

New York State Energy Transition 1990 - 2050

**A Goals-Driven Perspective
on the Value of Beneficial Electrification**

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NYS Energy Transition Objectives / Goals

Objectives

• Reduce GHG Emissions

• Increase Efficiency

• Increase Reliability

• Distributed Electricity Generation

• More Resilient

• Energy Independence

Transition Goals

- Reduce 1990 Level GHG Emissions
-40% by 2030, -80% by 2050
- Carbon Free Electricity
50% by 2030 >>> (70% by 2030)
80% by 2050 >>> (100% by 2040)
- Improve Energy Efficiency
-185 Tbtu by 2025
- Reduce Buildings Energy Use
23% by 2030
- Reduce Summer Peak Load
- Minimize Winter Peak Load

Primary Goal

Conversion Targets

- Solar 6,000 MW by 2025
- Off-shore Wind 2,400 MW by 2030
9,000 MW by 2035
- On-shore Wind ? MW by 2030
- Short Term Storage 1,500 MW by 2025
3,000 MW by 2030
- Long Term Storage ?
- Carbon-Free HVAC 83,000+ by 2025
- Carbon-Free Vehicles 1,000,000 by 2025

Are These Sufficient ?

Difficult to Know How Goals Will Be Achieved Without a Master Plan than Shows All Inter-dependent Timelines

Combustion Fuels Approach 1990 - 2015

- **GHG Emissions Goals Cannot Be Achieved**

By Simply:

- **Switching Combustion Fuels**
- **Incrementally Improving Vehicle Emissions**

Conversion to Cleaner Diesel and Natural Gas Saves 100's of Lives per Year

- **Good CO2 Reduction in 3 of 5 Sectors** **CO2 Down 19%**

- **CO2 Progress Offset by Methane Leakage** **GHG Down 6%**

- **Combustion Energy Use Decreased** **Down 7.8%**

- **Lost Energy Down Very Little** **Down 1.5%**

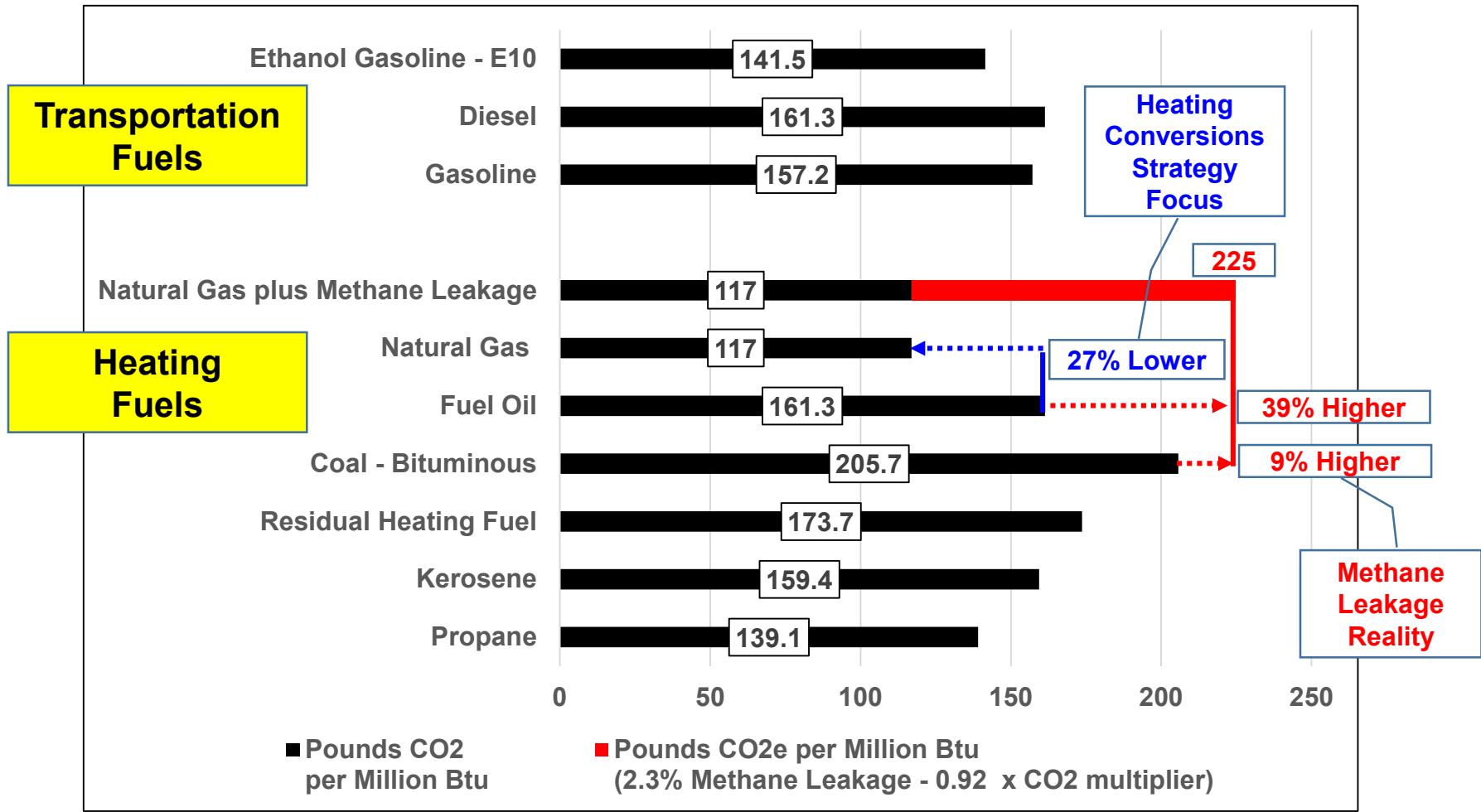
- **Total Energy Use Down Very Little** **Down 0.2%**

