Demand Side Management (DSM)—Natural Gas

Summary:

This initiative analyzes the potential of a natural gas efficiency standard (NGES) to promote the cost-effective replacement of older, less efficient ~~household~~ natural gas-fired appliances and equipment among the residential, commercial and industrial sectors as well as the associated potential from heating, ventilation and air conditioning system improvements. ~~that utilize natural gas with more energy efficient models, as well as looking at improvements in overall system efficiency for heating and hot water heating.~~

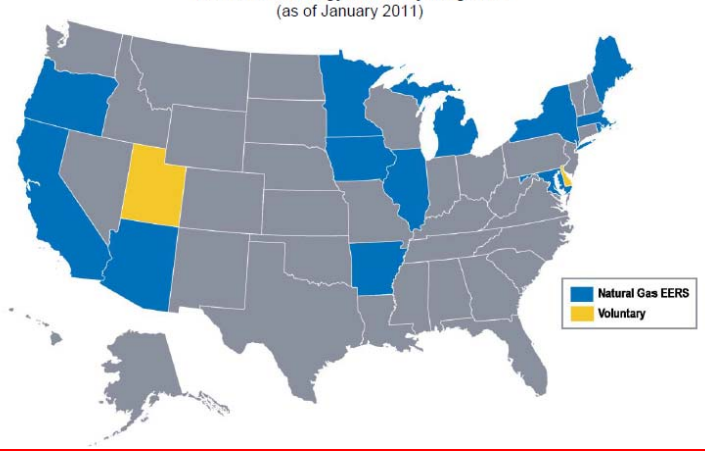
Goals:

Residential sector: Achieve 36 percent reductions from reference case natural gas demand in 2020.
Commercial sector: Achieve 28 percent reductions from reference case natural gas demand in 2020.

Background:

Similar to Act 129 of 2008 which requires the seven largest electric distribution companies to establish energy efficiency and conservation plans to meet proven cost-effective load reduction targets the same approach is recommended here for natural gas distribution companies (NGDCs). According to the American Council for an Energy Efficient Economy (ACEEE), programs to help natural gas customer reduce their energy use and costs through increased energy efficiency have existed for over 30 years in some states. As noted in Figure 1, several states have established natural gas efficiency standards (NGES) for natural gas distribution companies (NDCs), for example, Illinois, Colorado, and New York.[1] As of January 2012, Delaware, Utah and New Jersey have pending NGES programs authorized by statute or executive order.[2]

Figure 1. State Energy Efficiency Resource Standard (EERS) Activity That Includes Natural Gas Energy Efficiency Programs
(as of January 2011)

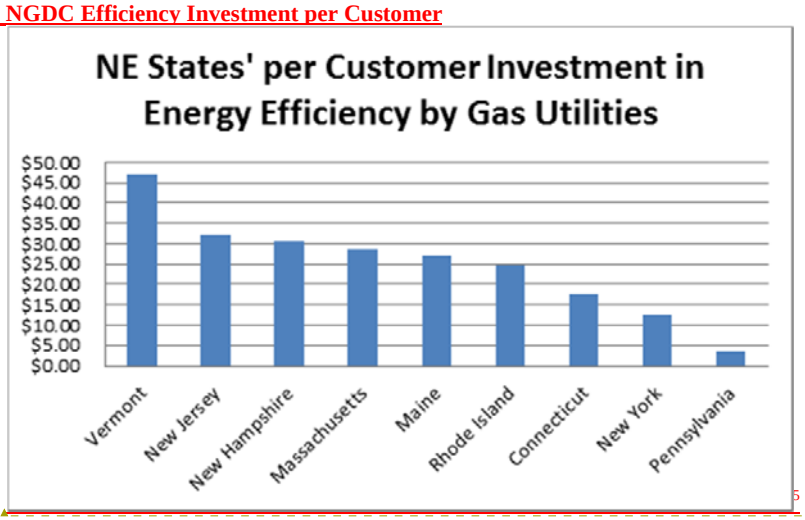


[1] ACEEE Policy Brief: State Energy Efficiency Resource Standards (EERS), updated September 2012, http://aceee.org/files/pdf/policy-brief/state-eers-summary-0912.pdf
[2] http://www.aceee.org/sites/default/files/publications/researchreports/u121.pdf page 9

