] The neoclassical paradigm at the core of market structural analysis makes assumptions about the nature of human behavior that are necessary for its propositions and conclusions to be valid. Economic actors are presumed to be narrowly focused on their own economic interest and fully capable of pursuing those interests with rational precision. People are assumed to rationally and consistently pursue selfish, utility maximization according to a time consistent discounting model based on Bayesian probabilities for outcomes in which all income and assets are fungible.[xxii]

Behavioral economics challenges every assumption of this model of economic actors at the level of motivation, perception and calculation. For purposes of policy analysis, we believe the findings of behavioral economics can be usefully divided into three groups – motivation, perception and calculation. Wilkinson's *Introduction to Behavioral Economic*, has two sets of chapters, one foundational, one advanced, that can be organized according to this scheme as follows:

Motivation:	Foundations: Values, Attitudes, Preferences and Choice, Nature and Measurement of Utility, Advanced: Fairness and Social Preferences
Perception	Foundations: Decision-making under Risk and Uncertainty, Utility Theory, Prospect Theory, Reference Points, Loss aversion, Decision Weighting Advanced: Behavioral Game Theory, Bargaining, Signaling, Learning
Calculation	Foundations: Mental Accounting, Framing and Editing, Budgeting and Fungibility, Choice Bracketing, Advanced: The Discounted Utility Model, Alternative Intertemporal Choice Models

People engage in behaviors for many reasons, other than economics, including habit and custom. Values other than economic value are important. Non-economic factors, like habit,

altruism and fairness are important motivators of human action. There appear to be specific biases in the way people value outcomes (e.g. avoiding loss is more highly valued making gains).

Whatever their motivation, people do not perceive their movement toward a goal as purely or simplistically efficiency maximizing. They view the world from an initial starting point and select goals and strategies from that perspective and they are influenced by social factors as they move toward the goal. People are reflective and social, sensitive to norms, social influence and learning. They view outcomes from a subjective perspective relative to where they are, where they were and where others are.

Their willingness and ability to engage in calculation is limited. In a complex world, calculation is challenging. They adopt rules of thumb and heuristics that result in bounded rationality. They do not discount well, misjudging small, low probability or distant events. We add to this, the observation that their ability to implement choice once made may deficient as well.

C. THE GENERAL EFFICIENCY GAP LITERATURE

This section reviews several discussions of the efficiency gap that draw on the generic analyses of market failure discussed above. It begins with two observations at a general level offered early in the debate, and then it looks at two more detailed frameworks. These two discussions of market failure in energy efficiency are by two major research organizations published over a decade apart (Lawrence Berkeley Laboratory and Resource for the Future). These are institutions that generally have very different views on the need for public policy. The first draws from a series of papers written in the mid-1990s by researchers at the Lawrence Berkeley Laboratory, who are generally supportive of government intervention in the market.[xxiii] The second draws from a series of papers written over a decade later by researchers at Resources for the Future, who are generally skeptical of government intervention.[xxiv] Despite the many years and different perspectives between them, they produce very similar discussions of the problem of market failure. We will briefly summarize the approaches taken in these studies and then present a composite description of the barriers, obstacles and challenges to increasing energy efficiency.

The Link Between the General Literature and the Efficiency Literature

These concepts of market failure form the general literature have direct applicability to the energy efficiency gap. Over a decade ago, Decanio authored a series of articles analyzing market failure in the adoption of energy efficiency technologies with a review of specific causes of market failures that highlights the endemic imperfections identified in the previous analysis. He was careful distinguish the source of market failure from behavioral issues that might arise at the individual level and to focus on structural and institutional issues.

> In thinking about why firms may not always behave optimally, it is important to remember that a firm is a collection of individuals; brought together under a complex set of contracts both written and unwritten, but that the firm itself is not an entity acting with a single mind… The behaviour of the firm is the outcome of

> the interplay of the motivations of the individuals comprising it, rules and conventions governing their interaction and the environment within which the firm operates….
>
> The individuals making up a business firm may all be rational seekers after their own interests, but he outcome of their collective action may be suboptimal. The presence of public goods, externalities, and the clash between individuals' private incentives and the good of the whole all combine to produce outcomes that fall short of what could be obtained if all the resources of the group were deployed by a single guiding intelligence.[xxv]
>
> His analysis launches from observations about "asymmetric information and divergent incentives" noting that "even without limitations on the ability of individuals to 'comprehend and compute' the complex reality they face, institutions and other restriction on information availability and real differences in the underlying interests of the parties can lead to suboptimal results."[xxvi]

He then explains the complex set of endemic problems that affect market behavior and outcomes.

> Indeed, a major task of organizational design is to induce the managers of a stockholder owned corporate to act in a manner as consistent as possible with the interests of the owners. This manifestation of the principal-agent problem leads to a variety of reason why profitable investments might not be undertaken.
>
> One frequently cited factor causing under investment in energy savings technologies is the alleged shortsightedness of management. This myopia is usually thought of as being manifested in very short payback periods required for energy (and other) investments, or unduly high internal hurdle rates. [xxvii]

While this may sound like recourse to the individual level, Decanio offers structural and institutional reasons why the myopia might exist.

> Yet deeper consideration of the situation facing the owners and management of a large, multidivisional corporation uncovers several factors that might lead to adoption of overly stringent investment criteria, despite the fact that the cost of capital faced by the firms is considerably lower than the hurdle rates that projects are required to meet in order to be accepted.
>
> Managerial compensation is often tied to recent performance, and in many corporations, managers are rotated through different jobs every few years… [T]]his sort of frequent job turnover may lead managers to prefer projects with short payback periods… The shareholders cannot easily observe the true profitability of projects, so they may not be able to prevent dissipation of profits into managerial slack (defined as the excess of resources allocated over the minimum necessary to accomplish the tasks assigned) if a lower hurdle rate close to the cost of capital were applied. Imposition of a too high hurdle rate means that some profitable projects are foregone, but it still constitutes a second-best solution to the owners' monitoring and control problem.

> In a principal-agent framework, executives may under invest in relatively risky projects if they perceive those project to have a potentially negative impact on their own welfare… a conflict to interest exists because even if the principal can observe which projects are selected, the principal cannot know *why* they were selected…
>
> A similar rationale for a bias in favor of projects with rapid paybacks arises when moral hazard is present in the agency relationship….Moral hazard is present if the principal (the owner) cannot observe either the manager's effort or the random state of nature, *ex post,* and the manager has disutility for effort. In this case, projects with more rapid paybacks may enable the owner to set contract terms for the manager that control the moral hazard at lower cost.[xxviii]

While Decanio emphasizes the endemic causes of failure in energy markets, almost a quarter of a century ago, Stern used the findings of the behavioral economics to explain why the neoclassical assumptions about consumer price increases were dubious, at best, for analyzing energy efficiency. Neoclassical economists assumed that consumers respond equally to the size of increases and decreases in real prices. Behavioral economics suggests that consumers may respond quite differently.

> Although people are typically assumed to respond to marginal prices, they are more likely to notice average prices, and the limited evidence suggests that what people perceive most clearly is neither of these, but rather the total cost (for example, the monthly electric bill, rather than the marginal price per kilowatt hour). People are usually assumed to respond to real, rather than nominal prices, although the evidence on this point is inconclusive… The assumptions, typical in policy models, that demand is a smooth function of price and that the behavioral response to price change is independent of the speed of change seem to disregard the perceptual processes that determine whether stimuli are recognizably differential. Smoothing curves makes sense for forecasting, but for policy analysis, it is important to know whether a small stimulus or slow change will produce a small response or will be imperceptible. Finally, the almost universal assumption that people respond to price increases and decreases symmetrically seems to contradict research on cognition that shows that people respond more strongly to prospects of loss (such as price increases) than to prospects of gain (such as price decreases).[xxix]

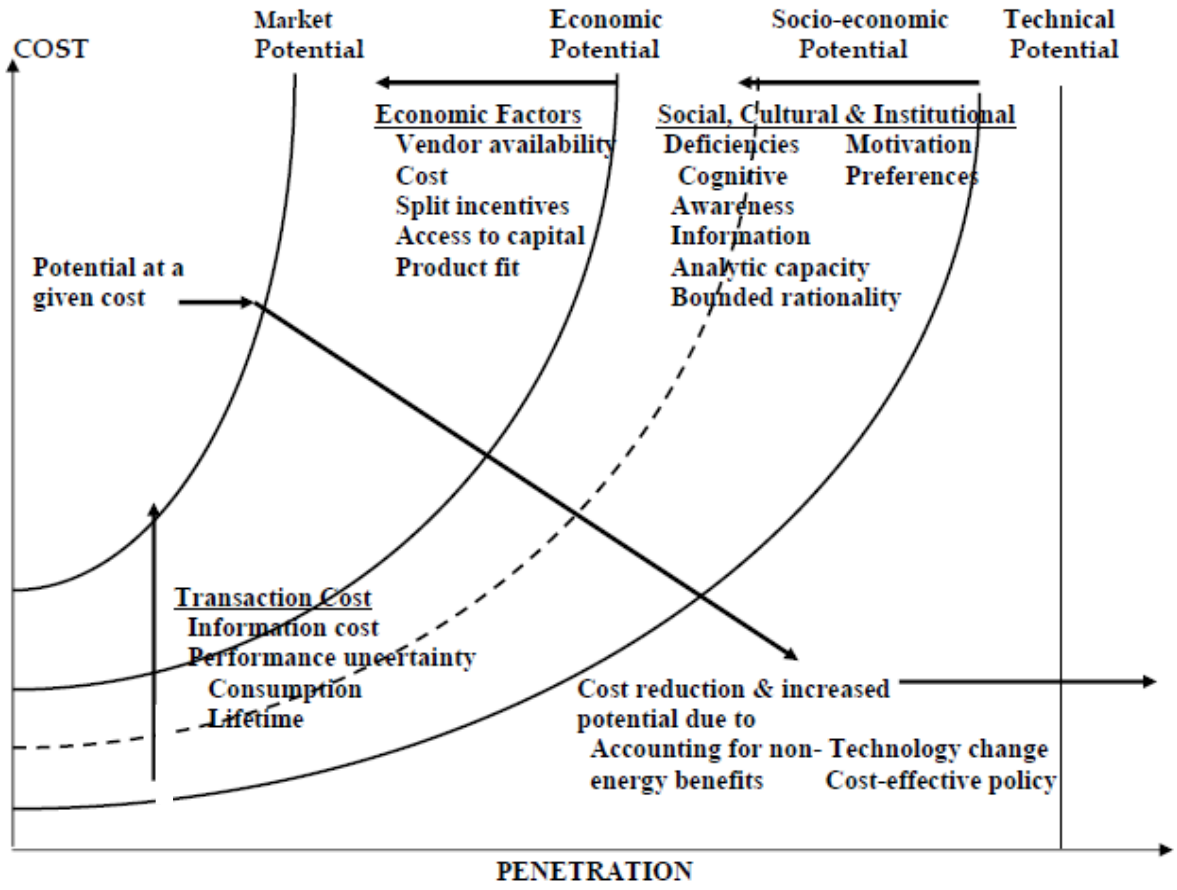
People may respond to the speed (more than size) of average (more rather than marginal), nominal (rather than real) changes in bills (not prices), and more to increases than decreases (rather than symmetrically).

