Opportunities and Challenges in Industrial Energy Efficiency

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Importance and Rationale for Energy Efficiency

Importance of Energy Efficiency

President Obama "I am also issuing a new goal for America: Let us cut in half the energy wasted by our homes and businesses over the next 20 years. The States with the best ideas to create jobs and lower energy bills will receive federal support to help make it happen"

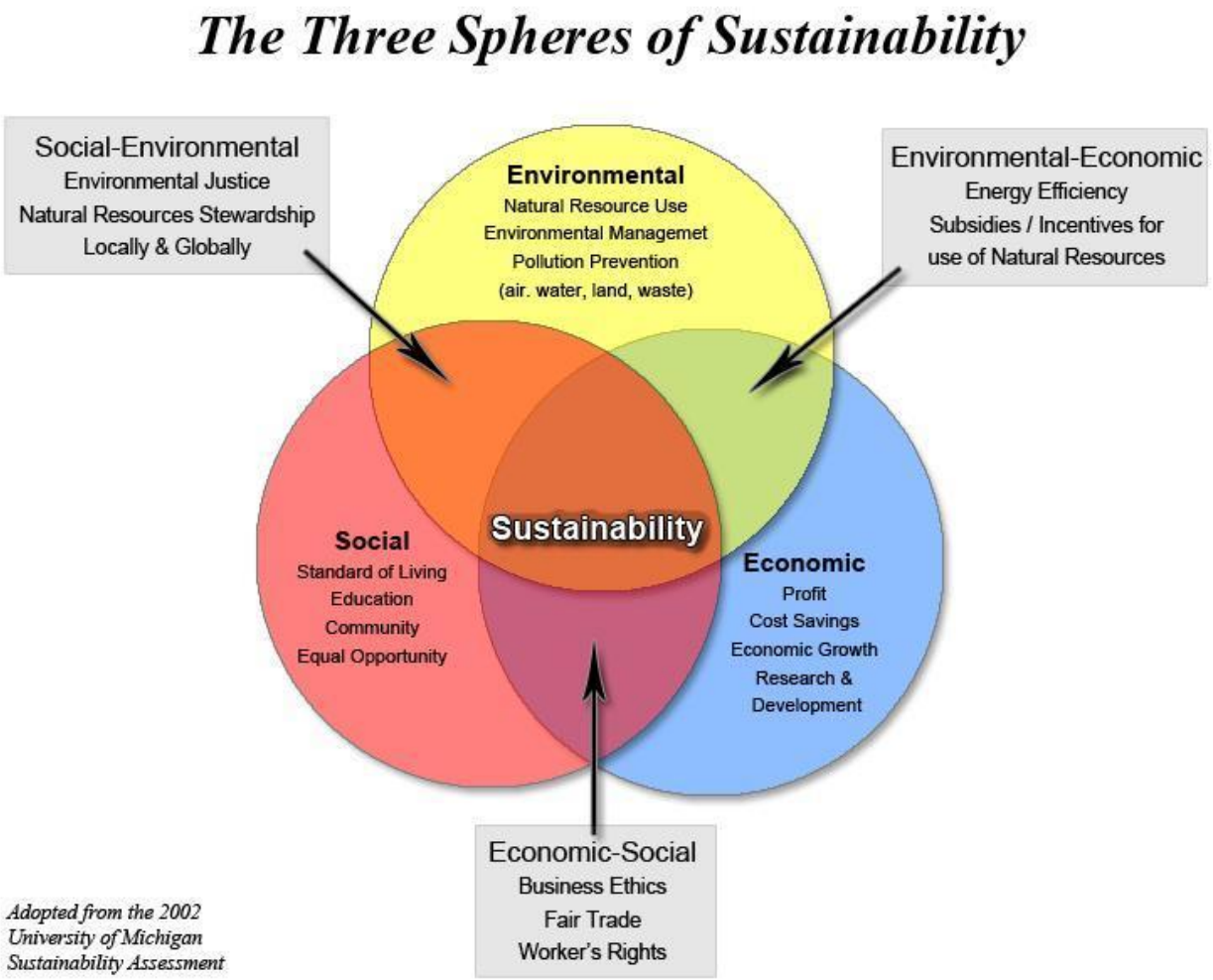
ACEEE - "Energy efficiency is easily the most affordable energy resource. The combination of supply side efficiency improvements and those by CHP technologies and efficiency improvement in industrial, commercial, and residential sectors would save taxpayers a significant amount of money over the next two decades" March 2011

Sustainability

- "Development which meets the needs of the present without compromising the ability of future generations to meet their own needs"

  UN Brundtland Commission

Sustainability

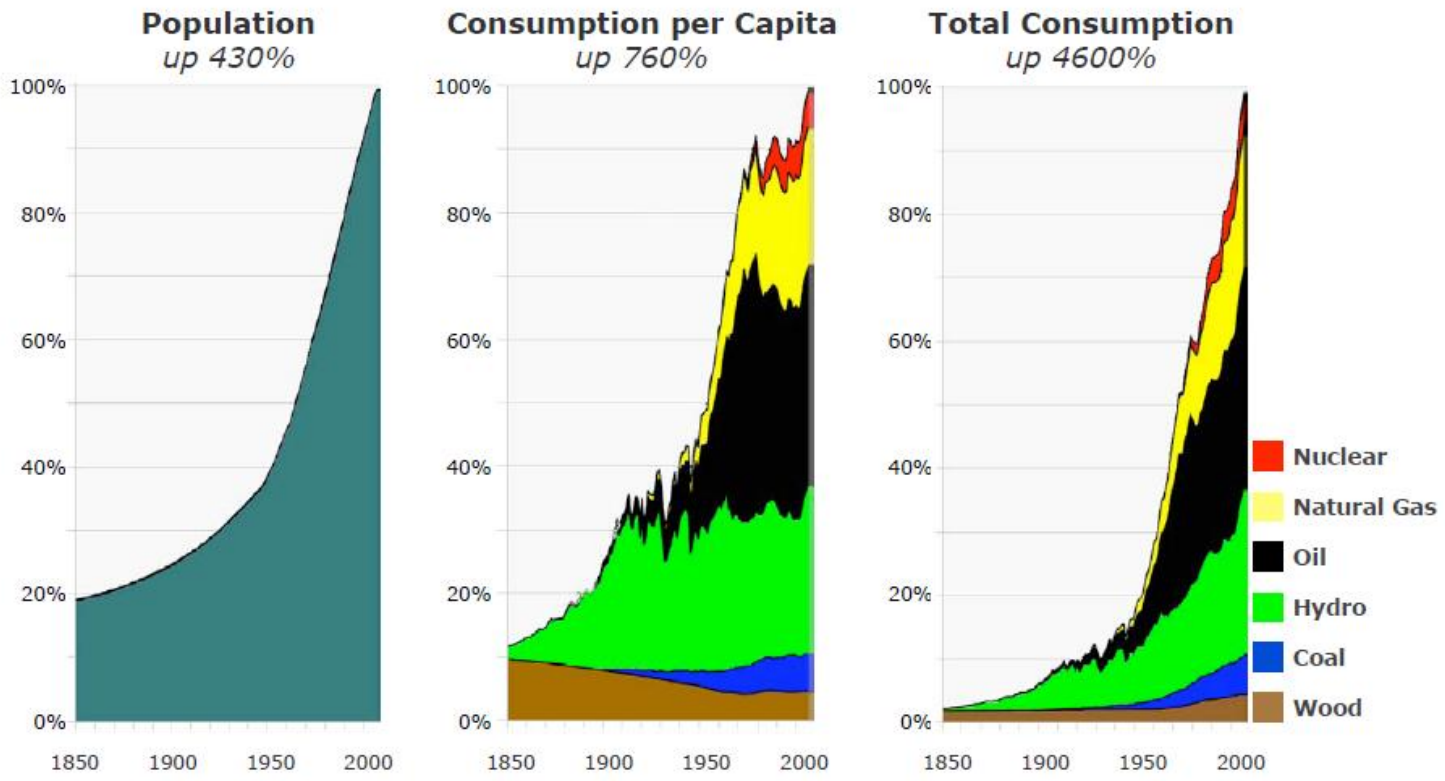


What is not sustainable?

World consumes 320 billion kWh of electricity every day

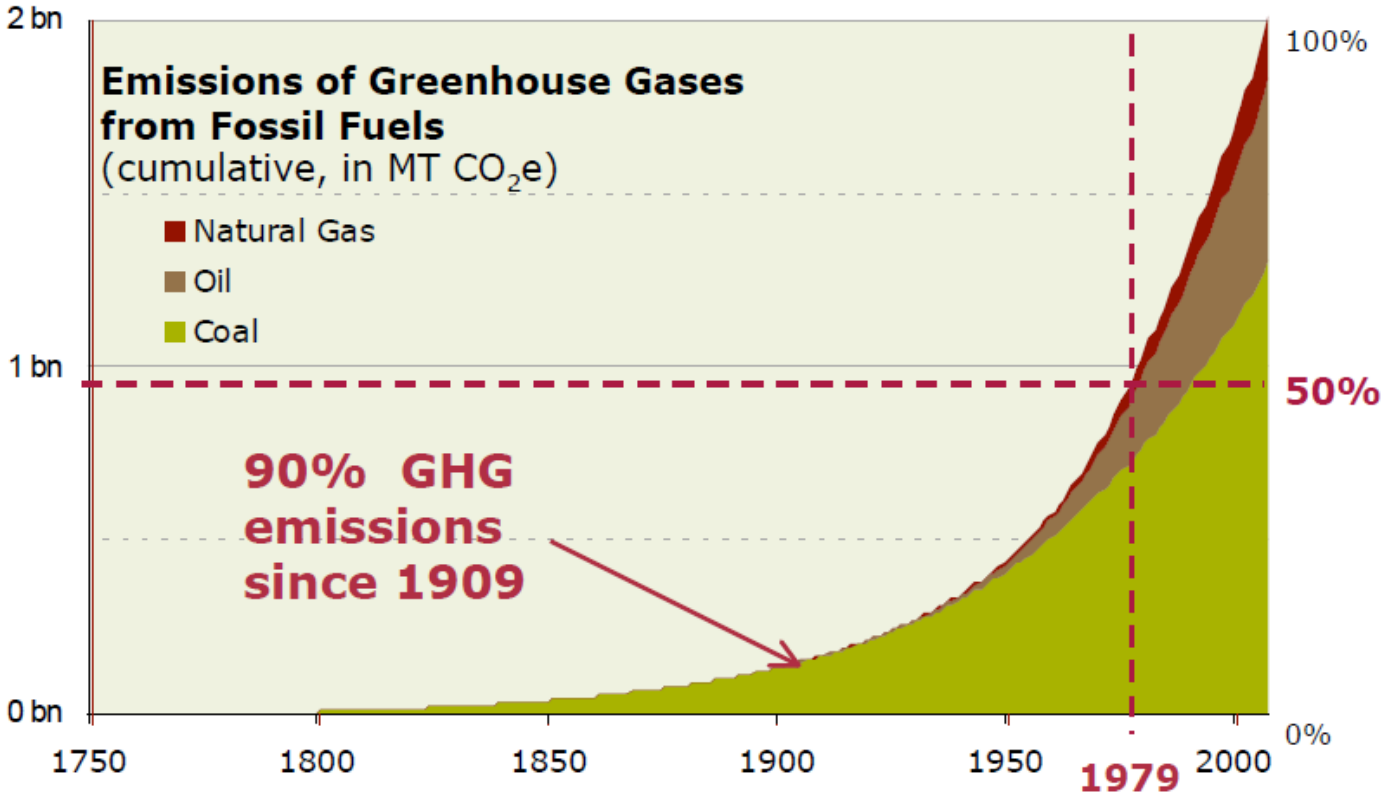
By the year 2030, we will be producing 4.2 billion tons of carbon dioxide per year – we will run out of atmosphere faster than we will run out of fossil fuels

