Energy solutions
for a changing world

Incorporating Energy Efficiency (EE) in Air Quality Planning

A Workshop for the Virginia Department of Environmental Quality

Presented by Ken Colburn, Chris James, and John Shenot

June 1, 2012

The Regulatory Assistance Project

50 State Street, Suite 3
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Introducing RAP, Chris, Ken, and John

- RAP is a non-advocacy, non-profit organization providing technical and educational assistance to government officials on energy and environmental issues.
- RAP Principals all have extensive utility regulatory experience.

Introducing RAP, Chris, Ken, and John

- Chris James is a senior associate at RAP; he previously led Connecticut's climate and energy efforts at the CT DEP.

- Ken Colburn is also a RAP senior associate; previously he consulted with states, directed NESCAUM, and led NH's air program.

- John Shenot joined RAP in 2011 after serving as policy advisor to Wisconsin's PSC and as an air quality engineer for Wisconsin's DNR.

Training Objectives

1. Enhance DEQ air quality planners' understanding of:
   a. the value of EE as an air quality improvement strategy;
   b. how to incorporate existing EE policies and programs in air quality plans; and
   c. how to assess the potential for additional or proposed future EE policies and programs to contribute toward air quality improvement.

Training Objectives (cont.)

2. Enhance the ability of SCC and VEO staff to more fully evaluate the cost effectiveness of EE policies and programs through a better understanding of avoided environmental and other costs that are real and quantifiable.

The Big Picture

- Energy Efficiency should be a key element of any air quality improvement strategy
- Tools & methods exist for quantifying the impacts of EE on air emissions and including the impacts in air quality plans
- Coordination among agencies is needed

Rationale for Energy Efficiency (EE) as an Air Quality Strategy

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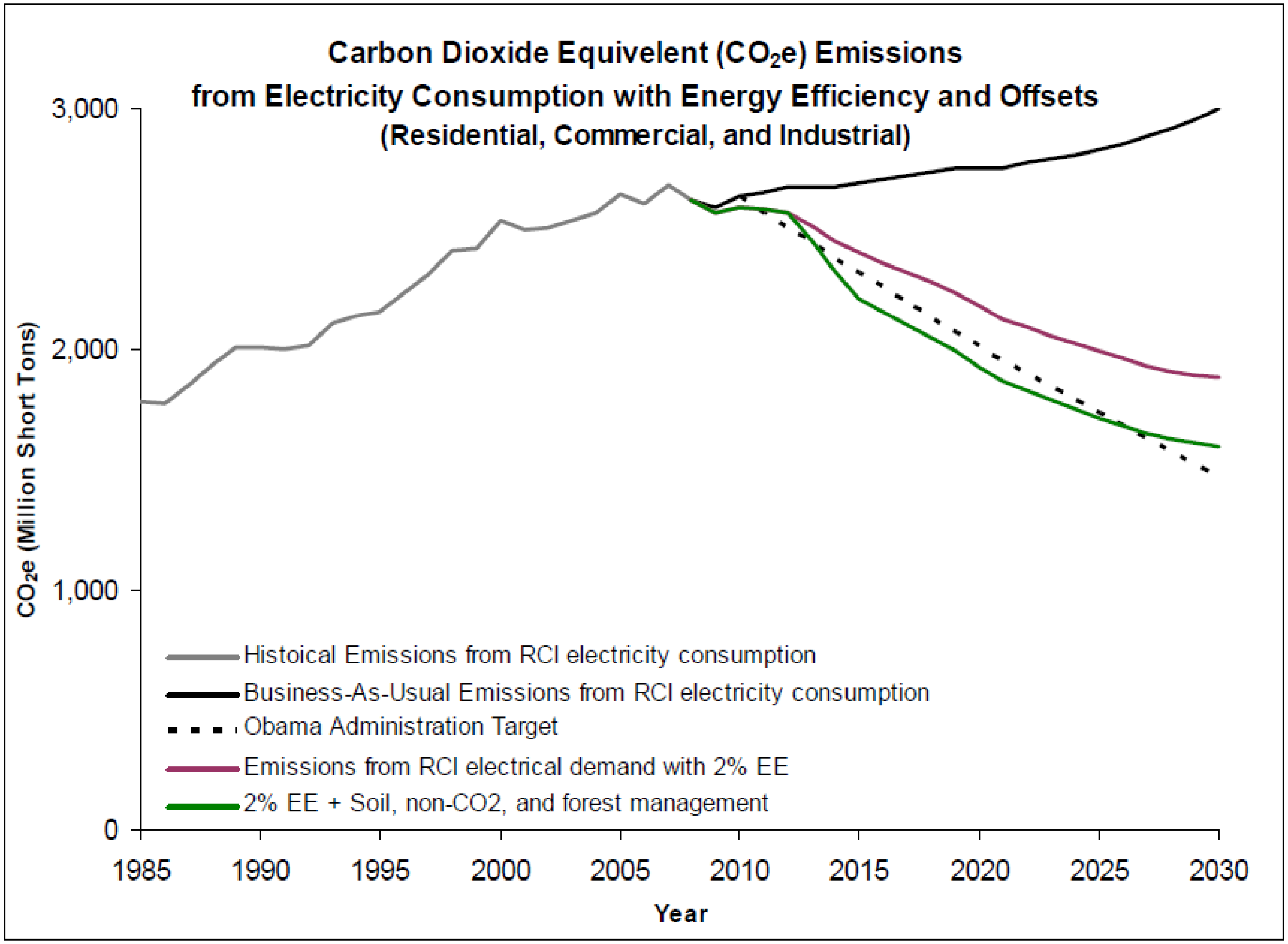
Outline

- Is EE a big deal or small potatoes?
- What exactly is "energy efficiency?"
- How does EE affect air quality?
- Current/upcoming challenges for environmental regulators
- What advantages does EE have over other air quality strategies?

National Potential of EE Programs to Reduce GHG Emissions



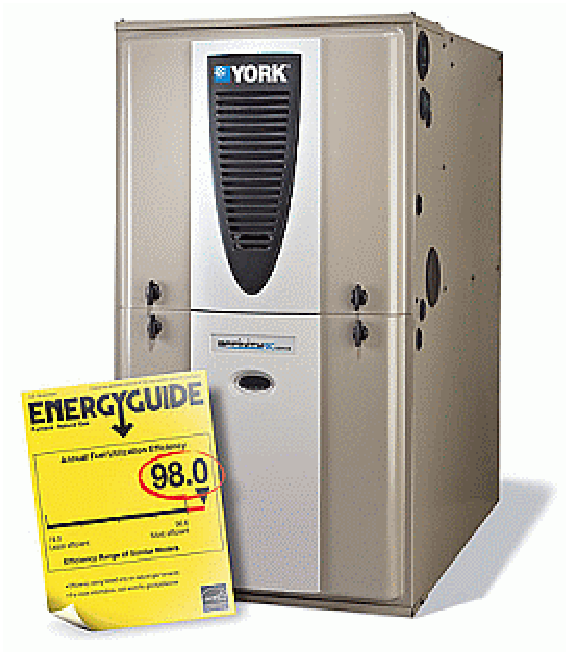
Energy Efficiency: Our Definition

- "Energy efficiency" refers to efforts to provide the same level of energy service or performance, such as heating or cooling a building, with less energy input.
  - Example: an energy efficiency program may aim at replacing a standard electric motor with a high-efficiency motor; this gets the same work done using less electricity.
- Actions that sacrifice comfort or performance in order to reduce energy may be virtuous but are not "energy efficiency" as we will use that term today.

