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August 7, 2013

VIA HAND DELIVERY

Ms. Gail Mount
Chief Clerk
North Carolina Utilities Commission
430 North Salisbury Street
Dobbs Building
Raleigh, NC 27603-5918

RE: In the Matter of: Application of Duke Energy Carolinas, LLC For Approval of New Cost Recovery Mechanism and Portfolio of Demand-Side Management and Energy Efficiency
Docket No. E-7, Sub 1032

Dear Ms. Mount:

Enclosed for filing in the referenced docket please find the following documents:

- An original and 30 copies of the Testimony of Natalie Mims on behalf of Southern Alliance for Clean Energy, South Carolina Coastal Conservation League, Natural Resources Defense Council and Sierra Club. ***Pages 25 and 26 of this document contain confidential information***.

- An original and one copy of the Public Version of the Testimony of Natalie Mims with the confidential information redacted.

- One copy of pages 25 and 26 containing confidential information which is indicated by gray highlighting and ***filed under seal***.

By copy of this letter and enclosure, I am serving all parties of record with a copy of the **Public Version** of Ms. Mims' testimony.

Sincerely,

Robin G. Dunn

Robin G. Dunn

RGD
Enclosures
cc: Parties of Record

*** *PUBLIC VERSION* ***

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-7, SUB 1032

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	)	
	)	**TESTIMONY OF NATALIE MIMS**
In the Matter of:	)	**ON BEHALF OF SOUTHERN**
Application of Duke Energy Carolinas,	)	**ALLIANCE FOR CLEAN ENERGY,**
LLC For Approval of New Cost	)	**SOUTH CAROLINA COASTAL**
Recovery Mechanism and Portfolio of	)	**CONSERVATION LEAGUE,**
Demand-Side Management and Energy	)	**NATURAL RESOURCES DEFENSE**
Efficiency Programs	)	**COUNCIL AND SIERRA CLUB**
	)	
	)	

Q. PLEASE STATE YOUR NAME, POSITION, AND BUSINESS ADDRESS.

A. My name is Natalie Mims. I am Director of Energy Efficiency for Southern Alliance for Clean Energy ("SACE"), and my business address is P.O. Box 1842, Knoxville, TN 37901.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?

A. I am testifying on behalf of SACE, the South Carolina Coastal Conservation League ("CCL"), Natural Resources Defense Council ("NRDC") and the Sierra Club (collectively, "Petitioners").

Q. PLEASE SUMMARIZE YOUR QUALIFICATIONS AND WORK EXPERIENCE.

A. I graduated from Pennsylvania State University in 2002 with a Bachelor of Arts in English and Political Science. I received a Master of Environmental Law and Policy from Vermont Law School in 2004. Since 2004, I have worked in the non-profit sector on a wide range of energy and environmental policy issues, including energy efficiency potential studies, energy efficiency program design and implementation, and evaluation, measurement and verification of efficiency programs.

I joined SACE in 2010 and became its Director of Energy Efficiency in 2013. I am the senior staff member responsible for SACE's utility energy efficiency advocacy across the Southeast, including Georgia, Alabama, Mississippi, Florida, North Carolina, South Carolina, and Tennessee. In this capacity, I am responsible for leading dialogue with utilities and regulatory officials on issues related to energy efficiency policy, program design, and evaluation. My work includes conducting detailed analysis of utility-run energy efficiency portfolios, providing written testimony and comments in regulatory proceedings, conducting presentations before regulators and interested stakeholders, and participating in energy efficiency stakeholder working groups, including the Duke Energy Carolinas, LLC's ("DEC" or the "Company") Collaborative. A copy of my resume is included as Mims Exhibit 1.

Q. HAVE YOU TESTIFIED PREVIOUSLY BEFORE THE NORTH CAROLINA UTILITIES COMMISSION (THE "COMMISSION")?

A. Yes. I submitted testimony on behalf of SACE in Docket E-7, Sub 1031, in which DEC applied for approval of its annual demand-side management ("DSM") and energy efficiency ("EE") cost recovery rider, Rider EE, for 2014.

Q. WHAT IS DEC REQUESTING THAT THE COMMISSION APPROVE IN THIS PROCEEDING?

A. DEC has filed an application pursuant to N.C. Gen. Stat. § 62-133.9 and Commission Rule R8-69 seeking Commission approval of a new DSM and EE cost recovery and incentive mechanism and a new portfolio of DSM/EE programs to replace its current "modified save-a-watt" (hereinafter, "Modified SAW") mechanism and programs that expire at the end of this year. DEC is also requesting certain changes to the procedures for qualified industrial and large commercial customers to "opt out" of the Company's DSM/EE programs and rider.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is several fold. First, I will discuss DEC's performance and its current cost-recovery mechanism, the Modified SAW mechanism. I will discuss DEC's energy efficiency potential, then turn to new measures and programs that DEC could offer in addition to its proposed energy efficiency portfolio, including the importance of obtaining and retaining commercial and industrial participation in DEC's efficiency programs. Next, I will present my concerns regarding DEC's proposed cost recovery and incentive mechanism and propose an alternative incentive structure, which would provide the Company with a better incentive to maximize its DSM/EE savings.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS WITH REGARD TO DEC'S APPLICATION.

A. In summary, I am recommending that the Company pursue all cost-effective energy efficiency, and seek to achieve the goals it agreed to in connection with the Duke Energy-Progress Energy merger. To help the Company achieve those goals, I make energy efficiency program recommendations to increase participation and provide efficiency opportunities to all customer segments, including low-income and large commercial industrial customers. I also recommend that we have a Collaborative meeting to focus on how to assist low and fixed-income customers, or bring representatives from those groups into the Collaborative as members. I support the proposed stakeholder group meeting to investigate the impact of increasing incentives, as well as to discuss the framework and outcomes of a study of opted-out customers proposed in Docket E-7, Sub 1031. Finally, I recommend an incentive that is indexed to both the UCT score and efficiency savings as a percentage of retail sales, and explain why this is a better incentive than DEC's proposed financial incentive.

DEC'S PERFORMANCE UNDER THE MODIFIED SAW MECHANISM

Q. HOW DO THE COMPANY'S ACHIEVEMENTS UNDER MODIFIED SAW COMPARE WITH ITS SAVINGS GOALS?

A. DEC has exceeded its savings targets at low cost for the third year in a row. The Company has achieved 150% of the nominal avoided cost benefits target, 115% of the capacity impacts of the original target, and 170% of the original energy impact requirements provided in the Modified SAW Settlement Agreement.[1] These savings were achieved at levelized system portfolio costs of $0.01/kWh.[2] As Table 1 illustrates, DEC continues to exceed its forecasted energy savings at lower cost per unit than anticipated. These results make DEC the leader on achieving low-cost energy efficiency in the Southeast.

[1] Testimony of Timothy Duff at 13.
[2] Assuming measures have a lifetime of ten years.

Table 1. Modified SAW and Estimated Annual Energy Savings and First-Year Cost

Year	Planned SAW Goal (GWh)[3]	Actual Savings (GWh)[4]	Planned First-Year Cost[5] ($/kWh)	Actual First-Year Cost[6] $/kWh
2010	234	501	$0.16	$0.08
2011	256	520	$0.18	$0.11
2012	383	490	$0.19	$0.10

DEC should be commended for its good work on energy efficiency implementation and high program performance. This track record indicates that the Company can achieve higher levels of efficiency than planned.

Q. DID YOU PARTICIPATE IN THE COLLABORATIVE THAT WAS ESTABLISHED IN CONNECTION WITH MODIFIED SAW?

A. I have been participating in DEC's Collaborative and find the group to be a helpful way to exchange information and stay up-to-date with program information. I support the Company's recommendation to continue the Collaborative through the next phase of energy efficiency implementation in North Carolina. I would also compliment the Company on the accessibility of its energy efficiency planning staff and their willingness to clarify or explain issues of interest over the past several years.

[3] Modified SAW Settlement Agreement, Exhibit B at 20.
[4] Duff Exhibit 1 at 2-3.
[5] SAW first-year cost calculations are based on information contained in the Modified SAW Settlement Agreement, Exhibit B at 20 and 24. First-year cost is calculated by dividing the first-year budget into the first-year savings; it does not cover the lifetime of the measure.
[6] Actual first-year cost calculations are based on information provided Duff Exhibit 1 at 2-3 and Exhibit 3, filed in NCUC Docket No. E-7 Sub 1031. Estimated first-year cost is calculated by dividing the first-year budget into the first-year savings; it does not cover the lifetime of the measure.

I offer one recommendation for the Collaborative. The low-income, fixed income and multifamily sectors are harder-to-reach segments, and it would be useful to have a Collaborative meeting focus on how to assist those customers, or bring representatives from those groups into the Collaborative as members. Such a meeting could investigate specific barriers to efficiency in the low-, fixed income and multifamily sectors, how to appropriately value low-income energy efficiency program benefits (e.g., fewer arrearages and disconnections), what current low-income efforts in North Carolina entail, and how DEC can leverage those existing activities to offer cost-effective low- and fixed-income efficiency programs.

DEC'S ENERGY EFFICIENCY POTENTIAL

Q. WHAT LEVELS OF ENERGY SAVINGS IS DEC PROPOSING TO ACHIEVE BASED ON ITS CURRENT APPLICATION?

A. As shown in Table 2, DEC is proposing to achieve about 400 gigawatt-hours of energy efficiency impacts annually each year from 2014-2017.

Table 2. Comparison of DEC Annual Energy Efficiency Impacts 2014-2017 (GWh)

	2012 Base IRP Case	Current Application	Economic Potential at 7 cents/kWh	Merger Settlement[7]	Economic Potential at 9-11 cents/kWh
2014	374	397	830	800	1116
2015	402	409	830	950	1116
2016	415	422	830	1100	1116

[7]The specific values presented in this column illustrate one path to achieving the targets in the Merger Settlement, although there are other paths to meeting this goal.

2017	458	429	830	1250	1116
Total	1649	1657	3317	4100	4464

Q. HOW DO THE COMPANY'S PROJECTED ENERGY SAVINGS COMPARE TO THE SAVINGS IDENTIFIED IN ITS 2012 IRP?

A. Table 2 compares the level of efficiency that DEC proposes in this application to the base case analyzed for the Company's 2012 IRP. DEC anticipates greater savings with this application than it did in the efficiency base case it analyzed for its 2012 IRP, but lower savings than the Company's economic potential at $0.07/kWh.

Q. HOW DO THE COMPANY'S PROJECTED ENERGY SAVINGS COMPARE TO THE TARGETS THE COMPANY AGREED TO IN CONNECTION WITH THE DUKE ENERGY-PROGRESS ENERGY MERGER?

A. In the S.C. Public Service Commission ("SC PSC") proceeding related to the merger of Duke Energy and Progress Energy, SC PSC Docket No. 2011-158-E, the companies entered into a settlement agreement with SACE, CCL and Environmental Defense Fund (the "Merger Settlement"), in which, among other things, DEC and PEC agreed to an annual energy savings target of 1% beginning in 2015, and a cumulative target of 7% of retail sales from 2014-2018. The Merger Settlement was approved by the SC PSC in its Order Approving Joint Dispatch Agreement, Order 2012-517 (July 11, 2012) at 43.

In this application, DEC is proposing annual energy savings of roughly 0.5% of retail sales and cumulative energy savings of roughly 2% of retail sales over the 2014-2017 period. These projections fall far short of the Company's commitments in the Merger Settlement.

Q. HOW DO THE COMPANY'S PROJECTED ENERGY SAVINGS COMPARE TO THE ECONOMIC POTENTIAL IDENTIFIED IN THE COMPANY'S ENERGY EFFICIENCY STUDY?

