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

A RAP Webinar
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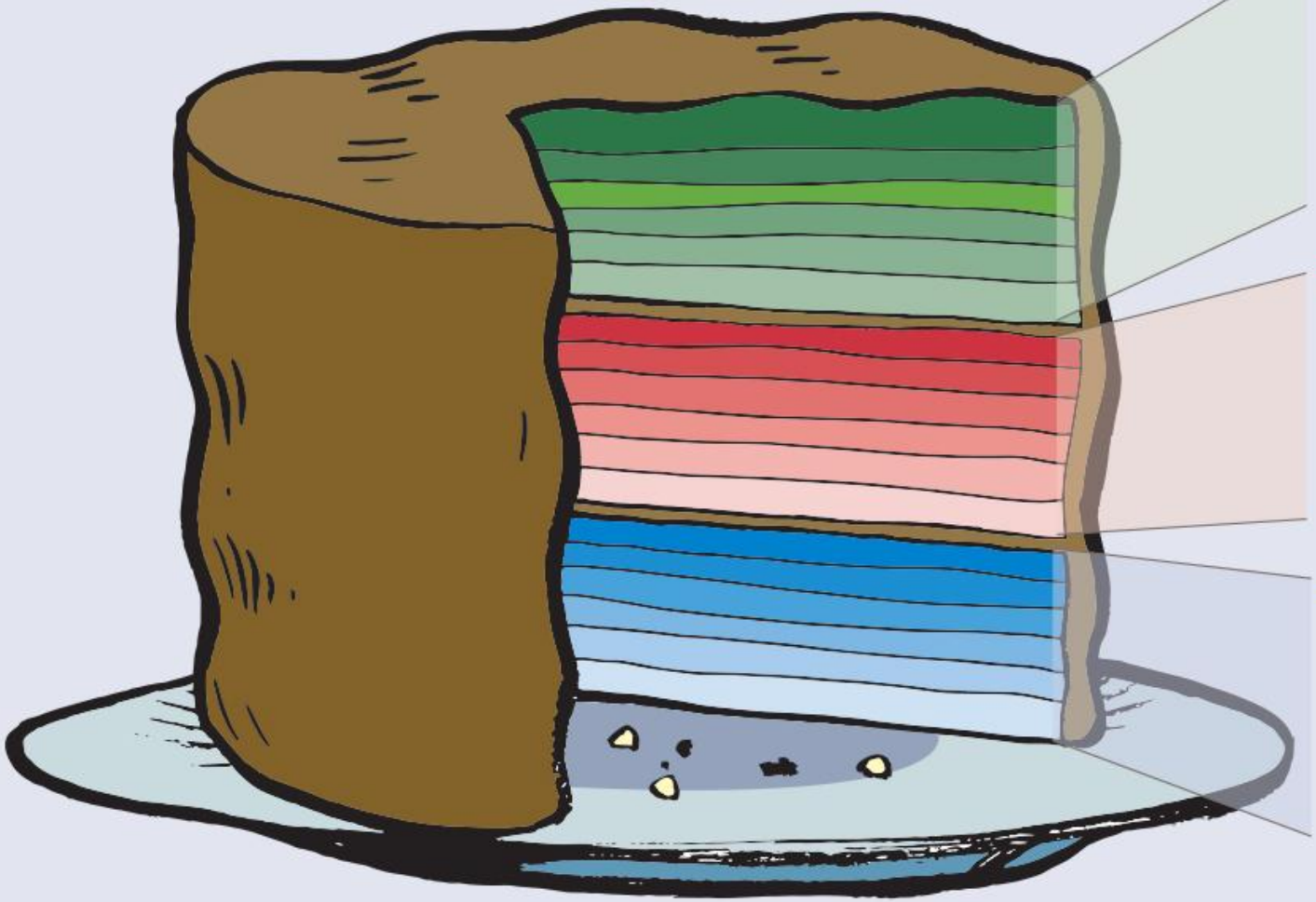
A "Layer Cake" of Benefits from Electric Energy Efficiency



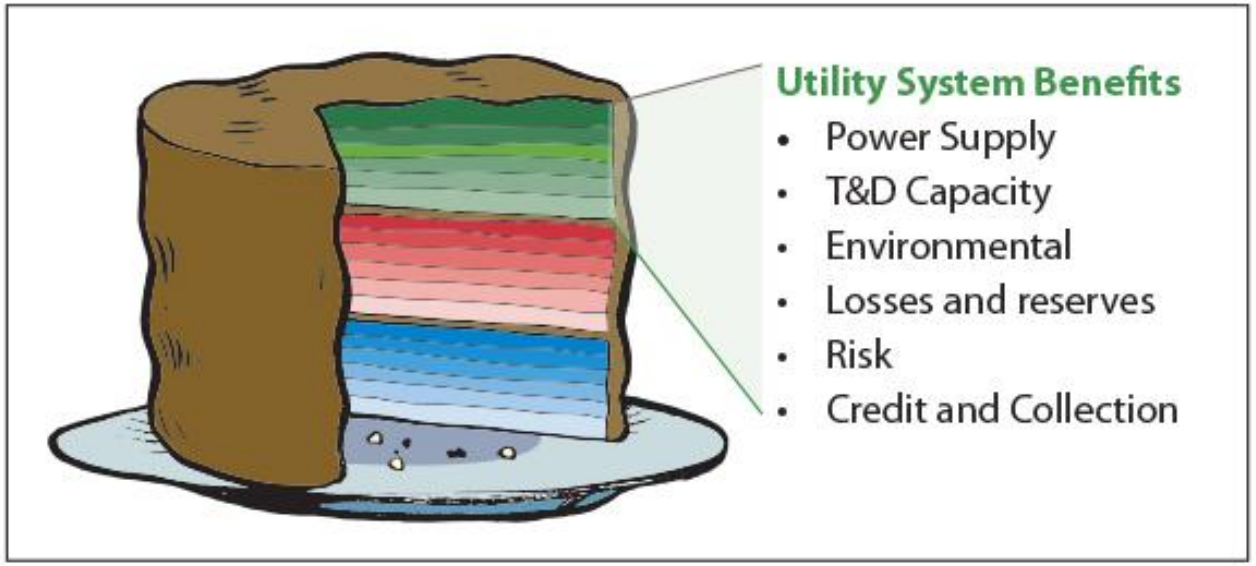
Utility System Benefits
- Power Supply
- T&D Capacity
- Environmental
- Losses and reserves
- Risk
- Credit and Collection

Participant Benefits
- Other Fuels
- Water, Sewer
- O&M Costs
- Health Impacts
- Employee Productivity
- Comfort

Societal Benefits
- Air Quality
- Water
- Solid Waste
- Energy Security
- Economic Development
- Health Impacts

UTILITY SYSTEM BENEFITS

These are most commonly considered by regulators.

