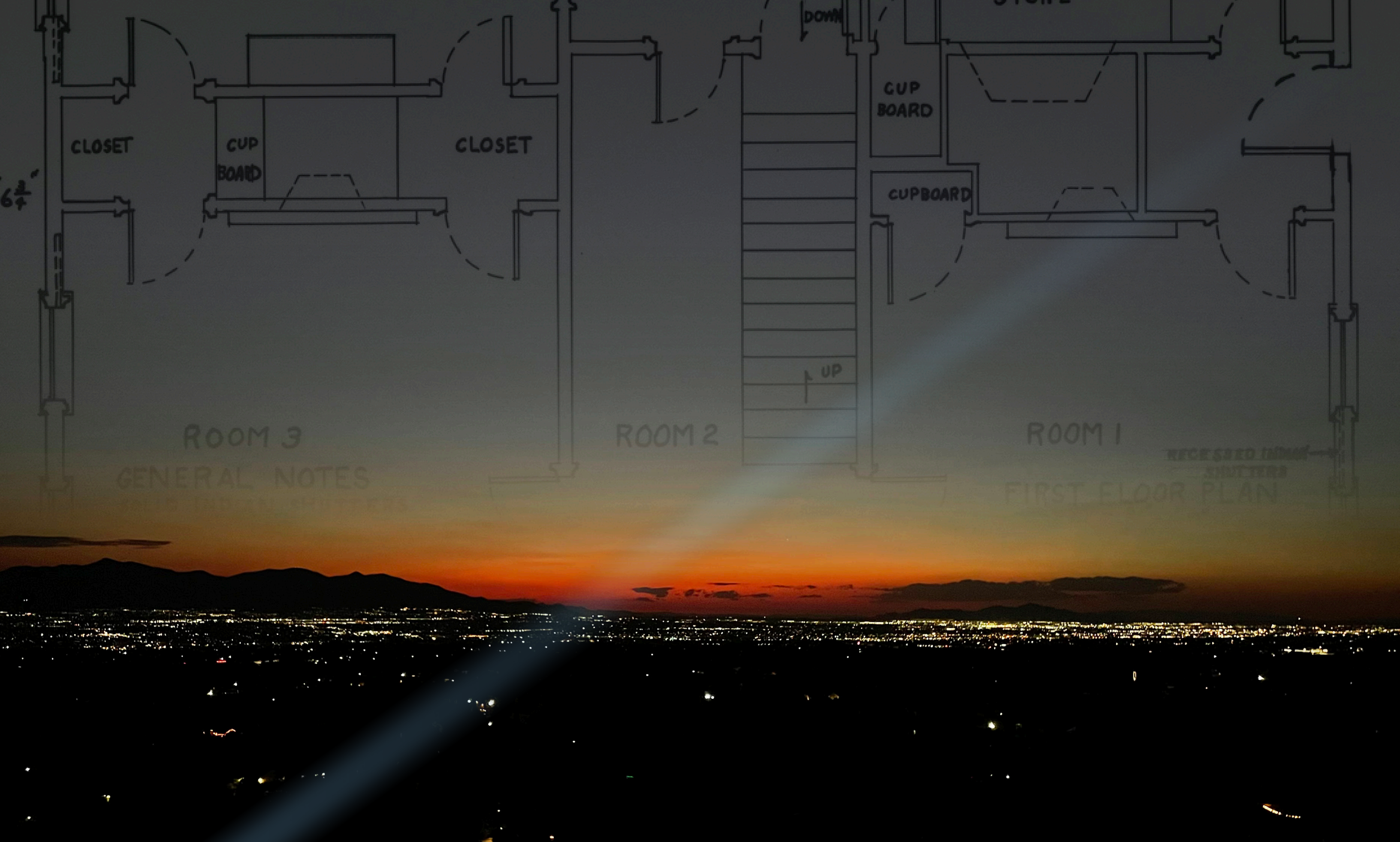

TO A HIGHER STANDARD

Building Codes, Improved Efficiency and Air Quality in Utah

Utah Foundation
RESEARCH • ANALYZE • INFORM

AUGUST 2022

To A Higher Standard

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INTRODUCTION

Poor air quality is both a health issue and an economic challenge in Utah, particularly along the Wasatch Front. One key driver of poor air quality is area source emissions, such as those from residences and commercial structures. Rapid population growth across Utah poses a challenge in terms of increasing emissions, but it also offers the opportunity to build in a manner that promotes greater air quality stewardship. Optimizing this opportunity may require changes to the building code.

Utah has kept up to date on commercial building code standards, but it has maintained older residential building standards that fall short of more efficient building practices. Some argue that upgrading the Utah building code would yield substantial reductions in various types of harmful emissions, while others suggest that higher standards drive up housing costs at a time when rising prices are already posing socio-economic challenges.

This study zeros in on those specific standards that address air quality – not only a major environmental concern, but one over which Utah has a degree of control. The study explores the costs and benefits of the newest building code recommendations – with the focus on reducing emissions that hurt Utah's air quality.

