

New Hampshire State Energy Perspectives

By

**Joseph C. Broyles
NH Office of Energy and Planning**

For

**New Hampshire Joint Engineering Societies'
2nd Annual Joint Engineering Societies Conference
Manchester, NH
October 9, 2008**

OEP: Who We Are

- An office within the governor's office.
- The Office of Energy and Planning is an executive level agency of 24 positions. Its mission is to support planning that enhances the state's economic growth while preserving its unique character and natural beauty; and to advocate sound energy policies that encourage the use of renewable resources, reduce energy demand and constrain energy price increases.

OEP: Energy Activities

- **Administer several energy-related programs including fuel assistance program, weatherization assistance program, state heating oil and propane price (SHOPP) monitoring**
- **Statutorily designated member of over 30 regulatory and advisory boards, including the energy planning advisory board (EPAB) and energy facilities site evaluation committee (FSEC)**
- **Compile, and analyze supply energy/price data to state agencies, the legislature and the public**
- **Conduct education outreach on energy conservation and efficiency, renewable energy, energy aspects of planning and other topics related to energy assurance**

Energy: The 30,000 Foot View

- **US: less than 5% of global population**
- **US: 25% of global petroleum consumption**
- **US: 25% of global CO₂ emissions**
- **US imports up to 60% of its petroleum (vs. 54% in 1970s when US goal was oil independence)**
- **NH mostly mirrors national picture**
- **Energy imports account for a major portion of our trade imbalance**
- **Global oil production capacity exceeds demand by about 1.5% at most**
- **Growing global competition for energy that was once “ours” to buy**
- **Energy use is implicated in climate change**

Energy At The State Level

Energy powers everything we do, thus impacts

- **Business competitiveness and profitability**
- **Budget planning - municipal, business, home**
- **Local economy**
- **Local taxes**
- **Cost of providing/maintaining infrastructure**
- **Cost of providing services**
- **Environmental quality**
- **Quality of life**
- **How and where we live, work, re-create**

New Hampshire Energy: Then and Now

Table 1. Changes in NH Population, Energy Use and Expenditures (inflation adjusted) for Energy, 1970-2005

Population	Total State Energy Use	Total Expenditures for Energy
170%	180%	287%

Table 2. New Hampshire Population, Economy and Energy Costs, 2005

Type of Data	Value	US Rank
NH Population	1.3 Million	41
NH Total Net Energy Consumption	335.4 TBtu	45
Gross Domestic Product (GDP), 2005 Dollars	\$54,119,000,000	41
Energy Expenditures, 2005 Dollars	\$4,582,000,000	42
Energy Expenditures/Person, 2005 Dollars	\$3,516	29
Average Energy Price per TBtu	\$18,680,000	8
Average Energy Consumption/Person, TBtu	257.4	45
Energy Expenditures/GDP	8.5%	N/A

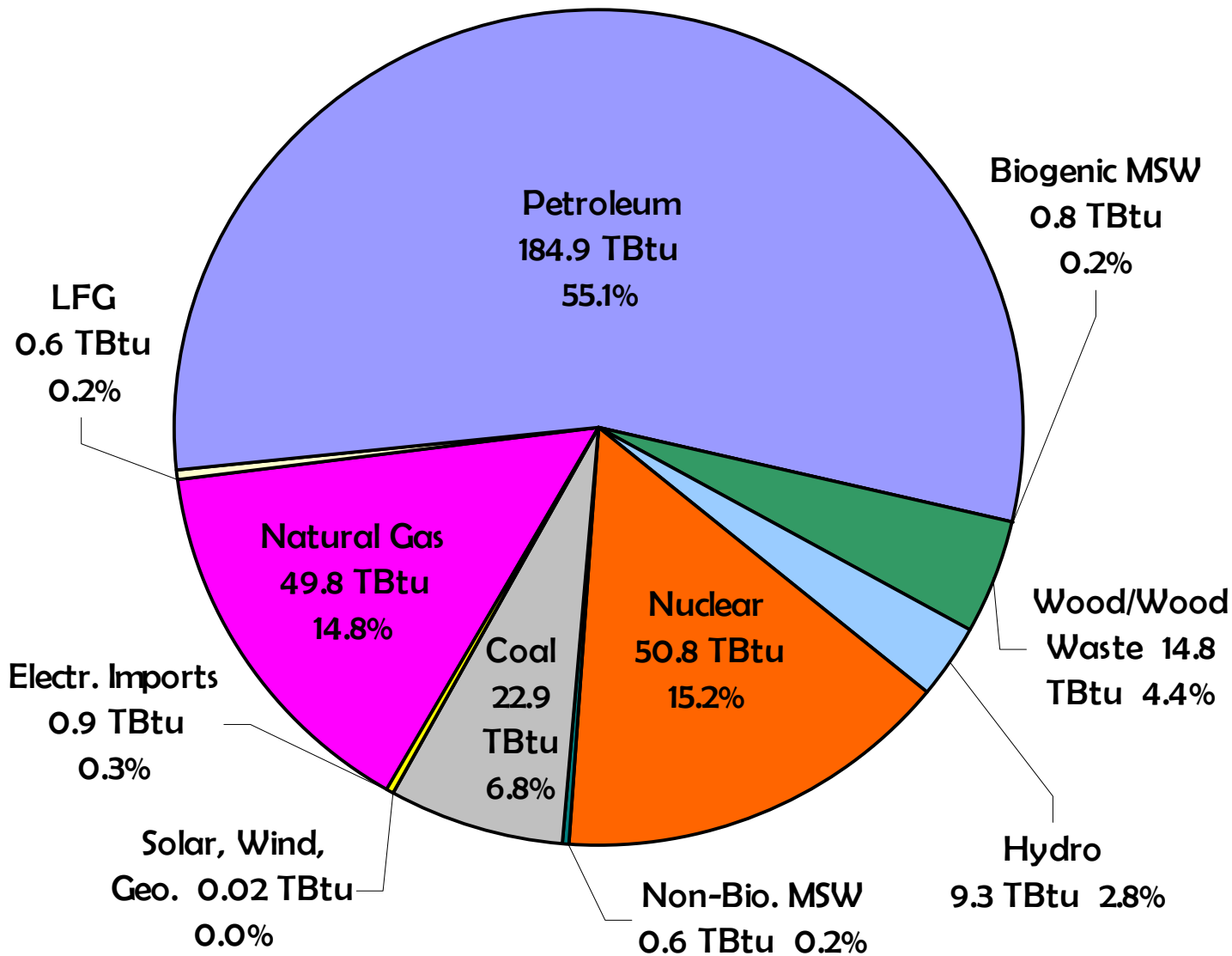
2005 NH Energy Consumption Overview

Summary of 2005 NH Energy Consumption by Source and Economy Sector, in Trillions of British Thermal Units (TBtu)

