MEMORANDUM

Pacific Northwest NATIONAL LABORATORY

Date:	**August 14, 2023**	Information Release:	**PNNL-SA-188473**
To:	Andrew Brisbo, Director, Bureau of Construction Codes Licensing and Regulatory Affairs (LARA) State of Michigan, brisboa@michigan.gov		
From:	Rob Salcido, Mechanical Engineer Darren Port, R&D Research Engineer YuLong Xie, Modeler and Data Analyst		
Subject:	**Cost-Effectiveness Analysis of the 2021 IECC for the State of Michigan**		

The State of Michigan is in the process of updating its current state residential energy code, which is an amended version of the 2015 International Energy Conservation Code (IECC) to the 2021 IECC. The Michigan Bureau of Construction Codes, a bureau within Licensing and Regulatory Affairs (LARA), requested a cost-effectiveness analysis, that considers the *Michigan Stille-Derossett-Hale Single State Construction Code Act*,[1] comparing the current state residential energy code to the unamended 2021 IECC.

The resulting analysis shows that a home designed to comply with the residential provisions of the 2021 IECC would yield short-term and long-term consumer benefits compared to a home built to the Michigan-amended 2015 IECC. When building to the 2021 IECC, Michigan households can expect to save 10.7% in energy costs, equating to $396 of annual utility bill savings. When amortizing costs and benefits over a typical 30-year mortgage, homeowners will see a positive cash flow in the first two to six years, depending on building type and climate zone. Over the course of 30 years, a first-time homebuyer will net approximately $7,300, and an average-income homebuyer around $9,250 in life-cycle cost savings. During the first year alone, collectively, Michigan residents could expect to save over $7,229,392 in energy costs and 44,850 metric tons in avoided CO_2 emissions. Adopting the 2021 IECC in Michigan is expected to result in homes that are energy efficient, more affordable to own and operate, and which are designed and constructed to modern standards for health, comfort, and resilience.

[1] http://www.legislature.mi.gov/(S(firl1osgatesrm01zii1u1r3))/mileg.aspx?page=getobject&objectname=mcl-act-230-of-1972&queryid=40215&highlight=

Table 1. Individual Consumer Impact of Moving from the Michigan Amended 2015 IECC to the 2021 IECC[2]

Metric	First-time Homebuyer	Average Income Homebuyer
Life-cycle cost savings of the 2021 IECC (Year 30)	$7,322	$9,281
Life-cycle cost savings of the 2021 IECC (Year 7)	$648	$696
Net annual consumer cash flow in year 1 of the 2021 IECC[3]	$101	$138
Years to positive cumulative cash flow	3	4
Annual (year 0) energy cost savings of the 2021 IECC[4]	$396	$396
Annual energy cost savings of the 2021 IECC (%)[5]	10.7%	10.7%
Simple payback period (years)	9.9	9.9

To meet the requirements of the *Michigan Stille-Derossett-Hale Single State Construction Code Act,* MCL 125.1504, the residential energy code shall be designed to provide standards and requirements for cost-effective energy efficiency. Cost-effective, as defined in MCL 125.1502a:

> *… means, using the existing energy efficiency standards and requirements as the base of comparison, the economic benefits of the proposed energy efficiency standards and requirements will exceed the economic costs of the requirements of the proposed rules based upon an incremental multiyear analysis. This multiyear analysis must meet the following requirements:*
>
> i. *Considers the perspective of a typical first-time homebuyer.*
> ii. *Considers benefits and costs over a 7-year time period.*
> iii. *Does not assume fuel price increases in excess of the assumed general rate of inflation.*
> iv. *Ensures that the buyer of a home who would qualify to purchase the home before the addition of the energy efficient standards will still qualify to purchase the same home after the additional cost of the energy-saving construction features.*
> v. *Ensures that the costs of principal, interest, taxes, insurance, and utilities will not be greater after the inclusion of the proposed cost of the additional*

[2] A weighted average is calculated across building configurations and climate zones.
[3] The annual cash flow is defined as the net difference between annual energy savings and annual cash outlays (mortgage payments, etc.), including all tax effects but excluding up-front costs (mortgage down payment, loan fees, etc.). First-year net cash flow is reported; subsequent years' cash flow will differ due to the effects of inflation and fuel price escalation, changing income tax effects as the mortgage interest payments decline, etc.
[4] Annual energy savings is reported at time zero, before any inflation or price escalations are considered.
[5] Annual energy savings is reported as a percentage of whole building energy use.

energy-saving construction features required by the proposed energy efficiency rules than under the provisions of the existing energy efficiency rules.

