Energy Trust of Oregon

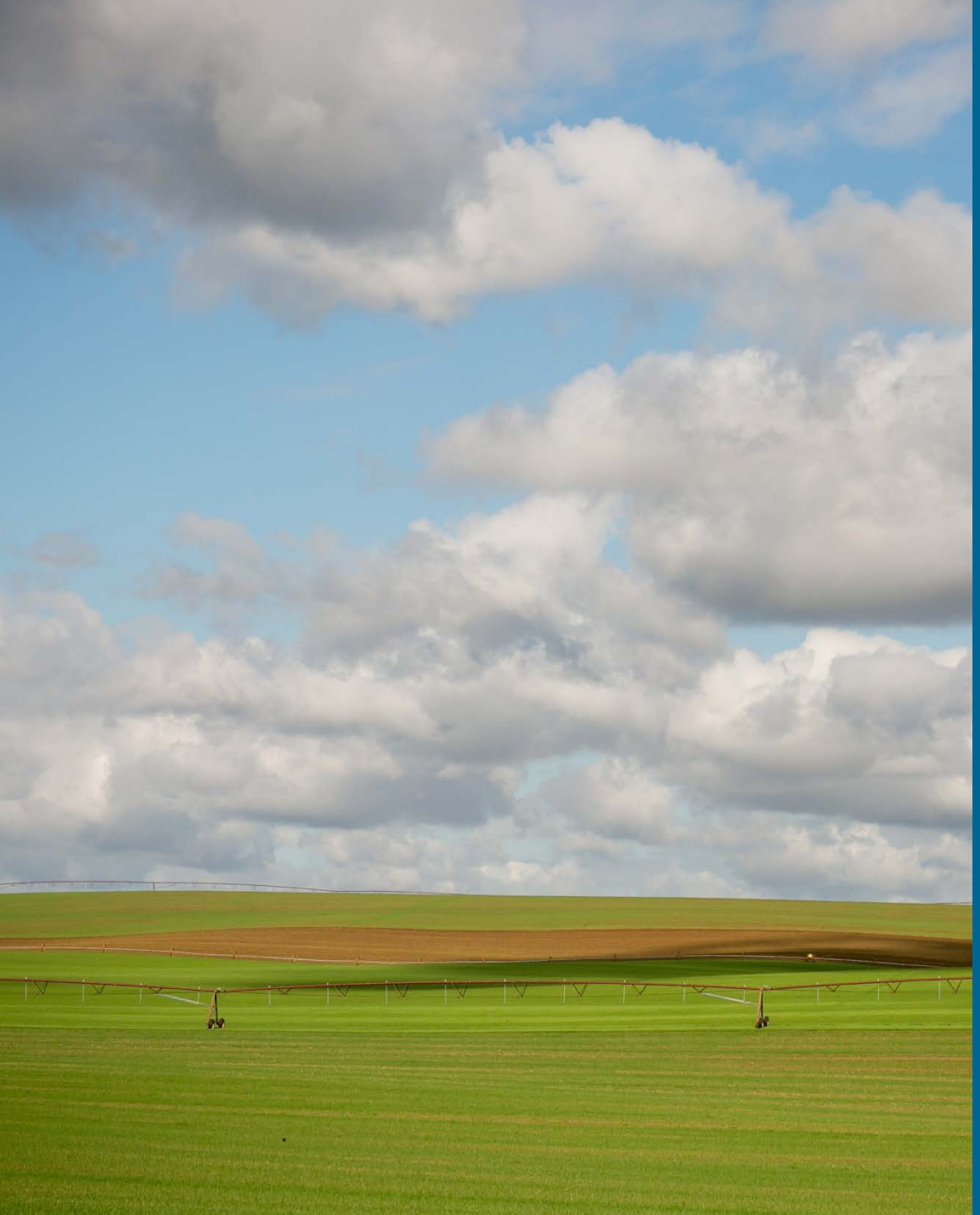
Forecasting the Future: Quantifying Uncertainty in Emerging Technologies