Energy Efficiency and Air Quality

<u>On-Site Impacts</u>

Example: gas furnace

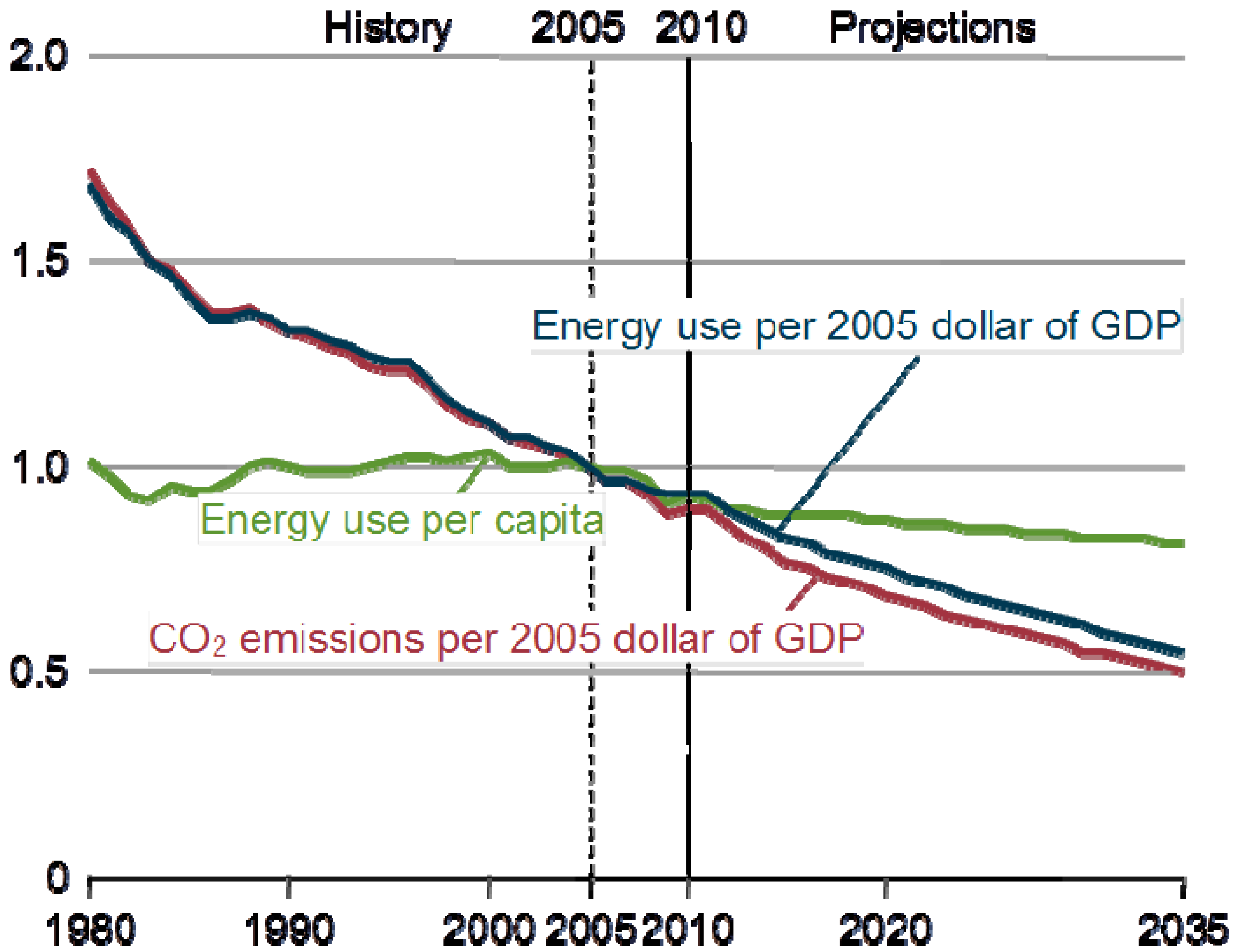


<u>Off-Site Impacts</u>

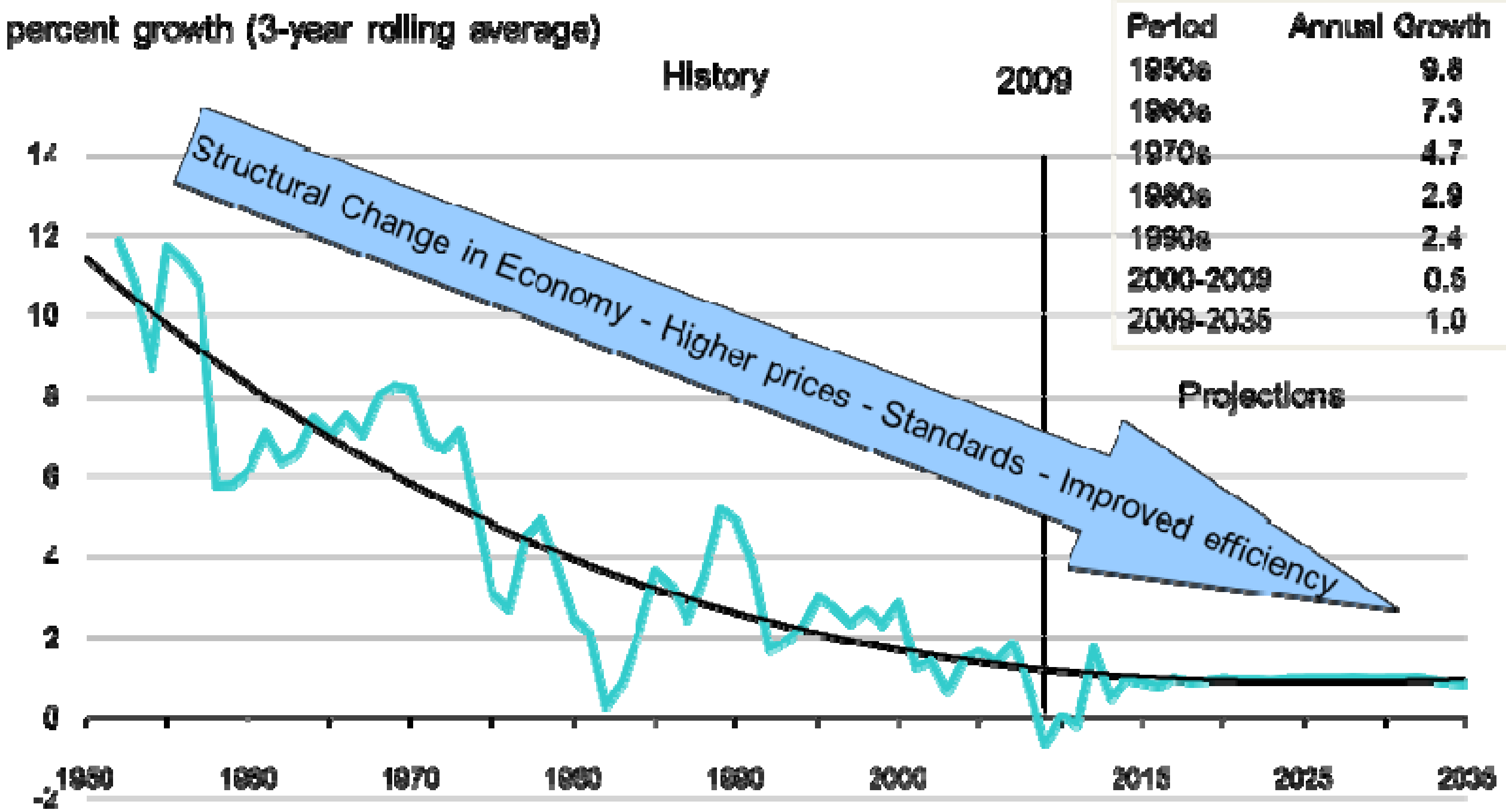
Example: central A/C

Money Isn't All You're Saving

U.S. Becoming Steadily More Efficient



Annual U.S. Electricity Growth Rate

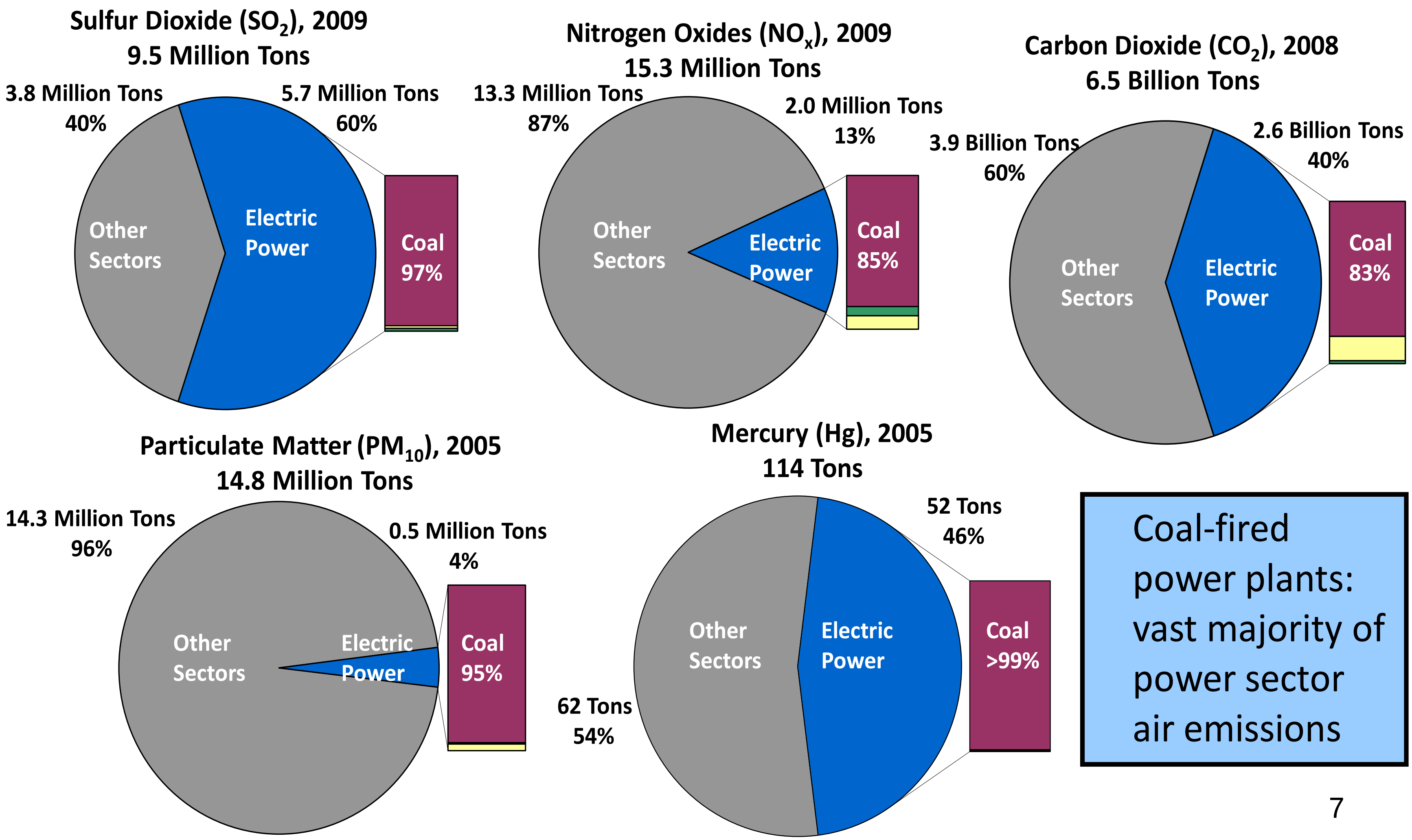


Period	Annual Growth
1950s	9.8
1960s	7.3
1970s	4.7
1980s	2.9
1990s	2.4
2000-2009	0.5
2009-2035	1.0

Source: EIA, *Annual Energy Outlook 2011*

Power Sector Impacts on Air Quality

Power Sector: A Major Share of US Air Emissions



Coal-fired power plants: vast majority of power sector air emissions

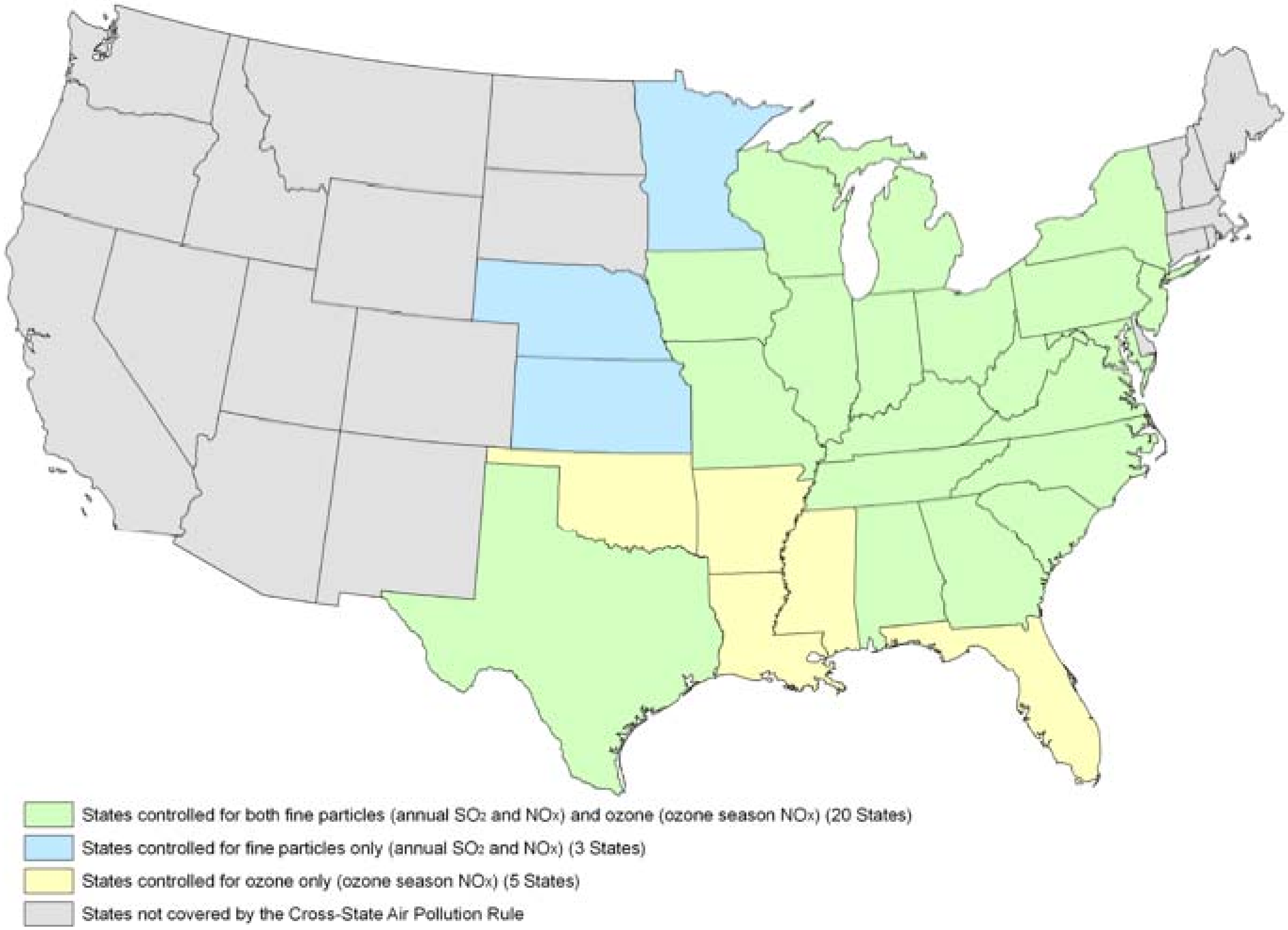
7

Sources: SO2 and NOx - NEI Trends Data and NEI 2005 Version 2 (2009) and CAMD Data & Maps (2010); PM10 - NEI Trends Data (2009); Hg - NEI 2005 Version 2 (2009); CO2 - Inventory of U.S. GHG Emissions and Sinks: 1990-2008 (2010) and 1990-2007; "Other" sources include transportation, other mobile sources, and industrial sources