In Pennsylvania NGDCs are required to provide energy efficiency and conservation programs to low-income customers (e.g. Low Income Usage Reduction Program [LIURP]). PA NGDCs spent nearly $15.8 million on LIURP program improvements and were projecting to spend $17.5 million in 2012.[3] ~~According to ACEEE, these programs spent an average of $7 to $8 million per year, are administered through utilities (e.g. Columbia, Dominion, Equitable, PGW, UGI Gas, etc), implemented by third party contractors, and program oversight is performed by the PA PUC. According to the American Gas Association, in 2010, Pennsylvania spent $11 million on low-income natural gas efficiency programs, $1.8 million on non-low-income residential programs, $34,000 on commercial programs and no funding was provided for industrial programs. Data and measurements about the effectiveness of these programs, in terms of therms saved, is not available.~~

NGESs have been implemented by states seeking to achieve a higher level of energy savings by establishing enforceable savings targets. NGESs typically include utility program budgets, program plans and rate recovery. An estimate from ACEEE indicates that total utility-sector natural gas energy efficiency program budgets for 2011, driven specifically by NGES, to be about $1.2 billion nationwide. This compares to $125 million in 2005 and $942 million in 2010 for utility-sector natural gas efficiency programs, achieving total annual savings of 89 million therms and 529 million therms, respectively.[4]

Figure 2. NGDC Efficiency Investment per Customer



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Potential Natural Gas Savings by Sector:

The ACEEE report "Energy Efficiency, Demand Response, and Onsite Solar Energy Potential in Pennsylvania,"[6] identifies significant energy efficiency opportunities in Pennsylvania. Numerous conservation and efficiency opportunities exist for natural gas. Tables 1 and 2 illustrate much of the potential gains that can be realized in the residential and commercial sectors. Not surprising, space

[3] PA PUC "2011 Report on Universal Service Programs & Collections Performance"
[4] http://www.aceee.org/sites/default/files/publications/researchreports/u121.pdf
[5] KEEA/ACEEE
[6] ACEEE et al. (2009). Energy Efficiency, Demand Response, and Onsite Solar Energy Potential in Pennsylvania. April. Pp. 9-10. http://www.aceee.org/pubs/e093.htm

heating is the largest usage category and largest area of opportunity. For the industrial sector ACEEE indicates that the natural gas savings potential is equal to 17 percent of this sector's estimated consumption in 2025. This estimate does not include site specific process heating measures, on which ACEEE states:

> "We anticipate an additional economic savings of 5–10 percent, primarily at large energy-intensive manufacturing facilities. The overall economic industrial efficiency resource opportunity is on the order of 22–27 percent. Therefore, the total economic potential for natural gas savings in the industrial sector in 2025 would be about 52,660 [B] Btu (billion Btu). P. 31."

Table 1. Residential Natural Gas Efficiency Potential and Costs by End-Use (2025)

End-Use	Savings (MMBtu)	Savings relative to Reference Case (%)	% of Total Efficiency Potential	Levelized Cost of Saved Energy ($/MMBtu)
Single Family Gas	**74,070**	**35%**	**100%**	**$5.01**
Space Heating	47,540	22%	64%	$3.70
Water Heating	16,840	8%	23%	$7.90
Cooking	920	0.4%	1%	$9.34
Existing	65,300	30%	88%	$4.86
New Homes	8,770	4%	12%	$4.82
Multifamily Gas	**9,620**	**46%**	**100%**	**$7.47**
Space Heating	4,350	20%	45%	$6.86
Water Heating	3,360	16%	35%	$3.04
Cooking	100	0.5%	1%	$11.71
Existing	7,810	37%	81%	$5.28
New Homes	1,810	9%	19%	$9.40
All Residential Gas	**83,690**	**36%**	**100%**	**$5.29**
Space Heating	51,890	22%	62%	$3.96
Water Heating	20,200	9%	24%	$7.09
Cooking	1,010	0.4%	1%	$9.57
Existing	73,10	31%	87%	$4.91
New Homes	10,590	5%	13%	$5.61

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End-Use	Energy Savings (MMBtu)
Single Family Gas	74,070
Space Heating	47,540
Water Heating	16,840
Cooking	920
Existing Homes	65,300
New Homes	8,770
Mult-family Gas	9,620
Space Heating	4,350
Water Heating	3,360
Cooking	100
Existing Homes	7,810
New Homes	1,810

All Reidential Gas	83,690
Space Heating	51,890
Water Heating	20,200
Cooking	1,010
Existing Homes	73,100
New Homes	10,590

Source: ACEEE 2009

Table 2. Commercial Natural Gas Efficiency Potential and Costs by End-Use (2025)