- **Energy Efficiency Negligible Improvement** **Up 0.5%**

Marginal Overall Progress After 25 Years

GHG Emissions for Fuels

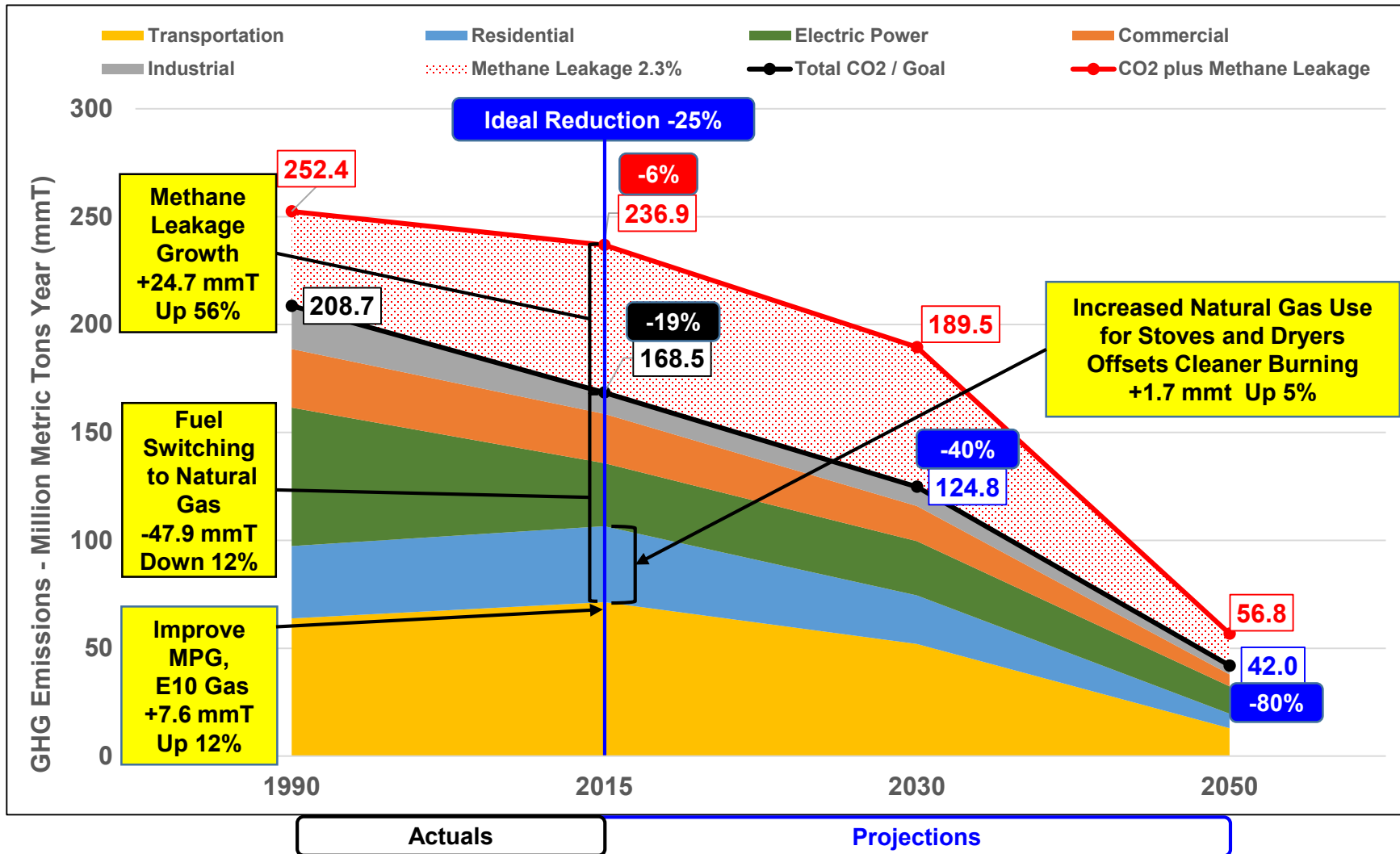
(Pounds CO₂e / Million Btu) including **2.3% Methane Leakage**



