FUEL SWITCHING WORKING GROUP
Docket No. M-00051865
Response of UGI Distribution Companies
To Staff Data Requests
March 9, 2010

1) Please provide the number of Pennsylvania customers in each EDC service territory that have access to natural gas. We define customers with access to natural gas as those customers who do not currently take natural gas service, but have the ability to connect to reasonably adjacent natural gas main.

2) Please provide the natural gas appliance penetration rates (by NGDC, if available) for those customers who do subscribe to natural gas service.

Response:

The UGI Distribution Companies ("UGI") currently serve in excess of 575,000 natural gas distribution customers in Pennsylvania. UGI currently does not have specific information concerning the number of potential customers along or within a reasonable distance of its mains, or its appliance saturation levels within its service territory, although it is in the process of developing this information and expects to have better information in the near future. In the mean time, UGI believes that the attached U.S. Census data can provide a reasonable estimate of natural gas's market share in Pennsylvania. Also attached is a copy of testimony presented to the Commission by Ronald Edelstein, who estimated from census data that approximately 1.2 million homes in Pennsylvania use electric water heating. Mr. Edelstein also provided estimates of the range of potential energy savings from fuel substitution programs.

TESTIMONY FROM RONALD EDELSTEIN RE ENBANC HEARING ON ALTERNATIVE ENERGY, ENERGY CONSERVATION AND EFFICIENCY, AND DEMAND SIDE MANAGEMENT

I am Ronald Edelstein, with the Gas Technology Institute (GTI). I am Director, Government and Regulatory Relations. I have 39 years of engineering experience, with 31 years related to energy research and development (R&D). I have three engineering degrees. I have served on the California R&D Working Group, the Board of the California Institute for Energy Efficiency, and the Tennessee Energy Conservation Task Force. I have been on review panels for R&D proposals for the New York State Energy Research and Development Authority (NYSERDA) for combined heat and power and residential energy efficiency R&D. I have testified in eight states on the benefits of gas consumer-interest R&D.

The purpose of my testimony is to ask the Pennsylvania Public Utility Commission (PUC) to consider the benefits of direct gas use in place of electricity in answer to the question "what types of new programs or changes to existing programs, if any, would be needed to achieve the targets contained in Act 129?" It is my contention that from a Btu, kWhr, and CO2 savings standpoint, direct use of gas in place of certain electricity uses could be one of the most cost effective means for Pennsylvania to achieve energy efficiency goals. Further additional energy efficiency savings can be had by deploying and using high-efficiency natural gas equipment in place of less-efficient devices in all end-use sectors.

Let's look at home energy use in Pennsylvania. A typical Pennsylvania home, from 2006 winter data[1], uses about 60 million Btu's (MMBtu) of thermal energy per year for a natural-gas-heated home using an 80% efficient gas furnace. This translates to an output thermal energy requirement of about 48 MMBtu/yr. For an electric resistance heating system (100% efficient), this converts to 14,134 kWhrs/yr. For a high-efficiency (264%) electric heat pump (EHP), this converts to 5,354 kWhrs/yr.

For hot water demand, a typical Pennsylvania home uses about 20.4 MMBtu of thermal energy per year. Considering that the average gas water heater has an efficiency of about 53%, this translates to an output energy requirement of 10.8 MMBtu/yr. Using a 100% efficient electric-resistance water heater, this converts to 3,168 kWhr/year. (Electric heat pump water heaters are very expensive and not widely available, and so will not be considered in this analysis.)

According to Bureau of Census 2006 data[2] there are 4.84 million occupied dwelling units in Pennsylvania. Further, there are 861,000 electricity-heated homes, 2.49 million natural gas heated homes, and 1.11 million oil-heated homes. Numbers of electric water heaters are not included in Bureau of Census data, but if we assume all houses have water heaters, and subtract out the number of natural gas and oil-heated houses (as also having gas or oil water heaters), we get a low-end estimate of at least 1.2 million homes with electric water heating

---

[1] A.G.A. Gas Facts: 2006 Data

[2] http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=&geo_id=04000US42&_geoContext=01000US%7C04000US42&_street=&_county=&_cityTown=&_state=04000US42&_zip=&_lang=en&_sse=on&ActiveGeoDiv=&_useEV=&pctxt=fph&pgsl=040&_submenuId=factsheet_1&ds_name=null&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry=

As a maximum market potential, If all electrically-heated homes (assuming all are EHP's) were converted to natural gas, then 4.6 million MWhrs of electricity could be saved in Pennsylvania. If all these houses were heated with electric resistance heating, this number would rise to 12.1 million MWhrs. (In reality the market potential is somewhere between the numbers, because most EHP's use backup electric resistance heating elements when the outside temperature falls below 30°F.)