KEY FINDINGS OF THIS REPORT

- Driven by Utah's rapid population growth, over 12% of Utah's homes have been built since 2010 – a far greater proportion than the U.S. average. With a robust pace in new residential and commercial construction expected to continue, there is a unique opportunity to build in a manner that reduces each structure's pollution emissions. The payoff is long-term, with many of these buildings maintaining reduced emissions far into the future.
- Heating air and water for residences and commercial buildings accounts for around 6% of winter inversion emissions for most Utahns; during other seasons and for Utahns living off the Wasatch Front, these emissions are a smaller proportion of local air pollution.
- Given the regional variations in air quality issues related to area source emissions, Utah might explore whether relevant variations in building codes are appropriate.
- The 2021 energy efficiency building standards are set for review by the Utah Legislature for adoption, rejection or amendment during the 2023 General Session.
- The main arguments for updating the energy efficiency standards in the building code include: lower utility costs for residents, better air quality, and an increase in Utah employment. The main points of opposition include: new homes are only a small part of the problem, home costs are too high already, and the government is getting too specific in its building mandates.
- A study of updating the Utah commercial code suggests a substantial savings in energy costs and commensurate emissions reduction, and most buildings would experience a decrease in per-square-foot initial construction costs due primarily to the need for smaller heating and air conditioning systems.
- Studies of updating Utah residential code show life-cycle cost savings that appear to justify a full implementation of the 2021 energy efficiency standard.
- Our analysis suggests that each home built to the 2021 energy efficiency standard would see emissions related to natural gas usage decrease by about one-third compared to homes built to current Utah code.
- The cost of implementing the 2021 energy efficiency standards would be between 0.4% and 0.7% of a new $600,000 home (under $5,000). In terms of household cash flow, initial costs would be recouped within two or three years. These homes would see a one-third annual reduction in local emissions – and a larger reduction during winter months.
- There is a standing energy efficiency loophole in Utah's building codes that is used with such frequency that it undermines any code update. It also creates transparency issues.
- Since the 2000s, the independence of Utah's Uniform Building Code Commission has diminished. Observers say that energy efficiency code adoption that affects air quality has become a much more political process.

This study proceeds from the assumption that modern civilization requires building codes for health, safety and general welfare. The Utah Foundation is not "taking sides" with this study, and recognizes that there are limits to Utah Foundation researchers' knowledge of building practices. That said, this study has been reviewed by builders, air quality officials, energy industry personnel and other stakeholders.

BACKGROUND

Utah saw the largest population growth percentage in the nation between 2010 and 2020: 18.4% compared to the national rate of 7.4%.[1] The housing built during that period accounts for 11.7% of Utah's total housing stock.[2] This compares to only 6.3% nationally. During that decade, more than 14,000 new single-family homes were built per year in Utah, along with a sharp increase in multifamily homes, bringing a related increase in the need for commercial buildings.[3] With a robust pace in new construction expected to continue, Utah has a unique opportunity to build in a manner that decreases pollution emissions. With buildings lasting decades or even centuries, making changes that yield efficiency improvements now pays dividends far into the future. To that end, building codes offer policymakers a critical policy lever.

Older buildings tend to be less efficient than newer ones, particularly older structures that have seen little upgrade over time. Some argue that Utah ought to focus on those older buildings. In fact, there are federal, state, utility-run, and other programs designed to clean up existing buildings. (See the sidebars on pages 11 and 25.) This includes funding to add insulation to attics, upgrade furnaces to higher efficiency models, replace windows, and install solar panels and battery storage units. These programs and householder-financed remodels have made major improvements to existing stock, making homes much more efficient than when they were first built.

But there is a cost premium to retrofitting structures with better insulation, tighter envelopes and improved ductwork. Although the increased cost to install high-efficiency systems in new construction often makes financial sense, retrofitting might be cost-prohibitive.

The Utah Foundation undertook this study to "fine tune" the newest model energy efficiency standards. For example, in terms of insulation, envelops, and ductwork, we initially explored each aspect's costs to Utah residents and benefits to Utahns' air quality. (Note that lighting requirements do not have local air quality impacts.) Through the course of this research, the Utah Foundation pivoted away from the fine-tuning approach for the following reasons:

1. While some of the building code's energy efficiency approaches that would benefit air quality are estimated as being more cost effective than others, they are determined by the model code authors to be cost effective as a "package" – to be taken together as interdependent.

2. As numerous studies show, the newest model provisions are cost effective across Utah, depending upon the efficiency options provided to builders.

3. Given the limited number of options that Utah has to improve air quality, it might make sense for the Utah Legislature to embrace the newest commercial and residential energy efficiency standards whole-heartedly in order to maximize the impact of code changes. Utah's current residential code is an estimated 29% less energy efficient than the newest model code.[4]

With a robust pace in new construction expected to continue, Utah has a unique opportunity to build in a manner that decreases pollution emissions. With buildings lasting decades or even centuries, making changes that yield efficiency improvements now pays dividends far into the future.

AREA SOURCES AND AIR QUALITY

There are three broad categories of emissions affecting Utah's air quality. Mobile sources – both on-road and otherwise – have historically created the greatest share of emissions in the state. A subcategory of these mobile sources are non-road emissions, which can include trains, construction machinery and even lawn mowers. Point sources – such as Utah's refineries and power plants – have the least emissions in aggregate, but the greatest individually. These include most large industrial sources, but also some non-industrial sources, such as major universities. Finally, area source emitters include most commercial buildings and homes. It is important to understand the contribution of area source pollution to understand the benefits of building code upgrades.

When Utahns think about bad air quality, they tend to consider the emissions caught during the winter in valley inversions, as well as summer ozone and periodic wildfire smoke. The distinction among these is important for the purposes of this report, because area sources emit pollutants at different times and in different ways.

The Utah Foundation wrote extensively about the effects of poor air quality in a 2014 report.[5] It included a description of myriad health consequences. Many additional consequences have been studied by universities and others since. A 2020 analysis from 23 Utah air quality researchers and specialists estimates that air pollution causes between 2,480 and 8,000 premature deaths in the state annually and decreases Utahns' median life expectancy by 1.1 to 3.6 years.[6]

The effects also include quality of life concerns as noted time and time again in the Utah Foundation's Quality of Life Index survey from Utahns across the state, particularly from Utahns living along the Wasatch Front.[7] Finally, the effects include economic development concerns, as bad air quality can reduce the state's appeal. The 2020 analysis estimates that the economic costs total between \$0.75 and \$3.3 billion annually – or about 1.7% of the state's gross domestic product.[8]

On a typical winter day along the Wasatch Front (Davis, Salt Lake, Utah and Weber counties, plus Tooele), mobile sources emit about 120 tons of pollution, area sources emit about 95 tons, point sources just over 40 tons, and non-road sources just under 40 tons.[9] (See Figure 1.)