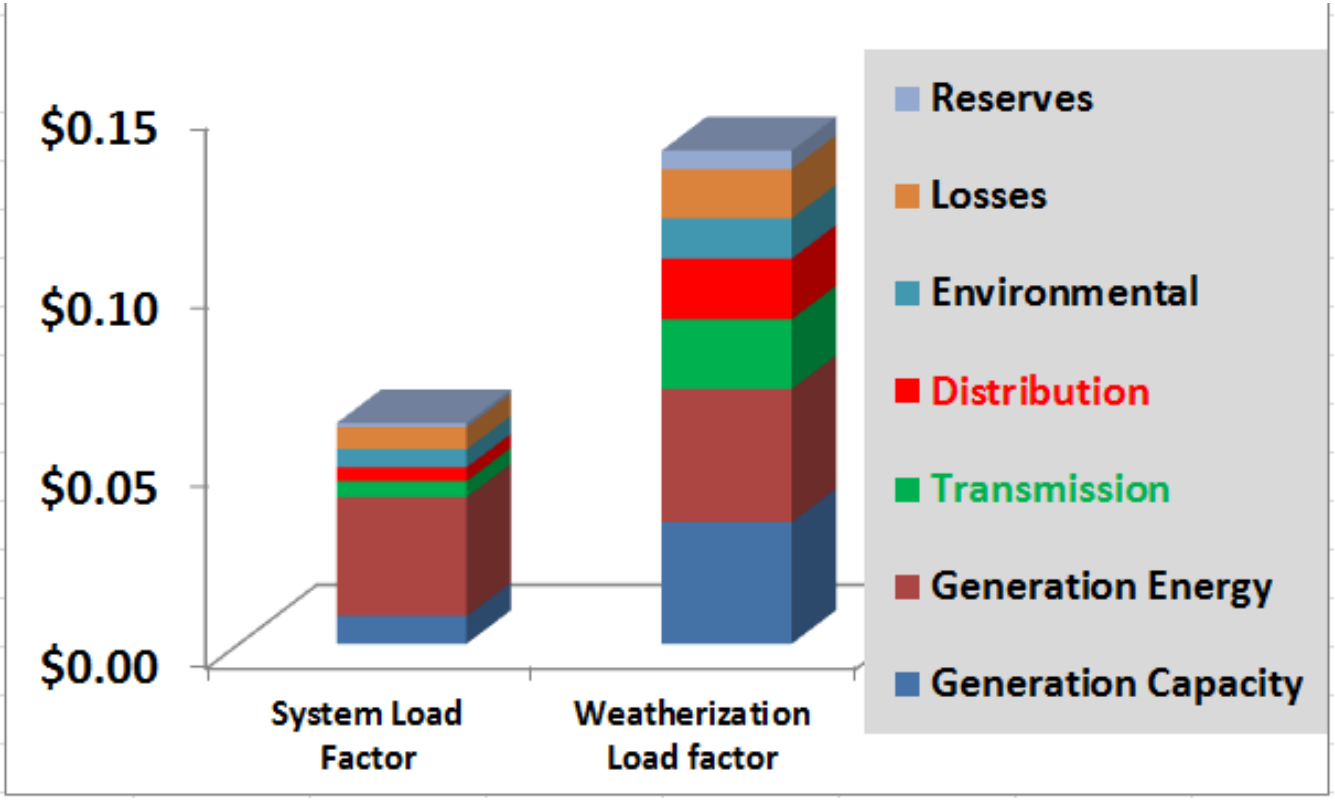


BUT:

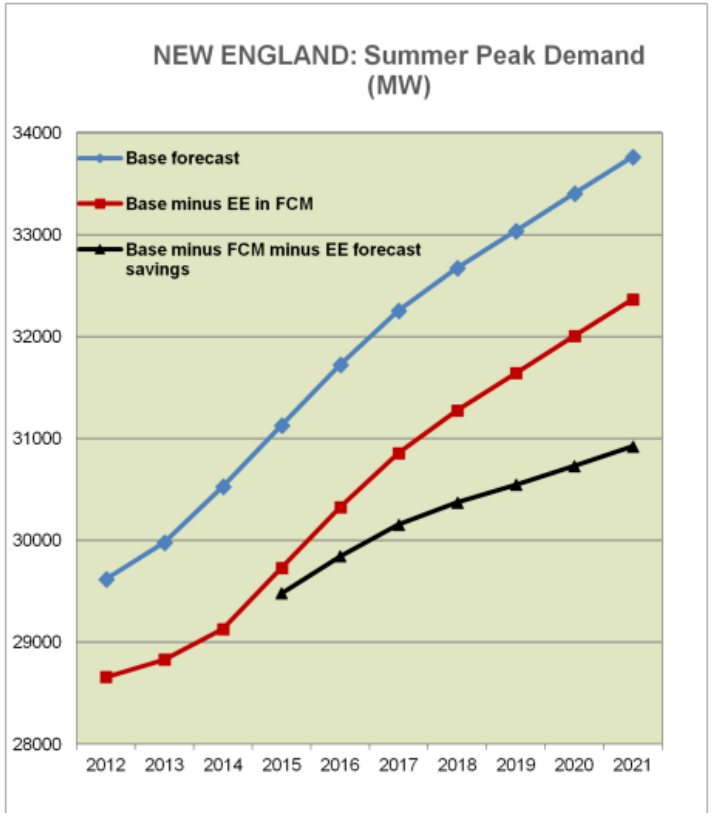
- **Many exclude or undervalue T&D benefits;**
- **Most undervalue line losses and reserves;**
- **Most exclude or undervalue risk benefits;**
- **Most undervalue environmental costs.**

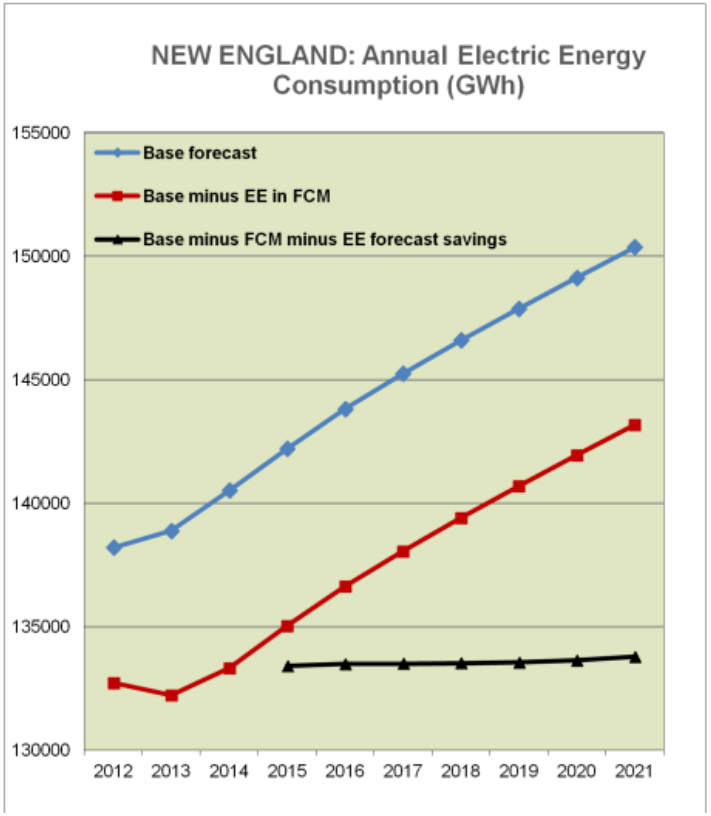
Utility System Capacity Benefits: Transmission and Distribution Costs