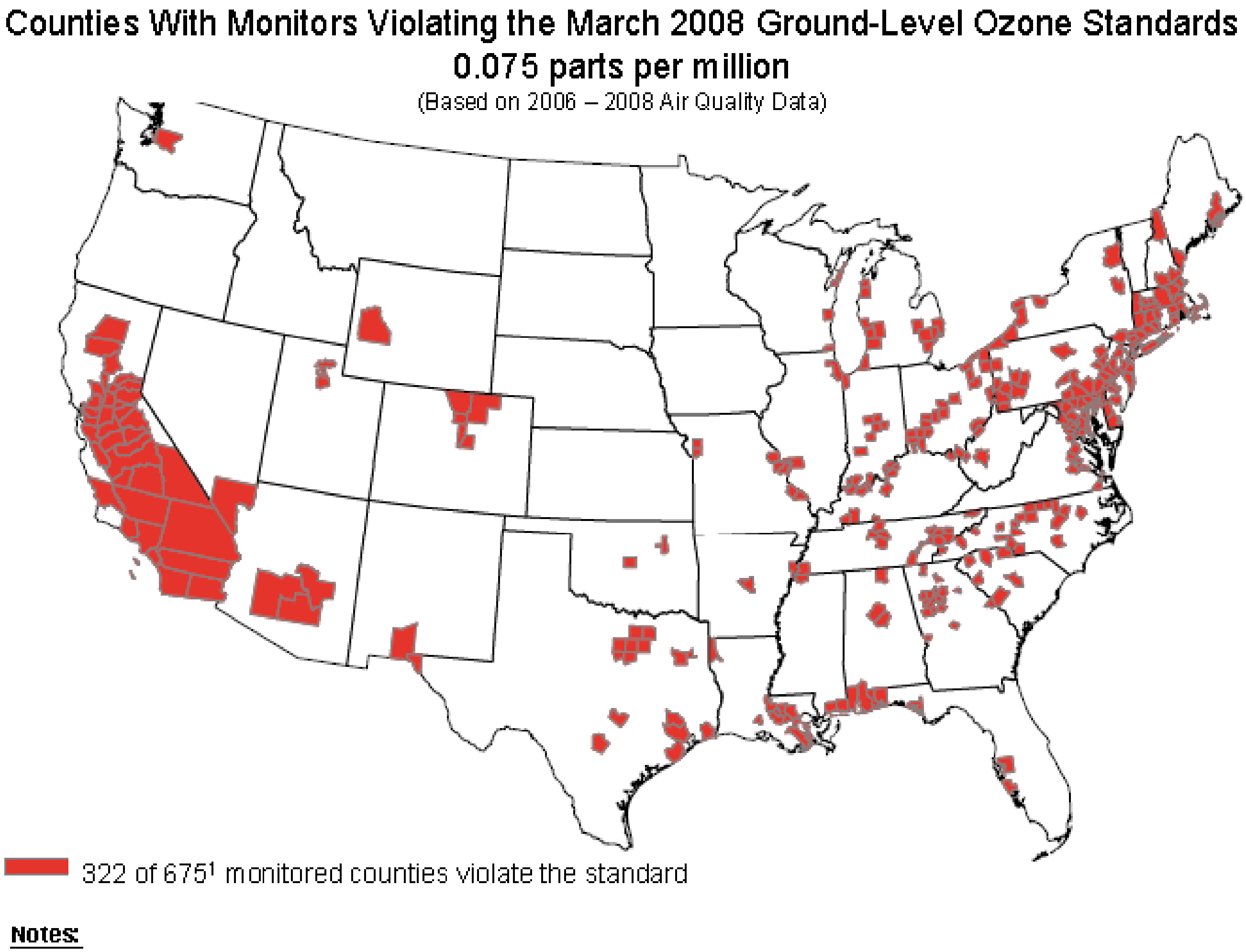
Total Net Generation by Energy Source in 2010

	Coal	Natural Gas	Oil	Nuclear	Hydro, Wind, Solar, Biomass, & Other
VA	34.9%	23.3%	1.8%	36.4%	3.6%
PJM	49.3%	11.7%	0.4%	34.6%	4.0%
US	44.8%	23.9%	0.9%	19.6%	10.9%

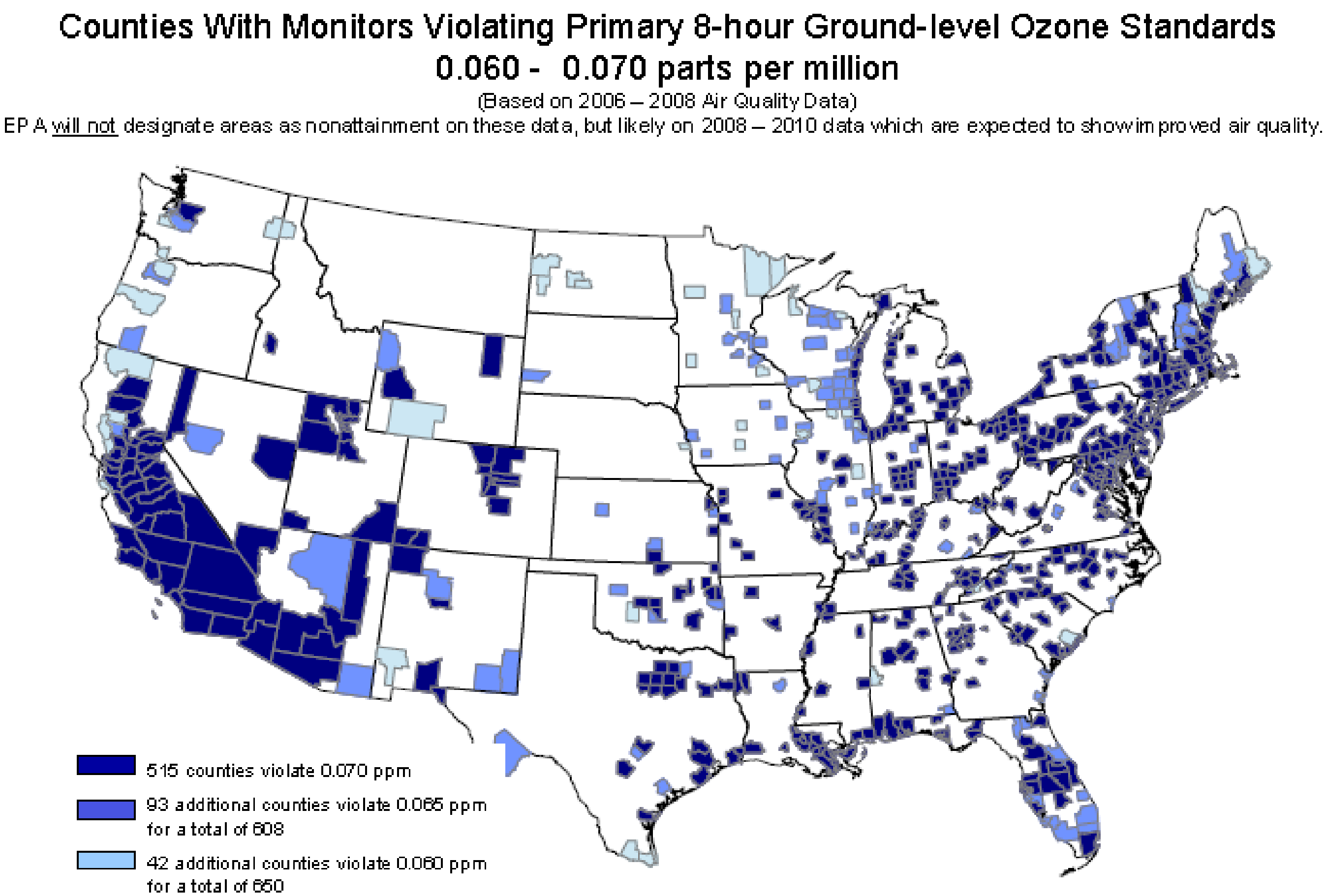
CSAPR "Transport Rule" States



2008 Ozone NAAQS



What if the Ozone NAAQS is Tightened?



Notes:
1. No monitored counties outside the continental U.S. violate.
2. EPA is proposing to determine compliance with a revised primary ozone standard by rounding the 3-year average to three decimal places.

Consequences of Nonattainment

U.S. Chamber of Commerce
Fighting For Your Business®

A non-attainment designation under the Clean Air Act carries serious repercussions including the loss of federal highway funding and the loss of economic development opportunities.

- **Loss of Federal Highway and Transit Funding**
  One year from the date of a non-attainment designation, federally funded highway and transit projects will not be allowed to proceed unless the state demonstrates there will be no increase in emissions associated with the projects.
- **Boutique Fuels**
  Non-attainment areas are subjected to the Clean Air Act's reformulated gasoline program, which significantly raises the price of motor vehicle fuels for consumers.
- **Enhanced Regulatory Oversight**
  Once an area is designated as being in non-attainment, EPA has the authority to intervene and revise permitting decisions throughout the state.
- **Restrictive Permitting Requirements**
  New and upgraded facilities in, or near, non-attainment areas are required to install the most effective emissions reduction controls without consideration of cost. Operators of existing facilities may also be required to install more restrictive control technologies than are otherwise required for similar units in areas that are in attainment.
- **Mandatory Emissions Offsetting**
  Prior to permitting the construction of new facilities, a state must offset any emissions increases by achieving reductions at existing facilities.
- **Loss of Economic Development Opportunities**
  The added regulatory and paperwork burdens, as well as expenses associated with constructing new facilities, or expanding existing ones, limit the amount of economic investment in non-attainment communities.