Increases in World Population and Energy Consumption 1850 -2007



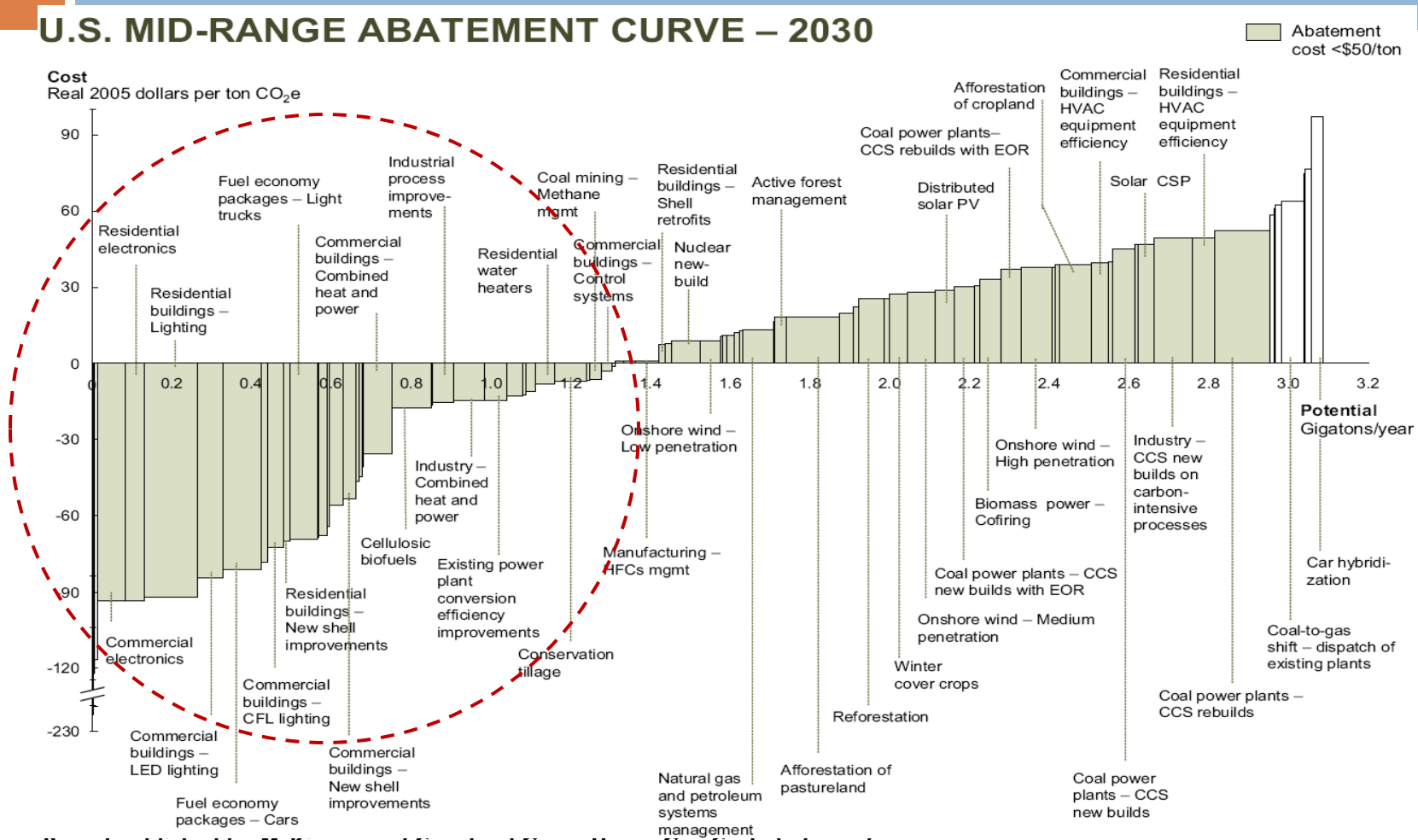
Source: Arulf Grubler (1998), BP Statistical Review of World Energy (2008), US Bureau of Census (2008)

90% of Human GHG Emissions During Past Century



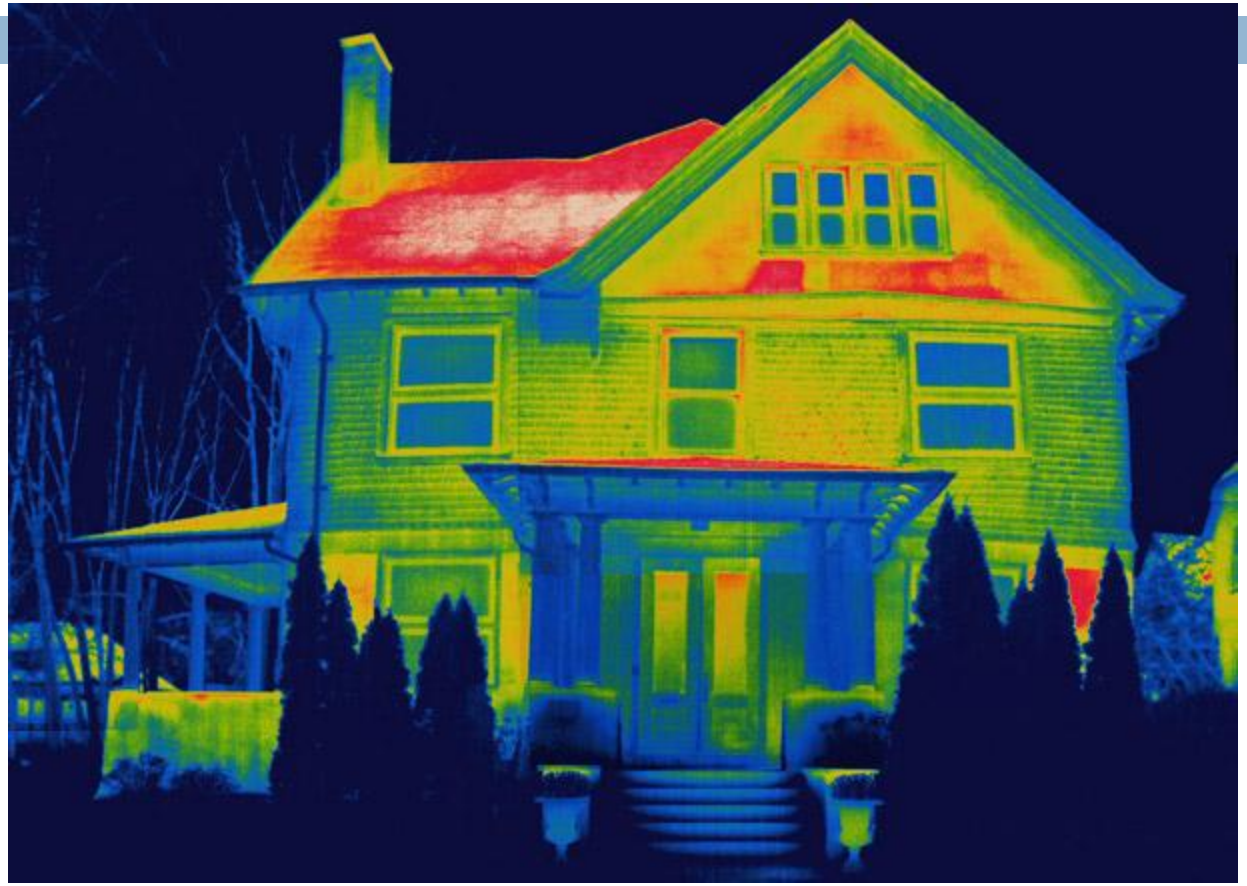
Source: RED calculations based on data from BP Statistical Review and J. David Hughes, Geological Survey of Canada (ret.)

Environmental Impact of Energy Efficiency and Management



- **Report published by McKinsey and Co. about Green House Gas Cost abatements**
- **The Figure shows that the energy efficiency and waste heat recovery opportunities have negative abatement cost factors**

Residential and Commercial Buildings



Why should organizations adopt energy efficient practices ?

