

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Docket No. R-2015-2518438

UGI Utilities, Inc. – Gas Division

Statement No. 11-R

**Rebuttal Testimony of
Theodore M. Love
(Green Energy Economics Group, Inc.)**

Topics Addressed: EE&C Plan

Dated: May 10, 2016

1 I. **INTRODUCTION**

2 **Q. Please state your name, occupation, and business address.**

3 A. My name is Theodore M. Love, and I am the Senior Analyst and Data Scientist at
4 Green Energy Economics Group, Inc. ("GEEG"), an energy consulting firm
5 founded in 2005. My office address is 147 South Oxford Street, Brooklyn, New
6 York.

7
8 **Q. Did you previously submit direct testimony in this proceeding on behalf of
9 UGI Utilities, Inc. – Gas Division ("UGI Gas" or the "Company")?**

10 A. Yes. I submitted my direct testimony, UGI Gas Statement No. 11, on January
11 19, 2016.

12
13 **Q. What is the purpose of your rebuttal testimony?**

14 A. My testimony responds to certain portions of the following direct testimony
15 submitted by other parties concerning the Company's proposed Energy
16 Efficiency and Conservation ("EE&C") Plan and related issues: (1) I&E Statement
17 No. 2, the direct testimony of Lisa A. Gumby submitted on behalf of the Bureau of
18 Investigation and Enforcement ("I&E"); (2) OCA Statement No. 3, the direct
19 testimony of Glenn A. Watkins submitted on behalf of the Office of Consumer
20 Advocate ("OCA"); (3) OCA Statement No. 4, the direct testimony of Roger D.
21 Colton submitted on behalf of OCA; (4) CAUSE-PA Statement No. 1, the direct
22 testimony of Mitchell Miller submitted on behalf of the Coalition for Affordable
23 Utility Services and Energy Efficiency in Pennsylvania ("CAUSE-PA"); (5) OSBA
24 Statement No. 1, the direct testimony of Robert D. Knecht submitted on behalf of

1 the Office of Small Business Advocate ("OSBA"); and (6) UGIII Statement No. 3,
2 the direct testimony of Michael Trzesniowski submitted on behalf of the UGI
3 Industrial Intervenors ("UGIII").
4

5 **Q. Before responding to the other parties' testimony about the EE&C Plan, I&E**
6 **witness Cline and OCA witness Effron have criticized the Company's 21-**
7 **year regression analysis that shows gas usage per customer declining. Do**
8 **you have a response?**

9 A. Yes. I believe these witnesses fail to recognize the important role energy
10 efficiency and conservation will play in reducing customers' gas usage in the
11 future. Setting aside UGI Gas's EE&C Plan, there are other initiatives that will
12 likely reduce energy consumption in Pennsylvania. For example, Pennsylvania's
13 current building codes for residential and commercial construction, which were
14 promulgated in 2013, are projected to reduce gas usage per customer.
15 Previously, Pennsylvania's building codes were based off of the 2006
16 International Residential Codes ("IRC") and International Energy Conservation
17 Code ("IEEC") with amendments. However, the new building codes are based
18 off of the 2009 IECC, with reference to the American Society of Heating,
19 Refrigerating and Air-Conditioning Engineers ("ASHRAE") 90.1-2007 for
20 commercial construction and 2009 IRC/Pennsylvania Alternative Residential
21 Energy Provisions ("PA Alt") for residential construction. By adopting these more
22 stringent standards, end energy usage per customer is projected to decline. In
23 fact, attached to my testimony as Exhibits TML-3 and TML-4 are the U.S.

1 Department of Energy's ("DOE") reports on the impacts of the building codes'
2 increased efficiency on the usage per customer in Pennsylvania specifically. As
3 seen in these reports, the DOE compared the energy end use under the 2006
4 IECC to the 2009 IECC and found that energy end use is projected to be much
5 less under the new building codes.

6
7 **II. I&E WITNESS LISA A. GUMBY**

8 **Q. In I&E Statement No. 2, Lisa A. Gumby recommends that the claim for the**
9 **Company's EE&C Plan be disallowed. What reasons does she provide in**
10 **support?**

11 A. Witness Gumby provides four reasons, none of which have merit. The four
12 reasons are: (1) natural gas distribution companies ("NGDCs") are not statutorily
13 required to implement EE&C Plans; (2) the EE&C Plan is not required for the
14 provision of safe and reliable service; (3) the current cost of natural gas may not
15 encourage participation in EE&C measures; and (4) UGI Gas's affiliate, Central
16 Penn Gas ("CPG"), did not implement an EE&C Plan in CPG's 2010 base rate
17 proceeding.

18
19 **Q. Do you agree with Ms. Gumby that the Company's claim for the EE&C Plan**
20 **should be disallowed because the EE&C Plan is voluntary and not**
21 **mandated by statute?**

22 A. No. Ms. Gumby fails to recognize that the Commission has supported and
23 approved voluntary EE&C Plans. In its Secretarial Letter dated December 23,
24 2009, issued at Docket No. M-2009-2142851 ("*December 2009 Secretarial*

1 Letter”), the Commission provided guidelines for electric distribution companies
2 (“EDCs”) exempted from Act 129 if they choose to develop and implement
3 voluntary EE&C Plans. Indeed, UGI Gas’s EDC affiliate, UGI Utilities, Inc. –
4 Electric Division (“UGI Electric”) currently has a voluntary EE&C Plan in place
5 that was approved by the Commission. Notably, Ms. Gumby did not take any
6 EDCs’ voluntary EE&C Plans into account when evaluating UGI Gas’s EE&C
7 Plan proposal. See Exhibit TML-5. Moreover, Philadelphia Gas Works (“PGW”)
8 has a voluntary natural gas EE&C Plan that was approved by the Commission.
9 Therefore, even though UGI Gas’s EE&C Plan is voluntary and not statutorily
10 required, I believe that the Company’s claim for the EE&C Plan should not be
11 disallowed on that basis.

12
13 **Q. Do you agree with Ms. Gumby’s statement on page 8 of her direct**
14 **testimony that the “only clear beneficiary” of the proposed EE&C Plan**
15 **would be the Company because of “guaranteed recovery through the**
16 **proposed rider”?**

17 **A.** No. As Ms. Gumby admitted in discovery, the Company receives no profit
18 through the EE&C Rider, and customers would only be responsible for the EE&C
19 costs incurred by their respective customer class. See Exhibits TML-6 and TML-
20 7. Moreover, Ms. Gumby has agreed that the Total Resource Cost (“TRC”) Test
21 is an appropriate method to evaluate the costs and benefits of voluntary EE&C
22 Plan and that the EE&C Plan is cost-effective on a TRC Test basis. See Exhibit
23 TML-7. The TRC Test evaluates whether “ratepayers, as a whole, received more

1 benefits (in reduced capacity, energy, transmission, and distribution costs) than
2 the implementation costs of the EE&C Plans.” *2016 Total Resource Cost (TRC)*
3 *Test*, Docket No. M-2015-2468992, at p. 6 (Order Entered June 22, 2015) (“*2016*
4 *TRC Test Order*”). Accordingly, since the EE&C Plan is projected to be cost-
5 effective on a TRC Test basis, and no party disputes this conclusion, UGI Gas’s
6 ratepayers as a whole would receive a benefit from the EE&C Plan.

7 In particular, the avoided cost of gas used in the TRC Test includes three
8 categories of benefits that are shared among all customers, not just participants.
9 First, customers benefit from the avoided transmission and distribution (“T&D”)
10 costs that are related to the reliability of the gas system. Second, customers
11 benefit from the difference between avoided gas cost and the average embedded
12 cost of gas, which will reduce UGI Gas’s cost of gas. Third, customers benefit
13 from price suppression due to lower demand.

14 Altogether, there are many beneficiaries if the EE&C Plan is approved,
15 including the customers participating in the EE&C Plan programs, who benefit
16 from reduced bills and increased comfort, as well as UGI Gas’s ratepayers, who
17 benefit from the three effects I listed previously. The immediate community also
18 benefits from new jobs, increased business competitiveness, and higher property
19 values. Finally, the Commonwealth and the country benefit from avoided
20 emissions of carbon and other pollutants, reductions in energy prices and
21 volatility, and increased energy security.

22

1 **Q. Ms. Gumby argues that the EE&C Plan claim should be disallowed because**
2 **it is not required for the provision of safe and reliable service. Would you**
3 **please respond?**

4 A. Ms. Gumby avers that UGI Gas “has not demonstrated that the proposed cost of
5 the EE&C plan will provide greater enhancements to reliability and safety than
6 equal investment elsewhere in the system.” See Exhibit TML-8. To my
7 knowledge, no Pennsylvania public utility has had to meet this standard for its
8 EE&C Plan (whether it is voluntary or mandated by statute) to be approved by
9 the Commission. Indeed, this standard is not listed in Act 129 or in the
10 Commission’s *December 2009 Secretarial Letter*. Therefore, I do not consider
11 this to be an appropriate standard by which to evaluate UGI Gas’s EE&C Plan.

12 Notwithstanding, EE&C Plans can help improve the safety and reliability of
13 UGI Gas’s service. As explained by Ms. Gumby in discovery, “[r]educing load on
14 a system can improve reliability and plant life for limited plant and equipment that
15 degrades with usage.” See Exhibit TML-8. Moreover, EE&C measures’ value in
16 improving system reliability is captured through the TRC Test because it includes
17 avoided T&D costs, which I explained earlier. In addition, an energy audit under
18 the Residential Retrofit Program and similar programs can identify and address
19 health and safety issues in a customer’s home.

20 Further, UGI Gas’s efforts to increase energy efficiency and conservation
21 and to replace its aging natural gas infrastructure or plan system capacity are
22 complementary. As Ms. Gumby has conceded, infrastructure replacement plans
23 and EE&C Plans are not mutually exclusive. See Exhibit TML-9. Thus, UGI Gas

1 can strive to achieve the goals of increased energy efficiency and conservation in
2 concert with those for infrastructure replacement and capacity planning.

3
4 **Q. Do you believe that the abundance of Marcellus Shale gas should be a**
5 **factor in the approval of UGI Gas's EE&C Plan, as argued by Ms. Gumby?**

6 A. No. UGI Gas's EE&C Plan reflects the abundance of Marcellus Shale gas. The
7 cost-effectiveness screening of programs reflects the low prices of gas resulting
8 from shale gas, including from the Marcellus Shale. For example, the avoided
9 costs used in the EE&C Plan's development included a Henry Hub price of
10 \$3.441/MMBtu in January 2020; eight years ago, in April 2008, the forward price
11 for January 2020 was about \$10.50/MMBtu. Therefore, the EE&C Plan includes
12 a 67% reduction in gas prices from conditions prior to the ramp-up of shale-gas
13 production. Importantly, the programs recommended in the EE&C Plan are cost-
14 effective even with the price reductions created by the abundance of Marcellus
15 Shale gas.

16 In addition, electric and gas energy-efficiency programs are not usually
17 motivated by fear of running out of fuel, so the abundance of Marcellus Shale gas
18 does not affect the value of energy efficiency in UGI Gas's territory, except
19 through the effects on avoided costs. When supply is adequate, ratepayers
20 benefit from reduced payments for gas and transportation charges. The value of
21 energy efficiency will be even higher if tighter environmental constraints result in
22 earlier coal-plant retirements, increased gas use for electric generation, higher
23 gas prices, and higher carbon costs than assumed in the UGI Gas analysis.

1 Energy efficiency in gas use is thus a valuable hedge or insurance policy for UGI
2 Gas's customers, both as gas consumers and as electric consumers.

3
4 **Q. Ms. Gumby argues that the current cost of natural gas may adversely affect**
5 **the EE&C Plan and its projected participation rates. Do you agree?**

6 A. No. First, as I previously explained, the Company accounted for the currently
7 projected cost of natural gas when developing the EE&C Plan. Therefore, to the
8 extent that there are any such adverse effects, the EE&C Plan accounts for
9 them.

10 Second, there has been growing support for the conservation of natural
11 gas, even as natural gas prices have fallen. Indeed, several entities have
12 undertaken efforts to implement energy efficient natural gas projects despite low
13 natural gas costs as described in Section 1.2 of Exhibit TML-2. Additionally, the
14 national effort to address carbon emissions through investments in energy
15 efficiency under the Clean Power Plan has garnered support from both Tom
16 Wolf, the Governor of Pennsylvania, and John Quigley, Secretary of the
17 Pennsylvania Department of Environmental Protection. See Exhibit TML-10.
18 Therefore, the Company believes that it cannot only achieve the projected
19 participation rates in the EE&C Plan, but also deliver cost-effective savings to
20 ratepayers along with environmental and economic benefits to the
21 Commonwealth and the country.

22 Third, the Commission has approved Pennsylvania EDCs' EE&C Plans
23 that offer incentives for natural gas energy efficiency measures. For example,

1 PPL Electric Utilities Corporation's ("PPL Electric") Phase III EE&C Plan offers a
2 range of incentives for non-electric high efficiency central heat (gas, oil, or
3 propane) under its Energy Efficient Home Program. See PPL Electric Phase III
4 EE&C Plan, Docket No. M-2015-2515642, at p. 52 (Apr. 22, 2016) (Compliance
5 Filing). To my knowledge, no parties opposed the inclusion of such incentives
6 simply because the current cost of natural gas is low.

7 Fourth, the price of natural gas should not be examined in a vacuum. It is
8 important to weigh the cost of natural gas, and the benefit provided by saving it,
9 against the costs of efficiency measures and programs. This cost-benefit
10 analysis has typically taken the form of the TRC Test in Pennsylvania, which I
11 have used for the EE&C Plan and which Ms. Gumby agrees is an acceptable test
12 for evaluating voluntary EE&C Plans. See Exhibit TML-7. Further, the EE&C
13 Plan portfolio has a very healthy TRC benefit-to-cost ratio (BCR) of 1.65. Indeed,
14 Ms. Gumby agrees that the EE&C Plan as proposed is cost-effective on a TRC
15 Test basis. See Exhibit TML-7. Thus, the TRC Test demonstrates that the
16 EE&C Plan, as proposed, should obtain benefits despite low natural gas costs.

17
18 **Q. Ms. Gumby uses tankless water heaters as an example for how low natural**
19 **gas costs may adversely affect the success of the EE&C Plan. Would you**
20 **please respond?**

21 A. Ms. Gumby's example has multiple flaws. First, as Ms. Gumby concedes,
22 tankless water heaters are a listed measure in the Commission's 2016 Technical

1 Reference Manual and are available measures under other utilities' EE&C
2 programs. See Exhibit TML-11.

3 Second, the articles cited by Ms. Gumby are outdated. The article from
4 GreenBuildingAdvisor.com is four years old, and the study referenced in the
5 article relies on data from six to eight years ago. The ConsumerReports.org
6 article is from eight years ago. Since these articles were published, the full
7 installed cost of tankless water heaters have fallen dramatically.
8 HomeAdvisor.com shows a current national average cost of \$1,525 and an
9 average cost for Pennsylvania of \$1,201, see Exhibit TML-12, nearly half of the
10 prices from the Minnesota study used by the GreenBuildingAdvisor.com article.
11 *Many other issues mentioned by Ms. Gumby, such as high installation costs,*
12 *have been addressed, as ConsumerReports.org reported in a 2015 update. See*
13 *Exhibit TML-13. Taken in the context of a natural replacement scenario, where*
14 *the comparison is the incremental difference between buying and installing a*
15 *storage tank water heater compared to a tankless water heater, the incremental*
16 *cost is now much less than the \$3,000 used in the analysis provided by Ms.*
17 *Gumby, given a baseline of buying and installing a standard storage tank water*
18 *heater.*

19 Third, tankless water heaters are cost-effective on a TRC Test basis. The
20 analysis performed for the EE&C Plan found that the measure had a TRC
21 benefit-cost ratio of 1.95 to 3.79 with net TRC Benefits of \$724 to \$966 per unit in
22 a natural replacement scenario, making it a very cost-effective measure under
23 the Residential Prescriptive Program.

1 Finally, the Residential Prescriptive Program, which offers an incentive for
2 tankless water heaters, is designed to address Ms. Gumby's simple payback
3 concern. By providing an upfront incentive, the simple payback of efficient
4 equipment can be reduced considerably. For example, an incentive that covers
5 50% of the cost of a measure will cut the simple payback in half.

6
7 **Q. Ms. Gumby also argues that the EE&C Plan claim should be disallowed**
8 **because UGI Gas's affiliate, CPG, withdrew its EE&C Plan in its 2010 base**
9 **rate case. Does this fact have any bearing on UGI Gas's proposed EE&C**
10 **Plan?**

11 A. No. CPG's EE&C Plan is different from UGI Gas's EE&C Plan. Indeed, UGI
12 Gas's EE&C Plan includes several of the details that were deemed missing from
13 CPG's EE&C Plan, including detailed program plans with measure and project
14 level assumptions and projections.

15
16 **Q. Do you agree with Ms. Gumby that the EE&C Plan is not in the public**
17 **interest?**

18 A. Absolutely not. As I have explained previously, the EE&C Plan is designed to
19 produce positive net benefits for UGI Gas's ratepayers despite the low natural
20 gas costs and the costs of participating in the EE&C programs. This is
21 exemplified by the EE&C Plan being cost-effective on a TRC Test basis.
22 Moreover, the EE&C Plan offers a range of EE&C programs and measures to all

1 customer classes. Therefore, I believe that the EE&C Plan is in the public
2 interest.

3
4 **III. OCA WITNESS GLENN A. WATKINS**

5 **Q. In OCA Statement No. 3, Glenn A. Watkins found that TRC Test analysis**
6 **employed by the Company is reasonable and that the proposed EE&C Plan**
7 **passes the TRC Test. Do you agree with his findings?**

8 **A.** Yes. I agree with Mr. Watkins's analysis that even using alternative inflation and
9 discount rates, the Company's proposed programs still meet the TRC Test.
10 Indeed, as Mr. Watkins's aptly states, "the residential programs proposed by UGI
11 pass the TRC under any reasonable assumed inputs and forecasts." See OCA
12 Statement No. 3, page 45, lines 27-28. This additional analysis conducted by Mr.
13 Watkins's provides strong support that the EE&C Plan programs will be
14 successful even in the extreme case where there are "no future increases in
15 natural gas prices." See OCA Statement No. 3, page 45, lines 23-24.

16
17 **Q. Although Mr. Watkins believes that the EE&C Plan passes the TRC Test, he**
18 **proposes certain modifications to the Plan. Would you please summarize**
19 **those modifications?**

20 **A.** Yes. For the Residential Prescriptive Program, Mr. Watkins recommends that all
21 equipment and appliances (except for Wi-Fi thermostats) exceed EnergyStar
22 minimum requirements. He also recommends that conversions from other fuel
23 sources, such as electricity or oil, should not qualify for incentives under the
24 *Residential Prescriptive Program and the Residential Retrofit Program.* In

1 addition, he requests certain clarifications and restrictions for the New
2 Construction Plan and Residential Retrofit Plan concerning incentives and
3 qualified measures. Moreover, Mr. Watkins requests that a \$21.0 million total
4 cap and certain annual caps and allowances be placed on spending for EE&C
5 programs. Finally, he asks that the Company provide at least 30 days' notice of
6 a proposed change to the EE&C Rider instead of one day's notice.

7
8 **Q. Do you agree with Mr. Watkins's recommendation that all measures under**
9 **the Residential Prescriptive Program, except for wireless thermostats, be**
10 **required to exceed EnergyStar requirements?**

11 A. No. Most of the proposed measures in the Residential Prescriptive Program
12 meet the EnergyStar minimum requirement and requiring that this level be
13 exceeded would deprive the Company of a valuable marketing tool and the ability
14 to leverage one of the most visible and respected brands associated with energy
15 efficiency in the country. Moreover, my understanding is that all of the Act 129
16 EDCs will offer incentives for EnergyStar-rated measures under their Phase III
17 EE&C Plans. Considering those utilities have had EE&C Plans in place for
18 nearly seven years and UGI Gas's EE&C Plan is brand new, I believe it is
19 appropriate for UGI Gas to offer incentives for measures that meet EnergyStar
20 minimum requirements.