Sept. 21, 2015

Energy Trust of Oregon

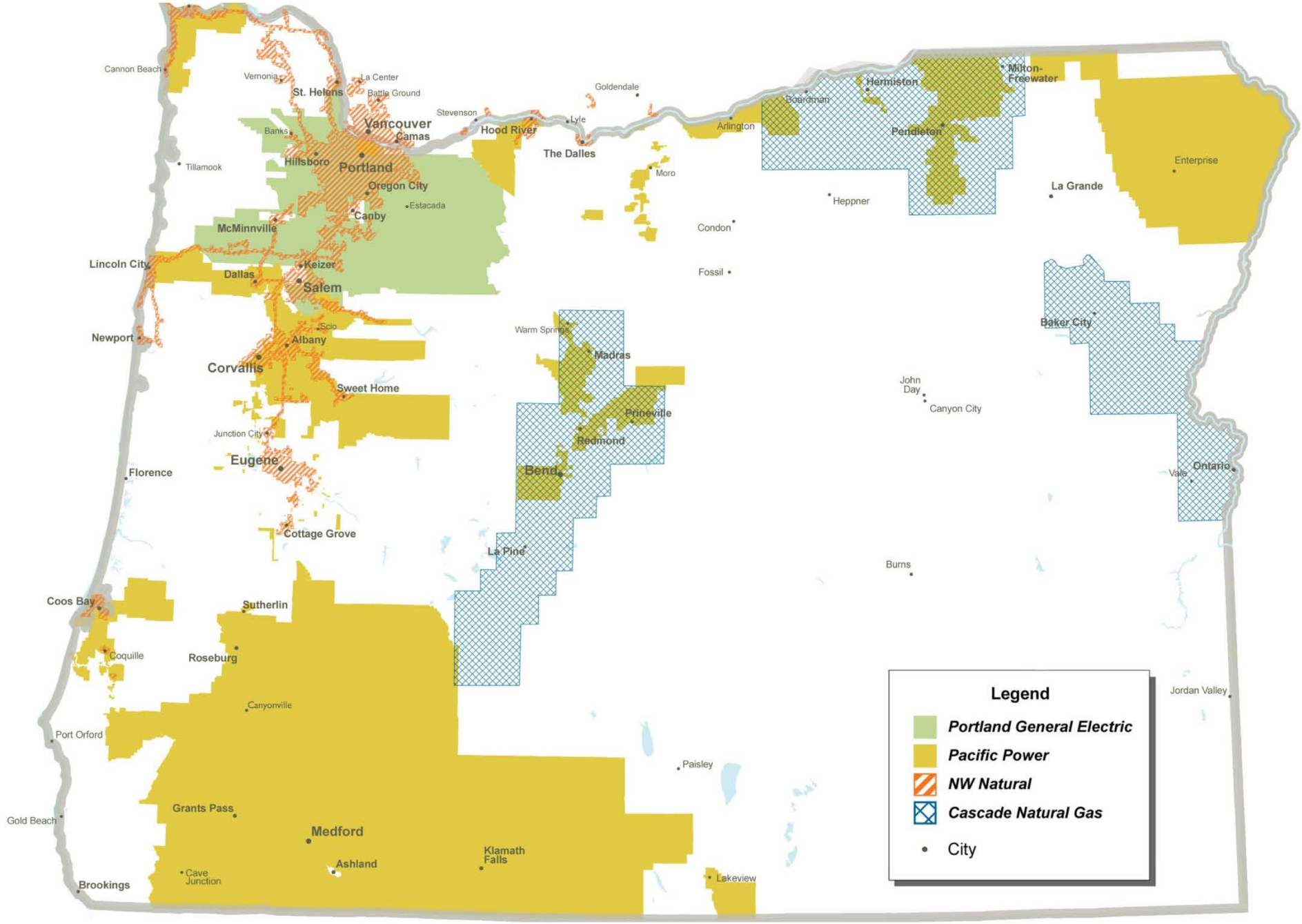
Agenda

- About Energy Trust
- Defining the Problem
- Our Resource Assessment
- How We Do It
- Results
- Questions

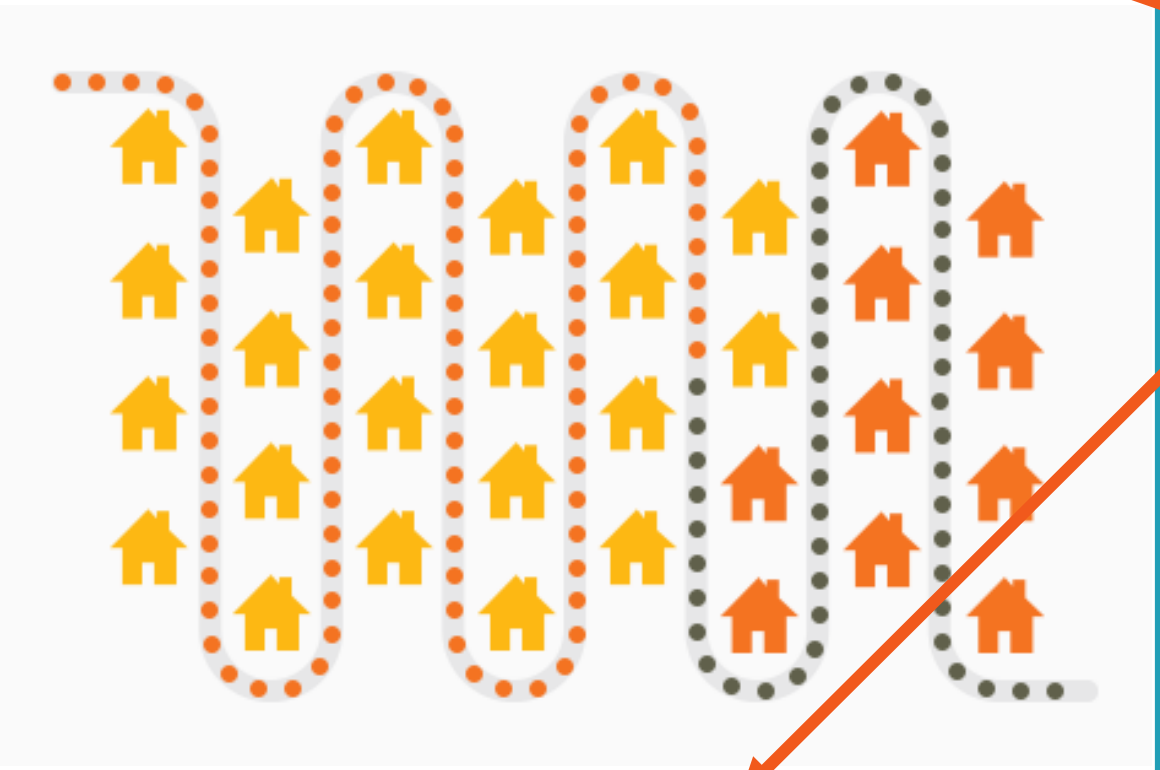


About

- Independent nonprofit
- Serving 1.5 million customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas
- Providing access to affordable energy
- Generating homegrown, renewable power
- Building a stronger Oregon and SW Washington


Cannon Beach
Vernonia
La Center
St. Helens
Battle Ground
Goldendale
Stevenson
Vancouver
Camas
Hood River
Lyle
The Dalles
Arlington
Boardman
Hermiston
Milton-
Freewater
Pendleton
Enterprise
La Grande
Banks
Tillamook
Hillsboro
Portland
Oregon City
Estacada
Canby
Moro
Heppner
Condon
McMinnville
Lincoln City
Keizer
Dallas
Salem
Fossil
Baker City
Newport
Scio
Albany
Warm Springs
Madras
Corvallis
Sweet Home
John
Day
Canyon City
Prineville
Junction City
Redmond
Eugene
Florence
Bend
Vale
Ontario
Cottage Grove
La Pine
Burns
Coos Bay
Sutherlin
Coquille
Roseburg
Jordan Valley
Canyonville
Port Orford
Paisley
Grants Pass
Gold Beach
Medford
Klamath
Falls
Ashland
Cave
Junction
Brookings
Lakeview
Legend
Portland General Electric
Pacific Power
NW Natural
Cascade Natural Gas
City

4,309,920 MWh



1,007,400 MWh

A clean energy power plant

- 492 average megawatts saved
- 115 aMW generated
- 39 million annual therms saved
- Enough energy to power 470,000 homes and heat 77,000 homes for a year
- Avoided 14.6 million tons of carbon dioxide

Definitions/Clarifications:

For Us:

- Resource Assessment = ‘Conservation Potential Assessment’
  - Only talking about energy efficiency resource potential, no renewables or other generation
  - Estimate of cost-effective energy efficiency resource potential that is achievable over a 20-year period

Defining the Problem:

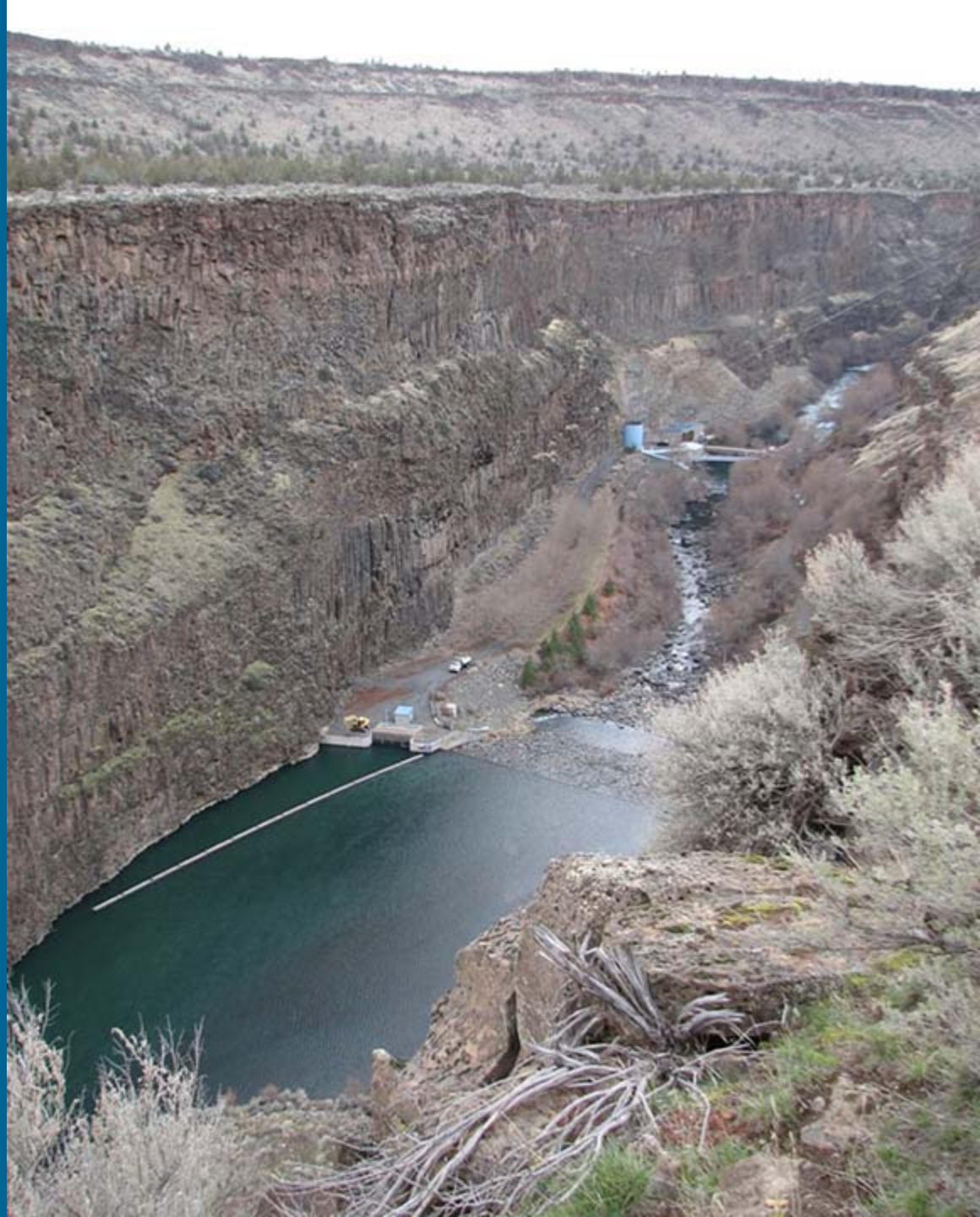
- Model Showing Declining Potential
- Included ‘firm’ Resources Only
- But New Technology Happens!
  - (LEDs, Ductless heat pumps, Heat Pump Water Heaters, Smart Thermostats, etc…)

It Happens, But What To Do With It?

- Its not ‘Firm’ now, but it Becomes Firm Nevertheless, and its Reasonable to Expect That It Will Continue to Happen
- We Realized Our Model Underestimated Savings Potential Over a 20-Year Period Without Emerging Technology
- We Sought a Method of Forecasting Savings that Incorporates Market and Program Innovations
- Goal to Create an Emerging Technology Overlay for Our Base Resource Assessment

What We Did…

- We prioritized Emerging Tech in our next resource assessment model upgrade
- Issued RFP for new model and Selected Navigant