The LBL Framework

A 2004 report to the California Energy Commission from Lawrence Berkeley Laboratory captures much of the above discussion of market failure in the form of technology penetration frontiers (See Exhibit III-3). The output variable is the reduction of greenhouse gas emissions, which is certainly appropriate for the current proceeding from the EPA point of view and, since

there is a direct physical relationship between tailpipe emissions and gasoline consumption, it fits the NHTSA purpose as well. We have preserved the labels from the original in Exhibit III-3, but added in some of the specific factors the analysis cites in its case studies. The graph shows the penetration of energy efficiency technologies along the X-axis and cost of carbon along the Y-axis.

EXHIBIT III-3: PENETRATION OF MITIGATION TECHNOLOGIES: A CONCEPTUAL FRAMEWORK



Source: Jayant Sathaye and Scott Murtishaw, *Market Failures, Consumer Preferences, and Transaction Costs in Energy Efficiency Purchase Decisions* (California Energy Commission, November 2004), consultant report, p. 11.

At the extreme right is the maximum technical potential reduction in carbon achievable with the penetration of available technology. In the 2008 rulemaking, NHTSA calculated this limit as the "Technology Exhaust" scenario. The level of reduction in carbon that is achieved in the marketplace is lower because several sets of factors keep the technologies from penetrating the market. The exhibit identifies all of the major categories of market imperfections, barriers, obstacles, etc. discussed above – behavioral factors (social, cultural & institutional), economic factors and transaction costs – each of which establishes a different frontier. Technological change and public policy play an important role in determining where the market will settle

along a given frontier as well as influencing where the technological limit is. Thus, this presentation arrays the market structure analysis presented in Exhibit III-1 in a technology investment framework.

We add a distinction within the Social/Cultural/Institutional category between what we call deficiencies, i.e. behavioral characteristics and processes that lead consumers to under invest in efficiency even though they are interested in doing so, and motivational factors, i.e. consumer preferences that lead to under investment in efficiency because they do not value it. This distinction is important in the current context because the agencies have assumed no change in product attributes. The goal is to achieve efficiency without changing the attributes of the vehicles. As the literature review shows, given constant preferences, there are numerous behavioral factors that reduce the amount consumers choose to invest in energy efficiency. Another set of factors moves consumer along the frontiers. A higher price on carbon, or a lower cost to reduce carbon would move investment up the frontier.

A 1996 paper prepared by leading analysts at the Lawrence Berkeley Laboratory,[xxx] written in the midst of the electricity deregulation movement, was driven by a concern that "ratepayer-funded utility energy-efficiency programs are likely to change in size, scope, and nature as the deregulation process proceeds."[xxxi] The paper "focuses on understanding to what extent some form of future intervention may be warranted and how we might judge the success of particular interventions."[xxxii] These questions remain front and center today.

Deregulation in the electricity sector did not fare very well or spread throughout the utility industry, and in the past few years, reliance on interventions in the market to increase efficiency and renewables has grown, even in the deregulated states.[xxxiii] The growth of market interventions is consistent with the conclusions in the LBL paper. "We conclude that there are compelling justifications for future energy-efficiency policies. Nevertheless, in order to succeed, they must be based on a sound understanding of the market problems they seek to correct and a realistic assessment of their likely efficacy".[xxxiv]

LBL identified four broad categories of factors that inhibited investments in energy efficiency – barriers, transactions costs, market failures, and behavioral (noneconomic) factors. Exhibit III-4 categorizes these barriers to efficiency and provides the supporting text. It identifies about two-dozen specific factors spread roughly equally across these four categories. A key aspect of the analysis is to identify each of the categories as coming from a different tradition in the economic literature. The barriers category is made up of what we have called market structural factors. The market failure category is made up of externalities and imperfect competition (which we place in the structural category).

EXHIBIT III-4: LAWRENCE BERKELEY LABORATORY MARKET FAILURE ANALYSIS

Barriers[1]

- Misplaced incentives
  - Agency[4]
- Capital
  - Illiquidity[8]
- Bundling
  - Multi-attribute
    - Gold Plating[11]
    - Inseparability[13]
- Regulation
  - Price Distortion[14]
- Chain of Barriers
  - Disaggregated Mkt.[15]

Transaction Cost[2]

- Sunk costs[3]
- Lifetime[5]
- Risk[6] & Uncertainty[7]
- Asymmetric Info.[9]
- Imperfect Info.[10]
- Availability
  - Cost[12]
  - Accuracy

Behavioral (noneconomic) factors[16]

- Custom[17]
- Values[18] & Commitment[19]
- Social group & status[21]
- Psychological
  - Prospect[24]
- Bounded rationality[26]
  - Ability to process info[27]

Market Failures

- Externalities
- Mis-pricing[20]
- Public Goods[22]
- Basic research[23]
- Information (Learning by Doing)[25]
- Imperfect Competition/Market Power[28]

Sources and Notes:

1) Six market barriers were initially identified: 1) misplaced incentives, 2) lack of access to financing, 3) flaws in market structure, 4) mis-pricing imposed by regulation, 5) decision influenced by custom, and 6) lack of information or misinformation. Subsequently a seventh barrier, referred to as "gold plating," was added to the taxonomy (p.9).

2) Neo-classical economics generally relies on the assumption of frictionless transactions in which no costs are associated with the transaction itself. In other words, the costs of such activities as collecting and analyzing information; negotiating with potential suppliers, partners, and customers; and assuming risk are assumed to be nonexistent or insignificant. This assumption has been increasingly challenged in recent years. The insights developed through these challenges represent an important new way to evaluate aspects of various market failures (especially those associated with imperfect information). Transaction cost economics examines the implications of evidence suggesting that transaction costs are not insignificant but, in fact, constitute a primary explanation for the particular form taken by many economic institutions and contractual relations (p. 22).

3) Transaction cost economics also offers support for claims that the illiquidity of certain investments leads to higher interest rates being required by investors in those investments (p. 23).

4) Misplaced, or split, incentives are transactions or exchanges where the economic benefits of energy conservation do not accrue to the person who is trying to conserve (p. 9).

5) Thus, as the rated lifetime of equipment increases, the uncertainty and the value of future benefits will be discounted significantly. The irreversibility of most energy efficiency investments is said to increase the cost of such investments because secondary markets do not exist or are not well-developed for most types of efficient equipment. This argument contends that illiquidity results in an option value to delaying investment in energy efficiency, which multiplies the necessary return from such investments (p. 16)

6) If a consumer wishes to purchase an energy-efficient piece of equipment, its efficiency should reduce the risk to the lender (by improving the borrower's net cash flow, one component of credit-worthiness5) and should, but does not, reduce the interest rate, according to the proponents of the theory of market barriers. (p.10). Potential investors, it is argued, will increase their discount rates to account for this uncertainty or risk because they are unable to diversify it away. The capital asset pricing model (CAPM) is invoked to make this point (p. 16).

7) Perfect information includes knowledge of the future, including, for example, future energy prices. Because the future is unknowable, uncertainty and risk are imposed on many transactions. The extent to which these unresolvable uncertainties affect the value of energy efficiency is one of the central questions in the market barriers debate. Of course, inability to predict the future is not unique to energy service markets. What is unique is the inability to diversify the risks associated with future uncertainty to the same extent that is available in other markets (p. 20).

8) In practice, we observe that some potential borrowers, for example low-income individuals and small business owners, are frequently unable to borrow at any price as the result of their economic status or "credit-worthiness." This lack of access to capital inhibits investments in energy efficiency by these classes of consumers (p. 10).

9) Finally, Williamson (1985) argues that the key issue surrounding information is not its public goods character, but rather its asymmetric distribution combined with the tendency of those who have it to use it opportunistically (p. 23).

10) [K]nowledge of current and future prices, technological options and developments, and all other factors that might influence the economics of a particular investment. Economists acknowledge that these conditions are frequently not and in some cases can never be met. A series of information market failures have been identified as inhibiting investments in energy efficiency: (1) the lack of information, (2) the cost of information, (3) the accuracy of information, and (4) the ability to use or act upon information (p. 20).

11) The notion of "gold plating" emerged from research suggesting that energy efficiency is frequently coupled with other costly features and is not available separately (p.11).

12) Even when information is potentially available, it frequently is expensive to acquire, requiring time, money or both (p. 20).

13) Inseparability of features refers specifically to cases where availability is inhibited by technological limitations. There may be direct tradeoffs between energy efficiency and other desirable features of a product. In contrast to gold plating where the consumer must purchase more features than are desired, the inseparability of features demands purchases of lower levels of features than desired. (p.12)

14) The regulation barrier referred to mis-pricing energy forms (such as electricity and natural gas) whose price was set administratively by regulatory bodies (p. 11).

15) On the cost-side of the equation, the critics contend that, among other things, information and search costs have typically been ignored or underestimated in engineering/economic analyses. Time and/or money may be spent: acquiring new information (search costs), installing new equipment, training operators and maintenance technicians, or supporting increased maintenance that may be associated with the energy efficient equipment (p.16). [T]he class, itself, consists of a distribution of consumers: some could economically purchase additional efficiency, while others will find the new level of efficiency is not cost effective (p. 13).

16) Discounted cash-flow, cost-benefit, and social welfare analyses use price as the complete measure of value although in very different ways; behavioral scientists, on the other hand, have argued that a number of "noneconomic" variables contribute significantly to consumer decision making (p. 17).

17) [C]ustom and information have evolved significantly during the market barrier debate (p. 11).

18) In the language of (economic) utility theory, the profitability of energy efficiency investments is but one attribute consumers evaluate in making the investment. The value placed on these other attributes may, in some cases, outweigh the importance of the economic return on investment (p. 19).

19) [P]sychological considerations such as commitment and motivation play a key role in consumer decisions about energy efficiency investments (p. 17).