21

1 **Q. Why does the EE&C Plan include incentives for tankless water heaters that**
2 **have a lower efficiency than the EnergyStar criteria for this type of**
3 **equipment?**

4 A. The current baseline for residential water heating is a storage tank water heater
5 which has an energy factor of 0.594, a level well below that of an entry-level
6 tankless model that has an efficiency factor of 0.82. In addition, the U.S. Energy
7 Information Administration's ("EIA") most recent survey of Residential Energy
8 Consumption Survey ("RECS") shows that only 4.1% of Pennsylvania residents
9 use a tankless water heater as their primary water heater. See Exhibit TML-14.
10 Given the wide efficiency gap, low market penetrations, and recently fallen prices
11 that I mentioned previously, I believe it is worth providing incentives for the base
12 level of tankless water heaters and higher incentives for the higher efficiency
13 EnergyStar models. This two-tiered approach can be used to drive more market
14 adoption of a technology that is still new to the American market. Going forward,
15 the Company will monitor the market for tankless water heaters and, if it deems
16 necessary, move to a single higher efficiency tier incentive.

17
18 **Q. Do you believe that the Company should be permitted to provide energy**
19 **efficiency rebates under the Residential Prescriptive Program and the**
20 **Residential Retrofit Program to customers who are switching to natural gas**
21 **service?**

22 A. Absolutely, for a variety of reasons. First, UGI Gas will only provide incentives
23 for efficient gas measures that cover a portion of the incremental cost of

1 choosing high-efficiency equipment rather than providing incentives for baseline-
2 efficiency natural gas equipment. In other words, a customer cannot receive a
3 rebate for only changing to a baseline unit. This ensures that the customers are
4 truly making an efficiency decision, not simply a fuel switching one.

5 Second, energy efficient natural gas appliances offer efficiency benefits
6 that often exceed their electric and oil counterparts. Not only does the customer
7 who implements the measure benefit from reduced energy costs, but ratepayers
8 as a whole benefit because these measures pass the TRC Test. Indeed, Mr.
9 Watkins acknowledges that "it may be legitimately argued" that converting from
10 alternative fuel sources "will promote the conservation of society's resources and
11 may even help reduce our carbon footprint." See OCA Statement No. 3, page
12 46, lines 27-28.

13
14 **Q. Mr. Watkins also requests certain clarifications and restrictions for the New**
15 **Construction Program and Residential Retrofit Program concerning**
16 **incentives and qualified measures. Would you please summarize his**
17 **requests?**

18 **A.** Mr. Watkins believes that the incentive payments for these programs are vague
19 and ambiguous. Accordingly, he asks that specific incentive criteria be
20 developed for measures implemented under these programs, such as: (1) energy
21 efficient windows and doors and insulation upgrades under the New Construction
22 Program; and (2) air leakage reduction and insulation upgrades under the
23 Residential Retrofit Program. In addition, he claims that there is ambiguity

1 regarding whether incentive payments will be made under both the Residential
2 Prescriptive and Residential Retrofit Programs. Finally, he proposes that the
3 New Construction Program only be available to developments that currently have
4 gas or will have gas (as per a main extension agreement).

5
6 **Q. Do you believe that specific measure-level incentive criteria should be**
7 **developed for the New Construction and Residential Retrofit Program?**

8 A. No. These programs were designed to follow a more comprehensive
9 performance-based approach, separate from the one-off measure incentives
10 provided by the Residential and Nonresidential Prescriptive programs. The
11 performance-based approach helps incent participants to go beyond single
12 measures and address the whole building during a retrofit or new construction
13 project. By paying for performance, the program can more flexibly address
14 challenges for each program and provide additional incentives for customers to
15 go deeper. These programs will still require evidence to determine savings and
16 hence incentive amounts, such as a measured reduction in CFM-50 readings
17 from a blower-door air test for air sealing reductions.

18
19 **Q. Will the EE&C Plan “pay twice” for measures under both the Residential**
20 **Prescriptive and Residential Retrofit Programs?**

21 A. No. A customer may only receive one incentive per measure or project. For
22 example, if a customer receives an incentive for a project under the Residential
23 Retrofit Program that includes the installation of an EnergyStar furnace, that

1 customer is not eligible to receive an additional incentive from the Residential
2 Prescriptive Program for that furnace. The same holds true for the New
3 Construction Program.
4

5 **Q. Please respond to Mr. Watkins's proposal to restrict the New Construction**
6 **Program to developments that currently have gas or will have gas (as per a**
7 **main extension agreement).**

8 A. Mr. Watkins recommends restricting the New Construction Program to
9 developments that "currently have gas or will have gas (as per a Main extension
10 agreement)." He states that "[t]his will prevent developers from using the New
11 Construction [Program] incentives to offset Mains extension charges or charges
12 imposed on new customers under the GET Gas Program." See OCA Statement
13 No. 3, page 47, lines 13-17. His proposal lacks merit for several reasons.

14 First, restricting the New Construction Program to developments that have
15 gas or will have gas is unnecessary and unsupported. No reason exists for
16 developers to participate in the New Construction Program unless the
17 developments already have gas or will have gas. Indeed, a developer cannot
18 sell a house with gas appliances unless gas service is available.

19 Second, it is unclear to me under Mr. Watkins's recommendation whether
20 developers participating in the GET Gas Program are prohibited from
21 participating in the New Construction Program. By saying that his proposed
22 restriction will prevent developers from offsetting "charges imposed on new
23 customers under the GET Gas Program," his testimony could be interpreted

1 suggesting that GET Gas developers be prohibited from the New Construction
2 Program. However, when asked to clarify whether GET Gas developers would
3 be prohibited from the program in discovery, Mr. Watkins failed to do so. See
4 Exhibit TML-15.

5 Third, if GET Gas developments are prohibited under Mr. Watkins's
6 proposal, it is unclear to me why they should be. Under both a traditional main
7 extension agreement and the GET Gas Program, a development "will have gas."
8 Therefore, I see no reason why the Company's New Construction Program
9 should treat traditional main extension agreements and the GET Gas Program
10 differently.

11 Fourth, Mr. Watkins's concern about a developer offsetting main extension
12 charges with the incentives lacks merit. These incentives are designed to offset
13 the costs of participating customers to implement measures that increase energy
14 efficiency; they are not designed to offset the costs of extending gas service. A
15 developer who builds only to building code would not be eligible for any
16 incentives under the EE&C Plan.

17
18 **Q. Mr. Watkins also recommends that a total cap of \$21 million be placed on**
19 **residential EE&C Plan spending. Do you agree?**

20 **A.** No. A total cap on residential EE&C program spending of \$21 million is
21 unsupported. Although the Company projects spending only an estimated \$21
22 million on residential EE&C programs, UGI Gas may need the flexibility to spend
23 more than the budgeted amount depending on the success of those programs.

1 Moreover, UGI Gas will report spending on residential EE&C programs every
2 year in its annual reports to the Commission. Therefore, Mr. Watkins and others
3 can monitor whether the Company is on track to stay within its approximately \$21
4 million budget for residential EE&C programs.

5
6 **Q. Mr. Watkins further proposes that annual caps and allowances be placed**
7 **on EE&C Plan spending. Would you please summarize your understanding**
8 **of these annual caps and allowances?**

9 A. Mr. Watkins recommends that the following annual caps and allowances be
10 placed on the residential programs:

- 11 1. *If actual spending in any year is less than \$4.2 million, UGI Gas may*
12 *carry-forward 75% of such underspending for a maximum of one year,*
13 *up to a maximum for the next year's total spending allowance of \$6.3*
14 *million (150% of \$4.2 million);*
- 15 2. The cap on any year's annual spending is \$6.3 million (150% of \$4.2
16 million); and
- 17 3. If actual spending in any year is greater than \$4.2 million (not include
18 any limited carry-forward from the previous year), the cumulative
19 overspending be reflected in future budgets and spending such that
20 the total five-year cap of \$21.0 million is not exceeded.

21
22 **Q. Do you agree with his proposal?**

1 A. No. First, as Mr. Watkins concedes, no Pennsylvania EE&C Plans are subject to
2 similar annual caps and allowances that he has proposed. See Exhibit TML-16.
3 Second, Mr. Watkins's annual caps and allowances proposal is overly complex
4 and impractical. His proposal would only apply for the residential programs and
5 would place an administrative burden on UGI Gas's staff to manage and adjust
6 those specific budgets depending on individual, annual spending in accordance
7 with his complex annual caps and allowances. Third, his proposal is
8 unnecessary. The Company will track and monitor the annual spending of all its
9 EE&C Plan programs and make any adjustments it deems necessary. Further,
10 such annual spending data will be included in UGI Gas's annual reports filed with
11 the Commission. Therefore, to the extent that Mr. Watkins has concerns about
12 the annual spending for residential EE&C programs, he can monitor such
13 spending throughout the five-year EE&C Plan phase.

14
15 **IV. OCA WITNESS ROGER D. COLTON**

16 **Q. OCA witness Colton raises issues concerning low-income customers'**
17 **ability to participate in the EE&C Plan. Would you please summarize them?**

18 A. Yes. Mr. Colton criticizes the Company for not offering EE&C program measures
19 that are directly targeted at low-income customers and argues that the EE&C
20 Plan effectively will exclude low-income customers from participating. As a
21 result, he recommends that the Commission establish a low-income savings
22 carve-out of 4.5%, meaning that 4.5% of the savings achieved by the Company
23 must be attributable to low-income customers.

24

1 **Q. Are low-income customers prohibited from participating in the Company's**
2 **residential EE&C programs?**

3 A. No. As I explained in my direct testimony, low-income customers are allowed to
4 participate in any of the programs available to residential customers. In fact, Mr.
5 Colton accepts that there is no *per se* restriction preventing low-income
6 customers from participating. See Exhibit TML-17.

7
8 **Q. Do you agree with Mr. Colton that the Company's EE&C Plan should**
9 **specifically target low-income customers?**

10 A. No. Although the EE&C Plan does not offer a low-income-specific program, the
11 Company already offers its Low-Income Usage Reduction Program ("LIURP"),
12 which is designed to improve low-income customers' energy efficiency. Indeed,
13 my understanding is that the Company nearly doubled its LIURP funding in the
14 past year through a program change approved by the Commission. Accordingly,
15 it appears that the Company is sufficiently addressing the energy efficiency
16 needs of low-income customers in its service territory.

17
18 **Q. Mr. Colton recommends that UGI Gas be required to achieve 4.5% of its**
19 **savings from low-income customers. Do you agree?**

20 A. No. First, Mr. Colton has performed no study or evaluation of the effect that his
21 4.5% low-income savings carve-out would have on the individual EE&C
22 programs, the TRC Test benefit-cost ratios of the EE&C Plan, or the TRC Test
23 benefit-cost ratio of the individual EE&C programs. See Exhibit TML-18.

1 Second, under his proposal, the Company would be unable to count savings
2 from low-income customers participating in non-low-income-specific residential
3 programs. See Exhibit TML-18. This would require the Company to develop
4 programs specifically for low-income customers with no direction from Mr. Colton
5 as to what types of programs, measures, and incentives should be offered, what
6 the funding level for these programs should be, or whether the programs'
7 measures should be directly installed.

8 Third, my high-level estimate of the cost for implementing such a low-
9 income-specific program comes to between \$5.0 million and \$8.8 million over the
10 five years of the portfolio. See Exhibit TML-19. This represents approximately
11 19% to 32% of the projected budget for all energy efficiency programs and would
12 require a significant reworking of the entire portfolio's design; it also would mean
13 fewer programs for other classes and perhaps an EE&C program that does not
14 meet TRC test.

15
16 **Q. Regarding multifamily housing, Mr. Colton argues that the EE&C Plan does**
17 **not adequately address providing EE&C measures to customers living in**
18 **multifamily buildings. Do you agree?**

19 **A.** No. First, as with low-income customers generally, nothing in the EE&C Plan
20 expressly prohibits customers living in multifamily buildings from participating in
21 the available EE&C programs. Second, while there is no specific stand-alone
22 multifamily program, the Nonresidential Retrofit Program is specifically designed
23 to be able to address the more complex issues found in many multifamily

1 buildings, such as those identified by Mr. Colton in his direct testimony. See
2 OCA Statement No. 4, page 54, lines 8-24. Therefore, I believe the EE&C Plan
3 adequately addresses multifamily buildings.
4

5 **Q. Mr. Colton avers that the Residential Retrofit Program is geared toward**
6 **high usage customers, which are predominantly not units in multifamily**
7 **buildings, and recommends that UGI Gas be directed to develop a**
8 **residential program and designate a portion of that budget to serve**
9 **multifamily properties. Would you please respond?**

10 A. I recognize that there are various types of multifamily buildings, such as
11 individually metered versus master-metered, and that multifamily buildings can
12 have a range in the number of units in them. However, I believe that the
13 Company's EE&C Plan provides sufficient opportunities for multifamily buildings
14 to participate in the EE&C programs. Although the Residential Retrofit Program
15 is geared toward high usage customers, nothing in the EE&C Plan prevents an
16 individually metered multifamily customer from participating in that program.
17 Moreover, the New Construction Program, which has a budget spread across
18 both residential and nonresidential customers, is an available EE&C program
19 option for individually metered multifamily buildings as well. Furthermore, for
20 master-metered multifamily buildings, the Nonresidential Retrofit Program is
21 available for those customers. Therefore, even though the Residential Retrofit
22 Program is geared toward high usage customers, the EE&C Plan has other
23 programs that collectively address the various types of multifamily housing.

1 As for Mr. Colton's recommendation that UGI Gas should develop a
2 residential program and designate a portion of that program's budget for
3 multifamily buildings, Mr. Colton has clarified that his proposal is for the
4 Company to develop a program dedicated specifically to individually metered
5 multifamily buildings. See Exhibit TML-20. However, his proposal lacks critical
6 details, such as a proposed budget or list of available measures that would be
7 provided under this program.

8
9 **Q. Mr. Colton also mentions that low-income customers have a particularly**
10 **high implicit discount rate¹ for investments in energy efficiency measures**
11 **(100%). Would you please respond?**

12 **A.** Although it may be true that low-income customers have a high implicit discount
13 rate, this is precisely why the Company's LIURP is important. The Company
14 provides measures under LIURP at no cost to those customers, which responds
15 to low-income customers' high implicit discount rate for investments in EE&C
16 measures. To leverage the opportunities for low-income customers to take
17 advantage of these opportunities, UGI Gas will refer any LIURP-eligible
18 customers to LIURP when they contact the Company about participating in an
19 EE&C program. Additionally, as noted above, it is my understanding that UGI
20 Gas's LIURP funding has been almost doubled going forwards as part of its
21 latest Universal Service Program filing.

22

¹ An implicit discount rate of 100% means that low-income customers cannot bear any of the
upfront costs of energy efficiency measures.

1 **V. CAUSE-PA WITNESS MITCHELL MILLER**

2 **Q. CAUSE-PA witness Miller argues that UGI Gas should either exempt its**
3 **confirmed low-income customers from paying the EE&C Rider or increase**
4 **LIURP funding by the amount collected from low income customers.**
5 **Would you please respond?**

6 A. I maintain that low-income customers that are not enrolled in the Company's
7 Customer Assistance Program ("CAP") should not be exempt from paying the
8 EE&C Rider. My understanding is that this approach is consistent with how
9 EDCs subject to Act 129 recover EE&C costs from low-income customers, as the
10 Commission has stated that low-income customers are not exempt from Act 129
11 EE&C cost recovery. *See, e.g., Energy Efficiency and Conservation Program,*
12 *Docket No. M-2014-2424864, at pp. 144-45 (Order Entered June 19, 2015).* If
13 confirmed low-income customers are fully exempted from the EE&C Rider, all
14 other residential customers will have to bear their costs, even if low-income
15 customers participate in the EE&C programs. Such an outcome is inconsistent
16 with cost causation principles. I further note that if low-income customers are
17 having difficulty paying their bills, they can take advantage of programs designed
18 to help low-income and payment troubled customers, such as CAP.

19
20 **Q. Do you agree with Mr. Miller that UGI Gas should use the EE&C programs**
21 **to generate LIURP referrals?**

22 A. Absolutely. As I mentioned previously, UGI Gas will refer any LIURP-eligible
23 customers to LIURP when they contact the Company about participating in an
24 EE&C program.

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VI. OSBA WITNESS ROBERT D. KNECHT

Q. Does the OSBA oppose the EE&C Plan?

A. No. Recognizing that the Commission has approved other voluntary EE&C Plans, the OSBA does not oppose the Company's voluntary EE&C Plan. Mr. Knecht further considers the Company's proposed spending for nonresidential programs to be "reasonably modest" compared to EDCs' EE&C Plans under Act 129. However, Mr. Knecht does have certain issues with the EE&C Plan.

Q. Would you please summarize Mr. Knecht's issues with the EE&C Plan?

A. Mr. Knecht first criticizes the Company for including carbon taxes and demand reduction induced price effects ("DRIPE") in its TRC Test calculations. He also questions the amount of subsidies provided to participants under the Nonresidential Retrofit and New Construction Programs. As a result, he recommends that, absent a clear need for that amount of subsidies, the Company modify its EE&C Plan so that "utility" costs do not exceed 50% of the costs for any of the nonresidential programs. In addition, he believes that the Company's allocation of the \$3.8 million in portfolio-wide administrative costs is unclear. Finally, he recommends that the Company track costs and develop separate EE&C Rider charges for small nonresidential customers (Rate Schedules N/NT) and large nonresidential customers (Rate Schedules DS and LFD).

1 **Q. Do you agree with Mr. Knecht that carbon taxes and DRIPE should not be**
2 **included in the Company's TRC Test calculations?**

3 A. No. The avoided cost benefits of carbon taxes and DRIPE should be included in
4 the TRC Test because they are tangible benefits that would result from UGI
5 Gas's EE&C Plan. Including carbon costs and DRIPE will produce more
6 accurate evaluations of UGI Gas's EE&C benefits, and hence a more accurate
7 evaluation of its programs. In addition, I observe that PGW's proposal to include
8 carbon taxes and DRIPE in its TRC Test calculations was recently recommended
9 for approval by Administrative Law Judges Christopher P. Pell and Marta Guhl.,
10 as noted by Mr. Knecht in footnote 30 of his testimony. *See Petition of*
11 *Philadelphia Gas Works for Approval of Demand-Side Management Plan for FY*
12 *2016-2020, and Philadelphia Gas Works Universal Service and Energy*
13 *Conservation Plan for 2014-2016 52 Pa. Code § 62.4 – Request for Waivers,*
14 *Docket No. P-2014-2459362 (Mar. 8, 2016) (Recommended Decision).* For
15 these reasons, I believe that the Company's proposal to include a price for
16 carbon and DRIPE in its TRC Test calculations is appropriate.

17
18 **Q. Do you share Mr. Knecht's concern with the amount of subsidies provided**
19 **to participants under the Nonresidential and New Construction Programs?**

20 A. No. First, Mr. Knecht understates the participant contribution percentages in
21 Table IEC-8. He assigns all "O&M/A&G" costs to only participants, when these
22 costs are more accurately spread out across all eligible ratepayers. This has the

1 effect of adding additional costs to participants that they would not incur, thereby
2 lowering the percentage contribution made by participants.

3 Second, the New Construction Program is designed to encourage more
4 comprehensive projects by offering higher incentives. One of the largest
5 opportunities for encouraging holistic approaches to energy efficiency is when a
6 building is first designed and built. It is more difficult and expensive to retrofit a
7 building with a large amount of energy efficiency measures after the building is
8 constructed. At that point, an EE&C measure's incremental cost would be the full
9 cost of the measure. To minimize the potential for this lost opportunity, the New
10 Construction Program is designed to offer higher incentives for more
11 comprehensive projects. Accordingly, the New Construction Program's
12 incentives are projected to be a larger portion of the total project cost when
13 compared to other programs in the EE&C Plan.