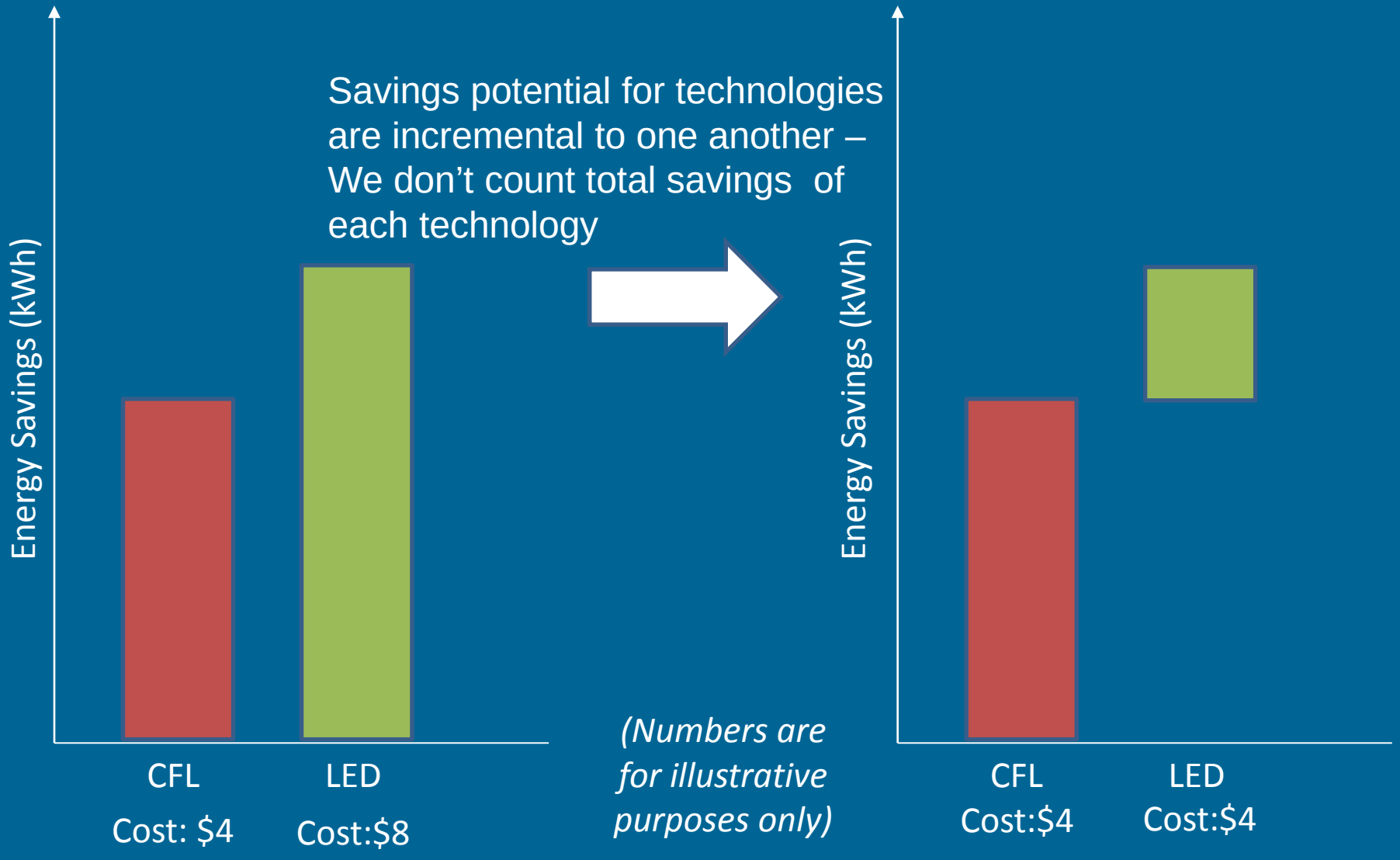
New Model

What’s new?

- Refreshed measure assumptions
- Define Measures Incrementally
- Better treatment of codes & standards
- New approach to emerging technologies

Define Measures Incrementally

Relative cost and savings determines ranking in competition groups of 'like' technologies in order to determine overall potential.



How We Do Emerging Tech…

- Predict future improvements
- Be realistic about odds of fruition
- Define incrementally to conventional measures

How We Do Emerging Tech…

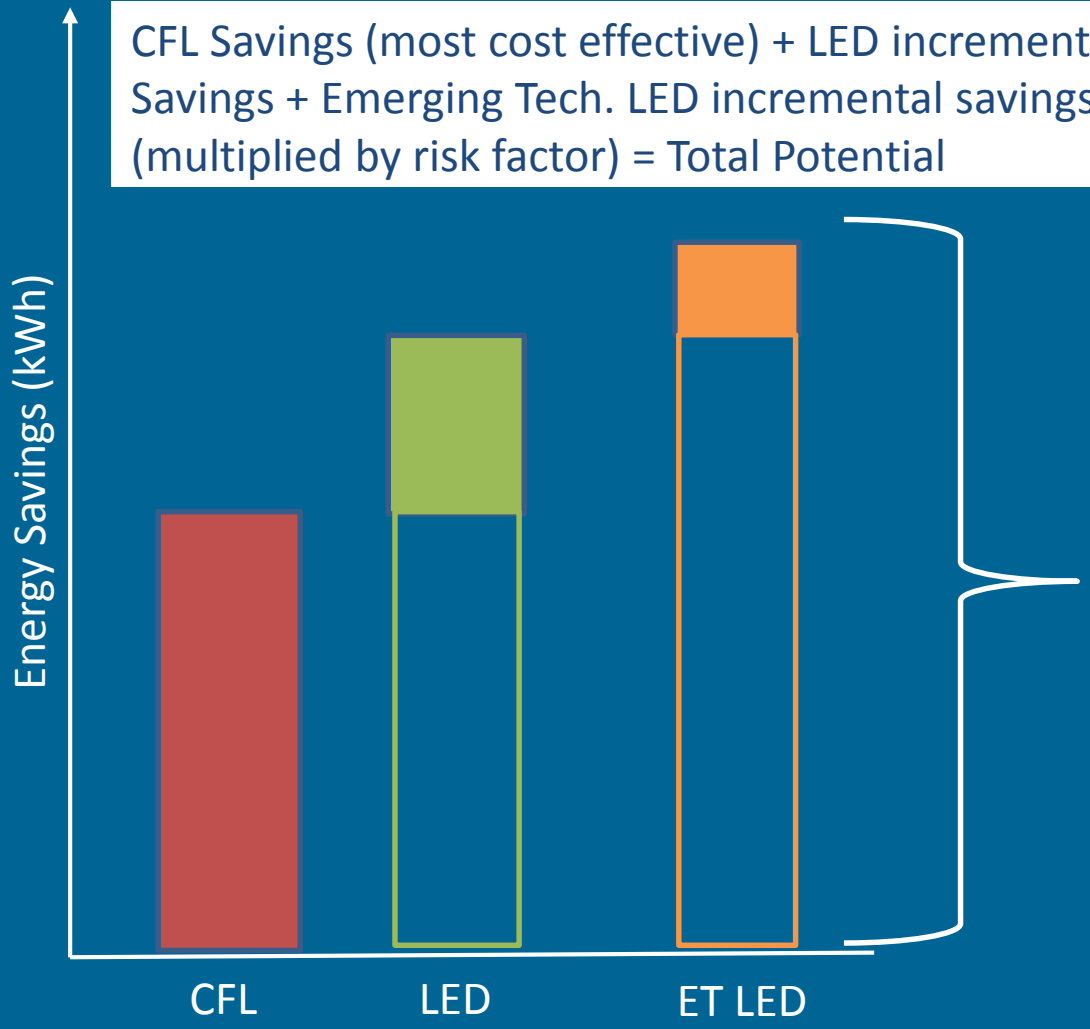
- Consider Emerging Technologies through 3rd Party Market Scans
  - Northwest Energy Efficiency Alliance
  - ACEEE
  - CEE
  - U.S Department of Energy
  - Northeast Energy Efficiency Partnerships
  - Efficiency Vermont
  - Minnesota Center for Energy and the Environment

Emerging Technologies (ELE)

Residential	Commercial	Industrial
• LED Lighting • CO2 Heat Pump Water Heaters • Advanced Heat Pumps • Home Automation/Controls • Advanced window and insulation technologies • Heat Pump clothes dryers	• LED Lighting • Advanced Rooftop Unit A/C • Evaporative coolers • Energy Recovery ventilators • Advanced refrigeration technologies • Smart/Dynamic windows	• LED Lighting • Advanced refrigeration controllers • Advanced motor technologies

Define Emerging Tech. Measures Incrementally in their Competition Groups

CFL Savings (most cost effective) + LED incremental Savings + Emerging Tech. LED incremental savings (multiplied by risk factor) = Total Potential



Total Potential split by competition groups - based on cost-effectiveness of each group, as displayed by the lighting scenario here with 3 bulb technologies

Risk Factor Method

- Use risk factors to hedge against uncertainty
  - Market Risk
  - Technical Risk
  - Data Source Risk