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



EE Impacts in ISO-NE Forecasts

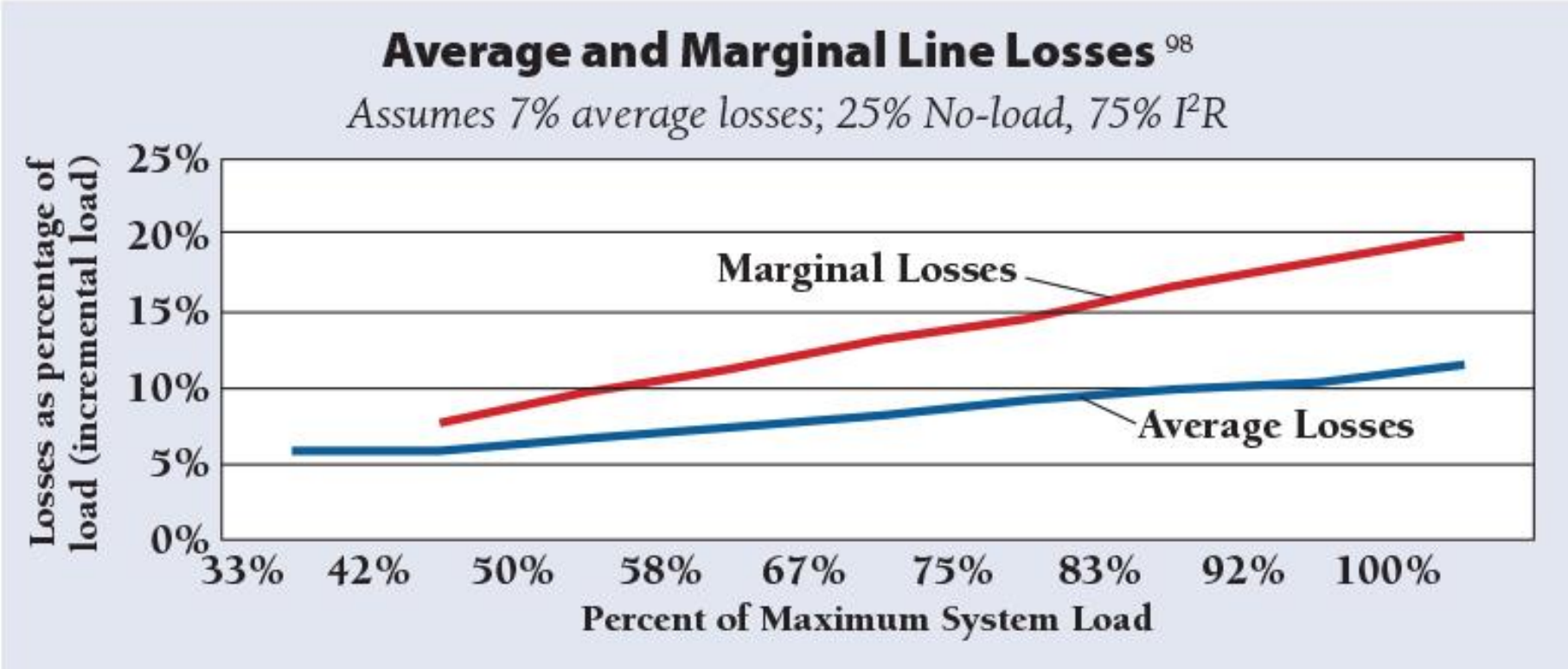




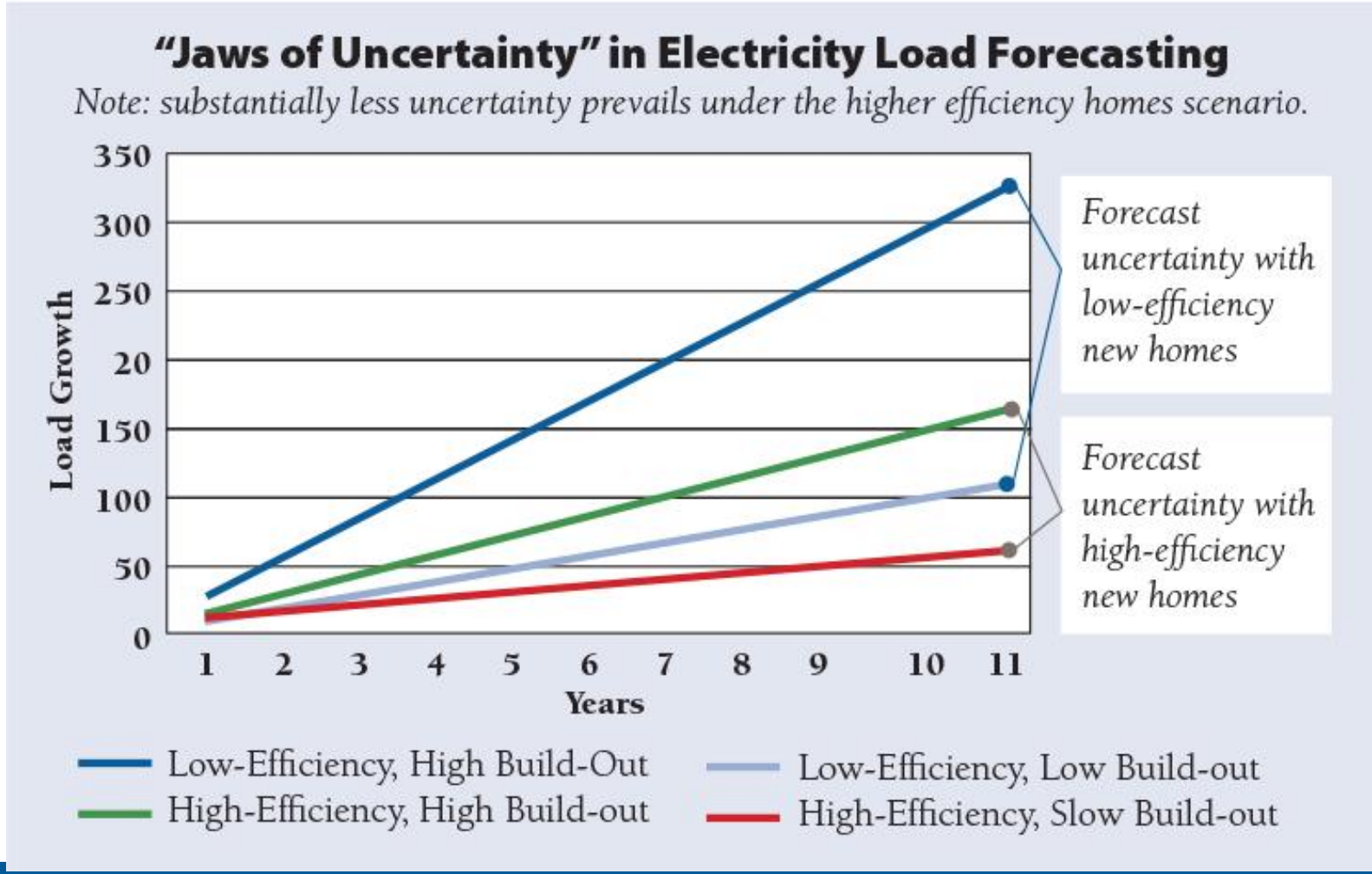
These results have already led to the cancellation of 10 planned transmission upgrades in New Hampshire and Vermont, saving $260 million.

Utility System Benefits: Line Losses and Reserves

- **Marginal losses are ~ 1.5X average losses;**
- **On-peak <u>marginal</u> losses can be 3X average losses.**



Utility System Benefits: Risk Benefits



Utility System Benefits: Environmental Costs (1)

- Existing emissions regulations typically require pollution control technologies and monitoring equipment
- Fixed & variable costs of operating and maintaining
- Costs depend on market structure
- Where EE contributes to early retirement, capital and fixed O&M costs of controls may be avoided

Utility System Benefits: Environmental Costs (2)

