



**RAP**

Energy solutions  
for a changing world

# Recognizing the Full Value of Energy Efficiency

## What's Under the Feel-Good Frosting of the World's Most Valuable Layer Cake of Benefits

Presented at the 2013 ACEEE National Conference  
on Energy Efficiency as a Resource

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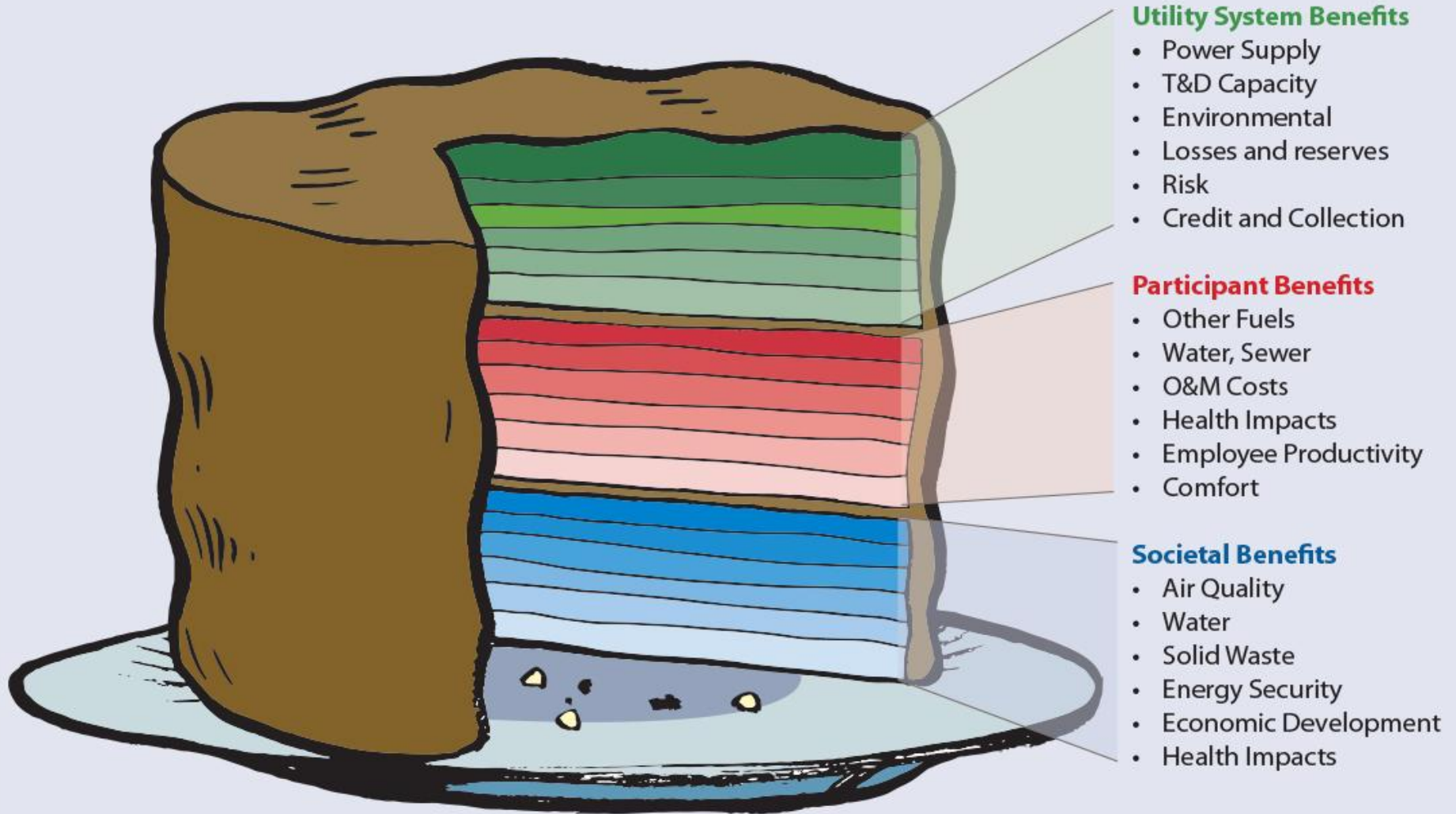
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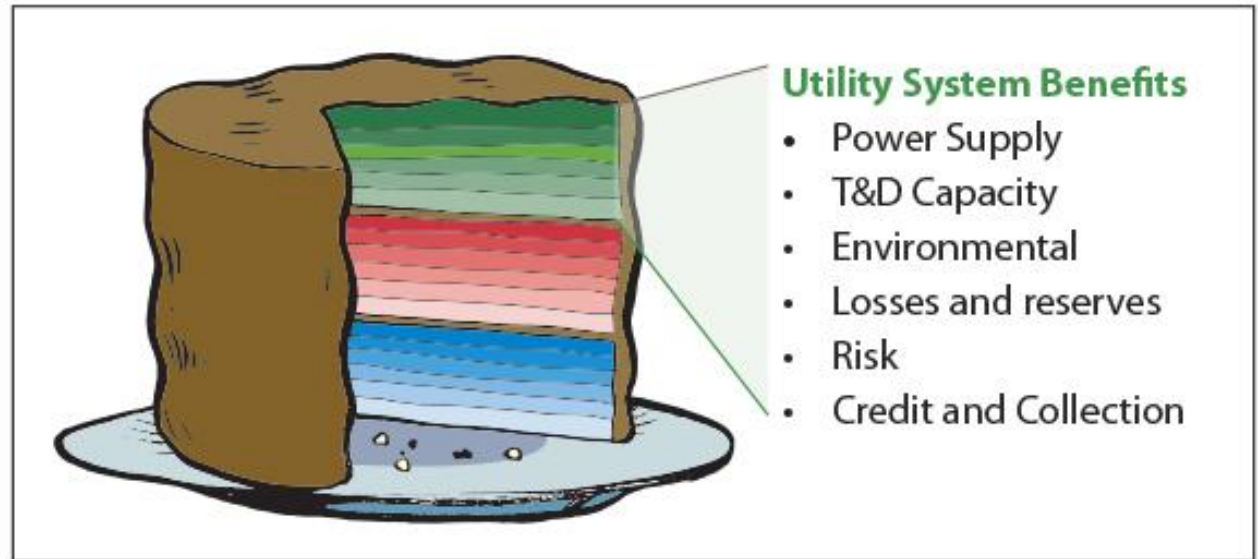
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## A "Layer Cake" of Benefits from Electric Energy Efficiency