About half of the emissions are nitrogen oxides (NOx) and about half are volatile organic compounds – both of which are precursors to the creation of small particulate matter, or $PM_{2.5}$, that ends up in Utah's winter inversions.[10] In addition, some direct $PM_{2.5}$ and other emissions get caught in these inversions.

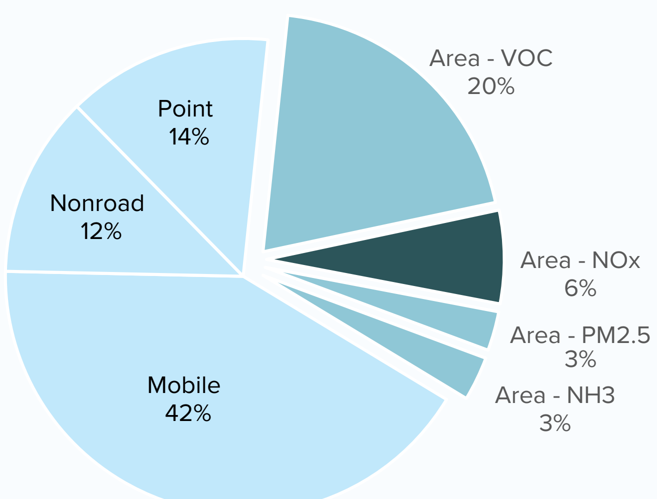
When it comes to area sources, most emissions are volatile organic compounds. Nitrogen oxides are also prevalent, with direct $PM_{2.5}$ and ammonia rounding out the area sources (the latter from crops and livestock).

At a more detailed level, area sources can be categorized as follows: solvent utilization; stationary source fuel combustion; storage and transport; waste disposal treatment and recovery; industrial processes; and miscellaneous area sources. Of the roughly 95 tons of area source pollutants per day, nearly 50 are from solvents (all of which are VOCs, primarily from surface coating and a variety of other commercial and consumer sources unrelated to building codes) and nearly 30 tons are from fuel combustion.[11]

Fuel combustion is predominantly from using natural gas to heat buildings' air and water. Of the fuel combustion amount, about five tons come from commercial and institutional buildings, about two tons from industrial buildings, and about 22 tons – or roughly three-fourths – from residential build-

Area source emissions account for about one-third of winter emissions; heating air and water for buildings results primarily in nitrogen oxides (NOx).

Figure 1: Emissions by Source, Typical Winter Day, Davis, Salt Lake, Tooele, Utah and Weber Counties



Source: Utah Division of Air Quality.

ings.[12] These emissions are mostly nitrogen oxides (91% of the total area source NO_x), with volatile organic compounds and direct $PM_{2.5}$ making up the remainder.

On an annualized basis, about 69% of the fuel combustion pollutants along the Wasatch Front come from natural gas combustion, with much of the rest (28%) from burning wood.[13] And on an annualized basis, nearly 3% of overall Wasatch Front air pollution is due to residential and commercial natural gas combustion. During winter inversion periods, this is likely around 6%. The levels are far lower during warmer months. (Note that the Utah Division of Air Quality has calculated that 4.1% of annual and 8.6% of winter NOx emissions are from natural gas.)

The percentages for natural gas combustion seemingly represent a small portion of the Wasatch Front pollution problem. Several sources are larger contributors to the problem. These include on-highway gasoline vehicles, on-highway diesel vehicles, off-highway diesel vehicles, solvents, and forest-fire smoke. And winter woodsmoke is not far behind natural gas combustion.[14] (See the sidebar on this page.) In short, addressing air quality requires that Utah address multiple individual contributing sources with separate solutions in order to make a meaningful combined impact. When it comes to the fuel combustion slice of the pie, building code upgrades offer policymakers significant potential leverage.

It is important to note that, off the Wasatch Front, residential and commercial natural gas combustion results in a far smaller proportion of pollutants. On an annualized basis, they account for just over 1% of air pollution, being vastly overwhelmed by other factors, such as oil and gas operations in the Uintah Basin.[15] In fact, much of the state outside the Wasatch Front has less to worry about in terms of air pollution (except the winter ozone in the Uintah Basin, wintertime inversion pollution in Cache County and to a lesser extent other Utah valleys, and the summer ozone leaving the Wasatch Front for neighboring counties to the east). Furthermore, there are significant differences in heating requirements in different areas of the state because average winter temperatures vary. Compare St. George, for example, to Salt Lake City. As a result, the state is broken into different climate zones based on different needs. Similarly, building code provisions that may be important to Wasatch Front air quality do not necessarily apply with the same urgency to other parts of the state. This is a key consideration for policymakers. Does Utah's one-size-fits-all approach make sense? The State might explore whether varying approaches to building codes are appropriate.

WOOD BURNING

Most indoor wood stoves and outdoor bonfires during the winter months contribute to unnecessary air pollution. Wood smoke – while relatively uncommon when compared to other emissions sources – contributes a large portion of the winter particulate emissions.

The Division of Air Quality enforces no-burn days when air quality is poor or expected to be poor – typically during winter inversion periods. These no-burn requirements cover Box Elder, Cache, Davis, Salt Lake, Tooele, Utah and Weber counties. The Division's compliance officers monitor neighborhoods using infrared cameras to detect heat plumes from chimneys. Officers can assess $150 fines to households that violate the no-burn requirement.

In 2015, the Utah Air Quality Board and the Utah Division of Air Quality proposed a complete ban on wood burning from November 1 through March 15 of each year for counties which were categorized as nonattainment. With the possibility of a complete wood-burning ban during the winter months – which would have been the most stringent ban on wood burning in the country – strong opposition arose. Wood stove owners protested the additional heating costs they would bear and pointed out how such a ban would seriously devalue the thousands of dollars invested in installing wood stoves in their homes. Furthermore, woodstove manufacturers, distributors, and contractors would lose a substantial amount of their business.

In the face of such opposition, the Utah Division of Air Quality backed off their proposal for a complete ban on wood burning during the winter months, and Governor Herbert signed legislation making it illegal to implement a complete ban on wood burning. That said, there is room for Utah to step up its game in reducing woodsmoke emissions.