14 Finally, the Nonresidential Retrofit Program is estimated to pay incentives
15 that are in line with the best practices of similar nonresidential retrofit natural gas
16 efficiency programs offered by PGW and other administrators in nearby states,
17 such as Massachusetts and Vermont.

18
19 **Q. Do you agree with Mr. Knecht's proposal to modify the EE&C Plan so that**
20 **"utility" costs do not exceed 50% of the costs for any of the nonresidential**
21 **programs?**

22 **A.** No. As mentioned before, I believe his calculation of participant participation
23 percentages is incorrect. In addition I see no support for why a cut off of 50% is

1 reasonable. As long as a program or portfolio maintains cost-effectiveness, I
2 believe it is reasonable to allow up to 100% of a participant's costs to be covered,
3 such as under a direct install program like LIURP. One of the only ways to reach
4 the smaller members of the commercial customer base is through such direct
5 install programs, where most, if not all, of the project costs are paid by the
6 program administrator.

7
8 **Q. Mr. Knecht also requests clarification regarding the allocation of portfolio-**
9 **wide administrative costs. Would you please respond?**

10 A. The portfolio-wide costs are allocated to rate classes based on the portion of total
11 incentives paid to that rate class in a given year, as a percentage of all incentives
12 paid in that year. The CHP Program is not included in the allocation of these
13 costs; only the efficiency programs are included.

14
15 **Q. Mr. Knecht also raises a concern with the Company's EE&C Rider and**
16 **proposes that the Company track costs and develop separate EE&C Rider**
17 **charges for small nonresidential customers (Rate Schedules N/NT) and**
18 **large nonresidential customers (Rate Schedules DS and LFD). Would you**
19 **please respond?**

20 A. As originally proposed, the EE&C Rider would have two applicable surcharges:
21 one for residential customers and one for nonresidential customers. After
22 reviewing Mr. Knecht's testimony, the Company agrees with Mr. Knecht that it
23 would be more prudent to develop a separate EE&C Rider charge for small

1 nonresidential customers. Additionally, UGI Gas proposes to develop separate
2 EE&C Riders charges for Rate Schedule DS and for Rate Schedule LFD. UGI
3 Gas agrees and believes that doing so will more accurately recover EE&C costs
4 based on the projected participation rates for these customers in the CHP
5 program.

6
7 **Q. What will the impact of this proposal be on the EE&C charges originally**
8 **proposed by the Company?**

9 A. The applicable charge for small nonresidential customers will increase from 2.78
10 cents per Mcf to 3.23 cents per Mcf. In addition, the applicable rate for Rate
11 Schedule DS will increase to 4.79 cents per Mcf. Finally, the applicable charge
12 for Rate Schedule LFD customers will decrease from 2.78 cents per Mcf to 1.34
13 cents per Mcf.

14
15 **VII. UGIII WITNESS MICHAEL TRZESNIEWSKI**

16 **Q. Would you please summarize your understanding of UGIII witness**
17 **Trzesniowski's concerns with the EE&C Plan and Rider?**

18 A. Mr. Trzesniowski questions whether the EE&C Rider should be applied to Rate
19 Schedule LFD customers, arguing that large transportation customers would
20 incur "considerable additional costs" and, like Lehigh University, have already
21 invested in EE&C measures. As a result, he recommends that the EE&C Rider
22 only apply to customers who "opt-in" to the EE&C Plan. In the alternative, he
23 proposes that Rate Schedule LFD should be entirely excluded.

24

1 **Q. Please respond to Mr. Trzesniowski's assertion that large transportation**
2 **customers would incur "considerable additional costs."**

3 A. It is important to recall that the EE&C Plan is cost-effective on a TRC Test basis.
4 That means that ratepayers as a whole will receive more benefits from the EE&C
5 Plan than its cost. I also note that the Company is proposing now to split the
6 nonresidential EE&C Rider charge into three separate charges: one for Rate
7 Schedules N/NT, one for Rate Schedule DS, and one for Rate Schedule LFD.
8 As a result, the applicable EE&C Rider charge for Rate Schedule LFD would
9 drop from 2.78 cents per Mcf to 1.34 cents per Mcf. This should reduce the costs
10 recovered from large transportation customers on Rate Schedule LFD, like
11 Lehigh.

12 In addition, Rate Schedule LFD customers will only be responsible for the
13 EE&C costs incurred by other Rate Schedule LFD customers. Any
14 over/undercollection of EE&C costs will be annually reconciled. Therefore, if Mr.
15 Trzesniowski truly believes that large transportation customers will not participate
16 in the EE&C Plan because they have previously implemented EE&C measures,
17 then large customers like Lehigh will not have as many EE&C costs to bear.

18

19 **Q. Do you agree with Mr. Trzesniowski that large transportation customers**
20 **will receive little to no direct benefit from the EE&C Plan because they have**
21 **already implemented EE&C projects?**

22 A. No. Although large transportation customers like Lehigh have previously
23 implemented EE&C projects, that fact does not mean that they would be

1 uninterested in participating in UGI Gas's EE&C programs. Indeed, the only
2 program available for Rate Schedule LFD under the EE&C Plan is the Combined
3 Heat and Power ("CHP") Program. Notably, not one of Lehigh's energy
4 efficiency projects was a CHP project. See UGIII Exhibit MT-5. Therefore, the
5 Company's EE&C Plan will offer new opportunities for large transportation
6 customers to implement CHP projects, which have been recently endorsed by
7 the Commission. See *Proposed Policy Statement on Combined Heat and*
8 *Power*, Agenda No. 2530484-CMR (Feb. 25, 2016) (Joint Motion by Chairman
9 Brown and Commissioner Powelson). Indeed, the Commissioners' Joint Motion
10 proposed a policy statement intended to, among other things, "[e]ncourage EDCs
11 and NGDCs to make CHP an integral part of their efficiency and resiliency plans,
12 as well as their marketing and outreach efforts." *Id.* (emphasis added).

13
14 **Q. Do large transportation customers receive a benefit from participating in an**
15 **EE&C program?**

16 A. Yes. For example, under the CHP Program, participating large transportation
17 customers would receive incentives for implementing CHP projects. These
18 incentives are meant to help offset the costs of such projects. In fact, Lehigh
19 participated in PPL Electric Utilities Corporation's ("PPL Electric") EE&C
20 programs and received incentives from PPL Electric for implementing EE&C
21 projects. See Exhibit TML-21. Although these incentive payments may not
22 equal the total cost of investment in EE&C projects, a large transportation

1 customer who implements one of these projects nonetheless receives a
2 monetary incentive that would not exist without the EE&C Plan.

3
4 **Q. Do you agree with Mr. Trzesniowski's proposal that the EE&C Rider should**
5 **only apply to those customers who opt-in to the EE&C Plan?**

6 A. No, for several reasons. First, Mr. Trzesniowski clarified in discovery that this
7 proposal applied to all customers, and not just Rate Schedule LFD customers.
8 See Exhibit TML-22. This would have a drastic effect on the EE&C Plan's
9 success. Since all of the EE&C costs would be spread amongst only the
10 customers who opt-in, many customers may choose not to participate. This
11 would adversely affect the Company's ability to achieve the level of savings and
12 participation set forth in its EE&C Plan. Second, Mr. Trzesniowski only has
13 testified about the impact of the EE&C Rider on large transportation customers.
14 Nothing in his testimony supports why residential and small nonresidential
15 customers should have to opt-in to the EE&C Plan. Indeed, I note that OCA,
16 CAUSE-PA, and OSBA do not oppose the EE&C Plan, although they do propose
17 certain modifications.

18
19 **Q. Do you agree with Mr. Trzesniowski's alternative proposal that large**
20 **transportation customers be excluded from the EE&C Rider?**

21 A. No. To be clear, Mr. Trzesniowski explained in discovery that his alternative
22 proposal is for Rate Schedule LFD customers to be able to opt-out of the EE&C
23 Plan. See Exhibit TML-20. Although Senate Bill 805 would amend Section

1 2806.1 to allow large commercial and industrial customers to opt-out of EDCs'
2 EE&C Plans at the beginning of a phase, that bill has not been enacted into law.
3 Therefore, no comparable opt-out for large transportation customers exists under
4 any other EE&C Plan in Pennsylvania. Therefore, no such opt-out should be
5 established for UGI Gas's EE&C Plan.

6

7 **Q. Does this conclude your rebuttal testimony?**

8 **A. Yes, it does.**

UGI Gas Exhibit TML-3

Impacts of the 2009 IECC for Residential Buildings at State Level

September 2009

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Executive Summary

The Building Energy Codes Program (BECP) recently conducted a nationwide residential energy code analysis for the U.S. Department of Energy (DOE). The analysis compares the requirements of the 2009 International Energy Conservation Code® (IECC) with the residential code—or typical construction practice in the absence of a code—in most states as of June 2009. The results, which include estimated typical energy savings of updating each state's code to the 2009 IECC, are provided in this report in chapters specific to each state.

An overview of the 2009 IECC and its major chapters, as well as a brief comparison to previous versions, is provided as introductory information. The IECC is then briefly compared to the International Residential Code, which contains a chapter with energy efficiency requirements that are very similar to the IECC.

Several states have either not adopted a mandatory energy code or developed their own codes which have minimal or no connection to the IECC. The latter—including California, Florida, Oregon, and Washington—were not included in this analysis as the codes in these states would be difficult to appropriately compare to the 2009 IECC and most of these states have energy offices that have already assessed the IECC on their own.

Chapter 2 is dedicated to outlining some of the major code differences in the 2009 IECC that are not contained in any previous version of the code, and to which much of the energy savings of the 2009 IECC compared to previous versions is attributable. These energy saving differences are described in further detail in the report, and include:

- Mandatory duct pressure testing coupled with maximum allowable duct leakage rates. These requirements are applicable when any portion of the ducts are outside the conditioned space.
- A requirement that 50% of lamps in a residence must be energy efficient
- Several improvements in basic envelope requirements
- Elimination of trade-off credits for high efficiency heating, cooling, or water heating equipment.

The full results of each state specific analysis are provided in the following report.¹

¹ DISCLAIMER: The results contained in this report are complete and accurate to the best of BECP's knowledge, based on information available at the time it was written.

1.0 Chapter 1 Overview of the 2009 IECC

1.1 Introduction

This report examines the requirements of the 2009 International Energy Conservation Code® (IECC) on residential buildings on a state-by-state basis with a separate, stand-alone chapter for each state. A summary of the requirements of the code is given for each state. The 2009 IECC is then compared to the current state code for most states² or typical current construction practice for the states that do not have a residential energy efficiency code. Estimated typical energy savings of updating each state's code to the 2009 IECC are reported.

1.2 Overview of the 2009 IECC

The International Energy Conservation Code sets requirements for the “effective use of energy” in all buildings. Certain buildings that use very low energy use (such as buildings with no heating or cooling) are exempt. The code applies to new buildings and to remodels, renovations, and additions to buildings.

Table 1 shows the organization of the 2009 IECC. The IECC has two separate categories of buildings: residential and commercial. The code requirements are almost entirely different for these two categories. Residential buildings are essentially defined as low-rise buildings (3 stories or less above grade) intended for long-term living (hotels/motels are classified as commercial buildings). The requirements for residential buildings are in Chapter 4; the requirements for commercial buildings are in Chapter 5. Chapters 1 through 3 and Chapter 6 apply to all buildings. This report only addresses the residential portion of the IECC, a separate report addresses commercial buildings³.

The only chapters of the IECC with specific requirements for residential buildings are Chapter 4 and, to a lesser extent, Chapter 1 and Chapter 3. Chapter 4 does reference certain commercial building requirements in Chapter 5 (for example, HVAC systems serving multiple dwelling units). Chapters 2 and 6 only provide supporting information.

Chapter 1 primarily addresses when the code applies and provides instruction to help confirm compliance with the code.

Table 2 below summarizes the sections in Chapter 1.

Chapter 2 defines terms used in the code.

Chapter 3 provides a U.S. map and tables of the climate zones used in the IECC. Climate zones in the code are set on county boundaries. These zones are shown in Figure 1. Section 303 specifies information required at the building site to verify insulation level and specifies National Fenestration Rating Council (NFRC) standards for

² States with their own home-developed codes are not compared to the IECC in this report. This includes California, Oregon, Washington, and Florida. This is done for two reasons. First, these states generally have codes that have little resemblance to the IECC, making a thorough comparison beyond the scope of this study. Second, these states generally have highly capable energy offices that are capable of assessing the IECC on their own (and often have). Alaska, Hawaii and Vermont also do not have an energy analysis here because of difficulties in assessing construction practice particular to those states. No energy analysis was conducted for states that have already adopted the 2009 IECC.

³ Many states adopt the ANSI/ASHRAE/IESNA Standard 90.1 for commercial buildings rather than the IECC and therefore 90.1-2007 is examined for commercial buildings in the separate report. The 2009 IECC permits compliance with Standard 90.1-2007 as one option for complying with the IECC for commercial buildings.

rating fenestration performance. Chapter 3 contains only one element that directly contains a specific construction requirement: protective covering for insulation on the exterior of foundations (Section 303.2.1).

Table 1. IECC Table of Contents

CHAPTER 1 ADMINISTRATION
101 Scope and General Requirements
102 Alternate Materials—Method of Construction, Design or Insulating Systems
103 Construction Documents
104 Inspections
105 Validity
106 Reference Standards
107 Fees
108 Stop Work Order
109 Board of Appeals
CHAPTER 2 DEFINITIONS
201 General
202 General Definitions
CHAPTER 3 CLIMATE ZONES
301 Climate Zones
302 Design Conditions
303 Materials, Systems and Equipment
CHAPTER 4 RESIDENTIAL ENERGY EFFICIENCY
401 General
402 Building Thermal Envelope
403 Systems
404 Electrical Power and Lighting Systems
405 Simulated Performance Alternative
CHAPTER 5 COMMERCIAL ENERGY EFFICIENCY
501 General
502 Building Envelope Requirements
503 Building Mechanical Systems
504 Service Water Heating
505 Electrical Power and Lighting Systems
506 Total Building Performance
CHAPTER 6 REFERENCED STANDARDS

Table 2. Overview of IECC Chapter 1

Section	Overview/summary
101 Scope and General Requirements	Defines how code applies to additions, alterations, renovations, and repairs. Exempts certain low energy buildings.
102 Alternate Materials—Method of Construction, Design or Insulating Systems	Provides code official leeway in interpreting requirements.
103 Construction Documents	Construction documents as required by the code official must be provided.
104 Inspections	Inspections must be permitted and code officials must give approval before allowing further construction or occupancy.
105 Validity	Instructs that remainder of code applies even if a portion is found to be illegal or void.
106 Referenced Standards	Referenced standards must be complied with; the IECC takes precedence if there are any conflicts.
107 Fees	Fees for permits.
108 Stop Work Order	Authority and conditions for stop work orders
109 Board of Appeals	For hearing and deciding appeals.

1.3 Residential Building Requirements – Chapter 4 of the IECC

The 2009 IECC sets construction requirements related to energy efficiency for four energy end-uses:

- 1) Space heating
- 2) Space cooling (air conditioning)
- 3) Water heating
- 4) Lighting⁴

Table 3 shows the organization of the IECC requirements in Chapter 4.

Most of the requirements in the IECC are contained in Section 402 for the building envelope (ceilings, walls, windows, floor/foundation). Figure 1 shows the prescriptive requirements for most envelope measures (there are also separate requirements for skylights, high mass walls, and steel-framed ceilings, walls, and floors).

⁴ Lighting is new to the scope of the IECC for residential buildings in 2009. Previous editions of the IECC only had requirements for space heating, space cooling, and water heating.

Table 3. Overview of IECC Chapter 4

Section	Overview/summary
401 General	Identifies the two compliance paths: prescriptive and performance. Requires a certificate to be posted on the building listing R-values and other energy efficiency information.
402 Building Thermal Envelope	This section contains most of the prescriptive requirements in the code. Insulation and fenestration requirements are given by climate zone. Air sealing requirements.
403 Systems	Contains requirements for heat pump controls, duct testing and sealing, piping insulation, and equipment sizing.
404 Electrical Power and Lighting Systems	Contains requirements for efficient lighting.
405 Simulated Performance Alternative	The performance approach. This utilizes the requirements of Sections 401 through 404 as a starting point and allows trade-offs. Unlike previous versions of the IECC this does not give extra credit for high efficiency heating, cooling, and water heating equipment. Compliance is determined using computer software. Allows more flexibility in meeting the code.

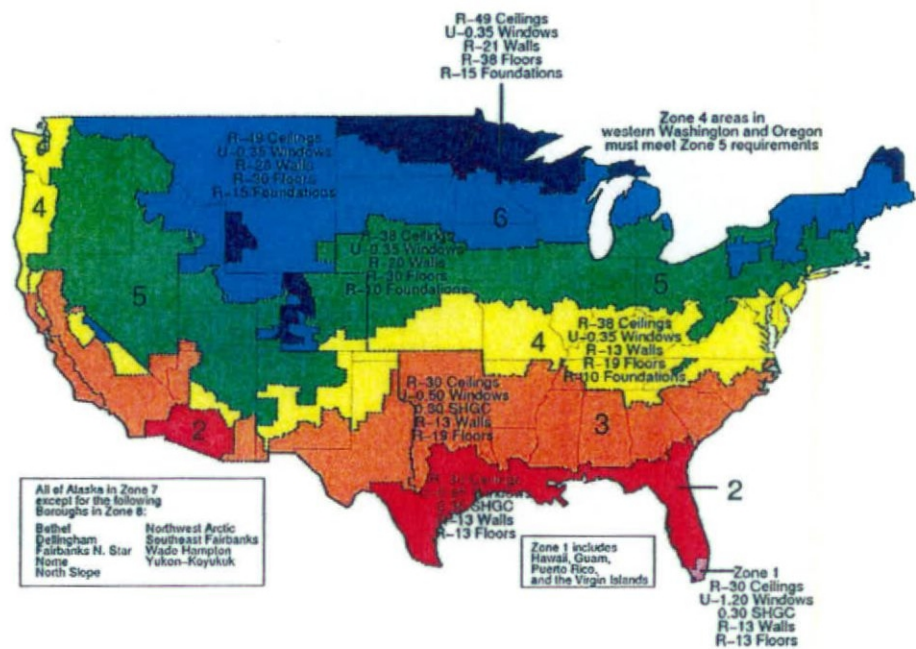


Figure 1. Prescriptive Envelope requirements

1.4 Comparison to Previous Versions of the IECC

The IECC is typically published every three years, though there are some exceptions. In the last two decades, full editions of the MEC came out in 1989, 1992, 1993, and 1995, and full editions of the IECC came out in 1998, 2000, 2003, 2006, and 2009⁵.

Though there were changes in each edition of the IECC from the previous one, the IECC can be categorized into two general eras: 2003 and before, and 2004 and after. This is because the residential portion of the IECC was heavily revised in 2004. The climate zones were completely revised (reduced from 17 zones to 8 primary zones in 2004) and the building envelope requirements were restructured into a different format. The code became much more concise and much simpler to use. These changes complicate comparisons of state codes based on pre-2004 versions of the IECC to the 2009 IECC.

The IECC also had substantial revisions from 2006 to 2009. These revisions were not to the code format, but rather were changes to specific requirements to improve energy efficiency and make the code more stringent. The 2009 has some important new requirements:

- The duct system now has to be tested and the air leakage out of ducts must be kept to an acceptable maximum level. Testing is not required if all ducts are inside the building envelope (for example in heated basements), though the ducts still have to be sealed.
- 50% of the lighting “lamps” (bulbs, tubes, etc.) in a building have to be energy efficient. Compact fluorescents qualify, standard incandescent bulbs do not.
- Trade-off credit can no longer be obtained for high efficiency HVAC equipment. For example, if a high efficiency furnace is used, no reduction in wall insulation is allowed. This will have a great impact on reducing the flexibility allowed by the REScheckTM software. No energy impact is assigned to this code change in the analysis of updating state codes to the 2009 IECC in this report.
- Vertical fenestration U-factor requirements are reduced from 0.75 to 0.65 in Climate Zone 2, 0.65 to 0.5 in Climate Zone 3, and 0.4 to 0.35 in Climate Zone 4.
- The maximum allowable solar heat gain coefficient is reduced from 0.40 to 0.30 in Climate Zones 1, 2, and 3.
- R-20 walls in climate zones 5 and 6 (increased from R-19)
- Modest basement wall and floor insulation improvements
- R-3 pipe insulation on hydronic distribution systems (increased from R-2)
- Limitation on opaque door exemption both size and style (side hinged)
- Improved air-sealing language
- Controls for driveway/sidewalk snow melting systems
- Pool covers are required for heated pools.

