

Exhibit No.: 7



## MEMORANDUM

Date: **10/3/2019**

To: **Jessica Quinn** Information Release # **PNNL-SA-147978**

From: **Z. Todd Taylor**

Subject: **Preliminary Cost-Effectiveness of the 2018 IECC for the State of Delaware**

PNNL has analyzed the cost effectiveness of moving from the current Delaware energy code, which is equivalent to the 2012 IECC, to the 2018 edition of the IECC. Moving to the 2018 IECC is expected to be cost-effective in Delaware when aggregated across single- and multifamily dwelling units. This assessment of cost-effectiveness is based on expected changes in construction cost related to energy savings analyzed for the single climate zone that occurs in Delaware (4). The analysis is based on DOE's established methodology for analyzing IECC-based codes.<sup>1</sup>

DOE's methodology evaluates 32 residential prototypes comprising two building types, four foundation types, and four HVAC types. These prototypes are simulated with TMY3 weather data from the Baltimore/Washington International Airport.

Delaware's current residential energy code is the 2012 IECC. Construction cost differences between the 2012 IECC and the 2018 IECC in Delaware were taken directly from extant and in-progress DOE/PNNL reports on the cost effectiveness of new code editions. National cost estimates were adjusted by a Delaware-specific construction cost multiplier<sup>2</sup> and appropriate Consumer Price Index (CPI) multipliers<sup>3</sup> to bring costs into 2019 dollars.

Life Cycle Cost (LCC) savings is the primary measure DOE uses to assess the economic impact of building energy codes. LCC is the calculation of the present value of costs over a 30-year period including initial equipment and construction costs, energy savings, maintenance and replacement costs, and residual value of components at the end of the 30-year period. When the LCC of the updated code (e.g., the 2018 IECC) is lower than that of the previous code (the current Delaware code), the updated code is considered cost-effective.

The energy prices used in the analysis are:

- Electricity price: \$0.13/kWh (\$0.0381/kBtu)
- Natural gas price: \$12.101/kCuFt (\$0.0114/kBtu)
- Heating oil price: \$3.285/gal (\$0.02372/kBtu)

<sup>1</sup> <https://www.energycodes.gov/development/residential/methodology>

<sup>2</sup> [https://bc3.pnnl.gov/sites/default/files/Location\\_Factors\\_Report.pdf](https://bc3.pnnl.gov/sites/default/files/Location_Factors_Report.pdf)

<sup>3</sup> <https://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/>

These prices are the state average residential energy costs for the most recently available (as of spring, 2019) year or heating season as appropriate. The prices and sales data are from the United States Energy Information Administration (EIA).<sup>4,5,6</sup> The heat contents of fossil fuels, used to convert volumetric measures such as gallons and cubic feet to energy measures, are taken from EIA sources: 1045 Btu/ft<sup>3</sup> for gas<sup>7</sup> and 138,500 Btu/gal for fuel oil.<sup>8</sup> Fuel prices are escalated over the analysis period based on EIA's year-by-year projections in the 2018 Annual Energy Outlook,<sup>9</sup> Reference Case Table 3.<sup>10</sup> Table 1 below shows the key economic parameters used in the analysis.

Table 1. Economic Parameters

Economic Parameter	Value	Notes
Study period	30 years	
Life of efficiency measures	60 years	
Discount rate (nominal)	5%	Equal to loan interest rate
Loan interest rate	5%	
Loan term	30 years	
Loan down payment	10%	
Private mortgage insurance rate	0.5% of loan balance	Eliminated after loan balance is less than 80% of home value
Loan fee rate	0.7% of loan amount	
Inflation rate	2.52%	Home value assumed to escalate with general inflation
Income Tax Rate	12%	12% federal, 5.55% state <sup>11</sup>
Property Tax Rate	0.43% <sup>12</sup>	

Table 2 shows the economic impact of upgrading the Delaware code to the 2018 edition of the IECC in terms of life-cycle cost savings (dollars per dwelling unit). Table 3 shows the annual

<sup>4</sup> [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.php?t=epmt\\_5\\_06\\_b](https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_06_b)

<sup>5</sup> [https://www.eia.gov/dnav/ng/ng\\_pri\\_sum\\_a\\_EPG0\\_PRS\\_DMcf\\_m.htm](https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm)

<sup>6</sup> [https://www.eia.gov/dnav/pet/PET\\_PRI\\_WFR\\_A\\_EPD2F\\_PRS\\_DPGAL\\_W.htm](https://www.eia.gov/dnav/pet/PET_PRI_WFR_A_EPD2F_PRS_DPGAL_W.htm)

<sup>7</sup> [https://www.eia.gov/dnav/ng/ng\\_cons\\_heat\\_a\\_EPG0\\_VGTH\\_btucf\\_a.htm](https://www.eia.gov/dnav/ng/ng_cons_heat_a_EPG0_VGTH_btucf_a.htm)

<sup>8</sup> [https://www.eia.gov/energyexplained/index.php?page=about\\_energy\\_units](https://www.eia.gov/energyexplained/index.php?page=about_energy_units)

<sup>9</sup> <https://www.eia.gov/outlooks/archive/aeo18/>

<sup>10</sup> <https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2018&cases=ref2018&sourcekey=0>

<sup>11</sup> <http://www.tax-rates.org/delaware/income-tax>

<sup>12</sup> <http://www.tax-rates.org/delaware/property-tax>

energy cost savings (dollars per dwelling unit) and Table 4 shows incremental construction costs (dollars per dwelling unit).

Table 2. Life-Cycle Cost Savings (\$/dwelling unit)

Potential New Code	Climate Zone	All Residential Dwelling Units
2018 IECC	4	447

Table 3. Annual Energy Cost Savings (\$/dwelling unit)

Potential New Code	Climate Zone	All Residential Dwelling Units
2018 IECC	4	27.82

Table 4. Incremental Construction Costs (\$/dwelling unit)

Potential New Code	Climate Zone	All Residential Dwelling Units
2018 IECC	4	93