Other Electricity Sector Environmental Regulations

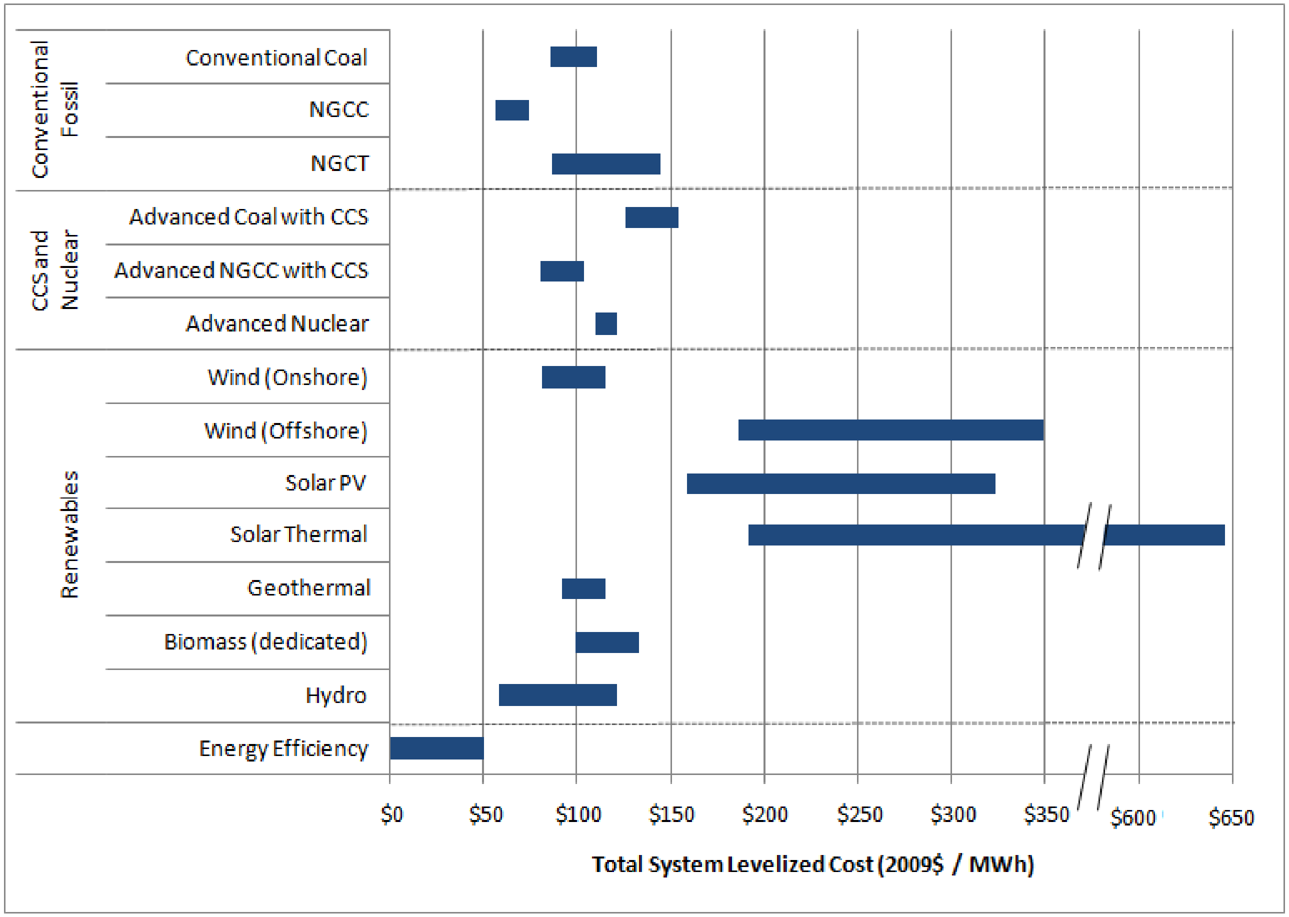
- Mercury and Air Toxics Standard
- NSPS for GHG Emissions
- PM2.5 NAAQS Revisions
- Coal Combustion Residuals (Ash) Rule
- SO2 NAAQS Revisions
- Effluent Limitation Guidelines
- 316(b) Cooling Water Rule

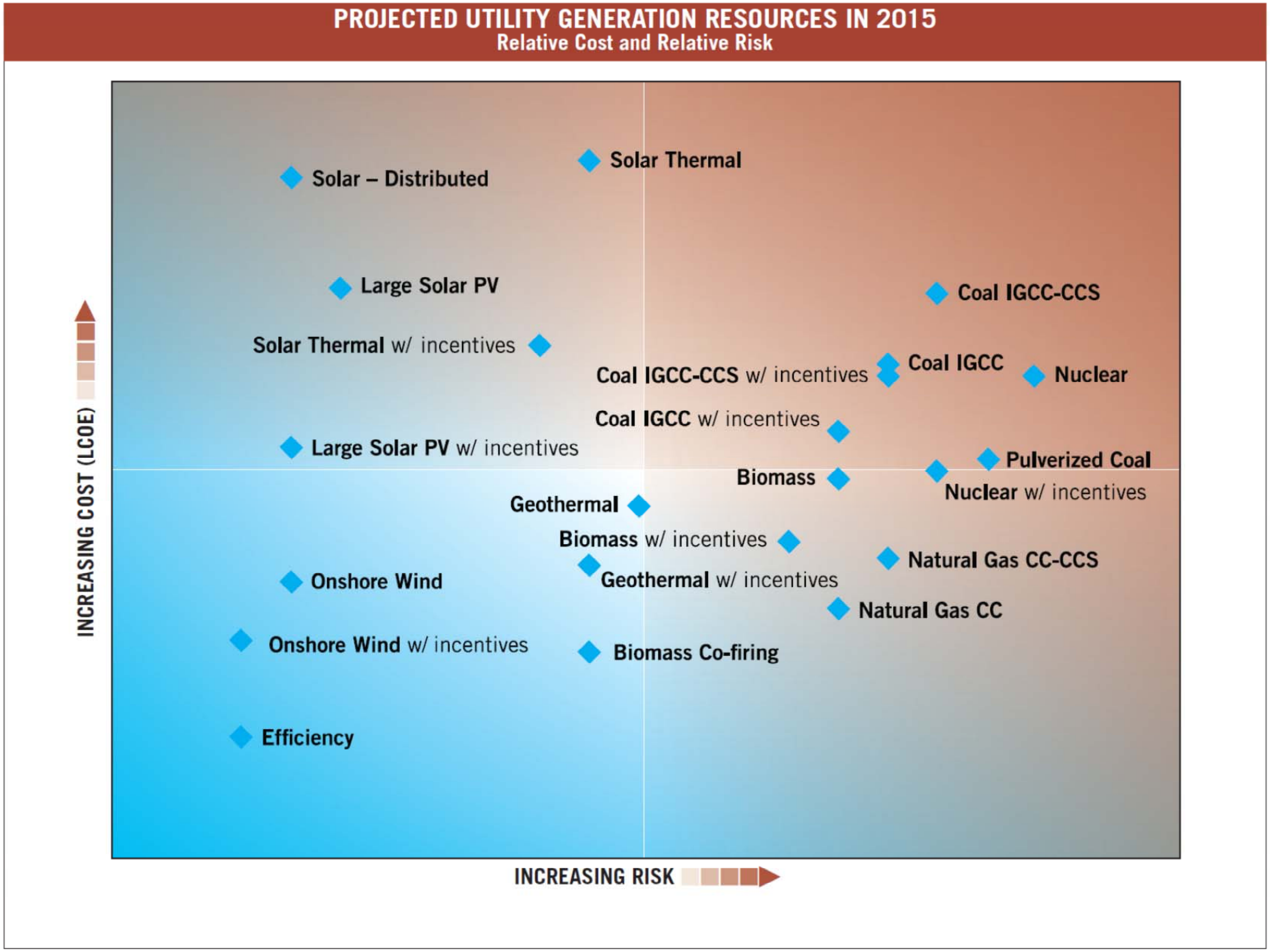
The Case for Efficiency

Energy Efficiency Provides Energy, Economic and Environmental Benefits

- Reduces criteria, toxic and GHG emissions
- Directly and indirectly reduces customer bills
- Provides inexpensive capacity to improve reliability of electricity system
- Reduces risk from fossil fuel price volatility and other unknowns
- Improves energy security
- Reduces stress on transmission and distribution
- Accumulates benefits over life of EE measure

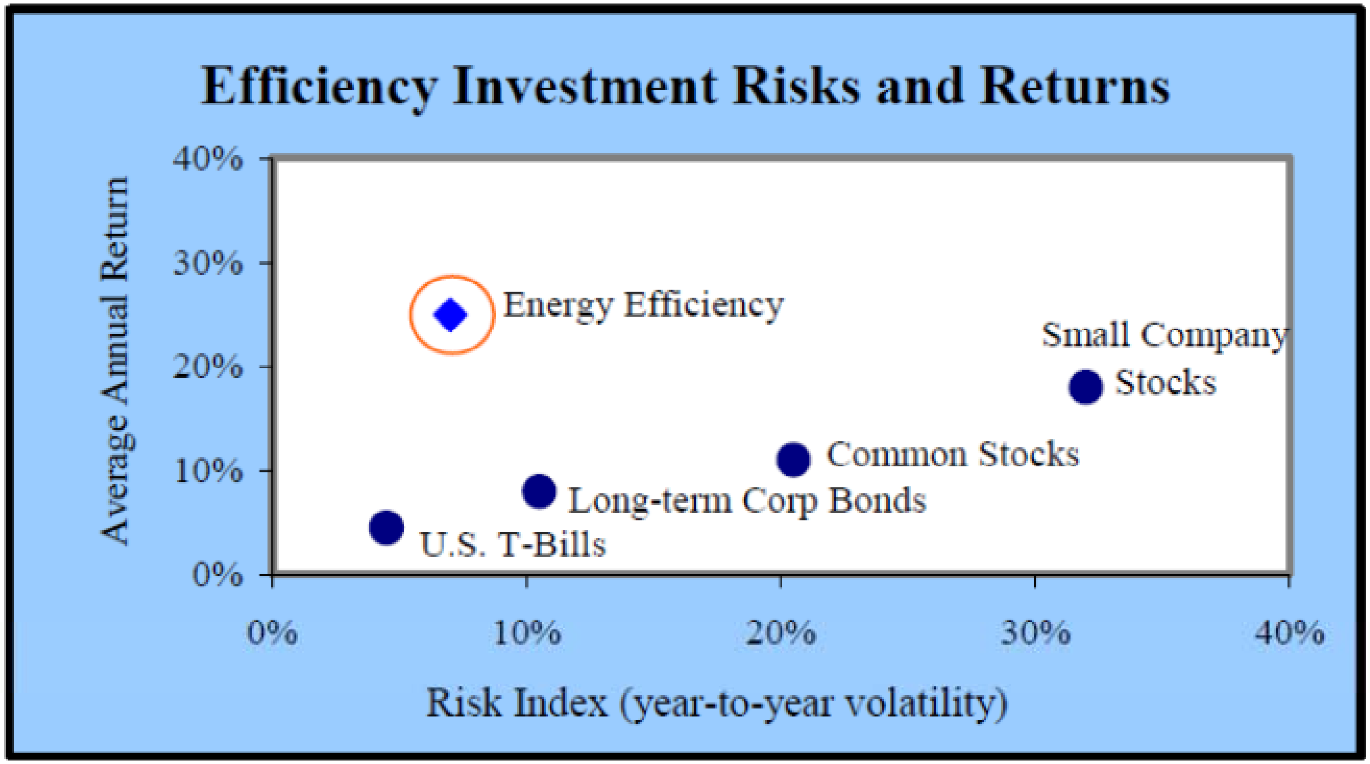
The Cheapest Form of New “Capacity”