20) Externalities refer to costs or benefits associated with a particular economic activity or transaction that do not accrue to the participants in the activity (p. 18).

21) Other factors, such as membership in social groups, status considerations, and expressions of personal values play key roles in consumer decision-making (p.17). In order for a market to function effectively, all parties to an exchange or transaction must have equal bargaining power. In the event of unequal bargaining positions, we would expect that self-interest would lead to the exploitation of bargaining advantages (p. 19).

22) Public goods are said to represent a market failure. It has been generally acknowledged by economists and efficiency advocates that public good market failures affect the energy services market. (p. 19) [T]he creation of information is limited because information has public good qualities. That is, there may be limits to the creator's ability to capture the full benefits of the sale or transfer of information, in part because of the low cost of subsequent reproduction and distribution of the information, thus reducing the incentive to create information that might otherwise have significant value (p. 20).

23) Investment in basic research in believed to be subject to this shortcoming; because the information created as a result of such research may not be protected by patent or other property right, the producer of the information may be unable to capture the value of his/her creation (p. 19).

24) Important theoretical refinements to this concept, known as prospect theory, have been developed by Tversky and Kahneman (1981, 1986). This theory contends that individuals do not make decisions by maximizing prospective utility, but rather in terms of difference from an initial reference point. In addition, it is argued that individuals value equal gains and losses from this reference point differently, weighing losses more heavily than gains (p.21).

25) The information created by the adoption of a new technology by a given firm also has the characteristics of a public good. To the extent that this information is known by competitors, the risk associated with the subsequent adoption of this same technology may be reduced, yet the value inherent in this reduced risk cannot be captured by its creator (p. 19).

26) This work is consistent with the notion of bounded rationality in economic theory. In contrast to the standard economic assumption that all decision makers are perfectly informed and have the absolute intention and ability to make decisions that maximize their own welfare, bounded rationality emphasizes limitations to rational decision making that are imposed by constraints on a decision maker's attention, resources, and ability to process information. It assumes that economic actors intend to be rational, but are only able to exercise their rationality to a limited extent (p.21).

27) Finally, individuals and firms are limited in their ability to use — store, retrieve, and analyze — information. Given the quantity and complexity of information pertinent to energy efficiency investment decisions, this condition has received much consideration in the market barriers debate (p. 20).

28) This barrier suggests that certain powerful firms may be able to inhibit the introduction by competitors of energy-efficient, cost-effective products (p. 10).

Source: Golove, William H. and Joseph H. Eto, ***Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency***

The LBL paper bases a substantial part of its argument on a transaction cost perspective as a critique of neo-classical economics.

> Neo-classical economics generally relies on the assumption of frictionless transactions in which no costs are associated with the transaction itself. In other words, the cost of such activities as collecting and analyzing information; negotiating with potential suppliers, partners and customers; and risk are assumed to be nonexistent or insignificant. This assumption has been increasingly challenged in recent years. The insights developed through these challenges represent an important way to evaluate aspects of various market failures (especially those associated with imperfect information).[xxxv]

Starting from the observation that "transaction costs are not insignificant but, in fact, constitute a primary explanation for the particular form taken by many economic institutions and contractual relations"[xxxvi] the LBL paper identifies such costs and information as a critical issue, pointing out that "the key issue surrounding information is not its public goods character, but rather its asymmetric distribution combined with the tendency of those who have it to use it opportunistically."[xxxvii] Indeed, information plays a very large role in the analysis, entering in six different ways. In addition to the public goods and asymmetry concerns, the paper identifies four other ways information can create a barrier to efficiency –"(1) the lack of information, (2) the cost of information, (3) the accuracy of information, and (4) the ability to use or act upon information."[xxxviii]

The RFF Framework

A recent paper from Resources for the Future, entitled *Energy Efficiency Economics and Policy,* addresses exactly the same issues as the earlier LBL paper – the debate over the "efficiency gap" observed in energy markets.

Much of the literature on energy efficiency focuses on elucidating the potential rationales for policy intervention and evaluating the effectiveness and cost of such interventions in practice. Within this literature, there is a long-standing debate surrounding the commonly cited "energy efficiency gap..." Within the investment framework… the energy efficiency gap takes the form of under investment in energy efficiency relative to a description of the socially optimal level of energy efficiency. Such under investment is also sometimes described as an observed rate or probability of adoption of energy-efficient technologies that is "too slow."[xxxix]

The RFF paper suggests three broad categories of market failures – the individual, the interaction between economic agents and the fit between economic agents and society. We refer to these three levels as the behavioral, the market structural and the societal levels.

In the present context, we consider behavioral failures to represent consumer behavior that is inconsistent with utility maximization, or in the current context, energy service cost-minimization. In contrast, market failure analysis is distinct in presupposing individual rationality and focusing on the conditions surrounding interactions among economic agents and society[xl] Exhibit III-5 is taken from the RFF paper, but extended in two ways. In the market

failure category, it shows the distinction between the structural and societal levels suggested by the above quote. It also includes a few more specific failures that were discussed in the text, but not included in the original table. There are about a dozen specific market failures spread across these categories. The text to define each of the barriers is provided in the table.

The societal level market failures are closest to what the traditional sources of the economic literature refer to as market failure. These are primarily externalities and public goods. These were also considered market failures in the LBL framework. The LBL barriers and transaction costs fit in the category of interactions between economic agents, as would imperfect competition.

One obvious and important point is that, once again, information problems occur in all three categories of the RFF analysis, with several manifestations in each. Information can be a problem at the societal level since it can be considered a public good that is not produced because the authors of the information cannot capture the social value of information. It is a structural problem because, where it is lacking, even capable, well-motivated individuals cannot make efficient choices and where it is asymmetric, individuals can take advantage of the less informed to produce outcomes that are not efficient. It is a problem at the behavioral level where individuals lack the ability to process and use information.

LBL did not offer specific policy recommendations to address the market imperfections, but RFF did. These are included in Exhibit III-5.

A second paper from RFF emphasizes a broader range of supply-side market imperfections that affects the long-term availability of technology. These affect research, development and demonstration, in addition to deployment. Beyond the general externality issue, there are a number of more discrete problems identified in the energy sector that are akin to classic externalities. Individual firms have little incentive to invest in basic research or to deploy enabling technologies because they have difficulty capturing the gains.[xli] There are investments that are necessary to support a variety of complementary investments whose value cannot be captured by individual actions. More broadly, knowledge spillovers flow from technological development in a manner that may have much greater social value than individual firms can capture.[xlii] Similarly, network effects of complex energy systems may create social values that exceed the private value of individual actions.[xliii] The challenge of large or complex projects can pose problems.[xliv] In complex systems, developing and deploying new technologies in response to policy mandates, assessing and assigning liability and providing insurance may be a great challenge.[xlv]

Individuals or firms can be expected to make private calculations that minimize their direct cost, but they cannot be expected to figure the benefits of avoiding the impact of more expensive alternatives down the road, costs that have broader impacts,[xlvi] particularly when the options impose high costs on a dispersed set of individuals.[xlvii] Cost compression and learning/innovation resulting from economies of scale is a benefit that policy may promote where individuals cannot.[xlviii]

EXHIBIT III-5: RESOURCES FOR THE FUTURE: POTENTIAL MARKET FAILURES

Potential Market Failures	Potential Policy Options
Societal	
Externalities[1]	
Environmental Externalities	Emissions pricing (tax, cap and trade)
Energy Security	Energy Taxation; strategic reserves
Public Goods[a]	Public Funding
Innovation market failures	
Research and development spillovers[2, b]	R&D tax credit; public funding
Learning-by-doing spillovers[3, c]	Incentives for early adoption
Learning-by-using[4,]	Information program
Network Effects[d]	Standards
Endemic	
Capital Market Failures	
Liquidity constraints[5,e]	Finance/Loan Programs
Information problems[6]	
Asymmetric info. > Adverse selection[8]	Information programs
Principal-agent problems[9]	Information programs
Transaction Costs	
Lack of information[7]	Information programs
Asset Lives[f]	
Incomplete Markets[g]	
Regulatory Distortion	
Average-cost electricity pricing[10]	Real-time pricing; market pricing
Behavioral[11]	
Prospect theory[12]	Education, information, product Stds.
Bounded rationality[13]	Education, information, product Stds.
Heuristic decision making[14]	Education, information, product Stds.
Information[15]	Education, information, product Stds

Sources and Notes: Numbers from: Kenneth Gillinham, Richard G. Newell, and Karen Palmer, *Energy Efficiency Economics and Policy* (Resources for the Future, April 2009) (Entitled "Commonly Cited Market and Behavioral Failures Relevant to Energy Efficiency Along with Potential Policy Responses"). Letters from:

1) **Externalities**: the common theme in energy market failures is that energy prices do not reflect the true marginal social cost of energy consumption, either through environmental externalities, average cost pricing, or national security (p. 9).

a) **Public Goods:**, Many technologies have competing or multiplicative (rather than additive) impact. The most compelling economics typically reside with the first abatement options in the analytical sequence. Pursuing energy efficiency in electric power, for example, has the potential to reduce the number of new coal-fired power plants needed (p. xx); The mismatch between near-term technology investment and long-term needs is likely to be even greater in a situation where the magnitude of desired GHG reductions can be expected to increase over time. If more stringent emissions constraint will eventually be needed, society will benefit from near-term R&D to lower the cost of achieving those reductions in the future. Similarly, rationales for public support of technology demonstration projects tend to point to the… inability of private firms to capture the rewards for rewards for designing and constructing first-of-a-kind facilities. (p. 120)

2) **R&D spillovers** may lead to underinvestment in energy-efficient technology innovation due to the public good nature of knowledge, whereby individual firms are unable to fully capture the benefits from their innovation efforts, which instead accrue partly to other firms and consumers (p. 11).

(b) "R&D tends to be underprovided in a competitive markets because its benefits are often widely distributed and difficult to capture by individual firms…. economics literature on R&D points to the difficulty firms face in capturing all the benefits from their investments in innovation, which tend to spill over to other technology producers and users." (pp. 118-120); In addition, by virtue of its critical role in the higher education system, public R&D funding will continue to be important in training researchers and engineers with the skill necessary to work in either the public or private sector to product GHG-reducing technology innovations (p. 120)… Generic public funding for research tends to receive widespread support based on significant positive spillovers that are often associated with the generation of new knowledge. (p. 136)."

3) **Learning-by-doing** (LBD) refers to the empirical observation that as cumulative production of new technologies increases, the cost of production tends to decline as the firm learns from experience how to reduce its costs (Arrow 1962). LBD may be associated with a market failure if the learning creates knowledge that spills over to other firms in the industry, lowering the costs for others without compensation.