# Utility System Benefits

**These are most commonly considered by regulators.**

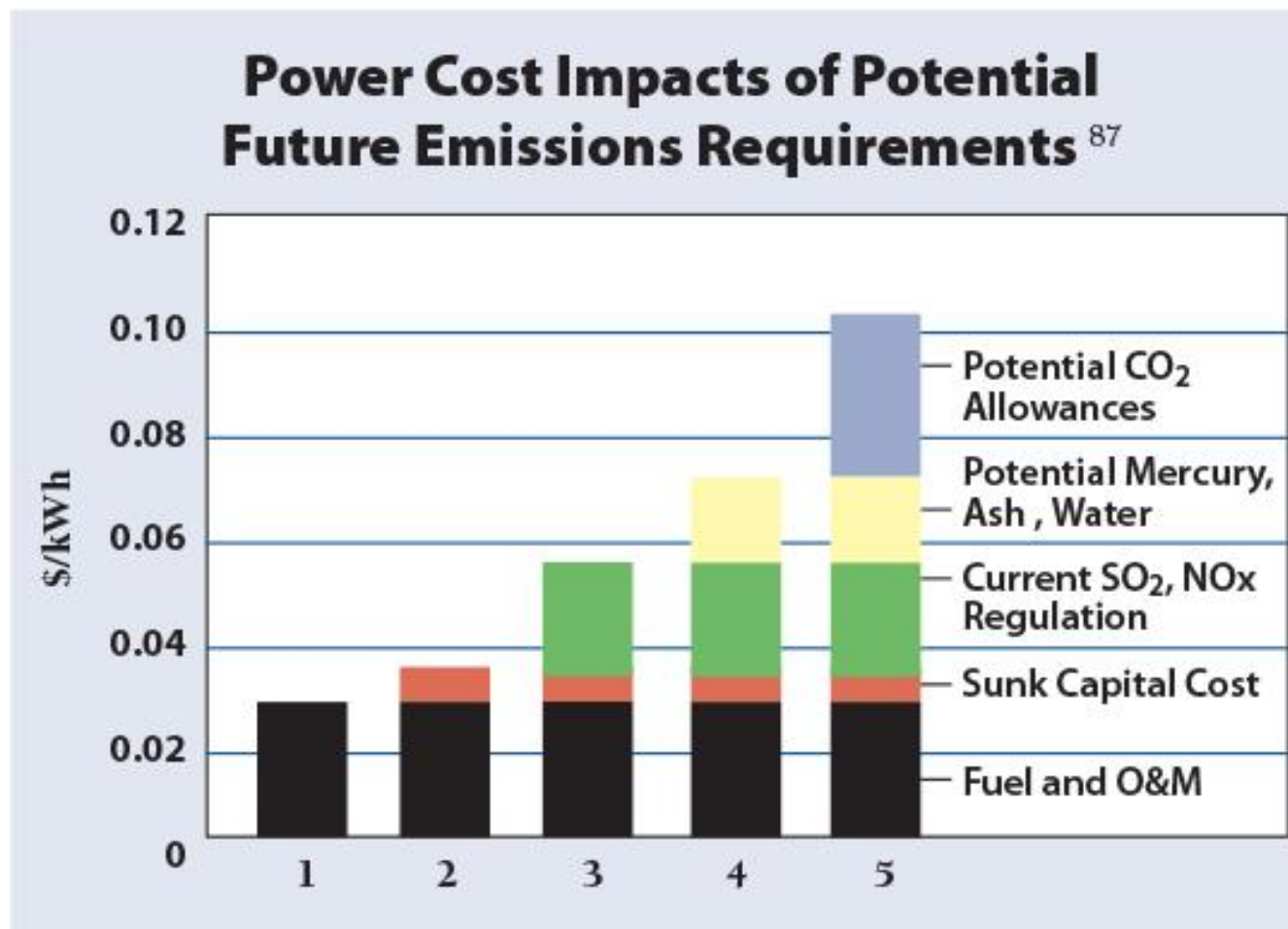


**BUT:**

- Most undervalue emission costs;
- Many exclude or undervalue T&D benefits;
- Most undervalue line losses and reserves;
- Most exclude or undervalue risk benefits.