**When Properly Accounting for Methane Leakage,
 Natural Gas GHG Emissions are
Higher than All Other Fuels**

Source: www.eia.gov/environment/emissions/co2_vol_mass.php

GHG Emissions Reduction Timeline By Sector 1990 - 2050



**Residential and Transportation Increasing as of 2015
Electric Power, Commercial, & Industrial Sectors Compensate
Goal is All Sectors Meet -80% by 2050**

Non-Combustion Fuels Approach

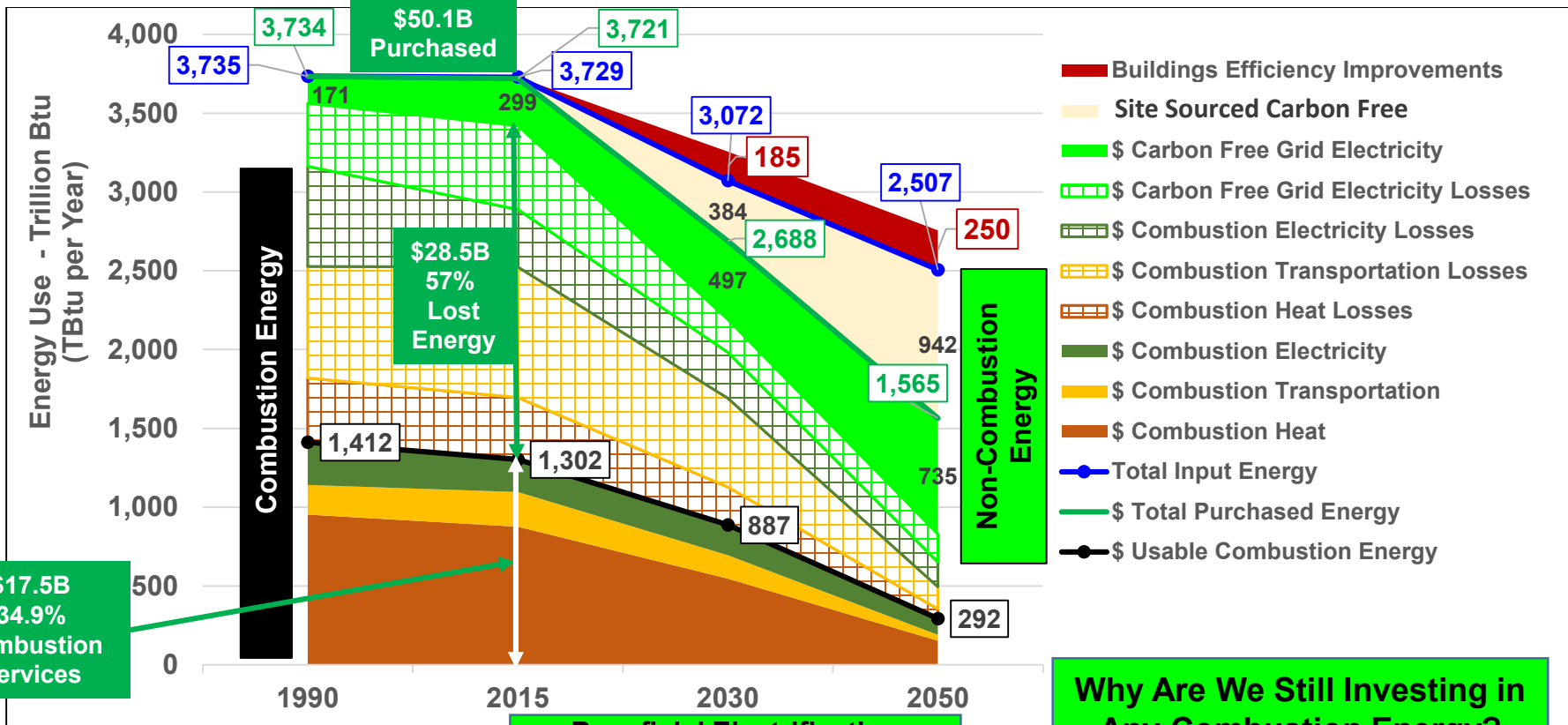
To reduce GHG Emissions **40% by 2030 and 80% by 2050**