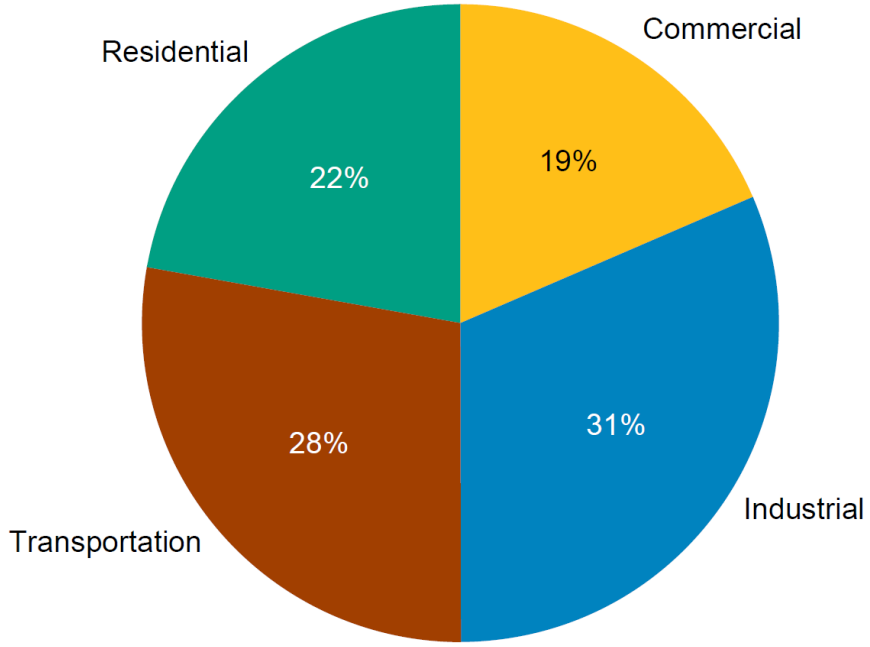
- Saves money annually
- Good payback on investment
- Reduce operating costs
- Increase profitability
- Being “green” and a responsible entity in the community
- Be prepared for regulations such as BoilerMACT

Energy Efficiency is a powerful solution !

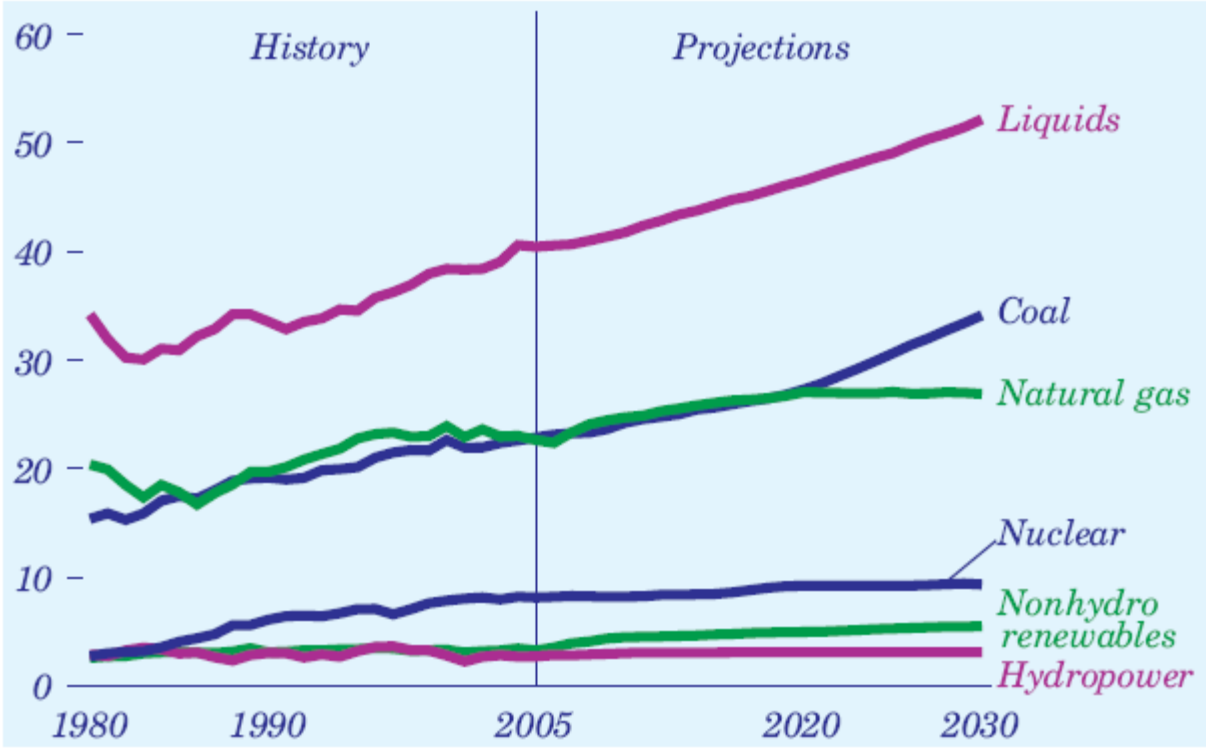
Opportunities and Challenges

Energy Consumption

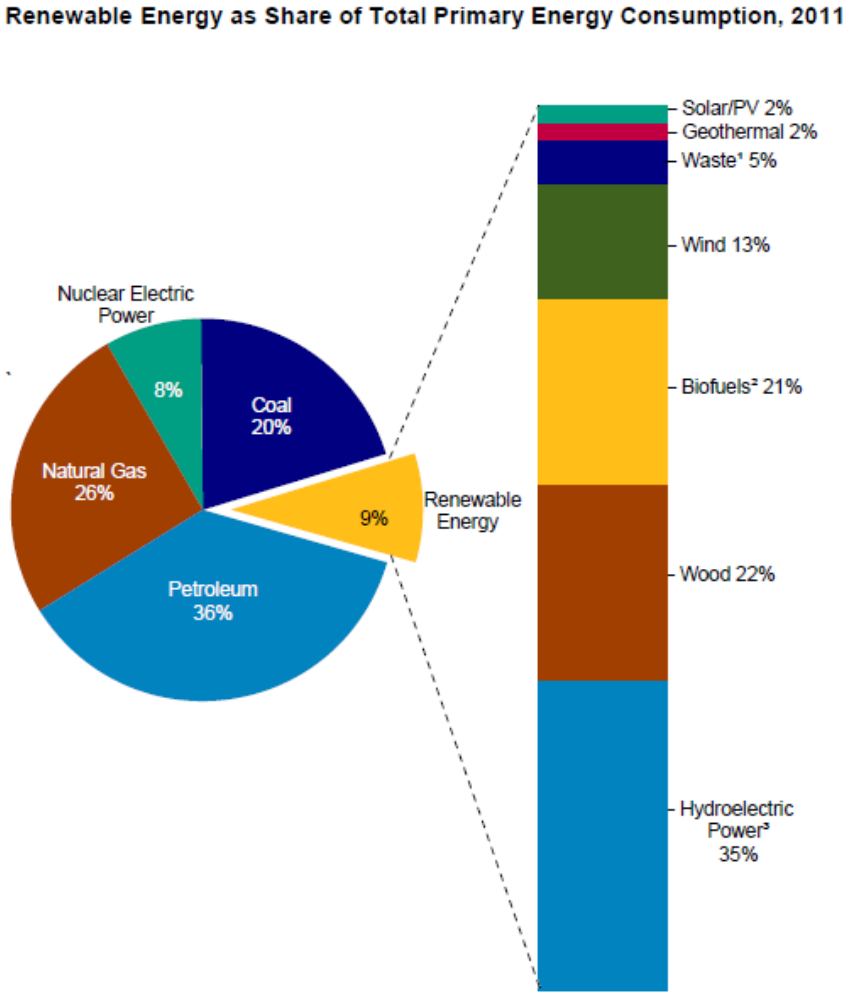
- US consumed 97.3 Quadrillion Btu
  - Produced 68.7 quadrillion Btu
  - Imported 28.59 quads exported 8 quads
  - Industry consumed approximately 31%
  - Transportation 28%
  - Residential 22%
  - Commercial 19%
- Total World Consumption 527 Quadrillion Btu
- World energy consumption is increasing rapidly in recent years
- Energy prices continue to increase



US Energy Use (Quads)