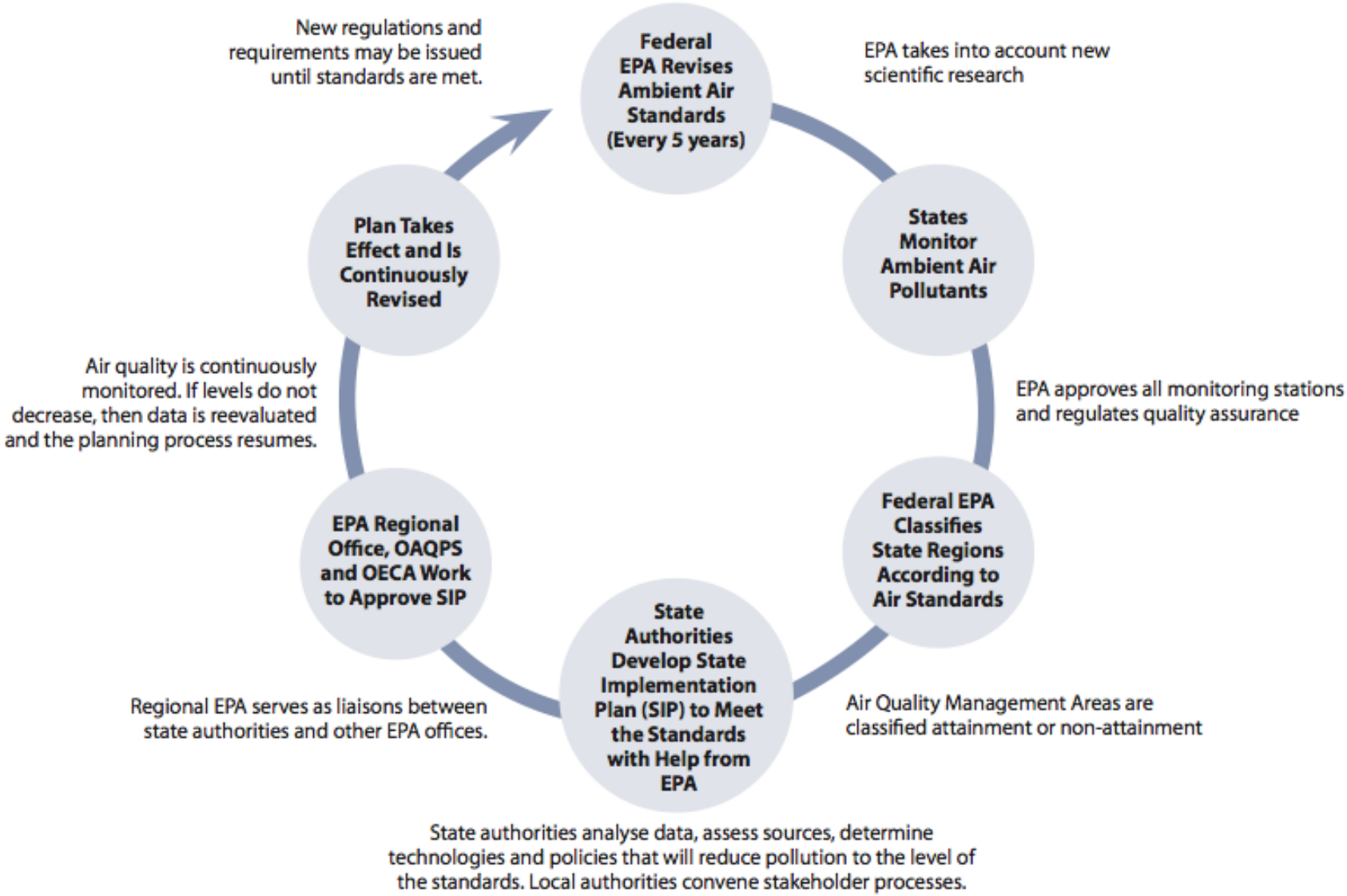
- Costs for <u>future</u> environmental regulations are similar:
  - Capital costs and fixed O&M costs
  - Variable O&M costs
  - Allowance costs
  - Permit fees
  - Emission-based fees
  - Other fees

- May not avoid these costs simply by reducing emissions or discharges…
- But can do so where EE contributes to retirements or deferral or avoidance of new generation
- Careful to avoid double-counting of avoided costs

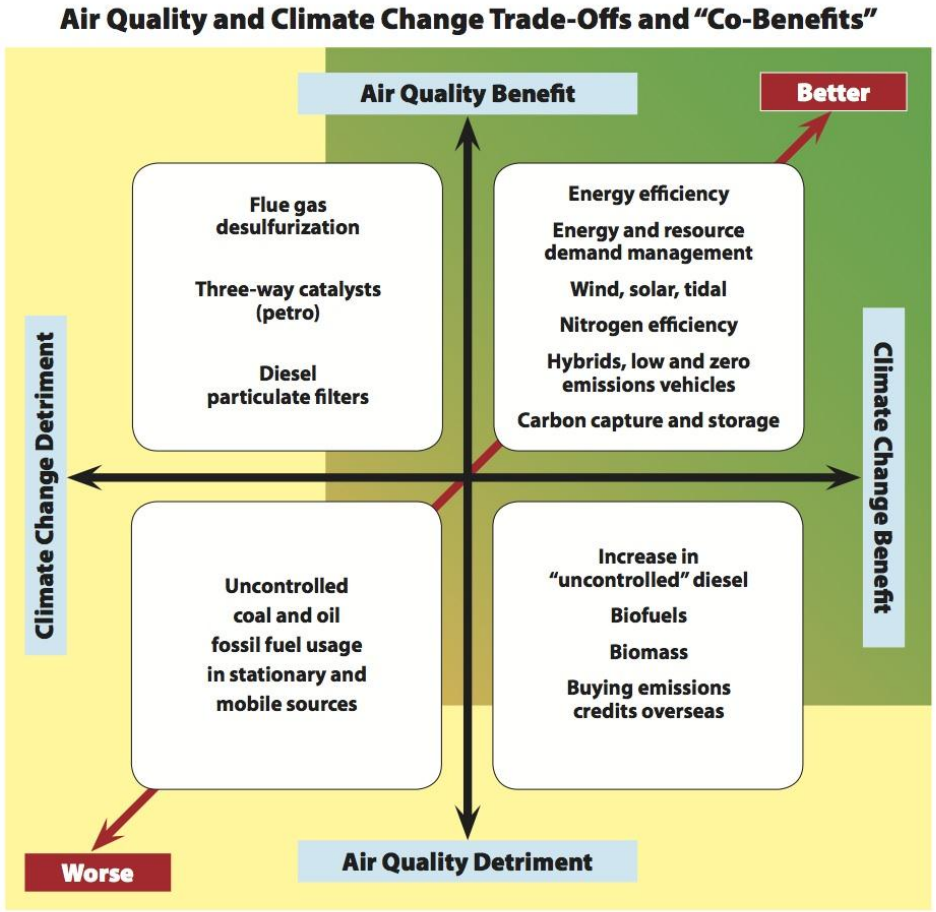
Utility System Benefits: Environmental Costs (3)

- Mercury & Air Toxics Standards (MATS)
- Transported pollution: “Son of CSAPR?”
- Clean Water Act: 316(b) Cooling water
- RCRA: Coal combustion residuals (CCR)
- New and forthcoming NAAQS revisions
- Clean Air Act §111: Control of greenhouse gas (GHG) emissions

Illustration of Periodic NAAQS Revisions and State SIP Processes under the Clean Air Act [23]