Sources:

- *Utah Foundation, Bringing Air Quality Home, February 2016, www.utahfoundation.org/wp-content/uploads/rr738.pdf.*
- *Department of Environmental Quality, https://deq.utah.gov/air-quality/mandatory-no-burn-days-stationary-source-compliance.*
- *Utah House Bill 396, Solid Fuel Burning Amendments, 2015 General Session, http://le.utah.gov/~2015/bills/static/ HB0396.html.*

BUILDING CODES AND AIR QUALITY

Building code regulations govern the construction, renovation and remodel of homes and businesses. In Utah, state government imposes a single code statewide. To build, renovate or remodel, a property owner or a general contractor pulls a permit from a local government. An inspector from that local government then ensures that the owner or contractor is following the state code.

Most building codes – including Utah's code – are based on a model code. The International Code Council publishes the commonly used International Building Code, the International Residential Code and the International Existing Building Code. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (known as ASHRAE) publishes a set of commonly used commercial-building focused standards. Building codes include energy efficiency requirements, such as insulation, building air sealing, sizing of heating and cooling equipment, and lighting efficiency. Each of these relates in some way to air quality. Since most homes and businesses in Utah use natural gas for area heating and water heaters, energy efficiencies in the building and the equipment would result in less need for natural gas, thus decreasing local emissions. This is the focus of the study. In addition, some homes and businesses use natural gas for cooking, clothes driers and otherwise. However, these are beyond the scope of this study.

It is important to note that local air quality is related to the energy efficiency included in building codes insofar as residential and commercial buildings use natural gas for heating air and water. If buildings use electric heat pumps instead of furnaces, those buildings' thermal envelopes do not matter in terms of local air quality. If buildings are using electric water heaters, the efficiency of those units and their related insulation have no effect on local air quality. However, thermal envelopes are perhaps more important in buildings with electric furnaces since the cost of using electricity can be higher than the cost of natural gas.

It should be noted that emissions due to energy produced from power plants farther afield may be of concern to those focused on greenhouse gases and climate impacts. This report, however, addresses the poor seasonal air in areas where the majority of Utahns live. Utah Foundation surveys show Utahns are far more concerned about air quality than climate change.[16] That said, improving air quality can have significant knock-on benefits in reducing greenhouse gas emissions.

Model Codes and Standards

Residential and commercial energy efficiency is covered by the International Code Council's International Energy Conservation Code – or IECC – which is published every three years, while ASHRAE also provides commercial energy efficiency standards, also published every three years.[17] Residential codes cover the construction of detached one- and two-family dwellings and multiple single-family dwellings – or townhomes – while commercial codes cover the construction of apartments and other buildings.

Under the IECC and ASHRAE, building codes have seen major improvements in efficiency.[18]

The latest residential IECC was issued in 2021. It is expected to yield large energy efficiency improvements.[19] The latest commercial IECC was also issued in 2021. It aligns closely with ASHRAE Standard 90.1-2019. As with the 2021 residential IECC, the 2021 commercial IECC and ASHRAE yield large energy efficiency increases. These efficiencies are explained in detail beginning on page 12.

Some version of the IECC has been adopted by 42 states for both residential and commercial buildings.[20] The remaining states provide "home rule" or "local control" to jurisdictions so that they may modify energy efficiency standards to their liking – as is the case in Colorado.[21] However, Colorado's 2022 General Assembly passed a law requiring local jurisdictions to adopt efficiency codes that are at least as efficient as the 2021 IECC by 2026 or be subject to the state's adopted code.[22] In Utah, local governments cannot require more than or allow less than what is set forth in the code approved by the Utah Legislature. Given Utah's varying pollution issues noted earlier, this might be something for the Utah Legislature to consider, perhaps as energy efficiency building code adoption moves its way through the Utah process.

The Building Code Adoption Process in Utah

Utah's Uniform Building Code Commission consists of 13 subject-matter experts and stakeholders appointed by the executive director of the Department of Commerce (though the licensed building inspector position is nominated by the Utah League of Cities and Towns). The nominees are approved by the Utah governor. Commission members have a wide range of expertise, from contractors and engineers to architects and building inspectors.[23] As of 2022, there is just one member from the general public who has no affiliation with the construction industry or real estate development industry. (There were two members from the general public before a recent legislative change). There is not a seat for an environmental advocacy representative, though an employee of Utah Clean Energy and former Uniform Building Code Commission member has actively participated in recent building code discussions.

The Commission's committees review building code specifics and other building matters to advise the full Commission.[24] The committees and Commission take a deep dive into building codes so that these particulars do not fall on the shoulders of the Utah Legislature. The work of the Mechanical Advisory Committee is most pertinent to energy efficiency and air quality.

The Mechanical Advisory Committee reviews the IECC model code. As with the other committees, the Mechanical Advisory Committee is reactive in that it responds to suggested code amendments provided by interested parties. Many amendments reviewed by the Mechanical Advisory Committee come from the Utah Home Builders Association – including about 50 amendments to the 2021 IECC model code. The committee reviews and then approves, rejects or amends the amendments. The Mechanical Advisory Committee then provides recommendations to the full Commission.

The Commission's meetings and public feedback aim to determine what it will recommend to the Utah Legislature. The Commission prepares a report and presents it to the Utah Legislature's Business and Labor Interim Subcommittee with its recommendations for adoption.[25] A bill from the Business and Labor Interim Subcommittee or from a legislative sponsor is then vetted and voted on by both bodies in the subsequent legislative session. The next Subcommittee review will take place in late 2022 to be voted on during the 2023 General Session.

The process is meant to provide Utah Legislators with the information they need to determine whether to adopt the newest building codes, including the updated energy efficiency code provisions. However, given the complexity of the codes, many will be forced to rely on lobbyists and their legislative colleagues for guidance on both adoption and further amendment. This report seeks to assist in decision making by pulling key information together in a manner that the broader public, policymakers and the press can easily understand.