A. The DEC system has over 22,330 GWh of economic efficiency available at $0.09 - $0.11/kWh in the next 20 years, according to the North and South Carolina potential studies conducted for the Company, or about 1,100 GWh a year. At a lower levelized cost of $0.07/kWh, which DEC's consultant used to determine the economic efficiency potential, the savings are only 830 GWh a year. By comparison, DEC is proposing roughly 400 GWh a year in this application. Thus, as shown in Table 2, DEC's projected energy savings are lower than the annual average economic potential identified for DEC in North and South Carolina. Accordingly, it is clear that DEC is not proposing to achieve all cost-effective energy efficiency potential, as DEC is proposing to achieve lower efficiency impacts than what was included in the 2012 IRP base case, Merger Settlement, and economic potential study.

Q. **DOES ESTIMATING THE ECONOMIC POTENTIAL AT $0.07/KWH CREATE AN ACCURATE ASSESSMENT OF HOW MUCH COST-EFFECTIVE ENERGY EFFICIENCY IS AVAILABLE?**

A. No. For the potential study, DEC's consultant used a levelized cost of $0.07/kWh to determine the economic potential of energy efficiency. Based on our analysis of avoided cost data provided by the Company in response to an informal data request, the benefit of energy efficiency is between $0.09 - $0.11/kWh on a levelized basis. Using $0.09 - $0.11/kWh increases the economic potential to 1100 GWh a year, a substantial increase over the 830 GWh a year identified in the Company's study.

Q. WHAT IS A REASONABLE ASSUMPTION ABOUT HOW MUCH ENERGY EFFICIENCY SAVINGS DEC CAN ACHIEVE?

A. Eleven states in the United States are saving approximately 1% of electricity sales each year, and the leading state saved upwards of 2% of electricity sales a year, based on the most current (2010) efficiency data.[8] While it is not realistic to assume that 100% of cost effective energy efficiency potential could be achieved by the utility, 1,100 GWh/year, or 1.4% of sales, is a good indicator of what level of annual savings an innovative energy efficiency program could achieve over the next few years. Given that there are utilities that achieved this level of savings in 2010, it does not seem unreasonable to incentivize DEC to achieve 1.4% savings in 2016. Furthermore, in the long run, it is likely that additional practices or technologies will be developed that offer further opportunities to achieve cost-effective energy savings, offering the opportunity to sustain high levels of annual program impacts for many years to come.

Q. WHY IS IT IMPORTANT THAT DEC MAXIMIZE ITS ENERGY SAVINGS FROM DSM/EE PROGRAMS?

A. Energy efficiency is the lowest cost resource available to utilities. Because EE reduces total system costs, it creates a universal benefit for both program participants and non-participants. SACE and the Sierra Club calculated the full value of energy efficiency cost savings in the DEC 2012 Integrated Resource

[8] Foster, Ben, Anna Chittum, Sara Hayes, Max Neubauer, Seth Nowak, Shruit Vaidyanathan, Kate Farley, Kaye Schultz, and Terry Sullivan. The 2012 State Energy Efficiency Scorecard. October 2012. ACEEE report Number E12C.

Plan analysis, which showed that portfolios with High EE/DSM resources cost $4.7 billion less than the "preferred plan" selected by DEC over the full analysis time frame, as illustrated in Table 3 below.[9]

Table 3. Customer Cost Savings from Increased Energy Efficiency

Revenue Requirement Forecast	**DEC** ($ billions present value)
High EE/DSM Case Base EE/DSM Case	$ 112.6 $ 117.3
Potential Savings	**$ 4.7**

Q. COULD YOU SUMMARIZE YOUR CONCLUSIONS ABOUT THE ENERGY SAVINGS POTENTIAL AVAILABLE TO DEC AND THE COMPANY'S ABILITY TO REACH THAT POTENTIAL?

A. DEC's energy efficiency potential studies indicate that DEC has access to enough cost-effective EE resources to support over 1,100 GWh of annual incremental energy savings for the next 20 years. This estimate assumes that the full cost-effective energy efficiency potential is achieved in equal installments over that 20- year period, although most high impact energy efficiency programs include a ramp-up period where the utility continually builds towards a savings target. It is important for DEC to persistently pursue energy efficiency because it reduces total system costs and creates a universal benefit for all of its customers.

[9]SACE calculated the avoided costs associated with increasing the level of energy efficiency and demand side management (EE/DSM) programs from the base to the high case levels. For a detailed cost comparison of DEC's Base, High EE/DSM, and Renewable capital expansion plans, see Sierra Club and Southern Alliance for Clean Energy's Initial Comments filed in Docket E-100 Sub 137.

DEC's PROPOSED PORTFOLIO AND OPPORTUNITIES FOR INCREASED SAVINGS

Q. PLEASE DESCRIBE THE PORTFOLIO OF PROGRAMS THAT DEC HAS PROPOSED FOR APPROVAL IN THIS DOCKET.

A. In this application, DEC is proposing a portfolio of EE/DSM programs that contains eight residential programs, nine non-residential programs, and three demand response programs.

It is a positive step that DEC has expanded its portfolio of energy efficiency programs to the harder-to-reach sectors, such as low-income customers, and multi-family programs in its portfolio. However, to capture all cost-effective energy efficiency, the Company must increase the participation in its proposed programs, include more measures, and offer additional programs in its energy efficiency portfolio.

Q. WHAT CAN THE COMPANY DO TO INCREASE PARTICIPATION AND ACHIEVE HIGHER LEVELS OF SAVINGS?

A. Given that there is almost twice as much additional cost-effective energy efficiency to capture beyond what DEC is proposing in this application, the Company should evaluate its proposed portfolio to see if there are additional changes that can be made to increase participation.

For example, DEC anticipates that the Energy Efficiency Appliances and Devices program will capture 25% of the efficiency impacts from 2014-2017. The program provides incentives for three groups of measures: efficient lighting, efficient water heating, and efficient pool equipment. DEC projects high participation rates for the Energy Efficiency Appliances and Devices program. From 2014-2017, DEC estimates there will be 2,055,048 participants.[10] According to DEC, a participant for this program could be a light bulb or a household. Regardless of which it is, the Appliance and Devices program will reach twice as many participants than all other residential programs combined from 2014-2017. Despite this high participation rate, DEC anticipates that its Energy Efficient Appliances and Devices program will only reduce load by 84 GWh over four years.[11] With such high participation rates, DEC could use this program as a lead generator to increase participation for other residential programs, such as the Appliance Recycling program, education, HVAC, low income, and energy assessment programs, all of which will touch less than 4% of customers over the four-year period.[12]

Q. ARE THERE ADDITIONAL EFFICIENCY MEASURES THAT DEC CAN ADD TO ACHIEVE HIGHER LEVELS OF SAVINGS WITH ITS PROPOSED PROGRAMS?

A. Yes. There are programs that could benefit from additional measures. The initial ramp-up phase of the DEC programs have focused on lighting conversions, representing over 85% of the efficiency impacts in the Modified SAW portfolio in 2009-2011. DEC is encouraged to continue to transition to more non-lighting program participation in its program portfolio, as it has started to do in 2012. The residential Appliances and Devices program impacts could be amplified by including clothes washers, dishwashers, televisions, and other consumer electronics.

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[10] Duff Exhibit 6.
[11] Id.
[12] Id.

The multi-family program could also be enhanced with additional measures. It will touch approximately a quarter of DEC's residential customers in four years, but accounts for only 1% of the projected residential energy efficiency savings.[13] The program, as proposed, focuses on installing efficiency lighting and water heating measures in multi-family buildings. This is a harder-to-reach customer segment, and DEC should consider how to maximize the savings associated with each multi-family unit addressed by including other efficiency measures. For example, ventilation improvements, programmable thermostats, motors and VFDs, HVAC upgrades, air sealing, and drain water heat recovery could all be added to make the multi-family program a more comprehensive offering. In addition, DEC is encouraged to further link its program efforts with those of state and local housing agencies and organizations to leverage resources and maximize impacts.

Q. ARE THERE ADDITIONAL PROGRAMS THAT THE COMPANY COULD OFFER TO INCREASE ITS ENERGY SAVINGS?

A. Yes. DEC's customers would benefit from the addition of an upstream manufactured housing incentive, additional cost-effective low-income programs, residential and non-residential new construction programs, as well as programs that target grocery commissioning, college campuses, and cities. Finally, I offer two suggestions for industrial programs: an energy management pilot that Bonneville Power Administration offers, and Xcel Energy's Process Efficiency program. These expanded program portfolios are considered

[13] <u>Id.</u>

common/standard practice with a number of successful utility programs around the country.

Q. **IS THERE A MANUFACTURED HOUSING INCENTIVE PROGRAM THAT YOU WOULD RECOMMEND AS A MODEL FOR DEC?**

A. One program that has been implemented by the Tennessee Valley Authority ("TVA") that DEC's customers could benefit from is an upstream manufactured housing incentive. In this program, TVA provides $1,450 to manufactured home producers in the form of a cost effective upstream incentive.[14] The incentive level was set to cover the majority of the incremental cost between a HUD and Energy Star manufactured home and has been effective in transforming the manufactured home market in TVA's territory. Each home that is installed within TVA's territory creates almost 12,000 kWh of savings for TVA.[15] In fiscal year 2012, TVA saved 5.7 GWh with this program, and the program had a cost benefit ratio of 4.8 using the Total Resource Cost test ("TRC").[16] In 2013, TVA anticipates that it will save 7 GWh with this program.[17] Given the prevalence of manufactured homes in DEC's service territory, the omission of such a program from the Company's portfolio represents a significant lost opportunity.

[14] TVA Website, http://www.tva.com/news/releases/janmar12/ee_manufactured_housing.html.
[15] Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs. Nowak, Seth, Martin Kushler, Patti Witte and Dan York. June 2013, Report Number U132.
[16] Id.
[17] Id.

Q. YOU ALSO MENTIONED PROGRAMS THAT SERVE LOW- AND FIXED INCOME CUSTOMERS. PLEASE ELABORATE.

A. DEC should also consider programs that serve low- and fixed-income customers. Petitioners suggest that DEC evaluate two implementation models that have been successful in the Northeast. The first, through Efficiency Vermont, offers the Weatherization Assistance Program to customers who are slightly above the income qualifications for the state-administered program. In addition, Efficiency Vermont piggybacks additional measures onto the Weatherization Assistance Program for both income-qualified customers and customers who are slightly above the qualifications. Both of these programs, called the Major Appliance Rehabilitation Services and the Weatherization Assistance Add-On Program, were part of Efficiency Vermont's 2011 cost-effective low-income program, along with three other programs. Together, Efficiency Vermont spent $3.5M on the programs in 2011 and saved over 6,400 MWh.[18] With a lifetime cost of energy at $0.05/kWh,[19] this package of programs was a cost-effective offering.

The second program, offered in Massachusetts, targets buildings owned by public housing authorities or non-profits that serve low-income populations. The program targets high-energy users with a benchmarking tool that compares energy consumption in a portfolio of buildings. This allows the building owners to quickly select projects based on the greatest energy savings available. In

[18] Id.
[19] Id.

2012, the program saved 9.7 GWh and spent $18M on single-family and multi-family buildings.[20]

DEC could also offer a low-income pilot similar to the one offered by Duke Energy Ohio, which was approved by the Ohio Public Utilities Commission ("Ohio PUC") in May 2013.[21] The pilot program will leverage funding from People Working Cooperatively, Inc. ("PWC"), a non-profit organization that serves low-income, elderly, and disabled homeowners. The pilot allows Duke Energy Ohio to purchase the energy savings, at $0.255 per first-year kWh, that are realized through leveraged funds acquired by PWC.[22] Duke Energy Ohio, prior to the pilot program, utilized PWC to deliver a large portion of its low-income weatherization activities, and PWC used Duke Energy Ohio to generate funding from government programs and private donors.[23] With the pilot, the incremental energy efficiency PWC produces will be purchased by Duke Energy Ohio, which counts toward Duke Energy Ohio's statutory energy efficiency mandate.[24] Duke Energy Ohio projects that this program will be cost-effective and, as a safeguard, the Ohio PUC placed a $2M cap on the pilot over its three-year life.[25] Further, the Ohio PUC required that Duke Energy Ohio's independent program evaluators review the program during the pilot to ensure that the costs do not exceed the TRC test.[26]

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[20] Id.
[21] Public Utilities Commission of Ohio, Case No. 13-662-EL.
[22] Id.
[23] Id.
[24] Id.
[25] Id.
[26] Id.