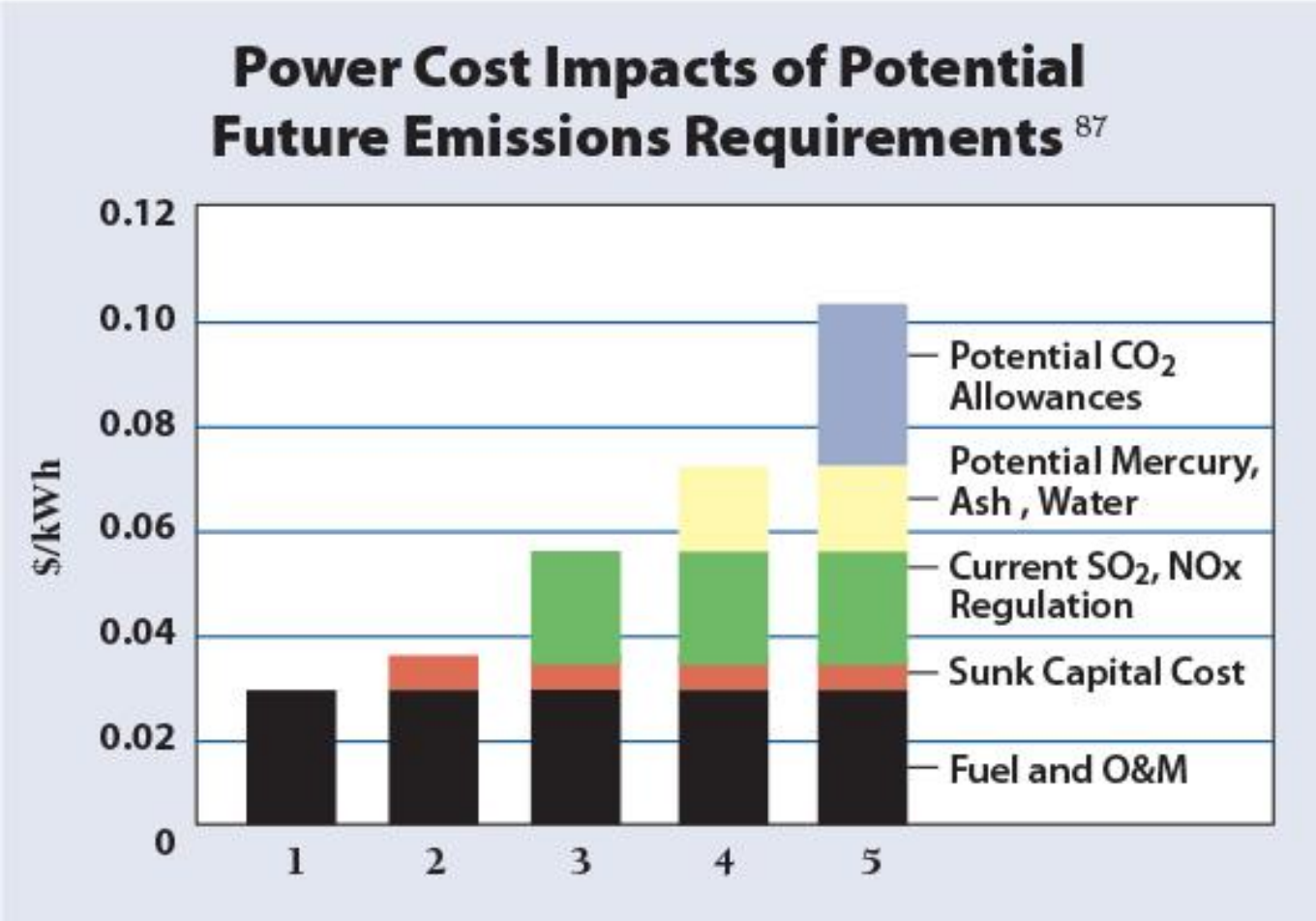


Air Quality and Climate Change Policies May Have Trade-Offs and Co-Benefits



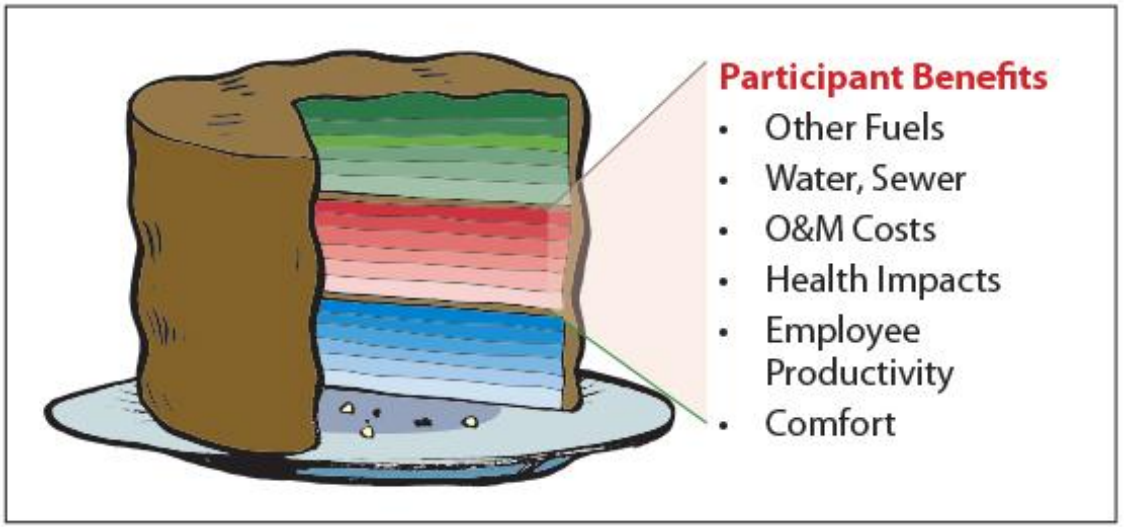
Utility System Benefits: Environmental Costs (4)

Some regulators consider only <u>existing</u> emission costs, not <u>prospective</u> emission costs for power plants.



PARTICIPANT BENEFITS

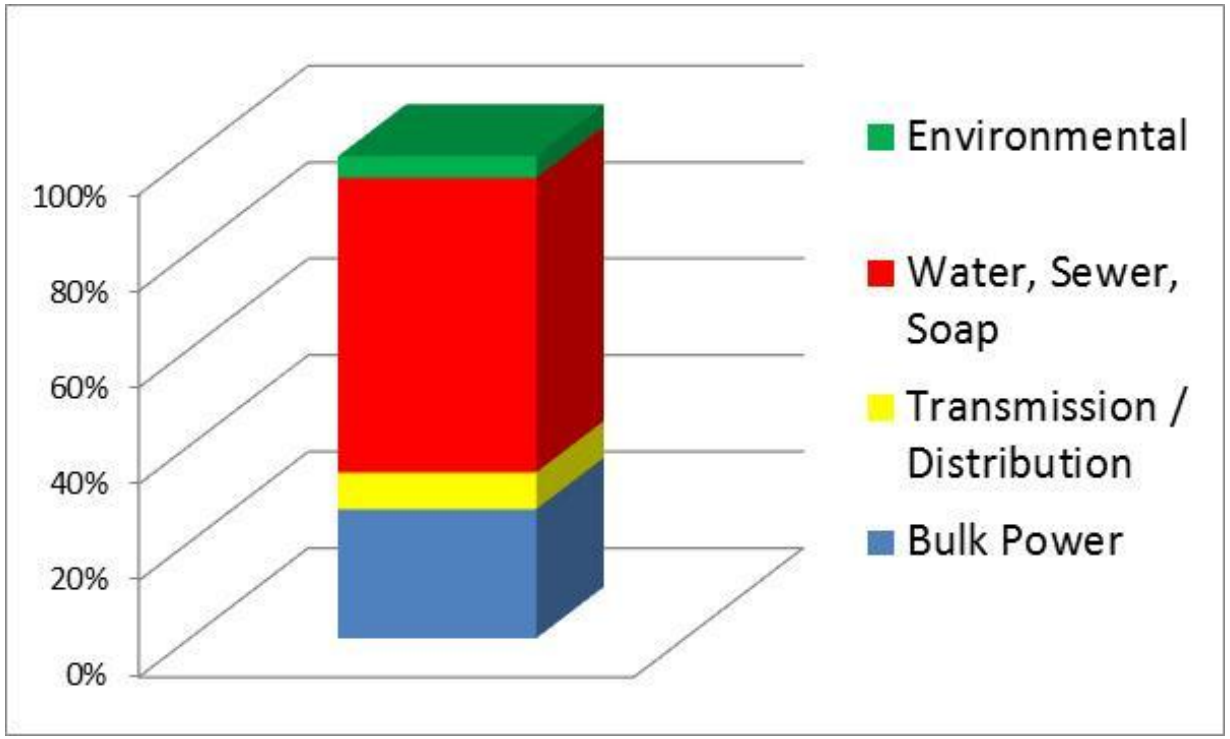
Regulators seldom consider non-electricity participant benefits; these can be very significant.