(c) Kopp and Pizer, p. 136, "Another potential rationale involves spillover effects that he process of so-called "learning-by-doing" –

a term that describes the tendency for production costs to fall as manufacturers gain production experience." (p. 136)

4) **Learning by Using:** Positive externalities associated with learning-by-using can exist where the adopter of a new energy-efficient product creates knowledge about the product through its use, and others freely benefit from the information generated about the existence, characteristics, and performance of the product (p. 12).

(e) **Network Effects:** Network effects provide a motivation for deployment policies aimed at improving coordination and planning – and where appropriate, developing compatibility standards – in situations that involve interrelated technologies, particularly within large integrated systems (for example, energy productions, transmission, and distribution networks). Setting standards in a network context may reduce excess inertia (for example, the so-called chicken-and-egg problems with alternative fuel vehicles), while simultaneously reducing search and coordination costs, but standard scan also reduce the diversity of technology options offered and may impede innovation over time. (p. 137)

5) **Capital:** Some purchasers of equipment may choose the less energy-efficient product due to lack of access to credit, resulting in underinvestment in energy efficiency and reflected in an implicit discount rate that is above typical market levels (p. 13).

(e) Similarly, rationales for public support of technology demonstration projects tend to point to the large expense; (p.120).

6) **Information:** Specific information problems cited include consumers' lack of information about the availability of and savings from energy-efficient products, asymmetric information, principal-agent or split-incentive problems, and externalities associated with learning-by-using (p. 11).

7) Lack of information and asymmetric information are often given as reasons why consumers systematically underinvest in energy efficiency. The idea is that consumers often lack sufficient information about the difference in future operating costs between more-efficient and less-efficient goods necessary to make proper investment decisions (p. 11).

8) Asymmetric information, where one party involved in a transaction has more information than another, may lead to adverse selection (p. 11).

9) Agency: The principal-agent or split-incentive problem describes a situation where one party (the agent), such as a builder or landlord, decides the level of energy efficiency in a building, while a second party (the principal), such as the purchaser or tenant, pays the energy bills. When the principal has incomplete information about the energy efficiency of the building, the first party may not be able to recoup the costs of energy efficiency investments in the purchase price or rent charged for the building. The agent will then underinvest in energy efficiency relative to the social optimum, creating a market failure (p. 12).

10) Prices faced by consumers in electricity markets also may not reflect marginal social costs due to the common use of average-cost pricing under utility regulation. Average-cost pricing could lead to under- or overuse of electricity relative to the economic optimum (p. 10).

(f) Similarly, rationales for public support of technology demonstration projects tend to point to the large expense; high degree of technical, market and regulatory risk; and inability of private firms to capture the rewards for rewards for designing and constructing first-of-a-kind facilities.(p. 120)

(g) Finally, incomplete insurance markets may provide a rationale for liability protection or other policies for certain technology options (for example, long-term CO2 storage). (p. 137)

(h) **Regulatory risk:** Similarly, rationales for public support of technology demonstration projects tend to point to the… high degree of technical, market and regulatory risk. The problem of private-sector under investment in technology innovation may be exacerbated in the climate context where the energy assets involved are often very-long lives and where the incentives for bringing forward new technology rest heavily on domestic and international policies rather than natural market forces. Put another way, the development of climate-friendly technologies has little market value absent a sustained, credible government commitment to reducing GHG emissions. (p. 120)

11) **Behavioral:** Systematic biases in consumer decision making that lead to underinvestment in energy efficiency relative to the cost-minimizing level are also often included among market barriers. (p. 8); The behavioral economics literature has drawn attention to several systematic biases in consumer decision making that may be relevant to decisions regarding investment in energy efficiency. Similar insights can be gained from the literature on energy decision-making in psychology and sociology. The evidence that consumer decisions are not always perfectly rational is quite strong, beginning with Tversky and Kahneman's research indicating that both sophisticated and naïve respondents will consistently violate axioms of rational choice in certain situations (p. 15).

12) The welfare change from gains and losses is evaluated with respect to a reference point, usually the status quo. In addition, consumers are risk averse with respect to gains and risk seeking with respect to losses, so that the welfare change is much greater from a loss than from an expected gain of the same magnitude (Kahneman and Tversky 1979). This can lead to loss aversion, anchoring, status quo bias, and other anomalous behavior (p. 16).

13) Bounded rationality suggests that consumers are rational, but face cognitive constraints in processing information that lead to deviation from rationality in certain circumstances (p. 16); Assessing the future savings requires forming expectations of future energy prices, changes in other operating costs related to the energy use (e.g., pollution charges), intensity of use of the product, and equipment lifetime. Comparing these expected future cash flows to the initial cost requires discounting the future cash flows to present values (p. 3).

14) Heuristic decision-making is related closely to bounded rationality and encompasses a variety of decision strategies that differ in some critical way from conventional utility maximization in order to reduce the cognitive burden of decision-making. Tversky (1972) develops the theory of elimination-by-aspects," wherein consumers use a sequential decision making process where they first narrow their full choice set to a smaller set by eliminating products that do not have some desired feature or aspect (e.g., cost above a certain level), and then they optimize among the smaller choice set, possibly after eliminating further products. (p. 16) For example, for decisions regarding energy-efficient investments consumers tend to use a simple payback measure where the total investment cost is divided by the future savings calculated by using the energy price today, rather than the price at the time of the savings— effectively ignoring future increases in real fuel prices (p. 17). The salience effect may influence energy efficiency decisions, potentially contributing to an overemphasis on the initial cost of an energy-efficient purchase, leading to an underinvestment in energy efficiency. This may be related to evidence suggesting that decision makers are more sensitive to up-front investment costs than energy operating costs, although this evidence may also be the result of inappropriate measures of expectations of future energy use and prices (p. 17).

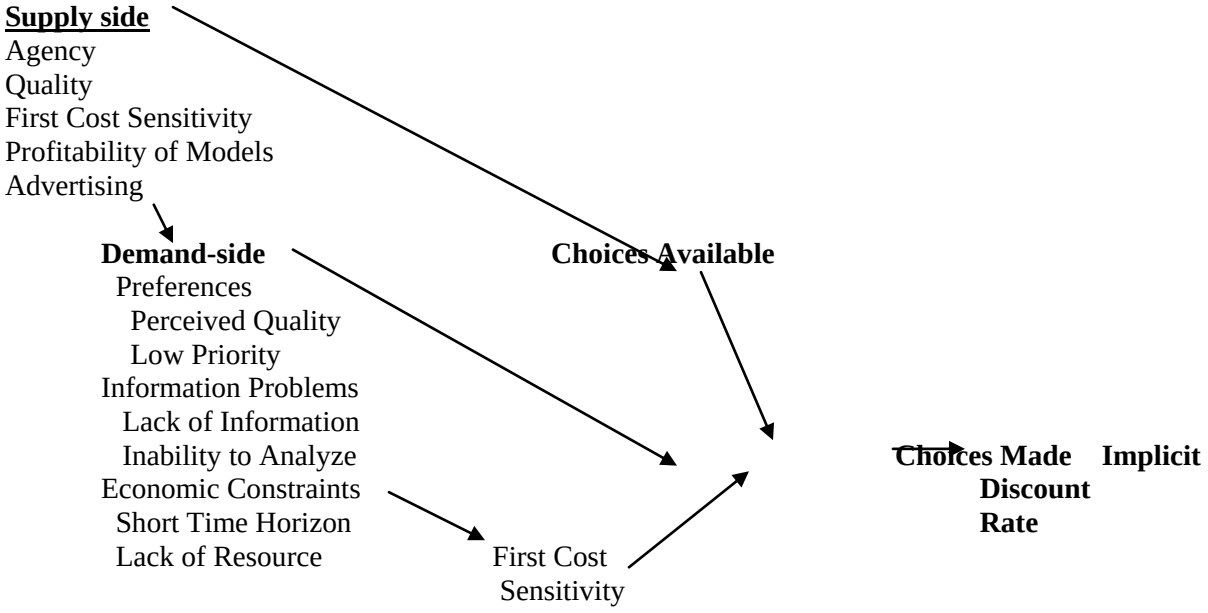
15) Alternatively, information problems may occur when there are behavioral failures, so that consumers are not appropriately taking future reductions in energy costs into account in making present investments in energy efficiency (p. 12).

Because of the long-lived nature of the assets in this sector, uncertainty plays an important role. Planning for and investing over such a long time period is difficult. There are critical technological development/deployment issues that arise at the societal level. Uncertainty about technologies in a space that emerges out of a policy concern rather than being the outgrowth of a market driven process, may pose a unique challenge[xlix] because the economic value is contingent upon a continuing commitment to the policy.[l]

D. THE IMPORTANT ROLE OF THE SUPPLY-SIDE IN THE ENERGY MARKET FAILURE

Since the sources of market failure on the consumer side have been acknowledged in the Notice and supporting materials, and worked over thoroughly in the literature, we believe it is important to elaborate on the supply-side causes of market failure. As depicted in Exhibit III-6, which is from our comments in the 2008 proceeding, we view the supply-side problems as antecedent to the demand-side problems. Because the Notice has raised the consumer welfare issue and the prospect of a joint standard setting process opens the possibility of altering the approach to standard setting, in these comments we expand the discussion of market failure, especially on the supply-side.

EXHIBIT III-6: IMPERFECTIONS IN THE AUTO MARKET



Source: Comments of the Consumer Federation of America, on National Highway Traffic Safety Administration Notice of Proposed Rulemaking; Docket No. NHTSA 2008-0089, RIN 2127-AK29; Average Fuel Economy Standards, Passenger Cars and Light Trucks; Model Years 2011-2015, July 1, 2008.

In 2008, we summarized the important role of supply side and market structural factors as follows; here we expand on that discussion.

The cars that are sold in the marketplace reflect not only what consumers want to but also, what automakers want to sell. Automakers spend millions on advertising and promotions to move the metal that makes the most profit for them. It is simply wrong to claim that all the advertising and marketing has no effect.

> Failing to recognize the imperfections on the supply-side leads NHTSA to an over reliance on automaker product plans. Thus, it is a much better representation of reality to say that the auto market undervalues fuel economy. The problem is not just the consumer. Indeed, the automakers may be a bigger part of the problem. If automakers are required to produce and sell more fuel-efficient vehicles, they will have to change their advertising and marketing focus. With the automaker resistance to more fuel efficient vehicles dampened, the apparent market valuation of fuel economy will rise quickly. It is the automakers who have been at least as large a drag on fuel economy as consumers.