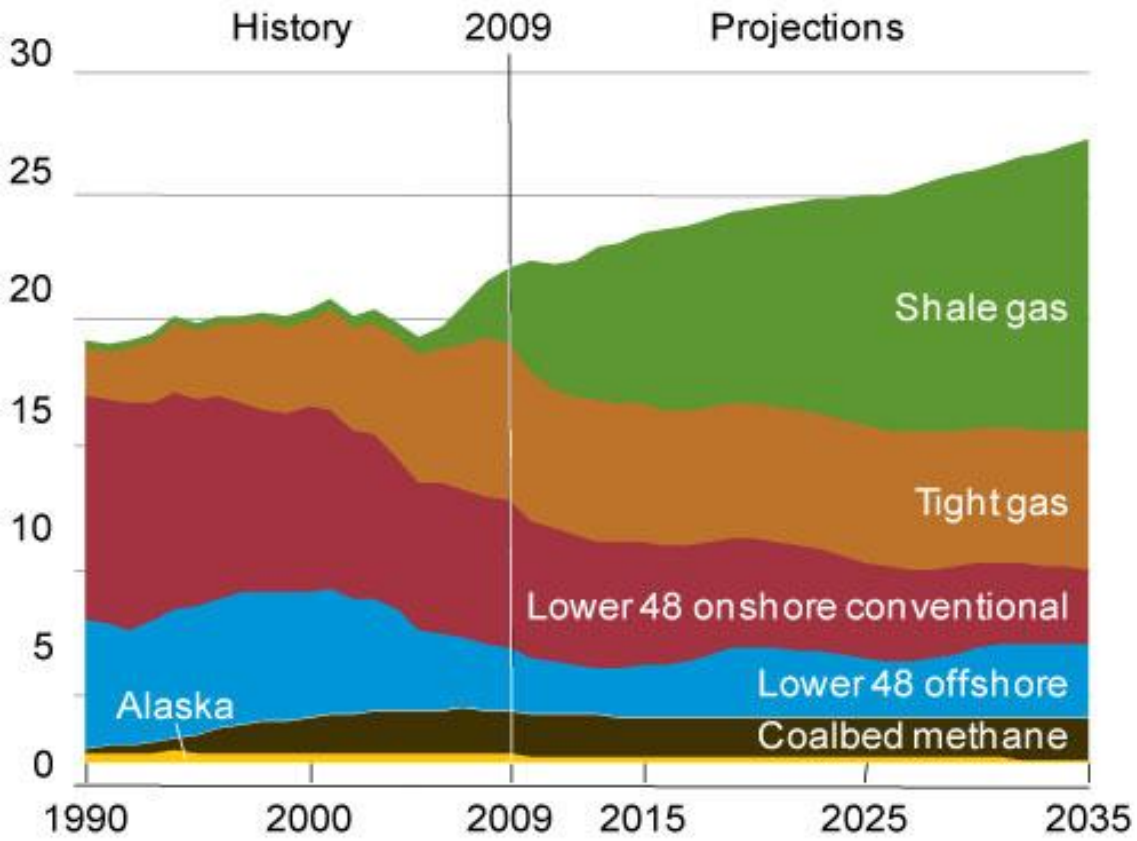


Renewable Energy Share in Primary Energy Mix

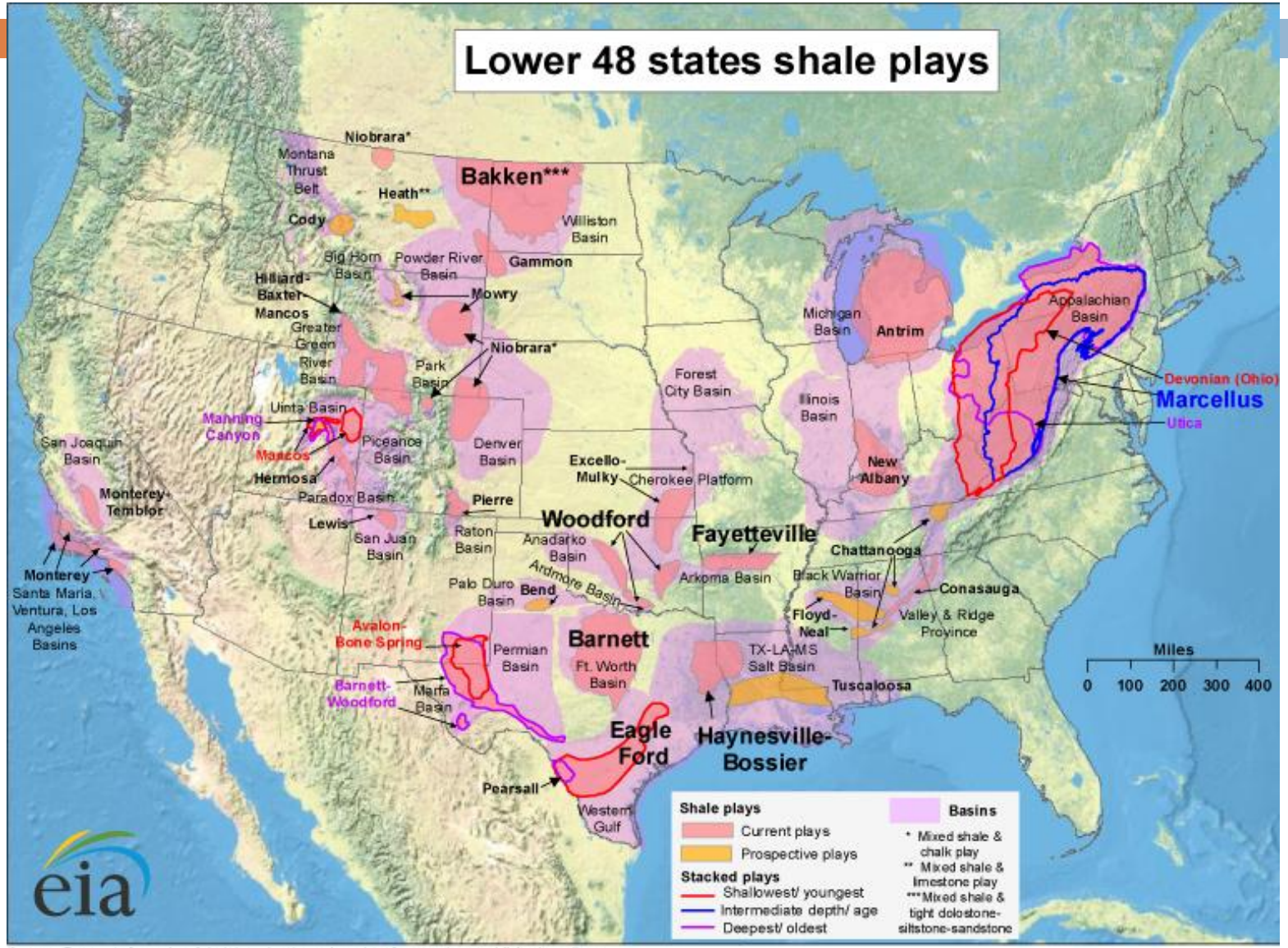


US Natural Gas Production

Figure 2. U.S. natural gas production, 1990-2035
(trillion cubic feet per year)



US Shale Gas Estimates



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

Total on shore shale gas in 48 states, **750 Trillion cubic feet**

AND

24 billion barrels of shale oil

Energy Management – ISO 50001 and SEP

ISO 50001 - Energy Management Standard

- Establishes a framework for industrial and commercial facilities and organizations to manage energy.
- Offers companies international approach for
  - Corporate sustainability programs
  - Energy cost reduction initiatives
  - Demand created along the manufacturing supply chain

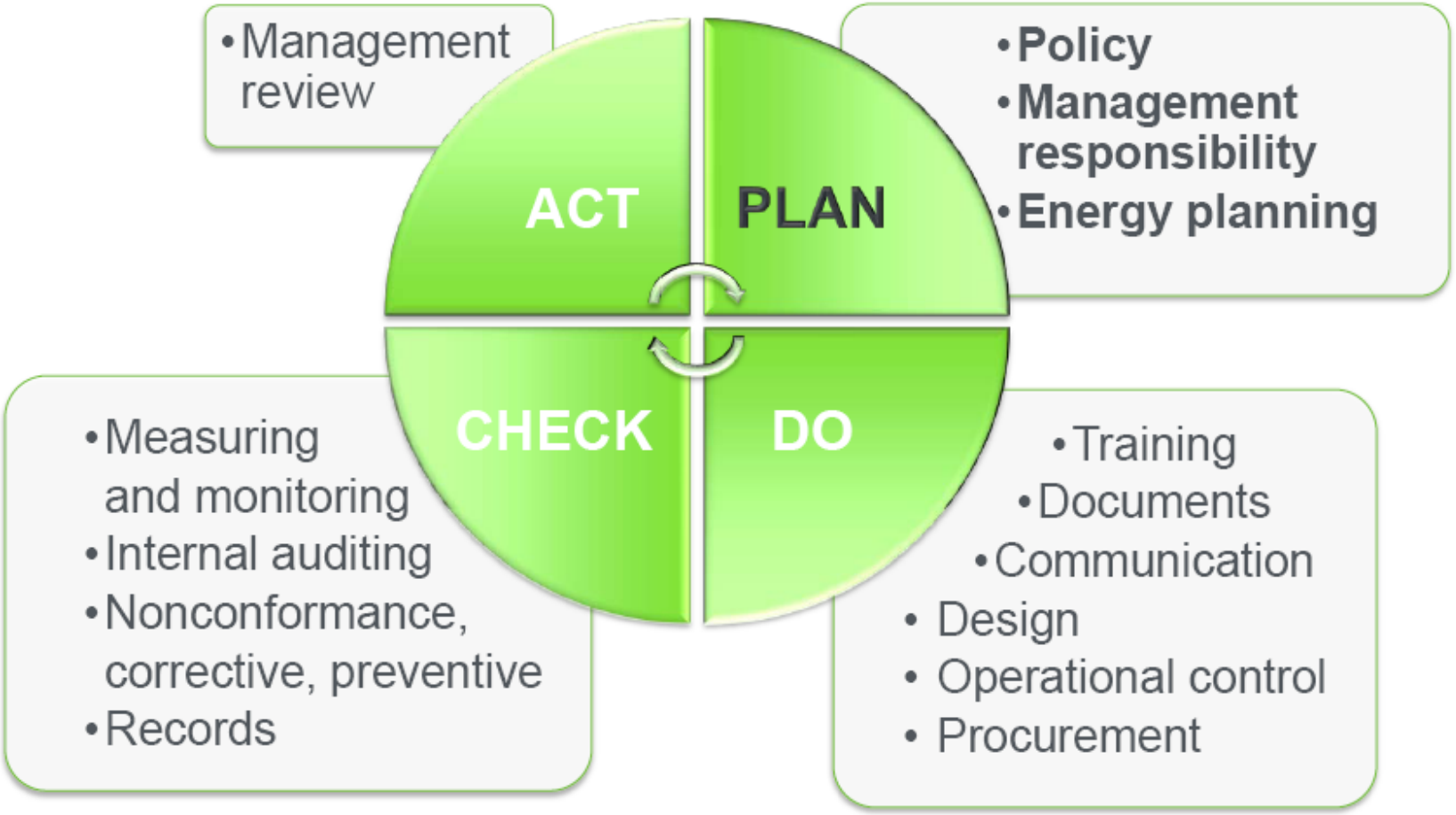
International Organization for Standardization