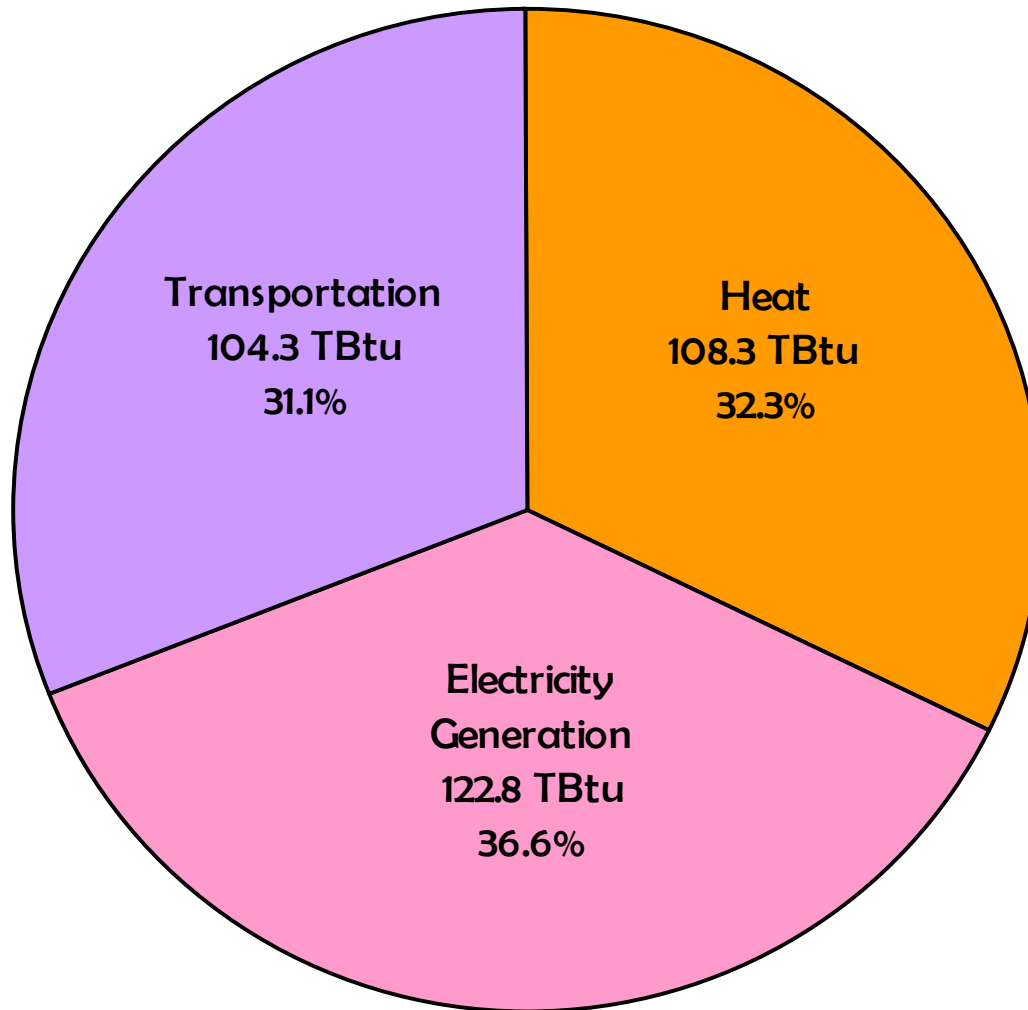
Gross Non-Renewable Energy Inputs 408.4 TBtu																		
< Uses	Petroleum 191.5 TBtu																Nuclear	Muni. Solid Waste
	Coal	Natural Gas	Asphalt/Road Oil	Aviation Gasoline	Distillate (Elec.)	Distillate (Heat)	Distillate (Transp.)	Jet Fuel	Kerosene	LPG (propane)	Lubricants	Motor Gasoline	Residual Fuel	Other	Petroleum Total			
Totals >	44.2	73	6.8	0.3	0.8	41.5	14.8	2.6	3.7	10.5	0.4	88.2	21.8	0.2	191.5	98.5	1.2	
Sector:																		
comm.	0.1	10				9			0.4	1.3		0.1	7.9		18.6			
industr.		7	6.8			4.6			0.2	1.5	0.1	1.8	0.9	0.2	16			
residen.		8				27.9			3.2	7.6					38.7			
transp.				0.3			14.8	2.6			0.3	86.3			104.3			
elec.gen.	44.1	48			0.8								13		13.8	98.5	1.2	

Gross Renewable Energy Inputs 42.1 TBtu													Totals			
< Uses	Biomass 22.3 TBtu												< Uses	Gross Energy Inputs (Primary Energy)	Electricity Exports and Associated Losses	Total Net NH Energy Consumption
	Muni. Solid Waste	Wood/Wood Waste	Landfill Gas	Biodiesel/Bioheat	Ethanol	Sewer/Manure Gas	Pyrolysis Liq/Gas	Geothermal	Hydro	Solar PV/Thermal	Wind	Electr. Net Imports				
Totals >	1.5	19.6	1.2	0.0	0.0	0.0	0.0	0.01	18.0	0.05	0	1.7	Totals >	450.5	-115.1	335.4
Sector:													Sector:			
comm.		0.4								0.02			comm.	29.2		29.2
industr.		6.6						0.1					industr.	29.8		29.8
residen.		2.7						0.01		0.03			residen.	49.4		49.4
transp.													transp.	104.3		104.3
elec.gen.	1.5	9.9	1.2						17.9			1.7	elec.gen.	237.8	-115.1	122.7

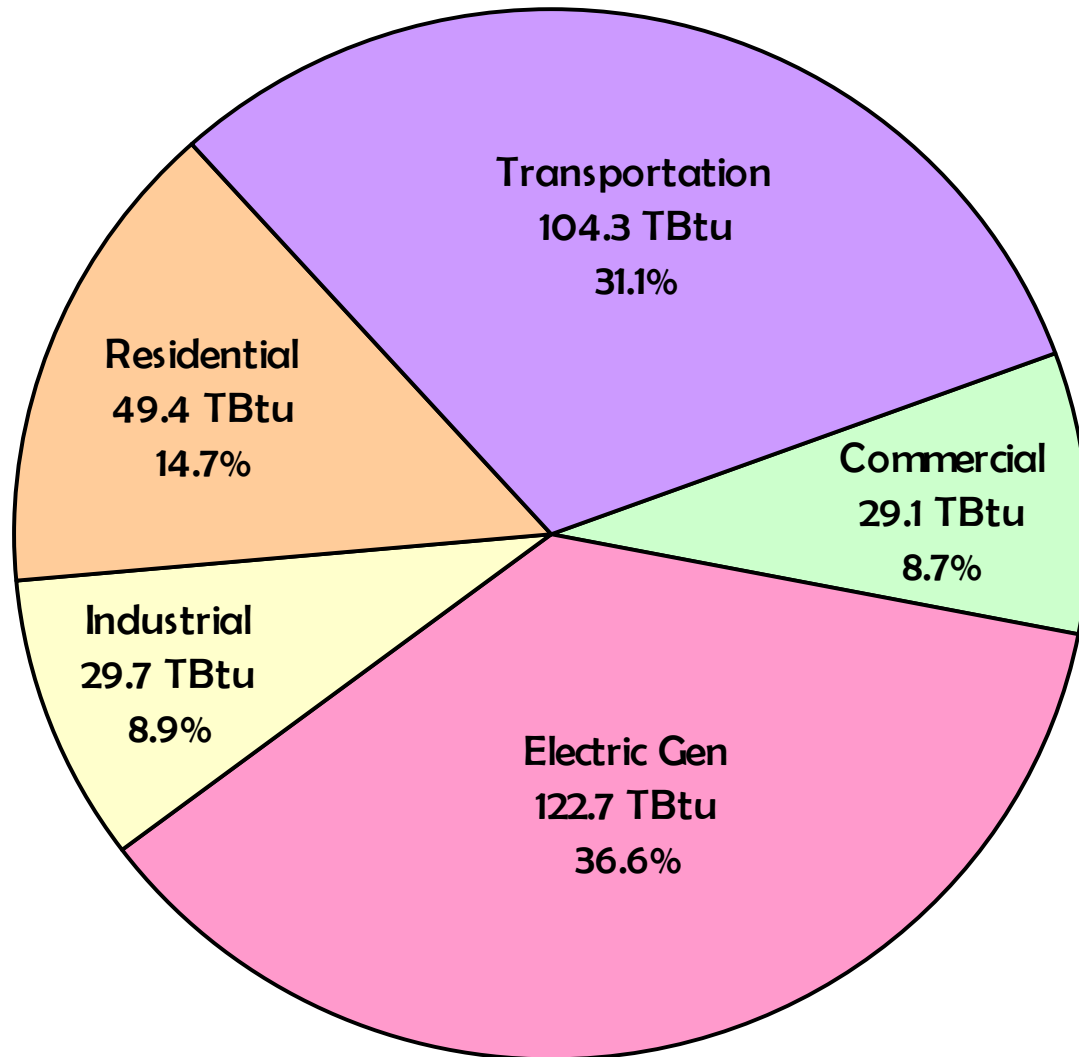
**Net Energy Use (excluding electricity exports) 2005:
335.4 TBtu**