A Life-Cycle Cost (LCC) cash flow analysis is the primary metric used to determine cost-effectiveness as defined in MCL 1225.1502a. As further described in Appendix A, this analysis determined that a first-time homebuyer will be cashflow positive in year three of owning the home and net $648 in year seven. A positive cash flow at the end of year seven indicates that adopting the 2021 IECC is cost-effective.

As described in more detail in subsequent sections of this memo, PNNL considered the criteria outlined above when assessing the individual and statewide economic and energy impacts of updating to the unamended 2021 IECC.

Methodology

DOE's cost-effectiveness methodology evaluates 32 residential prototypes comprising two building types, four foundation types, and four HVAC system types. Simulations are conducted for single-family and multifamily buildings. The prototypes used in the simulations are intended to represent a typical new one- or two-family home or townhouse and a low-rise (3-story) multifamily building, such as an apartment, cooperative, or condominium. All buildings are evaluated with central air conditioning and each of four heating system types: gas furnace, oil furnace, heat pump, and electric furnace. The multifamily prototypes are simulated with a central oil-fired boiler instead of individual oil furnaces. Four foundation types are examined for all buildings: vented crawlspace, slab-on-grade, and a finished heated basement with basement wall insulation. To meet the 2021 IECC additional efficiency measure requirements, this analysis assumed HVAC ducts are placed entirely within conditioned space, as that is common construction practice in Michigan.[6][7][8] Table 2 contains the Michigan-specific foundation type weights based on current construction practices found in the field based on an ongoing state residential energy code field study.[9]

---

[6] A residential field study currently conducted by the Midwest Energy Efficiency Alliance (MEEA) has made 51 observations of installed duct systems (supply and return) of the 51 house observations conducted; 40 (78%) have supply and return ducts in 100% conditioned space, and 49 (96%) have at least 90% of ducts in conditioned space. The construction code for the houses included in the study is the 2015 IECC.

[7] As cited in DTE Energy Comments to LARA, *2021 Michigan Energy Code Comments*, "94% of the 5,000 homes submitted to the DTE New Home Construction program since 2019 have had at least 95% of ducts inside conditioned space." https://www.michigan.gov/lara/-/media/Project/Websites/lara/bcc-media/Rules-Info/Part-10-Michigan-Energy-Code/Compiled-2021-Energy-Codes-Advisory-Meeting-Comments-322.pdf?rev=9fe80d902fc547ac864918012652d6a2&hash=061E4101D96506D30961ABDF9D2A84F9

[8] The *Cost-Effectiveness of the 2021 IECC for Residential Buildings in Michigan* analysis used a heat pump water heater as the additional efficiency measure. https://www.energycodes.gov/sites/default/files/2021-07/MichiganResidentialCostEffectiveness_2021_0.pdf

[9] The field study is being conducted by the principal investigator, the Midwest Energy Efficiency Alliance (MEEA).

Table 2. Weighting Factors by Foundation Type

Parameter	Weight (%)
Crawlspace	10%
Slab-on-Grade	16%
Heated Basement	74%

Selected prototypes are simulated in EnergyPlus with TMY3 weather data for climate zones 5A, 6A, and 7. Construction cost differences between the Michigan-amended 2015 IECC and the 2021 IECC were taken directly from DOE/PNNL reports on the cost-effectiveness of new code editions. National cost estimates were adjusted by a Michigan-specific construction cost multiplier[10] and appropriate Consumer Price Index (CPI) multipliers[11] to bring costs into 2023 dollars.

Life-Cycle Cost (LCC) 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 30 years 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 2021 IECC) is lower than that of the previous code (the Michigan amended 2015 IECC), the updated code is considered cost-effective. For this Michigan analysis, life-cycle costs were obtained at the end of year 30, as outlined in the DOE methodology, and year 7, to consider the cost-effectiveness timeframe outlined in MCL 125.1502a. Additionally, a range of economic parameters were considered to reflect the impact on a first-time homebuyer.