Q. PLEASE PROVIDE SOME DETAIL ON NEW CONSTRUCTION PROGRAMS.

A. As the housing and commercial property market begins to pick up, DEC should consider implementing both residential and non-residential new construction programs. Although measures applicable to newly constructed buildings may currently be available, a program specifically aimed at incentivizing developers, builders, design and architecture firms, and financial decision-makers is likely to be more effective. Dedicated new construction programs, specifically designed to capture these opportunities in the early planning and construction stages, should be very cost effective in program impact evaluations with higher spill-over rates of market transformation compared with the "one-size-fits-all" program that tries to address both retrofit and new construction in the same offering.

Q. PLEASE DISCUSS YOUR RECOMMENDATIONS TARGETED TO THE NON-RESIDENTIAL SECTOR.

A. Within the non-residential sector, there are additional programs that could be used to ensure that DEC captures all cost-effective efficiency. The Company offers many measures in its non-residential programs, so my program suggestions are focused on how the measures are offered, as opposed to which measures are offered.

Public Service Electric and Gas Company ("PSE&G"), a New Jersey investor-owned utility, offers a retrofit commissioning program that focuses on energy savings through improved operations and maintenance (O&M) practices and no/low-cost retrofit measures that are specific to supermarkets. PSE&G

chose to focus on supermarkets for a variety of reasons, including the estimate that every $1 in energy savings generated in a supermarket is equivalent to increasing sales by $59.[27] The program is implemented in three phases, and participants are required to conduct measurement and verification for a 12-month period following program participation to ensure the savings persist. Follow up evaluations indicated that the program resulted in approximately $45,000 of energy cost savings per store.[28]

Many utilities offer targeted incentives to universities because of their replication with multiple building opportunities and willingness to control operating costs through energy efficiency. One example is the partnership between NSTAR Electric and Gas ("NSTAR") and MIT with their Efficiency Forward program. MIT committed to annual reduction targets of about 10GWh a year, and NSTAR committed to paying a fixed incentive for each kWh saved.[29] In addition to its energy saving targets, MIT committed to reinvesting a portion of the savings into more efficiency projects. Further, by providing a flat rate incentive, NSTAR simplified the process for MIT, enabling the school to focus on project implementation rather than determining what the incentive rate would be for a variety of projects. Another example involves the incentives that Pacific Gas & Electric ("PG&E") provides to California universities and

[27] Bryant, Elaine, Paul J. Romano. Innovation in Retro-Commissioning Program Design: The Value of Customer Partnerships. Presentation at Association of Energy Professionals Annual Conference, February, 2012.
[28] Id.
[29] http://web.mit.edu/facilities/environmental/efficiencyforward/

colleges.[30] PG&E offers a variety of services to reduce university and college energy bills, including retrocommissioning, energy audits, and incentives for measures such as HVAC, daylighting, lighting, and energy management systems.

Municipalities and local government can also benefit from utility efficiency programs. PSE&G offers a Direct Install Program for government and non-profit facilities.[31] The program has been designed to successfully overcome financing and installation barriers widely common in this sector by offering direct installation of efficiency measures and on-bill financing. The program starts with PSE&G conducting an audit and identifying energy efficiency opportunities.[32] After the cost proposal is approved, PSE&G installs the efficiency measures and pays 100% of the upfront cost.[33] The participant then repays 20% of the cost over two years, interest free, through on-bill financing.[34] Entergy Texas also offers a municipal energy efficiency program called CitySmart. This program provides technical and financial support to municipal governments to help them overcome their unique barriers and further their efforts to implement efficiency improvements. Entergy offers an incentive of $165/kW +$0.02/kWh in the summer and $150/kW +$0.01/kWh in the winter.[35] Finally, DEC may consider exploring efficiency programs that focus on municipality street lighting and wastewater treatment facilities. These are

[30] http://www.pge.com/sites/en/mybusiness/save/rebates/bybusiness/colleges.page
[31] http://www.pseg.com/business/small_large_business/save_energy/gov_efficiency.jsp
[32] Id.
[33] Id.
[34] Id.
[35] http://www.entergy-texas.com/energy_efficiency/city_smart.aspx

often major savings opportunities that are often expensive, and local governments may not be able to cover the upfront costs with smaller city budgets.[36]

Q. DO YOU HAVE ANY SUGGESTIONS FOR PROGRAMS THAT COULD BE OFFERED TO INDUSTRIAL CUSTOMERS?

A. The Bonneville Power Association ("BPA") offers an Energy Management Pilot to its industrial customers. The goal of the pilot is to achieve energy efficiency impacts in the industrial sector through improved operations and maintenance ("O&M") practices and capital measures. The Evaluation, Measurement and Verification ("EM&V") report for the pilot program was completed in February 2013.[37] According to the report, the program provides long-term energy-management consulting services that educate and train industrial energy users to: (1) develop and execute a long-term energy-planning strategy, and (2) integrate energy management into their business planning permanently. The pilot has three core components: Energy Project Manager Co-Funding that enables a facility to devote staff time to energy management; Track and Tune which helps industrial facilities improve O&M efficiencies both financially and technically, and High-Performance Energy Management which provides industrial facilities with training and technical support, engaging both upper management and process engineers to implement energy management in their core business practices.

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[36] http://aceee.org/sector/local-policy/toolkit/water

[37] Energy Management Improvement Pilot Final Report, prepared by The Cadmus Group for Bonneville Power Administration Energy Smart Industrial Program. February 1, 2013.

The pilot achieved efficiency impacts that reduced participants' electricity consumption by 4.4%, and was cost-effective based on the TRC, Utility Cost Test ("UCT") and Participant Cost Test ("PCT") scores.[38]

Finally, Xcel Energy's Process Efficiency program could also be useful to DEC industrial customers.[39] The program is conducted in three phases. During the first phase, the detailed energy management plans are created and customer support for the plan is developed. In the second phase, data mining occurs to turn energy monitoring data into useful, easy to understand visual representations of energy performance. Implementation occurs during phase three, and long-term incentives are provided to generate results and encourage ongoing energy management. EM&V of the program in 2012 indicated that the conversion rate from efficiency opportunities to implementation is ~90%, which is much higher than for programs that offer technical studies as the incentive.[40] Xcel Energy has achieved over 150% of its GWh goal every year from 2009-2012 with its Process Efficiency Program.[41] Based on what DEC filed, this program appears to be similar to the Energy Management and Information Services Pilot, but perhaps slightly more in depth, and learning more about Xcel's successes could provide some program insights to DEC staff.

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[38] Energy Management Improvement Pilot Final Report, prepared by The Cadmus Group for Bonneville Power Administration Energy Smart Industrial Program. February 1, 2013.

[39] Kennedy, Dominic, Lori Nielsen, Chandan Rao, Nikhila Rao and Stuart Moulder. Leveraging Senior Executive Engagement, Long Term Performance Incentives and Data Mining to Achieve Significant Savings and Sustainable Energy Management Practices for Large Customers. 2013 ACEEE Summer Study on Energy Efficiency in Industry.

[40] Id.

[41] Id.

Q. MANY CUSTOMERS ARE UNABLE TO AFFORD THE UP-FRONT COST OF ENERGY EFFICIENCY INVESTMENTS. HOW COULD THE COMPANY ADDRESS THIS PROBLEM?

A. On-bill financing is growing in popularity as a way to provide energy efficiency services to lower-income and fixed-income customers. Over 30 utilities and cooperatives around the country are offering on-bill financing in its program portfolios.[42] PSE&G in New Jersey has introduced a financing component in their multi-family program that allows customers to repay their share of the energy efficiency program installation costs over time, on their utility bill, interest free. PSE&G's program is designed so that the owner's share of the efficiency upgrade should be offset by the cost savings from the upgrade.[43] Similarly, closer to home, Central Electric Power Cooperative and the Electric Cooperatives of South Carolina spearheaded an on-bill financing program in 2010. Based on the program evaluation that was completed in June 2013, the typical participant saved over $1,150 a year in energy costs, receiving a net savings of $280 a year after paying $870 for their efficiency equipment.[44]

Q. WHAT IS DEC DOING TO ATTRACT INDUSTRIAL CUSTOMERS?

A. DEC is requesting approval for an additional "opt-in" period. I fully support this request and commend the Company for developing alternative paths to discourage customers from opting out of its programs. I also support DEC Witness Duff's proposal to convene a stakeholder group to evaluate whether

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[42] Database of State Incentives For Renewables and Efficiency, 2013. www.dsireusa.org/incentives.
[43] Leaders of the Pack: ACEEE's Third National Review of Exemplary Energy Efficiency Programs. Nowak, Seth, Martin Kushler, Patti Witte and Dan York. June 2013, Report Number U132.
[44] Keegan, Patrick. Help My House Final Summary Report. 2013. Prepared for Ceentral Electric Power Cooperative, Columbia, South Carolina, and The Electric Cooperatives of South Carolina, Cayce, South Carolina.

higher customer incentives are appropriate for commercial and industrial programs.[45]

Q. WHY IS IT IMPORTANT FOR DEC TO CONTINUE TO PURSUE INDUSTRIAL AND LARGE COMMERCIAL CUSTOMERS?

A. There are two main reasons. First, industrial and large commercial customers have significant energy efficiency impacts and, without capturing those impacts, it will be difficult for DEC to meet its Merger Settlement commitments. A recent analysis by Duke University and the U.S. EPA shows that if the average industrial facility moves from the 50th percentile of energy efficiency to the 75th percentile, it will save 20-30% of its energy. This is a huge opportunity that will not be captured without appropriate action to overcome barriers to industrial energy efficiency. This analysis is attached as Mims Exhibit 2.

Second, industrial and large commercial customers that opt out of energy efficiency programs are receiving the system benefits of efficiency without paying for them. As discussed in SACE and the Sierra Club's comments on DEC's 2012 IRP, DEC's IRP portfolio analysis demonstrates that increased levels of energy efficiency lower total system cost, providing a universal benefit to all customers on the system, including large customers who opt out (and thus do not have to bear any of the cost of energy efficiency). A system-wide, "universal" benefit occurs when efficiency reduces demand, average fuel costs are reduced, and system costs fall, which puts downward

[45] NCUC Docket No E7 Sub 1032, Duff Testimony, 48-49.

pressure on rates. Over the long term, as power plants are deferred or avoided entirely, the cost of building those power plants is not put into the rate base, placing further downward pressure on rates.[46]

Q. WHAT IS YOUR ESTIMATE OF THE UNIVERAL BENEFIT OF ENERGY EFFICIENCY?

A. At the levels of energy efficiency impacts included in the Company's application, the universal benefit of energy efficiency will reduce system costs by about [redacted]. This universal benefit does not include the additional [redacted] in bill reductions that accrue to program participants. At the level of energy efficiency impact required to meet the goals in the Merger Agreement, both the participant benefits and the universal benefits of energy efficiency would be even greater.

Q. HOW DID YOU CALCULATE THE UNIVERSAL BENEFIT OF ENERGY EFFICIENCY?

A. As illustrated in Table 4 below, the universal benefit is calculated as total system benefits, adjusted for two factors. First, some benefits are only received by participants: the portion of participant bill savings associated with fuel costs (and other variable costs) is not shared with other system customers. Second, another effect of energy efficiency is that some of the revenue requirement associated with fixed costs is no longer collected from program participants, and thus is collected in another manner. As proposed by the Company in its application, these costs would be recovered through a three-year lost revenue

[46] While some or all of the downward pressure on rates results from deferring or avoiding building power plants, this is counteracted by lost revenues assocated with fixed costs from existing plants. However, opt-out customers, because they do not pay for the 36 months of lost revenues, are not affected by this and are effectively subsidized by all other customers.

adjustment mechanism. Once those two adjustments are made, the [redacted] in remaining cost savings are universal benefits that accrue to all customers regardless of participation, customer class or opt-out status.