Risk Factors for Emerging Technologies

Risk Category	10%	30%	50%	70%	90%
Market Risk (25% weighting)	High Risk: • Requires new/changed business model • Start-up, or small manufacturer • Significant changes to infrastructure • Requires training of contractors. Consumer acceptance barriers exist.			Low Risk: • Trained contractors • Established business models • Already in U.S. Market • Manufacturer committed to commercialization	
Technical Risk (25% weighting)	High Risk: Prototype in first field tests. A single or unknown approach	Low volume manufacturer. Limited experience	New product with broad commercial appeal	Proven technology in different application or different region	Low Risk: Proven technology in target application. Multiple potentially viable approaches.
Data Source Risk (50% weighting)	High Risk: Based only on manufacturer claims	Manufacturer case studies	Engineering assessment or lab test	Third party case study (real world installation)	Low Risk: Evaluation results or multiple third party case studies

Emerging Tech Risk Factor Example - LED

Risk Factor	Weighting	X	Risk Factor	=	Weighted Risk Factor
Market Risk:	25%	X	90%	=	22.50%
Technical Risk:	25%	X	90%	=	22.50%
Data Source Risk:	50%	X	70%	=	35%
Total Risk Factor =					Sum = 80%
ET LED Incremental Savings:	5 kWh	X	80%	=	4 kWh Risk-Adjusted Potential
Savings per Socket for Competition Group = CFL Savings + LED Incremental Savings + Risk-Adjusted ET LED Incremental Savings				=	__ kWh

RESULTS

Outputs:

<table>
<tr><td>Not technically feasible</td><td colspan="3">Technical Potential</td></tr>
<tr><td>Not technically feasible</td><td>Market barriers</td><td colspan="2">Achievable Potential
85% of Technical</td></tr>
<tr><td>Not technically feasible</td><td>Market barriers</td><td>Not cost effective</td><td>Cost-Effective Potential</td></tr>
</table>