1.5 The IECC Compared to the International Residential Code (IRC)

Chapter 11 of the IRC contains energy efficiency requirements that are very similar to the IECC. This Chapter allows compliance with the IECC as an option for IRC compliance. The scope of the IRC is limited to one- and two-family dwellings and to townhouses, whereas the IECC includes other low-rise multifamily buildings such

⁵ There was also a published version of the IECC in 2004, but that version is referred to as a “supplement” edition.

as apartments. States can adopt the IRC, the IECC, or both. While nearly all the requirements in the IRC are identical to those in the IECC, there are a few differences between the 2009 IECC and 2009 IRC. Most notably:

- The IRC requires 0.35 solar heat gain coefficient (SHGC) glazing in Climate Zones 1-3, the IECC requires 0.30 SHGC. Impact resistant fenestration in Climate Zones 2 and 3 is allowed to have an SHGC of up to 0.40 in the IRC only.
- The IECC has higher basement wall and floor insulation levels in colder zones.
- The IRC has no “mandatory” (cannot be traded off) requirements related to fenestration U-factor or SHGC, the IECC does.
- Compliance with the IECC is allowed as an alternative to Chapter 11 of the IRC. The IRC does not directly contain a simulated performance alternative; the IECC must be used instead for this compliance alternative.

Because of these changes, the 2009 IRC does not achieve equivalent energy savings to the 2009 IECC.

1.6 Current State Codes

This report addresses each state code individually, but a brief summary of state codes is presented here. Almost 40 states have adopted the IECC or its predecessor, the Model Energy Code (MEC), as their mandatory state code. Many of these states have made some modifications or amendments to the IECC or MEC. These modifications can vary from a few minor changes to extensive revisions.

Some states have no mandatory codes. As of the date of this report, these states are:

- Alabama
- Hawaii
- Kansas
- Mississippi
- Missouri
- North Dakota
- South Dakota
- Wyoming

Four states have developed their own codes that have minimal or no connection to the IECC:

- California
- Florida
- Oregon
- Washington

In certain cases, cities or counties within a state have a different code from the rest of the state. For example, Austin and Houston have adopted progressive energy codes that exceed the minimum Texas statewide code.

2.0 Chapter 2 – Energy Analysis of Major Improvement in 2009 IECC

The 2009 IECC contains major differences that are not contained in any previous version of the IECC. These changes account for much of the energy savings attributable to the 2009 IECC compared to any of the older versions of the IECC.

2.1 Duct Testing

Section 403.2.2 of the 2009 IECC requires air ducts systems, where any of the ducts pass outside of the conditioned space (into attics, garages, etc.), to be pressure tested for leakage with maximum leakage rates specified. The duct system now has to be tested to prove that the air leakage out of ducts is kept to an acceptable level. Testing is not required if all ducts are inside the building envelope (for example in heated basements), though all ducts are required to be sealed.

The IECC has always required ducts to be sealed. However, multiple studies have shown that visual inspection of ducts is not adequate. Ducts are often located in difficult to access areas such as attics and crawl spaces. Cracks and other leakage points in ducts may not be visible because they are covered by insulation, hidden from view, or simply too small to be readily apparent to the human eye. Testing of completed homes in Washington state, where prescriptive code requirements for duct sealing apply, “showed no significant improvement” over non-code homes (Washington State University 2001). Another study from Washington state concluded: “Comparisons to air leakage rates reported elsewhere for homes built before the implementation of the 1991 WSEC show no significant improvement by the general population” despite years of training emphasizing duct sealing (Hales et al. 2003). The requirement to meet a specific leakage limit will result in improving the buildings that would have had the leakiest ducts. Figure 2 illustrates this effect.

Numerous other studies around the nation show substantial duct leakage in new homes, including those in states with codes requiring duct sealing. For example, a 2001 study of 186 houses built under the MEC in Massachusetts reported “serious problems were found in the quality of duct sealing in about 80% of these houses” (Xenergy 2001). Pressurization tests in 22 of these houses found an average leakage to the outside of the house of 183 cfm, or 21.6% of the system flow, at a pressure of 25 Pascals.

The IECC allows a variety of compliance methods. Notably, the testing can be done at rough-in stage immediately after the ducts are installed. This allows potentially costly call backs to be avoided if the tested leakage rate exceeds code requirements.

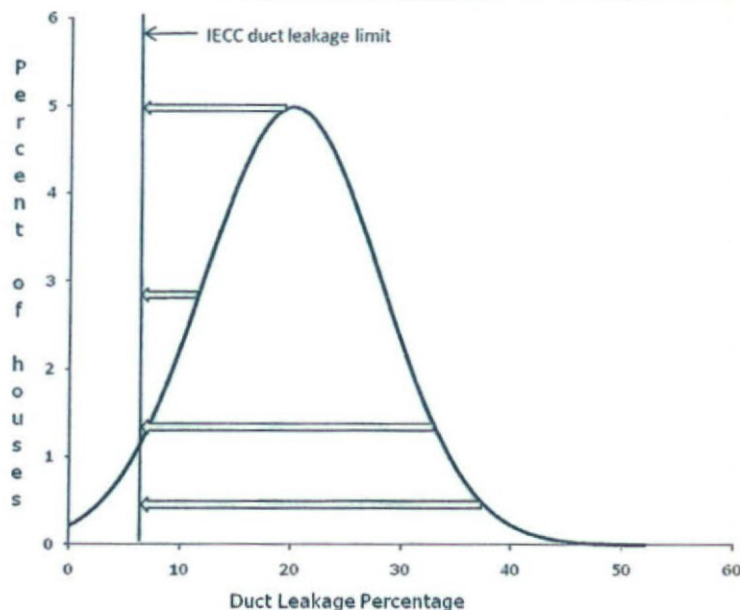


Figure 2. Impact of improved duct sealing. The curve illustrates the approximate distribution of leakage rate in new homes. The arrows show the reduction in duct leakage necessary to meet the code requirement.

2.2 Lighting

The 2009 IECC requires 50% of lamps (bulbs, tubes) within a residence to be energy efficient. There were no requirements for lighting in single-family homes in previous versions of the IECC. This includes but is not limited to CFLs. Standard incandescent bulbs do not qualify. Savings attributable to the lighting requirements in the IECC will decrease as Federal law requires improved light bulbs in 2012 to 2014.

2.3 Envelope Improvements

The 2009 IECC has a number of improvements in basic envelope requirements over the 2006 IECC. Allowable glazed fenestration (windows and skylights) SHGC has been reduced to a maximum of 0.30, meaning that no more than 30% of the sun's heat can pass through the window into the home. Fenestration U-factor requirements have improved in Climate Zones 2, 3, and 4. Wall insulation for wood frame walls has been bumped up from R-19 to R-20 in Climate Zones 5 and 6. Floor insulation and basement wall insulation have increased in the very coldest zones.

2.4 Elimination of Equipment Trade-offs

Previous versions of the IECC allow reductions in envelope measures to below-code levels if heating and cooling equipment efficiency is improved to above-code levels. For example, a popular trade-off in colder climates is to use a high efficiency gas furnace allowing a reduction of wall insulation. The 2009 IECC eliminates these types of trade-offs. Since these trade-offs are by definition energy neutral, their elimination in theory would not impact energy use. However, building envelope measures often have longer lifetimes than heating and cooling equipment so there can be long-term impacts. Additionally, there is expected to be some "free rider" effect where high efficiency equipment will be used regardless of the IECC requirements and the trade-offs, so the older IECC allowed envelope reductions as an unintended side effect.

3.0 References

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The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

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Impacts of the 2009 IECC on Residential Buildings in Pennsylvania

September 2009

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Analysis of 2009 International Energy Conservation Code Requirements for Residential Buildings in Pennsylvania

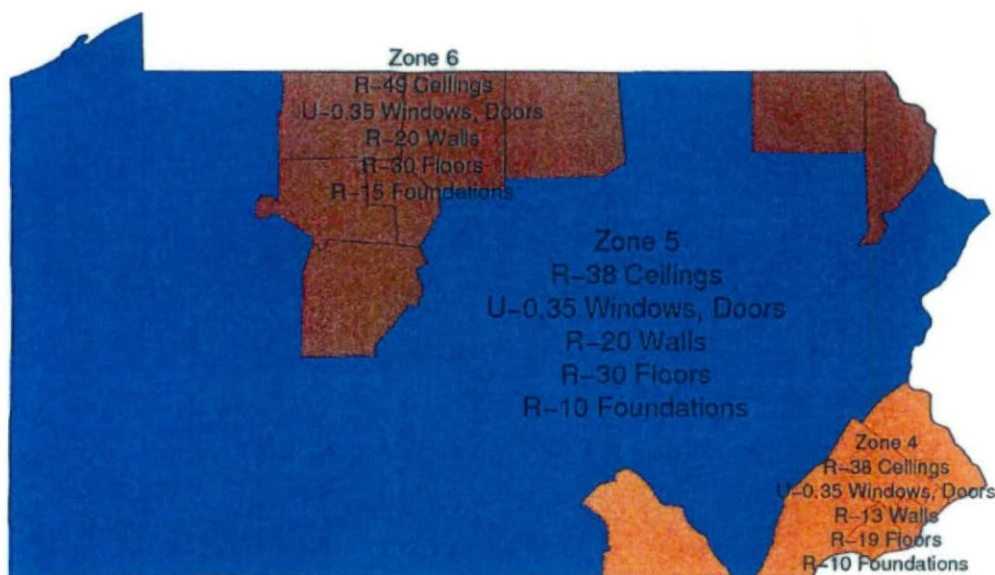
Summary

The 2009 International Energy Conservation Code (IECC) contains several major improvements in energy efficiency over the current state code, the 2006 IRC and IECC with amendments. The most notable changes are improved duct sealing and efficient lighting requirements. A limited analysis of these changes resulted in estimated savings of \$218 to \$263 a year for an average new house at recent fuel prices.

Overview of the 2009 IECC

The IECC scope includes residential single-family housing and multifamily housing three stories or less above-grade intended for permanent living (hotel/motel is not “residential”). The code applies to new buildings and additions/alterations/renovations/ repairs.

The map below shows the primary building envelope requirements for all residential buildings in the 2009 IECC.



Notable requirements in the 2009 IECC:

- Building envelope must be caulked and sealed.
- Slab-on-grade insulation is R-10 to a depth of 2 feet in Zones 4 and 5 and 4 feet in Zone 6.
- Supply ducts in attics must be insulated to R-8. Return ducts in attics and all ducts in crawlspaces, unheated basements, garages, or otherwise outside building envelope must be insulated to R-6.
- All ducts must be sealed and either:
 - *verified by pressure testing* – the duct system has to be tested and the air leakage out of ducts must be kept to an acceptable maximum level.
 - *installed entirely within the building thermal envelope* – testing is not required if all ducts are inside the building thermal envelope (for example in heated basements), though the ducts still have to be sealed.
- Piping for hydronic (boiler) heating systems must be insulated to R-3.

- Although vapor retarders are not required by the IECC, the I-codes do set wall vapor retarder requirements in Section R601.3 of the 2009 IRC, and vapor retarders are required in Zones 5 and 6.
- Less insulation is allowed for mass walls and more insulation required for steel framing.
- 50% of the lighting “lamps” (bulbs, tubes, etc.) in a building must be high efficacy. Compact fluorescents qualify, standard incandescent bulbs do not.
- Standard I-code administrative requirements (inspections, documentation) apply.
- A certificate must be posted near the electrical panel listing insulation levels and other energy efficiency measures.

Exemptions/Allowances from prescriptive measures:

- One door and 15 ft² of window area are exempt
- Skylight U-factors are allowed to be U-0.60
- 500 ft² or 20% of ceiling area of cathedral ceiling, whichever is less, is allowed to have R-30 insulation

Mandatory Requirements:

Windows can never exceed an area-weighted U-factor of 0.48 in Zones 4 and 5 and 0.40 in Zone 6. The 2009 IECC also identifies a set of other requirements that are strictly “mandatory” that must be done in all buildings, such as building envelope and duct sealing.

Compliance Paths:

The IECC effectively contains three alternative compliance paths.

- 1) Prescriptive measures. This is considered the simplest path. These requirements do not vary by building size, shape, window area, or other features. The IECC has a single table of requirements for insulation R-values and window and door U-factors and SHGC. There is a corresponding U-factor table that permits compliance of less common component types (e.g., structural insulated panels), albeit without any cross-component trade-offs.
- 2) Total building envelope UA (U-factor multiplied by area). This is the path predominantly used by the REScheck™ software. Based on the prescriptive U-factor table, it allows trade-offs whereby some energy efficiency measures can fall below code requirements if balanced by other measures that exceed code requirements.
- 3) Simulated performance (requires software programs). This path allows compliance if the home has a calculated annual energy consumption (or energy cost) equal to or less than that of a standard reference design that just meets the code’s prescriptive requirements. This path allows for crediting energy efficiency measures not accounted for in the other paths, such as renewable energy measures. The 2009 performance path differs from previous editions of the IECC in that it allows no tradeoff credit for the use of high efficiency space heating, space cooling, or water heating equipment.

Main Differences between the Pennsylvania Code and the 2009 IECC

The Pennsylvania code, known as the Uniform Construction Code (UCC) uses the 2006 IRC and IECC with the addition of an alternative path to Chapter 11 of the 2006 IRC. The UCC regulations are located at:

<http://www.dli.state.pa.us/landi/cwp/view.asp?a=310&q=211676>

The prescriptive alternative path that Pennsylvania developed is intended to supplement the IRC and be consistent in format and scope. The alternative path defines the counties in the state into South, Central, and North Climate Zones, which are the same as the 2006 IECC/IRC for Climate Zones 4, 5, and 6.

The code requirements in the alternative are nearly all the same as the IRC. The following are the differences we have identified:

- A. Ceilings without attic spaces: The Pennsylvania alternative path allows an unlimited area of R-30 insulation in designs of roof/ceiling assemblies where there is not sufficient space for the required higher R-value. The 2006 IECC and IRC limit this provision to 500 ft².
- B. Fenestration: For Climate Zone 6, the 2006 IRC has a mandatory limit on area-weighted fenestration average U-factor of U-0.55 for windows and U-0.75 for skylights. These limits can never be exceeded regardless of how energy efficient the rest of the building is. In contrast, the Pennsylvania alternative has no such window or skylight U-factor limits.
- C. Heating equipment efficiency trade-offs: The Pennsylvania alternative provides a predefined combination of increased minimum equipment efficiencies and reduced thermal envelope requirements as shown in Table PA502. The 2006 IRC and IECC have no such predefined trade-offs though similar trade-offs may be obtain via the performance path in the IECC.

The 2006 IECC has the same format (including the same climate zones) and many of the same requirements as the 2009 IECC. The major differences between these editions of the IECC are listed below:

- The current state code requires ducts to be sealed but not to a specific leakage rate verified by testing as is required in the 2009 IECC (if any ducts are outside the building envelope).
- 50% of the lighting "lamps" (bulbs, tubes, etc.) in a building have to be high efficacy in the 2009 IECC; the 2006 IECC has no lighting requirement. Compact fluorescents qualify, standard incandescent bulbs do not.
- Trade-off credit can no longer be obtained for high efficiency HVAC equipment in the 2009 IECC. For example, if a high efficiency furnace is used, no reduction in wall insulation is allowed. (This will have a substantial impact on the flexibility allowed by the REScheckTM software and other energy performance analysis tools.)
- A number of thermal envelope requirements have improved in the 2009 IECC. These are highlighted in Table 1.

Table 1. Comparison of Envelope Requirements

Components	Climate Zone 4A		Climate Zone 5A		Climate Zone 6A	
	2006 IECC	2009 IECC	2006 IECC	2009 IECC	2006 IECC	2009 IECC
Ceiling	38	38	38	38	49	49
Skylight U-factor	.60	.60	.60	.60	.60	.60
Fenestration U-factor	.40	.35	.35	.35	.35	.35
Fenestration SHGC	NR	NR	NR	NR	NR	NR
Wood Frame Wall	13	13	19	20	19	20
Mass Wall	5/10	5/10	13/19	13/17	15/19	15/19
Floor	19	19	30	30	30	30
Basement Wall	10/13	10/13	10/13	10/13	10/13	15/19
Slab	10, 2ft	10, 2ft	10, 2ft	10, 2ft	10, 4ft	10, 4ft
Crawl Space	10/13	10/13	10/13	10/13	10/13	10/13

Other changes in the 2009 IECC compared to the state code:

- R-3 pipe insulation on hydronic distribution systems (increased from R-2)
- Stricter area limits on door exemptions
- Improved (more detailed) air-sealing language
- Snow melt controls
- Pool covers are required for heated pools

Energy Analysis

A brief energy analysis was conducted comparing the current state code to the 2009 IECC. The EnergyGauge™ software was used to determine the energy impacts of changes in envelope requirements. EnergyGauge™ is based on the DOE-2 energy simulation software developed by DOE (Lawrence Berkeley National Laboratory 1981).

Two sets of buildings were simulated: one with energy efficiency levels set to the prescriptive requirements of the current state code, and one with energy efficiency levels set to the prescriptive requirements of the 2009 IECC. All inputs other than the changes in energy efficiency levels were identical in the two sets of simulations.

The analysis assumed a two-story, single-family house with a conditioned floor area of 2,400 ft². It was assumed that the house had 8.5-ft high ceilings, a ceiling area (bordering the unconditioned attic) of 1,200 ft², a gross exterior wall area of 2,380 ft², and a window area of 357 ft² (15% of the wall area) equally oriented north, south, east, and west. Heating with a natural gas furnace (\$1.20/therm) and central electric air conditioning (\$.12/kWh) were assumed.

High-efficacy lighting was assumed to increase from 10% to 50% of all lighting within the building, reducing lighting energy use by 26%, or \$74 a year. Savings attributable to the lighting requirements in the IECC will decrease as Federal law requires improved light bulbs in 2012 to 2014. Improved duct sealing was assumed to

save 10% of the heating and cooling costs. Actual savings will vary depending on many factors, including how well ducts are currently sealed in the absence of any testing requirements.

Table 2 shows the estimated annual energy savings per house that result from meeting the improved requirements in the 2009 IECC. Total savings includes heating, cooling, and lighting and is shown as a percentage of the end-uses covered by the 2009 IECC (heating, cooling and water heating).

Table 2. Energy End Use and Percentage Savings

<i>Climate Zone</i>	<i>Annual Energy Cost (\$)</i>				<i>Savings 2009 IECC vs. PA Code</i>	
	<i>PA Code</i>		<i>2009 IECC</i>		<i>Savings (\$/yr)</i>	<i>Percent Savings</i>
	<i>Heating</i>	<i>Cooling</i>	<i>Heating</i>	<i>Cooling</i>		
Philadelphia (CZ 4B)	1348	192	1176	175	263	14
Harrisburg (CZ 5B)	1190	185	1065	166	218	13
Bradford (CZ 6B)	1699	63	1521	57	258	12



The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

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Impacts of Standard 90.1-2007 for Commercial Buildings at State Level

September 2009

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Executive Summary

The Building Energy Codes Program (BECP) recently conducted a nationwide commercial energy code analysis for the U.S. Department of Energy (DOE). The analysis compares ANSI/ASHRAE/IESNA¹ Standard 90.1-2007 with the commercial code in each state as of June 2009. The results are provided in this report in chapters specific to each state.