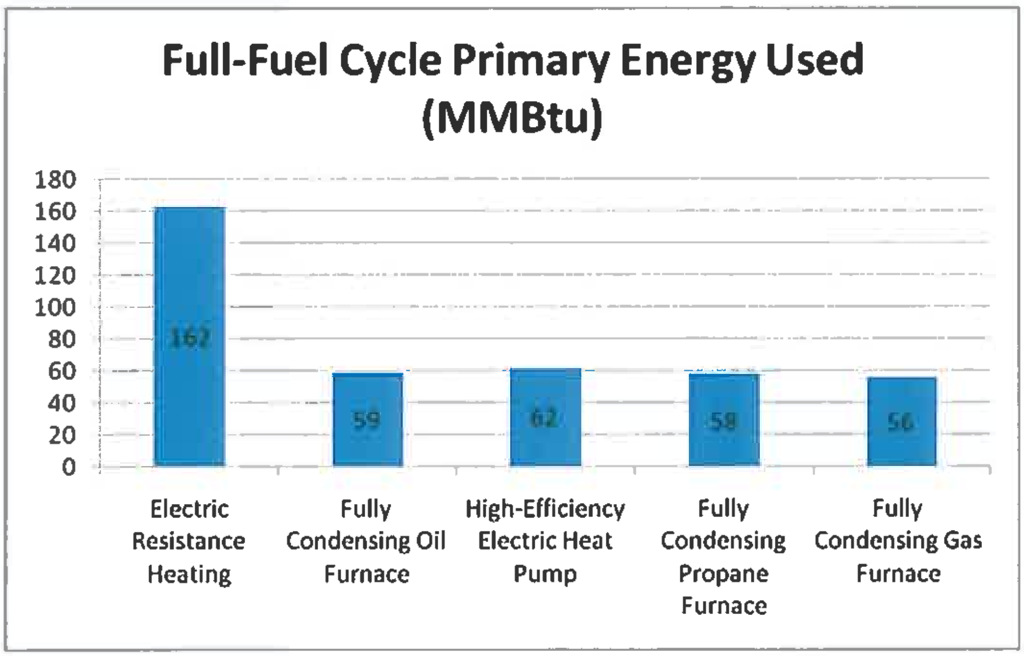
Also as a maximum market potential, if all electric water heaters were converted to natural gas, then another 3.9 million MWhrs could be saved by Pennsylvanians per year.

So the total maximum market potential of just these two initiatives combined ranges from 8.5 million MWhrs to 16 million MWhrs. How does this compare to total residential electricity use in Pennsylvania? According to U.S EIA data[3] , total 2006 residential electricity consumption in Pennsylvania was 51.8 million MWhrs. ***So conceivably, by replacing all residential electric heating systems and electric hot water units with direct natural gas appliances, we could save 16% to 31% of the residential electricity used in Pennsylvania!*** The magnitude of the savings from just these two initiatives dwarfs savings from other typical energy or equipment substitution strategies, like using compact fluorescent light bulbs or wall insulation, as shown in the following Maryland market potential study[4].

Energy Conservation Measure	Estimated Annual kWh savings	Annual Electric Bill Savings	Estimated Reduction in Household Electricity Consumption
Replace all lights with Compact Fluorescent Lights (CFLs)	1000	$130	6%
Blow-in Wall Insulation	700	$90	4%
Seal Ductwork	650	$85	4%
Repair Ceiling Leaks	600	$80	3%
Upgrade to an ENERGY STAR, front-load clothes washer	400	$50	2%
Upgrade Attic Insulation	300	$40	2%
Upgrade a 10 year old refrigerator to an ENERGY STAR refrigerator	300	$40	2%
Upgrade to ENERGY STAR room air conditioner	250	$30	1%
Install low flow showerhead	250	$30	1%