UTAH CODE ADOPTION TIMELINE

2016 – The Utah Legislature adopts the 2015 IECC provisions for the commercial code and the 2015 IECC provisions for the residential code, with amendments.

2019 – The Utah Legislature adopts the 2018 IECC provisions for the commercial code but takes no action on the 2018 IECC for the residential code.

2021 – The Mechanical Advisory Committee begins its 2021 IECC review.

2022 (June) – The Mechanical Advisory Committee completes its 2021 IECC review, providing recommendation to the Uniform Building Code Commission.

2022 (July) – The Commission set its recommendations on the 2021 IECC.

2022 (August) – The Commission holds public hearings on its recommendations for the 2021 IECC.

2022 (September) – The Commissions will provide its recommendations for the 2021 IECC to the Business and Labor Interim Committee.

2023 (January-March) – The Utah Legislature will vote to approve, reject or amend the 2021 IECC.

Utah's Approach to Energy Efficiency in its Building Code

According to a 2013 report from the Pacific Northwest National Laboratory, Utah was considered an "aggressive" state in terms of energy efficiency code adoption for commercial buildings (one of only 14 states). The state nearly always accepted the newest IECC between 2003 and 2018 within one year of release (except the 2012 code which it approved two years later). Utah has most recently adopted the 2018 IECC for commercial buildings, along with the ASHRAE, section 90.1-2016.[26]

However, the state is considered "slow" for residential building code adoption (one of 20 states). While the Commission accepted the 2003 and 2006 IECC in 2004 and 2007, respectively, the Utah Legislature then made the Commission an advisory body, giving itself the final say in building code updates. (The Utah Home Builders Association lobbied to change the Commission from a code *adoption* body to a code *recommendation* body; the Association fought for the change because it did not like the fire sprinkler requirement or the large improvements in energy efficiency in the 2009 code.)

The Utah Legislature updated the 2009 IECC, but for the residential provisions it replaced the energy efficiency section with less-efficient 2006 IECC requirements.

The Utah Legislature did not adopt the residential provisions of the 2012 IECC model code, but in 2016 accepted the residential provisions of the 2015 IECC code with amendments. A key amendment to the 2015 code allows Utah builders to use a specific version of a software program allowing them to calculate compliance with energy codes. As a result, it is possible for Utah builders to use the state-approved REScheck program based on older 2012 IECC standards that includes a cost-effective equipment trade-off to comply with Utah code.[27] This approach will result in less energy efficiency for the lifespan of some buildings. (See the sidebar on this page.)

Many Utah builders use the less-energy-efficient approach. However, others comply using more current standards or by directly adhering to the specifics in the Utah code. And others far surpass the code, targeting consumer interest in high efficiency that can result in utility bill savings for residents and lower emissions for communities.

THE LOOPHOLE IN UTAH BUILDING CODES

Builders may comply with the Utah Code using two main approaches: prescriptive or performance. The prescriptive path requires builders to follow the specifics of each part of the energy efficiency code, such as building walls with the code's prescribed amount of insulation and using windows that have the code's prescribed efficiency. The performance paths allow builders to meet an overall energy efficiency target, where one builder might use more wall insulation but lower window efficiency, while another builder might use better windows but a bit less wall insulation. They choose these particular methods because of personal preference and cost effectiveness, as long as they meet the building's overall performance requirement.

There are several performance paths recommended by the International Code Council. Utah Code includes an additional performance path: 2012 REScheck. The 2012 REScheck software includes a trade-off that allows builders to upgrade mechanical systems in exchange for less-than-code standards on air tightness and insulation. For example, a builder might opt for a high-efficiency furnace but have wall insulation that is far below current efficiency recommendations. This trade-off is not recommended in newer standards because, while furnaces wear out and are updated throughout the life of a home, exterior walls typically remain unchanged. This mechanical trade-off is seen as a loophole; it is no longer part of IECC standards. In effect, it allows builders to build to an outdated standard.

The Utah Legislature created a requirement to improve upon the 2012 REScheck software by requiring a higher calculation for energy efficiency, increasing efficiency requirements over the 2012 REScheck by 3% in 2017 to 5% in 2021. While the loophole has gotten smaller, it remains in place. The Responsible Energy Code Alliance suggests that Utah is the only state that fully allows the mechanical trade-off loophole.

Given that the Federal Register requires only three iterations of REScheck, the 2012 version could be eliminated now that the 2021 version has been added to the list of existing versions. This would effectively close the loophole by disallowing Utah builders access to the mechanical trade-off.

Sources:

- *Utah Mechanical Advisory Committee.*
- *Utah Code, Title 15A, Chapter 3, Part 7, Section 701 https://le.utah.gov/xcode/Title15A/Chapter3/15A-3-S701.html.*
- *A representative of the Responsible Energy Code Alliance.*
- *Energy.gov, REScheck, www.energycodes.gov/rescheck.*
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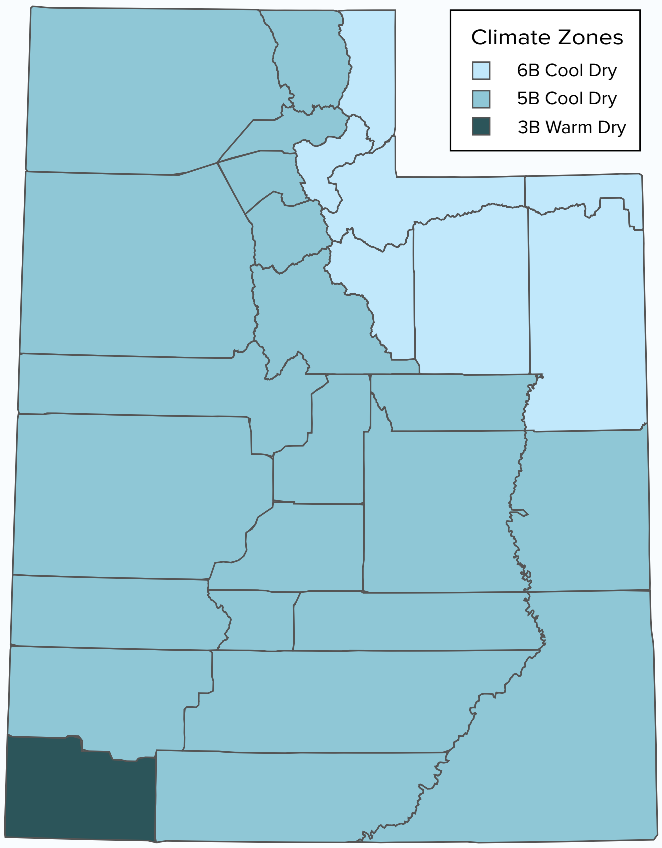
- *US Government Printing Office, Federal Register, 15112, Vol. 79, No. 52, March 18, 2014.*
- *Pacific Northwest National Laboratory, Building Energy Codes Program: National Benefits Assessment, 1992-2040, pp. 3.14-3.15 and 4.9-4.12, www.greenbuildinglawblog.com/uploads/file/DOE%20Building%20Energy%20Code%20Savings%20Report%20Oct%202013(1).pdf.*
- *Energy.gov, Status of State Energy Code Adoption, www.energycodes.gov/status/commercial and www.energycodes.gov/status/residential.*