Table 4.: Universal Benefit of Energy Efficiency[47]

Benefit & Adjustment	Amount ($M NPV)
Total System Benefits (Avoided cost)	[redacted]
Lost Revenues, fuel only (Adjustment 1)	[redacted]
Gross Universal Benefit	[redacted]
LRAM (adjustment 2)	[redacted]
Net Universal Benefit	[redacted]

Q. WHAT CAN DEC DO TO MITIGATE THE SUBSIDIZATION OF OPT-OUT CUSTOMERS?

A. DEC should amend its opt-out requirements to increase accountability and transparency. Customers who opt out should have to show on a regular basis that they are actually saving energy and contributing to the overall universal benefit. Positive steps in this direction are already being taken. The joint proposed order filed by DEC and the Public Staff in Docket E-7, Sub 1031 states that "it is appropriate for the Company, the Public Staff, and other interested parties to explore and develop a consensus position regarding the merits of conducting a limited study or survey of opted-out customers, and if deemed to be a prudent endeavor, the parameters of such a study." In addition, Company witness Duff's direct testimony in this docket indicates that DEC has committed to convene a stakeholder group prior to June 1, 2014,

[47] All data net of free riders.

specifically focused on investigating the impact that increasing incentives above their current levels would have on opt-out eligible customer participation, program cost-effectiveness, and potential free-ridership. I believe that this stakeholder group meeting would be the appropriate forum for parties to discuss a potential study of opted-out customers. If the Commission adopts the joint proposed order filed in Docket E-7, Sub 1031, I would recommend that the Company file, as a component of its 2014 DSM/EE rider filing, an update regarding the outcome of these discussions and any formal proposal regarding an opt-out study should it be deemed feasible and appropriate.

DEC'S PROPOSED COST-RECOVERY AND INCENTIVE MECHANISM

Q. PLEASE DESCRIBE THE COST RECOVERY AND INCENTIVE MECHANISM THAT DEC HAS PROPOSED IN THIS DOCKET.

A. DEC proposes a mechanism with three components: (1) recovery of costs incurred by the Company to offer and deliver EE and DSM programs to customers; (2) recovery of net lost revenues incurred for up to 36 months of a measure's life for EE programs; and (3) a shareholder incentive with different earning tiers based on the cost-effectiveness of the Company's EE/DSM portfolio.

Q. HOW DOES THE PROPOSED MECHANISM COMPARE TO THE MODIFIED SAW MECHANISM?

A. Like the Modified SAW mechanism, DEC's proposed new mechanism would allow the Company to recover its program costs and 36 months of net lost revenues. In addition, several other elements of the Modified SAW program are carried over to the proposed cost recovery mechanism, including the Found Revenues Decision Tree, EM&V agreement from the Commission's Rider 3 Order, opt-out waiver, rate period following the vintage and calendar year waiver, and Program Flexibility Guidelines.

Q. DO YOU SUPPORT CARRYING OVER THESE ASPECTS OF THE MODIFIED SAW MECHANISM INTO THE NEW MECHANISM?

A. Yes. I support the Company's request to recover its program costs and 36 months of net lost revenues. In addition, I do not object to the Found Revenue Decision tree, the opt-out waiver, or the rate period following a vintage and calendar year being carried over into the new cost recovery mechanism. Moreover, I support the EM&V agreement and the Program Flexibility Guidelines being included in the new cost recovery mechanism. A comparison of these key criteria as components of DEC and Petitioners' proposed cost recovery mechanisms can be found in Table 5.

Table 5. Key Criteria for the Proposed New Cost Recovery Mechanism

Criterion	DEC's Proposal	Petitioners' Proposal
Cost Recovery	• Performance based • Based on actual program costs	• Same
Lost Revenues	• 36 months of lost revenues • True-up based on actual energy savings and actual rates	• Same
EM&V	• Participation and EMV true-up • EM&V applied beginning the month after study sample	• Same
Flexibility Agreement	• From Commission approved Flexibility Agreement, using	• Same

	TRC scores as factor for many measure and program changes	
Found Revenues	• From Found Revenue tree	• Same
Annual goal	• None	• Merger commitments (approximately 1.4% of annual retail sales)
True-up	• True-up based on actual program costs and portfolio UCT score	• True-based on actual program costs, UCT score and portfolio impact
Incentive levels	• 7.5-15% of program costs	• Same

Q. WHAT IS THE MAJOR DIFFERENCE BETWEEN THE COMPANY'S PROPOSED MECHANISM AND THE MODIFIED SAW MECHANISM?

A. The main difference in the proposed cost recovery mechanism—and the major point of disagreement between DEC and Petitioners—is using solely the portfolio UCT score as the index for the financial incentive.

Q. WHAT RATIONALE DOES DEC OFFER FOR ITS UCT INDEX INCENTIVE?

A. The Company states in its application that the UCT is the best tool to use to determine its incentive because it: (1) is straightforward; (2) ties the Company's ability to earn an incentive to how cost-effectively it delivers the EE/DSM portfolio; (3) ties the incentive to how the Company performs related to variables and performance it can control; and (4) provides an incentive for the Company to offer all cost-effective EE/DSM.[48]

[48] Duff Direct Testimony at 15-17.

Q. DO YOU BELIEVE THAT IT IS APPROPRIATE TO TIE THE COMPANY'S INCENTIVE SOLELY TO THE COST-EFFECTIVENESS OF ITS DSM/EE PORTFOLIO?

A. No. The Company should earn an incentive based on achievement of energy savings, as well as on portfolio cost-effectiveness. An incentive indexed solely to the UCT portfolio score incentivizes the wrong behavior by encouraging the Company to invest in only the *most* cost-effective programs rather than *all* cost-effective efficiency programs. In other words, the incentive mechanism could motivate the Company to emphasize investments in low-cost programs that will not serve all customer classes equally. For example, if the Company's portfolio has a UCT score close to 2.25 (or any number that is on the edge of the tiers) then tying the Company's incentive to portfolio cost-effectives creates a disincentive for the Company to develop and expand programs that are more expensive and have a lower UCT score, but are still cost-effective. Often, these are residential and harder-to-reach sectors such as low-income customers. Without these programs, DEC would be unlikely to maximize its achievement of EE.

Q. HOW DO YOU RESPOND TO THE COMPANY'S ASSERTION THAT ITS PROPOSED INCENTIVE SHOULD BE TIED TO SOMETHING IT CAN CONTROL (I.E., PORTFOLIO COST EFFECTIVENESS)?

A. I do not agree that the basis for the performance incentive should be what the Company can control. The basis for the incentive should be DEC's achievement of energy efficiency impacts. Moreover, I do not agree that the Company can only control the cost-effectiveness of its EE/DSM portfolio. DEC controls EE/DSM program planning, design, partnerships, communication with large customer account representatives, incentive level, implementation, free ridership and spillover screening, EM&V timing and many costs. These tools enable the Company to manage not only cost effectiveness, but also the scale of program impacts, the types of customers who participate in its programs, and many other important outcomes.

Finally, the most cost-effective portfolio first maximizes the amount of energy efficiency program investments with a UCT score that is greater than one, and then maximizes the UCT score of those program investments by maintaining cost controls and maximizing the verified savings (kW and kWh) resulting from those programs (e.g., by marketing to achieve a beneficial spillover-to-free ridership ratio). Achieving this goal maximizes the universal benefit achieved by the energy efficiency program investments.

Q. DO YOU THINK THAT THE COMPANY SHOULD RECEIVE A 15% INCENTIVE FOR A UCT PORTFOLIO SCORE OF 2.25 OR HIGHER?

A. No. The proposed incentive is excessive for the level of savings that the Company is projecting. As shown in Table 6, the Company is proposing to continue receiving a 15% incentive for efficiency impacts lower than those achieved with the Modified SAW mechanism.

Table 6. DEC Gigawatt-hour Past and Planned Efficiency Impacts

DEC Performance	
2009	55
2010	501
2011	520
2012	490
2013	N/A
DEC Application	

2014	397
2015	409
2016	422
2017	429

Because it is unlikely that the Company's UCT score will drop below 2.25, DEC is essentially asking for a flat 15% incentive. As discussed below, DEC should have the opportunity to earn a 15% return, but I do not agree that the Company should receive this level of incentive for modest energy savings. The intent of the original Modified SAW settlement was to allow a 15% incentive at a "stretch" level of savings that would be considered a challenge to achieve in the early years of a new efficiency initiative, and that lower levels of incentives would be appropriate for levels of achievement that do not require the Company to take risks or pursue innovation.

Moreover, the Company is asking for a very high reward without taking on a corresponding level of risk. An examination of DEC's projected energy savings shows that the level of risk that the Company is taking is lower in the proposed mechanism than it was in the Modified SAW. Because the Modified SAW was based on avoided cost and had a GWh annual target, the Company was responsible for both controlling the costs of the programs and for achieving prescribed levels of savings. Now, in the proposed cost recovery mechanism, the Company is seeking to achieve a comparable level of incentive for portfolio performance results that it has been consistently achieving for four years, and it will not be required to achieve a prescribed level of energy efficiency impacts.

The highest reward levels should be reserved for the highest levels of performance, not for business as usual.

PETITIONERS' PROPOSED INCENTIVE

Q. WHAT ARE PETITIONERS' GOALS FOR THE INCENTIVE THAT THE COMMISSION APPROVES IN THIS PROCEEDING?

A. Petitioners' primary goal in this proceeding is that the Commission establish a predictable, performance-based incentive where the Company makes more if the customers save more. This will ensure that the Company receives a fair incentive that will encourage DEC to capture all cost-effective efficiency, thereby reducing system costs and lowering customer bills. Petitioners believe that DEC must be incentivized to achieve the commitments it made in the Merger Settlement. An incentive mechanism should also encourage DEC to pursue "social" programs—EE/DSM programs that benefit low- and fixed-income customers.

Q. DO YOU HAVE AN ALTERNATIVE TO RECOMMEND THAT ACHIEVES THESE GOALS BETTER THAN DEC'S PROPOSED INCENTIVE?

A. Yes. In light of these goals, I propose an alternative incentive mechanism, in which the Company's incentive is tied to energy savings, measured as a percentage of the prior year's retail sales, in addition to the UCT portfolio score.

Table 8. Petitioners' Proposed Incentive Structure

Portfolio UCT Score	EE as % of Prior Year Retail Sales			
	Up to 0.49 %	0.5 – 0.94 %	0.95 – 1.39 %	1.4 % and above
1.00 – 1.24	7.5%	7.5%	7.5%	7.5%
1.25 – 1.74	7.5%	10%	10%	10%
1.75 – 2.25	7.5%	10%	12.5%	12.5%
2.25 and above	7.5%	10%	12.5%	15%

Under our proposed incentive structure, all efficiency program impacts, including those from low- and fixed-income programs, would count toward the Company's annual efficiency impacts. The prior year's retail sales would include sales to all customers, including opt-out eligible customers. Similar to DEC's proposal, the earned incentive for the Company would be calculated at the end of the vintage and calendar year. The Company would calculate the incentive by dividing the energy efficiency impacts of the vintage year into the prior year's electricity sales, and by calculating the UCT portfolio score. The resulting percentage and UCT would be compared to the index shown in Table 8, and the corresponding allowed after-tax return is then multiplied by the program costs to determine the allowed incentive.

Q. HOW DOES YOUR PROPOSED INCENTIVE ACHIEVE PETITIONERS' GOALS LISTED ABOVE?

A. Our proposed incentive achieves our goals because it is:

- Predictable – It is easy for the Company and its regulators to track the performance incentive throughout the year and over multiple years because the incentive is based on current efficiency impacts divided by the prior year's sales (data which are available at any point in the year).