Standard 90.1-2007 was chosen for this analysis because it is the baseline energy standard established in the American Recovery and Reinvestment Act of 2009 and the subject of DOE's forthcoming determination of energy savings for Standard 90.1. An overview of Standard 90.1-2007, as well as a brief comparison to previous versions, is provided as introductory information.

States with unique energy codes were not included in the analysis as the codes in these states would be difficult to appropriately compare to Standard 90.1 and most of these states have energy offices that routinely assess their codes against the national codes. In states with codes prior to and including the 2000 IECC or Standard 90.1-1999, those states with no statewide energy code, and home rule states which did not specifically request that another code be used, Standard 90.1-1999 was used as the baseline for comparison. Standard 90.1-1999 was chosen as the default baseline because BECP believes it fairly represents current construction practice in states with older codes or no codes.

Three DOE Benchmark buildings were used for the simulation used in this analysis: a medium office building (53,600 ft²), a mid-rise apartment building (33,700 ft²), and a non-refrigerated warehouse (49,500 ft²)—representing the Standard 90.1 nonresidential, residential, and semiheated requirements, respectively. The buildings are described in further detail in the report, and in Appendix A.

Locations for the analysis were selected based on obtaining a sample representative of each climate zone in the state, where TMY2 weather file locations existed, making sure to include the state capital. In the absence of a TMY2 weather file for a particular climate zone in a state, a representative location in an adjacent state was used for the purposes of the simulation. These locations, and the full results of each state specific analysis completed by BECP, are provided in the following report.²

¹ American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America

² DISCLAIMER: The results contained in these reports are complete and accurate to the best of BECP's knowledge, based on information available at the time it was written.

1.0 Introduction

This report describes the results of a nationwide commercial energy code analysis undertaken by the Building Energy Codes Program (BECP) for the U.S. Department of Energy (DOE). The task involved comparing each state's current commercial energy code³ to ANSI/ASHRAE/IESNA⁴ Standard 90.1-2007 (Standard 90.1-2007). State-specific results are provided in separate chapters.

The commercial comparison is made to Standard 90.1-2007 because that is the baseline commercial energy standard established in the American Recovery and Reinvestment Act of 2009. Standard 90.1-2007 will also soon be the subject of DOE's latest determination of energy savings for Standard 90.1.

2.0 Overview of Standard 90.1-2007

Standard 90.1-2007 sets requirements for the cost-effective use of energy in commercial buildings. Certain buildings that have very low energy use, such as buildings with no heating or cooling, are exempt. Standard 90.1-2007 applies to new buildings and to alterations and additions to existing buildings.

Table 1 shows the organization of Standard 90.1-2007. Most of the actual requirements are contained in Sections 5-10.

Table 1. Standard 90.1-2007 Table of Contents

1 – Purpose
2 – Scope
3 – Definitions, Abbreviations, and Acronyms
4 – Administration and Enforcement
5 – Building Envelope
6 – Heating, Ventilating, and Air Conditioning
7 – Service Water Heating
8 – Power
9 – Lighting
10 – Other Equipment
11 – Energy Cost Budget Method
12 – Normative References
Appendices

Sub-section numbers are standardized across the requirements sections. For example, sub-section 4 (x.4) is always the Mandatory Requirements. Table 2 shows the basic organization of the sub-sections used in Sections 5-10, although not all sub-sections are used in every Section.

³ Defined as the commercial energy code in effect on January 1, 2009, and referred to as the "base code". Exceptions to this definition are noted in the individual state chapters.

⁴ The American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineering Society of North America

Table 2. Organization of Sub-Sections

x.1 – General
x.2 – Compliance Paths
x.3 – Simple Buildings or Systems
x.4 – Mandatory Requirements
x.5 – Prescriptive Requirements
x.6 – Alternative Compliance Paths
x.7 – Submittals
x.8 – Products

3.0 Comparison to Previous Versions of Standard 90.1

The first Standard 90.1 was published in 1975, with revisions released in 1980, 1989, and 1999. Standard 90.1 was placed under continuous maintenance in 1999 which allowed the Standard to be updated with publication of approved addenda. Beginning with Standard 90.1-2001, the Standard moved to a three-year publication cycle.

Substantial revisions to the Standard have occurred since 1989. One major change was a complete revision of the climate zones in 2004. These revised climates zones are shown in Figure 1.

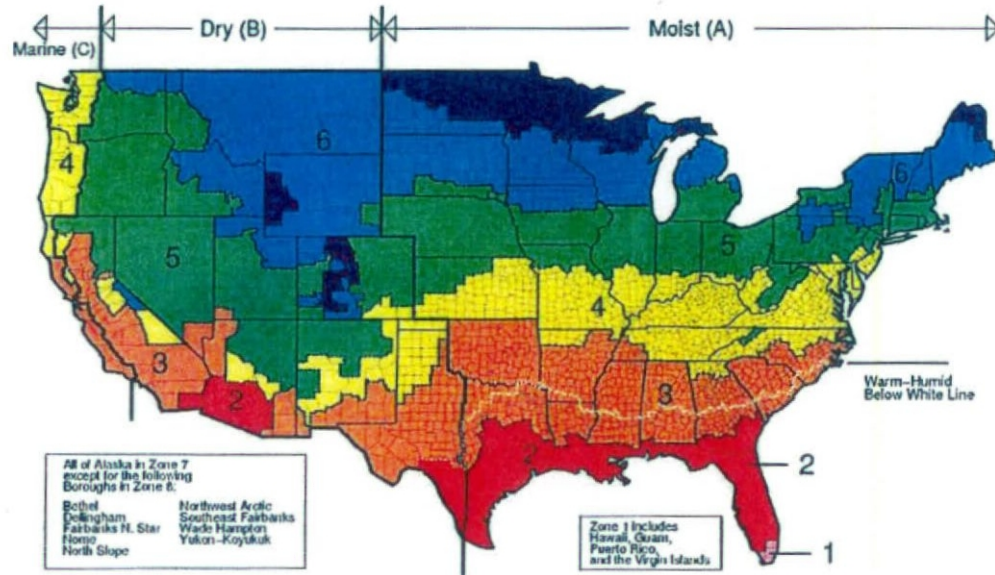


Figure 1. Climate Zones

Some of the significant requirements in Standard 90.1-2007 include:

- Stringent building insulation requirements
- Simplified fenestration requirements excluding orientation and window wall ratio
- Demand control ventilation requirements for spaces with an occupant density greater than 40 people per 1000 ft²
- Separate simple and complex mechanical requirements.

4.0 Energy Analysis Assumptions

An energy analysis was conducted comparing each state's base code to Standard 90.1-2007. The EnergyPlus software was used to determine the energy impacts. EnergyPlus was developed by the U.S. Department of Energy⁵ (DOE).

4.1 State Base Codes

States with unique energy codes (i.e., those that do not adopt/amend the International Energy Conservation Code® [IECC] or Standard 90.1) were not included in the analysis. This decision was made by DOE for two reasons: 1) these states generally have codes that have little resemblance to Standard 90.1, making a thorough comparison beyond the scope of this effort, and 2) most of these states have highly capable energy offices that routinely assess their codes against the national codes. However, states that were not included in the original analysis may request to be considered for a similar analysis by contacting BECP at techsupport@becp.pnl.gov.

In some cases, decisions about base codes needed to be made. For example, all versions of the IECC include two compliance options for commercial buildings: the commercial requirements in the IECC and Standard 90.1. Since there can only be one base code in the analysis, if a state specifically adopts the IECC as its commercial code, the commercial requirements from the applicable IECC were used in the analysis. There are several states with older commercial codes⁶. For states with codes prior to and including the 2000 IECC or Standard 90.1-1999, Standard 90.1-1999 was used as the base code.

Standard 90.1-1999 was chosen as the baseline construction for states with older codes because it has been around long enough (about 10 years) to allow many of the concepts and requirements embodied in it to become common practice in the construction industry. Standard 90.1-1999 also represents a major change in ASHRAE standards, coming ten years after the previous version of Standard 90.1. Standard 90.1-1999 is old enough that states considering adoption of Standard 90.1-2007 will still see significant savings, but not so old that states will be misled by the savings shown in this report. Keeping with the concept of Standard 90.1-1999 as "common practice" in the construction industry, Standard 90.1-1999 was also used as the base code for states with no state-wide commercial energy code. Some home rule states⁷ requested a specific code be used in the analysis; for all other home rule states Standard 90.1-1999 was used as the base code.

⁵ EnergyPlus is available and discussed in more detail at <http://apps1.eere.energy.gov/buildings/energyplus/>

⁶ Examples include codes based on 90A90B, 90.1-1989, and the 1992 Model Energy Code.

⁷ In home rule states, codes are adopted and enforced on a local level.

4.2 Benchmark Buildings

Three DOE Benchmark buildings⁸ were used for the simulation: a medium office building, a mid-rise apartment building, and a non-refrigerated warehouse (semiheated). These three building types represent the Standard 90.1 nonresidential, residential, and semiheated requirements, respectively. For states that have adopted a newer version of Standard 90.1 (1999 or later), the three types of envelope requirements were compared directly. For states that have adopted a version of the IECC that contains only a single set of commercial envelope requirements (any version prior to the 2009 IECC), the medium office and mid-rise apartment buildings were modeled using the single set of IECC requirements. The warehouse building was modeled using the semiheated envelope requirements from the reference standard version of Standard 90.1 incorporated in the version of the IECC under consideration. DOE assumes that any designer of a warehouse that would truly be considered semiheated within Standard 90.1 would be motivated to use the Standard 90.1 semiheated envelope requirements as allowed by the IECC.

Use of the IECC requirements for semiheated values in a comparison with Standard 90.1-2007 would lead to the awkward conclusion that the IECC is more stringent. This is true in the sense that use of more insulation in semiheated buildings will save some energy. However, because Standard 90.1-2007 is the designated comparison and it has separate semiheated envelope requirements, DOE chose to compare those semiheated requirements in the ASHRAE reference standard to the IECC.

The medium office has a gross area of 53,600 ft², three floors, and a window-to-wall ratio (WWR) of 33%. The HVAC systems are assumed to be a gas furnace and a packaged DX unit. The walls are modeled as steel frame walls, and the roof as insulation entirely above deck.

The mid-rise apartment building has a gross area of 33,700 ft², four floors, and a WWR of 15%. The assumed heating system is a gas furnace, with one split DX system assumed to provide cooling for each apartment. The walls are modeled as steel frame walls, and the roof as insulation entirely above deck.

The semiheated warehouse has a gross area of 49,500 ft², one floor, and no windows in the storage area. Limited heating is provided by unit heaters and no cooling is provided. The walls and roof are modeled as metal building walls and roof.

The DOE Benchmark buildings are also further described in Appendix A.

Equipment efficiencies are assumed to be the current Federal requirements for all codes. While older codes may have older (lower) equipment efficiencies listed in them, equipment that meets the requirements of these old codes may no longer be manufactured or imported into the United States. Thus, this equipment is typically not available. There are some pieces of HVAC equipment that are not covered by the Federal requirements (notably, chillers), but the HVAC equipment modeled in the three benchmark buildings used in the analysis is covered by the Federal requirements.

The HVAC system for the medium office building is simulated with an economizer when required by the code. By default, the economizer requirements are based on Table 6.5.1 in Standard 90.1-2004. A design day simulation was done in all climate zones to determine the cooling capacity and the economizer requirement. The typical cooling capacity in the medium office building exceeds 135,000 Btu/h in all climate zones. Table 3 shows the economizer requirement for representative locations in the various climate zones. The building

⁸ The Benchmark buildings are available at and discussed in more detail at http://www1.eere.energy.gov/buildings/commercial_initiative/benchmark_models.html.

simulation assumes that the economizer high limit shutoff will be controlled by differential dry bulb temperature, a control option allowed by the Standard. Under this control scenario, when the outdoor air temperature is below both the return air temperature and the high ambient shutoff temperature, the economizer is enabled.

Table 3. Economizer Requirements in Standard 90.1-2004

Climate Zone	Representative City	Economizer Requirement
1A	Miami	No
2A	Houston	No
2B	Phoenix	Yes
3A	Atlanta	No
3B	Los Angeles	Yes
3C	San Francisco	Yes
4A	Baltimore	No
4B	Albuquerque	Yes
4C	Seattle	Yes
5A	Chicago	Yes
5B	Denver	Yes
6A	Minneapolis	Yes
6B	Helena	Yes
7	Duluth	Yes
8	Fairbanks	Yes

4.3 The 2003 IECC and Lighting Power Density

Over the two decades of commercial energy code development, changes in allowable lighting power density have been one of the most important drivers of energy efficiency. As an example, Table 4 shows the allowable interior lighting power densities for the three buildings used in this analysis. Similar differences in requirements for other building types can also be listed.

Table 4. Comparison of Lighting Power Density Requirements

Standard/Code Version	Allowable Interior Lighting Power Density (whole building) – watts per square foot		
	Office	Mid-Rise Apartment	Warehouse
Standard 90.1.1989, 1998 IECC, 2000 IECC	1.5 to 1.9	Apartment lighting not covered, Multifamily not listed	0.4 to 0.8
Standard 90.1-1999, Standard 90.1-2001	1.3	Apartment lighting not covered, Multifamily 1.0	1.2
Standard 90.1-2004, Standard 90.1-2007, 2003 IECC, 2006 IECC, 2009 IECC	1.0	Apartment lighting not covered, Multifamily 0.7	0.8

The issue with the 2003 IECC is that it uses Standard 90.1-2001 as its reference standard. The 2003 IECC contains the low lighting power densities exemplified by the 1.0 watt per square foot value in the actual text of Chapter 8. But the 2003 IECC also allows the use of Standard 90.1-2001 under the provisions of Chapter 7. And Standard 90.1-2001 has the mid-range interior lighting power densities exemplified by the 1.3 watts per square foot value. No other version of the IECC has as significant a discontinuity between the requirements of the IECC and the requirements of the ASHRAE reference standard.

For this analysis, the requirements of the 2003 IECC were used. While lighting designers may very well have discovered this discontinuity, the use of the 2003 requirements provide a conservative estimate of the savings associated with adoption of Standard 90.1-2007. Use of Standard 90.1-2001 lighting densities as the baseline would simply increase the savings.

The simulation models for nonresidential and semiheated buildings use the lighting power density requirements for office and warehouse, depending on the activity type of the thermal zone. In the case of the residential building model, the lighting power density is not regulated in older codes and is assumed to be 0.36 W/sf in apartment units based on the Building America benchmark model. The office area and corridor lighting requirements in the residential building model are based on Standard 90.1-2004 requirements.

4.4 Selected Locations

The approach used to select representative locations for the analysis first focused on the goal of having one location to represent each climate zone within a state, with one of the locations being the state capital. TMY2 weather file locations were used. When a climate zone in a state was not represented by a TMY2 weather file location in that state, a representative location in an adjacent state was selected to represent the climate zone for purposes of the simulation. However, a representative city within the actual state is referenced in the report tables. A listing of the selected locations is shown below.

BUILDING ENERGY CODES PROGRAM

IMPACTS OF STANDARD 90.1-2007 FOR COMMERCIAL BUILDINGS AT STATE LEVEL

State	Location	Climate Zone	State	Location	Climate Zone
AL	Mobile	2A	NE	Omaha	5A
AL	Montgomery	3A	NV	Las Vegas	3B
AK	Anchorage	7	NV	Reno	5B
AK	Fairbanks	8	NH	Manchester	5A
AR	Little Rock	3A	NH	Concord	6A
AR	Fayetteville	4A	NJ	Newark	4A
AZ	Phoenix	2B	NJ	Paterson	5A
AZ	Sierra Vista	3B	NM	Las Cruces	3B
AZ	Prescott	4B	NM	Albuquerque	4B
AZ	Flagstaff	5B	NY	New York City	4A
CO	La Junta	4B	NY	Albany	5A
CO	Boulder	5B	NY	Binghamton	6A
CO	Eagle	6B	NM	Santa Fe	5B
CO	Alamosa	7B	NC	Charlotte	3A
CT	Hartford	5A	NC	Raleigh	4A
DE	Wilmington	4A	NC	Boone	5A
DC	Washington DC	4A	ND	Bismarck	6A
GA	Savannah	2A	ND	Minot	7
GA	Atlanta	3A	OH	Cincinnati	4A
GA	Rome	4A	OH	Columbus	5A
HI	Honolulu	1A	OK	Oklahoma City	3A
ID	Boise	5B	OK	Guymon	4A
ID	Pocatello	6B	PA	Philadelphia	4A
IL	Belleville	4A	PA	Harrisburg	5A
IL	Springfield	5A	PA	Bradford	6A
IN	Evansville	4A	RI	Providence	5A
IN	Indianapolis	5A	SC	Columbia	3A
IA	Des Moines	5A	SD	Yankton	5A
IA	Mason City	6A	SD	Pierre	6A
KS	Topeka	4A	TN	Memphis	3A
KS	Goodland	5A	TN	Nashville	4A
KY	Lexington	4A	TX	Austin	2A
LA	Baton Rouge	2A	TX	Houston	2B
LA	Shreveport	3A	TX	El Paso	3A
ME	Portland	6A	TX	Fort Worth	3B
ME	Caribou	7	TX	Amarillo	4B
MD	Baltimore	4A	UT	Saint George	3B
MD	Mtn. Lake Park	5A	UT	Salt Lake City	5B
MA	Boston	5	UT	Logan	6B
MI	Lansing	5A	VT	Burlington	6A
MI	Alpena	6A	VA	Richmond	4A
MI	Sault Ste. Marie	7	WV	Charleston	4A
MN	St. Paul	6A	WV	Elkins	5A
MN	Duluth	7	WI	Madison	6A
MS	Biloxi	2A	WI	Superior	7
MS	Jackson	3A	WY	Torrington	5B
MO	Saint Louis	4A	WY	Cheyenne	6B
MO	St. Joseph	5A	WY	Rock Springs	7B
MT	Helena	6B			



The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

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Impacts of Standard 90.1-2007 on Commercial Buildings in Pennsylvania

September 2009

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(9/2003)

Pennsylvania

Summary

Standard 90.1-2007 contains improvements in energy efficiency over the current state code, the 2006 International Energy Conservation Code (IECC). Standard 90.1-2007 would improve energy efficiency in commercial buildings in Pennsylvania. The analysis of the impact of Standard 90.1-2007 resulted in energy and cost savings.

Main Differences Between the Current State Code and Standard 90.1-2007

The 2006 IECC is the most commonly adopted commercial building energy code at the time this report was written. The reference standard for the 2006 IECC is Standard 90.1-2004 and the 2006 IECC shares many features with Standard 90.1-2004. However, the 2006 IECC was created slightly later than Standard 90.1-2004 and thus was able to benefit from changes to Standard 90.1 being contemplated for Standard 90.1-2007. The 2006 IECC is widely considered to be slightly more stringent due to the later creation date plus the differences in the development process at ASHRAE and ICC.

- Less strict requirements for vestibules in cold climates in Standard 90.1-2007.
- A requirement for demand controlled ventilation in high occupancy spaces in Standard 90.1-2007.
- Fan power limitation in Standard 90.1-2007.
- Revision of the additional lighting power allowance for retail displays to lower the allowance for some categories of merchandise in Standard 90.1-2007.
- Lack of residential and semiheated space requirements in the 2006 IECC. (However, these are available by way of the ASHRAE reference standard, Standard 90.1-2004.)
- Lack of a detailed space-by-space lighting design method in the 2006 IECC. (However, this is available by way of the ASHRAE reference standard, Standard 90.1-2004.)
- More stringent economizer requirements in colder climates in Standard 90.1-2007.

A comparison of the thermal envelope requirements is provided in Table 1.