PROJECTED UTILITY GENERATION RESOURCES IN 2015
Relative Cost and Relative Risk
Solar Thermal
Solar – Distributed
Large Solar PV
Coal IGCC-CCS
Solar Thermal w/ incentives
Coal IGCC-CCS w/ incentives
Coal IGCC
Nuclear
Coal IGCC w/ incentives
Large Solar PV w/ incentives
Pulverized Coal
Biomass
Nuclear w/ incentives
Geothermal
Biomass w/ incentives
Natural Gas CC-CCS
Onshore Wind
Geothermal w/ incentives
Natural Gas CC
Onshore Wind w/ incentives
Biomass Co-firing
Efficiency
INCREASING COST (LCOE)
INCREASING RISK

Another View Toward Risk



Source: ACEEE estimates adapted from the U.S. EPA and the Vanguard Group

Further Benefits of Industrial EE

- Measures can be highly cost-effective; some have negative payback period
- Improves economic competitiveness
- Energy savings improve profit margin
- Improved worker conditions
- May be eligible for lower insurance premiums due to reduced occupational exposure and risk

EE vs. Pollution Controls

- Both contribute to better air quality and improved public health, but...
- **EE is an investment** that more than pays for itself over time, lowers overall system-wide costs of serving electric demand, improves reliability, and provides other co-benefits
- **Pollution controls are an expense** that increases system-wide costs of serving electric demand and provides little or no co-benefits

EPA's RIA for the MATS Rule Reflects Reduced Compliance Costs Through EE

Table D-2. Electric System Generation & Energy Efficiency Costs (billions of 2007$)

	2015	2020	2030
Total Costs			
Base Case	$144.3	$155.2	$200.4
Base Case w/ Energy Efficiency (EE)	$142.3	$150.3	$189.8
Toxics Rule Case	$155.2	$165.3	$210.3
Toxics Rule Case w/ Energy Efficiency (EE)	$152.9	$159.3	$198.9
Incremental Costs			
Base to Base w/EE	-$2.0	-$4.9	-$10.6
Toxics Rule to Toxics Rule w/EE	-$2.3	-$6.0	-$11.4
Base to Toxics Rule	$10.9	$10.1	$10.0
Base with EE to Toxics Rule w/EE	$10.5	$9.0	$9.1
(Base to Toxics Rule) to (Base w/EE to Toxics Rule w/EE)	-$0.3	-$1.1	-$0.8

Source: Integrated Planning Model run by EPA, 2011, and EPA estimates of energy efficiency policy costs.

Challenges with Using EE as an Air Quality Strategy

- Efficiency measures installed in an area with air quality problems don't necessarily reduce power plant emissions in that area
- Forecasting the energy savings and emission reductions that result from EE policies and programs is challenging (but we can suggest practical ways to do it)

Estimating Energy Savings from EE Policies and Programs

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Outline

- Defining "Energy Savings"
- Importance of Energy Savings Data
- Looking Forward: Market Potential Studies
- Looking Backward: Evaluation, Measurement & Verification (EM&V)
  - Gross versus Net Savings
  - First Year, Lifetime, and Lifecycle Savings
- Importance of Timing and Location of Savings
- Real Examples from Virginia

Preview of Key Points

- The potential energy savings that will result from new efficiency policies can be predicted
- The actual energy savings that result from implemented policies can be verified
- Estimates are not as certain as CEM data, but methods are rigorous

“Energy Savings” Defined

Energy Savings = Baseline – Actual

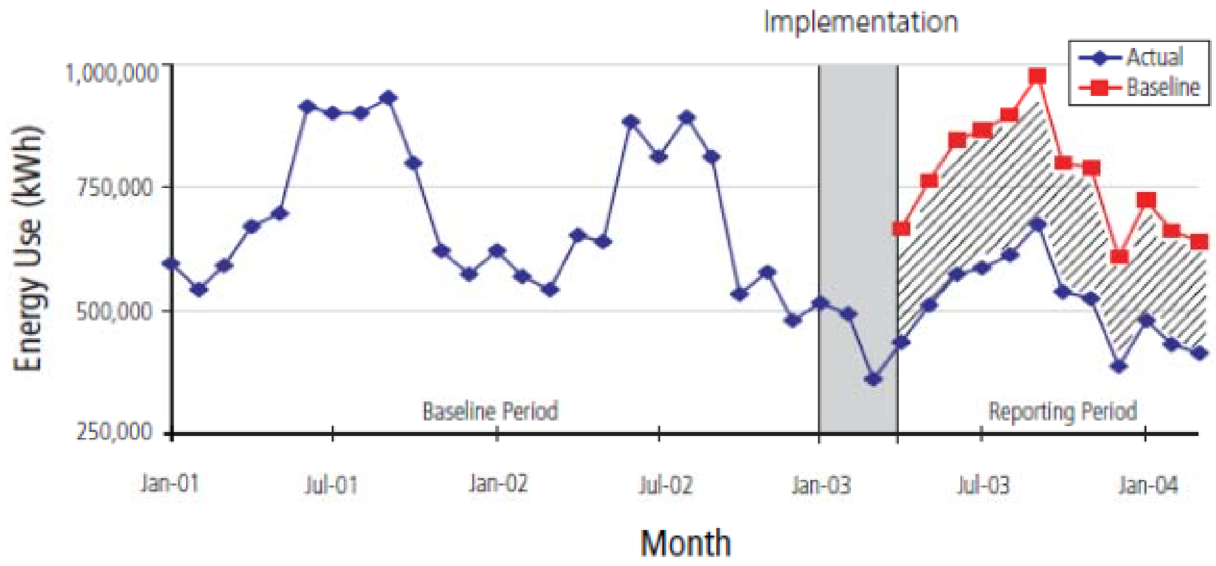
where

Actual is the amount of energy used during a given period; and,

Baseline is the amount of energy that would have been used during the same period had the efficiency measure(s) not happened

Energy Savings Visualized

Figure 4-1. Comparison of Energy Use Before and After a Program Is Implemented



Source: National Action Plan for Energy Efficiency, *Model Energy Efficiency Program Impact Evaluation Guide*, November 2007.

Easy Example

- Exit signs operate all day every day
- LED exit sign uses 44 kWh/year
- Incandescent exit sign uses 350 kWh/yr
- **Annual savings = 306 kWh/sign**

Importance of Energy Savings Data

Source: EPA State and Local Climate and Energy Program

- States use energy savings data to help inform and address the following important needs:
  - **PUCs** need retrospective, timely information to ensure ratepayer value and cost-effectiveness
  - **Energy system planners** need to know how EE policy is likely to affect the energy system (consistent with resource plans)
  - **Governors** need talking points on the multiple benefits achieved with recent EE/RE investments
  - **DEPs** need to know when and where EE/RE is likely to affect air emissions, and the magnitude of these impacts

Looking Forward: Potential Studies

What is a Market Potential Study?

- Prospective, quantitative assessment of market potential for deploying EE and/or RE (but usually just EE)
- Most often conducted by a third party under contract with a utility, state utility commission, or state energy office

Possible Purposes of a Potential Study

- Design or build support for new policies
- Identify alternatives to new generation, transmission and distribution assets
- Set realistic EE targets and/or budgets
- Select measures to include in EE programs
- Forecast energy savings
- Forecast emission reductions

Scope of Potential Studies

- Can cover a single neighborhood, a utility service territory, an entire state, or a region
- May be limited to electricity, or a fuel like natural gas, or all sources of energy
- Might cover all sectors of the economy, or just a subset (e.g. residential customers)

Multiple Meanings of “Potential”

Not technically feasible	**Technical Potential**			
Not technically feasible	Not cost effective	**Economic Potential**		
Not technically feasible	Not cost effective	Market and adoption barriers	**Achievable Potential**	
Not technically feasible	Not cost effective	Market and adoption barriers	Program design, budget, staffing, and time constraints	**Program Potential**

Overview of Methodology for EE Potential Studies

- Identify technically feasible EE measures
- Determine costs of each measure
- Calculate benefits of each measure over time, relative to baseline assumptions
- Screen measures for cost effectiveness
- Adjust for barriers to adoption, expected market penetration, etc.

EE Potential in Virginia

- *Staff's Report to the State Corporation Commission* (SCC 2007)
- *Energizing Virginia: Efficiency First* (ACEEE 2008)
  - American Council for an Energy-Efficient Economy (ACEEE), Summit Blue Consulting, ICF International, and Synapse Energy Economics

SCC Investigation (2007)

- Not a true market potential study
- Commission directed staff to:
  - determine whether an electric energy savings goal in VA statutes can be achieved cost-effectively
  - identify the mix of programs that should be implemented to cost-effectively achieve the statutory goal

Virginia's Energy Savings Goal

- Enacted by the Legislature in 2007
- Goal: By the year 2022, to reduce the consumption of electric energy through the implementation of cost-effective energy efficiency programs by an amount equal to 10% of the amount consumed in 2006.

Results: Staff Report to SCC (2007)

- “There is a body of evidence indicating that the 10% goal is physically attainable”
- “The Staff believes that the 10% goal... can be achieved even using a relatively conservative test for “cost-effectiveness”
- “While the Staff believes that the 10% goal is attainable, there is substantial debate about the best way to achieve the goal”

Summary of Results from ACEEE (2008)

Table 2. Summary of Cost-Effective Energy Efficiency Potential in Virginia by Sector (2025)

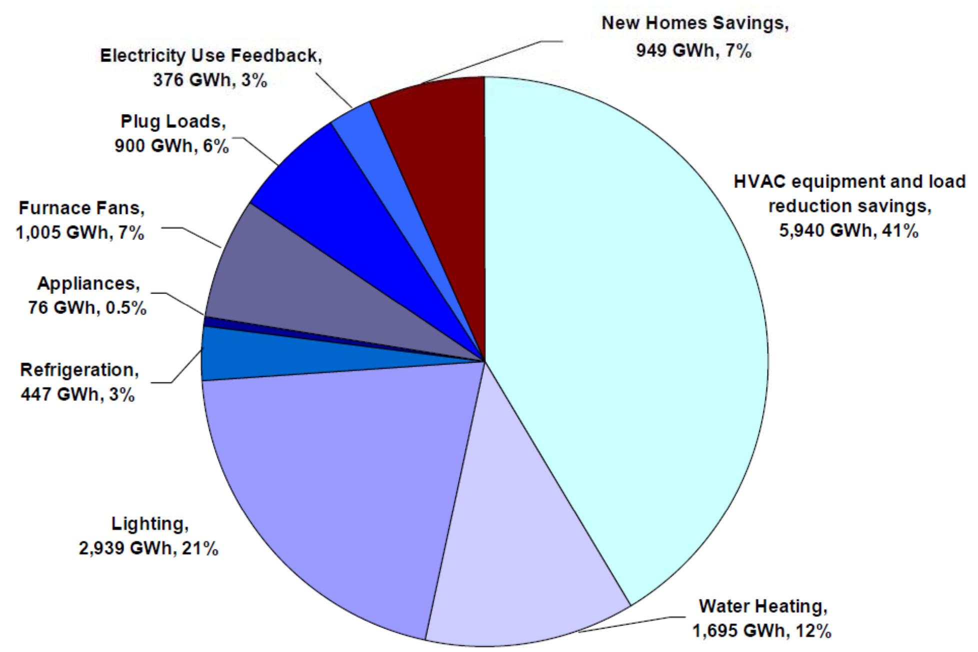
Sector	Efficiency Potential (GWh)	As % of Electricity Consumption in 2025
Residential	14,328	26%
Commercial	19,191	28%
Industrial	5,152	25%
Combined Heat & Power	5,700	6%*
Total	44,371	31%

** Note: As percentage of commercial and industrial sectors combined.*

Detailed Example for Residential Sector: ACEEE (2008)