[3] http://www.eia.doe.gov/cneaf/electricity/esr/table5.html
[4] Ref: http://www.energy.state.md.us/facts/empower/index.asp

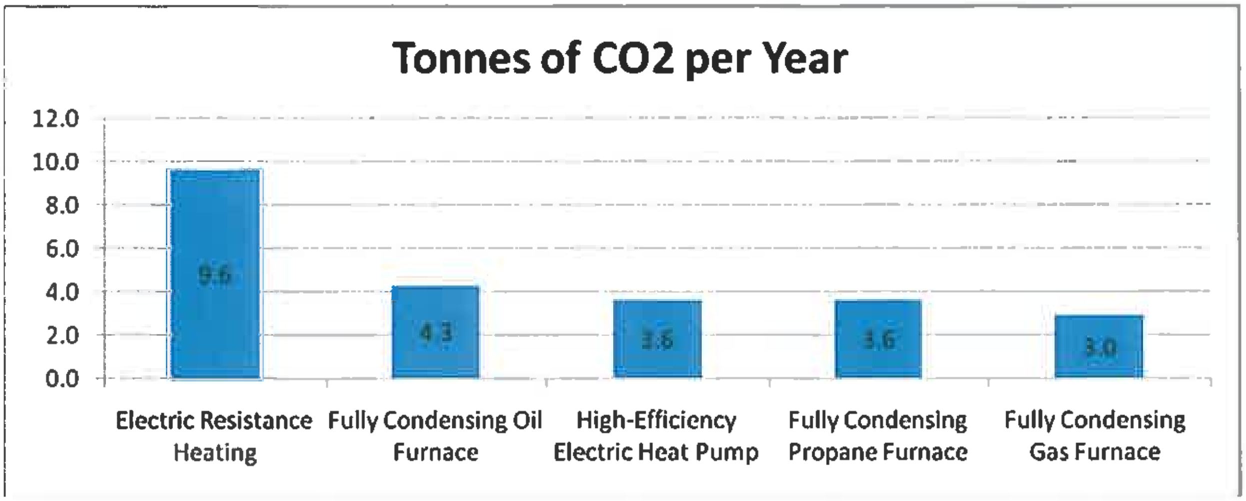
How do these initiatives stack up when compared on a primary energy savings basis? By primary energy, we refer to energy from its source to energy delivered to the home. This is also referred to variously as full fuel cycle analysis, or "well to wheels" analysis (for vehicles). In order to perform this analysis, a full fuel cycle efficiency train from wellhead or coal mine to the home must be developed. For instance, A.G.A. analysis[5], updated by GTI, indicates that the weighted efficiency of primary fuel production, processing, transport, and electric transmission and distribution (T&D) is on the order of 80.7%. Multiplying this by power plant conversion efficiency of 33%-50% means that only 26.6%-40.3% of the primary energy gets delivered to the home from coal mine or wellhead to electric meter. The Pennsylvania weighted[6] full fuel cycle efficiency for from wellhead/mine mouth, through conversion efficiency, through electric T&D efficiency is 29.7%. For a natural gas system, overall T&D efficiencies are 90.5%. (Of course, for full fuel cycle energy use and efficiencies, the appliance efficiency must also be included.) So, from an energy use standpoint, looking at the best of each technology, we find that a fully condensing natural gas furnace offers the lowest fully fuel cycle energy use, closely followed by propane, then oil, then a high-efficiency EHP, and lastly by electric resistance heating.



The results are even more dramatic when considering CO_2 reduction potential. First, from fundamental chemistry, burning one MMBtu of natural gas produces about 117 pounds of CO_2. Burning the same amount of propane produces about 138 pounds of CO_2. Burning one MMBtu of oil produces about 160 pounds of CO_2. Finally, burning one MMBtu of coal produces about 206 pounds of CO_2. As Pennsylvania's electricity mix is about 55% percent coal (and 36% nuclear which produces essentially zero CO_2), the CO_2 production numbers for electricity, combined with full fuel cycle efficiency analysis, produces results depicted in the following table.