Automakers prefer to sell certain models because they are more profitable. They prefer simple technologies that are less demanding to produce and maintain. They have a first cost bias, seeking to keep the sticker price low. They seek to influence the public to purchase the vehicles that best suit their interests. On the supply-side there is an agency problem – a separation between the builder or purchaser of buildings and appliances and the user. Suppliers may not choose to manufacture or stock efficient vehicles if they are less profitable, hoping that advertising and showroom persuasion can point consumers in the direction the manufacturers want them to go.

Consumers are influenced by advertising and may not perceive quality properly. The priorities afforded to any particular attribute are difficult to discern in a multi-attribute product. They lack the information necessary to make informed choices. The life cycle cost calculation is difficult, particularly when projections about future gasoline prices and vehicle use are necessary.

Even when they do consider efficiency investments, they may not find the more efficient vehicles to be available in the marketplace.

We view the apparent high discount rate attributed to consumers as the result of other factors not the root cause of the demand-side problem. We do not accept the claim that consumers are expressing irrational preferences for high returns on efficiency investments; irrational because they appear to be a return that is so much higher than they can get on other investments they routinely have available. Rather, we view the implicit discount rate as a reflection of the fact that the marketplace has offered an inadequate range of options to consumers who are ill-informed and unprepared to conduct the appropriate analysis and who lack the resources necessary to make the correct actions.[li]

The apparently grossly irrational discount rate reflects market imperfections and failures, not irrational consumers.

The implicit discount rates calculated from consumer choices reflect not only individual time preferences but a whole collection of variables that may depress the ultimate level of investment. The calculated discount rate is affected by consumers' price expectations and their levels of certainty about these; the extent to which available information is imperfect, mistrusted, or ignored; the purchase of some equipment to quickly replace nonfunctioning equipment rather than to minimize life-cycle cost; the presence in the market of builders, landlords, and other purchasers who will not pay for the energy the equipment uses; the fact that consumers with limited capital do not always purchase what they would if they had more capital; differential marketing efforts for different products, and so forth. Recognizing such possibilities, some analysts say that the data reflect "market discount rates."[lii]

The implication is that policies that alter the supply-side conditions in which consumers make decisions will lead to different market outcomes.

In a recent analysis Greene focused attention on the consumer decision-making under uncertainty about investments in fixed assets as the origin of the market failure. He sees this as a problem that lies at the intersection of transaction cost[liii] and behavioral economics,[liv] but then pointed out that there are a host of potential supply-side problems that can drive the market from optimum efficiency. As those who control the information, automakers have the ability to exploit consumers opportunistically.[lv] As the agents who choose which product attributes to bundle, they influence the range of choices available to consumers.[lvi] The under investment in efficiency technologies becomes a market problem. "If markets undervalue energy efficient technology, it follows that companies will also undervalue investments in research and development to create new efficient technologies."[lvii] Other authors add additional endemic problems that arise in energy markets including moral hazard[lviii] and the failure of secondary markets to develop for energy efficiency.[lix]

While this approach alone implicates the supply-side of the market in the overall market failure, one does not have to see the supply-side contribution to market failure as derivative of the demand-side problem. The supply-side is an independent cause of market failure, not simply a reflection of demand-side problems. "Actual Firms are more complicated and perhaps less efficient than simple profit-maximization models suggest, even when managers and employees are fully rational.[lx]

The supply-side of the market is imperfect at the individual level, although here the unit of analysis is the firm. The deficiencies of the firm compound deficiencies of the individuals that make them up.

> This market failure has little to do with the working of neoclassical markets because the rational action approach fails to appreciate two critical points. First, innovation, organizations and technological substitution are socially regulated matters, and as such they are shaped by a host of non-economic factors. Second, while current technologies may be less than optimally efficient in energy and environmental terms, they enable a highly integrated network of industry actors to produce… in uncertain environments…

> Economic actions are embedded in social relations; the natural evolution of even the most rational organizations involved the absorption of rational ends into a framework of cultural means. organizations as the tools of managers whose ends are not necessarily congruent with those of owners, employees or the long term welfare of the enterprise… Organizations that appear rational frequently make serious mistakes, bad investments and poor management decisions… The behavior of firms seems to be shaped by a combination of cultural, institutional, macro-social/economics and technical factors).[lxi]

It is a mistake to assume that either firms or consumers act in markets solely on the basis of rational self-interest. Economic calculations take place in social and cultural contexts including social obligations, normative expectations, social status attainment, and risk avoidance.

Decanio offers a similar set of observations launching from the observation that performance by firms varies widely.[lxii] He points to a range of factors that push firms from optimum behavior, emphasizing the institutional challenges of large, bureaucratic organizations.

> Perceptive observers have identified a tendency in free societies toward rigidity and over-bureaucratization brought on by the accumulation of rent-seeking activities, political advantage of special interests, and institutionalization of otherwise transitory market advantages. The same kind of institutional arteriosclerosis can afflict business.
>
> All of these explanations of why firms do not make profitable energy-savings investments can be fit within an expanded economic decision framework that includes transaction and monitoring costs, second-best solutions to information deficiencies and bounded rationality of individual members of organizations… Corporate culture, which fundamentally influences the firm's attitude towards change and adaptation, is too complex to be described in terms of economical simplification.[lxiii]

He offers a litany of factors that drive firms from the optimum, including conflict of interest between the center of periphery of the organization, high hurdle rates, priorities, incentives, risk avoidance, sunk costs, and monitoring costs.

Suppliers who make the major choices are affected by factors much like consumers. They are risk averse and exhibit a first cost bias that reflects constrained resources. Efficient products may not be stocked by dealers because of lack of demand[lxiv] or lack of capital. A bias for short-term profits may inhibit innovation. "Firm size may also significantly influence innovation… uncertainty of markets and the drive for short term gains means that these advantages generally translate into higher profits for lower selling costs, rather than innovations in quality or efficiency.[lxv]

> The organizations can become obstacles to change.
>
> No only do markets often fail to deliver efficiency, but sometimes they introduce uncertainties that make innovation risky… Activity in the industry is highly

> cyclical… the structure of the industry represents, in part, an adaptation to market cycling.[lxvi]
>
> Large-scale manufacturing and distribution systems can also act as inertial brakes on change… Ironically, complacency resulting from market dominance may also reduce the perceived benefits of innovation.[lxvii]

At the individual level on the supply-side, there is an agency problem – a separation between the builder and purchaser of buildings and appliances and the user.[lxviii] Suppliers may not install energy efficiency technologies properly, as it requires different skills or considerations.[lxix]

At a more general level, producers are people, just as consumers and they are influenced and affected by the same behavioral factors as consumers. Their profit motivation may mitigate some aspects of the behavioral economic factors that result in less than optimal behavior, but it does not cure all of the problems, with respect to efficient outcomes. Indeed, as suggested above, their profit motive may exacerbate the problem because of the tendency to opportunistically exploit information asymmetries or to under invest in research to maximize short-term profits. IN short, the supply-side also suffers from problems of motivation, perception, calculation and operation with respect to efficiency.

> Firms are faced with myriad concerns other than economic optimization or technical innovation, including internal competition for resources and control, goal conflicts, information relations and institutional inertia. Changing organizational environments offer opportunities for innovation, but stabilizing network connections can inhibit technical change and slow its transfer. Large-scale systems exhibit considerable momentum, but evolve at uneven rates under the influence of contending interests and ways of thinking…
>
> Perceived costs and risks include question of reliability of alternatives, maintenance problems, call back complaints and risk of damage to reputation, uncertainties regarding requirements and costs of gearing up; uncertain source of supply and technical support; and exclusive distribution agreements.[lxx]

Policy Implications

At one level, the policy implications of this broader view of market failure are fundamental. For example, several of the analysts who conclude that there is substantial market failure suggest that this requires policy makers to rethink their view of price as a policy instrument.

> Energy analysts have rarely asked two central behavioral questions about price effects: How does the information embodied in price enter a consumer's awareness? And how does awareness of price affect action? Rather, policy models usually make strong assumptions about price responses that probably distort the cognitive processes that mediate those responses…

> People may respond to price changes not only as a function of their magnitudes, but also as a function of whether they notice the stimulus… A policy implication of the attentional view of the price response is that it will sometimes be more effective to invest resources in drawing consumers' attention to an increase than to increase the size of the incentive.[lxxi]

At another level and for the purposes of this proceeding, the policy implication is focused in a different area. Whatever one thinks about the merits of price versus other policy instruments is irrelevant. Congress has made the choice of policy instruments in the statutes that authorize the agencies to set standards. Standard setting may be the best solution to the market failure, or the second best (compared to price), but Congress has chosen it. The agencies could conclude that the policy will be less effective than the engineering analyses project because the policy instrument does not address critical market imperfections, but they must do so within the parameters set by Congress.

In fact, we have seen both conceptual and empirical evidence to suggest that standard setting and approach to policy that is an effective instrument for achieving the goals Congress has set. In the above analysis, the role that standards can play in addressing the behavioral factors underlying market failure, about which there is consensus, seems to be widely accepted.

Recent analyses seem to put these issues at the core of the problem in the energy market. That is, with the overwhelming evidence of a large and persistent efficiency gap, some have tried to "resolve" the market failure problem by relabeling it. Instead of a market failure, it is seen as a "normal" market that is sluggish in the face of uncertainty surrounding investments that are irreversible and immobile resulting in sunk costs. Faced with the risk of loss in an uncertain environment, consumers and producers wait. It has been pointed out that this does not resolve the policy debate, since policies to reduce risk and uncertainty can speed the market toward "objectively" efficient outcomes, particularly where the individual perception of risk is different from the actual societal level of risk. The entire analysis is reframed as an externality problem, centered not on the true cost to society, but on the true risk to society.

In fact, some analysts envision this broader role for the setting of standards.

> The uncertainty/loss aversion model of consumers' fuel economy decision making implies that consumers will undervalue expected future fuel savings to roughly the same degree as manufacturers' perception that consumers demand short payback periods. This suggests that increasing fuel prices may not be the most effective policy for increasing the application of technologies to increase passenger and light truck fuel economy. This view is supported by the similar levels of technology applied to U.S. and European passenger cars in the 1990s, despite fuel prices roughly three times higher in Europe. It is also circumstantially supported by the adoption by governments around the world of regulatory standard for light-duty vehicle fuel economy and carbon dioxide emissions.[lxxii]

This view moves standards into the transaction costs arena as a solution to the market failure problem. But the ability of standards to address the market failure problems goes beyond their ability to address the barriers to investment in efficiency enhancing technologies grounded in the view that focuses on consumer behavioral and transaction cost economics. Standard can address the behavioral and transaction cost problems that afflict the supply-side of the market, as well as some of the structural problems, as shown in Exhibit III-7.