Table 1. Comparison of Envelope Requirements (U-factors in Btu/hr.ft².°F)

	Climate Zone 4A		Climate Zone 5A		Climate Zone 6A	
	IECC 2006	90.1-2007	IECC 2006	90.1-2007	IECC 2006	90.1-2007
<i>Nonresidential</i>						
Exterior Wall	0.125	0.064	0.085	0.064	0.085	0.064
Roof	0.063	0.048	0.048	0.048	0.048	0.048
Slab	NR	NR	NR	NR	NR	R-10/2ft.
Window*	0.57 (0.39)	0.52 (0.40)	0.57 (0.39)	0.48 (0.40)	0.57 (0.39)	0.48 (0.40)
<i>Residential</i>						
Exterior Wall	0.125	0.064	0.085	0.064	0.085	0.064
Roof	0.063	0.048	0.048	0.048	0.048	0.048
Slab	NR	R-10/2ft.	NR	R-10/2ft.	NR	R-15/2ft.
Window*	0.57 (0.39)	0.52 (0.40)	0.57 (0.39)	0.48 (0.40)	0.57 (0.39)	0.48 (0.40)
<i>Semiheated</i>						
Exterior Wall	0.134	0.134	0.123	0.123	0.113	0.113
Roof	0.097	0.097	0.097	0.097	0.097	0.097
Slab	NR	NR	NR	NR	NR	NR

*Window SHGC shown in parentheses next to the U-factor

Energy Analysis

An energy analysis was conducted comparing each state's base code to Standard 90.1-2007. The EnergyPlus software was used to determine the energy impacts. Summary savings results are shown below by building type. Results are shown for the electricity and natural gas energy use intensity (in kWh/sf-year and kBtu/sf-year, respectively) for both the base code and Standard 90.1-2007. Results are also shown for the percent reduction of overall site energy usage and energy cost from the base case to Standard 90.1-2007. The energy cost savings are estimated using national average energy costs of \$0.0939 per kWh for electricity and \$1.2201 per therm for natural gas. Presentation of the individual results for electricity and natural gas usage allows interested parties to calculate source energy or energy cost savings based on state (rather than national average) fuel prices. Total annual energy usage for the three building prototypes may be calculated by multiplying the energy use intensity numbers by the square footage of the prototype building.

Pennsylvania Energy End Use and Percentage Savings							
Building Prototype	Location	Energy Use Intensity				Savings 90.1-2007 vs. IECC 2006	
		IECC 2006		90.1-2007		Energy	Cost
		Electricity (kWh/sf/yr)	Natural Gas (kBtu/sf/yr)	Electricity (kWh/sf/yr)	Natural Gas (kBtu/sf/yr)		
Nonresidential	Philadelphia	12.56	5.47	11.93	4.79	5.9%	5.4%
Residential	Philadelphia	9.17	17.68	8.96	13.30	10.4%	6.8%
Semiheated	Philadelphia	4.31	15.28	4.31	15.15	0.4%	0.3%
Nonresidential	Harrisburg	11.81	6.01	11.48	5.25	4.1%	3.4%
Residential	Harrisburg	9.15	14.35	9.11	12.23	5.0%	2.9%
Semiheated	Harrisburg	4.33	15.31	4.33	15.20	0.5%	0.3%
Nonresidential	Bradford	12.08	8.59	11.61	7.17	6.1%	5.0%
Residential	Bradford	8.80	23.91	8.78	20.82	5.9%	3.6%
Semiheated	Bradford	4.36	25.34	4.35	25.22	0.3%	0.2%



The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

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Impacts of Standard 90.1-2007 for Commercial Buildings at State Level

September 30, 2009

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Appendix A – Prototype Building Descriptions

Table A-1: Nonresidential Prototype Building Characteristics

Characteristic	Prototype Building Model Description
GENERAL	
Building Type	Medium Office
Gross Floor Area	53,600 ft ²
Building Shape	Rectangle
Aspect Ratio	1.5 (164 ft x 109 ft)
Number of Floors	3
Window-to-Wall Ratio	33% (modeled as strip windows of 5 ft. high)
Floor Height	13 ft
Floor-to-Ceiling Height	9 ft
Exterior Wall	Steel-framed wall
Roof	Insulation entirely above deck, metal deck roof
Floor	8" Slab-on-grade
INTERNAL LOADS	
Occupancy	
Number of People	5 persons / 1000 sf
Lighting	
Power Density	1.0 w/sf
Plug Load	
Average Power Density	0.75 w/sf
HVAC	
Heating Type	Gas furnace
Cooling Type	Packaged DX Unit
Fan Control	Variable air volume
Distribution/Terminal Units	VAV terminal box with electric reheating coil
Cooling T-stat	75°F (80°F setback)
Heating T-stat	70°F (60°F setback)
SERVICE WATER HEATER	
Water Heater Type	Electric storage water heater
Tank Capacity, gallons	260
Supply Temperature, °F	120

Table A-2: Residential Prototype Building Characteristics

Characteristic	Prototype Building Model Description
GENERAL	
Building Type	Multifamily residential building
Gross Floor Area	33,700 ft ²
Building Shape	Rectangle
Aspect Ratio	2.75 (152 ft x 56 ft)
Number of Floors	4
Activity Area	Each floor has 8 (25'x38') apartments, except ground floor which has 7 apartments and one lobby/office
Window-to-Wall Ratio	15% (4ft high view windows)
Floor Height	10 ft
Floor-to-Ceiling Height	10 ft (for the office area only)
Exterior Wall	Steel-framed wall
Roof	Insulation entirely above deck, metal deck roof
Floor	8" Slab-on-grade
INTERNAL LOADS	
Occupancy	
Number of People	78 persons total (average 2.5 persons per apartment unit)
Lighting	
Average Power Density	<ul style="list-style-type: none"> • Apartment units: 0.36 w/sf • Corridors: 0.5 w/sf • Office area: 1.1 w/sf
Plug Load	
Average Power Density	0.62 w/sf
HVAC	
Heating Type	Gas furnace
Cooling Type	Split system DX (one per apartment)
Fan Control	Constant volume
Distribution/Terminal Units	Single zone/direct air
Cooling T-stat	75°F (no setback assumed)
Heating T-stat	70°F (no setback assumed)
SERVICE WATER HEATER	
Water Heater Type	Individual residential electric storage water heater
Tank Capacity, gallons	20 (per apartment unit)
Supply Temperature, °F	120

Table A-3: Semiheated Prototype Building Characteristics

Characteristic	Prototype Building Model Description
GENERAL	
Building Type	Non-refrigerated warehouse
Gross Floor Area	49,500 ft ²
Building Shape	Wide rectangle
Aspect Ratio	2.2 (330 ft x 150 ft)
Number of Floors	1
Activity Area (percentage of gross floor area)	<ul style="list-style-type: none"> • Bulk storage area: 34,500 ft² (70%) • Fine storage area: 12,450 ft² (25%) • Office area: 2,550 ft² (5%)
Window-to-Wall Ratio	<ul style="list-style-type: none"> • Storage area: No windows • Office area: 12% view windows
Floor Height	28 ft
Floor-to-Ceiling Height	14 ft (for the office area only)
Exterior Wall	Metal building wall
Roof	Metal building roof
Floor	6" Slab-on-grade
Door	7 opaque doors (3'x7'), 7 roll-up dock doors (8'x10')
INTERNAL LOADS	
Occupancy	
Number of People	5 (in the office area)
Lighting	
Average Power Density	<ul style="list-style-type: none"> • Bulk storage area: 0.8 w/sf • Fine storage area: 0.8 w/sf • Office area: 1.0 w/sf
Plug Load	
Average Power Density	Office: 0.75 w/sf Bulk storage: 0.24 w/sf
HVAC	
Heating Type	<ul style="list-style-type: none"> • Bulk storage area: Unit heater • Fine storage area: Gas furnace • Office area: Gas furnace
Cooling Type	<ul style="list-style-type: none"> • Bulk storage area: No cooling • Fine storage area: Direct expansion • Office area: Direct expansion
Fan Control	Constant volume
Distribution/Terminal Units	Single zone/Direct air

Characteristic	Prototype Building Model Description
Cooling T-stat	<ul style="list-style-type: none"> • Fine storage area: 80°F • Office area: 75°F (85°F setback)
Heating T-stat	<ul style="list-style-type: none"> • Bulk storage area: 50°F • Fine storage area: 60°F • Office area: 70°F (60°F setback)
SERVICE WATER HEATER	
Water Heater Type	Electric storage water heater
Tank Capacity, gallons	20
Supply Temperature, °F	120

UGI Gas Exhibit TML-5

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

UGI UTILITIES, INC. – GAS DIVISION

Docket No. R-2015-2518438

**Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II**

Witness: Lisa A. Gumby

UGI-I&E-II-12 Please reference I&E Statement No. 2, page 7, lines 12-21.

- (a) Is it I&E's position that EE&C Plans are only appropriate when mandated by statute? Please explain your response in detail.
- (b) Please state whether Ms. Gumby is familiar with Philadelphia Gas Works' EE&C Plan.
- (c) Please state whether Ms. Gumby is familiar with voluntary EE&C Plans for electric distribution companies ("EDCs") not subject to Act 129.

Response:

- (a) **No, a mandate by statute is only one consideration and the absence of a mandate by statute is an important consideration. Supply and cost are also relevant considerations in determining whether an EE&C plan is appropriate or will be successful. Whether the plan will contribute to the provision of safe and reliable service should also be considered. Finally, the failure of UGI to satisfy the Commission's standards and successfully implement an EE&C plan at its CPG subsidiary should also be considered.**
- (b) **Yes.**
- (c) **No. EDC voluntary EE&C plans were not evaluated for this NGDC EE&C plan proposal.**

UGI Gas Exhibit TML-6

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

UGI UTILITIES, INC. – GAS DIVISION

Docket No. R-2015-2518438

**Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II**

Witness: Lisa A. Gumby

UGI-I&E-II-14 Please reference I&E Statement No. 2, page 8, lines 3-4.
Ms. Gumby states that “the only clear beneficiary, due to the
guaranteed recovery through the proposed rider, would be the
Company.”

- (a) Is it I&E’s position that UGI Gas will receive a profit from the proposed EE&C Rider? Please explain any affirmative response in detail.
- (b) Do you agree that customers participating in the EE&C Plan’s programs would benefit from reduced gas costs? Please explain any negative response in detail.
- (c) Do you agree that EE&C programs and measures provide benefits beyond bill savings for participating customers? If so, please detail all benefits, state whether you believe they should be included in any cost-benefit analysis for evaluating EE&C Plans and programs, and state why such benefits should be included in that cost-benefit analysis.

Response:

- (a) No.
- (b) No. It would depend on the cost of the investment, finance method, gas savings, and payback period. Simply experiencing reduced gas usage or costs does not necessarily equate to a benefit if total cash outflow is greater than that which existed prior to the efficiency improvement.
- (c) Yes. However, Pennsylvania excluded societal benefits from its Act 129 cost-benefit analyses. I agree with the Commission’s position that excludes societal benefits from the cost-benefit analysis.

UGI Gas Exhibit TML-7

PENNSYLVANIA PUBLIC UTILITY COMMISSION
v.
UGI UTILITIES, INC. – GAS DIVISION
Docket No. R-2015-2518438

Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II
Witness: Lisa A. Gumby

UGI-I&E-II-13 Please reference I&E Statement No. 2, page 7, line 21 to
page 8, line 2; page 11, lines 15-18.

- (a) Is it I&E's understanding that when an EDCs fail to meet its required energy consumption or peak demand reduction goals under Act 129 and the Commission's EE&C Orders that ratepayers are not obligated to pay "program costs"? Please explain.
- (b) Are EDCs and NGDC EE&C program costs "unreasonable" if they fail to achieve their required levels of energy consumption or peak demand reduction? Please explain.
- (c) Do you agree that "program costs" differ from any penalty paid by an EDC under Act 129?
- (d) Do you agree that the Total Resource Cost ("TRC") Test is the appropriate method by which to evaluate the costs and benefits of EE&C Plans and programs? If not, please detail which method(s) should be used instead and state your reasons in support.
- (e) Do you agree that UGI Gas's EE&C Plan as proposed is cost-effective on a TRC Test basis? Please explain any negative response in detail.
- (f) Do you agree that under the EE&C Rider, customers will only be responsible for the EE&C costs incurred by their respective customer class?

Response:

- (a) **No. However, EDC's are subject to a penalty for failure to meet plan projections which does not extend to voluntary EE&C plans. UGI has not proposed to refund program costs to customers or absorb ongoing program costs in the event that its plan should fail to meet projections.**

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

UGI UTILITIES, INC. – GAS DIVISION
Docket No. R-2015-2518438

**Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II**

Witness: Lisa A. Gumby

- (b) Program costs can be unreasonable regardless of whether targets are achieved.**
- (c) Yes.**
- (d) I agree that the TRC test is the method established for the Act 129 EE&C plans, so it would be an acceptable test to apply for proposed voluntary EE&C plans in Pennsylvania.**
- (e) Yes, as proposed. However, the participation assumptions are speculative and failure to achieve the anticipated participation levels could deem the plan not cost effective.**
- (f) I agree, as proposed, that appears to be the case.**

UGI Gas Exhibit TML-8

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

UGI UTILITIES, INC. – GAS DIVISION

Docket No. R-2015-2518438

**Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II**

Witness: Lisa A. Gumby

UGI-I&E-II-15 Please reference I&E Statement No. 2, page 8, lines 12-14;
page 8, line 20 to page 9, line 2.

- (a) Is it I&E's position that EE&C programs and measures never improve the reliability of the distribution system? Please explain your response in detail.
- (b) Is it I&E's understanding that Marcellus Shale gas production wells are directly connected to UGI Gas's distribution system? Please explain any positive or negative response in detail.
- (c) Do you agree that a reduction of gas usage would free up supply that could be used to provide service to other customers on days of peak demand? Please explain any negative response in detail.
- (d) If the answer to subpart (b) is in the affirmative, do you agree that this would improve the reliability of UGI Gas's distribution system? Please explain any negative response in detail.
- (e) Is it I&E's position that EE&C programs and measures never improve the safety of service provided to customers? Please explain your response in detail.
- (f) Is it I&E's position that EE&C programs and measures are only appropriate when they improve the safety and/or reliability of an NGDC or EDC distribution system?

Response:

- (a) **No. Reducing load on a system can improve reliability and plant life for limited plant and equipment that degrades with usage; however, there are many items in plant and equipment where reliability and life are not related to usage.**

PENNSYLVANIA PUBLIC UTILITY COMMISSION
v.
UGI UTILITIES, INC. – GAS DIVISION
Docket No. R-2015-2518438

**Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II**
Witness: Lisa A. Gumby

- (b) No. However, UGI has specifically altered pipeline contracts to access Marcellus Shale gas, and the impact of the Marcellus Shale capacity is affecting natural gas prices regardless of the point of origin.**
- (c) No, not necessarily. UGI consistently states in its 1307(f) proceedings that its peak demand is growing; however, reducing average usage or concentration of conservation efforts in specific geographic areas may not help supply peak demand needs in UGI's large system as peak demands may not be coincident.**
- (d) N/A**
- (e) No. However, UGI has not demonstrated that the proposed cost of the EE&C plan will provide greater enhancements to reliability and safety than equal investment elsewhere in the system.**
- (f) No.**

UGI Gas Exhibit TML-9

PENNSYLVANIA PUBLIC UTILITY COMMISSION

v.

UGI UTILITIES, INC. – GAS DIVISION

Docket No. R-2015-2518438

**Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II**

Witness: Lisa A. Gumby

UGI-I&E-II-21 Please reference I&E Statement No. 2, page 10, lines 20-22.

- (a) Please provide copies of all studies, documents, and analyses relied upon in support of this statement.
- (b) Is it I&E's position that infrastructure replacement plans and EE&C Plans are mutually exclusive? If so, please provide all documents, studies, and analyses relied upon by Ms. Gumby in support of this response.

Response:

- (a) **First, this statement must be read within the context of the entirety of my direct testimony. Second, I also took into consideration my review of the I&E filed Gas Safety testimony, which UGI has already received.**
- (b) **No.**

UGI Gas Exhibit TML-10

Clean Power Plan Presents New Opportunities for PA Energy

Clean Power Plan Presents New Opportunities for Pennsylvania Energy

August 03, 2015

Harrisburg, PA –The Environmental Protection Agency today released the Clean Power Plan. Pennsylvania will use this as an opportunity to write a plan that could improve public health, address climate change, and improve our economy and power system. Pennsylvania's Department of Environmental Protection will give all stakeholders every opportunity to provide input into drafting a Clean Power Plan that is tailored to fit Pennsylvania's economy.

"My administration is committed to making the Clean Power Plan work for Pennsylvania," said Governor Wolf. "Working with the legislature, industry leaders and citizens we will create a plan to ensure these new rules are applied fairly; allow for adjustments, and that they create economic opportunities for the commonwealth's energy economy. Today's plan sets ambitious but achievable goals for reducing carbon emissions statewide and addressing climate change in fair and smart ways that takes into account legitimate concerns of all parties."

"Pennsylvania is a leader in energy, and we need to do everything in our power to advance the next generation of energy production while protecting jobs in Pennsylvania," continued Governor Wolf. "Clean coal is a part of our energy portfolio, as is natural gas, solar, wind, and other sources of power, and all of this has to be part of a comprehensive strategy. My administration looks forward to working with industry leaders and legislators as well as citizens to find the right balance and develop an effective and responsible state plan."

Pennsylvanians will have multiple options for input as the Department of Environmental Protection (DEP) formulates a state-specific plan to comply with the EPA rule. A public comment period on the EPA rule will begin in early September, with additional comment periods over the next three years as the Pennsylvania plan is drafted and finalized.

"We will make certain that we craft a Pennsylvania solution that protects the state's vital role as a net electricity exporter," said DEP Secretary John Quigley. "Our strategy must ensure we are protecting our diverse resources and creating economic opportunities. We'll explore different methods of reaching the required reductions, options of partnering with fellow states, and other considerations."

DEP staff have already begun assessing the implications of the Clean Power Plan through the National Governors Association Policy Academy, which is developing detailed economic modeling to find solutions that meet Pennsylvania's needs. These modeling exercises will continue now that the details of the plan

5/9/2016

Clean Power Plan Presents New Opportunities for PA Energy

have been released.

"Cutting pollution from power plants, utilizing natural gas, supporting nuclear power plants, increasing the amount of renewable energy in Pennsylvania, and improving energy efficiency statewide all can fight climate change and be an economic driver," said Sec. Quigley. "When our businesses upgrade power plants, install solar panels or improve energy efficiency, that's a win for the environment and a win for Pennsylvania's economy."

The Clean Power Plan sets a nationwide goal of cutting carbon emissions by 32% from 2005 levels by 2030, with progress towards those reductions by 2022.

"Pennsylvania is committed to achieving our target emission reductions, and we will develop the right tools and smart policies to do so," said Quigley.

The final EPA rule will be published in the Federal Register on September 4, 2015, and public comment will be available for the following 60 days. Public hearings will also be held across the state, with details to be released.

UGI Gas Exhibit TML-11

PENNSYLVANIA PUBLIC UTILITY COMMISSION
v.
UGI UTILITIES, INC. – GAS DIVISION
Docket No. R-2015-2518438

Responses of the Bureau of Investigation and Enforcement
to UGI Utilities, Inc. – Gas Division Set II
Witness: Lisa A. Gumby

UGI-I&E-II-19 Please reference I&E Statement No. 2, page 10, lines 1-16.

- (a) Would you agree that tankless water heaters are an available measure under other utilities' EE&C programs?
- (b) Would you agree that tankless water heaters are listed in the Commission's 2016 Technical Reference Manual?
- (c) Would you agree that there are benefits beyond bill savings associated with tankless water heaters?

Response:

- (a) **Yes. However, conversion to gas tankless water heaters from conventional electric is often the purpose of their inclusion.**
- (b) **Yes. See (a).**
- (c) **I would agree that there are both pluses and minuses associated with tankless water heaters. Pluses will not outweigh the minuses for all consumers, and the high capital and installation costs could easily outweigh the energy savings over the useful life.**

UGI Gas Exhibit TML-12

5/9/2016

2016 Tankless Water Heater Installation Costs

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Install a Tankless Water Heater Costs

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National

Average reported costs:

\$1,525

based on 651 cost profiles

Most homeowners spent between:

\$822 - \$2,247

based on 651 cost profiles

Pennsylvania

Average reported costs:

\$1,201

based on 19 cost profiles

Most homeowners spent between:

\$915 - \$1,486

based on 19 cost profiles

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5/9/2016

2016 Tankless Water Heater Installation Costs

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Conventional hot water tanks may become a thing of the past considering all the modern-day advances now available. With the innovation of the tankless water heater, consumers are promised a quick and abundant supply of hot water anytime they need it. Are the cost and space savings beneficial enough for consumers to make the change?