The energy savings from the simulation analysis are converted to energy cost savings using Michigan's latest average fuel prices. Fuel prices are escalated over the analysis period based on an escalation factor of 4.05% for all fuel types. As outlined in MCL 125.1502a, the fuel price escalation used in the analysis does not exceed the inflation rate.

Data updated and published monthly by the U.S. Energy Information Administration (EIA) are used to determine Michigan's latest average fuel prices for the three fuel types considered in this analysis—electricity, natural gas, and fuel oil. To avoid seasonal fluctuations and regional variations in the price of electricity, the analysis used the average annual residential electricity price of 18.02 ¢/kWh[12] in 2022. The EIA reports an annual average cost of $11.52/1,000 ft3 and average heat content of 1,056 Btu/ft3 for natural gas delivered to consumers in Michigan in

[10] 2020 RSMeans. https://www.rsmeans.com
[11] https://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/
[12] Table 5.6.B. Average Price of Electricity to Ultimate Customers by End-Use Sector. https://www.eia.gov/electricity/monthly/

2022[13]. The resulting average price of $1.104/therm for natural gas was used in this analysis. In addition, the EIA reports an annual average cost of $4.159/gallon for No. 2 fuel oil.[14]

Table 3. Fuel Prices Used in the Analysis

Electricity ($/kWh)	Gas ($/Therm)	Fuel Oil ($/gal)
0.1802	1.104	4.159

The financial and economic parameters used in calculating LCC and annual consumer cash flow are based on the latest DOE cost-effectiveness methodology with Michigan-specific economic scenarios. To better align with down-payment rates in Michigan and consider impacts from a first-time homebuyer perspective in the state, this analysis presents average mortgage realities for two different types of homebuyers, a first-time homebuyer and an average-income Michigan homebuyer.

The first-time homebuyer is generally categorized as having less equity or the ability to put down a substantial downpayment. Both nationally[15] and the Michigan Housing Authority[16] defines first-time homebuyers as having not owned a home in three years. According to a 2022 National Association of Realtors (NAR) report, *Ninety-seven percent of first-time buyers financed their home purchase, with a typical downpayment of six percent*.[17] Consistent with this research, and results from previous years,[18] this analysis assumed a 6% down payment and interest rate of 6% for a typical Michigan first-time homebuyer.

According to the Pew Research Center, average-income buyers whose annual household income is two-thirds to double the national median income possess the means or have the equity to pay a higher down payment. For this scenario, this analysis assumed the average average-income buyer makes a 12% down payment[19] on a loan with an average interest rate of 5% for home purchases.[20] The parameters are summarized in Table 4 for reference.

---

[13] http://www.eia.gov/oil_gas/natural_gas/data_publications/natural_gas_monthly/ngm.html
[14] https://www.eia.gov/dnav/pet/pet_pri_wfr_dcus_SMI_w.htm
[15] https://themortgagereports.com/76236/who-qualifies-first-time-home-buyer
[16] https://www.michigan.gov/mshda/homeownership/homebuyers/mi-home-loan#:~:text=Program%20Description%3A,family%20size%20and%20property%20location
[17] https://www.nar.realtor/sites/default/files/documents/2022-highlights-from-the-profile-of-home-buyers-and-sellers-report-11-03-2022_0.pdf
[18] A typical down payment for first-time buyers has ranged between six to seven percent since 2018, according to NAR. https://www.nar.realtor/blogs/economists-outlook/tackling-home-financing-and-down-payment-misconceptions#:~:text=However%2C%20in%20actuality%20the%20typical,payment%20was%2017%25%20last%20year.
[19] https://www.nar.realtor/sites/default/files/documents/2021-home-buyers-and-sellers-generational-trends-03-16-2021.pdf
[20] https://themortgagereports.com/61853/30-year-mortgage-rates-chart#loan-purpose

The 30-year mortgage time frame is used as it is the most common loan product; 90 percent of homeowners choose a 30-year mortgage, according to Freddie Mac.[21]

Additionally, from a National Association of Home Builders report titled What Buyers Really Want,[22] buyers are willing to pay extra for a home if they understand it will lead to annual savings in utility costs. 57% are willing to pay $5,000 or more, on top of the price of the home, to save $1,000 a year in utilities.