Cost-Effectiveness Screen

Total Resource Cost (TRC) test

- BCR = NPV of Benefits/Total Resource Cost

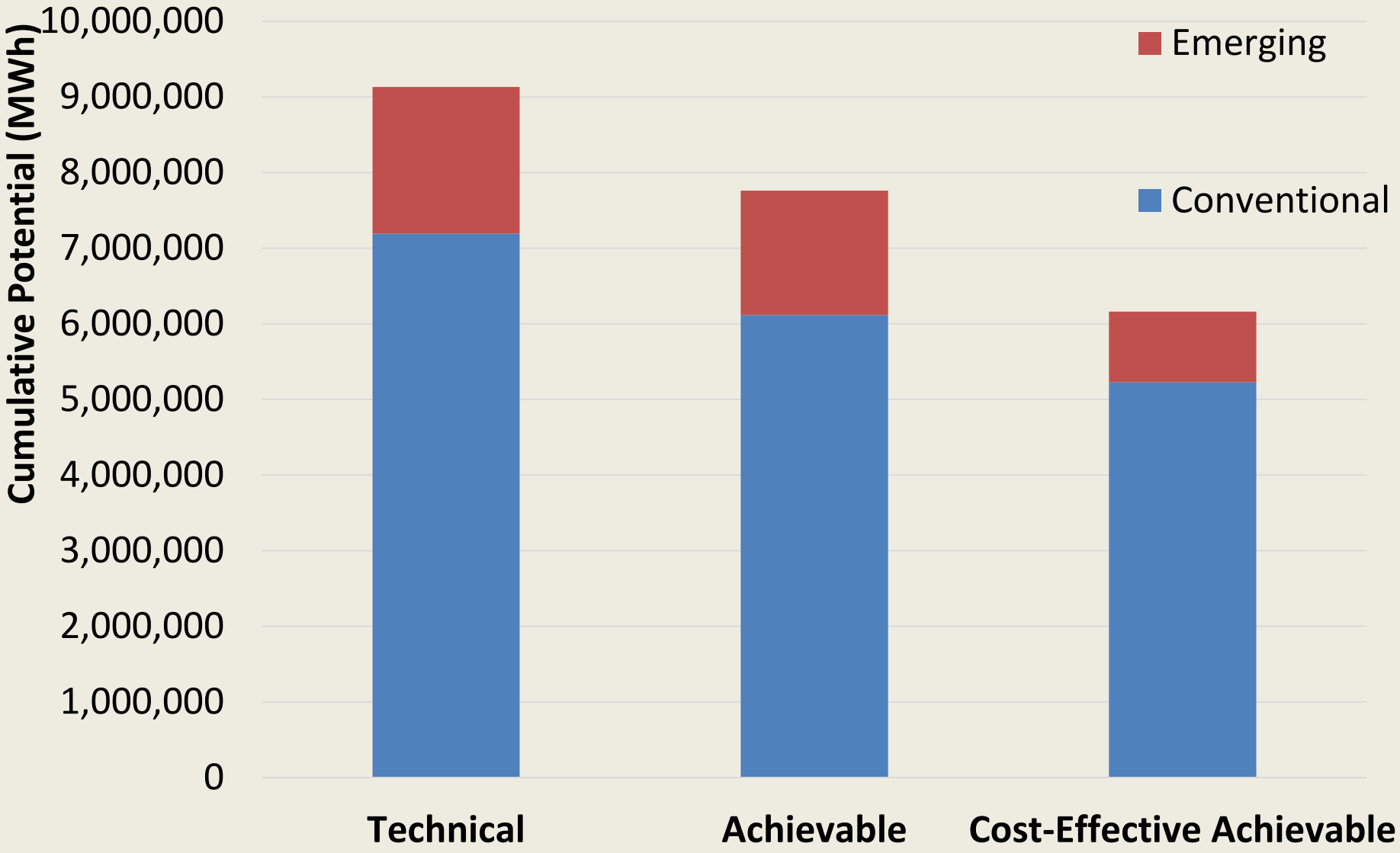
Benefits

- Savings x Avoided Costs
- Quantifiable non-energy benefits

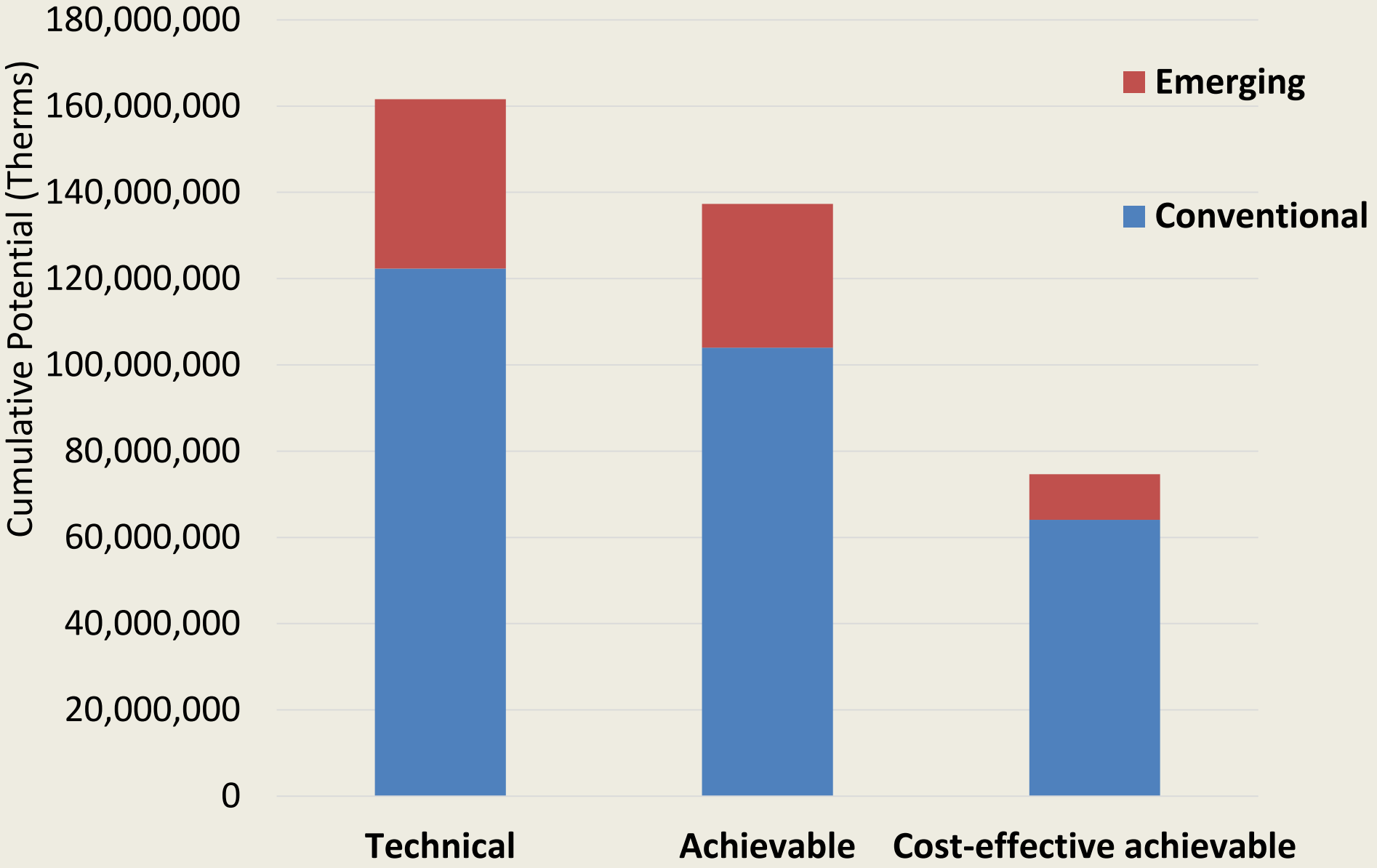
Measure Costs