Installation Costs of Various Tankless Water Heaters

First of all, consumers who hire a professional to install their tankless water heater can expect to pay either an hourly fee or a flat fee. The total installation cost may vary depending on the type of tankless water heater that is installed and the professional who installs it. Understanding what type of tankless water heater to install is the next step.

Consumers should choose the type of tankless water heater that is best suited to their needs. For example, a Noritz gas tankless hot water heater of 199,000 BTUs is sufficient for an average household with several bathrooms. Factors such as installing proper ventilation to prevent carbon monoxide poisoning and completely changing the size of gas lines and fittings will take an average of 10 hours. Thus, labor costs may run higher for these models.

For consumers with low hot water demand, there are other tankless hot water heaters on the market that don't require as much time to install. Electric tankless water heaters such as a point-of-use mini-tank water heater that can be installed right under the sink by a plumber with electrical skills. An electrical timer, an electrical outlet and water supply lines are needed for the installation of this type of water heater. The average time to install this product is about two hours, so consumers can expect to pay a much lower installation charge for this model as compared to other models that are more complicated and time consuming to install.

Another factor that will affect installation costs is a reduction offered on certain tankless hot water heaters. Consumers can take advantage of a tax credit on products that qualify with Energy Star. Tankless water heaters that have the Energy Star symbol are energy-efficient appliances by government standards. The products are also highly rated in performance, quality and features.

Consumers will also need to figure in material and labor costs for other parts needed in the installation. The accessories needed for a tankless water heater typically include a termination vent kit, tankless gas connector kit, two-piece lead-free brass tankless water heater valve set, along with fittings and mounting hardware.

Gas or Electric Tankless Water Heater?

Gas tankless water heaters are widely available in a large variety of models and sizes to choose from. Tankless gas water heaters also range in output from 140,000 BTUs to 380,000 BTUs and are available in residential and commercial grades.

Electric tankless water heaters are less expensive than gas models. Installation of this type of tankless heater is not as complicated when compared to gas models because there is no need to vent. They also are easier to maintain, perform very well and produce high energy ratings.

Electric hybrid model tankless heaters are initially high in cost but actually heat water quicker than standard electric models. These tankless heaters also do not need ventilation and are very economical. However, this type of tankless water heater is only available in models up to 8,700 BTUs.

Point-of-use electric tankless heaters offer a lot of attractive features such as the low cost of the product and ease of installation. They are also very convenient to use under sinks, in small areas and even near washing machines. This type of tankless water heater is an excellent option for people who need small water heaters for campers, boats and small bathrooms. They are non-corrosive, insulated, attractive and lightweight. The point-of-use feature helps to save water by conveniently providing quick hot water.

Choosing the Right Tankless Water Heater

Tankless water heaters don't come in particular gallon capacity sizes like conventional hot water tanks. So how can consumers determine which one will fit their needs? For both gas and electric tankless water heaters, the demand of water needed at one time, known as the flow rate, should be considered.

The flow rate is calculated by measuring the gallons of water per minute, or gpm. To find a particular flow rate, consumers should find out which appliances and fixtures are used at the same time and then add those figures together to determine the maximum gpm required of the tankless water heater.

- Washing machine ♦ 1.5 to 3.0 gpm
- Shower ♦ 1.0 to 2.0 gpm
- Bathroom faucet ♦ 0.5 to 1.5 gpm
- Dishwasher ♦ 1.0 to 2.5 gpm
- Kitchen faucet ♦ 3.0 to 9.0 gpm

5/9/2016

2016 Tankless Water Heater Installation Costs

Pros of Tankless Hot Water Heaters

One of the greatest advantages of tankless hot water heaters is the fact that water is heated extremely fast. Depending on the gpm of the tankless water heater, it will produce continuous hot water based on the consumer's needs.

Another very attractive pro is the savings tankless water heaters offer. Because water heating accounts for almost 30 percent of a home's energy bills, a tankless water heater can cut these costs by up to 50 percent savings. These savings amount to about \$80 annually.

Tankless hot water heaters last an average of 20 years and are easy to maintain. They are also very small and can be put in many places that won't allow conventional hot water tanks. The average size is about 28 inches tall by 20 inches wide and 10 inches deep.

Cons of Tankless Hot Water Heaters

The biggest con of tankless water heaters is the initial cost of the purchase and installation, which is higher than the total cost of conventional water heaters. Even with energy bill savings, it will take about 20 years, which is the lifespan of the product, for consumers to make up the initial cost.

Another con about tankless water heaters is inconsistent water temperatures. Customers state that faucets do not produce an instant flow of hot water as they expected and that this feature resembles conventional hot water tanks.

During power outages, tankless water heaters will not work to produce hot water. Unlike conventional water heaters, there is no backup water source in emergency situations.

Consumers who have hard water must install a water softener to their tankless water heater in order to avoid problems that can occur from calcium buildup. The life of the water heater can be greatly shortened if it is not annually maintained.

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13 Comments



UGI Gas Exhibit TML-13

Have the new tankless water heaters improved? Doing away with the cold water sandwich and other issues

Published: February 09, 2015 09:00 AM



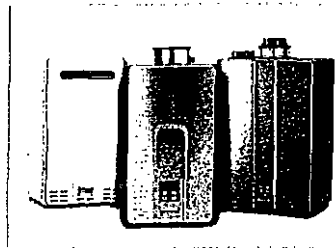
Photo: Stacey Newman

Tankless water heaters have always been full of promise. By heating water only when you need it, the suitcase-sized units could potentially save homeowners lots of energy and a bit of storage space, plus the endless hot water supply meant no more cold showers. But our first tests of tankless water heaters back in 2008 found that they didn't always deliver, especially when they were replacing an existing conventional water heater. Between their steep upfront costs, complicated installations, and inconsistent water temperatures, *thankless* water heaters was more like it.

Manufacturers haven't given up on the technology, however. And their commitment might just be starting to pay off. Many of the tankless water heaters on display at the recent Design & Construction Week trade show claim to address those early growing pains. Here are the most common past problems, and how this latest generation of tankless water heaters is addressing them. We'll find out if the promises are for real when we get the units into our labs for testing.

Problem: Installation was often complicated—and costly

Solution: Improved designs promise to make it easier to switch from a conventional tanked unit to a tankless one. The manufacturer Noritz, for example, is positioning the input and output waterlines at the top of its units, instead of at the bottom, which used to be the norm. That mirrors the location of the lines on tanked units, simplifying the retrofit. Noritz also has a flexible exhaust pipe with a proprietary adaptor that allows it to be connected to existing ductwork more easily than the standard PVC piping.



Rinnai tankless water heaters

Several manufacturers are also saying that their new tankless water heaters will work with existing 1/2-inch gas lines. That wasn't common when we last tested the units, and it should make retrofit installations easier and less expensive.

Problem: Inconsistent water temperatures

Solution: Manufacturers have also tackled this issue. Rinnai, for example, has added a recirculation pump to its units to ensure that water comes out hot from the start and stays that way for as long as it's running. Korean manufacturer Navien goes one step further by including a buffer tank on certain models that stores a ready supply of hot water. That eliminates the cold-water sandwich and ensures consistent temperatures.

Problem: Constant maintenance was required

4/28/2016

New and Improved Tankless Water Heaters - Consumer Reports News

Solution: During our last long-term testing, scale buildup was a big concern, since it could decrease efficiency, restrict water flow, and eventually damage tankless models. In homes with hard water, installing a water softener was recommended, which added to the upfront costs. Rinnai has addressed this issue by developing isolation valves that make routine maintenance and descaling the unit easier.

Possible drawbacks

Even with these innovations, tankless water heaters aren't for everyone. For example, if your current water heater is electric and you don't have natural gas or propane capability, a tankless model might not make sense because you'd almost need to double the capacity of your electrical system to power the electric tankless unit. Also, if you live in an area with extremely cold incoming ground water, you'd need a very large capacity tankless unit, and maybe even multiple units, to get the water hot enough—and that might not be practical.

Otherwise, today's tankless water heaters could be worth a look. We'll find out for sure when we buy some of the newest units and bring them into our labs for testing.

—Daniel DiClerico (@dandiclerico on Twitter)

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UGI Gas Exhibit TML-14

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Water Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Number of Storage Tank Water Heaters									
0.....	2.9	1.3	0.6	0.3	0.3	0.7	0.4	0.2	Q
1.....	108.1	19.3	4.8	2.2	2.7	14.4	6.7	4.7	3.0
2 or More.....	2.7	0.2	0.1	Q	Q	0.2	Q	Q	Q
Number of Tankless Water Heaters²									
0.....	110.4	19.4	4.9	2.2	2.7	14.6	6.7	4.7	3.1
1.....	3.1	1.4	0.7	0.3	0.4	0.7	0.4	0.2	Q
2 or More.....	0.1	Q	Q	N	Q	N	N	N	N
Main Water Heater									
Main Water Heater Type									
Storage Tank.....	110.6	19.4	4.9	2.2	2.7	14.6	6.8	4.7	3.1
Tankless.....	2.6	1.3	0.6	0.3	0.4	0.7	0.4	0.2	Q
Do Not Use Hot Water.....	0.4	Q	N	N	N	Q	Q	Q	N
Housing Units Served by Main Water Heater³									
One Housing Unit.....	100.0	15.5	4.4	2.0	2.5	11.1	4.0	4.4	2.6
Two or More Housing Units.....	13.1	5.2	1.1	0.5	0.6	4.1	3.1	0.5	0.6
Do Not Use Hot Water.....	0.4	Q	N	N	N	Q	Q	Q	N
Fuel Used by Main Water Heater									
Natural Gas.....	58.3	11.4	2.3	1.4	0.9	9.1	4.4	2.0	2.6
For One Housing Unit.....	49.6	7.9	1.6	1.1	0.6	6.3	2.5	1.7	2.1
For Two or More Housing Units.....	8.7	3.5	0.7	0.4	0.3	2.8	1.9	0.4	0.5
Electricity.....	46.8	5.1	1.4	0.5	0.9	3.6	1.2	2.0	0.4
For One Housing Unit.....	43.7	4.3	1.2	0.4	0.8	3.1	0.8	2.0	0.3
For Two or More Housing Units.....	3.0	0.8	0.2	0.1	0.1	0.6	0.5	Q	Q
Propane/LPG.....	4.2	0.7	0.2	0.1	0.1	0.5	0.2	0.3	Q
Fuel Oil.....	3.6	3.5	1.5	0.5	1.1	1.9	1.3	0.5	Q
Other.....	0.4	Q	Q	N	Q	Q	Q	Q	N
Do Not Use Hot Water.....	0.4	Q	N	N	N	Q	Q	Q	N

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Water Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes.....	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Size of Main Water Heater									
Used by One Housing Unit									
Small (30 Gallons or Less).....	15.1	1.9	0.5	0.2	0.3	1.3	0.4	0.6	0.3
Medium (31 to 49 Gallons).....	54.4	8.1	2.3	1.0	1.3	5.8	2.4	2.2	1.2
Large (50 Gallons or More).....	28.3	4.5	1.0	0.5	0.5	3.5	1.1	1.4	1.0
Used by Two or More Housing Units									
Small (30 Gallons or Less).....	0.9	0.2	Q	Q	Q	0.2	0.1	Q	N
Medium (31 to 49 Gallons).....	2.6	0.8	0.2	0.1	0.1	0.5	0.4	Q	Q
Large (50 Gallons or More).....	9.3	4.0	0.8	0.3	0.4	3.2	2.4	0.3	0.5
Tankless Water Heater.....	2.6	1.3	0.6	0.3	0.4	0.7	0.4	0.2	Q
Do Not Use Hot Water.....	0.4	Q	N	N	N	Q	Q	Q	N
Age of Main Water Heater									
Less Than 2 Years.....	14.1	2.5	0.8	0.5	0.3	1.7	0.9	0.5	0.4
2 to 4 Years.....	21.2	3.9	1.0	0.5	0.5	2.9	1.5	0.7	0.7
5 to 9 Years.....	35.8	6.7	1.7	0.7	1.0	5.0	2.0	2.0	1.0
10 to 14 Years.....	22.1	3.6	1.0	0.4	0.6	2.6	1.1	1.0	0.6
15 to 19 Years.....	9.0	1.7	0.4	0.2	0.3	1.3	0.8	0.4	Q
20 Years or More.....	11.0	2.4	0.6	0.2	0.4	1.8	1.0	0.4	0.4
Do Not Use Hot Water.....	0.4	Q	N	N	N	Q	Q	Q	N
Main Water Heater Insulated With Water Heater Blanket									
Yes.....	14.0	2.4	0.7	0.3	0.4	1.8	0.9	0.5	0.3
No.....	96.6	17.0	4.2	1.9	2.3	12.8	5.8	4.2	2.8
Tankless Water Heater.....	2.6	1.3	0.6	0.3	0.4	0.7	0.4	0.2	Q
Do Not Use Hot Water.....	0.4	Q	N	N	N	Q	Q	Q	N
Secondary Water Heater									
Secondary Water Heater Type									
Storage Tank.....	2.8	0.3	0.1	Q	Q	0.2	Q	Q	Q
Tankless.....	0.6	0.1	Q	Q	Q	Q	Q	N	N
Only One Water Heater or Do Not Use Hot Water.....	110.2	20.4	5.4	2.4	3.0	15.0	7.1	4.9	3.1

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Water Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes.....	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Fuel Used by Secondary Water Heater									
Natural Gas.....	1.3	0.2	Q	Q	Q	0.1	Q	Q	Q
Electricity.....	1.6	0.1	Q	Q	Q	Q	Q	Q	Q
Propane/LPG.....	0.3	Q	N	N	N	Q	Q	N	N
Fuel Oil.....	0.1	0.1	0.1	Q	Q	Q	Q	N	N
Other.....	0.1	Q	Q	Q	Q	Q	Q	N	N
Only One Water Heater or Do Not Use Hot Water.....	110.2	20.4	5.4	2.4	3.0	15.0	7.1	4.9	3.1
Size of Secondary Water Heater									
Small (30 Gallons or Less).....	0.7	Q	Q	N	Q	Q	Q	Q	Q
Medium (31 to 49 Gallons).....	1.3	0.1	0.1	Q	Q	Q	Q	Q	Q
Large (50 Gallons or More).....	0.9	Q	Q	Q	Q	Q	Q	Q	Q
Tankless Secondary Water Heater.....	0.6	0.1	Q	Q	Q	Q	Q	N	N
Only One Water Heater or Do Not Use Hot Water.....	110.2	20.4	5.4	2.4	3.0	15.0	7.1	4.9	3.1
Age of Secondary Water Heater									
Less Than 2 Years.....	0.4	0.1	Q	Q	N	Q	Q	N	Q
2 to 4 Years.....	0.8	0.1	Q	Q	Q	Q	N	Q	Q
5 to 9 Years.....	0.9	0.1	Q	Q	Q	Q	Q	Q	Q
10 to 14 Years.....	0.6	Q	Q	Q	Q	Q	N	N	Q
15 to 19 Years.....	0.2	Q	Q	Q	N	Q	Q	N	N
20 Years or More.....	0.4	Q	Q	Q	Q	Q	N	Q	N
Only One Water Heater or Do Not Use Hot Water.....	110.2	20.4	5.4	2.4	3.0	15.0	7.1	4.9	3.1
Hot Tub or Spa and Fuel									
Yes.....	6.4	1.2	0.2	0.1	0.2	0.9	0.2	0.4	0.3
Electricity.....	4.5	0.8	0.2	Q	0.2	0.6	0.2	0.3	0.1
Natural Gas.....	1.5	0.2	N	N	N	0.2	0.1	Q	Q
Other.....	0.3	Q	Q	Q	Q	Q	Q	Q	N
No.....	107.3	19.6	5.3	2.4	2.8	14.4	6.9	4.5	2.9

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final

Water Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes.....	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Heated Swimming Pool and Fuel									
Yes.....	2.1	0.4	0.1	Q	Q	0.3	0.1	Q	0.2
Natural Gas.....	1.1	0.2	Q	Q	N	0.2	Q	N	0.1
Electricity.....	0.5	Q	Q	Q	Q	Q	N	N	Q
Propane/LPG.....	0.2	0.1	Q	Q	Q	Q	Q	Q	Q
Other.....	0.3	Q	Q	Q	Q	Q	Q	N	N
Pool Not Heated.....	5.9	1.3	0.3	0.1	0.2	1.0	0.5	0.3	0.2
No Swimming Pool.....	70.6	10.9	3.0	1.1	1.9	7.9	2.9	3.1	1.9
Not Asked (Apartments and Mobile Homes).....	35.1	8.1	2.1	1.2	1.0	6.0	3.7	1.4	0.9
Heated Aquarium (20 gallons or larger)									
Yes.....	4.4	0.8	0.2	0.1	0.1	0.6	0.2	0.2	0.2
No.....	109.2	20.0	5.3	2.4	2.9	14.7	7.0	4.7	3.0

¹Total U.S. includes all primary occupied housing units in the 50 States and the District of Columbia. Vacant housing units, seasonal units, second homes, military housing, and group quarters are excluded.

²Tankless water heaters, also known as instantaneous or on-demand water heaters, are water heaters that do not contain a storage tank. The water is only heated as it passes through the heat exchanger.

³Use of a water heater for another housing unit also includes the use of the water heater for a business or farm building as well as another housing unit.

Q = Data withheld either because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 10 households were sampled.

N = No cases in reporting sample.

Notes: • Because of rounding, data may not sum to totals. • See Glossary for definition of terms used in these tables.