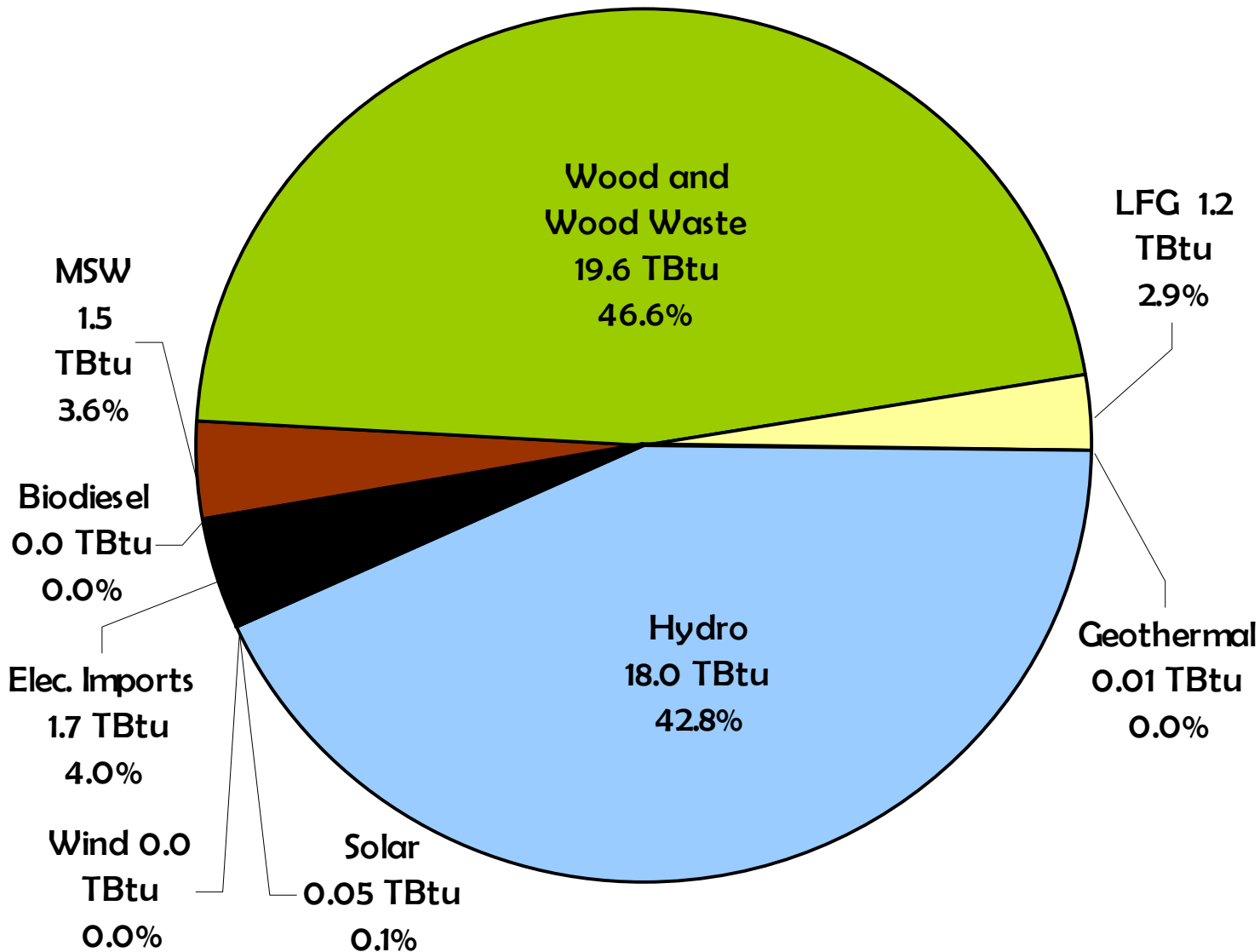
**NH Net Energy Use
by End Use Type 2005: 335.4 TBtu**



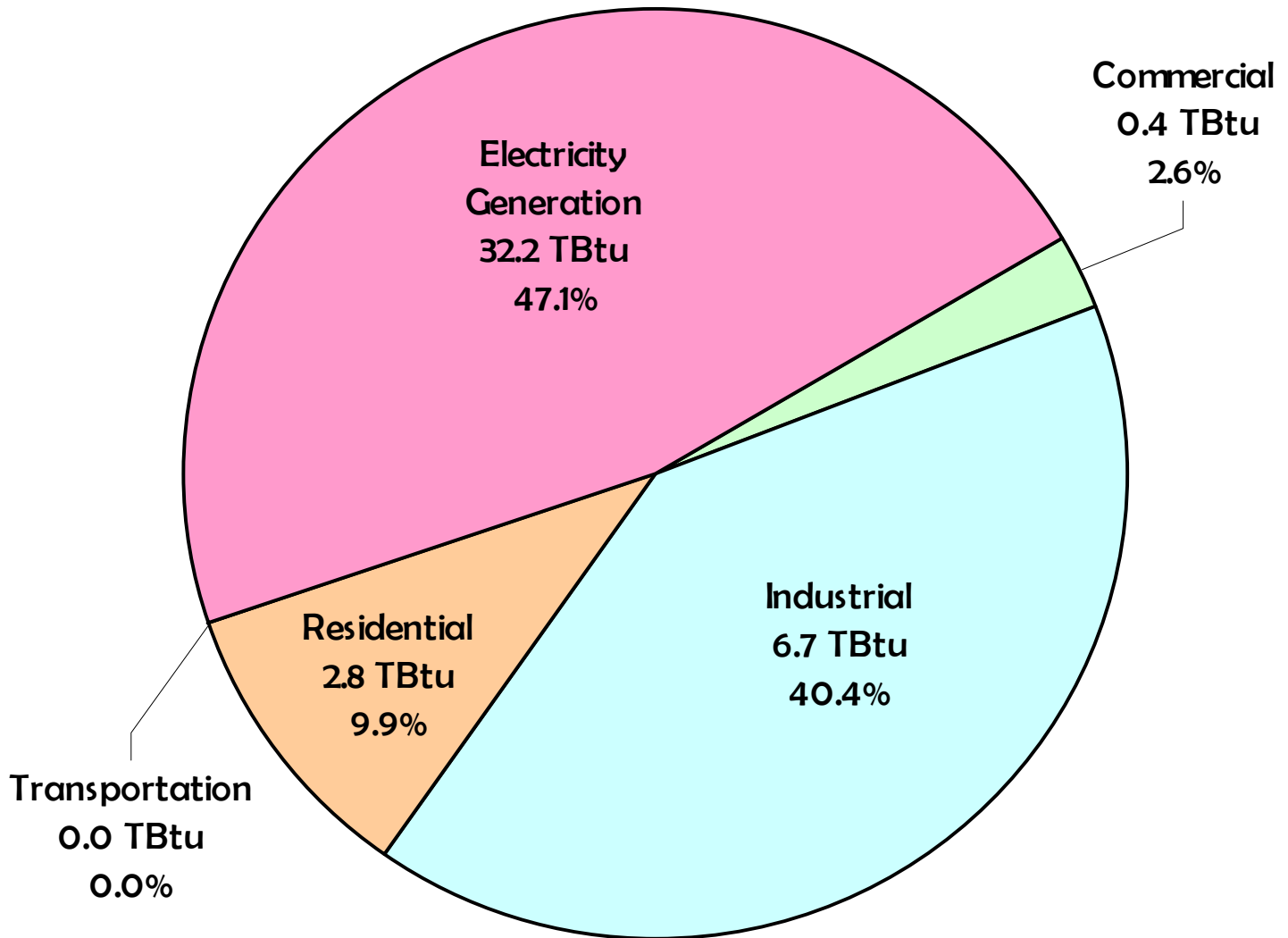
Net Energy Use by Sector 2005: 335.4 TBtu