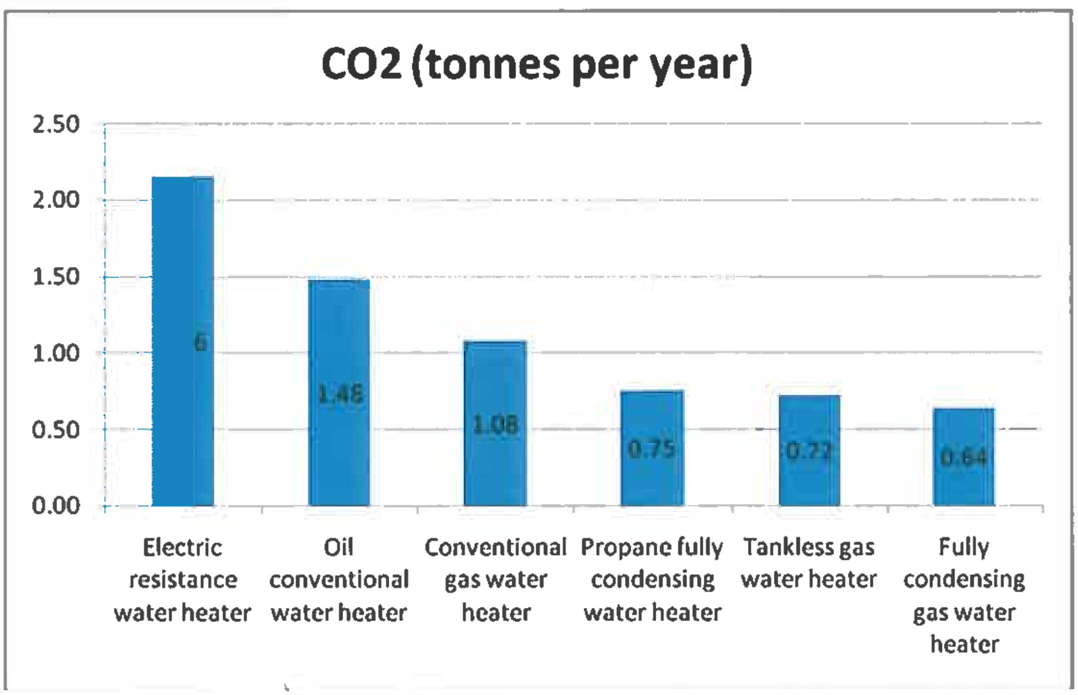
[5] American Gas Association, "A Comparison of Carbon Dioxide Emissions attributable to New Natural Gas and All-Electric Homes, October 31, 1990.

[6] U.S. EPA eGRID2006 Version 2.1 State File (Year 2004 Data)



So a fully condensing gas furnace produces less than one-third the CO_2 of electric resistance heating, and 17% less CO_2 than a high-efficiency EHP. (Further, the actual performance of EHP units has been shown[7] to be even lower than rated if the backup electric resistance heating element comes on more often than anticipated.)

Comparable results occur for water heating, if one uses the high-efficiency fully condensing gas water heater (90% efficient) or the tankless gas water heater (80% efficient). And the electric heat pump water heater is not a practical option at this time, so only electric resistance heating is available.



---

[7] Northwest Gas Association, Pacific Northwest Regional Assessment of the Potential Benefits of the Direct Use of Natural Gas as a Regional Resource Strategy, Navigant, August 2008

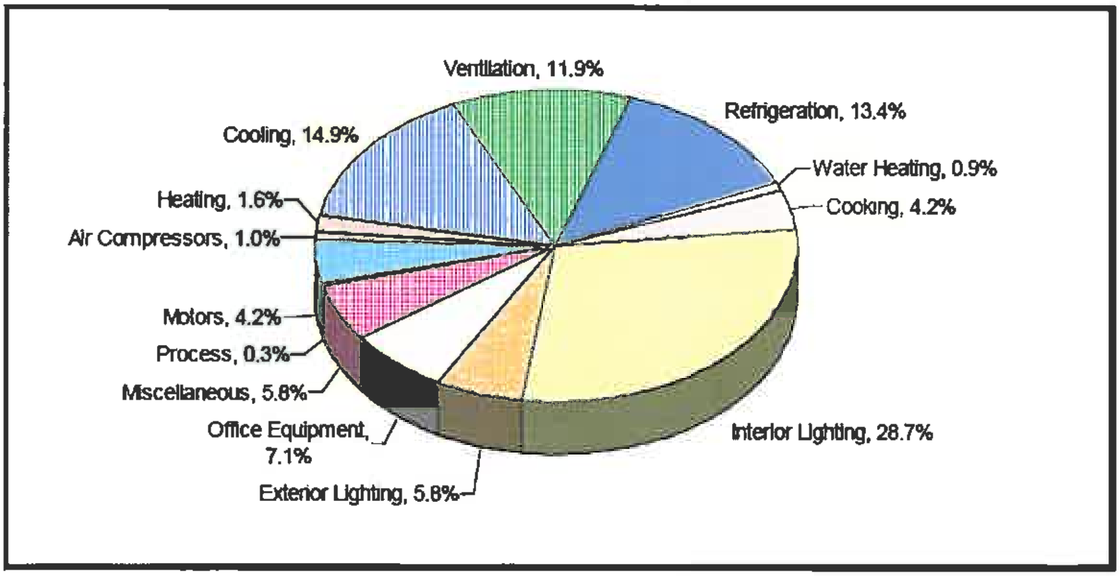
As indicated in the chart, the fully condensing gas water heater offers the lowest CO_2 production, followed by the tankless gas unit, then the fully condensing propane unit, the conventional gas water heater, the conventional oil water heater, and then lastly the electric resistance water heater, with a CO_2 output of over three times higher than the best natural gas unit.