Status of ISO 50001

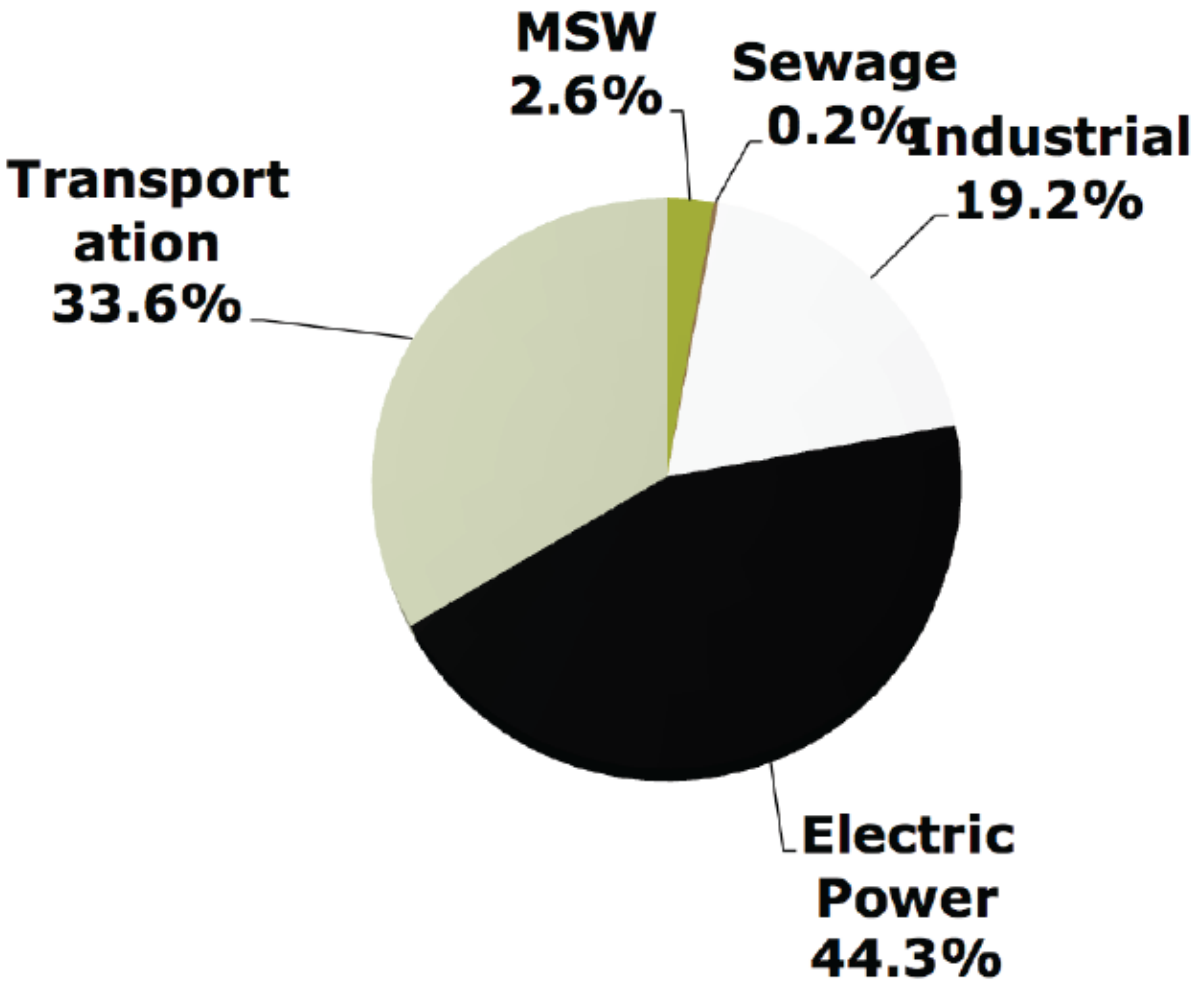
- **Published on June 15, 2011**
- Available for purchase from ANSI
- Developed by ISO Project Committee 242; United States and Brazil led effort with the United Kingdom and China
- 59 countries participated, 14 of which observed

http://www1.eere.energy.gov/energymanagement/index.html

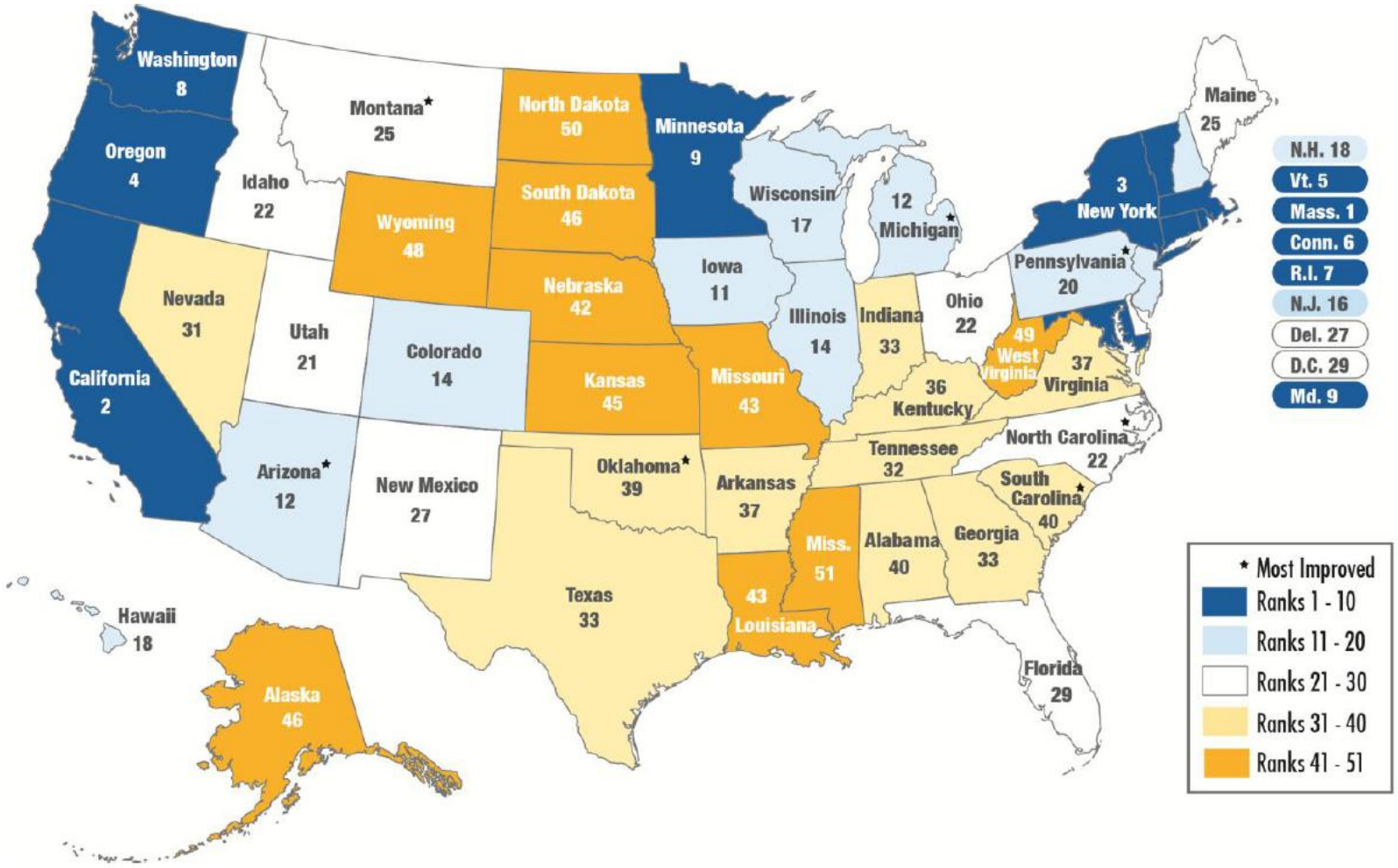
P-D-C-A to ISO 50001



Identified US Energy Waste Streams



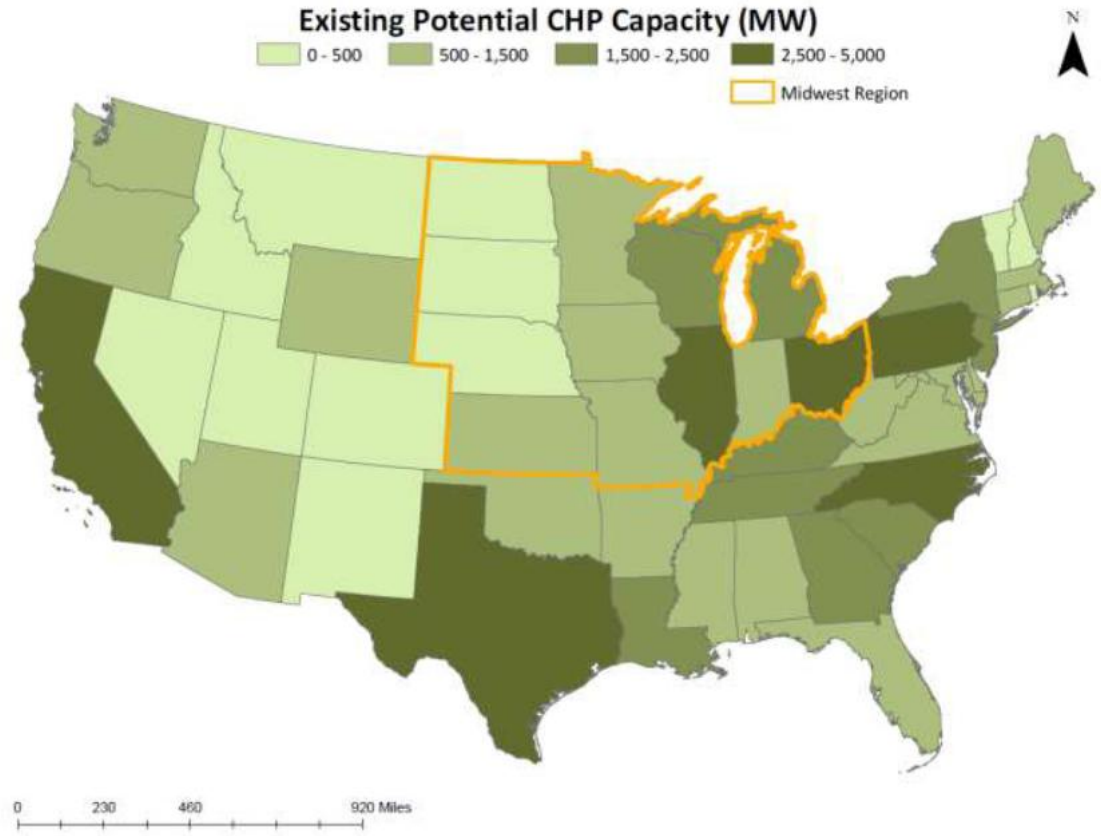
2012 ACEEE State Energy Efficiency Scorecard



What makes a State Energy Efficient ?