BUILDING CODE ENERGY EFFICIENCY CONCEPTS

Building codes are complex. The same is true for the energy efficiency portion of those codes. There are at least four important concepts to understand within to fully grasp how these codes are related to air quality. It is important to understand Utah's climate zones and the three general areas regarding efficiency: air tightness of construction, insulation and holding heat, and equipment.

Building codes are specific to an area's climate; Utah has three zones.

Figure 2: Climate Zones in Utah



Source: PNNL.

Climate Zones

Climate zones are a categorization of each county in the U.S. from which to determine how to apply the building codes. For example, a hot and dry zone may need a different building-efficiency requirement than a cold humid one.

Utah has three zones: two that are cool and dry (6B and 5B) and one that is hot and dry (3B for Washington County in the southwest corner of the state). (See Figure 2.) The higher the number the cooler the zone, while an A is humid, a B is dry, and a C is "marine." The climate zone map was recently updated, removing Box Elder and Cache counties from the "cool dry" 6B zone to the slightly warmer "cool dry" 5B zone.[28,29]

Air Tightness Construction

The "tightness" of the building increases its energy efficiency, and in turn can result in a lower dependence on the furnace – decreasing air pollution emissions. A tight home is related to the construction and materials that make up the bottom floor, exterior walls and top-level ceiling, as well as the windows, doors and vents around the home.

The tightness of a home envelope is measured by air changes per hour – the number of times per hour that air enters a room and is mixed and exchanged with air from inside. This air exchange can be passive ventilation (such as through windows, doors and vents) or active ventilation (such as heating, air conditioning and mechanical ventilation systems). One air exchange does not completely replace all the air in your house, but some stays and lingers – particularly in rooms with fewer windows and those without exterior doors. When running a blower to pressurize a home, conventional homes have between four and 10 air changes per hour, while an efficient home might have 2.5 air changes per hour. It is important not to have too few air exchanges in order to maintain good air quality, but not too many air exchanges or the home will have low energy efficiency.

Insulation and Holding Heat

While air is constantly being circulated in and out of buildings, an important part of energy efficiency is how well a home building holds heat. Insulation is an important aspect of this, as are the construction and layout of window and doors.

Ceiling and wall insulation provide heat-holding aspects, as well as supporting a space's envelope. The basement walls and concrete slab are also important.

HIGHER STANDARDS FOR STATE BUILDINGS

In addition to following commercial buildings codes, Utah's Division of Facilities Construction and Management sets special, higher standards for state government buildings.

The Division's High Performance Building Standard is a self-authored code based on other standards to be used when constructing buildings with an expected life of 50 years or more. It applies to all state-funded projects. Used to improve performance and decrease total cost of ownership, the intent is to save the taxpayer dollars in the long run throughout the life cycle of the building. It includes performance requirements (how efficient the structures must be) as well as process requirements (how to build the structures).

The first version of the Standard was drafted in 2015 and fully adopted in 2017. With four years of lessons learn, the Standard was updated in 2021.

The 2021 Standard focuses on delivering "high performance, low cost of operation" buildings by deploying an energy use intensity performance target provided by the Division. The major efficiency change in the 2021 Standard provides energy modeling with a tool designed to achieve energy use intensity less than or equal to the Outcome Based Performance Target; this is based on a post-occupancy measured performance or 15% improvement over Utah's current commercial code (ASHRAE 2016). The performance-based energy target aims to provide low-cost approaches to measurably increase building performance as a model for more energy efficiency across the state.

A deeper analysis of the Division's requirements is outside the scope of this study.

Note: The energy use intensity (EUI) target is equivalent to a mile per gallon target in automobiles. Energy use intensity is calculated in 1,000 BTUs per square foot per year, by type of building, such as a university building, a government office, a post office, a dormitory or a vehicle storage building. (BTU, or British thermal unit, is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. It is roughly equal to a one therm.)

Sources:

- *Utah's Division of Facilities Construction, https://dfcm.utah.gov/energy-efficiency-program/high-performance-building-standard/ at 10:25, 24:00 and elsewhere.*
- *Utah's Division of Facilities Construction and Management, Design Requirements, February 2, 2021, pp. 51-52. See 5.5.2 B.1 and C.4.*
- *ANSI/ASHRAE/IESNA Standard 90.1-2016 Section 4.2.1.1 and Appendix G.*
- *Nexant, Nexant Helps Develop Utah's High Performance Building Standard, March 18, 2021, www.prnewswire.com/news-releases/nexant-helps-develop-utahs-high-performance-building-standard-301250390.html.*

Heat-holding and envelope is measured by U-factor and R-value. The R-value is simply a material rating that measures the resistance of such material to heat; the higher the rating, the better it is at reducing the transfer of heat – either into the space in the summer or out of the space in the winter. U-factor is the measure of heat loss or gain based on the various construction materials used in a home; the lower number, the less heat loss or gain occurs.