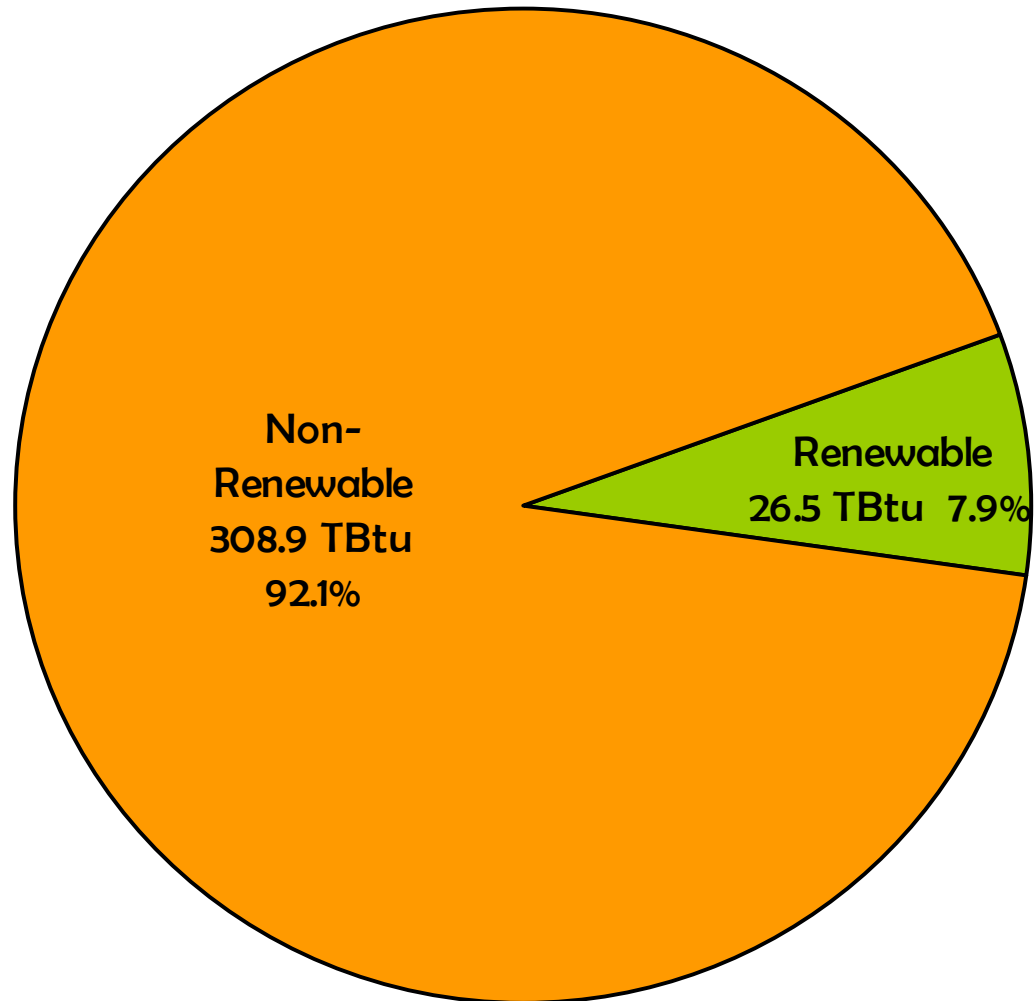
**Gross Renewable Energy
Use by Type 2005: 42.1 TBtu**



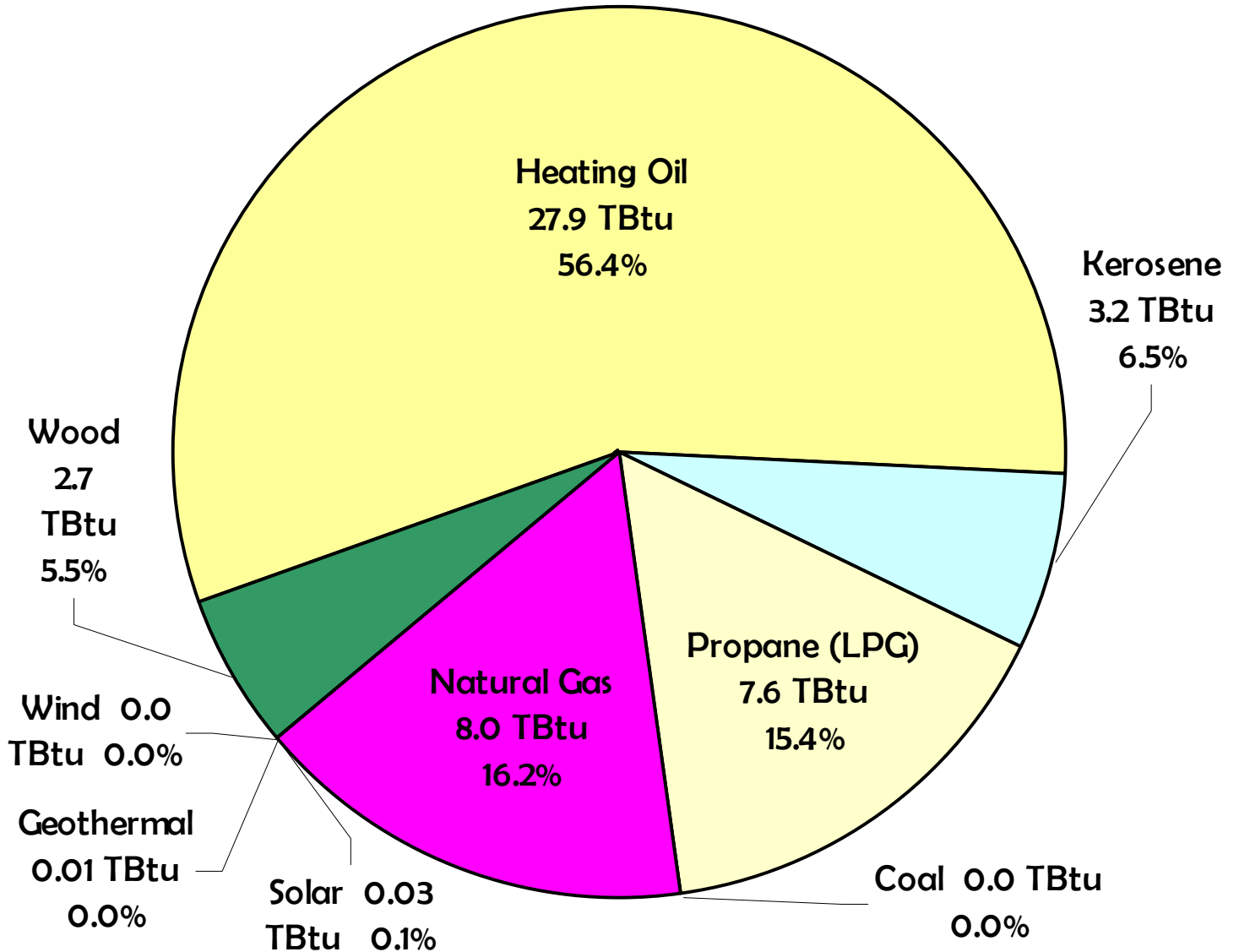
**Gross Renewable Energy Use
by Sector 2005: 42.1 TBtu**