- 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

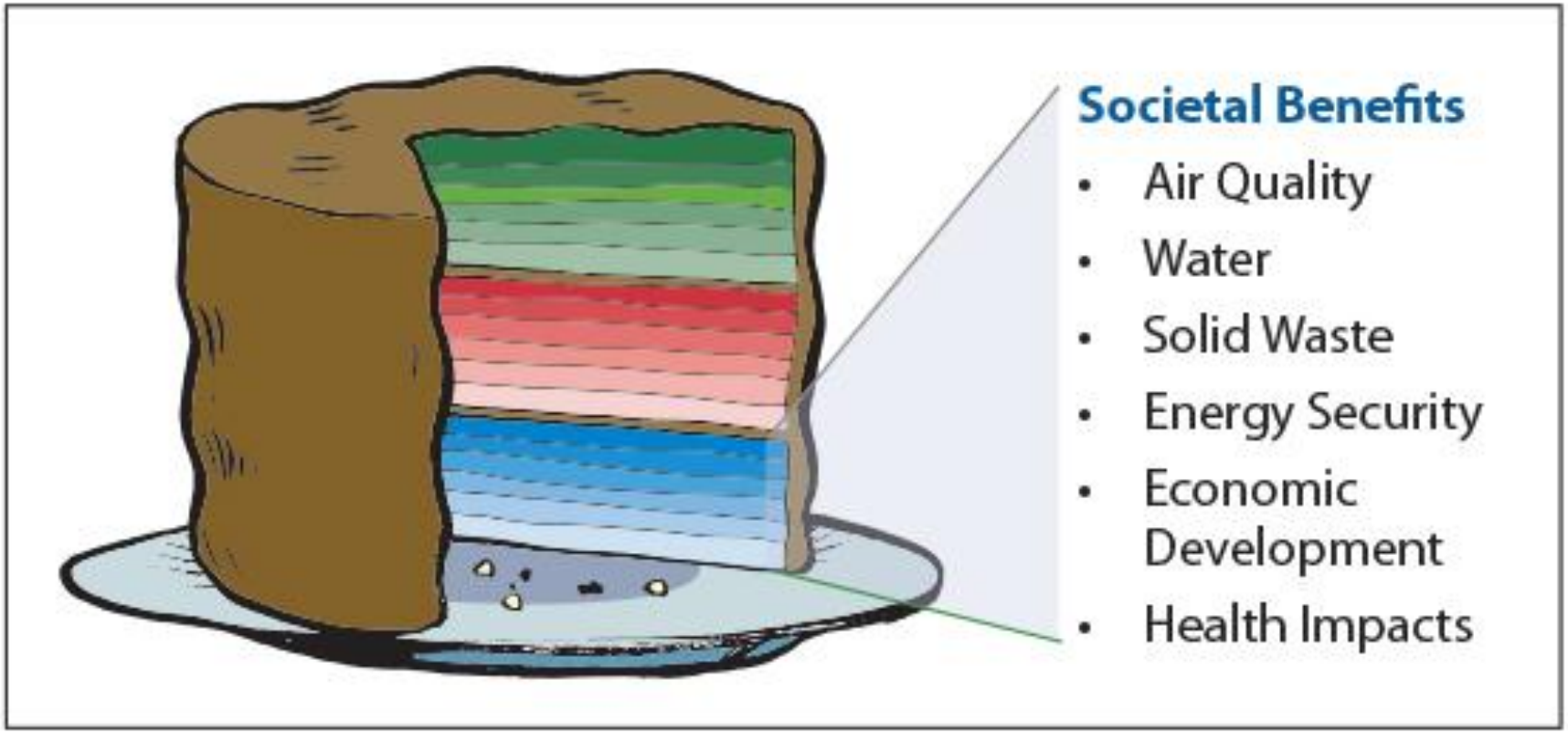
- Many energy efficiency measures save labor, improve employee productivity, or reduce other maintenance costs;
- Some measures may increase these costs.

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 (1)

- Damage costs are larger than mitigation costs, but often considered "externalities"

Illustrative Mitigation and Damage Costs

Emission Type	Mitigation Cost	Damage Cost
Mercury – lb.	$33,000	$181,500
PM2.5 – ton	$13,000	$60,000
CO2 – ton	$8	$80

Societal Benefits: Emissions (2)

- Using a weighted average may be appropriate

Table 7

Probability-Weighting of Prospective Emission Regulations

(Note: All values are strictly illustrative.)

Emission Type	Probability of Regulation	Mitigation Cost	Damage Cost	Probability Weighted PAC/TRC Cost	Probability Weighted Societal Cost
Mercury-Lb	75%	$33,000	$181,500	$24,750	$70,125
$PM_{2.5}$-Ton	50%	$13,000	$60,000	$6,500	$36,500
CO_2-Ton	25%	$8	$80	$2	$62

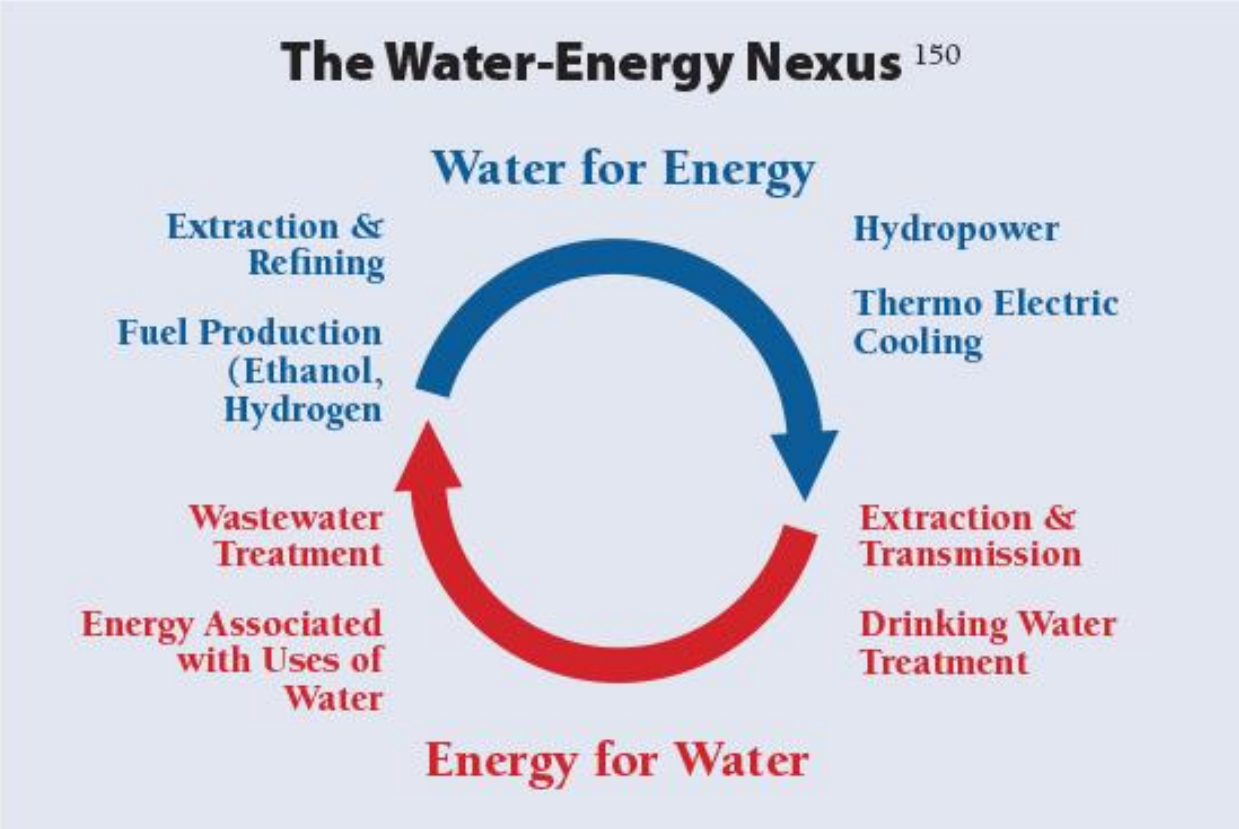
Societal Benefits: Water

Water–Energy Connection is Critical

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

Water production, 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
Total Benefit	**$9,140**	$5,640	$12,990
Total Cost	$6,070	$6,070	$6,070
Benefit-Cost Ratio	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 Cost Test (PACT)	Total Resource Cost Test	Societal Cost Test
Utility System Benefits	X	X	X
Participant Resource Benefits		X	X
Participant Non-Resource Benefits		X	X
Societal Non-Energy Benefits			X

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.

