Heating Oil Conservation and Fuel Switching

Summary:

Demand Side Management (DSM) for Heating Oil

This initiative aims to replace or upgrade inefficient household appliances that utilize fuel oil with more energy-efficient models. This initiative recognizes potential for additional greenhouse gas (GHG) reductions through fuel switching from heating oil to natural gas but DEP does not have any data with which to estimate the potential for fuel switching because it is largely dependent upon the rate of natural gas distribution line expansion.

Goal:

DSM for Heating Oil

Residential sector: Achieve 37 percent reductions from reference case oil consumption in 2020.
Commercial sector: Achieve 26 percent reductions from reference case oil consumption in 2020.

Natural Gas

Fuel switching to natural gas can also yield significant reductions in greenhouse gas emissions. Fuel switching to natural gas has increased dramatically with the significant decrease in natural gas prices and is expected to continue. However, large geographical areas of the Commonwealth still do not have access to natural gas, including urbanized areas of the southeast. Additionally, there are numerous neighborhoods where natural gas is available on one street but not another. Fuel switching to natural gas was not quantified in this work plan because of:

- The difficulties assessing the extent of the distribution pipeline build out that may be possible through 2020
- The relative costs associated with the expansion of the distribution pipeline network
- Costs associated with the connection to the gas distribution system and,
- Average cost savings associated with the conversion from heating oil to natural gas.

Fuel switching to natural gas should be encouraged by first ascertaining what may be the barriers to greater deployment and providing incentives to hasten the transition to this cleaner-burning, domestically produced fuel.

According to the U.S. Energy Information Administration (EIA) the average Pennsylvania home fueled by heating oil uses about 540 gallons per year whereas, the average home fueled by natural gas uses about 70,000 thousand cubic feet (MCF) per year.[1] EIA data for 2011 indicates that that average delivered cost of natural gas to the residential sector was $12.46 per MCF.[2] The average price of heating oil in Pennsylvania for the same time period was $3.59 per gallon. At these prices the average family could save approximately $1,050 per year in heating fuel costs by switching to natural gas.

Implementation Steps for Conservation:

Encourage:

1. Air Sealing and Insulation (10 percent–40 percent annual energy savings)
    - Pennsylvanians using oil for heating use about 400 gallons per household.
    - By air sealing & insulation, consumers could probably save 25 percent of this.
2. Increased furnace and boiler efficiency to >95 AFUE
    - Nationwide and in PA, about 50 percent of homes use oil for heating.

[1] http://www.eia.gov/consumption/residential/data/2009/index.cfm?view=consumption#end-use-by-fuel
[2] http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm

- The minimum allowed annual fuel utilization efficiency (AFUE) rating for a non-condensing, fossil-fueled, warm-air furnace is 78 percent; the minimum rating for a fossil-fueled boiler is 80 percent; and the minimum rating for a gas-fueled steam boiler is 75 percent.
- Although older furnace and boiler systems had efficiencies in the range of 56 percent-70 percent, modern conventional heating systems can achieve efficiencies as high as 97 percent, converting nearly all the fuel to useful heat for the home. Energy efficiency upgrades and a new high-efficiency heating system can often cut fuel bills and a furnace's pollution output in half. Upgrading a furnace or boiler from 56 percent to 90 percent efficiency in an average cold-climate house will save 1.5 tCO_2 emissions each year if heated with gas, or 2.5 tCO_2 if heated with oil (DOE, Energy Savers).
- Therefore consumers could expect to see a 15 percent–50 percent range in energy savings from "heating season" improvements (depending on age and efficiency of equipment being replaced).

3. Solar domestic hot water heaters
   - Heating water accounts for 14 percent–25 percent of total household energy consumption. Solar water heaters can provide 85 percent of DHW needs.
4. Instantaneous hot water heaters with an energy factor >0.80
   - For homes that use 41 gallons or less of hot water daily, demand water heaters can be 24 percent–34 percent more energy efficient than conventional storage tank water heaters.
   - They can be 8 percent–14 percent more energy efficient for homes that use a lot of hot water—around 86 gallons per day. You can achieve even greater energy savings of 27 percent—50 percent if you install a demand water heater at each hot water outlet.

Implementation Steps for Fuel Switching:

Recommend the PUC hold hearings for input to improve the availability/distribution of natural gas in Pennsylvania.

Encourage the use of on-bill financing and other creative financing options to assist with the payment of new installations and hook-up fees.