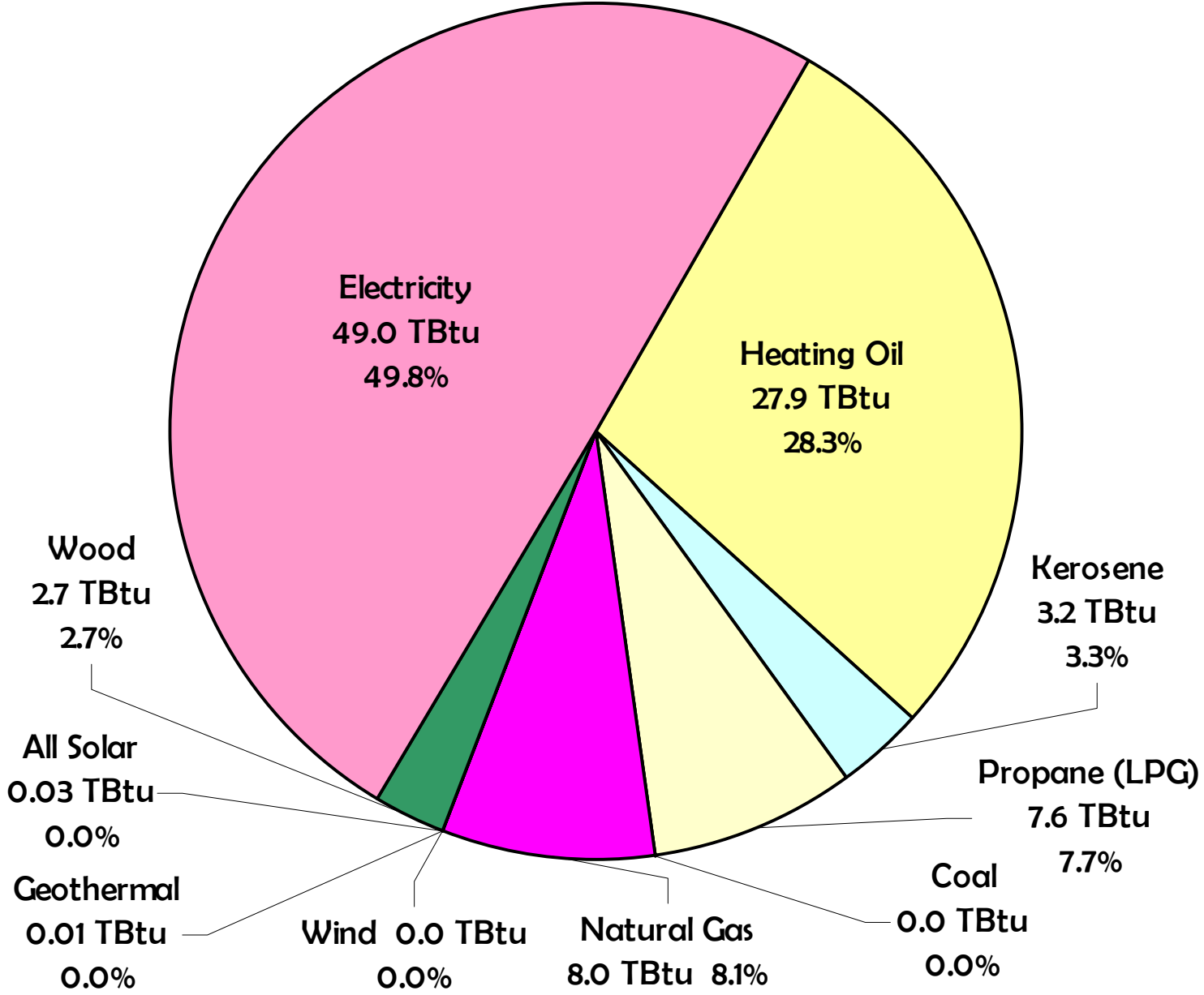
Net Energy Use (excluding exported electricity) 2005: 335.4 TBtu



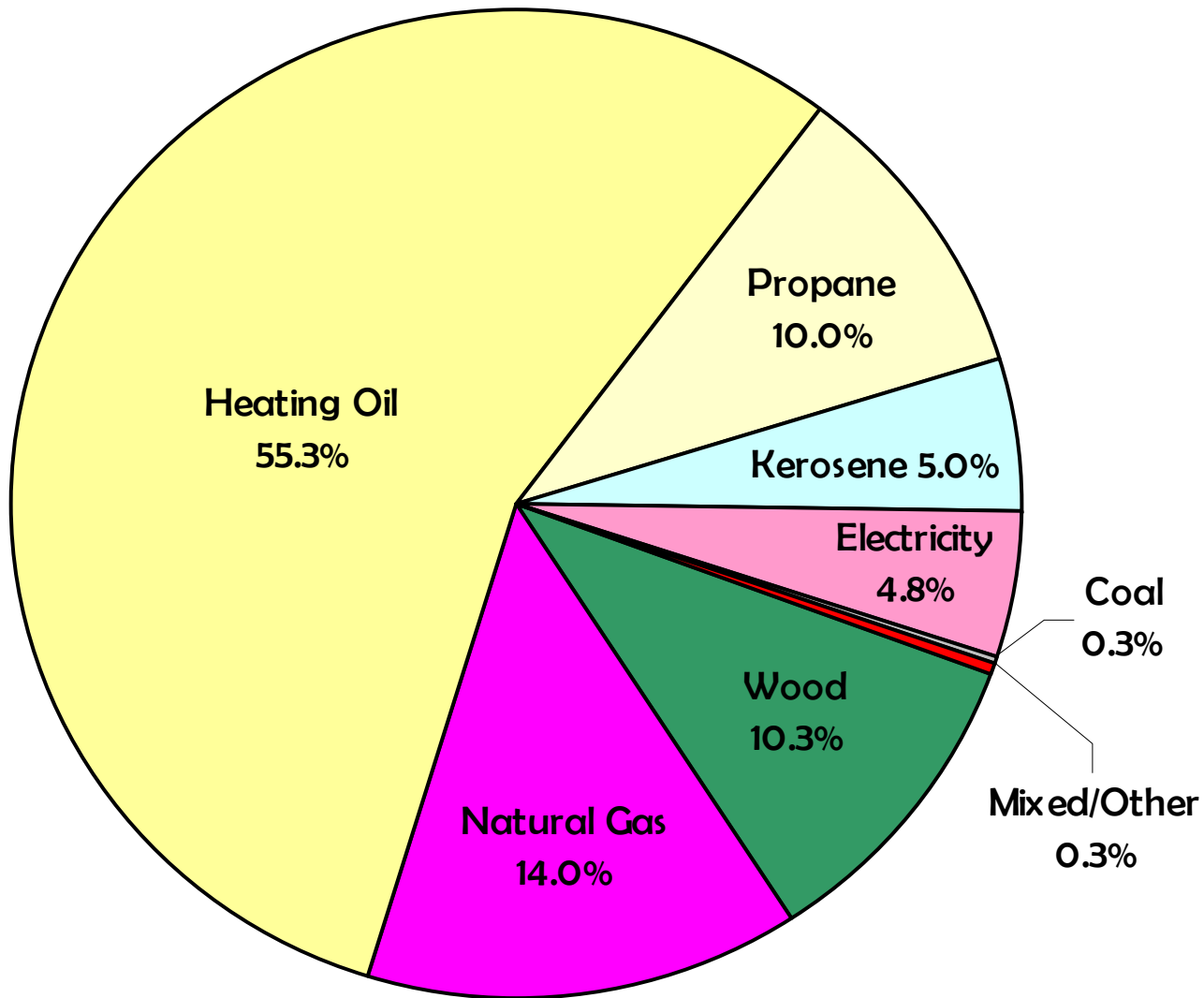
**Residential Sector Non-Electric Energy
Use 2005: 49.4 TBtu**



Residential Sector Total Energy Use 2005: 98.4 TBtu



**Percentage of NH Households Heating
with Different Fuels, 2000**



NH Petroleum Fuel Consumption, 2005

- 4.1 **million** gallons per day
- 1.5 **billion** gallons per year
- These were **3.8** and **1.4** respectively in 2003
- *NH energy demand growth > population growth*

ALL FOSSIL FUELS (COAL, PETROLEUM PRODUCTS, NATURAL GAS) and URANIUM USED IN NH COME FROM OUT OF STATE!