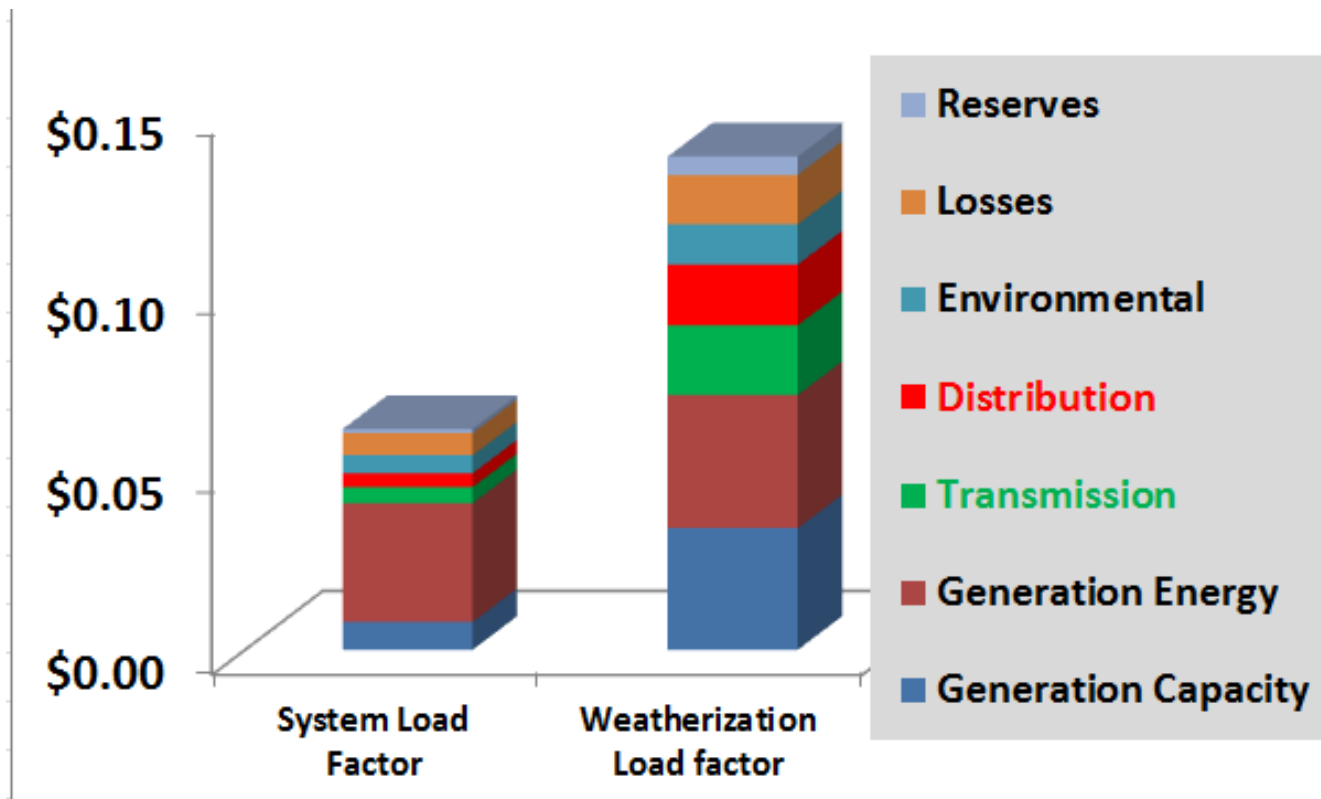
# Utility System Benefits: Emission Costs

Some regulators consider only existing emission costs, not prospective emission costs for power plants.



# Utility System Capacity Benefits: Transmission and Distribution Costs

When the Washington UTC included load shape, the value of residential retrofit weatherization doubled.

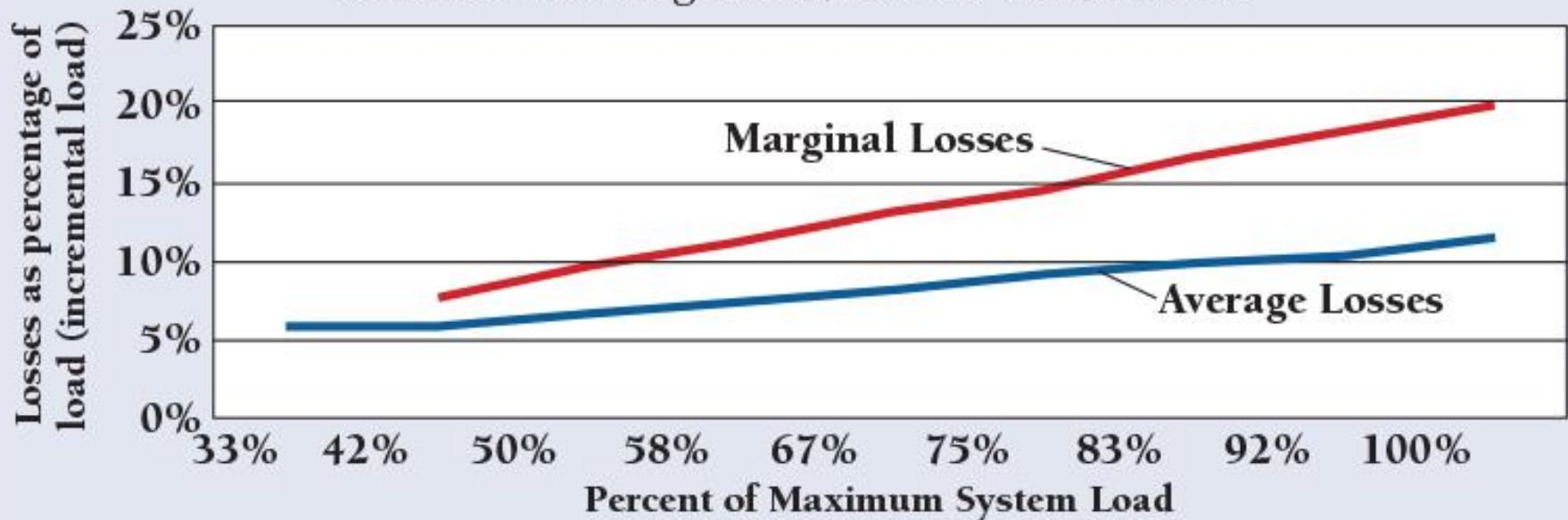


# Utility System Benefits: Line Losses and Reserves

- Marginal losses are ~ 1.5X average losses;
- On-peak marginal losses can be 3X average losses.