Table 4. Economic Parameters Used in the Analysis

Parameter	First-Time Homebuyer	Average Income Homebuyer
Mortgage interest rate (fixed rate)	6.0%	5.0%
Loan fees	1.0%	1.0%
Loan term	30 years	30 years
Down payment	6%	12%
Nominal discount rate (equal to mortgage rate)	6%	5.0%
Inflation rate	4.05%	4.05%
Marginal federal income tax	12%	12%
Marginal state income tax	4.05%	4.05%
Property tax	1.62%	1.62%

To evaluate the cost-effectiveness of the changes introduced by the 2021 IECC over the Michigan-amended 2015 IECC, PNNL estimated the incremental construction costs associated with these changes. For this analysis, cost data sources consulted by PNNL include:

- Building Component Cost Community (BC3) data repository
- 2020 RSMeans Residential Cost Data
- 2018 ENERGY STAR Cost & Savings Estimates[23]
- Price data from nationally recognized home supply stores

The incremental costs are calculated separately for each code change (Michigan amended 2015 IECC to the 2021 IECC) and then added together to obtain a total incremental cost by climate zone, building type, and foundation type.

Tables 5 and 6 show the climate zone-specific incremental construction costs when updating to the 2021 IECC based on the single-family and multifamily prototypes used in this analysis. These costs have been adjusted using a construction cost multiplier of 0.989 to reflect local Michigan construction costs based on location factors provided by 2020 RS Means and

[21] https://sf.freddiemac.com/articles/insights/why-americas-homebuyers-communities-rely-on-the-30-year-fixed-rate-mortgage
[22] www.nahb.org/blog/2022/03/top-10-features-for-first-time-home-buyers
[23]https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%203%20Cost%20%20Savings%20Summary.pdf

converted to 2023 dollars. Incremental construction costs for individual measures included in this analysis were compared to the incremental costs in the 2021 CONSOL Report – *Impact of 2021 IECC on 2015 Michigan Residential Code.* Measure level cost estimates between the two reports were found to be similar, with PNNL costs being slightly higher on average.

Table 5. Total Single-Family Construction Cost Increase for the 2021 IECC Compared to the Michigan Amended 2015 IECC

Single-family Prototype House			
Climate Zone	**Crawlspace**	**Heated Basement**	**Slab**
5A	$4,238	$4,442	$4,915
6A	$3,738	$3,480	$4,415
7	$4,972	$4,714	$4,972
Average	$4,189	$4,339	$4,861

Table 6. Multifamily Construction Cost Increase for the 2021 IECC Compared to the Michigan Amended 2015 IECC[24]

Multifamily Prototype Apartment/Condo			
Climate Zone	**Crawlspace**	**Heated Basement**	**Slab**
5A	$1,933	$1,743	$2,033
6A	$1,428	$1,170	$1,528
7	$2,249	$1,990	$2,249
Average	$1,880	$1,682	$1,979

Consumer Impacts

Moving to the 2021 IECC is cost-effective for first-time homebuyers living in single-family and low-rise multifamily units in Michigan. Over 30 years, a first-time homebuyer will net approximately $7,300, and an average-income homebuyer around $9,250 in life-cycle cost savings, as shown in Table 7.

[24] In the multifamily prototype model, the heated basement is added to the building, and not to the individual apartments. The incremental cost associated with heated basements is divided among all apartments equally.

Tables 7 through 8 display typical cost-effectiveness metrics analyzed in DOE national and state energy code analyses. These metrics include climate zone specific life-cycle cost savings, consumer cash flow timeframe,[25] and annual energy cost savings. Table 7 shows the 7-year and 30-year life cycle cost savings for a first-time homebuyer and an average-income homebuyer.