One caveat, when considering approval of electric-to-gas conversion measures, the Commission may want to consider the capital investment needed to connect new gas load associated with electric conversions. These costs will need to be factored into the Total Resource Cost (TRC) Test in determining how economic the measures will be. The TRC Test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.

Of course, displacement of oil-fired space and water heating systems can produce energy and environmental benefits as well.
Finally, we would be remiss not to point out that efficiency, Btu, and CO_2 benefits can also be attained by replacing less efficient natural gas furnaces and water heaters with the more efficient ones discussed above.

For the commercial market sector, the following two figures[8], while from California data, are illustrative of electricity use and natural gas use in that sector.

Figure E-3: Electric Usage by End Use

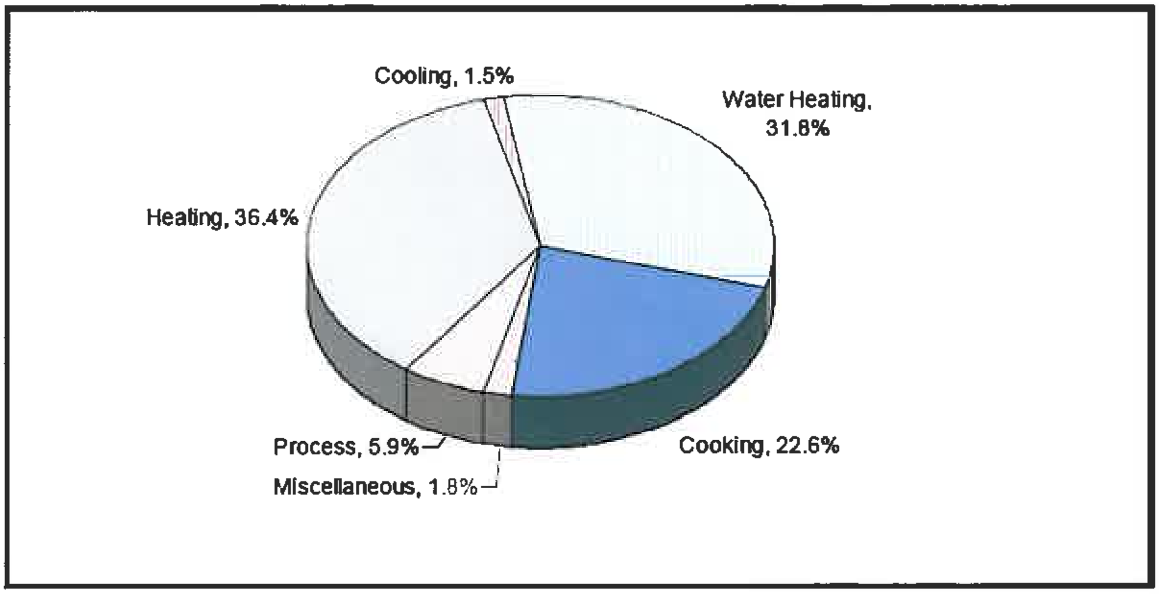


As can be seen from the electricity use pie chart, interior lighting, space cooling, refrigeration, and venting dominate the commercial electricity market sector, accounting together for almost 70% of commercial sector electricity use. While heating in Pennsylvania will be higher than in California, even doubling the heating percentage will not make it an appreciable load segment. Water heating is

[8] California Energy Commission, California Commercial End Use Survey, CEC-400-2006-005, March 2006

similarly a small percentage of load for this sector. So in order to reduce electric load in the commercial sector, we would recommend deployment of commercial gas space cooling or gas heat pump technology. In order to reduce overall (gas, electricity, and oil) energy use in this sector, combined heat and power (CHP) systems that offer 70-80% total energy use are preferred.