## Average and Marginal Line Losses <sup>98</sup>

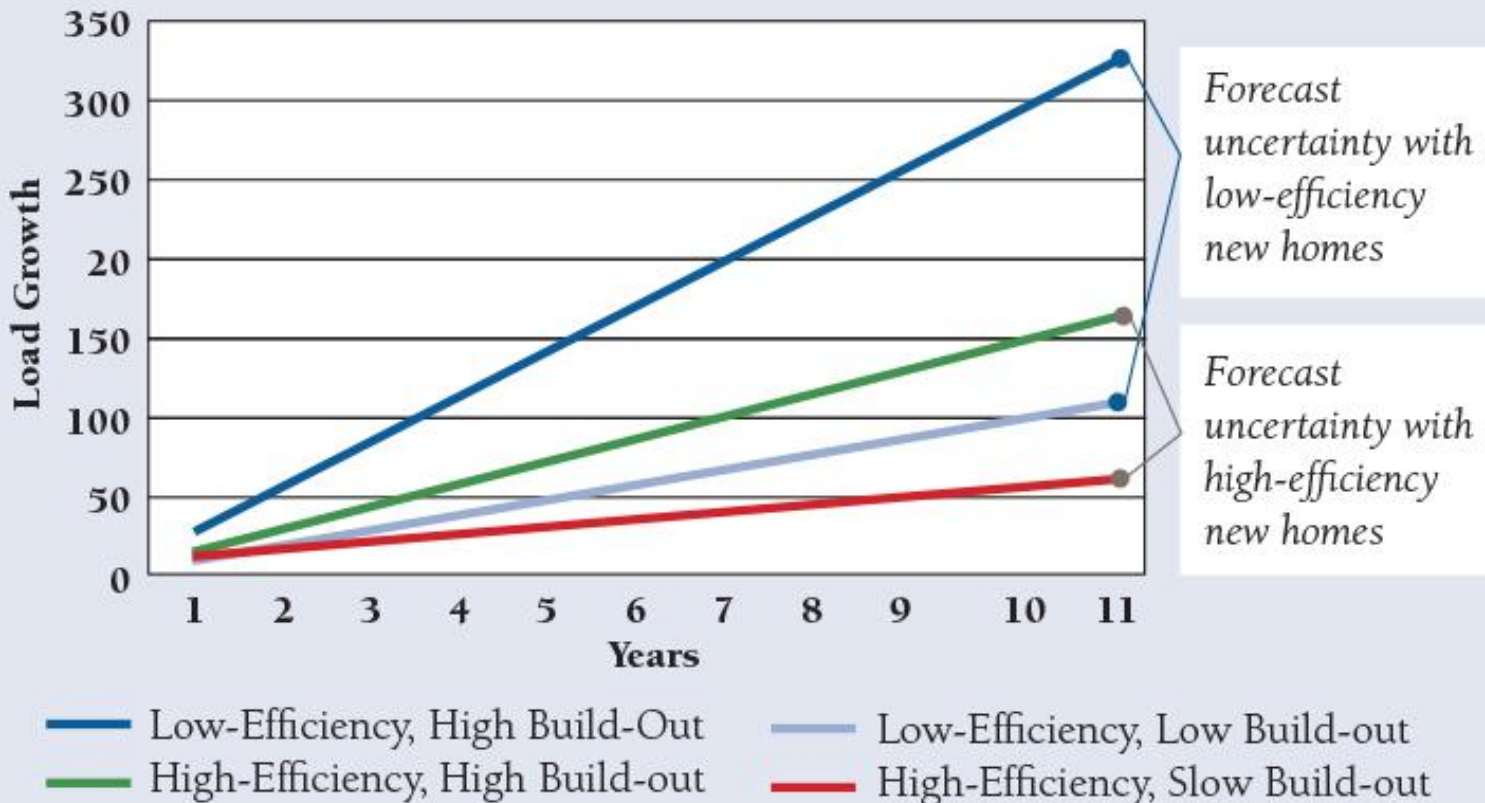
*Assumes 7% average losses; 25% No-load, 75% I<sup>2</sup>R*



# Utility System Benefits: Risk Benefits

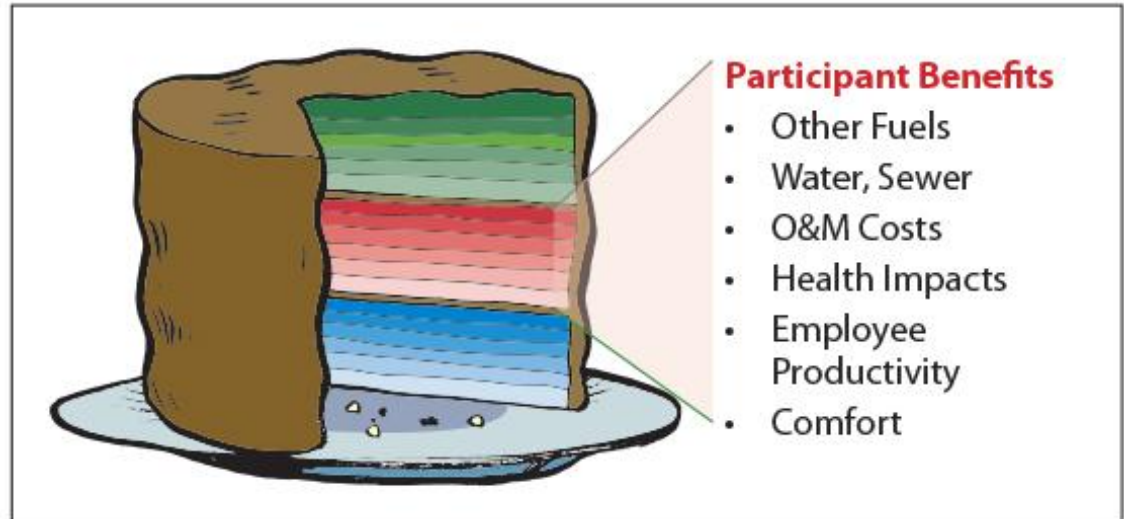
## “Jaws of Uncertainty” in Electricity Load Forecasting

Note: substantially less uncertainty prevails under the higher efficiency homes scenario.