Table 7. First Time Homebuyer Life-Cycle Cost Savings of the 2021 IECC Compared to the Michigan Amended 2015 IECC

Climate Zone	First-Time Homebuyer 7 yr. LCC ($)	First Time Homebuyer 30 yr. LCC ($)	Average Income Homebuyer 7 yr. LCC ($)	Average Income Homebuyer 30 yr. LCC ($)
5A	$614	$7,288	$662	$9,259
6A	$962	$7,785	$1,018	$9,675
7	$46	$4,463	$74	$6,000
Average	$648	$7,322	$696	$9,281

When building to the 2021 IECC, Michigan households can expect to save 10.7% in energy costs, equating to $396 of annual utility bill savings. When amortizing annual energy savings and the upfront costs of construction (i.e., often referenced as first costs) – ranging from approximately $3,500 to $5,000 per single-family home and $1,200 to $2,300 per multifamily unit – over a typical 30-year mortgage, homeowners will see a positive cashflow in the first two to six years, depending on building type and climate zone, as shown in Table 8. This means the energy cost savings are greater than the increased loan payment by this time. The additional mortgage downpayment is paid off from the energy cost savings by year 3 (years to positive savings in Table 8). Based on a 7-year life-cycle cost analysis, the average first-time homebuyer can expect to save nearly $648 (as shown in Table 7).

Table 8. First Time Homebuyer Consumer Cash Flow from Compliance with the 2021 IECC Compared to the Michigan Amended 2015 IECC

	Cost/Benefit	5A	6A	7	Average
A	Incremental down payment and other first costs	$278	$223	$297	$272
B	Annual energy savings (year one) [23]	$421	$409	$357	$419
C	Annual mortgage increase	$271	$217	$289	$265

[25] Consumer Cash Flow: Net annual cost outlay (i.e., difference between annual energy cost savings and increased annual costs for mortgage payments, etc.)

D	Net annual cost of mortgage interest deductions, mortgage insurance, and property taxes (year one)	$54	$43	$58	$53
E = [B-(C+D)]	Net annual cash flow savings (year one)	$96	$149	$10	$101
F = [A/E]	Years to positive savings, including up-front cost impacts	3	2	6	3

On a statewide average, the cost-effectiveness analysis shows that adopting the 2021 IECC over the amended 2015 IECC will have a simple payback in 9.9 years, as shown in Table 9. Simple payback is a commonly used measure of cost-effectiveness, defined as the number of years required for the sum of the annual returns on investment to equal the original investment. Simple payback does not consider any financing of the initial costs through a mortgage or favored tax treatment of mortgages. In other words, simple payback is the ratio of the incremental construction cost and the first-year energy cost savings.

Table 9. Simple Payback Period for the 2021 IECC Compared to the Michigan Amended 2015 IECC

Climate Zone	Simple Payback (Years)
5A	10.0
6A	8.3
7	12.7
Average	9.9

Simple payback calculations may be helpful for the annual returns on investment equal to the original investment. However, this may oversimplify financial evaluation to exclude the best financial performance options. Given the limitations of the simple payback analysis, LCC is the primary metric DOE uses to determine the cost-effectiveness of the code or specific code changes. As stated previously, an LCC analysis comprehensively examines all homeowner costs and savings attributable to the efficiency investment over a 30-year period.

In addition to the economic benefits outlined in this analysis, energy-efficient homes built to the latest energy-efficient codes are more durable, resilient, and help lower mortgage default rates,

nationally, on average, by 32 percent.[26] While mortgage costs are typically static month over month, energy costs can vary at different times of the year. In less efficient homes, these cost swings are more volatile, disproportionately impacting first-time and less affluent homebuyers. Michigan is currently ranked third in mortgage foreclosures nationally.[27] By updating to the 2021 IECC, Michigan homeowners will see more stable energy bills month over month, reducing the financial strain that can lead to foreclosure. Furthermore, states adopting the latest model energy codes are provided favorable insurance underwriting as they rank higher on the ISO's Building Code Effectiveness Grading Schedule (BCEGS®). This national program rates communities on a scale of one (exemplary commitment to code enforcement) to ten. Currently, Michigan's score is four[28] based on the 2015 building codes. Lastly, these homes are more resilient, enabling occupants to safely shelter in place longer during power outages and extreme weather events.[29]

Please review the latest DOE Residential Cost-Effectiveness Methodology for a more detailed description of PNNL's approach to evaluate residential energy code cost-effectiveness, including building prototypes, energy and economic assumptions, and other considerations.[30]