Figure E-4: Natural Gas Usage by End Use



Considering natural gas use, by contrast, space heating, water heating, and cooking account for over 90% of natural gas use in this sector! So deployment of high-efficiency space heating, water heating, and commercial cooking equipment is of prime importance to reduce natural gas use in the commercial sector.

"Hidden" within the natural gas consumption data by application is the use of boilers in the commercial sector (mainly for space heating and hot water). According to an Oak Ridge National Laboratory (ORNL) report[9], over 12% of commercial buildings are served by boilers. Commercial boilers at office buildings, health care facilities, and educational establishments account for almost two-thirds of commercial boiler units and capacity. Commercial boilers consume approximately 28 percent of all (non-electricity) energy consumption at commercial facilities. Over 85% of boiler load is met by natural gas. (Other boiler fuels include oil, coal and even electricity.) Many of these boilers are decades old, with efficiencies of only 50-60%. Even near-condensing boilers constructed in the 1980's and beyond are 80-85% efficient, For this sector deployment of condensing boilers, with efficiencies of 90-94%, will substantially reduce energy use.

In the industrial sector, deployment of CHP systems offer major energy saving opportunities. Increased efficiency process heating systems also offer large energy savings.

---

[9] ORNL, Characterization of the U.S. Industrial/Commercial Boiler Population, May 2005

Industrial boiler use[10] accounts for 37% of all (non-electric) energy consumed at industrial facilities. The biggest consumers of boiler fuel are the chemicals and paper industry. While byproducts and waste fuels are the largest source of industrial boiler fuels, natural gas is the second largest fuel source. Industrial boilers tend to be larger than commercial boilers and used more often. Industrial boilers are even older than commercial boilers, so the 50-60% efficiency numbers are more prevalent. Deployment of condensing boilers (90%-94% efficiency) in this sector can save considerable energy.

In conclusion, major electricity savings, energy savings, and CO2 reductions can be achieved by the State of Pennsylvania if the state takes into account full fuel cycle analysis and encourages the direct use of natural gas (in place of electricity and oil) for space and water heating in residential and commercial markets. Further in the commercial and industrial sectors, deployment of CHP systems and fully condensing boilers can save considerable energy. Specifically for the commercial sector, deployment of (1) natural gas cooling systems and (2) high-efficiency space heating, hot water heating, and cooking equipment can save additional electricity and natural gas, respectively.

[10] Ibid

S2504: Physical Housing Characteristics for Occupied Housing Units
Data Set: 2006-2008 American Community Survey 3-Year Estimates
Survey: American Community Survey
Geographic Area: Pennsylvania

NOTE. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

Subject	Occupied housing units	Margin of Error (+/-)	Owner-occupied housing units	Margin of Error (+/-)	Renter-occupied housing units	Margin of Error (+/-)
Occupied housing units	**4,877,735**	**6,828**	**3,484,690**	**9,670**	**1,393,045**	**8,717**
UNITS IN STRUCTURE						
1, detached	58.3%	0.2	74.3%	0.2	18.5%	0.3
1, attached	18.3%	0.1	18.5%	0.1	17.8%	0.3
2 apartments	4.5%	0.1	1.1%	0.1	13.1%	0.3
3 or 4 apartments	4.0%	0.1	0.5%	0.1	12.8%	0.3
5 to 9 apartments	3.2%	0.1	0.3%	0.1	10.4%	0.2
10 or more apartments	7.6%	0.1	1.0%	0.1	24.1%	0.3
type of housing	4.1%	0.1	4.4%	0.1	3.1%	0.1
YEAR STRUCTURE BUILT						
2000 or later	6.4%	0.1	7.2%	0.1	4.6%	0.1
1990 to 1999	9.7%	0.1	11.0%	0.1	6.6%	0.2
1980 to 1989	10.0%	0.1	10.3%	0.1	9.2%	0.2
1960 to 1979	23.1%	0.1	22.1%	0.2	25.9%	0.4
1940 to 1959	23.1%	0.1	23.5%	0.1	22.1%	0.3
1939 or earlier	27.6%	0.1	25.9%	0.1	31.6%	0.4