# Participant Benefits

Regulators seldom consider non-electricity participant benefits; these can be very significant.

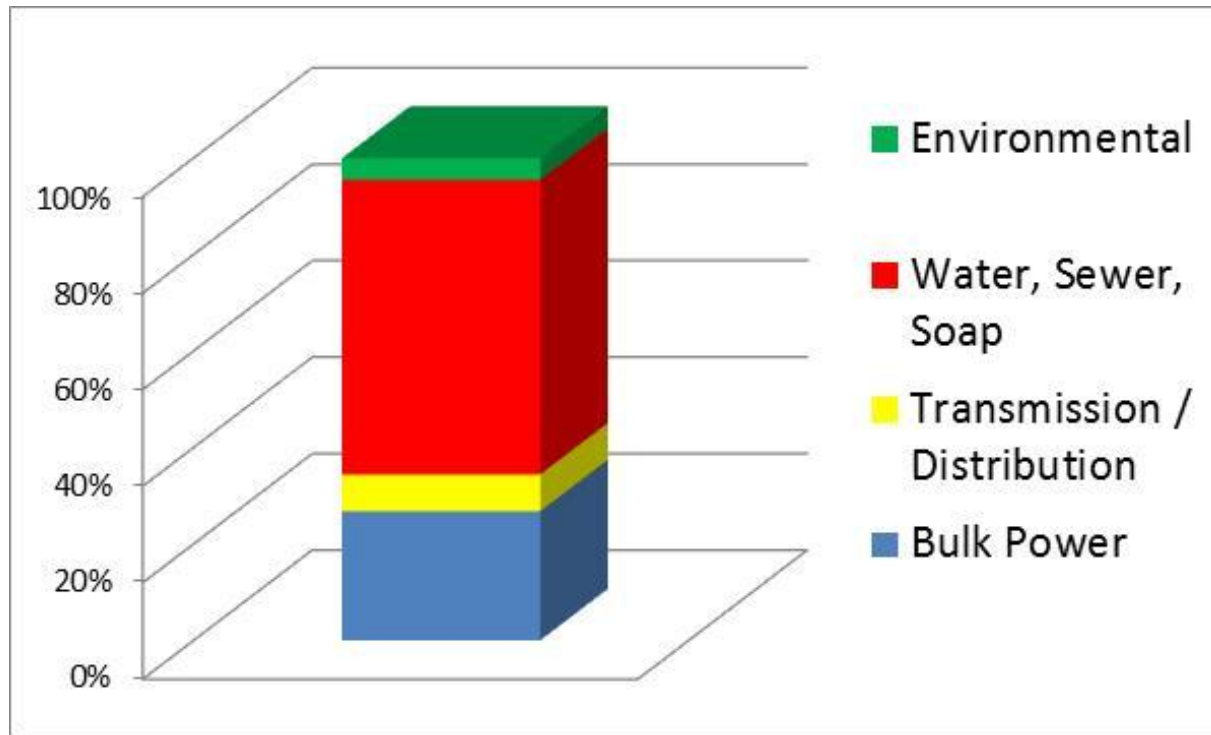


- Affects consumer willingness to pay;
- If ignored, many cost-effective measures may be omitted from utility programs.



# Participant Benefits: Water, Sewer, Other Resources

Northwest Power and Conservation Council:



# Participant Benefits: O&M, Labor Productivity

- Many energy efficiency measures save labor, improve employee productivity, or reduce other maintenance costs;
- Some measures may increase these costs.



# Participant Benefits: Health

- New Zealand “Heat Smart” Low-Income Retrofit Program Evaluation:
- 90% of benefits were health-related.