Source:

http://www.eia.Doe.Gov/emeu/states/hf.jsp?incfile=sep_use/total/use_tot_nh.html&mstate=new%20hampshire

NH Fossil Fuel Costs 2005, \$ Nominal

\$2.9 billion

Of which

\$2 billion or 70%

(conservative assumptions and calculation)

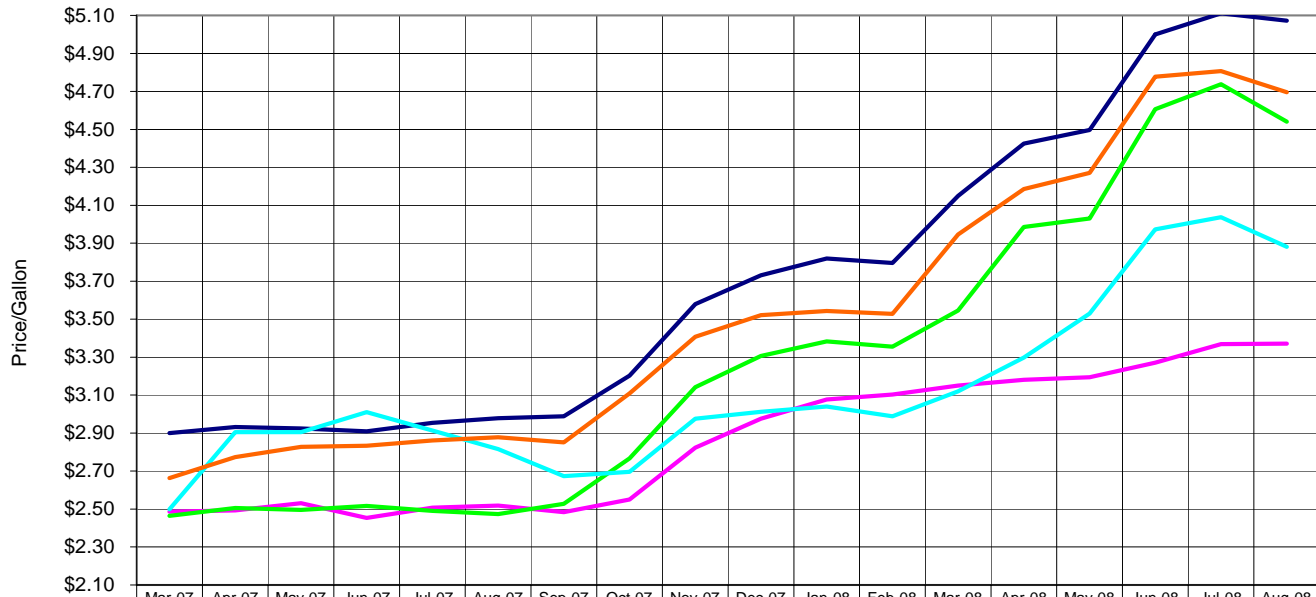
Was exported from NH

Expenditure data source:

[http://www.eia.Doe.Gov/emeu/states/hf.jsp?incfile=sep_prices/
total/pr_tot_nh.Html&mstate=new%20hampshire](http://www.eia.Doe.Gov/emeu/states/hf.jsp?incfile=sep_prices/total/pr_tot_nh.Html&mstate=new%20hampshire)

18 Month NH Petroleum Fuels Prices Trends

New Hampshire Eighteen Month Price Trend
for Petroleum-Based Fuels
March 2007 - August 2008



	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08
— Kerosene	\$2.900	\$2.932	\$2.925	\$2.910	\$2.954	\$2.978	\$2.988	\$3.202	\$3.580	\$3.731	\$3.820	\$3.796	\$4.149	\$4.425	\$4.497	\$5.000	\$5.111	\$5.073
— Propane	\$2.486	\$2.493	\$2.530	\$2.453	\$2.507	\$2.518	\$2.483	\$2.550	\$2.823	\$2.976	\$3.077	\$3.103	\$3.150	\$3.181	\$3.194	\$3.270	\$3.369	\$3.372
— #2 Heating Oil	\$2.464	\$2.506	\$2.496	\$2.516	\$2.490	\$2.474	\$2.528	\$2.767	\$3.142	\$3.307	\$3.383	\$3.355	\$3.547	\$3.986	\$4.030	\$4.607	\$4.738	\$4.541
— Regular Gasoline	\$2.499	\$2.905	\$2.905	\$3.011	\$2.914	\$2.816	\$2.673	\$2.696	\$2.976	\$3.012	\$3.040	\$2.989	\$3.120	\$3.299	\$3.530	\$3.974	\$4.037	\$3.881
— Diesel	\$2.664	\$2.773	\$2.828	\$2.833	\$2.861	\$2.877	\$2.852	\$3.109	\$3.408	\$3.521	\$3.543	\$3.528	\$3.946	\$4.186	\$4.271	\$4.777	\$4.807	\$4.696

NH Electricity Expenditure Estimate 2005, \$ Nominal

\$1.4 billion

Source:

http://www.eia.Doe.Gov/emeu/states/hf.jsp?incfile=sep_prices/total/pr_tot_nh.Html&mstate=new%20hampshire

Total NH Energy Expenditure Estimate 2005, \$ Nominal

\$4.6 Billion (net of electricity exports)

Source:

http://www.eia.Doe.Gov/emeu/states/hf.jsp?incfile=sep_prices/total/pr_tot_nh.Html&mstate=new%20hampshire