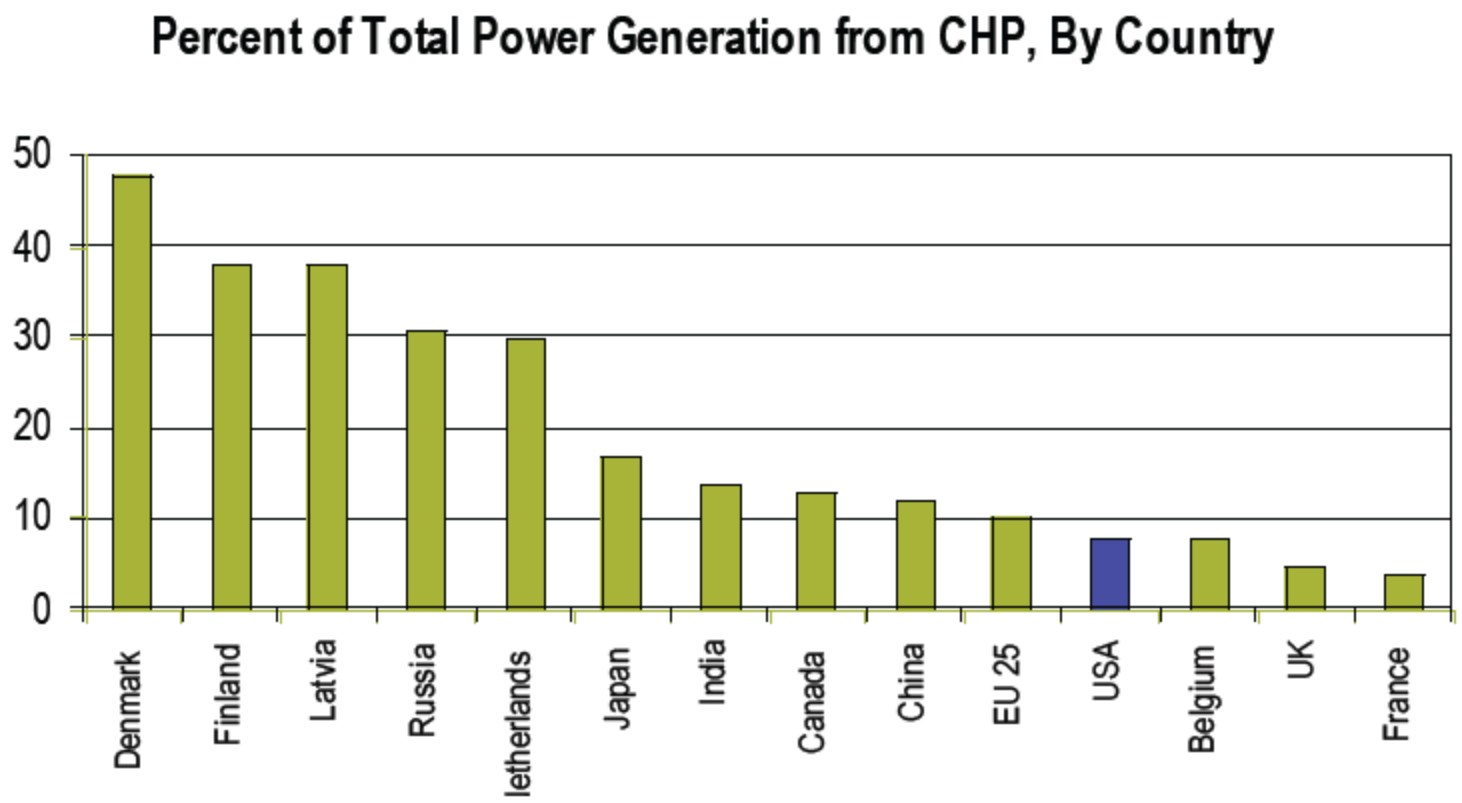
Policies and Regulations	Performance Implementing Programs
Energy Efficiency Resource Standards	Electricity Savings from Utility-Sector Energy Efficiency Programs
Utility Decoupling and Performance Incentives	Budgets for Utility-Sector Electricity and Natural Gas Efficiency Programs
Building Energy Codes	Building Energy Code Compliance Efforts
Tailpipe Emission Standards	Mass Transit Funding
Efficient Land-Use Policies	Financial Incentives for Energy Efficiency
Combined Heat and Power Policies	Research and Development
"Lead by Example" Policies for State Facilities and Fleets	
Appliance Efficiency Standards	

CHP – Technical Potential



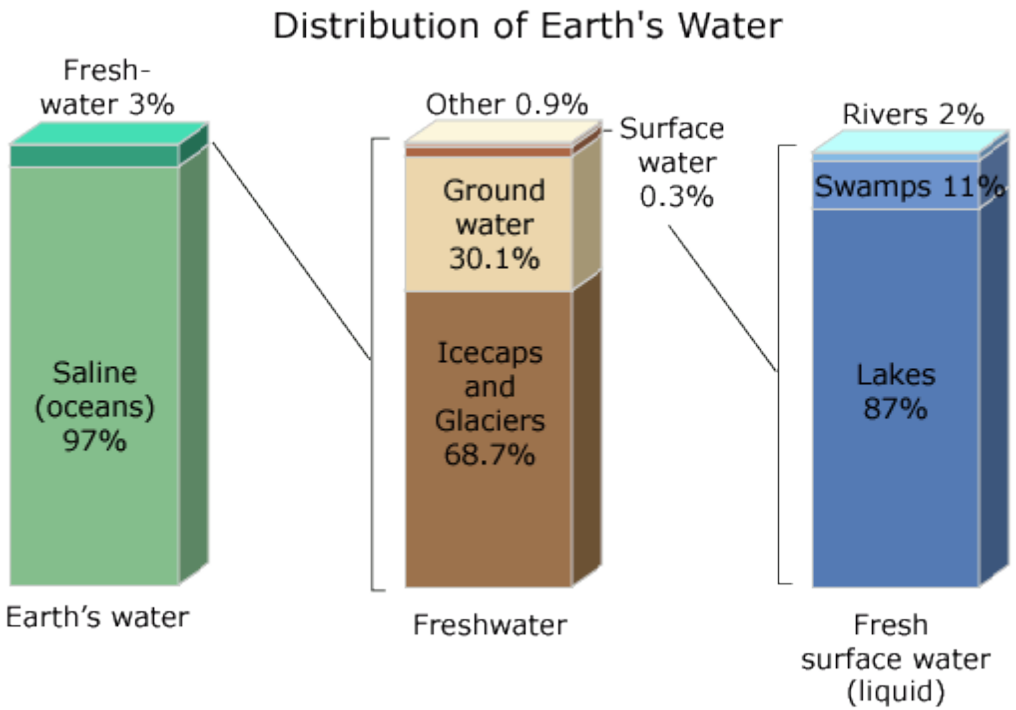
Source: Hedman B. (ICF) 2010. "Effect of a 30% ITC on the Economic Market Potential for CHP"

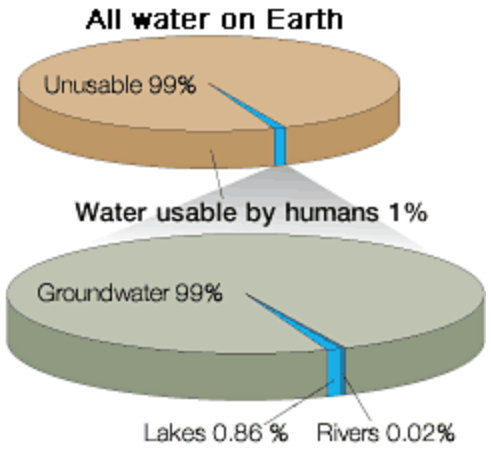
CHP today is 9% of US Power –
Potential for 2 -5 fold expansion



Energy Water nexus

- Distribution of water on Earth





Source: Water Science for Schools, US Geological Survey

Energy Water Nexus

- The major fresh water consuming sectors are not buildings – they are agriculture and thermoelectric power.
- Agriculture and thermoelectric use about 40% each, while buildings use about 12% of the supply.
- Our energy security is closely linked to the state of our water resources. Water resources are require to achieve any sort of energy security in the years and decades ahead.
- Our water security cannot be guaranteed without careful attention to related energy issues. The two issues are inextricably linked.

Energy Water Nexus

- Each kilowatt hour of electricity requires about 27 gallons of water.
- 500 MW coal-fired power plant requires over 12 million gallons per hour of water for cooling and other process requirements.

