Heating Oil Conservation and Fuel Switching

Summary:

Demand Side Management (DSM) for Heating Oil

This ~~aspect of 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.

~~**Bioheat**~~

~~This aspect of the initiative aims to blend all heating oil sold in PA with biodiesel, up to a maximum of 5%, consistent with the levels required for the sale of on-road diesel fuel sold in PA, via the Biofuel Development and In-State Production Incentive Act (Act 78 of 2008). For analytical purposes, a blend of **2% (B2) biodiesel is anticipated for years 2013 and 2014 after which, 5% (B5)** is the projected blending requirement. Bioheat is the industry term for heating oil that is blended with biodiesel. Heating oil is essentially the same as diesel, with some difference in sulfur content and a colorant added to deter tax evasion through its potential use as a transportation fuel. The use of bioheat has been proven to reduce maintenance concerns and burns cleaner than conventional heating oil. Significant, positive experience utilizing bioheat exists. Numerous customers throughout south central and southeastern PA have been using bioheat in their furnaces and boilers for many years. The PA Department of General Services also has bioheat on contract for state agencies.~~

Natural Gas

~~While not quantified as part of this analysis, f~~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 ~~the~~ difficulties assessing the extent of the distribution pipeline build out that may be possible through 2020
- ~~and t~~The relative costs associated with the expansion of the distribution pipeline network
- ~~and hook-up c~~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

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

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.

~~**Bioheat**~~
~~Require all heating oil sold in PA to be blended with 5% biodiesel by 2020.~~

Implementation Steps for Conservation:
~~Representatives from the Northeast Regional Biomass Program, including PA, have been working in association with oil heat industry representatives to promote greater awareness and acceptance of bioheat among both customers and distributors. Further discussions should occur between the Departments of Public Welfare, the Office of Consumer Advocate, and the DEP so that all are aware of potential economic considerations in implementing such an initiative. Implementation would require an amendment to Act 78 of 2008 to include heating, up to a maximum of 5%, or the introduction of legislation that is similar in its requirements.~~

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

[2] http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm

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%	
~~**Biofuel for heating**~~		~~**5%**~~	
~~**Lifecycle emissions factor for biofuel**~~	~~Y/N~~	~~**Y**~~	
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
~~Projected cost of heating oil blended with B2~~	~~$3.37~~	~~$3.91~~	~~$/gal~~
~~Projected cost of heating oil blended with B5~~	~~$3.37~~	~~$3.92~~	~~$/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)		**-$~~1,273~~142**	$million
Cost effectiveness (DSM)		**-$~~556~~**	$/tCO2e
Total Fuel Consumption after DSM	199,949	137,752	Billion Btu
Total Heating Oil Consumption after DSM	1,366	941	Million Gal
~~**Biofuel Analyses**~~			
~~Biofuel consumption for heating~~	~~9,997~~	~~6,888~~	~~Billion Btu~~
~~Biofuel consumption (unblended)~~	~~68~~	~~54~~	~~Million gal B100~~
~~Consumption of B5 blended heating oil~~	~~0~~	~~995~~	~~Million Gal B5~~
~~Consumption of B2 blended heating oil~~	~~1,441~~	~~0~~	~~Million Gal B2~~
~~Bioheat emissions rate~~		~~0.003~~	~~tCO_2 / MMBtu~~
~~Net cost of biofuel component~~	~~$277.27~~	~~$230.66~~	~~$ million~~
~~Net Present Value (2013-2020) (biofuel for heat)~~		~~**$1,636**~~	~~$million~~
~~Emissions reduction from biofuel component~~	~~**0.022**~~	~~**0.018**~~	~~$MMtCO_2e$~~
~~Cost-Effectiveness~~		~~**$322**~~	~~$/tCO_2e$~~

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$)**
5.~~7~~2	-$~~19~~22	-$~~34~~37	~~28.4~~23.3	-$~~363~~142	-$~~12.79~~6.11

Economic Cost:

See Table 1 above.

Potential Overlap:

- ~~Biofuels Investment and In-State Production Act~~
- ~~RC-1 through RC-4~~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.