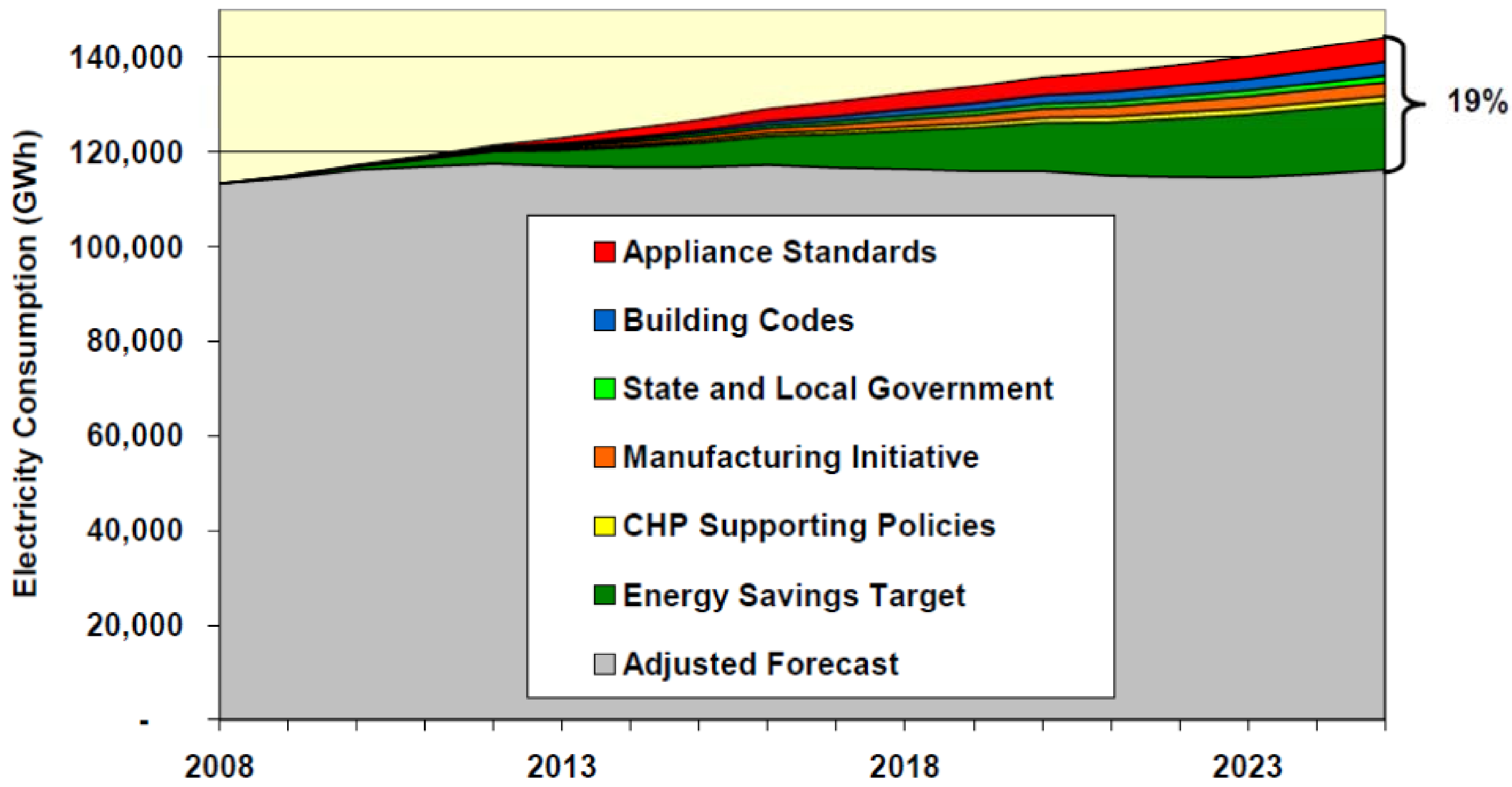
Figure 11. Residential Energy Efficiency Potential in 2025 by End-Use in Virginia

Total: 14,328 GWh
26% of Projected Electricity Consumption in 2025



Potential Reductions in Electricity Use: ACEEE (2008)

Figure 21. Estimated Reductions in Electricity Use in Virginia through Energy Efficiency — Medium Scenario



Looking Backward: EM&V

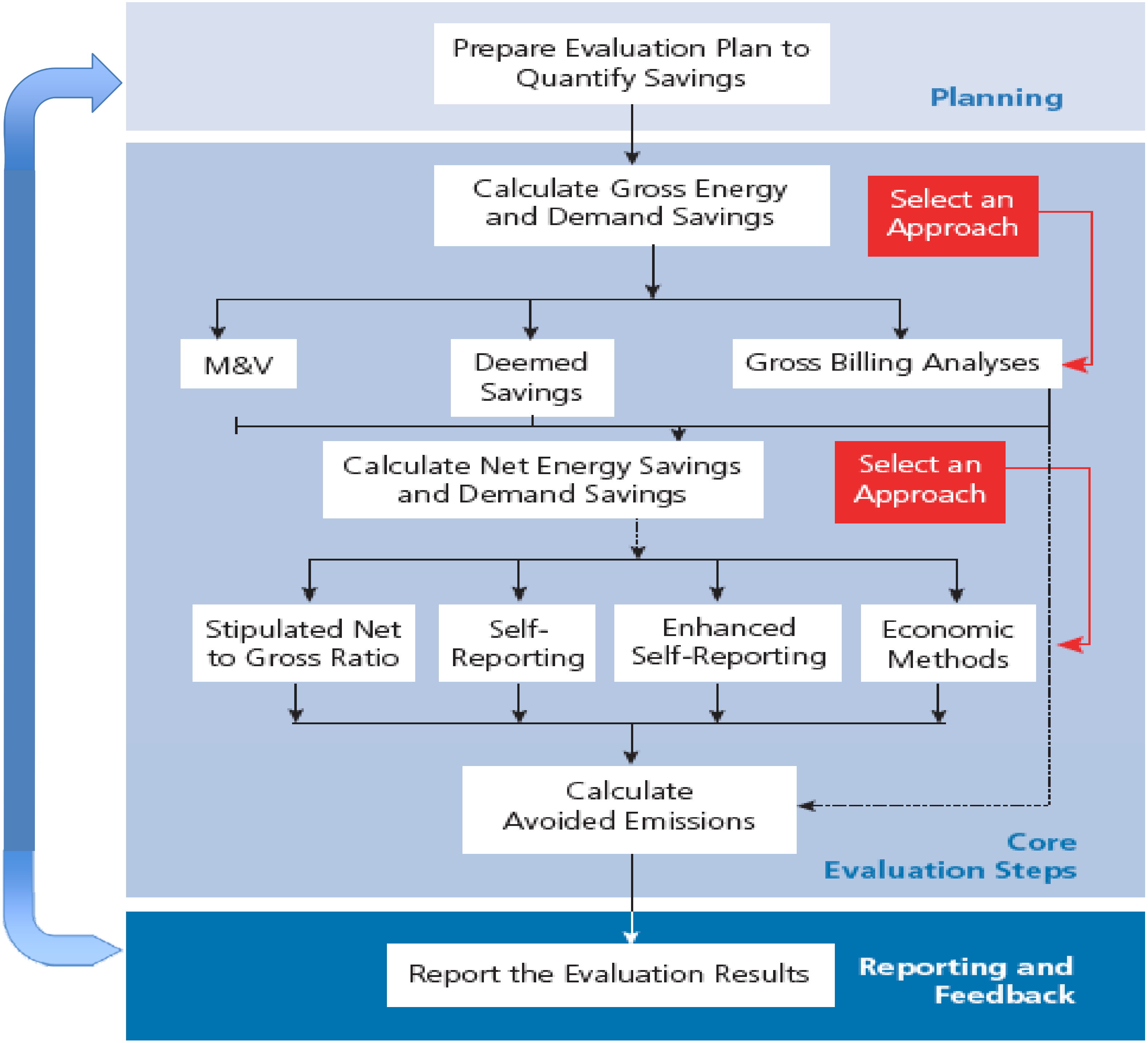
EM&V Definition and Background

Source: EPA State and Local Climate and Energy Program

- "Evaluation, measurement, and verification" is the process of estimating energy, peak demand, and emissions impacts from energy efficiency (EE) policies, programs, or projects
  - EM&V for EE programs is a mature field with well-developed methods
  - Conducted for several decades in nearly all states/municipalities with significant public investment in EE
- EM&V refers to retrospective analysis
  - It does not include forecasting the impacts of future policies, programs, or projects (although EM&V data are used to inform and improve forecasting)

EM&V is Serious Business

- In 2009, industry-wide spending on EM&V was estimated to exceed $200 million in the U.S.
- Ratepayer-funded programs spend between 0.5% and 5% of total program funding on EM&V, with mean of 2.8%


Prepare Evaluation Plan to Quantify Savings
Planning
Calculate Gross Energy and Demand Savings
Select an Approach
M&V
Deemed Savings
Gross Billing Analyses
Calculate Net Energy Savings and Demand Savings
Select an Approach
Stipulated Net to Gross Ratio
Self-Reporting
Enhanced Self-Reporting
Economic Methods
Calculate Avoided Emissions
Core Evaluation Steps
Report the Evaluation Results
Reporting and Feedback

Step 1: Estimate Gross Energy Savings

- Gross Savings = the amount that results directly from actions promoted by the EE program, regardless of the extent to which the program actually prompted the change
- Involves a combination of methods:
  - Measured and verified savings
  - Deemed savings
  - Gross billing analysis

Measured &Verified Savings

- Used for large, complex, or "risky" projects or for programs in which a variety of factors determine savings
  - **Project savings** determined by metering, modeling, or engineering calculations
  - **Program savings** determined by selecting a representative sample of projects, measuring the savings from those selected projects, and extrapolating the results to the entire program

Deemed Savings

- Used for simple projects with well-understood savings that don't significantly vary from project to project
- Stakeholders stipulate that they will use deemed values to estimate energy savings for each project within a program
- Less accurate but also less expensive than M&V

Gross Billing Analysis

- Less common method
- Uses aggregated utility billing data and statistical methods, rather than project- or customer-specific measurements

Step 2: Estimate Net Energy Savings

- Net Savings = the portion of gross savings that can be attributed to the EE program, separating out other factors that influence behavior and consumption
- Why might net savings be different than gross savings?

Estimating Net Energy Savings: Why?

- **Free riders**: participants who would have acted even in the absence of the program
- **Spillover**: changes in energy use caused indirectly by the presence of the program
- **Rebound**: savings from installing an efficient device that are offset by greater use of the device

Estimating Net Energy Savings: How?

- Net-to-Gross Ratio (NTGR): 4 approaches
  1. Self-reported survey responses from program participants
  2. Self-reported survey responses enhanced with interviews or other documentation
  3. Statistical/economic models that compare behavior of participants & non-participants
  4. Deemed/stipulated NTGR based on past use of the other methods

National Grid Net Savings Example

In 2006, National Grid undertook a study of free ridership and spillover in its commercial and industrial energy efficiency programs. That study identified a free ridership rate of 10 percent and a spillover rate of 14 percent for custom installations as determined using the Design 2000*plus* software program. The net-to-gross ratio for custom installations is equal to:

$$
\begin{aligned}
NTGR &= (1 - \text{free ridership} + \text{spillover}) \\
&= (1 - 0.10 + 0.14) \\
&= 1.04
\end{aligned}
$$

In this case, net savings for custom installations in National Grid's Design 2000*plus* Program are 4 percent higher than gross savings.