Energy Water Nexus

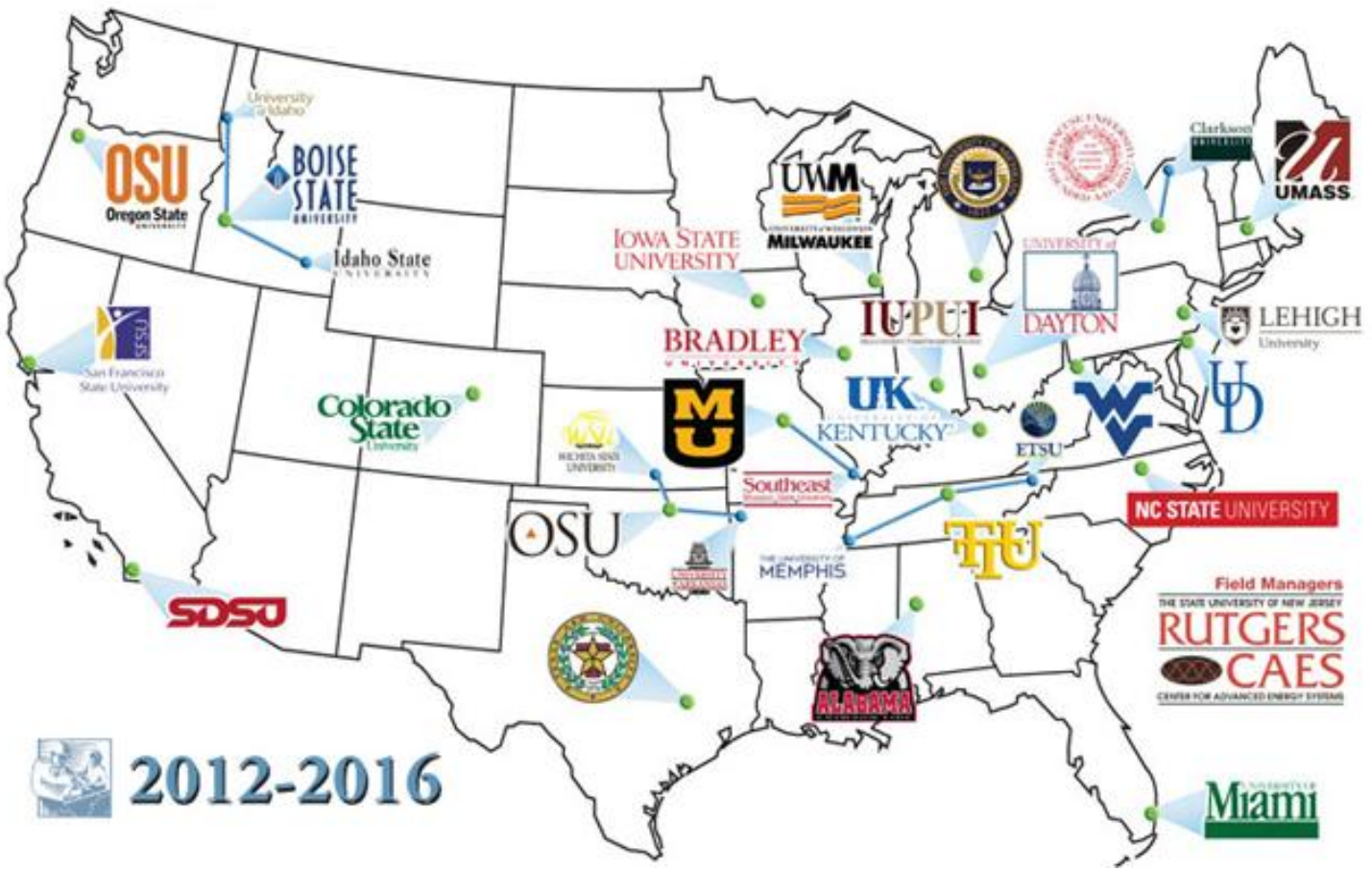
- We must greatly increase the energy and water efficiency of our built environment and agriculture.
- Water is going to be a bigger and tougher problem than energy to solve.
- Non-water based renewables must be our focus.

Industrial Assessment Center

Mission

To provide energy efficiency, waste minimization, and productivity improvement services

Industrial Assessment Centers (IAC)



Industrial Assessment Center

- DOE funded
- Additional funding from WVDE, WVDEP, EPA, USDA, Maryland Energy Agency (MEA)
- 24 Centers across the US
- Beginning 22nd year in IAC program
- Have conducted 473 energy assessments for manufacturing facilities (by WVU-IAC)
- Have conducted numerous energy assessments for commercial, institutional, and government buildings
- Research publications in peer reviewed journals and conferences
- Students graduating and finding jobs in the energy efficiency field

IAC Manufacturing Plant Selection Criteria

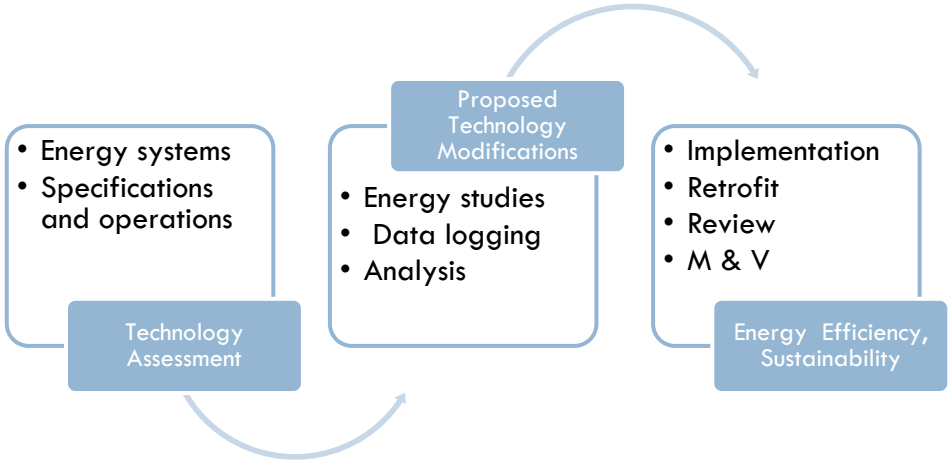
- Within (SIC) 20-39 or NAICS 31-33
- Within 150 miles of a host campus
- Gross annual sales below $100 million
- Fewer than 500 employees at the plant site
- Annual energy bills more than $100,000 and less than $2 million
- No professional in-house staff to perform the assessment

Exceptions

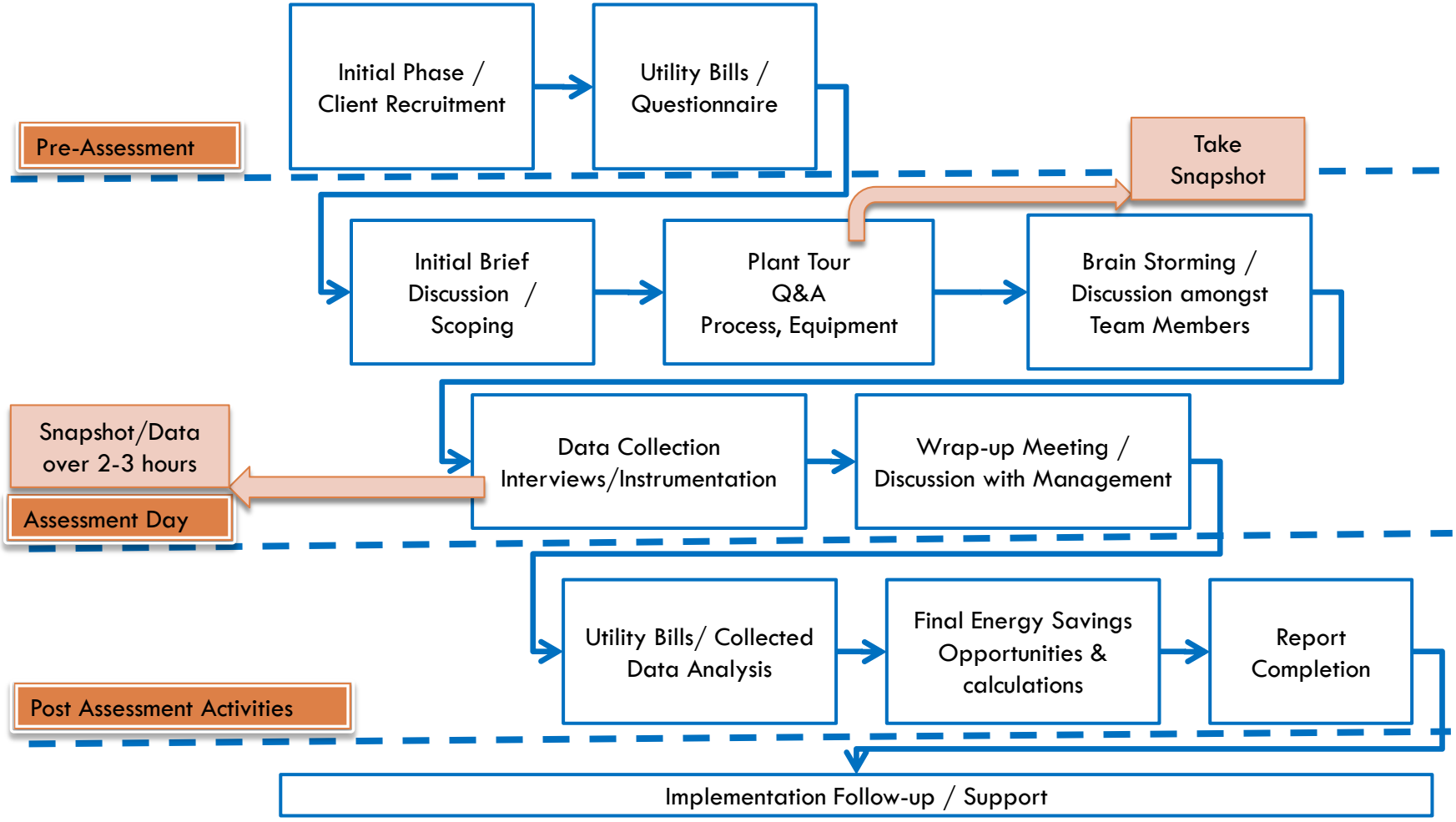
- Manufacturing plants in WV do not have to meet the criteria due to funding from WVDE
- The WVDEP grant allows energy assessments of government, institutional, and commercial buildings in specific counties in WV
- The Save Energy Now (SEN) grant from DOE allows energy assessments for large manufacturing facilities in WV and region
- The USDA grant allows energy assessments for small rural businesses in WV

IAC Assessment: Demonstrated Improvement

- Technology Assessment
- Delivered Results in terms of Energy Efficiency, Lower Energy Costs, Lower GHG Emissions