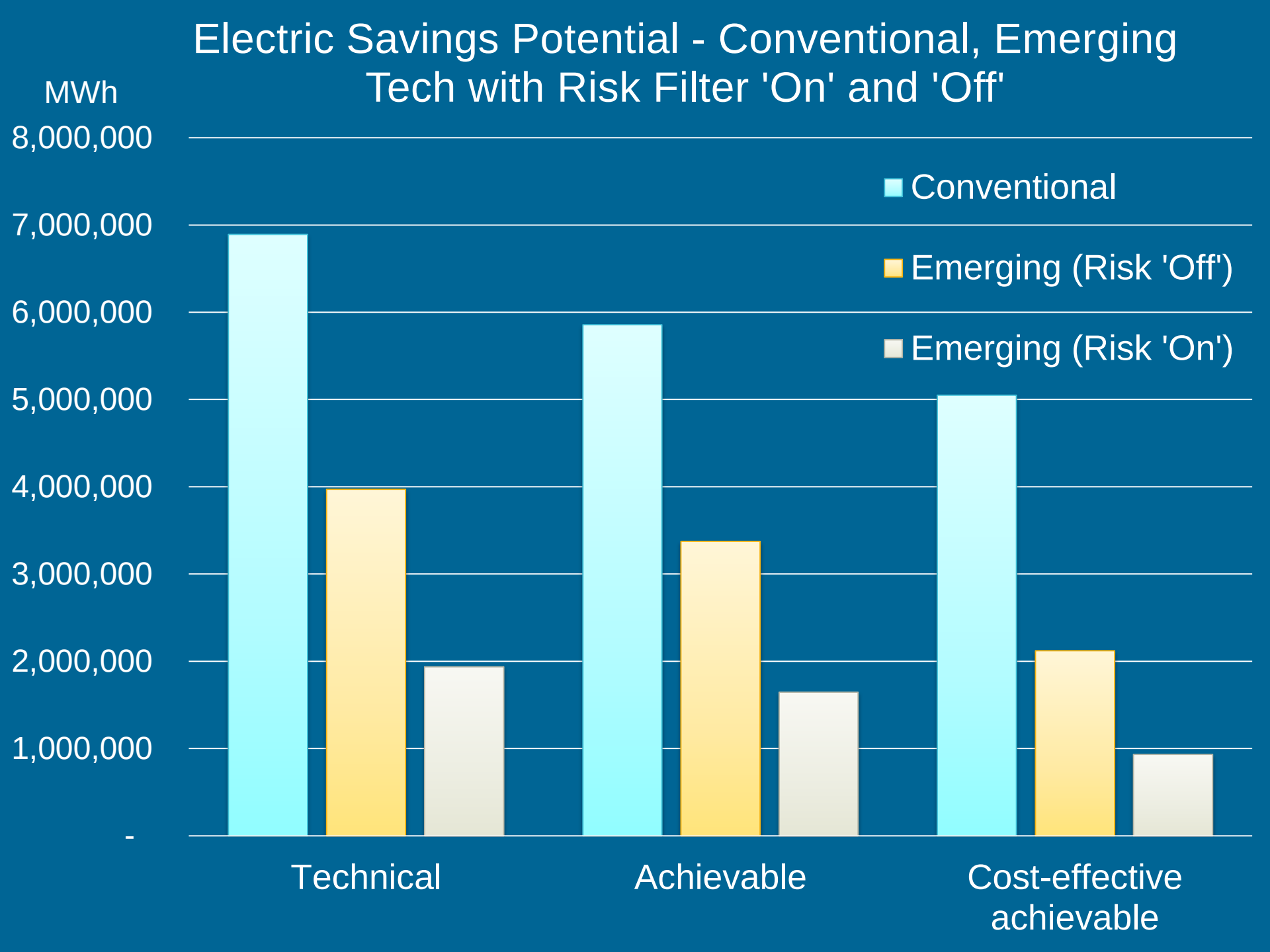
- Total Resource Cost

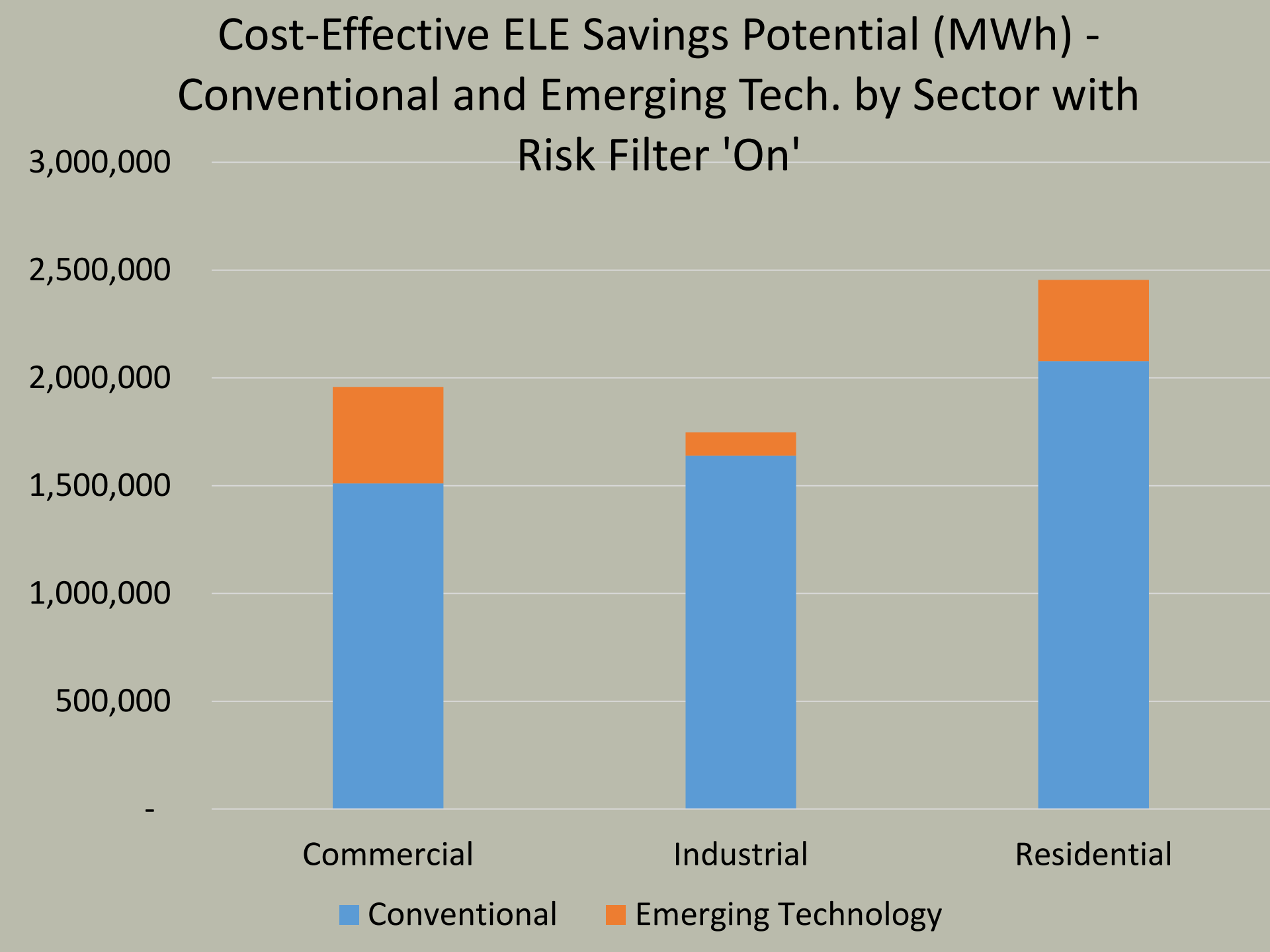
Conventional vs. Emerging Technology Electric Potential with Risk Factors 'On'



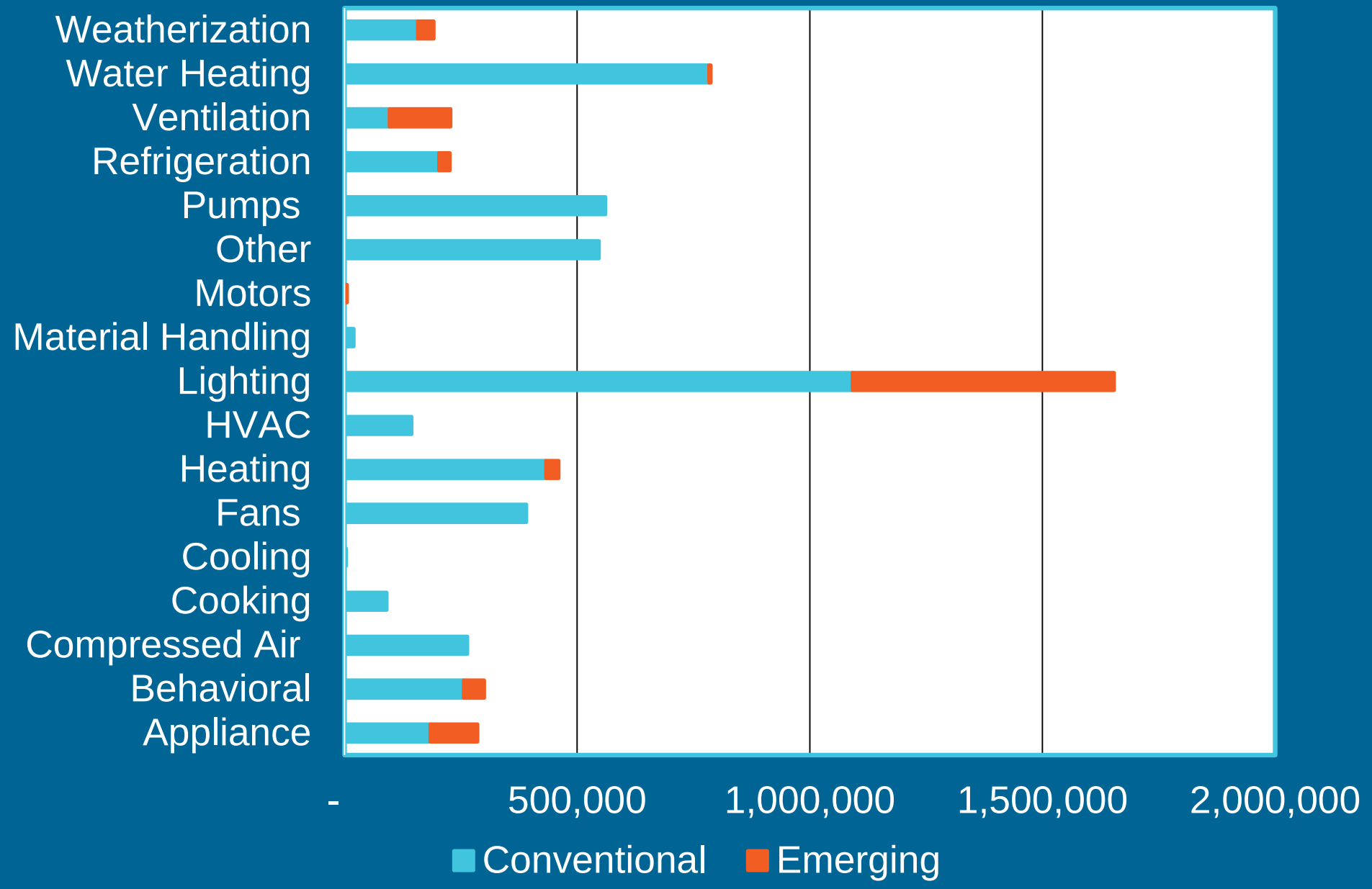
Conventional vs. Emerging Technology Gas Potential with Risk Factors 'On'