- Performance-Based – The Company is rewarded for achieving higher energy efficiency impacts as a percentage of sales. The higher the energy efficiency impacts, the greater the Company's earnings.
- Fair – The Company and its customers are appropriately sharing the risks and benefits of the energy efficiency programs. The Company would receive a 10% incentive for achieving energy efficiency impacts of 0.5% of sales, and the opportunity remains for the Company to earn a 15% incentive through innovative and attainable energy efficiency performance in line with the Merger Settlement goals.
- Equitable – By allowing all savings to count towards the Company's energy efficiency goals, programs that serve a social good also earn the Company a return.

Q. HOW DOES PETITIONERS' INCENTIVE COMPARE TO DEC'S INCENTIVE USING DEC'S PROPOSED EE IMPACTS?

A. Table 9 compares the annual financial incentive for DEC's proposal and Petitioners' proposal. If DEC achieves the level of savings that it describes in its application, it would earn about $64M in incentive, as compared to about $43M under the Petitioners' proposal.

Table 9. Comparison of DEC and Petitioner Incentive from 2014-2017

Year	DEC Proposal			Petitioners' Proposal		
	UCT score	Incentive	Incentive Cost ($M)	Savings as a % of sales	Incentive	Incentive Cost ($M)
2014	2.84	15%	$15.1	0.52%	10%	$10.1
2015	2.83	15%	$15.8	0.53%	10%	$10.5
2016	2.80	15%	$16.1	0.54%	10%	$10.7
2017	2.72	15%	$16.7	0.54%	10%	$11.1
Total	$73.3M			$42.4M		

Q. WHY IS YOUR PROPOSED ENERGY SAVINGS IMPACT INDEXED INCENTIVE SUPERIOR TO DEC'S PROPOSED INCENTIVE?

A. The primary advantage of the Petitioners' proposal is that it is indexed to performance, which was a defining element in the Modified SAW mechanism, as opposed to the proposed mechanism in this docket, which is solely indexed to the cost-effectiveness of the portfolio. It is critical for the Company to receive an incentive based on how much energy efficiency it generates to encourage DEC to achieve all cost-effective energy efficiency.

Q. DOES THAT CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

CERTIFICATE OF SERVICE

I certify that the persons on the service list have been served with the foregoing ***PUBLIC VERSION*** of Testimony of Natalie Mims on behalf of Southern Alliance for Clean Energy, South Carolina Coastal Conservation League, Natural Resources Defense Council and Sierra Club either by electronic mail or by deposit in the U.S. Mail, postage prepaid.

This the 7th day of August, 2013.

Robin G. Dunn

Robin G. Dunn

NATALIE A. MIMS

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RELEVANT WORK EXPERIENCE

SOUTHERN ALLIANCE FOR CLEAN ENERGY
Energy Efficiency Director, January 2013 - current
Earlier position: Energy Policy Manager, October 2010– December 2012

- Responsible for ongoing energy efficiency portfolio and program level quantitative and qualitative research and analysis of major utilities in the Southeast
- Track and participate in energy efficiency regulatory proceedings Current regulatory proceedings include IRP, cost-recovery filings, energy efficiency program pilots and existing program modifications
- Responsible for reviewing and writing comments for all major energy efficiency regulatory proceedings for utilities in Tennessee, North and South Carolina, Georgia and Florida
- Lead participant for SACE at TVA, Duke Energy and Georgia Power DSM working groups

ROCKY MOUNTAIN INSTITUTE
Senior Consultant, July 2009 – October 2010
Earlier positions: Intern, Fellow, Analyst, and Consultant October 2004- July 2009

- Project manager for nine-person team creating energy efficiency component of national analysis to eliminate US fossil fuel consumption by 2050
- Project manager for company-wide energy efficiency strategy and development
- Lead on energy efficiency analysis for major southeastern IOU low-carbon strategy
- Lead author on published national analysis on electric productivity
- Member of senior leadership of Energy and Resources Team at the organization. Contributed to team strategy, resource planning and staffing for 12-20 person team and hiring as well as organizational professional development strategy
- Contributed to writing Hawaii Energy Strategy 2007 and planning Hawaii Biofuels Summit Contributed to RMI filings in Energy Efficiency docket before Hawaii Public Utility Commission
- Participated in Hawaii Energy Policy Forum Energy Efficiency working group
- Significant contributor to consulting and research projects including: national and state energy policies, utility revenue adjustment mechanisms, utility regulatory structures, private sector investment in energy efficiency, corporate carbon management strategy, renewable energy market assessments, large and small scale sustainable development projects, Hawaii agricultural sustainability barriers and solutions

PUBLICATIONS

- Legislative Options to Improve Transportation Efficiency. November 2005, RMI.
- Feebates: A Legislative Option to Encourage Continuous Improvements to Automobile Efficiency. February 2008, RMI.
- Plug-In Hybrid Electric Vehicles and Environmentally Beneficial Load Building: Implications on California's Revenue Adjustment Mechanism, Presented at Association of Energy Service Professionals Conference, January 2008.
- Industrial Electric Productivity: Myths, Barriers, & Solutions. Presented at ACEEE Industrial Summer Study, July 2008.
- Assessing the Electric Productivity Gap and the U.S. Efficiency Opportunity. Presented at IEPEC, August 2009.

EDUCATION

MASTER OF ENVIRONMENTAL LAW & POLICY
Vermont Law School, South Royalton, Vermont

August 2004

- Relevant coursework includes: Environmental Justice, Environmental Law, Land Use, Water Law, Federal Natural Resource Law, Comparative Methods of Dispute Resolution, Environmental Law Principles, Extinction: The Endangered Species Act, Legal Research & Writing, Ecology
- Activities: Solutions Conference 2004

B.A. ENGLISH & B.A POLITICAL SCIENCE
The Pennsylvania State University, State College, Pennsylvania
May 2002

- Honors: Blue & White Scholarship; Dean's List five semesters; National Collegiate Honor Scholar
- Relevant coursework includes: Economics, Social & Developmental Psychology
- Activities: Shaver's Creek Outdoor School Camp Counselor, May 2001

Plant Energy Benchmarking: A Ten Year Retrospective of the ENERGY STAR Energy Performance Indicators (ES-EPI) [1]

Gale Boyd, Duke University
Walt Tunnessen, US Environmental Protection Agency

ABSTRACT

Over the past several years, there has been growing interest among policy makers and others in the role that benchmarking industrial energy efficiency can play in climate, air, and other potential regulatory actives. For over ten years, the U.S. Environmental Protection Agency (EPA) has supported the development of sector specific industrial energy efficiency benchmarks, known as ENERGY STAR® Energy Performance Indicators (ES-EPI). To date there are ES-EPIs that are either completed or under development for fourteen broad industries. Within these industries, ES-EPIs account for over two dozen sub-sectors and many more detailed product types. Newer versions, or "updates" for three of the industries' ES-EPI have been developed in recent years. Through the process of updating these ES-EPIs, the program has been able to observe changes in the energy performance of the sector as well as the range in performance found in the sector. This paper reviews approaches for developing energy efficiency benchmarks in the context of providing an overview of the approach that has been used in this research to develop this ES-EPI, summarizing the industry specific and general findings regarding the range of performance within and across industries. Observations about industrial plant benchmarking and lessons learned are explored. Over the 10 years of preparing ES-EPI we find that there are few sectors that are best represented by a simple "energy per widget" benchmark; that less energy intensive sectors tend to exhibit a wider range of performance than energy intensive ones; and that changes over time in the level and range of energy performance, i.e. "industry curve shift", for ES-EPI that have been updated do not reveal any single pattern.

Introduction

ENERGY STAR is a voluntary program launched by the EPA in 1992 to identify and promote energy efficient products, buildings, homes, and manufacturing facilities.[2] The program was established to find cost-effective ways to reduce greenhouse gas emissions associated with energy use. Initially focused on consumer products, the program expanded into the commercial building market in 1995 and released its first energy-efficiency benchmark for office buildings in

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[1] This paper was developed at Duke University with funding from the U.S. Environmental Protection Agency's Office of Atmospheric Programs, ENERGY STAR for Industry. The paper and associated analysis would not have been possible without the input of all the industry participants in the ENERGY STAR Focuses on Energy Efficiency. Their willingness to provide data, guidance on important issues affecting manufacturing energy use, and time and energy in testing the models was invaluable. We would also like to thank the ACEEE reviewers for their comments on the paper. Some results in this paper were prepared while the author was a special sworn status research associate at the Triangle Census Research Data Center. Any opinions and conclusions expressed herein are those of the author and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. Any errors are the sole responsibility of the author.
[2] See EPA (2011) for more information.

Mims Exhibit 2

1998. In 2000, the EPA expanded the program to include manufacturing plants. The goal of ENERGY STAR for Industry is to identify and promote best practices that help improve the energy efficiency of industrial plants. To that end, ENERGY STAR focuses on providing tools that encourage better corporate energy management. A key and unique aspect of the program's strategy to improve energy management practice is the development of sector specific energy performance benchmarks.

Starting in 2002 EPA has supported the development of a suite of sector specific, intra-industry benchmarking tools called ENERGY STAR Energy Performance Indicators (ES-EPI). These ES-EPIs compute an Energy Performance Score (EPS) or "ENERGY STAR score" that compares plant's performance against its peers to ranks a specific plant on a percentile scale (1-100) based in individual product, material, and location characteristics that impact energy use.

The goal of the ES-EPI is to provide companies within a manufacturing sector with an objective measure of how their plant compares to the rest of the industry. EPA had observed that most companies lack sufficient information on the relative efficiency of their plants. Consequently, many companies did not know if their companies where operating efficiently or where the frontier for improved efficiency lies. By creating a benchmarking for energy efficiency within a sector, EPA believed it could provide valuable information that would motivate companies to take action to improve the performance of their plants. EPA reasoned that companies would be motivated to improve their efficiency in order to reduce costs and improve operating margins. In the process of improving their energy efficiency, the sector's greenhouse gas emissions associated with fossil fuel consumption could also be reduced in a cost effective manner.

The second objective of developing ES-EPI was to establish criteria for determining which plants would qualify for recognition. Through its product labeling program and commercial building program, EPA was able to observe the positive impact that providing recognition to top performers on overall sector efficiency. In order to provide recognition for energy efficient manufacturing plants, EPA needed an objective and transparent means to determine which plants are best-in-class. The establishment of an ES-EPI would provide that means and by involving the industry in its development, the process for which the ES-EPI is developed would ensure transparency as well as confidence by the industry that the tool and method are accurate.

To develop an ES-EPI, ENERGY STAR needed to address a variety of key issues:

- How to define energy efficiency?
- What metrics should be used to measure efficiency?
- How do you adjust or normalize for differences between plants?

Defining Energy Efficiency[3]

Efficiency is a measure of relative performance; but relative to what? Defining energy efficiency requires a choice of a reference point or benchmark against which to compare energy use. Energy efficiency benchmarks can be developed through a variety of means, such as

[3] This section draws from Boyd, G. (2012). A Statistical Approach to Plant-Level Energy Benchmarks and Baselines: The Energy Star Manufacturing-Plant Energy Performance Indicator. Carbon Management Technology Conference. Orlando, Florida USA.

engineering and theoretical estimates of performance or through observing the range of actual levels of performance. The choice of method used to define efficiency depends on the need to define a reference point for energy efficiency. One of the challenges with using energy efficiency benchmarks based on engineering or theoretical estimates is that they are often dismissed by industry as being economically infeasible.

Consequently, ENERGY STAR for Industry program has focused on developing benchmarks based on actual or observed operational performance rather than theoretical estimates of potential efficiency levels. Additionally, EPA need to identify a benchmarking method that would be perceived by end users as being economically feasible is important for the adoption of the benchmarking system and ultimately its impact on driving change.