---

[26] *Home Energy Efficiency and Mortgage Risks*. UNC Center for Community Capital and Institute for Market Transformation. 2013. www.ccc.unc.edu and www.imt.org
[27] https://www.attomdata.com/news/market-trends/foreclosures/attom-january-2023-u-s-foreclosure-market-report/
[28] National Building Code Assessment Report Building Code Effectiveness Grading Schedule. ISO /Verisk. 2019 Edition. https://www.verisk.com/siteassets/media/downloads/underwriting/location/2019-bcegs-schedule.pdf
[29] *Enhancing Resilience in Buildings Through Energy Efficiency*. PNNL. 2023. https://www.energycodes.gov/sites/default/files/2023-07/Efficiency_for_Building_Resilience_PNNL-32727_Rev1.pdf
[30] https://www.energycodes.gov/sites/default/files/2021-07/residential_methodology_2015.pdf

MEMORANDUM

Pacific Northwest NATIONAL LABORATORY

Appendix A – Cash Flow Analysis

Table A-1 and Table A-2 illustrate the annual cash flows a first-time and average-income homebuyer would experience over the life of a 30-year mortgage. Cash flows are based on the 30-year life-cycle cost analysis as described in this report, and accounts for associated mortgage costs and economic benefits when buying a home built to the 2021 IECC, as compared to Michigan's amended 2015 IECC. Mortgage costs include the incremental construction costs of building to the 2021 IECC, loan fees, mortgage insurance, property tax, and measure level replacement costs. Annual savings include energy bill savings (electric, gas, oil) and mortgage tax deductions. For each year of the analysis, the cashflows show the energy savings and tax deductions as positive values. The additional costs (loan payments, insurance, taxes) are negative values.

When the cumulative cash flow is positive, energy cost savings exceed the additional downpayment costs (year 0) and annual loan payment costs, resulting in savings to the homeowner in that year - indicating that the code is cost-effective. For example, in Table A-1, a first-time homeowner will see a positive cash flow of $54 in year 3 of owning the home. In all subsequent years, the homeowner will yield additional positive cash flow until they sell the house. If the homeowner chooses to sell the home in year 7, they will have netted $648, and the remaining incremental costs will be passed on to the next owner. If the homeowner stays in the home for the entire mortgage term, they will see a total cost savings of $7,322. Tables A-1 and A-2 highlight the 30-year cash flow described above for a first-time and middle-income homeowner, respectively, with year 7 and year 30 highlighted. Given that in both scenarios, a homeowner would see a positive cash flow well before year 7 as outlined in the Michigan Stille-Derossett-Hale Single State Construction Code Act, MCL 125.1504, the 2021 IECC is deemed cost-effective.

The columns in the cash flow table are explained below.

- **Downpayment** – the increase in downpayment due to the cost of meeting the requirements of the 2021 IECC.
- **Loan Fees** – the additional costs of obtaining credit due to adoption of the 2021 IECC.
- **Electric Savings** – energy cost savings by reducing electric energy consumption through the 2021 IECC.
- **Gas Savings** – energy cost savings by reducing gas energy consumption through the 2021 IECC.
- **Oil Savings** – energy cost savings by reducing oil energy consumption through the 2021 IECC.
- **Loan Payment** – increase in mortgage costs due to additional costs.
- **Tax Deductions** – tax reduction due to increased mortgage interest payments.

- **Mortgage Insurance Payment** – private mortgage insurance (PMI) required when a down payment is less than 20% of the purchase price.
- **Property Tax Payment** - additional tax paid due to efficiency measures giving the home a higher value.
- **Replacement Costs** – costs for replacement when measures run over their expected lifetime.
- **Residual Value** – the value of efficiency measures with remaining useful life at the end of the analysis period.
- **Total Energy Savings** – the sum of all energy cost savings (electric, gas, oil).
- **Net cash flow** – the sum of total energy cost savings and loan payments, taxes, insurance, and replacement costs.
- **Cumulative cash flow** – represents the net present value of the measure for each year.