End-Use	Savings (MMBtu)	Savings over Reference Case (%)	% of Efficiency Potential	Weighted Levelized Cost of Saved Energy ($/MMBtu)
HVAC equipment & controls	26,200,000	15%	54%	$ 2.39
Building shell	2,000,000	1%	4%	$ 0.30
Water Heating	5,400,000	3%	11%	$ 6.27
Cooking	4,000,000	2%	8%	$ 1.11
Other	7,200,000	4%	15%	$ 8.43
Existing Buildings	44,700,000	26%	93%	$ 3.19
New Buildings	3,500,000	2%	7%	$ 2.45
Total Gas	48,200,000	28%	100%	$ 3.28

~~Source: ACEEE 2009~~

End-Use	**Energy Savings (MMBtu)**
HVAC Equip. & Controls	26,200,00
Building Shell/Envelope	2,000,000
Water Heating	5,400,000
Cooking	4,000,000
Other	7,200,000
Existing Buildings	44,700,000
New Buildings	3,500,000
Total	48,200,000

Source: ACEEE 2009

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Table 3. Industrial Natural Gas Efficiency Potential and Costs (2025)

Measures	Energy Savings (MMBtu)
Load Control	2,809,000
Improved Insulation	5,618,000
Steam Trap Maintenance	4,389,000
Automatic Steam Trap Monitoring	1,756,000
Other Boiler Measures	5,255,000
HVAC Measures	622,000
Process Controls & Management	3,679,000
Efficient Burners	2,929,000
Process Integration	4,346,000
Other Process Heat Measures	5,359,000
Total	36,762,000

Source: ACEEE 2009

Table 4. Industrial Natural Gas Conservation Practices and Costs (2025)

Measures	Savings (MMBtu)
Load Controls	2,809,000
Improved Insulation	5,618,000
Steam Trap Maintenance	4,389,000
Auto Steam Trap Monitoring	1,756,000
Other Boiler Measures	5,255,000
HVAC Measures	622,000
Process Controls & Mgmt.	3,679,000
Efficient Burners	2,929,000
Process Integration	4,346,000
Other Process Heat Measures	5,359,000
Total	36,759,000

Source: ACEEE 2009

~~GHG Reductions:~~
~~According to the American Gas Association, in 2010, customers saved nearly 81 trillion Btus through natural gas efficiency programs, offsetting 4.2 million metric tons of CO2 emissions.[7]~~

~~**Economic Cost:**~~
~~According to the American Gas Association, residential natural gas efficiency program participant in the U.S. saved on average ten percent of usage or about 76 therms per year, averaging $62 in cost savings on their annual bills.[8]~~

[7] ~~http://www.aga.org/Kc/analyses-and-statistics/studies/efficiency_and_environment/Documents/AGA%20Natural%20Gas%20Efficiency%20Programs%20Report%20-%202010%20Program%20Year%20-%20FINAL%20-%20DEC%202011.pdf~~

~~http://www.aceee.org/sites/default/files/publications/researchreports/u121.pdf page 8 of pdf~~

Additional Details of Potential Opportunities:

1. Air Sealing and Insulation (10 percent–40 percent annual energy savings)
   - Pennsylvanians using natural gas for heating use about 600 therms 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 natural gas 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.
5. ENERGY STAR high-efficiency washing machines
   - Most ENERGY STAR-qualified clothes washers extract more water from clothes during the spin cycle. This reduces the drying time and saves energy and wear and tear on your clothes.
   - ENERGY STAR-qualified clothes washers clean clothes using 50 percent less energy than standard washers (including energy used in the washing process, including machine energy, water heating energy, and dryer energy).
6. Pilot lights
   - Standing pilot lights may use over 7 therms (700,000 British thermal units) of gas per appliance, if left on year round.
   - Replacing old appliances that have pilot lights on full time with appliances that have electronic (intermittent) ignitions could create savings.
   - Some people feel that standing pilot lights on appliances are gradually becoming the exception, instead of the rule, with new appliances on the market using electronic ignitions. However, even though electronic ignition pilot lights are becoming increasingly common, without legislation, standing pilots may not disappear by 2020 because they are cheaper to manufacturer, and the

[8] http://www.aga.org/Kc/analyses-and-statistics/studies/efficiency_and_environment/Documents/AGA%20Natural%20Gas%20Efficiency%20Programs%20Report%20-%202010%20Program%20Year%20-%20FINAL%20-%20DEC%202011.pdf

appliance is sometimes viewed as a solution to emergency heat when the electricity fails, because they do not need electric power to start.