The reference point for economic potential (observed practice) depends, in part, on the reason for measuring efficiency as well as the available information to create a reference. Generally, the *Ceteris Paribus* principle ("all other things being equal or held constant") is usually desired in creating the reference point, or benchmark. From a practical perspective there is a hierarchy of measures and methods by which one can "hold constant" things that influence *energy use* that are not part of *energy efficiency.* The first is some measure of production activity, either production itself or alternatively a ubiquitous input into the production process. This is most commonly done by computing the ratio of energy use to activity, a measure of energy intensity. Energy intensity is a common metric that controls for changes in production and is commonly confused with energy efficiency, as in the statement "*the industry or plant's energy efficiency has improved based on the fact that the corresponding energy intensity has declined over time.*" This type of statement brings us to the second way that one may approach the ceteris paribus principle for measuring efficiency, comparing energy intensity a particular plant, firm, or industry to itself over time. This approach is a plant (firm, etc.)[4] specific *baseline* comparison, or *intra-plant* efficiency benchmark. The baseline approach has the advantage of controlling for some plant specific conditions that do not change during the comparison period.

The next level of this ceteris paribus principle is an *inter-plant* comparison that may include a variety of factors that influence energy use, but may not be viewed as efficiency. Factors may include difference in the types of product and materials used, as well as location specific conditions. Intra-plant comparisons within an industry also get us closer to the notion of an observed best-practice benchmark of economic energy efficiency, since by definition there is some group of plants that are the best performers. This was the notion introduced by (Farrell 1957) and has been the basis for measuring production efficiency in economics. A modified approach has been adopted by ENERGY STAR (Boyd 2005) and its evolution is discussed by (Boyd, Dutrow et al. 2008).

Intensity Metric Selection

Intensity ratios provide a basic metric for measuring energy efficiency and performance compared to a baseline. To measure intensity you need a measure of energy and something for the denominator. For the numerator in ENERGY STAR uses total source energy, defined as the net Btu total of the fuels (Btu) and electricity (Kwh) with electricity converted to Btu based on the level of efficiency of the U.S. grid for delivered energy, i.e. including generation and

[4] Throughout the paper we will refer to the plant level as the unit of observation, but the concept may also apply to more aggregate levels like firms and industries, an sometimes to less aggregate levels like process units.

transmission losses. A net measure is needed for when energy is transferred off site, most commonly in the form of steam or electricity.

The choice of the denominator is a major issue for measuring intensity. Ideally the denominator should capture some measure production. (Freeman, Niefer et al. 1997) show that industry level trends in energy intensity based on value, both total and value added, can differ dramatically from those based on physical quantities. As Freeman et all have observed, there are many challenges with creating efficiency benchmarks based on price indexes, cost and other value measurements.[5]

Given issues with linking energy use with price indexes, ENERGY STAR focused on using metrics based on physical quantities. For physical production to be meaningful it needs to be at a high level of industry specificity. For example, the "Dairy" industry produces many products that cannot be aggregated, but "Fluid Milk" can. Therefore, within industries, it is necessary to differentiate between specific types for plants and manufacturing operations.

Similarly, ENERGY STAR has avoided using physical size (sq ft) as the main denominator for energy intensity benchmarks for most industrial facilities.[6] While commonly used for commercial buildings where energy use is primarily tied to plug loads, lighting and HVAC systems, energy intensity based on size (sq. ft) does not correspond well with production energy use. While ENERGY STAR ES-EPIs provide energy intensity rations for users, their value for developing intra-plant comparisons is limited. For intra-plant comparison, there are multiple factors that must be considered.

Multi-Factor Benchmarks

When making intra-plant comparisons, it necessary consider a variety of factors that do not neatly fit neatly under the denominator of an energy intensity ratio. While all plants may make a common product, other differences can significantly affect energy intensity. The difficulty with applying an industry level inter-plant benchmark is controlling for inter-plant difference other than production volume. While the things that differ between plants are numerous, we have found that the primary difference that have the most impact on energy fall into the following categories:

- Product mix
- Process inputs
- Size - Physical or productive capacity and utilization rates
- Climate (and other location specific factors)

The choice of factors to include in the analysis depends upon the nature of the production process, the configuration of the industry (e.g. is upstream integration common or rare), the

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[5] As Freeman et all (2007) note, *"For an industry producing a single, well-defined, homogeneous good, it is relatively easy to construct an accurate price index. Most industries, however, produce many poorly-defined, heterogeneous goods. For a variety of reasons, the more diverse the slate of products produced by an industry, the more difficult it becomes to construct an accurate price index. ...the accuracy of industrial price indexes is of extreme importance to industrial energy analysts and policy makers who use value-based indicators of energy intensity."*

[6] The one exception is Pharmaceutical manufacturing where energy intensity is expressed as MMBTU/SQ FT. This metric was chosen largely because of the huge impact of HVAC systems in pharmaceutical manufacturing.

availability of data to represent these factor, and ultimately the outcome of the statistical tests for significance. In order to address these types of factors, the ES-EPI uses a multivariate approach to normalization where multiple effects are simultaneously considered (Boyd and Tunnessen 2007). The next sections discussed the four basic categories of effects that are commonly considered. There is further elaboration on the way this is implemented the section on industry specific comparisons.

Product mix. Not all plants produce exactly the same product. In fact, many plants themselves produce multiple products. The diversity between plants gives rise to a mix of derived demands for specific processes and energy services. To the extent that the final product is the results of a series of energy using steps the energy use of the plant will depend on the level and mix of products produced. Rather than specifying each process step individually, the approach used here is to identify those products that use significantly more (or less) energy and measure those energy requirements with a statistical comparison.

One approach to controlling for product mix is to segment the industry into cohorts based on product categories. This works best when there is no overlap between plants that produce the various basic products and there are sufficient numbers of plants to conduct the statistical comparison between those resulting groups. This means each sub-group is effectively treated as a separate industry for evaluation proposes. A good example is the glass industry where containers and flat glass are distinct industry segments.

When such natural sub sectors do not exist and multiple products are produced within a plant, additional approaches are needed. The statistical approach used by ENERGY STAR is well suited to testing if a particular grouping of products is appropriate for benchmarking differences in energy. When industries produce a mix of products that differs across plants then the product mix (share of activity) of distinct products is needed. This approach was first used in the ES_EPI for wet corn mills and was later applied to mane other sectors (see below). Other industries like pharmaceuticals or autos that also have a diverse range of products may be treated differently for benchmarking. In the case of Pharmaceuticals where final production of the product occurs in a clean room environment, product mix was less important for benchmarking "fill and finish" facilities.

Physical size. Size and utilization rates may directly impact energy use. Size may impact specific engineering and managerial advantages to energy use. If there is a substantial "fixed" level of energy use in the short run, the utilization rates may have a non-linear impact on energy intensity. In order to include size (and utilization) as a normalizing factor in the EPI a meaningful measure of size or capacity is needed. It may be measured on an input basis, output basis, or physical size. In some cases there may be advantages to larger scale of production. If it is the case that a larger production capacity or larger physical plant size has less than proportionate requirements for energy consumption then there are economies of scale with respect to energy use. In the cement industry the scale is quite important. The larger size of the kiln (rather than several smaller kilns) has advantages in terms of energy use. The ES-EPI for this sector accounts for this.

Process inputs. There are three ways that process inputs are important for benchmarking. The first is that inputs like materials, labor, or production hours may be good proxy measures of overall production activity when measures of production output are not available or have specific shortcomings[7]. The second is in the identification for upstream (vertical) integration, i.e. whether a plant makes an intermediate product or purchases some pre-processed input. This is an important "boundary" issue for the energy footprint of a plant, even when two plants produce identical outputs. The third way is a variation of the second, relating to material "quality." If there are alternative input choices that differ qualitatively and also with respect to energy use then input quality measures can be introduced into the benchmark.

The first way process inputs can be helpful in developing a statistical benchmark of energy use is that inputs like materials, labor, or production hours may be good proxy measures of overall production activity when measures of production output are not available or have specific shortcomings. If a physical measure of output is not readily available and pricing makes the value of shipments a questionable measure of production then physical inputs can be a useful proxy. For some industries the basic material input is so ubiquitous that it makes sense to view energy use per unit of basic input rather than (diverse) outputs. Process inputs may also be useful in measuring utilization, either directly or indirectly. Corn refining is a good example of this approach. The former uses a ubiquitous inputs, corn. Sometimes physical production data is lacking in some way but material flows can be used instead. For example, sand, lime, soda ash, and cullet (scrap glass) are the primary inputs to glass manufacturing.

The second way that process inputs are important for inter-plant benchmarking is when vertical integration is common in a sector. Industries are categorized by the products they produce, but some sectors may face a "make or buy" decision in the way they organize production. A plant may purchase an intermediate product or produce it at the plant as part of a vertically integrated plant. For example, an auto assembly plant may stamp body panels or ship them in from a separate facility. The energy use of these two facilities is not directly comparable. The inter-plant benchmarking approach must account for those "make or buy" decisions in the specific plant configurations. Examples range from food processing, where plant may make juice from concentrate or fresh fruit or paper mills which may purchase (some) market pulp or recycled fibers.

The third way that process inputs are important for inter-plant benchmarking is when differences in material quality may also be related to energy use. For example, if the materials mix to produce a product directly impacts energy uses, then the statistical model can apply different weights to the materials mix in the same manner that it does with product mix. In other words, product/process level differences in energy use can be inferred from the volume and types of materials used in production. To be considered in the statistical normalization, they must be measured on a consistent plant-level basis across the industry. For cement plants the hardness and moisture content of the limestone is hypothesized to influence energy use, but no consistent data is available for this, leaving it the subject of future analysis if data can be collected.

Climate. There are many things under the control of a plant or energy manager, but one they cannot control is "the weather." In most manufacturing plants heating, ventilation and cooling (HVAC) contributes to energy demand and weather determines how much is required to maintain comfort. Since the benchmarking approach used here is annual, seasonal variation does not enter into the analysis, but differences due to the location of a plant and annual variation from the locations norm will play a role. The approach that has been taken for all sectors under

[7] As discuss in Freeman, et al (1997)

study is to include heating and cooling degree days (HDD and CDD) into the analysis to determine how much these location driven differences in "weather" impact energy use.

In principle all plant have some part of energy use that is HVAC related, but when the HVAC component of energy use is small relative to total plant consumption the statistical approach may not be able to measure the effect accurately enough to meet tests for reliability. For some sectors weather is a factor in the process, like auto assembly. It a factor because of paint booths and climate control technology need for those systems. Pharmaceuticals manufacturing, where "clean room" production environment is common, is another good example. The climate impact in this sector is only applicable to the "finish and fill" production stage. The more energy intensive chemical preparation stage is not sensitive to climate. Even in industries where the HVAC component is not an obvious (large) part of energy use there may be effects that the ES-EPI analysis needs to test for. Chillers may be sensitive to CDD (summer) loading.

Detailed Overview of the ES-EPI Tools

Drawing from the general approach above, Table 1 summarizes the factors that have been included in each EPI to explain difference in inter-plant energy use. It is clear that each industry is unique in the characteristics that "matter" for benchmarking. About half of the sectors have been finalized by EPA and the rest are under review. Twenty use some type of physical units for activity; of those, 18 have 2 to 5 different sub-product types or use some other information to further characterize product differences, i.e. price or size. Some measure of plant size and utilization is included in 5, but the small number is due more to data limitations, i.e. available plant level capacity information. Person or operation hours are included in 8 industries. In some cases the labor hours *may* be playing a similar role to utilization, i.e. capturing non-production activity that uses energy. About half of the sectors include process inputs, either as a ubiquitous measure of input, e.g. corn in corn refining or scrap in minimills, or in the form of raw vs. preprocessed inputs, e.g. fresh fruit vs concentrate in Juice production or virgin vs. recycled fiber in paper production. The selection of inputs is based in part on data availability, but then only included when the estimated effect is of reasonable size and statistically significant.

Table 2 further describes the statistical form of the models. Seven sectors exhibit a skewed distribution of energy intensity and are modeled as stochastic frontiers; the rest are best approximated as log normal, i.e. the percentage difference from average performance are "bell shaped." The earliest benchmark year is 2002. This is largely driven by the data available when the analysis was conducted. 2007 is the most recently available data from Census. Sectors that use industry or trade association provided data tend to have more recent benchmark years. For the less energy intensive industries using Census of Manufacturing (CM) data, the energy content of the fuels is imputed using cost data and state level energy prices. This is done since the sample sizes in the Manufacturing Energy Consumption Survey (MECS) are too small. For industries with larger MECS samples the more detailed energy information is used directly.