Table A-1 Cashflow Analysis for first time homebuyer 2021 IECC over the Michigan Amended 2015 IECC

	Down Payment	Loan Fees	Electric Savings	Gas Savings	Oil Savings	Loan Payment	Tax Deductions	Mortgage Insurance Payment	Property Tax Payment	Replacement Costs	Residual Value	Total Energy Savings	Net Cashflow	Cumulative Cashflow
time.0	-$235	-$37	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$272	-$272
year.1	$0	$0	$210	$182	$3	-$250	$33	-$21	-$62	$0	$0	$395	$96	-$176
year.2	$0	$0	$209	$182	$3	-$236	$31	-$20	-$61	$0	$0	$394	$109	-$68
year.3	$0	$0	$209	$182	$3	-$222	$29	-$19	-$60	$0	$0	$393	$121	$54
year.4	$0	$0	$208	$181	$3	-$210	$27	-$17	-$59	$0	$0	$392	$133	$186
year.5	$0	$0	$208	$181	$3	-$198	$25	-$17	-$58	$0	$0	$391	$144	$330
year.6	$0	$0	$207	$180	$3	-$187	$23	-$16	-$57	$0	$0	$390	$154	$484
year.7	**$0**	**$0**	**$206**	**$180**	**$3**	**-$176**	**$21**	**-$15**	**-$56**	**$0**	**$0**	**$389**	**$164**	**$648**
year.8	$0	$0	$206	$179	$3	-$166	$20	-$14	-$55	$0	$0	$388	$173	$821
year.9	$0	$0	$205	$179	$3	-$157	$18	-$13	-$54	$0	$0	$387	$182	$1,003
year.10	$0	$0	$205	$178	$3	-$148	$17	$0	-$53	$0	$0	$386	$202	$1,205
year.11	$0	$0	$204	$178	$3	-$140	$15	$0	-$52	$0	$0	$385	$209	$1,414
year.12	$0	$0	$204	$177	$3	-$132	$14	$0	-$51	$0	$0	$384	$216	$1,629
year.13	$0	$0	$203	$177	$3	-$124	$13	$0	-$50	$0	$0	$383	$222	$1,851
year.14	$0	$0	$203	$176	$3	-$117	$12	$0	-$49	$0	$0	$382	$228	$2,079
year.15	$0	$0	$202	$176	$3	-$111	$11	$0	-$48	$0	$0	$381	$233	$2,312
year.16	$0	$0	$202	$175	$3	-$104	$10	$0	-$47	$0	$0	$380	$238	$2,550
year.17	$0	$0	$201	$175	$3	-$98	$9	$0	-$46	$0	$0	$379	$243	$2,793
year.18	$0	$0	$200	$174	$3	-$93	$8	$0	-$45	$0	$0	$378	$247	$3,040
year.19	$0	$0	$200	$174	$3	-$88	$7	$0	-$45	$0	$0	$377	$252	$3,292
year.20	$0	$0	$199	$173	$3	-$83	$6	$0	-$44	-$6	$0	$376	$250	$3,542
year.21	$0	$0	$199	$173	$3	-$78	$6	$0	-$43	$0	$0	$375	$259	$3,801
year.22	$0	$0	$198	$172	$3	-$73	$5	$0	-$42	$0	$0	$374	$263	$4,064
year.23	$0	$0	$198	$172	$3	-$69	$4	$0	-$41	$0	$0	$373	$266	$4,330
year.24	$0	$0	$197	$172	$3	-$65	$4	$0	-$41	$0	$0	$372	$269	$4,599
year.25	$0	$0	$197	$171	$3	-$62	$3	$0	-$40	-$53	$0	$371	$219	$4,818
year.26	$0	$0	$196	$171	$3	-$58	$2	$0	-$39	$0	$0	$370	$275	$5,093
year.27	$0	$0	$196	$170	$3	-$55	$2	$0	-$38	$0	$0	$369	$277	$5,370
year.28	$0	$0	$195	$170	$3	-$52	$1	$0	-$38	$0	$0	$368	$279	$5,649
year.29	$0	$0	$195	$169	$3	-$49	$1	$0	-$37	$0	$0	$367	$282	$5,931
year.30	**$0**	**$0**	**$194**	**$169**	**$3**	**-$46**	**$0**	**$0**	**-$36**	**$0**	**$1,107**	**$366**	**$1,391**	**$7,322**

Table A-2 Cashflow Analysis for average homebuyer 2021 IECC over the Michigan Amended 2015 IECC