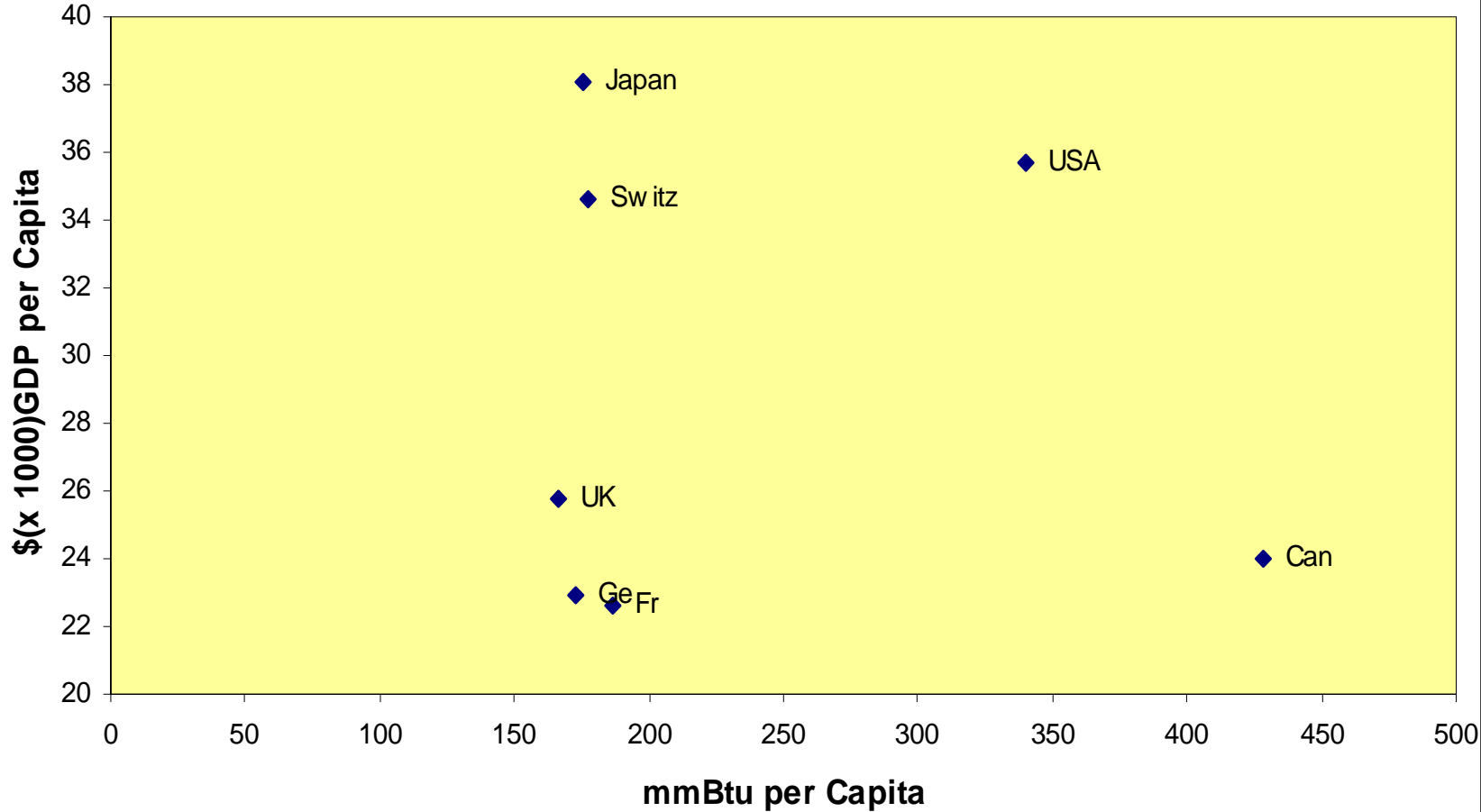
Modeling Exported Energy Dollars

OEP Estimate of Dollars That Were Exported from NH to Purchase Diesel Fuel and #2 Oil, 2004			Hypothetical Illustration of Dollars That Could Have Been Retained if NH-produced Biodiesel Had Been in Use, 2004		
NH Diesel Fuel and #2 Oil End Uses	\$Million Nominal Spent	\$Million Nominal Exported	NH Diesel Fuel and #2 Oil End Uses	\$Million Nominal Exported	\$Million Nominal Retained
Electricity generation	8.3	7.1	Electricity generation (if B20)	7.1	1.4
Heat	479.6	410.1	Heat - all uses (if B5)	410.1	20.5
Transportation	222.4	182.1	Transportation (if B20)	182.1	36.4
Totals	\$710.3	\$599.3	\$Million Nominal Retained:		\$58.4

Why Assume Price Trend Will Continue?

- **“Plan for the worst, hope for the best” - in “business as usual” paradigm**
- **Geopolitical considerations:**
 - **Growing demand for petroleum and natural gas**
 - **Crude oil production barely exceeds demand**
 - **Crude oil price influences other energy prices**
 - **Political/social unrest in oil producing regions - even fear of unrest – drives up futures prices**
- **Increasing costs for exploration and production of new petroleum and natural gas resources**
- **Increasing compliance and environmental costs for exploration and production**

Energy, Dollars and Standard of Living



Data sources:

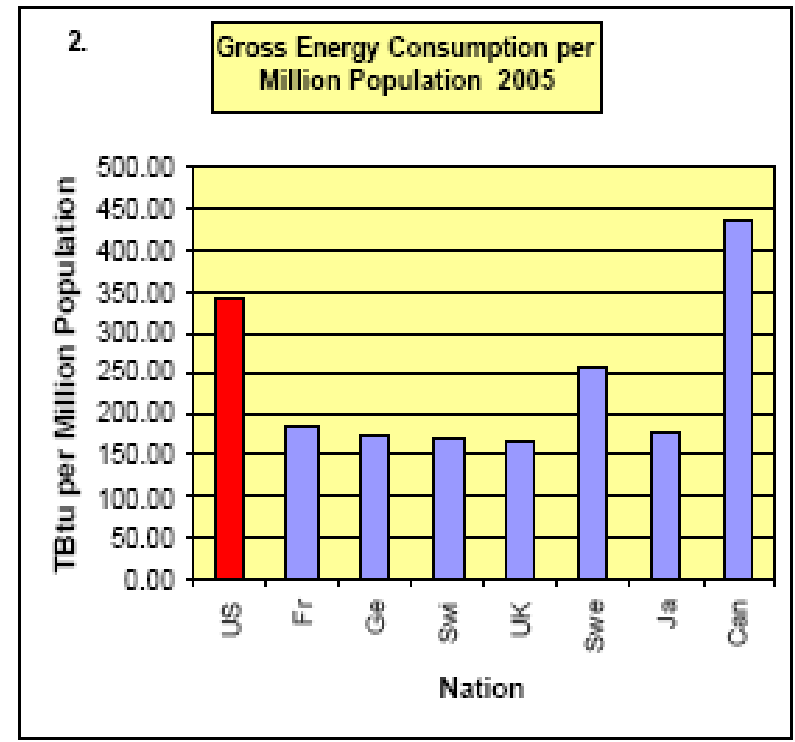
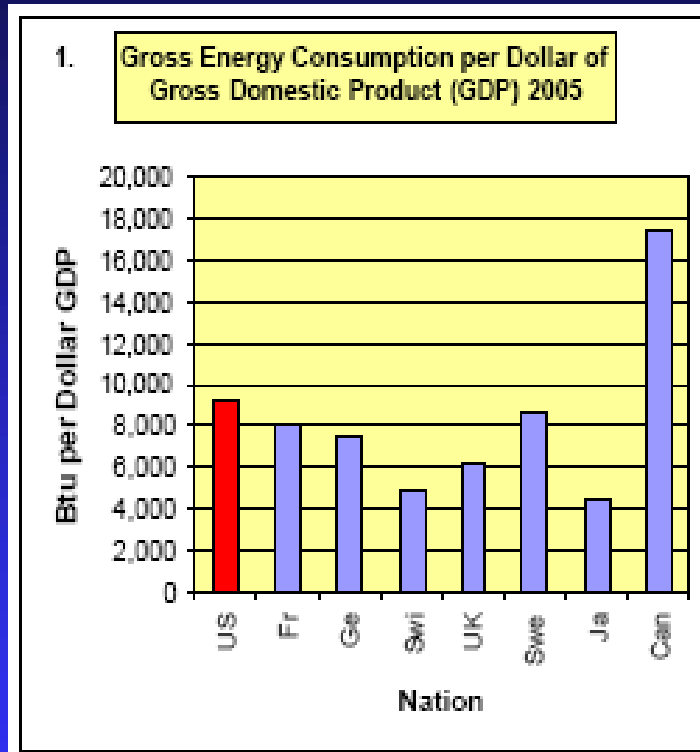
www.eia.doe.gov/pub/international/iealf/tableb2c.xls

www.eia.doe.gov/pub/international/iealf/tablee1c.xls

What We Can See (And Not See) in the Preceding Graph:

- US is relatively inefficient; Implications for US companies' competitiveness are obvious
- US could improve efficiency considerably and still have a quality of life comparable to that in nations with whom we tend to compare ourselves
- Where's china? Definitely a competitor nation in many sectors – but there are difficulties in obtaining useful data and in comparing very different quality of life criteria

Energy Efficiency and Quality of Life Comparisons: Another View



Implication from either view: We can become much more efficient and economically competitive with little or no impact on our quality of life (NH efficiency is approximately equal to US average shown here).