> A principle finding is that frictionless models of competitive equilibrium are incomplete and potentially misleading guide to energy policy. Good policy arguably involves more than simply "getting prices right." A potential role exists for governments to intercede when the vagaries of market institutions lead to lags in the development and adoption of energy-efficient technologies.[lxxiii]
>
> Subjective uncertainty, however, may stem from the fact that precise estimates of energy prices and equipment performance are costly to obtain from the perspective of individual consumers. If the costs of gathering information were pooled across individuals, substantial economies of scale should be achieved which could reduce the uncertainties associated with certain technologies.[lxxiv]
>
> The informational requirements that must be met to identify an efficient tax regime, however, are particularly onerous. The government must know not only the level of consumer expectations but also the specific way in which they are formed, and this information must be effectively conveyed to manufacturers through the structure of the tax. In practice, such information may be very difficult to obtain reducing the efficacy of tax instruments.
>
> Such limitations suggest a potential role for the direct regulation of equipment performance. Energy efficiency standards led to demonstrable improvement in the fuel economy of automobiles in the 1970s and early 1980s. State and local governments set requirements concerning the thermal performance of building elements.[lxxv]
>
> In some cases the direct regulation of equipment performance might side-step problems of asymmetric information, transaction costs and bounded rationality, obviating the need for individual consumers to make unguided choices between alternative technologies.[lxxvi]

EXHIBIT III-7: CAUSES OF MARKET FAILURE ADDRESSED BY STANDARDS

ENDEMIC FLAWS	TRANSACTION COSTS
Agency	Sunk Costs, Risk
Asymmetric Information	Risk & Uncertainty
Moral Hazard	Imperfect Information
STRUCTURAL PROBLEMS	SOCIETAL FAILURES
Scale	Externalities
Bundling	Information
Cost Structure	
Product Cycle	BEHAVIORAL FACTORS

Availability	Motivation
	Calculation/Discounting

This literature review has presented a broad-brush overview of a very large subject. Many of the analyses cited present empirical evidence to support the conceptual conclusions we have woven together into the case for the importance of the supply-side and market structure and causes of market failure. Building the analytic framework has a substantial pay-off. It leads to important conclusions about the path public policy should follow.

- Standards are a good candidate to address the problem.

- Because they do not assess the extent to which the supply-side causes the efficiency gap, the consumer choice models as currently configured are not a measure of the value consumers would or should place on energy efficiency if the market was not so fundamentally flawed. They will mislead policy makers about the value of policies to promote efficiency.

- Understanding the important role that institutions and organizations play in the economy also allows us to conduct an institutional capacity assessment of the two agencies. Motivation (legislative mandate), perspective (time horizon, technology forcing), calculation (economic constraints), and implementation (measurement of fuel economy) all argue for the EPA under the Clean Air Act as the lead agency.

A CONSUMER ANALYSIS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY STANDARDS:

THE CORNERSTONE OF CONSUMER-FRIENDLY ENERGY/ENVIRONMENTAL POLICY

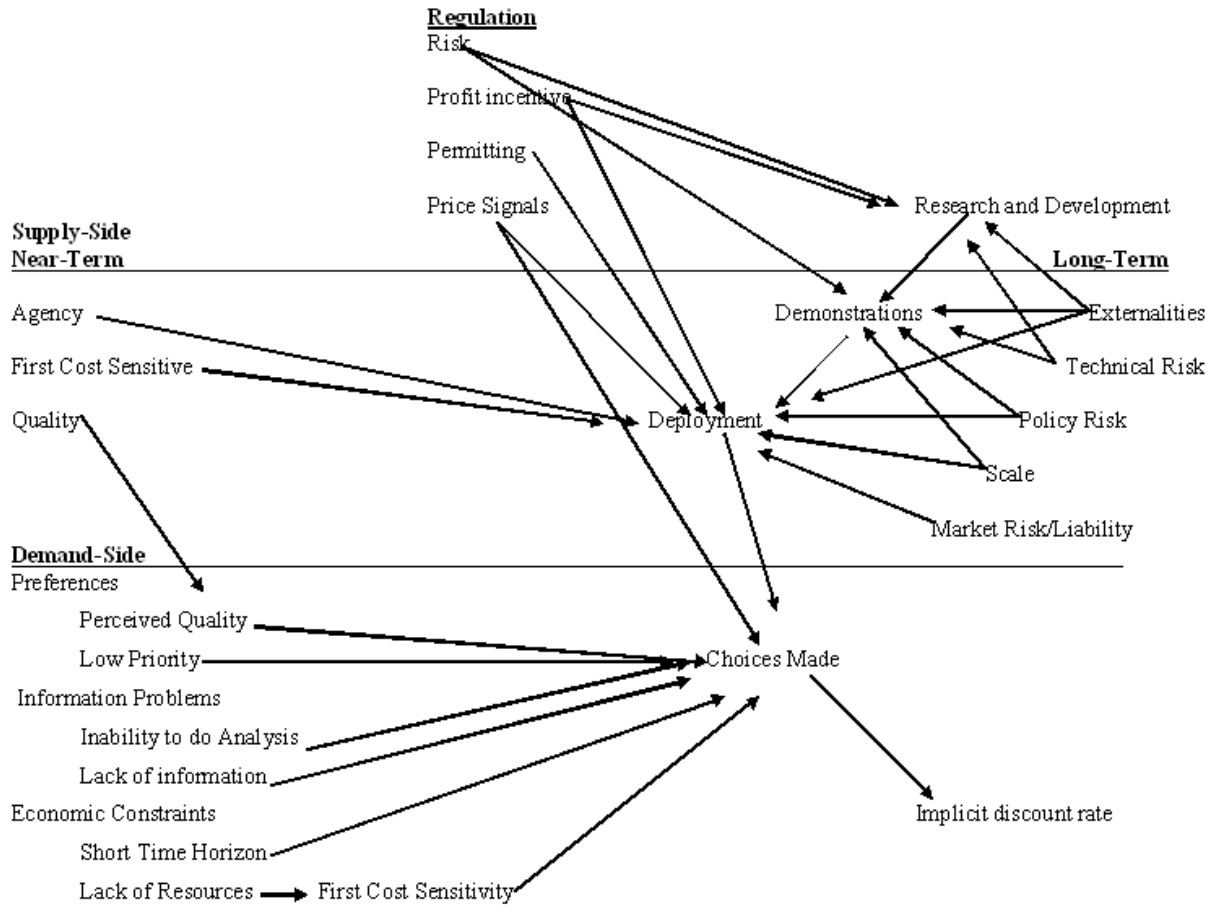
CONSUMER FEDERATION OF AMERICA

MAY 2009

Why The Market Won't Take Care of the Problem

The existence of very low (or even negative) cost options is inconvenient for the simple market solution argument, since it implies major market imperfections, but it is central from the consumer point of view. These are opportunities that appear to reduce energy costs more than they cost to implement but they have not been seized. McKinsey and Company has undertaken the important task of identifying the sources of demand-side market failure,[lxxvii] while Resources for the Future has analyzed the sources of supply-side market failures.[lxxviii] Exhibit V-3 divides the imperfections into the short-term and long-term, supply-side and demand-side market imperfections.

Exhibit V-3: Imperfections Affecting Electricity Markets



Source: Derived from Raymond J. Kopp and William A Pizer, *Assessing U.S. Climate Policy Options* (Washington, D.C.: Resources for the Future, November 2007); Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? – McKinsey and Company for the Conference Board.

There are imperfections at every stage of the product cycle – research, development, demonstration and deployment. Demand-side efficiency in buildings and for appliances is a matter of deployment, but consumer behavior represents a small part of the overall challenge. Indeed, in the electricity sector many of the decisions are not made by consumers, but are made by builders and utilities acting as the agents for consumers, above all in their choice of appliance and generation facilities.

These observations eviscerate the knee-jerk, economist's attack on standards and mandates and other regulatory policies to target specific measures to reduce greenhouse gases.

- If mandates address market imperfections, they can help accomplish the goal.

- If the options targeted by the mandates are low cost (inframarginal), they are not likely to cause inefficiencies.
- Mandates force utilities to think about, analyze and invest in alternatives that are not their private preference, but are socially preferable.

We view the apparent high discount rate attributed to consumers as the result of other factors not the root cause of the demand-side problem. We do not accept the claim that consumers are expressing irrational preferences for high returns on efficiency investments, irrational because they appear to be a return that is so much higher than they can get on other investments they routinely have available. Rather, we view the implicit discount rate as a reflection of the fact that the marketplace has offered an inadequate range of options to consumers who are ill-informed, unprepared to conduct the appropriate analysis and who lack the resources necessary to make the correct actions. Adding the disconnect between the initial purchase decision and the bill-payer which constrains the choices available to consumers and we arrive at a complex set of imperfections that affect consumer behavior in the market. In short, an apparently irrational discount rate reflects market imperfections and failures, not irrational consumers.

Demand-side: Consumers appear to apply high discount rates to energy efficiency investments,[lxxix] are sensitive to first costs[lxxx] and may not give efficiency a high priority in a multi-attribute product.[lxxxi] They lack the information necessary to make informed choices[lxxxii] and perceive differences in quality and the availability of options.[lxxxiii] Even when they do consider efficiency investments, they may not find the more efficient appliances to be available in the marketplace. [lxxxiv]

At the individual level there is an agency problem – a separation between the builder or purchaser of buildings and appliances and the user.[lxxxv] Demand is most directly determined by produces (landlords and builders) not consumers in many instances.

This understanding of the nature of the market failure has important implications for policy choices. A consumer subsidy for efficiency or a performance standard to reduce consumption may contribute more to reduced emissions on the demand-side at a lower cost to society than a producer subsidy or regulatory relief that contributes by expanding supply. The policy needs to recognize both.

The Supply-Side; There are supply-side market imperfections at work in the electricity market as well. The broader range of supply-side market imperfections affects research, [lxxxvi] development and demonstration, in addition to deployment.[lxxxvii] Individuals or firms can be expected to make private calculations that minimize their direct cost, but they cannot be expected to recognize the very complex interactions in technologies[lxxxviii] or to incorporate the value of avoiding some high cost options down the road (particularly when the options impose high costs on a dispersed set of individuals).[lxxxix] Similarly, the much lower cost of prefitting the energy efficiency of buildings compared to retrofitting building and production processes[xc] may not be reflected in near term decisions.