IAC Assessment Methodology



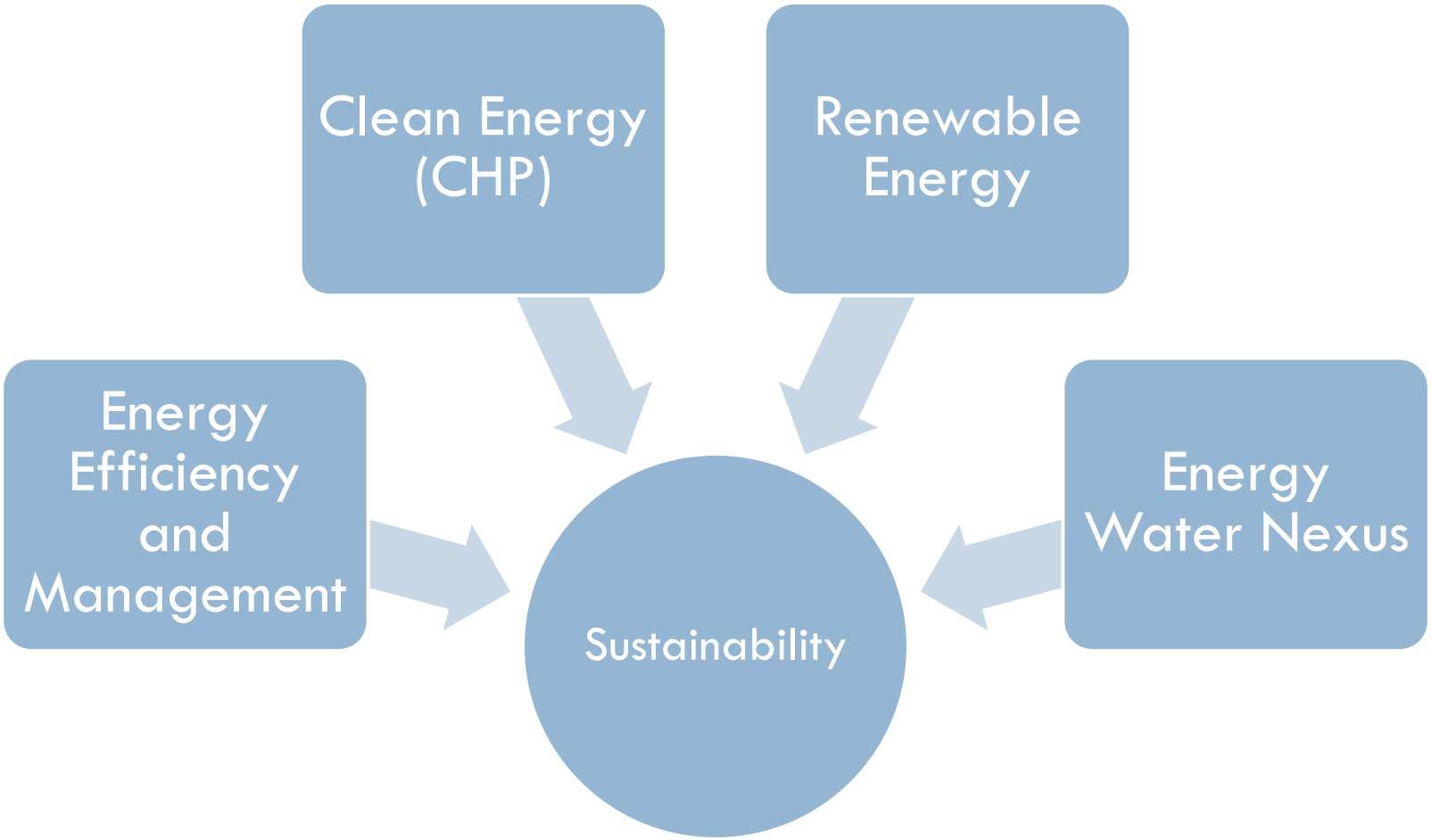
Impact of IAC – WVU

- Total energy saved: 5.4 Trillion Btu per year by 456 manufacturing facilities (implemented 2.38 TBTU/yr)
- Implemented projects worth of $11.6 million USD to achieve savings of $18.2 million USD
- Total CO_2 emissions saved: 711,410 tons per year (314,016 implemented)
- Demand savings separate
- Payback on investment: average less than 2 years

	Recommended Savings		Implemented Savings	
	Energy (MMBTU/yr)	Cost ($/yr)	Energy (MMBTU/yr)	Cost ($/yr)
Demand (kW-mo/yr)	408,174	4,050,585	200,002	1,980,503
Electricity	1,293,477	15,489,521	608,533	7,462,407
Natural Gas	3,334,920	24,995,890	1,149,785	7,777,808
Coal	369,048	1,048,973	254,787	554,048
Wood	377,716	257,478	147,520	135,493
Fuel Oil	106,978	895,474	43,997	417,937
Subtotal	**5,482,139**	**47,528,399**	**2,388,276**	**18,162,599**

CO_2 Savings	Recommended Savings (Tons)	Implemented Savings (Tons)
Electricity	414,992.69	195,238.69
Natural Gas	188,422.98	64,962.85
Coal	38,214.92	26,383.19
Wood	61,152.22	23,883.49
Fuel Oil	8,627.24	3,548.14
Total	**711,410.05**	**314,016.36**

Research Focus of IAC



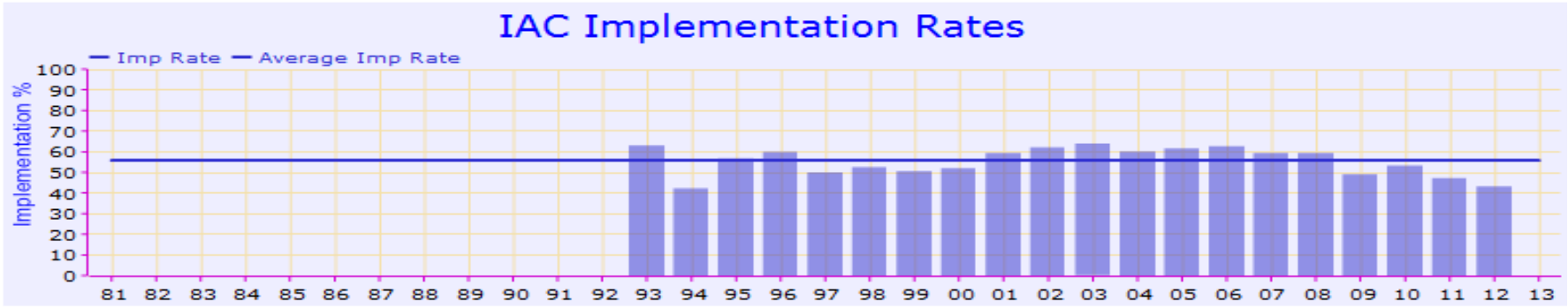
Research Partners

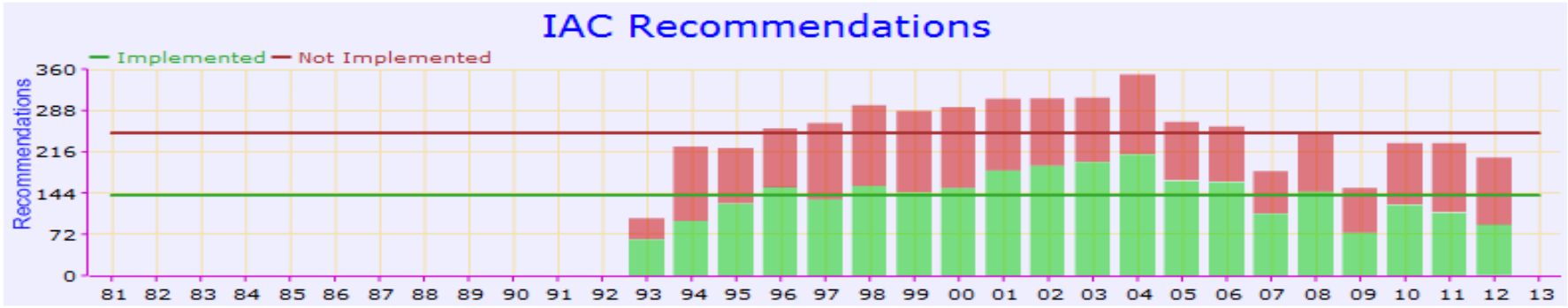
- DoE, EERE, NETL
- WVDE
- Industries of the Future WV (IOF-WV)
- WV Manufacturing Extension Partnership (WV MEP)
- International Lead Zinc Research Organization (ILZRO)
- WVDEP
- Pennsylvania DEP
- EPA
- USDA
- PPG
- Bayer
- DN American
- Lawrence Berkeley National Laboratory
- Oak Ridge National Laboratory

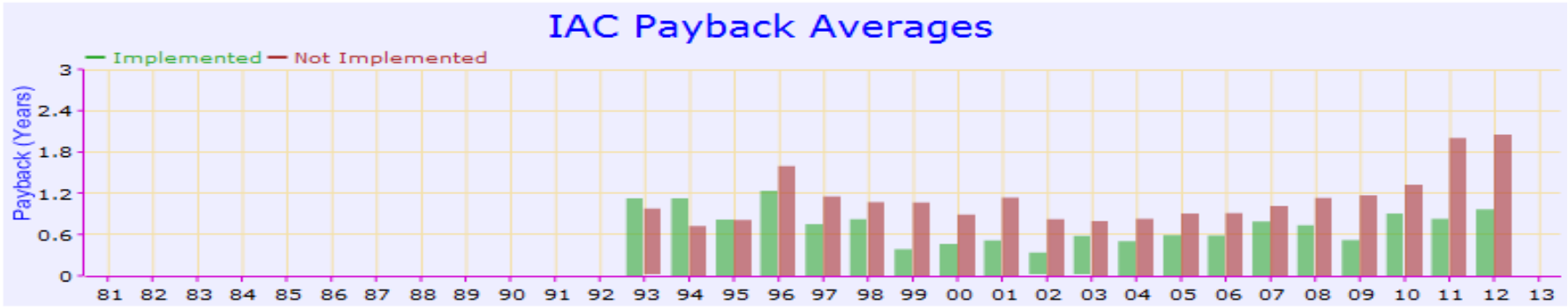
IAC Energy Efficiency Improvement Focus Areas

- Electrical Systems
- Lighting
- Compressors
- Motors (Fans, Pumps, etc.)
- HVAC
- Steam
- Process heating

Implementation







Recent Energy Assessments in WV

- Steel of WV, Huntington
- Rubberlite, Huntington
- Northwest Pipe, Washington
- Quad Graphics, Martinsburg
- Ply Gem, Martinsburg
- Koppers, Follansbee
- Flying W Plastics, Glenville
- Silgan Plastics, Wheeling

Organizations employing students

- Honeywell
- Oak Ridge National Laboratory
- Bombardier
- CASCO
- Sieben Engineering
- Hudson Technologies
- GE
- American Axle

QUESTIONS ?

It is our Earth……we cannot live anywhere else….

* Promote sustainability *