**Hospital Admissions for Respiratory Ailments**

**Down 43%**

**Days off Work**

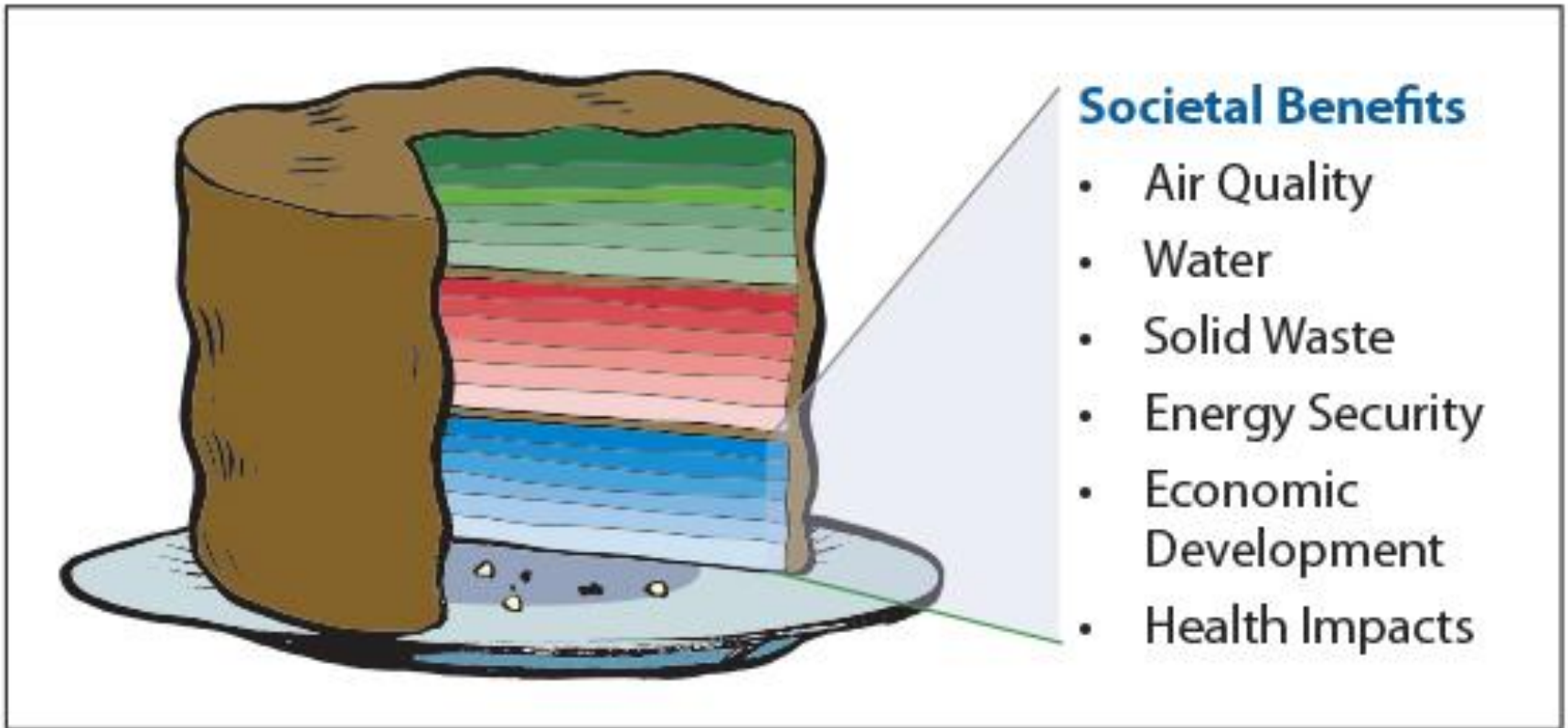
**Down 39%**

**Days off School**

**Down 23%**

**Significant Mortality Benefits: ~18 deaths/year**

# Societal Benefits



# Societal Benefits: Emissions

- Unregulated fine particulates significant;
- Damage costs larger than mitigation costs;
- Weighted average may be appropriate.

## Illustrative Mitigation and Damage Costs

Emission Type	Mitigation Cost	Damage Cost
Mercury – lb.	\$33,000	\$181,500
PM 2.5 – ton	\$13,000	\$60,000
CO2 – ton	\$5	\$80

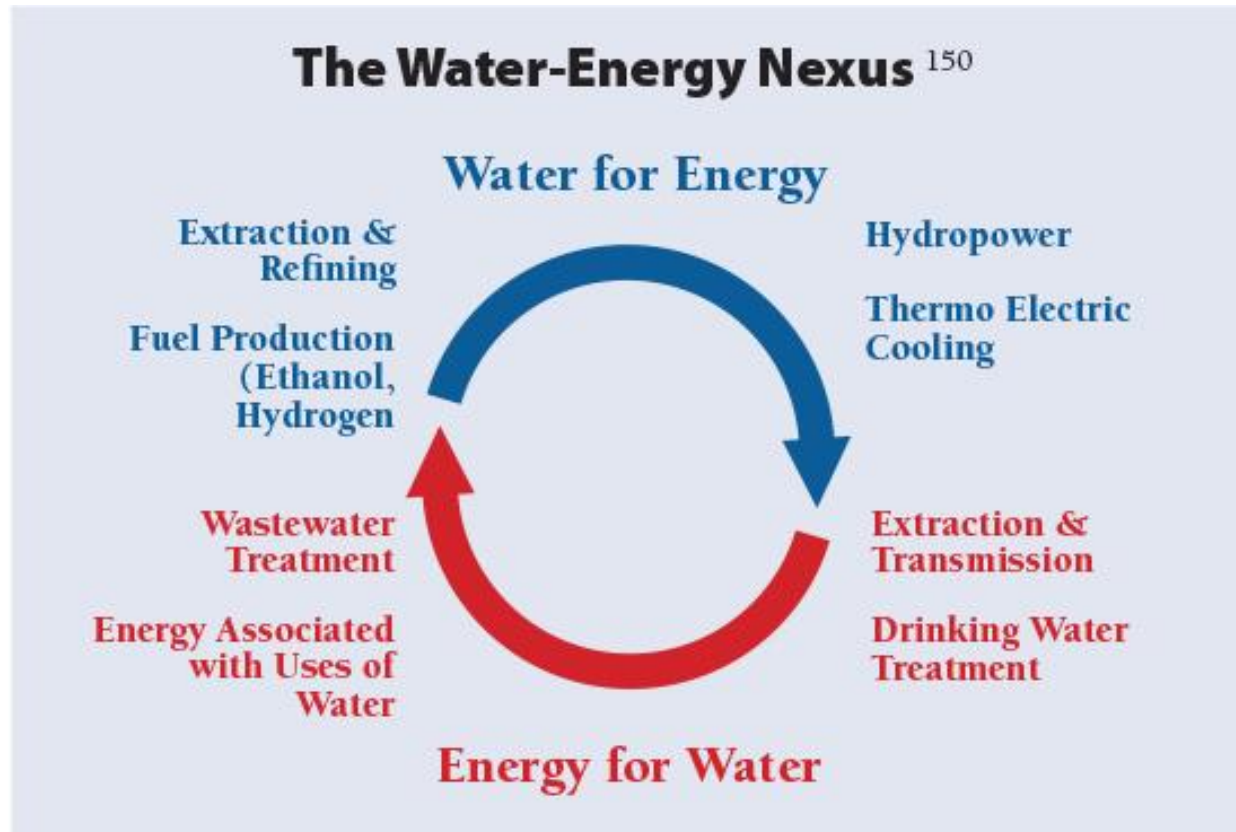
# Societal Benefits: Water

## Water–Energy Connection is Critical

Power production is the second-largest water user (after irrigation);