Individual firms have little incentive to invest in basic research or to deploy enabling technologies because they have difficulty capturing the gains. These are investments, like transmission facilities, that are necessary to support a variety of complementary investments with large and lower cost abatement potentials.[xci]

Suppliers may not stock efficient appliances[xcii] and may not install it properly, as it requires different skills or considerations.[xciii]

There are other critical technological development/deployment issues that arise at the societal level. Uncertainty about technologies in a space that is a whole new field of endeavor, one that emerges out of a policy concern rather than being the outgrowth of a market driven process, poses a unique challenge.[xciv] The economic value is contingent upon a continuing commitment to the policy.[xcv] Cost compression and learning/innovation resulting from economies of scale[xcvi] is a similarly external benefit that policy may promote where individuals cannot.[xcvii] More broadly, knowledge spillovers flow from technological development in a manner that may have much greater social value than individual firms can capture.[xcviii] Similarly, network effects of complex energy systems may create social values that exceed the private value of individual actions. [xcix]

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[i] George Cooper, *The Origin of Financial Crises" Central Banks, Credit bubbles and the Efficient Market Fallacy* (New York: Vintage, 2008); Justin Fox, *The Myth of the Rational Market* New York: Harper, 2009); Richard Posner, *A Failure of Capitalism* Cambridge: Harvard University Press, 2009); Mark Cooer and Barbara Roper, Reform of *Financial Markets: The Collapse of Market Fundamentalism and the First Steps to Revitalize the Economy* (Consumer Federation of America, 2009).

[ii] John B. Taylor, *Economics* New York: Houghton Mifflin, 1998), p. 49.

[iii] Taylor, Economics, p. 405.

[iv] Taylor, *Economics*, p. 404.

[v] W. Kip Viscusi, John M. Vernon and Joseph E. Harrington, Jr., *Economics of Regulation and Antitrust,* Cambridge: MIT Press, 2001), p. 2.

[vi] F. M Scherer and David Ross, *Industrial Market Structure and Economic Performance* (Houghton Mifling: Boston, 1990) (hereafter Scherer and Ross), p. 4.

[vii] Scherer and Ross 1990, p. 4: We begin with the fundamental proposition that what society wants from producers of goods and services is good performance. Good performance is multidimensional… Decisions as to what, how much and how to produce should be efficient in two respects: Scarce resources should not be wasted, and production decisions should be responsive qualitatively and quantitatively to consumer demands. The operations of producers should be progressive, taking advantage of opportunities opened up by science and technology to increase output per unit of input and to provide consumers with superior new products, in both ways contributing to the long-run growth of real income per person. The operation of producers should facilitate stable full employment of resources. The distribution of income should be equitable. Equity is notoriously difficult to define, but it implies at least that producers do not secure rewards in excess of what is needed to call forth the amount of services supplied.

[viii] Scherer and Ross 1990 p. 4: Performance in particular industries or markets is said to depend upon the conduct of sellers and buyers in such matters as pricing policies and practices, overt and taciturn interfirm cooperation, product line and advertising strategies, research and development commitments, investment in

production facilities, legal tactics (e. g. enforcing patent rights), and so on.

[ix] Scherer and Ross 1990, p. 5: Conduct depends in turn upon the structure of the relevant market, embracing such features as the number and size distribution of buyers and sellers, the degree of physical or subjective differentiation prevailing among competing seller's products, the presence or absence of barriers to entry of new firms, the ratio of fixed to total costs in the short run for a typical firm, the degree to which firms are vertically integrated from raw material production to retail distribution and the amount of diversity or conglomerateness characterizing individual firms' product lines.

Market structure and conduct are also influenced by various basic conditions. For example, on the supply side, basic conditions include the location and ownership of essential raw materials; the characteristics of the available technology (e.g. batch versus continuous process productions or high versus low elasticity of input substitution); the degree of work force unionization; the durability of the product; the time pattern of production (e.g. whether goods are produced to order or delivered from inventory); the value/weight characteristics of the product and so on. A list of significant basic conditions on the demand side must include at least the price elasticity of demand at various prices; the availability of (and cross elasticity of demand for) substitute products; the rate of growth and variability over time of demand; the method employed by buyers in purchasing (e.g. acceptance of list prices as given versus solicitation of sealed bids versus haggling); and the marketing characteristics of the product sold (e.g. specialty versus convenience shopping method).

[x] Scherer and Ross, p. 6: As the solid arrows of Figure 1.1 suggest, we shall be concerned mainly with causal flows running from market structure and/or basic conditions to conduct and performance. That is, we seek theories that permit us to predict ultimate market performance from market structure, basic conditions, and conduct.

There are also important feedback effects (dashed arrows in Figure 1.1). For instance, vigorous research and development efforts can alter an industry's technology, and hence it cost conditions and/or the degree of physical productions differentiation. Or sellers' pricing policies may either encourage or discourage entry or drive firms out of the marker, thereby transforming the dimension of market structure. In this sense, both basic conditions and market structure variables are *endogenous*, that is determined within the whole system of relationships and not fixed by outside forces.

[xi] Scherer and Ross 1990, p. 16-17.

[xii] Scherer and Ross 1990, p. 53.

[xiii] Scherer Ross, pp. 53-54.

[xiv] Douglass C. North, *Institutions, Institutional Change and Economic Performance* (Cambridge: Cambridge University Press, 1990), p. 27. .

[xv] North, p8…. 11.

[xvi] North, p. 27.

[xvii] North, p. 34.

[xviii] North, p. 7.

[xix] North, p. 54.

[xx] North, p. 32.

[xxi] Wilkinson, Nick, *An Introduction to Behavioral Economics* (Hampshire, Palgrave, 2008); Camerer, Colin F, George Lowenstein and Matthew Rabin (Eds.), *Advances in Behavioral Economics* (New York: Russell Sage, 2004).

[xxii] Paraphrasing Wilkinson, Introduction, p. 5.

[xxiii] Golove, William H. and Joseph H. Eto, Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency.

[xxiv] Kenneth Gillinham, Richard G. Newell, and Karen Palmer, *Energy Efficiency Economics and Policy* (Resources for the Future, April 2009).

[xxv] Stephen J. Decanio, "Barriers within Firms to Energy-Efficient Investments," *Energy Policy*, September 1993, (hereafter, Barriers)pp. 906-907.

[xxvi] Decanio, Barriers, p. 908.

[xxvii] Decanio, Barriers, p. 908.

[xxviii] Decanio, pp. 908, 909

[xxix] Stern Paul C., "Blind Spots in Policy Analysis: What Economics Does Not Say about Energy Use," *Journal of Policy Analysis and Management,"*5:2 (1986), p. 203.

[xxx] Golove, William H. and Joseph H. Eto, *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency,* Energy and Environment Division, Lawrence Berkeley Laboratory, March 1996.

[xxxi] Golove and to, Market Barriers, p. iv.

[xxxii] Golove and Eto, Market Barriers, p. iv.

[xxxiii] There has recently however, been a dramatic re-commitment to publicly-sponsored energy efficiency and a substantial increase in allocated resources. (Sanstad, p. 6-5).

[xxxiv] Golove and Eto, Market Barriers, p. x.

[xxxv] Golove and Eto, Market Barriers, p. 22.

[xxxvi] Golove and Eto, Market Barriers, p. 23.

[xxxvii] Golove and Eto, Market Barriers, p. 23.

[xxxviii] Golove and Eto, Market Barriers, p. 20.

[xxxix] Kenneth Gillinham, Richard G. Newell, and Karen Palmer, *Energy Efficiency Economics and Policy* (Resources for the Future, April 2009), p. 7.

[xl] Gillingham, Newell and Palmer, p. 8.

[xli] Raymond J. Kopp and William A Pizer, *Assessing U.S. Climate Policy Options* (Washington, D.C.: Resources for the Future, November 2007).pp. 118-120, "R&D tends to be underprovided in a competitive markets because its benefits are often widely distributed and difficult to capture by individual firms…. economics literature on R&D points to the difficulty firms face in capturing all the benefits from their investments in innovation, which tend to spill over to other technology producers and users."

[xlii] Kopp and Pizer, Assessing, " In addition, by virtue of its critical role in the higher education system, public R&D funding will continue to be important in training researchers and engineers with the skill necessary to work in either the public or private sector to product GHG-reducing technology innovations (p. 120)… Generic public funding for research tends to receive widespread support based on significant positive spillovers that are often associated with the generation of new knowledge. (p. 136)."

[xliii] Kopp and Pizer, Assessing, p. 137. Network effects provide a motivation for deployment policies aimed at improving coordination and planning – and where appropriate, developing compatibility standards – in situations that involve interrelated technologies, particularly within large integrated systems (for example, energy productions, transmission, and distribution networks). Setting standards in a network context may reduce excess inertia (for example, the so-called chicken-and-egg problems with alternative fuel vehicles), while simultaneously reducing search and coordination costs, but standard scan also reduce the diversity of technology options offered and may impede innovation over time.

[xliv] Kopp and Pizer, Assessing, p. 120, "Similarly, rationales for public support of technology demonstration projects tend to point to the large expense; high degree of technical, market and regulatory risk; and inability of private firms to capture the rewards for rewards for designing and constructing first-of-a-kind facilities."

[xlv] Kopp and Pizer, Assessing, p. 137, "Finally, incomplete insurance markets may provide a rationale for liability protection or other policies for certain technology options (for example, long-term CO2 storage)."

[xlvi] Kopp and Pizer, Assessing, p. xx, Many technologies have competing or multiplicative (rather than additive) impact. The most compelling economics typically reside with the first abatement options in the analytical sequence. Pursuing energy efficiency in electric power, for example, has the potential to reduce the number of new coal-fired power plants needed.

[xlvii] Kopp and Pizer, Assessing, p. 120, "The mismatch between near-term technology investment and long-term needs is likely to be even greater in a situation where the magnitude of desired GHG reductions can be expected to increase over tie. If more stringent emissions constraint will eventually be needed, society will benefit

from near-term R&D to lower the cost of achieving those reductions in the future."

[xlviii] Kopp and Pizer, Assessing, p. 136, "Another potential rationale involves spillover effects that he process of so-called "learning-by-doing" – a term that describes the tendency for production costs to fall as manufacturers gain production experience."

[xlix] Kopp and Pizer, Assessing, p. 120, "The problem of private-sector under investment in technology innovation may be exacerbated in the climate context where the energy assets involved are often very-long lives and where the incentives for bringing forward new technology rest heavily on domestic and international policies rather than natural market forces."