Equipment

There are several pieces of equipment that are important for the energy efficiency of a building. Perhaps the most important aspect in Utah is the home heating, ventilation and air conditioning (HVAC) system. The "tightness" of the system's ducts is also important, as are duct insulation and placement. For instance, if a HVAC system has ducts in an attic space that is hot in the summer and cold in the winter, the system will be less efficient.

In addition, water heater efficiency is important, as are other appliances. Efficiency lowers natural gas usage or electricity usage, depending on the appliance type.

Finally, lighting efficiency and controls affect the overall energy efficiency of a building in terms of electricity usage.

HERS INDEX

The HERS Index – or Home Energy Rating System Index – is used to measure a home's energy efficiency. The lower the rating, the less energy the home will consume. This is based on all aspects of efficiency, including the envelope, insulation and equipment. Some think of the HERS like a mile-per-gallon rating.

A 100 on the scale is a typical home built to the 2006 IECC standard. A 130 on the index would be 30% less efficient, using 30% more energy. A 70 is a home built to the 2018 IECC standard – which is 30% more energy efficient.

The "Energy Rating Index" compliance path of the IECC is very similar to giving a home a HERS Rating. The ERI a more flexible way to meet the IECC than using the prescriptive approach. It is similar to REScheck as included in the Utah Code, but without the mechanical trade-off loophole.

Sources:

- *Pacific Northwest National Laboratory, Identification of RESNET HERS Index Values Corresponding to Minimal Compliance with the IECC Performance Path, May 2014, www.energycodes.gov/sites/default/files/2019-09/HERSandIECCPerformancePath_TechnicalReport.pdf.*
- *ICC, 2021 International Energy Conservation Code, Chapter 4, https://codes.iccsafe.org/content/IECC2021P2/chapter-4-re-residential-energy-efficiency#IECC2021P2_RE_Ch04_SecR406.*

UNDERSTANDING THE COSTS AND BENEFITS OF CODE UPDATES

Increasing a building's energy efficiency often comes with a higher upfront construction cost (though not always; see the PNNL Commercial Study subsection on page 15). The upfront cost is typically the key issue of debate when discussing building code updates since homes built to the newest building codes are inherently more expensive than their less-efficient counterparts. For example, higher quality appliances and windows would constitute a larger burden at the point of purchase. However, the cost savings on these efficiency improvements help pay the initial cost over time. This cost effectiveness comes from a decrease in monthly utility payments.

There are several ways of looking at costs:

- Simple Payback Period: This is the number of years for energy cost savings to exceed the added building costs. This is initial cost divided by annual costs – without taking into account household mortgages, inflation, and changes in fuel prices – resulting in the years needed to pay back the initial cost. Builders often look at simple payback period to estimate cost effectiveness.
- Consumer Cash Flow: This is the difference between energy costs and increased mortgage payment from added building costs.
- Life-Cycle Cost: This is a project's 30-year cost savings, taking into account the energy savings, mortgage payment costs and tax implications. The U.S. Department of Energy uses life-cycle cost to determine whether code recommendations are economically justified, where a life-cycle cost of less than $0 is cost effective in that benefits exceed costs over the period.[30]

When building codes are produced, they include items packaged together (like insulation and fenestration), which may not necessarily be cost effective for each individual item, but are cost effective as a package using life-cycle cost analysis.[31] In addition to these costs and benefits, there are other societal benefits that many stakeholders consider:

- Emissions: The heart of efficiency, energy code changes aim for lower energy use. Lower energy use results in lower emissions – both air pollution and greenhouse gases.
- Employment: Energy efficiency can generate jobs. This includes a direct employment increase for the efficient construction of new homes. Also, researchers include the indirect employment created from a reduction in energy costs, which savings may stimulate the economy in other ways. The Utah Foundation's 2021 report *Going for the Green: How Utah Can Thrive in the New Climate Economy* explored these issues in depth.[32]

Arguments for Updating Codes

Support for efficient building practices come from several areas. Environmental groups support the adoption of the current standard to manage air pollution and greenhouse gas emissions.[33] But they also tout the ancillary benefits of lower utility payments for residents and overall economic benefits.

Business groups may also support current standard adoption. As part of their public policy priorities agenda, the Salt Lake Chamber states that they "support targeted building standards that are more energy-efficient and improve air quality" as part of a broader effort to improve Utah's air quality.[34]

Finally, as part of the state's 2014 *Utah Energy Efficiency & Conservation Plan: Preparing for Utah's Energy Future*, a state Building Team Committee provided several energy efficiency and conservation recommendations, including that the state "adopt current and future energy codes."[35]

Arguments Against Updating Codes

The Utah Home Builders Association suggests that new homes are not the problem, since they are responsible for only a small proportion of overall emissions. The Association suggests instead targeting older homes with retrofits. They are also concerned about the increased cost of new homes over the past decade, suggesting that it would be improper to add additional cost from energy efficiencies.[36] Builders also fear of overreach in the code, such as requiring specific appliances.

Some have suggested that improvements pit sustainability against affordability. Instead, they suggest that the government should incentivize builders to become more efficient, either directly through state incentives or by providing utilities with greater flexibility in offering incentives. They also suggest focusing on programs designed to retrofit older homes that suffer from the greatest inefficiencies.

WEATHERIZATION

Utah receives federal Weatherization Assistance Program funding from the Department of Energy to install energy efficiency retrofits to lower-income Utahns households (up to 200% of the federal poverty level). Over its 45-year lifetime, the program has weatherized 52,413 units serving an estimated 157,239 individuals.

Most recently, the federal government allocated $31.7 million to Utah over five years in the Infrastructure Investment and Jobs Act that Congress passed in the fall of 2021. The Utah Office of Housing and Community Development allocates $7-8 million per year to sub-grantees.