Sample sized vary depending on the industry, although these sample sizes should be viewed as a complete count of all the plants. Some data is dropped due to incomplete reporting or other "data quality screens" such as for extreme outliers.

Table 1. ES-EPI Benchmarks Inputs, by Industry and Sub-Sector

Focus industries	Product mix	Units	Inputs	Size or capacity	External	Other
Cement (V 2.0)	3 product types	Tons	-	Capacity & # of Kilns	Utilization	Person hours
Corn Refining (V 2.0)	5 product types	Bushels	Corn	Capacity	Utilization	Feed moisture
Dairy - Fluid Milk *	6 product types	Gallons	Whole milk	-	Weather TBD	Person hours
Dairy - Ice cream *	4 product types	Gallons	2 types	-	Weather TBD	Person hours
Ethyl Alcohol **	Single	Gallons	-	-	-	-
Food - Juice (Canned)	4 x 2 product types	Gallons	2 types	-	-	-
Food - Frozen Fried Potatoes	Single	lbs	-	-	-	Warehouse (frozen)
Food - Tomato products **	1 sub-product type		2 types	-	-	Person hours
Baking - Cookies & Crackers	3 product types	lbs	-	-	-	-
Baking - Bread & rolls *	5 Product types	tonss	Raw dough	-	Weather TBD	Freezers
Glass - Flat	-	lbs	Sand	-	-	-
Glass - Container	Price	lbs	Sand, Cullet	-	-	-
Iron and Steel - Integrated *	5 product/activities	tons	-	Furnace capacity	Utilization	-
Iron and Steel – Minimills *	Price	tons	Scrap	Furnace capacity	Utilization	-
Metal casting - Iron *	4 product types	Tons, other	-	-	Weather TBD	Person hours
Metal casting - Investment steel *	-	hours	-	-	Weather TBD	Person hours
Metal casting - "Other" steel *	3 product types	$	-	-	Weather TBD	-
Motor Vehicle V2.0	vehicle size	#	-	-	Weather, Utilization	Air Tempering
Pharmaceuticals	3 activity types *	%	-	Facility size (ft2)	Weather, Utilization	Operation hours
Printing - Lithograph *	6 product types	$	2x3 types	-	Weather TBD	-
Pulp Mills	3 product types *	tons	2 types	-	-	Water treatment
Paper & Board Integrated Mills	3 product types *	tons	3 types	-	-	Water treatment, bleaching chemicals
Ready Mix Concrete *	2 activities	Tons,miles	-	-	-	-

* Under Industry Review, ** Preliminary

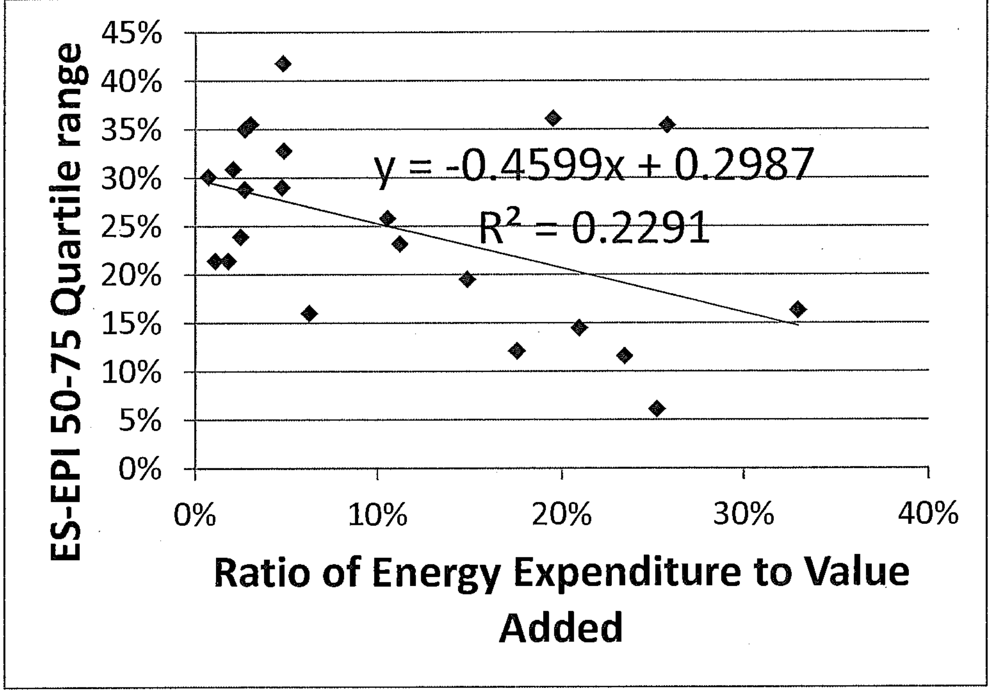
Table 2. ES-EPI Benchmarks Model Details, by Industry and Sub-Sector

Focus industries	Model	Year	# of plants	Data source	75 to 50th
Cement (V 2.0)	log normal	2000-2008	96	PCA	-6.1%
Corn Refining (V 2.0)	half normal frontier	2004-2009	37	Industry	-14.5%
Dairy - Fluid Milk *	log normal	2002	258	CM	-29.0%
Dairy - Ice cream *	log normal	2002	89	CM	-23.9%
Ethyl Alcohol **	log normal	2007	111	CM	-35.4
Food - Juice (Canned)	log normal	2002	44	CM	-41.8%
Food - Frozen Fried Potatoes	log normal	2002	27	CM	-16.0%
Food - Tomato products **	log normal	2002	40	CM	-43.7%
Baking - Cookies & Crackers	log normal	2002	64	CM	-30.9%
Baking - Bread & rolls *	log normal	2007	207	CM	-28.8%
Glass – Flat	log half normal frontier	2002	38	CM, MECS	-16.3%
Glass - Container	log normal	2002	62	MECS	-11.6%
Iron and Steel - Integrated *	log half normal frontier	2005-2009	12	Industry	TBD
Iron and Steel – Minimills *	log normal	2002	39	CM, MECS	-12.1%
Metal casting - Iron *	log normal	2006	83	CM, MECS	-23.2%
Metal casting - Investment steel *	Exponential frontier	2007	51	CM	-32.8%
Metal casting - "Other" steel *	log normal	2007	59	CM	-25.8%
Motor Vehicle (V2.0)	Gamma frontier	2003-2005	33	Industry	-21.4%
Pharmaceuticals	log half normal frontier	2004-2006	61	Industry	-30.1%
Printing - Lithograph *	Log half normal	2007	775	CM	-35.0%
Pulp Mills	log normal	2002	28	CM, MECS	-36.1%
Paper & Board Integrated Mills	log normal	2002	99	CM, MECS	-19.5%
Ready Mix Concrete *	log normal	2008-2009	62	NRMCA	-35.5%

* Under Industry Review, ** Preliminary

The last column labeled 75 to 50th represents the third quartile range, i.e. percent difference of the 75th percentile, i.e. the ENERGY STAR certified plant level, and the average or median performance, the 50th percentile. This ranges from as low as 6% to nearly 44%. Figure 1 compares this third quartile range to the industry average share of energy cost to value added. This cost share reflects how "important" energy is in the sector. We see a clear correlation between high cost shares and the range of performance. This makes sense since industries with higher relative energy costs would put more effort into management of those costs. There are outliers in this relationship, however. They include pulp mills and ethanol (dry mill) plants. The latter is a preliminary estimate. The result for pulp mills may suggest the need for additional scrutiny. However, the EPI uses net purchased energy and pulp mills provide a large amount of internally generated power from black liquor and CHP. There may actually be a wide range of practices in terms of net purchased energy in this sector than for other energy intensive ones.

Figure 1. Correlation between Industry Average Energy Share and 50-75 Quartile Range

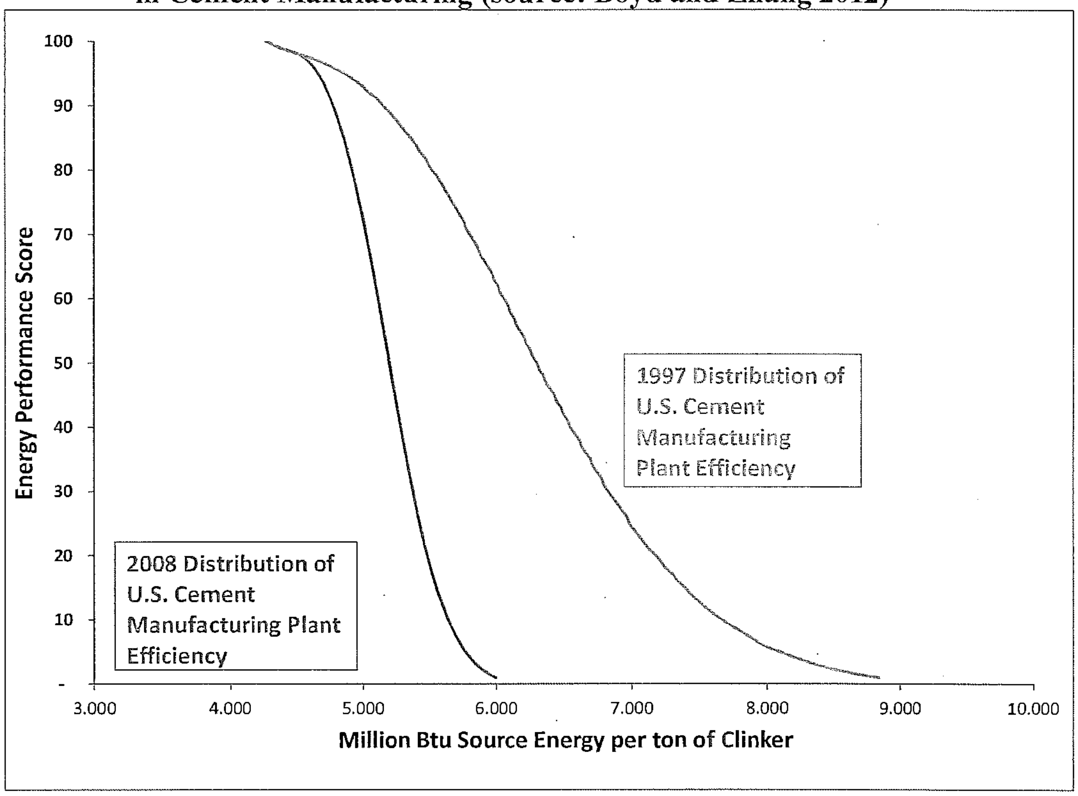


Updates for benchmark year for three ES-EPI

In the 2010, EPA began a process of updating the benchmark year data for the first three ES-EPIs that were officially released; Auto assembly, Cement, and Corn refining (see (Boyd 2005; Boyd 2006; Boyd 2008) for detailed descriptions of the earlier models). Comparing the old benchmark with the new benchmark reveals information about how these three, very different industries have changed over time. Since the ES-EPI analysis reveals both the general level and range of energy performance the comparison focuses on how much the change in the "best practice" and the change in the range of performance contribute to the overall reduction in energy use in the sector (see (Boyd and Zhang 2012), (Boyd and Delgado 2012), and (Boyd 2010) for the details of the updates).

For the cement industry, if one computes the ratio of total energy costs to total value of shipments (adjusted for inflation) in 1997 and 2007 from data collected in the Economic Census, one would conclude that this measure of energy intensity has fallen ~16%, from 0.184 to 0.158. Aggregate data may also give the impression that all plants have made the same steady improvements. The picture that emerges from our plant level statistical analysis is somewhat different and more subtle (figure 2); poorer-performing plants from the late 1990s have made efficiency gains, reducing the gap between themselves and the top performers, whom have changed only slightly. The results from this study focus on energy efficiency and controls for other structural changes in the industry, e.g., increases in average plant size, which also tend to lower energy use. Our estimate of the overall energy efficiency improvement in the 96 plants in our database represents a 13% percent change in total source energy and the source of these changes is clearly not uniform.