Analysis:

Target Assumptions	2015	2020	Units
First Year Results Accrue	2015		
Year in Which Target is Reached		2020	
Natural Gas Savings Target		50,060	BBtu
Residential		60	BBtu
Commercial		30,000	BBtu
Industrial		20,000	BBtu

Results Summary	2015	2020	Units
Annual GHG Emission Reductions	0.44	9.24	MMtCO2e
Net Present Value		-$3,575	$ million
Cumulative Emissions Reductions		24.58	MMtCO2e
Cost-Effectiveness		-$145.44	$/tCO2e

Summary Analysis and Assumptions	2015	2020	Units
Annual Savings Target	8,343	8,343	BBtu
RCI Gas Sales (Baseline)	555,538	563,032	BBtu
RCI Gas Sales (DSM)	547,194	512,318	BBtu
RCI Energy Reductions	8,343	176,733	BBtu
RCI Gas Prices (statewide averages)			
Residential	$12.34	$12.64	$/MMBtu
Commercial	$11.58	$13.70	$/MMBtu
Industrial	$10.05	$10.69	$/MMBtu
City Gate	$6.40	$6.56	$/MMBtu
Implied Rate Payer Savings	$92	$2,209	$million
Implied NGDC Program Costs	$32	$35	$million
Implied Net Costs	-$60	-$2,174	$million
Discounted Costs	-$47	-$1,335	$million
GHG Reductions	0.44	9.24	MMtCO2e
Cost-effectiveness	-$107	-$145	$/tCO2e
Net Present Value		-$3,575	$million

Analytical Assumptions and Assertions:

1. The analysis does not consider any change to the number of consumers and assumes that consumption declines each year as a result of DSM.
2. Energy savings are cumulative, carrying forward from year-to-year.
3. The analysis estimates NGDC program costs equal to 0.5% of baseline sales (includes delivered price i.e. commodity price plus charges).
4. The analysis includes an annual discount rate of 5 percent.

5. Delivered natural gas prices are based on reported average statewide price data from EIA for 2011 and adjusted according to EIA AEO 2012 projections through 2020, as follows:
    a. Residential @ $12.10/MMBtu in 2011; $12.64/MMBtu in 2020
    b. Commercial @ $10.12/MMBtu in 2011; $13.70/MMBtu in 2020
    c. Industrial @ $9.57/MMBtu in 2011; $10.69/MMBtu in 2020
    d. City Gate @ $6.28/MMBtu in 2011; $6.56/MMBtu in 2020

The analysis, based on cost-effective measures identified by ACEEE, as alluded to Tables 1 through 4, indicates that significant GHG reductions can be achieved in a highly cost-effective fashion. Even if the program costs for the NGDCs were increased the GHG reductions would be still be achievable in a cost-effective manner. Proposed draft legislative language authored by KEAA would also yield GHG reductions but significantly less so. An analytical comparison of the KEAA proposal would result in 2.1 MMtCO2e reduced in 2020 as compared to the 9.2 MMtCO2e proposed in this work plan yet the difference in cost-effectiveness is not overly significant between these possible scenarios; a savings of $126/ton of CO2e reduced for KEAA as compared to $145/ton of CO2e from this work plan (based on ACEEE data). The results of the analysis lend support to either approach for implementation of a DSM program to be implemented by the NGDCs and overseen by the PUC, as is done with electricity via Act 129 of 2008.

Implementation Steps:

Legislation should be introduced to facilitate the increased utilization of more efficient natural gas combustion technology, equipment and practices by consumers in the residential, commercial and industrial sectors of Pennsylvania. Education and outreach is key to the success of any such program and is expected to be incorporated into the plans of NGDCs. An example of specific legislative language for consideration is included below:

Amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, providing for energy efficiency and conservation programs; incentive ratemaking and revenue protection for natural gas distribution companies; and financing of energy efficiency improvements.

- The commission shall adopt an energy efficiency and conservation program to require each natural gas distribution company to adopt and implement cost-effective energy efficiency and conservation plans to reduce energy demand and consumption for all customer classes.
- Each natural gas distribution company's energy efficiency and conservation programs will reduce the total consumption of its retail customers by a minimum of 0.5%, and by May 31, 2020 by a minimum of 2.0%.
- Gas distribution companies shall recover on a full and current basis from customers all reasonable and prudent costs incurred in the provision of these programs.
- Gas utilities may also earn an incentive for exceeding their targets. Likewise they may face a financial penalty for failure to meet their targets.
- The plan will include an annual evaluation mechanism to determine cost effectiveness for each gas company program and rates will be reconciled at least annually. In addition programs will be evaluated by an independent evaluator.
- Conservation service provides will be selected to implement various sector plans in order to effectively reach different customer classes.
- Low income plans will be developed proportionate to households share of total gas usage in utility service areas.