Where to Find Price Projections

- The US department of energy (DOE) makes projections, some to regional level, but not for individual states:
 - Short-term energy outlook US (monthly)
<http://www.eia.doe.gov/emeu/steo/pub/contents.html>
 - Annual energy outlook 2008 with projections to 2030 <http://www.eia.Doe.Gov/oiaf/aeo/index.html>
 - International energy outlook worldwide projections to 2030 <http://www.eia.doe.gov/oiaf/ieo/index.html>
 - Investment banks and brokerage houses make projections. They may not project for single states.

What Will Energy Prices Do in Future?

- **OEP Does not and cannot make projections:**
 - Too many variables
 - Even the “experts” are stymied. Example: Price volatility since Spring 2008
 - Risks accusation of government influencing a free market
- **However, long- term record shows generally rising prices. Given a finite planet, growing world population and rising standards of living in developing nations, expectation of rising prices is not unreasonable.**

The NH Energy Supply Future?

Some “high profile” energy sources in the media;
Most people are familiar with potential benefits of:

- Solar
- Geothermal
- Wind
- Biomass
- Nuclear
- “Hydrogen economy”

- *But: how to compare, analyze and choose?*

Concepts You Can Always Use

- It costs energy - and thus money - to get energy.
- Generally, getting energy uses more energy than the energy you can use.
- Sometimes we pay that price to get convenience.
- Using energy translates, usually, into using money.
- Using small, localized, renewable energy sources:
 - Enhances energy assurance/security.
 - May help stabilize prices.
 - Keeps dollars in local or regional economies.
- Renewable energy sources cannot supply 100% of our energy demands, and may never be able to.

Information, Continued...

- Technologies and economics change so much and so suddenly that it is not really feasible to recommend a particular option for a specific location or application.
- When considering an energy choice, it is helpful to ask where it came from and what was involved in getting it to you. “Involved” includes political, social, economic, energy costs and environmental impacts.
- Also: how does it match your specific location, needs, use patterns?
Examples?
- And: experts abound (see resources links >).

Some “High Profile” Energy Sources

- **Solar – both thermal and electric (PV)**
 - **Very different technologies and costs**
 - **These work in NH; There is enough sunlight**
- **Geothermal (geoexchange)**
 - **Practical all over NH for heating and cooling**
 - **Electric generation potential is not known**
 - **Economics of deep drilling to heat source may be a factor; Improved technology may change this**
- **Wind – to generate electricity**
 - **Not always available (time)**
 - **Very site-specific availability over short distances**
 - **Aesthetically controversial**
 - **Disputes over bird/bat kills; site choice may be key**

“High Profile” Sources, Cont’d.

- **Biomass – Definition varies. Included here are liquid fuels such as ethanol and biodiesel, often treated separately as “biofuels”:**
 - **NH forest wood resource is underutilized**
 - **Cellulose (wood) - to ethanol may be more energy-efficient than corn – to – ethanol; but technology may not yet be economically competitive with corn-derived ethanol**
 - **“Biorefinery” concept on the horizon?**
 - **Non-hydro energy for electricity generation (mostly wood) was about 7% of total, 2005**
 - **Can NH grow field crops to produce biodiesel?**

Note: Biofuels have less energy/gallon than petroleum fuels, precluding some uses, such as jet fuel.

Still More “High Profile” Sources...

- Nuclear - Two major processes:
 - **Thermonuclear fusion** (controlled)
 - a) Still experimental; commercialization horizon seems always to be 50 years in the future...
 - b) Energy cost to obtain hydrogen “fuel”?
 - **Nuclear fission** (all current nuclear power plants)
 - a) No known plans to build another in NH
 - b) Future of nuclear power industry is unclear:
 - Controversy rages on many aspects
 - Permitting/approvals process and economics may determine nuclear power’s future

And More...

- **“Hydrogen economy”:**
Desire for a common “energy currency”, yet:
 - **Costly technical challenges in handling hydrogen**
 - **Energy costs to obtain hydrogen are significant**
 - **Hydrogen can also be separated from carbon-based materials such as petroleum, but**
 - a) **costs a lot of energy**
 - b) **can release carbon dioxide, a greenhouse gas**

Fuel cells notes:

- **Run on hydrogen, often from carbon-based fuel**
- **Carbon-based fuels release carbon dioxide, a greenhouse gas**
- **Mainstream commercialization awaits more durable membranes, less costly fuel cells**

Creating the NH Energy Future

- A mix of energy sources may be the most practical way to meet our large energy demands while providing more energy assurance and price stability

A good start: 14.5% of the electricity generated in New Hampshire in 2005 came from renewable sources, mainly hydropower and biomass.

AND (*not* “or”):

- The least expensive, least polluting, least price-volatile, most secure, most “renewable” energy is the energy you do not consume!

NH Government Is Active:

- **HB 873 (2007)** proposes a renewable portfolio standard (RPS) for NH electricity generation
- **Gov. Lynch** calls for 25% renewable energy by '25
www.nh.gov/governor/news/082906energy.htm
- **Governor Lynch** directs state government to reduce energy use by 10%
- **System benefits charge** on electricity bills supports energy conservation www.nhsaves.com
- **Natural Gas energy conservation programs**
www.northernutilities.com/business
www.keysenergy.com/psbusiness/energy/saving_nh_kednh.jsp
- **Building energy efficiency codes**
www.puc.nh.gov/EnergyCodes/energypg.htm

Energy Efficiency and Renewable Energy Information Resources

- **NH Office of Energy and Planning** www.nh.gov/oep See links in Quick Assistance box, including NH Energy Facts, source of pie charts and energy overview table. See also the [OEP Programs](#) and [Resource Library](#) links.
- **NH Public Utilities Commission** www.puc.nh.gov/ PUC regulates natural gas, electricity and also administers the building energy codes.
- **NH Industries of the Future** www.nhiof.org/toolbox/
- **New Hampshire Sustainable Energy Association** www.nhsea.org
- **Plymouth Area Renewable Energy Initiative** www.plymouthenergy.org
- **Legislation:** http://www.gencourt.state.nh.us/bill_status/quick_search.html Note: Type in Bill # with no gap: HB873.

Recent State Actions

Governor Lynch's Executive Order 2005-4 requires a 10% reduction in energy use by state government.

25 x '25 Initiative - Governor Lynch (2006) committed NH to this national effort to obtain 25% of our energy from renewable sources by 2025. [6.6% in 2004; significant increases expected in 2006 data due to 10% ethanol in most gasoline consumed in NH; also gains in other renewables]

HB 873 (2007) Establishes a renewable portfolio standard (RPS) requiring a percentage of electricity sold in NH to come from renewable energy sources. People and companies who generate electricity from renewable energy and deliver it into the grid will also be able to sell renewable energy credits.

Public Utilities Commission (PUC) Rule 2500 (2008) and **HB 1628 (2008)** provides details of renewable energy funding, required by RPS law. Final details pending; funds anticipated to become available in or after July 2009. See <http://www.puc.nh.gov/> for progress updates.

Recent State Actions, Cont'd.

HB 1561 (2008) Established an Energy Efficiency and Sustainable Energy Board. Check for progress at <http://www.puc.nh.gov/> .

HB 1631 (2008) Directs Dept. of Transportation to purchase fuels containing specified amount of biodiesel.

HB 1632 (2008) extends Biodiesel Study Commission created by **HB 689 (2007)** to investigate feasibility of establishing biodiesel production and markets in NH. See report at 2008 Legislature extended Commission for another year; final report due November 2008.

Thermal Renewable Study Group created by **HB 873** to determine feasibility of establishing a thermal renewable standard analogous to the (electricity) Renewable Portfolio Standard of **HB 873**. Report due by end of November 2008.

HB 310 (2008) empowers and establishes guidelines for cities and towns to regulate small wind power installations; many details proscribe “unreasonable” restrictions or requirements.

Joseph C. Broyles
Energy Program Manager

NH Office of Energy and Planning
4 Chenell Drive
Concord NH 03301
603-271-8341
joseph.broyles@nh.gov

www.nh.gov/oep