	Down Payment	Loan Fees	Electric Savings	Gas Savings	Oil Savings	Loan Payment	Tax Deductions	Mortgage Insurance Payment	Property Tax Payment	Replacement Costs	Residual Value	Total Energy Savings	Net Cashflow	Cumulative Cashflow
time.0	-$470	-$34	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$504	-$504
year.1	$0	$0	$212	$184	$3	-$211	$26	-$20	-$63	$0	$0	$399	$131	-$373
year.2	$0	$0	$213	$185	$3	-$201	$24	-$19	-$62	$0	$0	$402	$144	-$229
year.3	$0	$0	$215	$187	$3	-$192	$23	-$18	-$62	$0	$0	$405	$156	-$73
year.4	$0	$0	$216	$188	$3	-$183	$21	-$17	-$61	$0	$0	$407	$168	$95
year.5	$0	$0	$218	$189	$3	-$174	$20	-$16	-$61	$0	$0	$410	$179	$275
year.6	$0	$0	$219	$191	$3	-$166	$19	$0	-$60	$0	$0	$413	$206	$480
year.7	**$0**	**$0**	**$221**	**$192**	**$3**	**-$158**	**$17**	**$0**	**-$60**	**$0**	**$0**	**$416**	**$216**	**$696**
year.8	$0	$0	$222	$193	$3	-$150	$16	$0	-$59	$0	$0	$419	$226	$922
year.9	$0	$0	$224	$194	$3	-$143	$15	$0	-$58	$0	$0	$421	$235	$1,157
year.10	$0	$0	$225	$196	$3	-$136	$14	$0	-$58	$0	$0	$424	$244	$1,401
year.11	$0	$0	$227	$197	$3	-$130	$13	$0	-$57	$0	$0	$427	$253	$1,654
year.12	$0	$0	$228	$198	$3	-$124	$12	$0	-$57	$0	$0	$430	$262	$1,916
year.13	$0	$0	$230	$200	$3	-$118	$11	$0	-$56	$0	$0	$433	$270	$2,186
year.14	$0	$0	$231	$201	$3	-$112	$10	$0	-$56	$0	$0	$436	$278	$2,464
year.15	$0	$0	$233	$203	$3	-$107	$9	$0	-$55	$0	$0	$439	$286	$2,750
year.16	$0	$0	$235	$204	$3	-$102	$8	$0	-$55	$0	$0	$442	$294	$3,044
year.17	$0	$0	$236	$205	$3	-$97	$8	$0	-$54	$0	$0	$445	$301	$3,345
year.18	$0	$0	$238	$207	$4	-$92	$7	$0	-$54	$0	$0	$448	$309	$3,654
year.19	$0	$0	$239	$208	$4	-$88	$6	$0	-$53	$0	$0	$451	$316	$3,970
year.20	$0	$0	$241	$210	$4	-$84	$6	$0	-$53	-$7	$0	$454	$316	$4,286
year.21	$0	$0	$243	$211	$4	-$80	$5	$0	-$52	$0	$0	$457	$330	$4,617
year.22	$0	$0	$244	$212	$4	-$76	$4	$0	-$52	$0	$0	$460	$337	$4,953
year.23	$0	$0	$246	$214	$4	-$72	$4	$0	-$51	$0	$0	$463	$343	$5,297
year.24	$0	$0	$248	$215	$4	-$69	$3	$0	-$51	$0	$0	$467	$350	$5,647
year.25	$0	$0	$249	$217	$4	-$66	$3	$0	-$51	-$67	$0	$470	$289	$5,936
year.26	$0	$0	$251	$218	$4	-$62	$2	$0	-$50	$0	$0	$473	$363	$6,298
year.27	$0	$0	$253	$220	$4	-$59	$2	$0	-$50	$0	$0	$476	$369	$6,667
year.28	$0	$0	$254	$221	$4	-$57	$1	$0	-$49	$0	$0	$479	$375	$7,042
year.29	$0	$0	$256	$223	$4	-$54	$1	$0	-$49	$0	$0	$483	$381	$7,423
year.30	**$0**	**$0**	**$258**	**$224**	**$4**	**-$51**	**$0**	**$0**	**-$48**	**$0**	**$1,471**	**$486**	**$1,858**	**$9,281**