Provided by National Grid based on a report from PA Consulting Group, 2006.

Temporal Aspects of Measurement

- Future net and gross savings caused by past actions can be forecasted
- Persistence is a key factor: will the efficiency of a project degrade over time?
- Need to understand if you are looking at:
  - First year savings
  - Lifetime savings
  - Lifecycle savings

Energy Savings Visualized

Table G-1. The Timing of Energy Savings from a Hypothetical Program

Program Year	Quantity	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
FY01	100	6,000	6,000	6,000	6,000	6,000	6,000									
FY02	100		6,000	6,000	6,000	6,000	6,000	6,000								
FY03	100			6,000	6,000	6,000	6,000	6,000	6,000							
FY04	100				6,000	6,000	6,000	6,000	6,000	6,000						
FY05	100					6,000	6,000	6,000	6,000	6,000	6,000					
FY06	100						6,000	6,000	6,000	6,000	6,000	6,000				
FY07	100							6,000	6,000	6,000	6,000	6,000	6,000			
18MCP	100								6,000	6,000	6,000	6,000	6,000	6,000		
CY09	100									6,000	6,000	6,000	6,000	6,000	6,000	
CY10	100										6,000	6,000	6,000	6,000	6,000	6,000

Source: Public Service Commission of Wisconsin, *Focus on Energy Evaluation: Annual Report (2010)*, April 2011.

Technical Reference Manuals

- A common basis for evaluating savings
  - By program
  - Differentiated by climate zone as needed
  - Defining baselines
- Slick on-line versions in Pacific Northwest and California
  - http://www.nwcouncil.org/energy/rtf/reports.htm#ptcs
  - http://www.deeresources.com/
  - http://www.energy.ca.gov/deer/

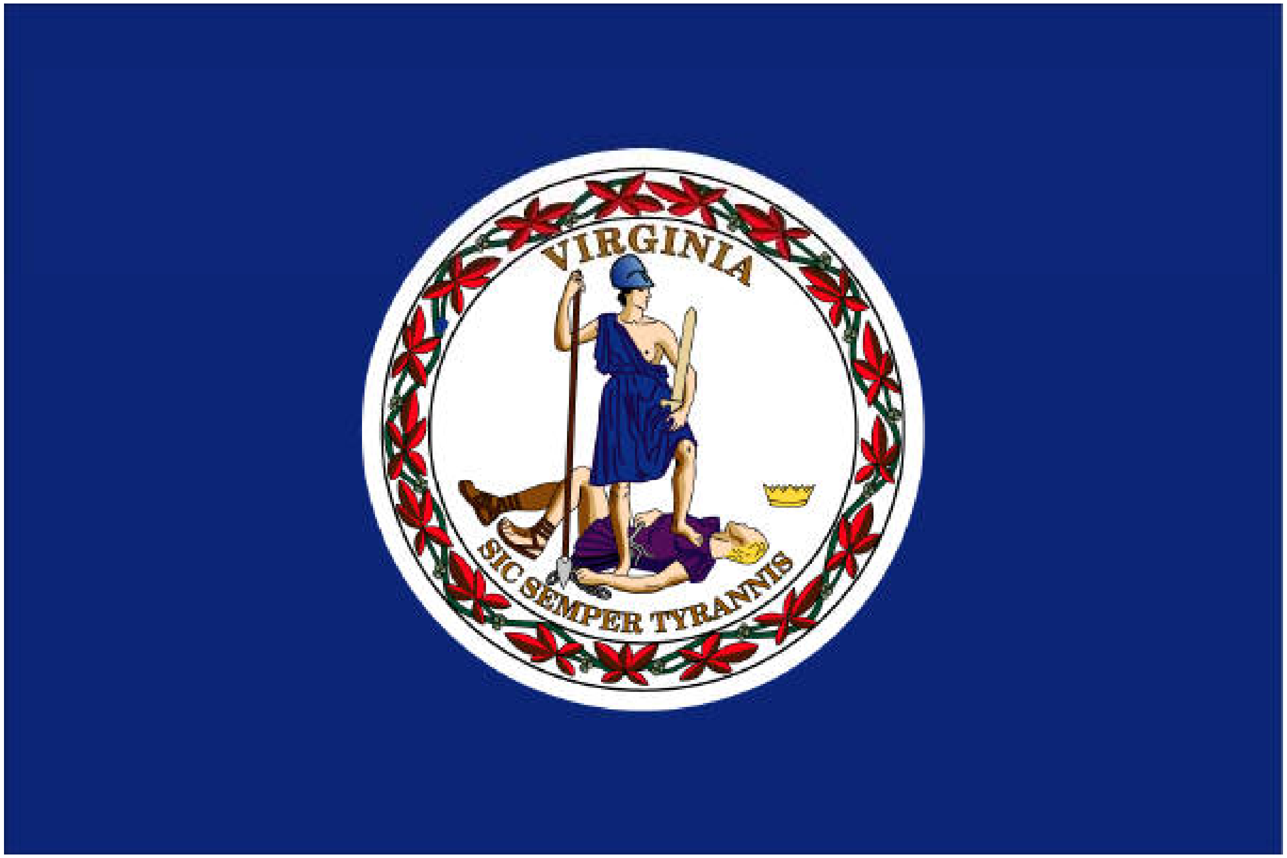
Importance of Timing and Location

- For some data uses, it doesn't matter when or where energy is saved
- But for air quality planning, it does matter because it (partially) determines which power plant won't be dispatched, and thus the emissions avoided
  - Day, night, weekday or weekend, etc.?
  - Concentrated in one geographic area, or evenly dispersed across the state?

Promising Examples

- Con Edison published a first-of-its-kind paper in 2011 describing their method for forecasting the expected future demand reduction at each substation that will result from their EE programs
- Con Edison and a few others also offer good examples of attempts to discern hourly variations in savings

Quantification Example: VA Statutory Goal



Step 1: Retail Electricity Sales History

YEAR	Retail Sales (GWh) Source: EIA Data
2006	106,721
2007	111,570
2008	110,106
2009	108,462
2010	113,806
2011	
2012	
2013	
2014	
2015	
2016	
2017	
2018	
2019	
2020	
2021	
2022	

Step 2: Retail Electricity Sales Forecast

YEAR	Retail Sales (GWh) Source: EIA Data	Forecasted Sales (GWh) Source: AEO 2010
2006	106,721	
2007	111,570	
2008	110,106	
2009	108,462	
2010	113,806	
2011		114,887
2012		115,979
2013		117,080
2014		118,193
2015		119,315
2016		120,449
2017		121,593
2018		122,748
2019		123,914
2020		125,092
2021		126,280
2022		127,480

Step 3: State Policy Goal

YEAR	Retail Sales (GWh) Source: EIA Data	Forecasted Sales (GWh) Source: AEO 2010	EE Savings Goal (GWh) Source: State Statute
2006	106,721		
2007	111,570		
2008	110,106		
2009	108,462		
2010	113,806		
2011		114,887	
2012		115,979	
2013		117,080	
2014		118,193	
2015		119,315	
2016		120,449	
2017		121,593	
2018		122,748	
2019		123,914	
2020		125,092	
2021		126,280	
2022		127,480	10,672

Step 4: Forecasted Energy Savings

	Retail Sales (GWh)	Forecasted Sales (GWh)	EE Savings Goal (GWh)	Assumed EE Savings (GWh)
YEAR	Source: EIA Data	Source: AEO 2010	Source: State Statute	Source: Interpolation
2006	106,721			
2007	111,570			
2008	110,106			
2009	108,462			
2010	113,806			
2011		114,887		
2012		115,979		
2013		117,080		1,067
2014		118,193		2,134
2015		119,315		3,202
2016		120,449		4,269
2017		121,593		5,336
2018		122,748		6,403
2019		123,914		7,470
2020		125,092		8,538
2021		126,280		9,605
2022		127,480	10,672	10,672

Step 5: Adjusted Retail Sales Forecast

YEAR	Retail Sales (GWh) Source: EIA Data	Forecasted Sales (GWh) Source: AEO 2010	EE Savings Goal (GWh) Source: State Statute	Assumed EE Savings (GWh) Source: Interpolation	Adjusted Sales (GWh) Source: Column C - Column E
2006	106,721				
2007	111,570				
2008	110,106				
2009	108,462				
2010	113,806				
2011		114,887			
2012		115,979			
2013		117,080		1,067	116,013
2014		118,193		2,134	116,058
2015		119,315		3,202	116,114
2016		120,449		4,269	116,180
2017		121,593		5,336	116,257
2018		122,748		6,403	116,345
2019		123,914		7,470	116,444
2020		125,092		8,538	116,554
2021		126,280		9,605	116,675
2022		127,480	10,672	10,672	116,808

Monetizing Avoided Air Quality Costs Resulting from EE

Workshop on Incorporating Energy Efficiency in Air Quality Plans
for Virginia Department of Environmental Quality

Presented by John Shenot, Chris James, and Ken Colburn

June 1, 2012

The Regulatory Assistance Project
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Outline

- Overview of EE Cost Effectiveness Tests
- Examples Showing How the Choice of Which Test to Use Matters
- Types of Air Quality-Related Benefits Included in Each Test
- Recent Changes to Virginia Policy on Cost Effectiveness Tests

Who Cares About Cost Effectiveness?

Source: State Energy Efficiency Action Network, www.seeaction.energy.gov

AUDIENCE	DATA NEEDS							
Key: ● Almost Always; ○ Sometimes; NA Rarely	First Year Gross Energy Saved (annual, monthly, hourly)	Net Energy Saved	Cost-Effectiveness (perspectives vary)	Savings Persistence	Lessons Learned (process evaluation)	Market Impacts	Participation Levels (e.g. customers served)	Environmental Benefits
Planners and System Operators	●	○	○	●	○	○	●	○
Program Administrators	●	○	●	●	●	○	○	○
Commissions	●	○	●	●	●	○	○	○
State and Federal Government	●	○	○	○	●	○	○	○
Finance Community	●	NA	●	○	○	NA	NA	○
Host Customers	●	NA	●	○	○	NA	NA	○
EM&V Practitioners	●	○	○	○	○	○	○	○

And Why Do They Care?

Source: State Energy Efficiency Action Network, www.seeaction.energy.gov

Audience	Needs and Concerns: What decisions must be made?
Planners and System Operators	• Prove energy efficiency is a viable resource. • Need data accurate and complete enough to analyze energy efficiency for resource planning and system operation (could include hourly impacts and load shape).
Program Administrators	• Run programs effectively/improve programs; compare programs. • Demonstrate that programs achieved expected savings. • Pass program cost-benefit tests.
Commissions	• Need credibility so that planning authorities will incorporate energy efficiency into load forecasts and resource planning. • Prove energy efficiency programs and portfolios are cost effective. Determine attribution and/or appropriate incentive payments. Compare programs.
State and Federal Government	• Measure and verify savings. Know that targets are met and energy efficiency benefits ratepayers. Compare savings across various programs and potential program activities. • Improve grant management by improving best practices. • Use energy efficiency data to determine green house gas (GHG) and other environmental impacts.
Finance Community	• Need data sufficient to show that efficiency is a viable investment.
Host Customers	• Need feedback justifying their participation (current EM&V uses hosts solely as data sources). Could benefit from individualized results from M&V activities.
(EM&V Practioners)	• Need better access to tools and data, support for capacity building, more people.