Figure 2. Comparison of Two Benchmark Distributions of Energy Efficiency in Cement Manufacturing (source: Boyd and Zhang 2012)



Results for the auto assembly industry are similar, but less dramatic (figure 3). There are two sources of improvement, the changes in the industry energy frontier, i.e. "Best Practices" and technology, and the changes in efficiency, i.e. whether plants are catching up or falling behind. The results suggest that slightly more than half of the improvement is changes in efficiency, which have slightly outpaced changes in the frontier. The combined effect when evaluated against the over 7 million vehicles produced in 2005 by the plants in our study implies in a reduction of 11.6%, or 1462 million lbs of CO_2, attributable to changes in observed industry energy efficiency practices.

Figure 3. Comparison of Two Benchmark Distributions of Energy Efficiency in Auto Assembly (Source: Boyd 2010)

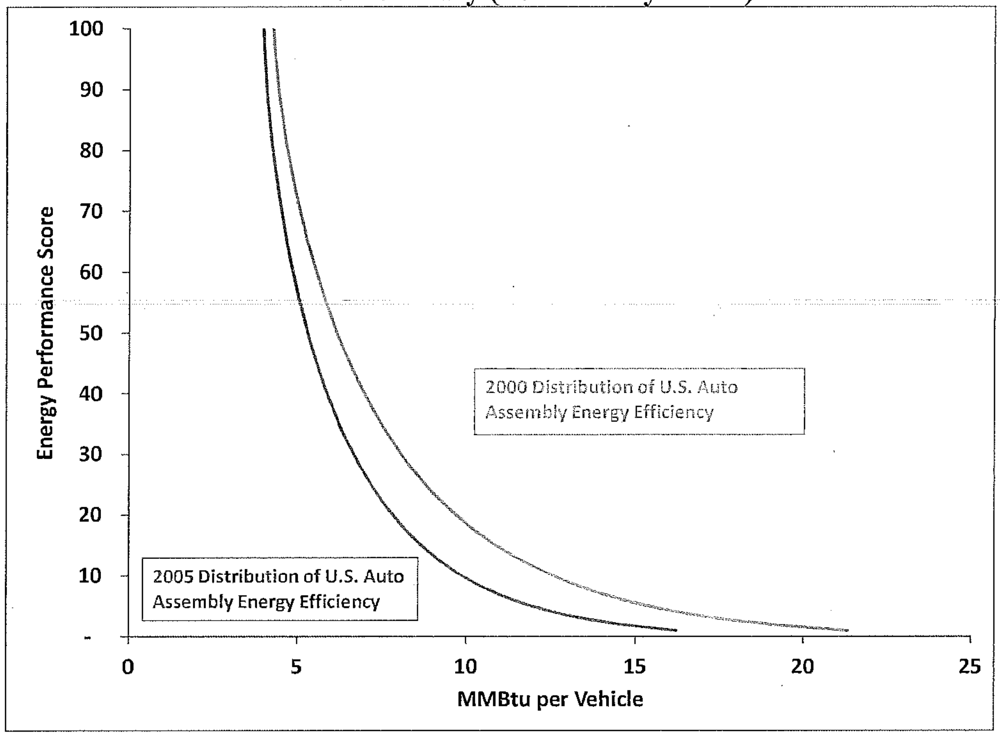
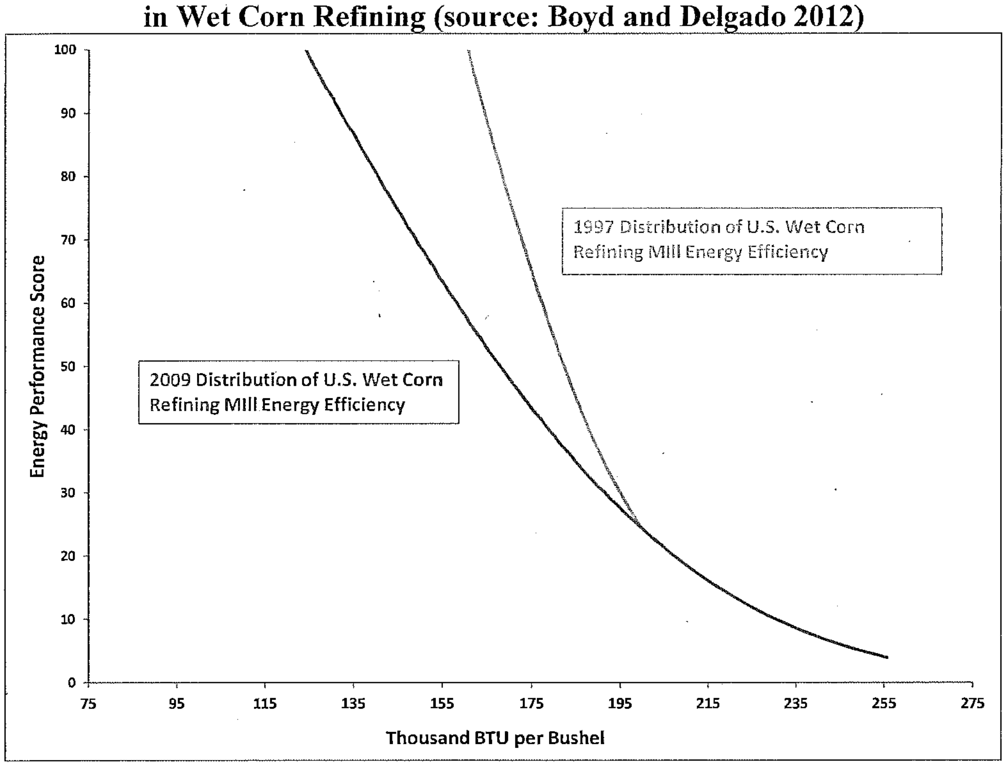


Figure 4. Comparison of Two Benchmark Distributions of Energy Efficiency in Wet Corn Refining (source: Boyd and Delgado 2012)



The change in the distribution of energy efficiency for a representative corn refining plant is shown in figure 4. If we multiply this plant-specific change in energy intensity by the level of corn input production for each plant operating in the industry in 2009, and total across all plants, we compute a reduction of 6.7 trillion Btu in annual energy use. Relative to an average annual total source energy consumption of 155 trillion Btu in 2009 for all the plants in our data set, this represents about a 4.3% reduction in overall energy use by this industry. When energy-related greenhouse gas emissions are considered, this represents an annual reduction of 470 million kg of energy-related CO_2 equivalent emissions from improved energy efficiency.

The change in performance from these three industry are all quite different. Cement reflects the case where best practice has changed very little, but "catching up" comprises the main source of improvements. Corn refining is at the opposite end of this spectrum, where there are substantial changes in the best plants, but laggards remain or in some sense are even falling behind by failing to keep pace. The auto assembly plants are a mixture of changes in best practice and some modest "catching up". These benchmark updates also reflect different time periods. When we compute the average annual change from the total reduction in energy use for each sector we see that the auto industry has made the greatest strides (see table 3).

Table 3. ES-EPI Benchmarks Updates: Rate of Change by Industry

Sector	New benchmark Year	Old Benchmark Year	Time period	Total reduction	Average annual change
Auto	2005	2000	5	12.0%	2.3%
Cement	2008	1997	11	13.0%	1.2%
Corn	2009	1997	12	4.3%	0.4%

Conclusions

The objective for developing sector-specific energy performance benchmarks was to create a tool that would motivate companies to take actions to improve the energy efficiency of their plants and ultimately help reduce greenhouse gas emissions in the industrial sectors benchmarked. As of December 2012, EPA had released 11 EPIs, awarded 120 ENERGY STAR plant labels, and engaged an additional twelve industrial sectors and subsectors in the EPIs development process. Compared to average plants (EPS score of 50) EPA estimated in 2011 that plants earning the ENERGY STAR have saved an estimated 314,190,357 MMBtus. [8]Companies using the ES-EPI report that they find the tools valuable and beneficial for evaluating current performance and setting efficiency goals. Many companies report they have incorporated the ES-EPI into their energy management programs and have made achieving ENERGY STAR certification as an objective.

Initially, ENERGY STAR faced some skepticism that a whole-plant benchmark could be developed. Skeptics largely believed that each plant is too "unique" for whole plant comparisons to be made. However, both the process and method used by EPA to develop the ES-EPIs has helped change skeptics participating in the industrial focus process into supporters for the ES-EPI. The *process* of engaging the industry in the development of the EPIs has been critical to the success of ENERGY STAR industrial benchmarking program. By developing the EPIs in a

[8] US EPA (2012)

transparent, objective, and collaborative process, EPA enabled industry participants to be directly involved in its design and testing from the beginning. This process enabled the ENERGY STAR team to identify potential factors for normalization, receive timely feedback on draft tools, quickly address concerns, and ultimately ensure a high degree of support and "buy-in" for the tool. By using a benchmarking method based on actual operational data and that allowed for normalization to address specific differences between plants, the ENERGY STAR team was able to overcome concerns that industrial plants are too heterogeneous, even within a specific sub-sector, to be able to benchmark.

The availability of sector-wide energy and production data through the US Census Bureau was critical for the initial development of the ES-EPIs. One the greatest barrier to any benchmarking exercise is inadequate or unrepresentative data. The ENERGY STAR program has benefited from the robust industrial energy and production data collected by the US Census through the Census of Manufacturing (CM) and the Manufacturing Energy Consumption Survey (MECS). The availability of this data for use in developing the statistical models behind the EPIs has been critical to ensuring the early success of the ENERGY STAR industrial benchmarking program. First, it provided EPA with the ability to develop the benchmarks without having to undertake a data collection. Second, by working with Census data, which has strict confidentially requirements, the ENERGY STAR team was able to build trust amongst industry participants that the company specific data used for benchmarking would be kept confidential and would not be shared with either focus participants and the EPA. While some of the more recent ES-EPIs have drawn on data provided by the industry, the availability and quality of the CM and MECS data enabled ENERGY STAR to successfully develop the first ES-EPIs and demonstrate that whole-plant energy performance benchmarking is possible.

The process of developing EPIs has uncovered new insights into energy use and the drivers of efficiency within the sectors benchmarked. Additionally, the establishment of industry baselines has enabled EPA to visualize the range of performance within a sector. Visualizing the distribution of performance offers important information for policy makers and others interested in promoting efficiency or reducing GHG emissions from specific industrial sectors. The slope of the baseline curve generated by the EPI can help policy makers and others evaluate what action is needed to improve the performance of the industry. For example, sectors with steep baseline curves and distributions indicate that the opportunities for improving energy efficiency through existing measures may be limited. These sectors should be considered for R&D investments to develop new technology that can create a step change in the level of performance. Additionally, these sectors may face greater difficulties reducing their GHG emissions through existing energy management measures. Whereas sectors with flatter curves indicate that more opportunities are available through existing technologies and practices. In these sectors, there is a greater distribution of performance, which usually suggests that existing energy management measures and investments can improve performance.

The process of benchmarking and re-benchmarking a sector provides further insights into the improvement potential of the industry over time. Understanding how the distribution of energy performance in a sector is changing or not changing can provide valuable information for policy makers as well as business leader in developing strategies to drive future performance gains.

The approach and method used by ENERGY STAR to benchmark whole-plant energy performance has potential applicability to other sustainability metrics, such as water and waste, as well as sub-systems within plants. While developing such benchmarks is beyond the scope of the ENERGY STAR program, several companies participating in the Industrial Focus process have recently initiated an independent effort that applies the ENERGY STAR benchmarking approach to process lines within the plant and to non-energy measures such as water. If successful, the results of this effort will break new ground in advancing the field of energy performance and sustainability benchmarking.

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