- *If total < 12-15¢/kWh, benefits likely left out.*

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;

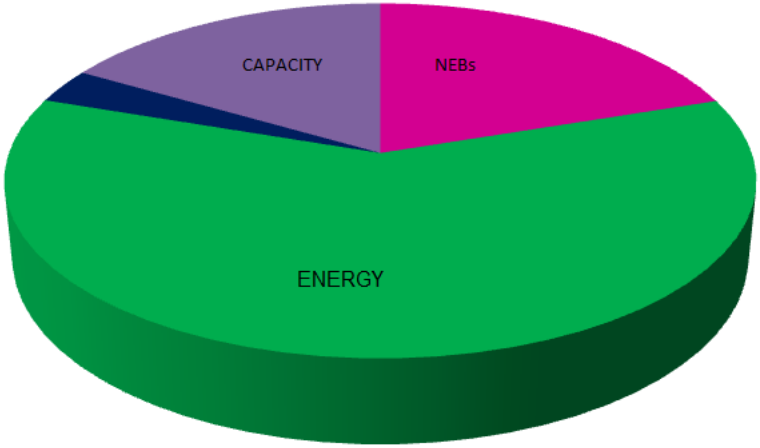
Default values for difficult-to-quantify (DTQ) NEBs;

Judgment is required of regulators.

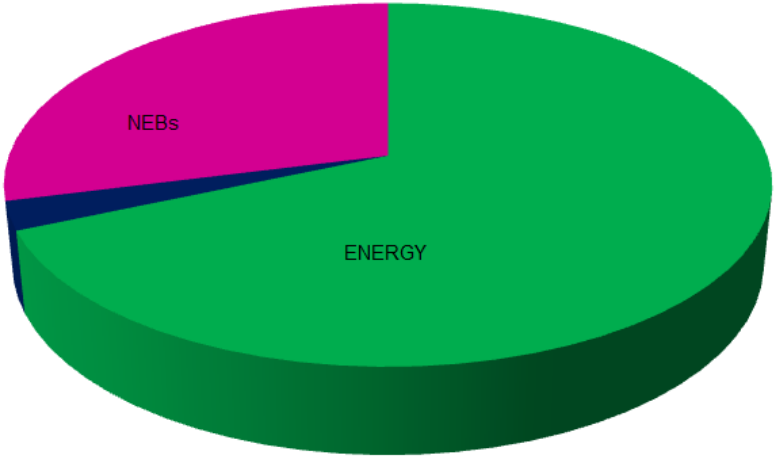
Massachusetts Benefits

Identifies Capacity, Energy, Resource, and Non-Energy Benefits.