Potential Overlap:

- High Performance Buildings Work Plans
- Energy Efficient Appliances

Subcommittee/Committee Comments:

Demand side management of natural gas 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 gas 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 gas 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.

The PUC should evaluate mechanisms to encourage demand side management for natural gas.

Key Data and Assumptions	-	2013	2020	Units
First Year Results Accrue			**2013**	
Savings Targets				
Natural Gas				
Achievable cost-effective savings in natural gas use as a fraction of total gas demand:				
Residential			**36%**	
Commercial			**28%**	
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 annual gas demand savings, residential		0.0%	4.5%	
Implied fractional annual gas demand savings, commercial		0.0%	3.5%	
Weighted Levelized Cost of Saved Energy				
Residential			**$5.29**	$/MMBTU
Commercial			**$3.28**	$/MMBTU
Value from Pennsylvania: Energy Efficiency, Demand Response and On-Site Solar Potenial. ACEEE 2009. See page 19 for residential and page 26 for commercial.				
Avoided Delivered Natural Gas Cost			**$4.6**	$/MMBtu

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Cooking	920	0.4%	1%	$9.34
Existing	65,300	30%	88%	$4.86
New Homes	8,770	4%	12%	$4.82
Multifamily Gas	**9,620**	**46%**	**100%**	**$7.47**
Space Heating	4,350	20%	45%	$6.86
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Cooking	1,010	0.4%	1%	$9.57
Existing	73,10	31%	87%	$4.91
New Homes	10,590	5%	13%	$5.61

~~Table 2. Commercial Natural Gas Efficiency Potential and Costs by End-Use (2025)~~

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End-Use	Savings (MMBtu)	Savings over Reference Case (%)	% of Efficiency Potential	Weighted Levelized Cost of Saved Energy ($/MMBtu)
HVAC equipment & controls	26,200,000	15%	54%	$ 2.39
Building shell	2,000,000	1%	4%	$ 0.30
Water Heating	5,400,000	3%	11%	$ 6.27
Cooking	4,000,000	2%	8%	$ 1.11
Other	7,200,000	4%	15%	$ 8.43
Existing Buildings	44,700,000	26%	93%	$ 3.19
New Buildings	3,500,000	2%	7%	$ 2.45
Total Gas	48,200,000	28%	100%	$ 3.28

~~Source: ACEEE 2009~~

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~~**GHG Reductions and Economic Costs:**~~

~~**Table 3. Estimated GHG Reductions and Cost-effectiveness**~~

~~**Work Plan Name**~~	~~**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$)**~~
~~DSM – Natural Gas~~	~~7.3~~	~~$0.18~~	~~$0.02~~	~~32.9~~	~~$1~~	~~$0.02~~

~~**Economic Cost:**~~
~~See table 3 above.~~

~~**Opportunities for Advancement of this Initiative:**~~
~~1. Air Sealing and Insulation (10 percent- 40 percent annual energy savings)~~
- ~~Pennsylvanians using natural gas for heating use about 600 therms 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 natural gas 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).
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   - 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.
5. ENERGY STAR front-loadinghigh efficiency washing machines
   - Most ENERGY STAR qualified clothes washers extract more water from clothes during the spin cycle. This reduces the drying time and saves energy and wear and tear on your clothes.
   - ENERGY STAR-qualified clothes washers clean clothes using 50 percent less energy than standard washers (including energy used in the washing process, including machine energy, water heating energy, and dryer energy).
6. Pilot lights
   - Standing pilot lights may use over 7 therms (700,000 British thermal units) of gas per appliance, if left on year round.
   - Replacing old appliances that have pilot lights on full time with appliances that have electronic (intermittent) ignitions could create savings.
   - Some people feel that standing pilot lights on appliances are gradually becoming the exception, instead of the rule, with new appliances on the market using electronic ignitions. However, even though electronic ignition pilot lights are becoming increasingly common, without legislation, standing pilots may not disappear by 2020 because they are cheaper to manufacturer, and the appliance is sometimes viewed as a solution to emergency heat when the electricity fails, because they do not need electric power to start.

Implementation Steps:

- Encourage natural gas utilities to engage in consumer education initiatives regarding these efficient technologies.
- Passage of new legislation structured around the concept of Act 129 of 2008 that would require natural gas distribution companies to reduce overall consumption by minimum percentages.

Potential Overlap:

- Appliance Standards Work Plan
- High Performance Buildings Work Plans

Subcommittee Recommendations:

Demand side management of natural gas 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 gas 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 gas 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.~~

~~The PUC should evaluate mechanism to encourage demand side management for natural gas.~~