Assumptions:

Values from Pennsylvania: Potential for Energy Efficiency, Demand Response, and Onsite Solar Energy (ACEEE 2009). See page 21 for residential and page 27 for commercial. This represents the cost-effective potential. Note that these savings are greater than the amount identified by ACEEE analysis as achievable by the set of policies analyzed. The policy analysis led to savings of 11 percent fuel oil in 2025, for residential and commercial combined (see page 46). The assumptions in this work plan imply stronger policies than those identified by ACEEE (mostly standards and utility programs)

Key Data and Assumptions	2013	2020	Units
First Year Results Accrue		**2013**	
Savings Targets			
Heating Oil			
Achievable cost-effective savings in heating oil use as a fraction of total oil demand:			
Residential		**37%**	
Commercial		**26%**	

Value from Pennsylvania: Energy Efficiency, Demand Response and On-Site Solar Potenial. ACEEE 2009. See page 21 for residential and page 27 for commercial. This represents the cost-effective potential. Note that these savings are greater than the amount identified as ACEEE analysis as achievable by the set of policies analysed. The policy analysis led to savings of 11% fuel oil in 2025, for residential and commercial combined (see page 46). This workplan assumptions imply stronger policies than those identified by ACEEE (mostly standards and utility programs)

Fraction of achievable savings reached under program		**100%**	
Year in which target fraction reached		**2020**	
Year in which programs fully "ramped in"		**2013**	
Fraction of full program savings by year	0%	100%	
Implied fractional new annual oil demand savings, residential	0.0%	4.6%	
Implied fractional new annual oil demand savings, commercial	0.0%	3.3%	

Weighted Levelized Cost of Saved Energy

Residential	**$0.63**	$/gal
Commercial	**$0.98**	$/gal

Value from Pennsylvania: Energy Efficiency, Demand Response and On-Site Solar Potenial. ACEEE 2009. See page 21 for residential and page 27 for commercial.

Assumed average measure lifetime		**8**	years
Avoided Delivered Heating Oil Cost		**$22.8**	$/MMBtu
Avoided Delivered Heating Oil Cost		**$3.2**	$/gal
Projected cost of heating oil	$3.35	$3.89	$/gal
Avoided Heating Oil Emissions Rate		0.07	tCO_2e / MMBtu

Additional Data and Analyses	**2013**	**2020**	**Units**
DSM Heating Oil Analyses			
Reduction in Oil Use (Cumulative)	8,943	71,360	Billion Btu
Reduction in Oil Use (Cumulative)	64	513	Million Gal
Reduction as % of overall projected sales in that year	4.28%	34.13%	
Incremental GHG Emission Savings, Heating Oil	**0.6**	**5.2**	$MMtCO_2e$
Net Present Value (2013-2020) (DSM)		**-$142**	$million
Cost effectiveness (DSM)		**-$6**	$/tCO2e
Total Fuel Consumption after DSM	199,949	137,752	Billion Btu
Total Heating Oil Consumption after DSM	1,366	941	Million Gal

Potential GHG Reduction:

Table 1. Estimated GHG Reductions and Cost-effectiveness

Annual Results (2020)			Cumulative Results (2013-2020)		
GHG Reductions ($MMtCO_2e$)	**Costs (Million $)**	**Cost-Effectiveness ($/tCO_2e$)**	**GHG Reductions ($MMtCO_2e$)**	**Costs (NPV, Million $)**	**Cost-Effectiveness ($/tCO_2e$)**
5.2	-$22	-$37	23.3	-$142	-$6.11

Economic Cost:

See Table 1 above.

Potential Overlap:

- High Performance Buildings

Subcommittee Recommendations

Demand side management of heating oil appliances and equipment in residential and commercial buildings offer excellent GHG reduction potential and excellent cost savings. This is especially important since aging equipment may be subject to replacement by electric alternatives which would increase PA electricity use and commensurate GHGs.

The technologies to achieve these goals are available now.

The real challenge for demand-side management (DSM) of heating oil equipment is upfront cost to the building owners. Federal and state incentives may significantly reduce this challenge, although many home owners do not have the ready cash. It may be imperative for utility-sponsored retrofits with pre-certified installers and constant fuel bills until the DSM is paid for.

Replacement of heating oil appliances and equipment have health benefits as well since older equipment is more subject to fumes and leakage in occupied spaces. Homes may also benefit from appropriately matched equipment sizing to the load, ensuring adequate temperatures are met, and reducing 'cycling'.

The GHG and energy cost savings benefits are excellent, but the upfront cost implications must be addressed through utility programs.