[l] Kopp and Pizer, p. 120, "Put another way, the development of climate-friendly technologies has little market value absent a sustained, credible government commitment to reducing GHG emissions."

[li] Comment of the Consumer Federation of America, on National Highway Traffic Safety Administration Notice of Proposed Rulemaking; Docket No. NHTSA 2008-0089, RIN 2127-AK29; Average Fuel Economy Standards, Passenger Cars and Light Trucks; Model Years 2011-2015, July 1, 2008, pp. 38-40.

[lii] Stern, Blind Spots, p. 209;

[liii] David L. Greene, John German and Mark A. Delucchi, "Fuel Economy: The Case for Market Failure," in Dan Sperling and James S. Cannon (Eds.), *Reducing Climate Impact in the Transportation* Sector (Springer, 2009), p. 183, The classical formulation of the rational economic choice model takes no account of the transaction costs of optimization. These include the time, effort and expense of collecting and processing information. If these costs outweigh the potential benefit of an optimal choice, rational consumers would decline to optimize. Comparing fuel economy numbers is relatively easy but few consumers have the tools to convert those fuel economy numbers into estimates present value fuel savings.

[liv] Green, German and Delucchi, Fuel Economy, p. 184. A variety of uncertainties make the investment in increased fuel economy a risky bet for consumers. Despite labeling, consumers are not sure what fuel economy will actually be achieved in real world driving. They cannot accurately predict future fuel prices any more than experts can. They are not even certain exactly how much driving they will do, or how long their car will last. Consumers preference for the status quo, combined with fuzzy preferences for future savings guarantee loss-averse behavior. Consumers may be rational and as well informed as possible, yet the market will still decline investments in energy efficiency that have positive expected net present value because of the combined effect of uncertainty and loss aversion.

[lv] Green, German and Delucchi, Fuel Economy, p. 183, Information asymmetry occurs when one party to a market transaction possess knowledge superior to the other. The suppliers of air conditioners, for example, will have better information about their energy efficiency than the buyers. This enables unscrupulous sellers to deceive consumes, resulting in a reluctance of consumers to trust even scrupulous sellers' high efficiency claims. The adoption of fuel economy labeling has undoubtedly diminished the importance of this problem, yet manufacturers still advertise vehicles based on their highway mileage rather than their combined city/highway fuel economy rating. (Greene, p. 183)

[lvi] Green, German and Delucchi, Fuel Economy, p. 203.

[lvii] Green, German and Delucchi, Fuel Economy, p. 204.

[lviii] Richard B. Howarth and Bo Anderson, "Market Barriers to Energy Efficiency," *Energy Economics*, October 1993, p. 268. Finally, the problem of "moral hazard' might arise under either energy service contracts or performance guaranteed. To the extent that the energy intensity of a device depends on user behaviour, institutions that weaken user incentives to minimize direct energy costs might lead to reduced energy efficiency. .

[lix] Richard B. Howarth and Alan H. Sanstad, "Discount Rates and Energy Efficiency, *Contemporary Economic Policy*, 13, *July* 1995, p. 104.

[lx] Howarth and Sanstad, Discount Rates, p. 107.

[lxi]Loren Lutxenhier, "Innovation and Organizational Networks: Barriers to Energy Efficiency in U.S; Housing Industry," *Energy Policy*, 22(10) 1994, pp. 867-868.

[lxii] Stephen DeCanio, "Why Do Profitable Energy-Savings Investment Projects Languish?" *Journal of General Management*, 20(1) 1994, p. 63. First, it is necessary to discard the baggage carried by most economists that immersion in a market environment guarantees efficiency behaviour by the market participants…. In actuality,

companies rise and fall; variations in performance are huge, both across and within sectors

[lxiii] DeCanio, Languish, p. 67

[lxiv] McKinsey and Company, *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? – McKinsey and Company for the Conference Board, 2007* p.x 16, "Even when consumers intend to purchase energy efficient devices, they may have a hard time finding the item, due to a retailer's approach to inventory management and stock optimization."

[lxv] Lutzenhiser, Innovation, p. 871.

[lxvi] Lutzenhiser, Innovation, p. 871.

[lxvii] Lutzenhiser, Innovation, p. 872.

[lxviii] McKinsey, Reducing, p. 41, "The owner, operator, occupant and bill-payer (benefit capturer) associated with a building may be separate entities or may not be involved for the full relevant time period; a result, their interests in supporting energy efficiency and GHG abatement are not aligned."

[lxix] Greene, German and Delucchi, Fuel Economy, pp. 95-96"Large annual increases in fuel economy require aggressive changes to every aspect of the vehicle. The industry does not have the resources to handle this level of change all at once. Even if it did, it would be too risky to implement the changes all at once….There are also many examples of poor quality vehicles and inadequate technologies rushed to market. The Chevy Chevette, Ford Pinto and Chrysler K cars all offered good fuel economy and sole well at the time, but developed reputations as relatively unreliable vehicles, damaging the reputations of the companies."

[lxx] Lutzenhiser, Innovation, p. 871-872).

[lxxi] Stern, Blind Spots, p. 203.

[lxxii] Green, German and Delucchi, Fuel Economy, p. 203; "Discount rates used by consumers in these purchases can be expected to include potentially substantial premia for risk, liquidity, and uncertainty,"

[lxxiii] Howarth and Anderson, Market Barriers, p. 264.

[lxxiv] Howarth and Anderson, Market Barriers, p. 265.

[lxxv] Howarth and Anderson, Market Barriers, p. 264.

[lxxvi] Howarth and Sanstad, Discount Rates, p. 108.

[lxxvii] Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? – McKinsey and Company for the Conference Board.

[lxxviii] Raymond J. Kopp and William A Pizer, *Assessing U.S. Climate Policy Options* (Washington, D.C.: Resources for the Future, November 2007).

[lxxix] McKinsey, p. 41. "Consumers expect many household investments to have a short, 2- or 3- year payback period, which implies a discount rate of nearly 40 percent… Builders have an incentive to minimize first costs at the expense of operating cost or carbon efficiency (pp. 40…41).

[lxxx] McKinsey, p. 41,"In addition, affordability constraints may reduce the willingness of consumers to invest in measures offering greater efficiency, even if the financial benefits are satisfactory."

[lxxxi] McKinsey, p. 40, "Efficiency is not a top priority for consumers."

[lxxxii] McKinsey, p. 41, "Customers typically have no accurate information about the energy consumed by any particular application. Consumers, architects, engineers, builders, contractors, installers, and building operators are often not aware of savings potential, or are poorly informed about performance benefits."

[lxxxiii] McKinsey, p. 41, "Real or perceived quality differences can deter consumers… In some cases, consumers worry that high-efficiency devices (such as some washing machines and dishwashers) will not perform as well as conventional models."

[lxxxiv] McKinsey, p. 41, "Even when consumers intend to purchase energy efficiency devices, they may have a hard time finding the item, due to a retailer's approach to inventory management and stop optimization."

[lxxxv] McKinsey, p. 41, "The owner, operator, occupant and bill-payer (benefit capturer) associated with a building may be separate entities or may not be involved for the full relevant time period; a result, their interests in supporting energy efficiency and GHG abatement are not aligned."

[lxxxvi] Resources for the Future, pp. 118-120, "R&D tends to be underprovided in a competitive market because its benefits are often widely distributed and difficult to capture by individual firms…. economics literature on R&D points to the difficulty firms face in capturing all the benefits from their investments in innovation, which tend to spill over to other technology producers and users."

[lxxxvii] Resources for the Future, p. 120, "For technology policies to help achieve a given level of emissions reductions at lower overall social cost than an emissions-pricing policy alone, they must be targeted to addressing market problems *other than* emission reductions per se."

[lxxxviii] Many technologies have competing or multiplicative (rather than additive) impact. The most compelling economics typically reside with the first abatement options in the analytical sequence. Pursuing energy efficiency in electric power, for example, has the potential to reduce the number of new coal-fired power plants needed.

[lxxxix] Resources for the Future, p. 120, "The mismatch between near-term technology investment and long-term needs is likely to be even greater in a situation where the magnitude of desired GHG reductions can be expected to increase over time. If more stringent emissions constraint will eventually be needed, society will benefit from near-term R&D to lower the cost of achieving those reductions in the future."

[xc] McKinsey, p. 40, "Switching to alternative designs may incur added costs for retrofitting."

[xci] McKinsey, p. 25, "Similar sequencing effects occur throughout the power and transportation sector in particular."

[xcii] McKinsey, p. 16, "Even when consumers intend to purchase energy efficient devices, they may have a hard time finding the item, due to a retailer's approach to inventory management and stock optimization."

[xciii] McKinsey, p. 41.

[xciv] Resources for the Future, p. 120, "The problem of private sector under-investment in technology innovation may be exacerbated in the climate context where the energy assets involved are often very-long lived and where the incentives for bringing forward new technology rest heavily on domestic and international policies rather than natural market forces."

[xcv] Resources for the Future, p. 120, "Put another way, the development of climate-friendly technologies has little market value absent a sustained, credible government commitment to reducing GHG emissions."

[xcvi] McKinsey, p. 25, "Costs and/or yields for some technologies improve according to the scale at which they are pursued. Penetration levels tend to drive the learning rate and can determine whether the technology achieve sufficient scale to propel economic success. Solar photovoltaics, CCS, biofuels, and LED lighting exhibit a broad range of outcomes depending on innovation and cost compression associated with reaching commercial scale."

[xcvii] Resources for the Future, p. 136, "Another potential rationale involves spillover effects that the process of so-called "learning-by-doing" – a term that describes the tendency for production costs to fall as manufacturers gain production experience."

[xcviii] Resources for the Future, "In addition, by virtue of its critical role in the higher education system, public R&D funding will continue to be important in training researchers and engineers with the skills necessary to work in either the public or private sector to product GHG-reducing technology innovations (p. 120)… Generic public funding for research tends to receive widespread support based on significant positive spillovers that are often associated with the generation of new knowledge. (p. 136)."

[xcix] Resources for the Future, p. 137. Network effects provide a motivation for deployment policies gained at improving coordination and planning – and where appropriate, developing compatibility standards – in situations that involve interrelated technologies, particularly within large integrated systems (for example, energy productions, transmission, and distribution networks). Setting standards in a network context may reduce excess inertia (for example, the so-called chicken-and-egg problems with alternative fuel vehicles), while simultaneously reducing search and coordination costs, but standards can also reduce the diversity of technology options offered and may impede innovation over time.