Water treatment and pumping, and wastewater treatment are huge users of electricity;

**Anything** that saves water OR electricity saves **both** water **and** electricity.



# Low-Income Programs Are Different

## WSU Cost-Benefit Analysis, 2011

### Energy, Utility, Participant, and Societal Benefits

Present Value	Mid	Low	High
Emissions Benefit	\$380	\$330	_*
Economic Benefit	\$1,310	\$690	\$1,970
Utility Benefit	\$340	\$80	\$680
Participant Benefit	\$2,270	\$920	\$4,660
Total Non-Energy	\$4,300	\$2,020	\$7,310
Energy Benefit	\$4,840	\$3,620	\$5,680
<b>Total Benefit</b>	<b>\$9,140</b>	\$5,640	\$12,990
<b>Total Cost</b>	\$6,070	\$6,070	\$6,070
<b>Benefit-Cost Ratio</b>	1.5	0.9	2.1

\*the emissions and economic benefit are combined in the high scenario

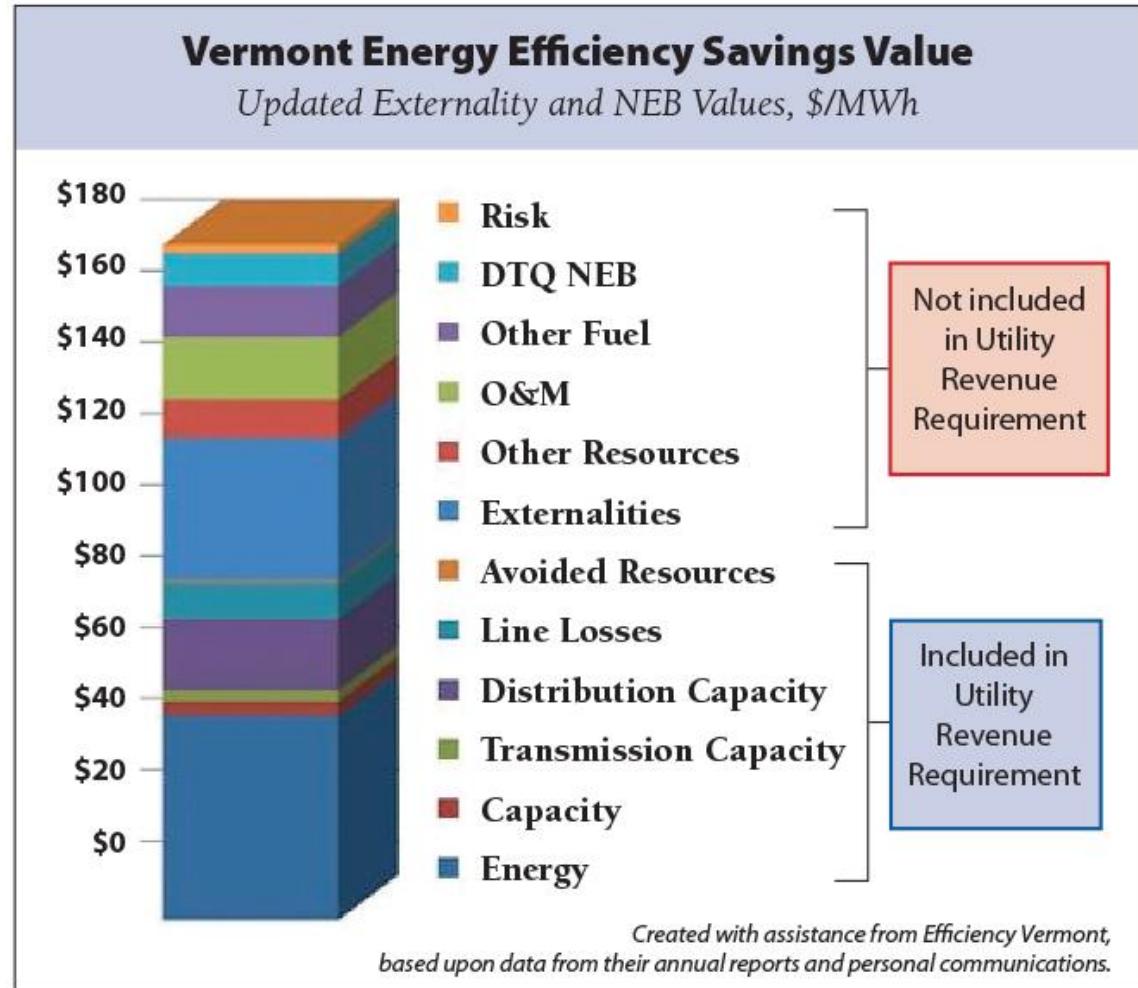
# Benefits Considered in Commonly Used Cost Tests

	Utility (PACT) Cost Test	Total Resource Cost Test	Societal Cost Test
<b>Utility System Benefits</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Participant Resource Benefits</b>		<b>X ?</b>	<b>X</b>
<b>Participant Non- Resource Benefits</b>		<b>? !</b>	<b>X</b>
<b>Societal Non- Energy Benefits</b>			<b>X</b>



# Utility Cost Test (or PACT): Flawed Even When Applied Properly

Can be used to support funding for uneconomic measures (Washington);  
Can be used to deny funding for economic measures (Louisiana).



# Total Resource Cost Test: Complex (and seldom applied well)

- Most commonly used (and misused) cost test.
  - All **costs**, but not all **benefits** considered;
  - Energy benefits often under-counted;
  - Non-energy benefits often totally ignored.