Electric Benefits



Gas Benefits

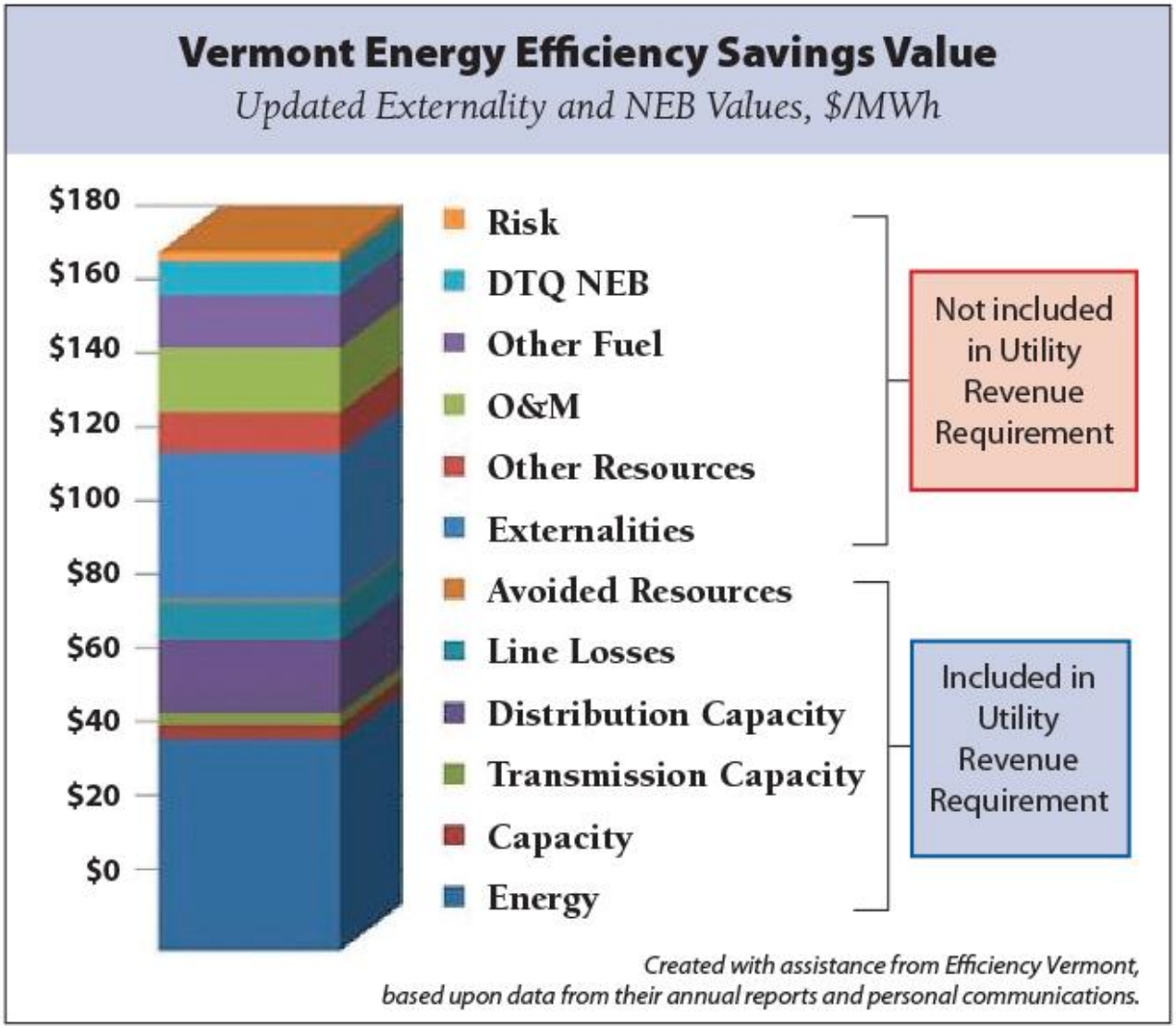


Vermont Benefits: "Net Cost" of EE

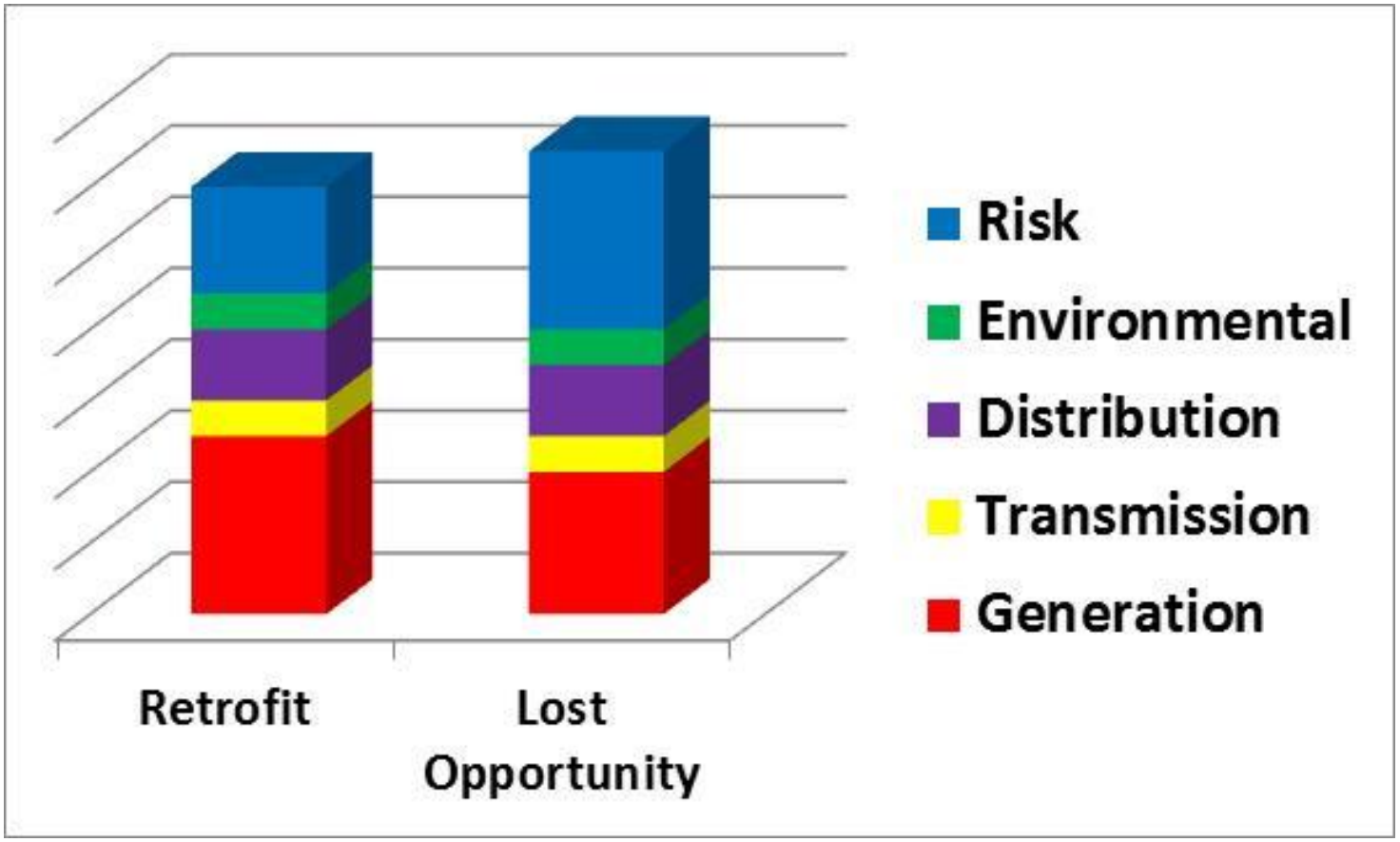
Efficiency continued to be an excellent value compared to other sources of energy: Efficiency Vermont delivered energy efficiency at 4.8 cents per kilowatt hour (kWh). Taking into account participating customers' additional costs and savings, the levelized net resource cost of saved electric energy was 1.6 cents per kWh. By contrast, the cost of comparable electric supply was 11.2 cents per kWh. Efficiency Vermont 2011 Annual Report

Benefits	$157,300,000	Total Resource Benefits[3]
	$ 23,600,000	Operations and maintenance savings
	$180,900,000	**Total Benefits**
Minus Costs	$ 35,900,000	Efficiency Vermont resource acquisition
	$ 35,600,000	Participant and third-party
	$ 71,500,000	**Total Costs**
Equals Net Benefits	**$109,400,000**	**Net Lifetime Economic Value to Vermont**

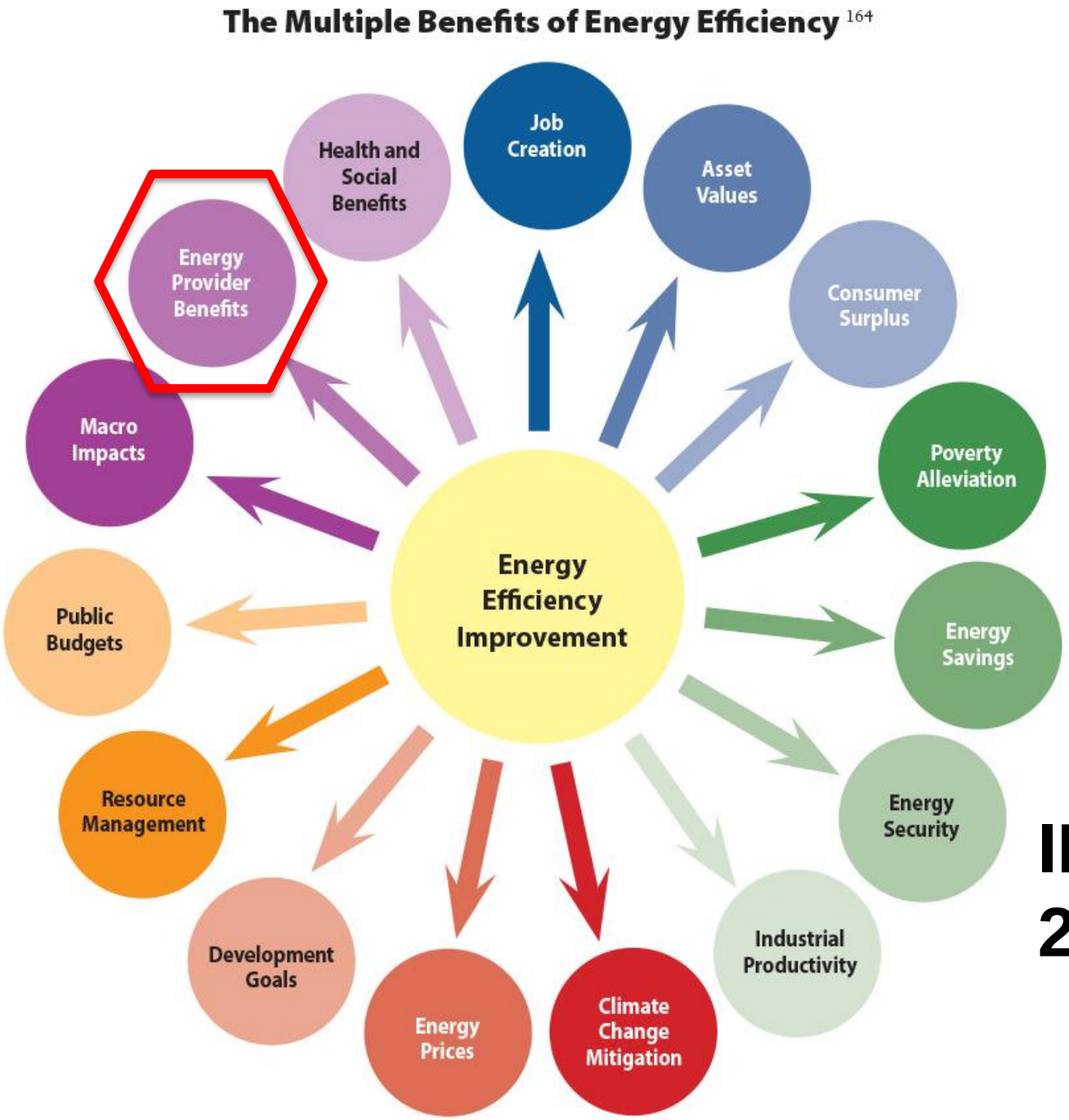
Vermont Benefits



NW Power and Conservation Council: High Value of Risk Mitigation



Schedulable Resources Accorded Higher Generation Value
Lost-Opportunity Resources Accorded Higher Risk Premium



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

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