Use of 40% and 80% of Combustion Fuels must be replaced with Non-Combustion Fuels

Then All other goals will be Met or Exceeded:

- Reduced Lost Energy
- Increased **Energy Efficiency**
- Reduced **Energy Use**
- Increased Grid **Carbon-Free Electricity**
- Increased On-site **Carbon-Free Electricity** and Heat

Energy Use Transition 1990 - 2050 (Trillion Btu)



Increased Efficiency	42.4%	43.2%	57.5%	78.5%
CO2 / Methane (mmT)	209/44	168/68	125/65	42/15

New Yorkers are Captive to Combustion Energy:
emissions intensive, expensive, wasteful, unhealthy
We Can Do Better

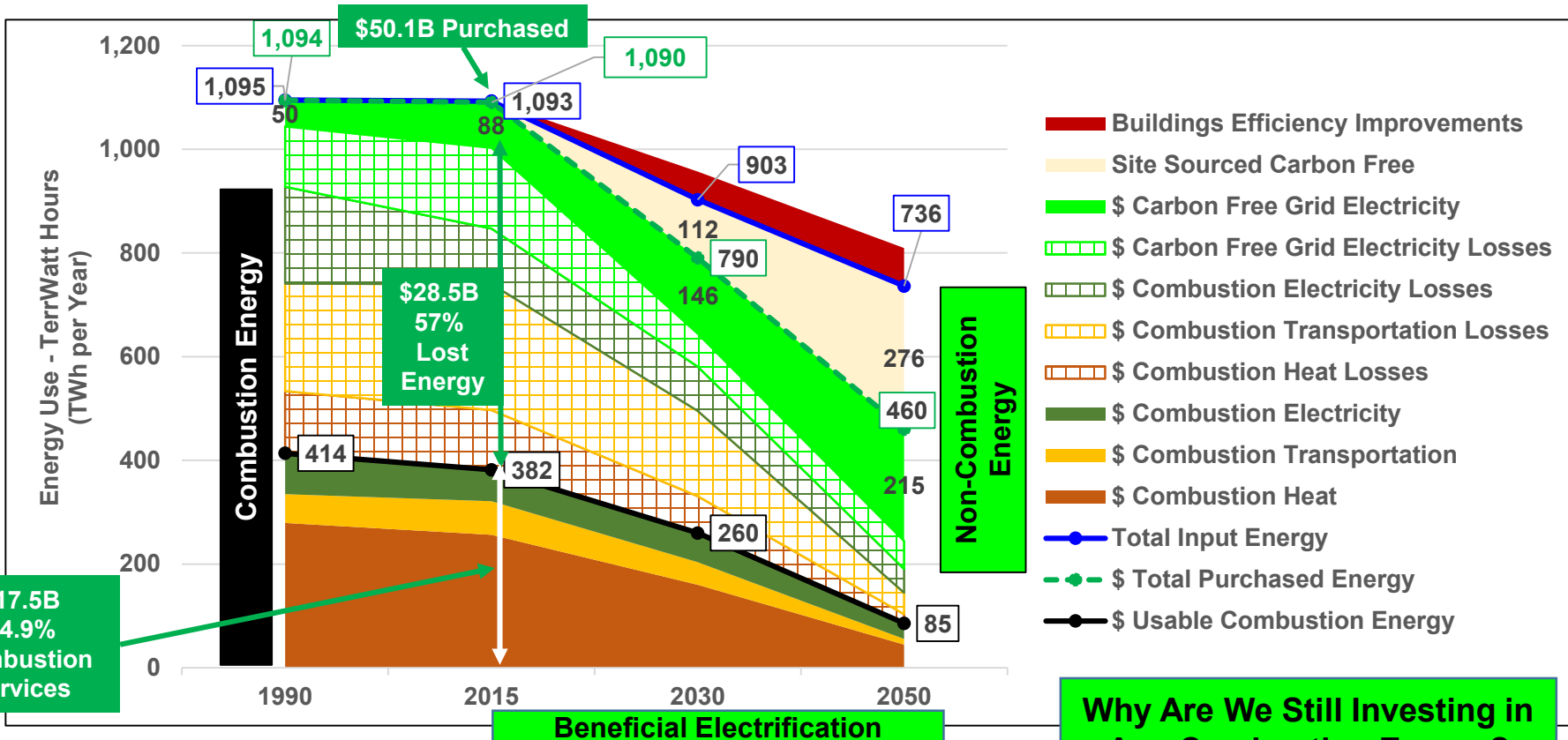
Total Energy Use Reduced 33%	1,228 TBtu
Purchased Energy Reduced 58%	2,169 TBtu
Carbon Free Electricity Increased 329%	564 TBtu
On-site Carbon Free Energy Increased	940 TBtu
Lost Energy Reduced 75%	1,613 TBtu
Combustion Energy Reduced 80%	1,245 TBtu