Overview of Cost Effectiveness Tests

Table 2-2. The Five Principal Cost-Effectiveness Tests Used in Energy Efficiency

Test	Acronym	Key Question Answered	Summary Approach
Participant cost test	PCT	Will the participants benefit over the measure life?	Comparison of costs and benefits of the customer installing the measure
Program administrator cost test	PACT	Will utility bills increase?	Comparison of program administrator costs to supply-side resource costs
Ratepayer impact measure	RIM	Will utility rates increase?	Comparison of administrator costs and utility bill reductions to supply-side resource costs
Total resource cost test	TRC	Will the total costs of energy in the utility service territory decrease?	Comparison of program administrator and customer costs to utility resource savings
Societal cost test	SCT	Is the utility, state, or nation better off as a whole?	Comparison of society's costs of energy efficiency to resource savings and non-cash costs and benefits

Source: Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.

Costs and Benefits Used in Each Test

Table 3-2. Summary of Benefits and Costs Included in Each Cost-Effectiveness Test

Component	PCT	PACT	RIM	TRC	SCT
Energy- and capacity-related avoided costs		Benefit	Benefit	Benefit	Benefit
Additional resource savings				Benefit	Benefit
Non-monetized benefits					Benefit
Incremental equipment and installation costs	Cost			Cost	
Program overhead costs		Cost	Cost	Cost	Cost
Incentive payments	Benefit	Cost	Cost		
Bill savings	Benefit		Cost		

Source: Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.

Note: Incentive payments include any equipment and installation costs paid by the program administrator.

Energy & Capacity Avoided Costs

Table 4-1. Universe of Energy and Capacity Benefits for Electricity and Natural Gas

Electricity Energy Efficiency	
Energy Savings	**Capacity Savings**
Market purchases or fuel and operation and maintenance costs	Capacity purchases or generator construction
System losses	System losses (peak load)
Ancillary services related to energy	Transmission facilities
Energy market price reductions	Distribution facilities
Co-benefits in water, natural gas, fuel oil, etc.	Ancillary services related to capacity
Air emissions	Capacity market price reductions
Hedging costs	Land use

The Choice of Test Matters

Table 2-3. Summary of Cost-effectiveness Test Results for Four Energy Efficiency Programs

Test	Southern California Edison Residential Energy Efficiency Incentive Program	Avista Regular Income Portfolio	Puget Sound Energy Commercial/ Industrial Retrofit Program	National Grid MassSAVE Residential
	Benefit-Cost Ratio			
PCT	7.14	3.47	1.72	8.81
PACT	9.91	4.18	4.19	2.64
RIM	0.63	0.85	1.15	0.54
TRC	4.21	2.26	1.90	1.73
SCT	4.21	2.26	1.90	1.75

Types of Air Quality-Related Benefits

- Avoided costs within the utility system (included in PACT, RIM, TRC and SCT):
  - Emission fees
  - Pollution control costs
- Avoided costs external to the utility system (included in SCT, but harder to quantify):
  - Non-utility costs of non-attainment
  - Public health costs

Consequences of Nonattainment

U.S. Chamber of Commerce
Fighting For Your Business®

A non-attainment designation under the Clean Air Act carries serious repercussions including the loss of federal highway funding and the loss of economic development opportunities.

- **Loss of Federal Highway and Transit Funding**
  One year from the date of a non-attainment designation, federally funded highway and transit projects will not be allowed to proceed unless the state demonstrates there will be no increase in emissions associated with the projects.
- **Boutique Fuels**
  Non-attainment areas are subjected to the Clean Air Act's reformulated gasoline program, which significantly raises the price of motor vehicle fuels for consumers.
- **Enhanced Regulatory Oversight**
  Once an area is designated as being in non-attainment, EPA has the authority to intervene and revise permitting decisions throughout the state.
- **Restrictive Permitting Requirements**
  New and upgraded facilities in, or near, non-attainment areas are required to install the most effective emissions reduction controls without consideration of cost. Operators of existing facilities may also be required to install more restrictive control technologies than are otherwise required for similar units in areas that are in attainment.
- **Mandatory Emissions Offsetting**
  Prior to permitting the construction of new facilities, a state must offset any emissions increases by achieving reductions at existing facilities.
- **Loss of Economic Development Opportunities**
  The added regulatory and paperwork burdens, as well as expenses associated with constructing new facilities, or expanding existing ones, limit the amount of economic investment in non-attainment communities.

Getting it Right

- Air regulators have information on air quality-related costs and benefits that utilities and other interveners might not provide to the SCC
- These costs/benefits can be substantial
- Air regulators and utility commissions should collaborate to ensure that cost-effectiveness tests are accurate and comprehensive

Recent Changes to Virginia Policy

- Until this year, SCC policy afforded the greatest weight to the RIM test
- In April 2012 the Assembly enacted (nearly unanimously) a new law providing that a program or portfolio of programs "shall not be rejected solely based on the results of a single test"

Other Opportunities to Consider EE in AQ Plans and SCC Proceedings

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Outline

- Utility EE Plans
- EE in IRP Processes
- Efficiency Power Plants
- Efficiency-Based Load Balancing

Utilities File EE Plans with SCC

- Many states require all utilities to fund energy efficiency programs with funds collected from ratepayers
- Virginia does not have *mandatory* EE, but utilities may request SCC approval to spend ratepayer money on EE programs that are cost effective and help achieve the commonwealth's EE savings goal

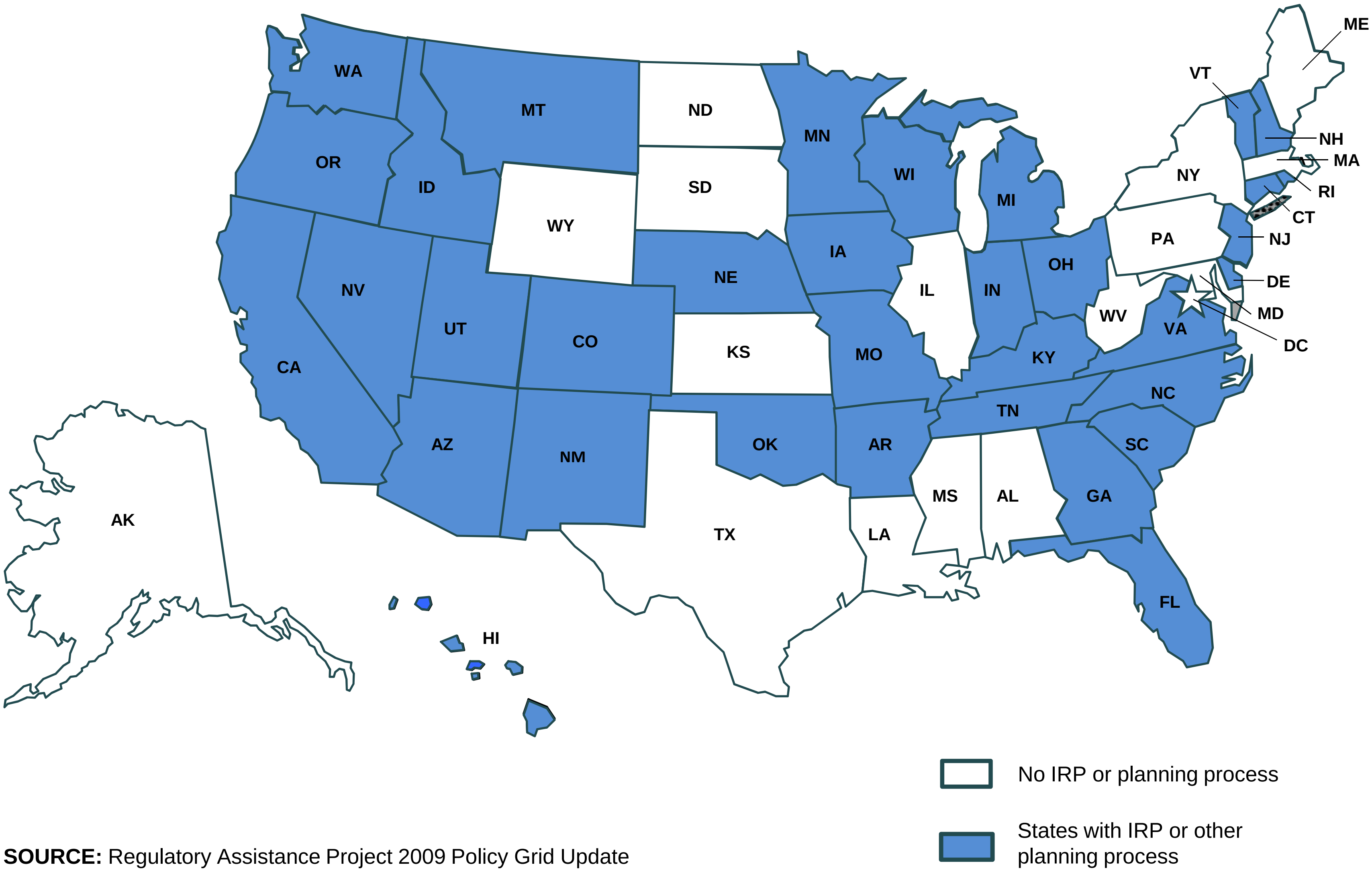
What is an Integrated Resource Plan?

- An IRP is a long-term, consolidated plan for meeting a utility's needs (or a state's needs), taking into consideration costs, quality and capability, risks, and reliability
- An IRP uses consistent economic assumptions and evaluates both supply and demand-side options
- It may not be the least cost plan

Resources Considered in an IRP

- Existing generation, transmission and distribution assets
- Existing power purchase agreements
- New generation/transmission/distribution
- New power purchase agreements
- Energy efficiency
- Demand response

U.S. STATES WITH INTEGRATED RESOURCE PLANNING OR SIMILAR PLANNING PROCESS
Effective December 2009



SOURCE: Regulatory Assistance Project 2009 Policy Grid Update

Efficiency Power Plants (EPP)

- An EPP is a bundled set of energy efficiency programs designed to deliver the energy and capacity equivalent of a large conventional power plant
  - Produces "negawatts" and "negawatt-hours" that are functionally equivalent to the kilowatts and kilowatt-hours produced by a conventional power plant

EPP is Tailored to Meet Utility Needs

- Can resemble a conventional peaking plant by emphasizing efficiency measures that reduce electricity during periods of peak power consumption; OR
- Can resemble a base-load power plant by emphasizing measures to reduce consumption during all hours of the day

“Efficiency Smart Power Plant” = EPP?

- American Municipal Power Inc. (AMP) agreed in a consent decree with EPA to build an EPP serving members in 6 states
  - AMP members in KY, MI, OH, PA, VA, WV
- Vermont Energy Investment Corporation under contract to “build” the EPP
- Project launched in 2011 and exceeded first year energy savings goals

Efficiency-Based Load Balancing

- Energy efficiency and demand response measures offer an alternative to flexible generation resources that quickly ramp up or ramp down to match load
- Increasingly possible with smart grid technologies that can remotely turn these measures on and off as needed

Conclusions

- Some routine SCC dockets – esp. utility EE plans and IRPs – present opportunities to promote greater consideration of the AQ benefits of energy efficiency
- Efficiency power plants and demand-side load balancing are newer concepts that are gaining traction and should be among the resource planning options considered

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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