Source: U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Relative Standard Errors, Final

Water Heating	RSEs for Total U.S. ¹	RSEs for Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Storage Tank Water Heaters									
0.....	5.6	7.6	11.3	12.1	17.2	11.2	14.7	19.6	28.3
1.....	0.2	0.5	1.4	1.6	2.1	0.5	0.9	0.7	0.7
2 or More.....	7.7	20.0	31.3	46.6	41.6	25.6	62.3	61.8	27.7
Number of Tankless Water Heaters²									
0.....	0.2	0.5	1.3	1.5	1.9	0.6	1.1	1.0	0.4
1.....	5.5	7.9	9.8	11.7	14.6	13.1	17.2	22.0	28.3
2 or More.....	26.3	95.5	95.5	0.0	95.5	0.0	0.0	0.0	0.0
Main Water Heater									
Main Water Heater Type									
Storage Tank.....	0.1	0.5	1.3	1.4	2.1	0.6	1.0	1.0	0.4
Tankless.....	5.8	8.3	10.5	12.2	15.5	13.5	18.0	22.0	28.3
Do Not Use Hot Water.....	20.2	38.9	0.0	0.0	0.0	38.9	34.4	105.5	0.0
Housing Units Served by Main Water Heater³									
One Housing Unit.....	0.4	1.1	2.2	3.4	3.1	1.5	3.6	2.0	5.9
Two or More Housing Units.....	2.7	3.3	9.0	13.0	13.1	4.1	4.5	18.2	27.5
Do Not Use Hot Water.....	20.2	38.9	0.0	0.0	0.0	38.9	34.4	105.5	0.0
Fuel Used by Main Water Heater									
Natural Gas.....	0.7	1.9	5.4	5.3	10.8	2.8	4.9	13.0	1.8
For One Housing Unit.....	0.9	2.5	6.9	7.8	12.0	3.0	7.4	10.3	7.2
For Two or More Housing Units.....	3.9	5.7	10.5	14.1	15.3	7.1	6.6	32.8	31.3
Electricity.....	1.1	5.4	8.3	8.7	12.1	7.0	12.4	12.2	13.7
For One Housing Unit.....	1.1	5.7	8.7	9.3	12.5	7.4	13.3	11.4	14.2
For Two or More Housing Units.....	7.9	14.2	24.3	36.1	31.7	17.8	21.5	52.7	37.9
Propane/LPG.....	5.7	15.2	36.2	37.8	47.5	19.8	36.3	29.6	106.4
Fuel Oil.....	3.9	3.7	6.1	13.6	6.5	6.9	9.0	18.0	44.9
Other.....	18.1	31.2	33.3	0.0	33.3	66.2	100.8	89.1	0.0
Do Not Use Hot Water.....	20.2	38.9	0.0	0.0	0.0	38.9	34.4	105.5	0.0

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Relative Standard Errors, Final									
Water Heating	RSEs for Total U.S. ¹	RSEs for Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Size of Main Water Heater									
Used by One Housing Unit									
Small (30 Gallons or Less).....	3.3	11.1	7.3	10.5	9.8	15.4	11.9	29.9	22.1
Medium (31 to 49 Gallons).....	1.2	2.2	4.3	4.9	6.7	2.6	4.0	4.8	7.9
Large (50 Gallons or More).....	2.2	4.3	8.6	12.7	11.6	5.1	8.2	10.3	8.6
Used by Two or More Housing Units									
Small (30 Gallons or Less).....	11.6	18.3	44.9	61.4	67.7	20.3	25.4	35.6	0.0
Medium (31 to 49 Gallons).....	7.4	12.3	17.6	27.4	20.5	15.8	17.6	76.0	33.3
Large (50 Gallons or More).....	3.6	4.7	10.5	16.2	14.0	5.8	5.2	31.4	34.8
Tankless Water Heater.....	5.8	8.3	10.5	12.2	15.5	13.5	18.0	22.0	28.3
Do Not Use Hot Water.....	20.2	38.9	0.0	0.0	0.0	38.9	34.4	105.5	0.0
Age of Main Water Heater									
Less Than 2 Years.....	2.9	5.7	8.9	11.0	14.7	7.3	9.3	16.9	14.5
2 to 4 Years.....	2.2	4.8	8.7	7.0	16.2	5.7	5.9	11.5	17.6
5 to 9 Years.....	1.6	3.6	3.6	6.6	3.8	4.8	9.6	4.6	10.4
10 to 14 Years.....	1.9	4.6	6.4	9.3	8.5	6.0	8.4	6.5	21.0
15 to 19 Years.....	3.7	9.9	9.6	11.8	13.6	12.8	12.1	29.6	51.2
20 Years or More.....	3.8	8.2	15.4	21.1	21.2	9.3	10.1	27.1	20.3
Do Not Use Hot Water.....	20.2	38.9	0.0	0.0	0.0	38.9	34.4	105.5	0.0
Main Water Heater Insulated With Water Heater Blanket									
Yes.....	2.9	6.7	11.9	15.8	17.3	8.3	8.1	22.6	16.2
No.....	0.5	1.1	2.0	2.4	3.1	1.5	1.9	3.4	2.0
Tankless Water Heater.....	5.8	8.3	10.5	12.2	15.5	13.5	18.0	22.0	28.3
Do Not Use Hot Water.....	20.2	38.9	0.0	0.0	0.0	38.9	34.4	105.5	0.0
Secondary Water Heater									
Secondary Water Heater Type									
Storage Tank.....	7.2	17.1	32.4	43.9	45.3	20.3	24.9	55.7	27.7
Tankless.....	12.7	22.2	27.0	30.5	46.3	35.6	35.6	0.0	0.0
Only One Water Heater or Do Not Use Hot Water.....	0.2	0.3	0.6	0.7	0.9	0.3	0.4	0.6	0.8

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Relative Standard Errors, Final									
Water Heating	RSEs for Total U.S. ¹	RSEs for Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel Used by Secondary Water Heater									
Natural Gas.....	9.6	20.0	35.5	52.6	37.1	23.8	50.2	111.9	24.5
Electricity.....	10.1	31.7	51.6	60.2	95.5	36.7	49.3	60.7	104.5
Propane/LPG.....	23.5	97.7	0.0	0.0	0.0	97.7	97.7	0.0	0.0
Fuel Oil.....	27.0	27.8	31.0	46.4	39.6	58.0	58.0	0.0	0.0
Other.....	31.9	60.4	70.1	99.8	94.9	102.9	102.9	0.0	0.0
Only One Water Heater or Do Not Use Hot Water.....	0.2	0.3	0.6	0.7	0.9	0.3	0.4	0.6	0.8
Size of Secondary Water Heater									
Small (30 Gallons or Less).....	14.1	38.1	67.4	0.0	67.4	43.4	99.9	71.3	65.1
Medium (31 to 49 Gallons).....	9.9	20.4	32.3	47.9	43.4	26.6	35.2	88.4	42.3
Large (50 Gallons or More).....	12.8	38.3	58.2	62.3	95.0	49.5	7.4	98.9	113.0
Tankless Secondary Water Heater.....	12.7	22.2	27.0	30.5	46.3	35.6	35.6	0.0	0.0
Only One Water Heater or Do Not Use Hot Water.....	0.2	0.3	0.6	0.7	0.9	0.3	0.4	0.6	0.8
Age of Secondary Water Heater									
Less Than 2 Years.....	17.1	28.1	71.2	71.2	0.0	30.4	26.3	0.0	113.0
2 to 4 Years.....	11.9	30.5	31.2	26.0	45.9	49.8	0.0	71.3	70.2
5 to 9 Years.....	12.1	25.6	32.6	57.2	38.9	37.2	48.6	88.4	72.4
10 to 14 Years.....	15.2	44.4	58.3	73.4	95.5	62.3	0.0	0.0	62.3
15 to 19 Years.....	20.1	59.7	72.0	72.0	0.0	102.9	102.9	0.0	0.0
20 Years or More.....	17.3	52.6	51.5	19.1	96.1	98.9	0.0	98.9	0.0
Only One Water Heater or Do Not Use Hot Water.....	0.2	0.3	0.6	0.7	0.9	0.3	0.4	0.6	0.8
Hot Tub or Spa and Fuel									
Yes.....	4.1	9.3	12.9	33.5	13.6	11.5	16.9	20.8	21.8
Electricity.....	4.8	8.3	15.4	44.9	16.0	10.0	24.5	12.6	20.8
Natural Gas.....	9.3	19.9	0.0	0.0	0.0	19.9	26.6	91.6	29.6
Other.....	25.0	55.1	43.3	33.5	73.7	84.7	70.1	110.2	0.0
No.....	0.2	0.5	0.6	0.7	0.9	0.7	0.6	1.8	2.0

Table HC8.8 Water Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Relative Standard Errors, Final

Water Heating	RSEs for Total U.S. ¹	RSEs for Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heated Swimming Pool and Fuel									
Yes.....	6.7	19.9	34.6	33.7	51.2	23.0	31.4	74.1	28.2
Natural Gas.....	10.3	24.3	99.4	99.4	0.0	24.7	40.7	0.0	31.0
Electricity.....	14.2	62.1	52.7	69.3	76.2	113.0	0.0	0.0	113.0
Propane/LPG.....	28.1	44.7	55.1	101.5	62.7	55.1	70.9	74.1	89.3
Other.....	16.9	49.2	68.6	98.7	96.1	69.0	69.0	0.0	0.0
Pool Not Heated.....	4.6	7.5	14.3	23.0	18.5	8.9	7.5	21.6	14.7
No Swimming Pool.....	0.4	1.2	3.7	7.0	4.4	2.4	5.3	6.5	10.3
Not Asked (Apartments and Mobile Homes).....	0.0	0.0	6.0	8.8	8.6	2.1	4.5	11.4	21.3
Heated Aquarium (20 gallons or larger)									
Yes.....	5.7	12.2	15.1	37.7	14.9	15.3	14.0	33.4	33.6
No.....	0.2	0.5	0.6	0.9	0.7	0.6	0.5	1.4	1.8

¹Total U.S. includes all primary occupied housing units in the 50 States and the District of Columbia. Vacant housing units, seasonal units, second homes, military housing, and group quarters are excluded.

²Tankless water heaters, also known as instantaneous or on-demand water heaters, are water heaters that do not contain a storage tank. The water is only heated as it passes through the heat exchanger.

³Use of a water heater for another housing unit also includes the use of the water heater for a business or farm building as well as another housing unit.

Q = Data withheld either because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 10 households were sampled.

N = No cases in reporting sample.

Notes: • Because of rounding, data may not sum to totals. • See Glossary for definition of terms used in these tables.

Source: U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.

UGI Gas Exhibit TML-15

Pennsylvania Public Utility Commission

v.

**UGI Utilities Inc. – Gas Division
Docket No. R-2015-2518438**

**Responses of the Office of Consumer Advocate
UGI Gas to OCA Set IV**

UGI Gas to OCA-IV-5

Please reference OCA Statement No. 3, page 47, lines 13-17.

- (a) Are developers participating in the GET Gas Program excluded from participating in the New Construction program under your proposal? If so, please explain in detail why they should be excluded and why they should be treated differently than developers who have natural gas distribution mains extended pursuant to traditional main extension agreements.
- (b) Please explain in detail how developers would offset new customers' GET Gas charges using incentives received under the New Construction program.
- (c) Please explain in detail Mr. Watkins's understanding of the costs that developers must pay when participating in the GET Gas Program.

Response:

- (a) Mr. Watkins is not proposing an EE&C plan, rather, this is the proposal of UGI. Furthermore, Mr. Watkins' recommendation on page 47, lines 13 through 17 simply states that the New Construction plan is only available for developments that currently have gas or will have gas.
- (b) If cash rebates or incentives are provided to developers/builders for new construction, by mathematical definition, this will offset any additional charges imposed for the extension of mains, service line costs, etc.
- (c) Unknown.

Witness: Glenn A. Watkins

UGI Gas Exhibit TML-16

Pennsylvania Public Utility Commission

v.

**UGI Utilities Inc. – Gas Division
Docket No. R-2015-2518438**

**Responses of the Office of Consumer Advocate
UGI Gas to OCA Set II**

UGI Gas to OCA-II-12

Please reference OCA Statement No. 3, page 48, line 1 to page 49, line 16.

- (a) Are you aware of any Pennsylvania EE&C Plans that are subject to similar annual caps and allowances proposed by Mr. Watkins in this proceeding? If so, please identify them and explain how they are similar.
- (b) Please provide a workable Excel spreadsheet showing the annual spending for the EE&C Plan under Mr. Watkins's proposed annual caps and allowances, assuming the Company's projected annual spending in EE&C Plan.
- (c) Please explain whether it is OCA's position that UGI should design its EE&C Rider's rate to recover \$4.2 million each year followed by an annual reconciliation.
- (d) Would you agree that with the start of a new EE&C Plan that the annual spending is likely to be lower in the early years of the Plan and then ramp up in the later years of the Plan? If not, please explain in detail your reasons in support.
- (e) Please explain how Mr. Watkins's proposed annual caps and allowances would affect the EE&C Rider.

Response:

- (a) No.
- (b) An Excel spreadsheet is not required to understand Mr. Watkins' recommended annual caps and allowances as his testimony is self-explanatory. Therefore, Mr. Watkins' did not prepare an Excel spreadsheet to develop his recommendation.
- (c) Neither Mr. Watkins' nor the OCA offered an opinion or recommendation as to whether a rider is or is not appropriate should the Commission approve an EE&C plan for UGI. As such, OCA offers no position to this question as posed.
- (d) Not necessarily. If the Commission approves a new EE&C plan, the amount of spending will depend on several factors including the effectiveness of marketing and customer awareness, the specific plans approved, limitations on spending, and customer acceptance.
- (e) See response to subpart (c) above.

Witness: Glenn A. Watkins

UGI Gas Exhibit TML-17

Pennsylvania Public Utility Commission

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**UGI Utilities Inc. – Gas Division
Docket No. R-2015-2518438**

**Responses of the Office of Consumer Advocate
UGI Gas to OCA Set II**

UGI Gas to OCA-II-14

Please reference OCA Statement No. 4, page 50, lines 20-21. Is there any restriction in the language of UGI's EE&C Plan that prohibits low-income customers from participating in the EE&C programs? If so, please identify that language.

Response:

Mr. Colton accepts UGI Witness Love's testimony, which states: "low-income customers are allowed to participate in any of the programs open to residential customers." (Love, at 9)

Witness: Roger D. Colton

UGI Gas Exhibit TML-18

Pennsylvania Public Utility Commission

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**UGI Utilities Inc. – Gas Division
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**Responses of the Office of Consumer Advocate
UGI Gas to OCA Set II**

UGI Gas to OCA-II-15

Please reference OCA Statement No. 4, page 51, lines 8-19.

- (a) Has Mr. Colton performed any study or evaluation of the effect that his recommended 4.5% low-income savings carveout would have on the costs and budgets of the EE&C Plan, the costs and budgets of the individual EE&C programs, the TRC benefit-cost ratios of the EE&C Plan, or the TRC benefit-cost ratios of the individual EE&C programs? If so, please provide copies of all such studies and evaluations.
- (b) Under this proposal, would UGI be able to count savings from low-income customers participating in standard non-low-income-specific residential programs toward the 4.5% savings carveout?
- (c) To your knowledge, were other Pennsylvania utilities' standard non-low-income-specific residential programs designed to target low-income customers? If so, please identify each utility and the associated program(s).
- (d) To your knowledge, did the other Pennsylvania utilities consider barriers to low-income participation when designing their standard non-low-income-specific residential programs? If so, please identify each utility and the associated program(s).
- (e) To your knowledge, have other Pennsylvania utilities obtained savings from low-income participants in standard non-low-income-specific residential programs that were not designed to target low-income customers? If so, please identify each utility and the associated program(s).
- (f) To your knowledge, have other Pennsylvania utilities obtained savings from low-income participants in standard non-low-income-specific residential programs even though they did not consider barriers to low-income participation when designing those programs? If so, please identify each utility and the associated program(s).

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**Responses of the Office of Consumer Advocate
UGI Gas to OCA Set II**

Response:

- a. No.
- b. No.
- c. Each Pennsylvania electric utility filing its respective Phase III Act 129 Energy Efficiency and Conservation (EE&C) plan was required to meet the low-income savings carve-out. The Phase III plans were required by Commission directive to include specified percentages of services and measured directed toward low-income customers.
- d. Mr. Colton is not aware of the extent to which, if at all, other Pennsylvania utilities considered barriers to low-income participation when designing their standard non-low-income-specific residential programs.
- e. Each Pennsylvania electric utility filing its respective Phase III Act 129 Energy Efficiency and Conservation (EE&C) plan did not track the extent to which low-income customers participated in standard non-low-income-specific residential programs that were not designed to target low-income customers.
- f. See, Response to OCA-II-15(d).

Witness: Roger D. Colton

UGI Gas Exhibit TML-19

Low Income Program Calculations

EE&C Plan Cost and Savings (FY 2017 - 2021)

Costs (Nominal)	\$	27,013,000	
		1st Yr	Lifetime
Gas Savings (MMBtus)		647,407	7,384,990
<i>Source: Exhibit TML-2</i>			

UGI LIURP Cost and Savings

PY 13 Avg cost per UGI LIURP job, including admin (2015\$)	\$	5,728	
PY 13 Reported Savings (MCF)		14,407	
PY 13 Report Savings (MMBtus)		1,484	
PY 13 Report Jobs		78	
Avg Lifetime Assumption		20	
		1st Yr	Lifetime
MMBtus / Job		19.02	380.49
<i>Source: 2013 Annual UGI Gas LIURP Filing (4/30/15)</i>			

Low Income Program Target

		1st Yr	Lifetime
% Carvout		4.50%	4.50%
Savings Target (MMBtus)		29,133	332,325
Projected Jobs			
5-yr Total		1,531	873
Annual		306	175
Projected Budget			
5-yr Total	\$	8,771,725	\$ 5,002,967
Annual	\$	1,754,345	\$ 1,000,593
% of EE&C Plan		32%	19%

CY13 to CY15 Inflation

1.02

<http://data.bls.gov/cgi-bin/cpicalc.pl?cost1=1&year1=2013&year2=2016>

UGI Gas Exhibit TML-20

Pennsylvania Public Utility Commission

v.

**UGI Utilities Inc. – Gas Division
Docket No. R-2015-2518438**

**Responses of the Office of Consumer Advocate
UGI Gas to OCA Set II**

UGI Gas to OCA-II-18

Please reference OCA Statement No. 4, page 59, lines 9-12.

- (a) Would this “residential program” be limited specifically to multifamily properties?
- (b) Please define what you mean by “multifamily properties.”
- (c) Please state whether this program should be designed for:
 - (i) All multifamily buildings;
 - (ii) Smaller multifamily buildings;
 - (iii) Individually metered multifamily buildings;
 - (iv) Individually metered multifamily buildings with low-income residents;
 - (v) Master-metered multifamily buildings; or
 - (vi) Master-metered multifamily buildings with low-income residents.

Response:

- a. Yes.
- b. Multi-family properties would include properties with two more units in each building.
- c. Within the constraints of Mr. Colton’s Direct Testimony, page 58, lines 6 – 7, the following responses are provided:
 - c-i. No, only multifamily buildings that are individually metered.
 - c-ii. Yes, if the multifamily buildings are individually metered.
 - c-iii. Yes.
 - c-iv. Yes.
 - c-v. No, since a master-metered building would not be a “residential” customer.
 - c-vi. No, since a master-metered building would not be a “residential” customer.

Witness: Roger D. Colton

UGI Gas Exhibit TML-21

**UGI INDUSTRIAL INTERVENORS RESPONSES TO
INTERROGATORIES AND REQUESTS FOR PRODUCTION OF DOCUMENTS
BY UGI UTILITIES, INC. – GAS DIVISION**

**DOCKET NOS. R-2015-2518438, C-2016-2527150, C-2016-2528559,
C-2016-2529436, C-2016-2529638,**

UGI Gas to UGIII-I-4. Please reference UGIII Statement No. 3, page 11, lines 22-23.

- (a) Please state whether Lehigh received any incentives from PPL Electric Utilities Corporation ("PPL Electric") for implementing Lehigh's "electrical efficiency projects."
- (b) Please state whether Lehigh's "electrical efficiency projects" were eligible to receive incentives under PPL Electric's EE&C Plan at the time the projects were implemented.

RESPONSE

- (a) Yes, Lehigh received incentives from PPL Electric's EE&C Plan pursuant to Act 129.
- (b) Some of Lehigh's electrical efficiency projects were eligible to receive incentives under PPL's EE&C Plan at the time the projects were implemented.

Response Provided by: Michael Trzesniowski
Lehigh University

Date: April 22, 2016

UGI Gas Exhibit TML-22

**UGI INDUSTRIAL INTERVENORS RESPONSES TO
INTERROGATORIES AND REQUESTS FOR PRODUCTION OF DOCUMENTS
BY UGI UTILITIES, INC. – GAS DIVISION**

**DOCKET NOS. R-2015-2518438, C-2016-2527150, C-2016-2528559,
C-2016-2529436, C-2016-2529638,**

UGI Gas to UGIII-I-5. Please reference UGIII Statement No. 3, page 12, lines 4-14.

- (a) Please clarify whether this recommendation would apply to all customers or only large commercial and industrial customers.
- (b) Please clarify whether the recommendation is for an "opt-in" or an "opt-out."
- (c) Under this recommendation, would a customer have to "opt-in" or "opt-out" at the beginning of the EE&C Plan Phase or could the customer "opt-in" or "opt-out" during the EE&C Plan Phase?
- (d) Would you agree that all customers, not only customers on Rate LFD, "can implement efficiency on their own"?

RESPONSE

- (a) This recommendation applies to all customers.
- (b) Lehigh's primary recommendation is that the EE&C program should allow interested customers to opt-in. In the alternative, and at a minimum, Rate LFD customers should be permitted to opt-out.
- (c) In Lehigh's view, customers should be permitted to choose whether to be involved in an EE&C Plan pursuant to a predetermined time table.
- (d) Yes.

**Response Provided by: Michael Trzesniowski
Lehigh University**

Date: April 22, 2016