Electric Savings Potential - Conventional, Emerging Tech with Risk Filter 'On' and 'Off'
MWh
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
Conventional
Emerging (Risk 'Off')
Emerging (Risk 'On')
Technical
Achievable
Cost-effective achievable


Cost-Effective ELE Savings Potential (MWh) - Conventional and Emerging Tech. by Sector with Risk Filter 'On'
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
Commercial
Industrial
Residential
Conventional
Emerging Technology

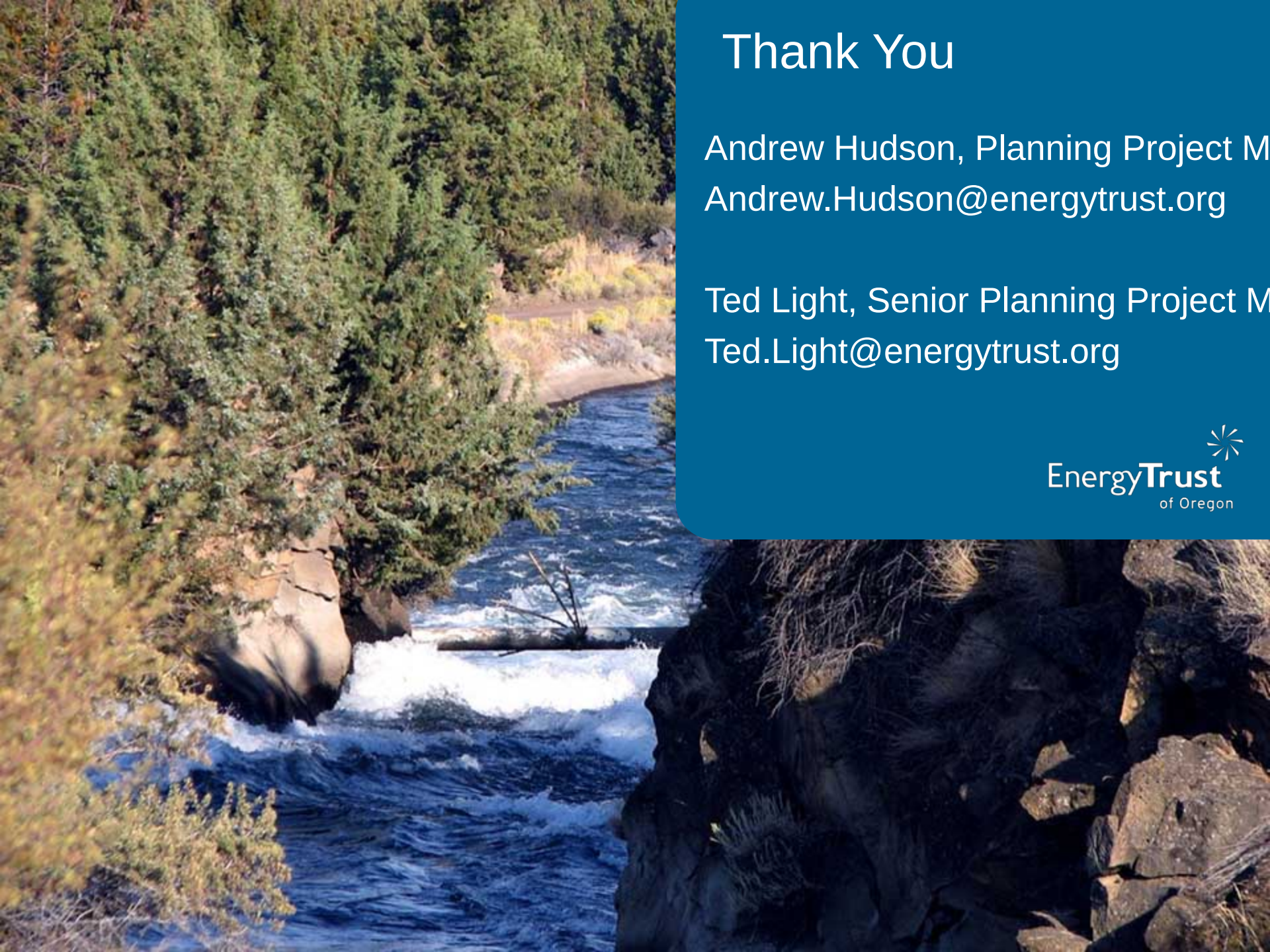
Cost-Effective ELE Savings Potential by End Use
Conventional and Emerg. Tech. Risk Filter 'On'



Emerging Technologies

End result:

- The estimate for any given emerging technology is not accurate
- Taken as a whole, provides a reasonably conservative estimate of what is possible



Thank You

Andrew Hudson, Planning Project M
Andrew.Hudson@energytrust.org

Ted Light, Senior Planning Project M
Ted.Light@energytrust.org

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