ROOMS						
1 room	0.9%	0.1	0.1%	0.1	2.8%	0.1
2 or 3 rooms	8.5%	0.1	1.4%	0.1	26.4%	0.4
4 or 5 rooms	28.9%	0.2	22.4%	0.2	45.1%	0.4
6 or 7 rooms	38.6%	0.2	45.9%	0.2	20.2%	0.3
8 or more rooms	23.1%	0.2	30.2%	0.2	5.6%	0.2
BEDROOMS						
No bedroom	1.1%	0.1	0.2%	0.1	3.4%	0.2
1 bedroom	9.8%	0.1	1.9%	0.1	29.7%	0.4
2 or 3 bedrooms	67.1%	0.2	69.9%	0.2	60.1%	0.4
4 or more bedrooms	22.0%	0.2	28.0%	0.2	6.8%	0.2
COMPLETE FACILITIES						
plumbing facilities	99.6%	0.1	99.6%	0.1	99.4%	0.1
facilities	99.4%	0.1	99.7%	0.1	98.6%	0.1
VEHICLES AVAILABLE						
No vehicle available	11.3%	0.1	5.3%	0.1	26.3%	0.3
1 vehicle available	33.7%	0.2	28.0%	0.2	48.0%	0.4
2 vehicles available	37.2%	0.2	43.9%	0.2	20.5%	0.3
available	17.8%	0.1	22.9%	0.2	5.2%	0.2
TELEPHONE SERVICE AVAILABLE						
With telephone service	96.8%	0.1	98.4%	0.1	92.9%	0.2
HOUSE HEATING FUEL						
Utility gas	51.5%	0.1	51.0%	0.2	52.8%	0.4

Bottled, tank, or LP gas	3.6%	0.1	4.2%	0.1	2.3%	0.1
Electricity	18.4%	0.1	14.4%	0.2	28.4%	0.3
Fuel oil, kerosene, etc.	22.2%	0.1	25.3%	0.2	14.2%	0.3
Coal or coke	1.3%	0.1	1.6%	0.1	0.5%	0.1
All other fuels	2.8%	0.1	3.4%	0.1	1.4%	0.1
No fuel used	0.2%	0.1	0.1%	0.1	0.4%	0.1
PERCENT IMPUTED						
Units in structure	1.3%	(X)	(X)	(X)	(X)	(X)
Year structure built	16.7%	(X)	(X)	(X)	(X)	(X)
Rooms	6.1%	(X)	(X)	(X)	(X)	(X)
Bedrooms	3.3%	(X)	(X)	(X)	(X)	(X)
Plumbing facilities	2.7%	(X)	(X)	(X)	(X)	(X)
Kitchen facilities	3.5%	(X)	(X)	(X)	(X)	(X)
Vehicles available	1.0%	(X)	(X)	(X)	(X)	(X)
available	0.9%	(X)	(X)	(X)	(X)	(X)
House heating fuel	2.3%	(X)	(X)	(X)	(X)	(X)

Source: U.S. Census Bureau, 2006-2008 American Community Survey

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see Accuracy of the Data). The effect of nonsampling error is not represented in these tables.

Notes:

·The percent imputed for units in structure, year structure built, rooms, bedrooms, plumbing facilities, and kitchen facilities is based on all housing units (both occupied and vacant housing units) instead of occupied housing units only.

·While the 2008 American Community Survey (ACS) data generally reflect the November 2007 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities. The 2008 Puerto Rico Community Survey (PRCS) data generally reflect the November 2007 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in PRCS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.

·Estimates of urban and rural population, housing units, and characteristics reflect boundaries of urban areas defined based on Census 2000 data. Boundaries for urban areas have not been updated since Census 2000. As a result, data for urban and rural areas from the ACS do not necessarily reflect the results of ongoing urbanization.

Explanation of Symbols:

1. An '**' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.

2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.

3. An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.