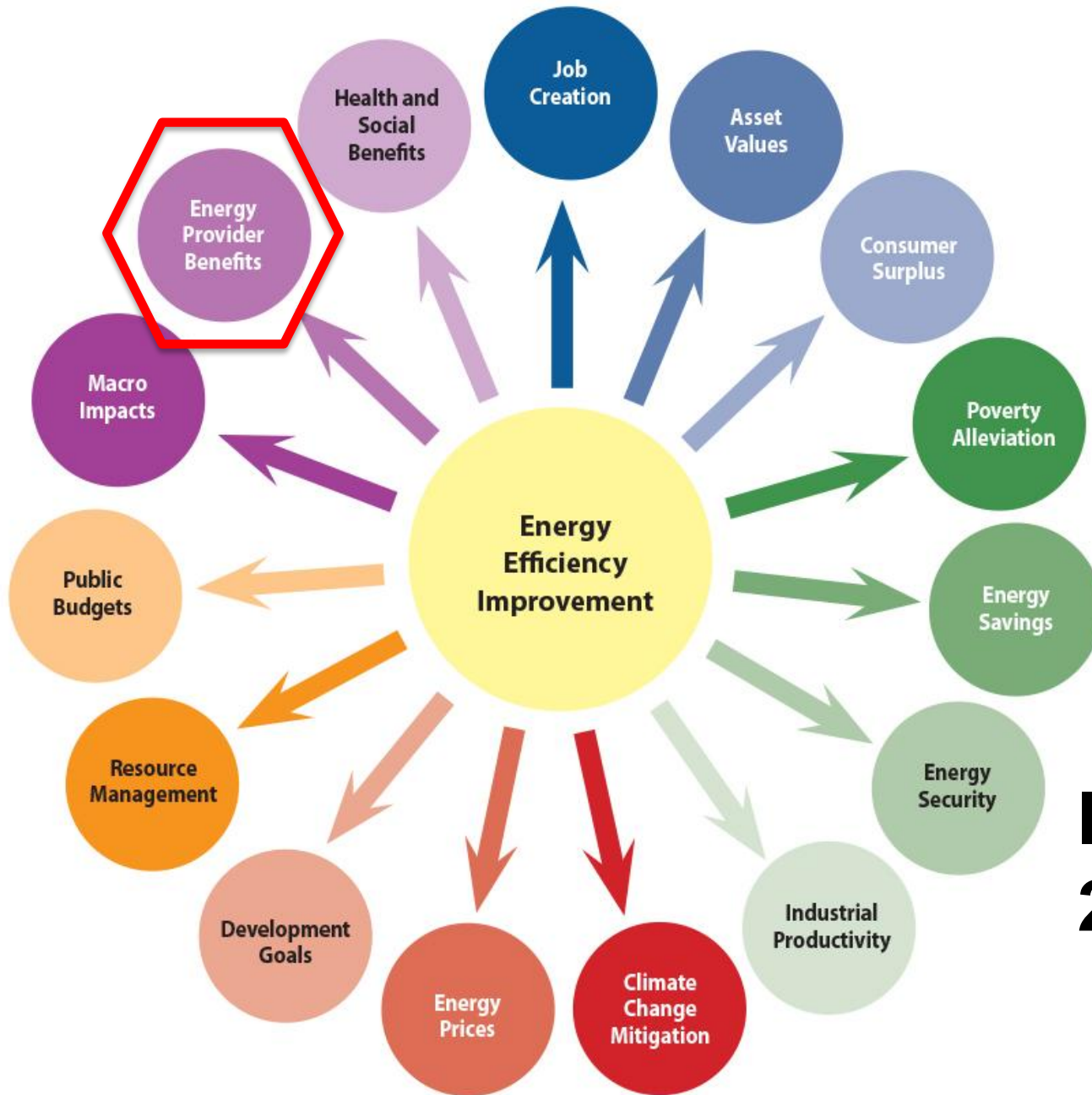
# Societal Cost Test: Challenging For Regulators

**Utility regulators** are fairly resistant to quantification of non-energy benefits (NEBs);  
**Utilities** not particularly well-suited to this task either;



**Manufacturers, vendors, and installers** should have a significant role in NEB justification.  
Several regulators have adopted **default values** for difficult-to-quantify (DTQ) NEBs and environmental costs, while allowing measure-specific analysis.

# The Multiple Benefits of Energy Efficiency <sup>164</sup>



**Why limit ourselves to only one element of benefits?**

**IEA  
2012**

# A Framework To Move Forward

- **Identify** all benefits;
- **Quantify** those that are quantifiable;
- **Measures** that pass TRC always go forward;
- **Vendors and manufacturers** have duty to justify DTQ benefit values;
- **Use Judgment**: regulators can establish default values for DTQ benefits;
- **Find funding partners** where cost-effectiveness depends on non-electricity benefits;
- **Programs** must ultimately be cost-effective.

# Related RAP Publications

- **Energy Efficiency Cost-Effectiveness Screening** (2012)  
[www.raonline.org/document/download/id/6149](http://www.raonline.org/document/download/id/6149)
- **US Experience with Efficiency As a Transmission and Distribution System Resource**, (2012)  
[www.raonline.org/document/download/id/4765](http://www.raonline.org/document/download/id/4765)
- **Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserves** (2011)  
[www.raonline.org/document/download/id/4537](http://www.raonline.org/document/download/id/4537)
- **Preparing for EPA Regulations** (2011)  
[www.raonline.org/document/download/id/919](http://www.raonline.org/document/download/id/919)
- **Incorporating Environmental Costs in Electric Rates** (2011)  
[www.raonline.org/document/download/id/4670](http://www.raonline.org/document/download/id/4670)
- **Clean First: Aligning Power Sector Regulation With Environmental and Climate Goals** [www.raonline.org/document/download/id/12](http://www.raonline.org/document/download/id/12)
- **Integrating Energy and Environmental Policy** (2013)  
[www.raonline.org/document/download/id/6352](http://www.raonline.org/document/download/id/6352)

## 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.raonline.org](http://www.raonline.org)

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