Combustion Energy Replaced With Grid and On-site Carbon Free Energy

- Lower Emissions
- **Higher Efficiency**
- **Lower Energy Use**
- **Lower \$ Cost**

Source: Consumption Data: <https://www.eia.gov/state/seds/seds-data-complete.php?sid=NY>

Energy Use Transition 1990 to 2050 (Terra-Watt Hours)



Why Are We Still Investing in Any Combustion Energy?

Increased Efficiency 42.4% 43.2% 57.5% 78.5%

CO2 / Methane (mmT) 209/44 168/68 125/65 42/15

New Yorkers are Captive to Combustion Energy:
emissions intensive, expensive, wasteful, unhealthy
We Can Do Better

Total Energy Use Reduced 33%	360 TWh
Purchased Energy Reduced 58%	635 TWh
Carbon Free Electricity Increased 329%	165 TWh
On-site Carbon Free Energy Increased	275 TWh
Lost Energy Reduced 75%	473 TWh
Combustion Energy Reduced 80%	329 TWh

Combustion Energy Replaced With Grid and On-site Carbon Free Energy

- Lower Emissions
- **Higher Efficiency**
- **Lower Energy Use**
- **Lower \$ Cost**

Source: Consumption Data: <https://www.eia.gov/state/seds/seds-data-complete.php?sid=NY>

Energy Usage and Consumption Cost Transition

Assumptions: \$13.4 Million per TBtu

		2015 - 2030		2015 - 2030			
Building Efficiency -185 Tbu by 2030, -250 Tbtu by 2050		3,729	3,080	\$50.100	\$36.376	27% Less	
		Trillion Btu Deltas		\$ Billion Dollar Deltas			
		Eliminate	Replace	Eliminate	Replace	Value: Zero Net Cost Energy	
			375		\$5.026		
			198		\$2.647		
33.1%	-404	-314		-\$4.202			
		-75		-\$1.010			
		-15		-\$0.206			
27.5%	-336	-265		-\$3.556			
		-71		-\$0.945			
39.4%	-481	-152		-\$2.033			
		-330		-\$4.418			
		Totals		-1,222	573	-\$16.371	\$2.647
17% Less		Net		-649	\$-13.724	84% Less	

		2015 - 2050		2015 - 2050			
Building Efficiency -185 Tbu by 2030, -250 Tbtu by 2050		3,729	2,512	\$50.100	\$21.280	58% Less	
		Trillion Btu Deltas		\$ Billion Dollar Deltas			
		Eliminate	Replace	Eliminate	Replace	Value: Zero Net Cost Energy	
			933		\$12.506		
			436		\$5.841		
25.6%	-662	-347		-\$4.652			
		-210		-\$2.812			
		-105		-\$1.406			
33.6%	-870	-687		-\$9.209			
		-183		-\$2.448			
40.8%	-1,055	-332		-\$4.443			
		-723		-\$9.690			
		Totals		-2,587	1,369	-\$34.661	\$5.841
33% Less		Net		-1,217	-\$28.820	83% Less	

Large Scale Beneficial Electrification Required

- **40% GHG Emissions Reduction by 2030**

Requires Significant Conversions / Additions:

- 3.3 Million Battery Electric Vehicles **220,000 per Year**
- 3.5 Million Housing Unit Heat Pumps **233,000 per Year**
- 40% Commercial, Industrial Buildings with Heat Pumps **27,000 per Year**
- 82.1 Terra-Watt Hours of Carbon Free Electric Power **5.5 TWh per Year**

- **80% GHG Emissions Reduction by 2050**

Requires Additional Conversions / Additions of:

- 5.2 Million Battery Electric Vehicles **260,000 per Year**
- 3 Million Housing Unit Heat Pumps **150,000 per Year**
- 80% Commercial, Industrial Buildings with Heat Pumps **20,250 per Year**
- 86.3 Terra-Watt Hours of Carbon Free Electric Power **4.3 TWh per Year**

**Current Pace of System Conversions
Must be Increased by 3-6 Times**