Approximately 75 full-time sub-grantees – trained through the Intermountain Weatherization Training Center – weatherize Utahns homes. Homeowners receive the Weatherization upgrades at no cost, while renters' landlords may need pay a portion of the costs. Participating households average nearly 35% in savings, or approximately $583 per year, after the completion of weatherization improvements.

Weatherization is a big deal in terms of air quality. When looking at the inventory of housing in Utah, only about 15% were built within the past decade. About half of homes were built before 1990. These, particularly those built before 1960, are relatively very inefficient. Homes built before 1960 were originally built with an estimated HERS of 300 – or three-times less efficient than homes built to IECC 2006. Though some of these would have already been retrofitted with better insulation, windows, doors, and other energy efficiency measures, and nearly all would have some newer, more-efficient heating systems and water heaters than were originally installed.

Source: Utah Office of Energy Development, Utah Energy and Innovation Plan, https://energy.utah.gov/plan/.

THE LATEST RECOMMENDED CODE

The main energy efficiency code for discussion by the Uniform Building Code Commission and the Utah Legislature is the IECC 2021. The IECC 2021 seeks to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."[37]

There are six major differences between Utah's current code – the residential 2015 IECC, as amended – and the 2021 IECC.[38]

1. Compliance Paths. The 2021 IECC clarifies and names the four compliance paths: Prescriptive, Total Building Performance, Energy Rating Index, and Tropical Climate Region.[39] For Utah, only the first three are appliable.

The prescriptive path might be considered simpler since a builder follows the code guidance for each part of the building process. This path simply requires builders to meet the minimum standard of each of the energy-efficiency measures, such at a minimum amount of wall insulation or a maximum amount of heat exchange through installed windows.

Each of the performance paths require either an energy rater or modelling software. For instance, using REM/Rate (not to be confused with REScheck), a builder needs to meet an Energy Rating Index – which is like the HERS score – where 100 is equal to a 2006 IECC and 0 is a net-zero home.[40] Performance and ERI paths allow for more builder flexibility in findings more cost-effective ways to achieve the same level of performance as the prescriptive path.[41] The performance paths are similar to the REScheck method allowed in current Utah code, though the 2021 IECC performance paths do not allow for the REScheck mechanical trade-off loophole which allows for builders to upgrade mechanical systems in exchange for less-than-code thermal envelope and insulation measures.

With the 2021 IECC, where there are numerous energy-efficient prescriptive path changes, there are also Total Building Performance and Energy Rating Index compliance path changes, such as reducing the ERI target scores.[42] In addition, the 2021 IECC places a cap on the amount of available onsite renewable energy that can be applied to support the performance path targets.[43]

2. Energy Efficiency Packages. Second, there is a new "Additional Energy Efficiency Package Options" section in the 2021 IECC. This gives credit to builders for using common high-efficiency strategies.[44] The four options are:

- HVAC option – requires an efficient furnace and air conditioner and/or an efficient heat pump (for combined heating and cooling).
- Water heater option – requires an efficient water heater.
- Envelope and ventilation option – requires 3.0 air exchanges per hour with an efficient ventilation system.
- Duct option – requires efficient ductwork, such as insuring that 100% of the ducts are placed within the thermal envelope (not in an uninsulated attic or other areas).

The IECC 2021 seeks to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

The new code sees several building envelope improvements.

Figure 3: Insulation and Minimum R-Values and Fenestration Requirements for the 2021 IECC, and changes from the 2018 IECC

Climate zone	Window & door U-factors	Window & door SHGC*	Ceiling R-value	Frame wall R-value	Floor R-value	Basement wall R-value*	Slab R-value and depth
3B (Wash. Co.)	~~0.32~~ 0.30	0.25	~~38~~ 49	20	19	5/19	0 10, 2ft
5B (most of Utah)	0.3	~~NR~~ 0.40	~~49~~ 60	~~20~~ 20+5	30	15/19	~~10, 2ft~~ 10, 4ft
6B (northern Utah)	0.3	NR	~~49~~ 60	20+5	30	15/19	10, 4ft

** Solar Heat Gain Co-efficient.*

Note: Skylight U-factor, mass wall R-value and crawlspace wall R-value are removed from the table; there are no changes.

Source: ICF.

3. Envelope and insulation. Third, there are efficiency gains in prescriptive path related to the thermal envelope. (See Figure 3.) These gains include the following:

- Window and door efficiency (fenestration U-factor) was improved for climate zone 3. Further, the minimum window and door efficiency of an area was improved in all climate zones, along with the addition of a maximum solar heat gain in climate zone 5.[45]
- Ceiling insulation was increased in each of Utah's climate zones.[46]
- The energy efficiency of wood frame insulation was increased in Utah's climate zone 5.[47]
- The energy efficiency and depth of slab edge insulation were increased in climate zones 5, and slab edge insulation is now required in climate zone 3.[48]
- A whole house pressure test and field verification are required for a lower air leakage rate.[49]

The 2021 code provides builders with more insulation options, such as the allowance for all interior insulation or a mix of interior and exterior insulation.

4. Ducts. Fourth, there are efficiency gains in the prescriptive provisions related to HVAC ducting.[50] Ducts account for a large decrease in home efficiency. Duct testing is now required for ducts in air-conditioned space; the duct testing exemption for ducts in air-conditioned space was removed. [51] In addition, the code lowers duct leakage rate, it requires mechanical ventilation systems to be tested and verified, and requires improvements in fan efficacy for ventilation fans and air handlers.[52]

5. Net Zero Guidance. Fifth, the new code includes a voluntary Zero Energy appendix to support zero energy residential construction.[53]

6. Lighting. Finally, there are efficiency gains in prescriptive path for lighting, though these are not related to the local air quality considerations discussed in this report.[54]

It is important to note that most of these updates to the 2021 IECC – even if adopted by the Utah Legislature – would not be applicable to much of the new construction in Utah. The 2021 IECC has many energy efficiency improvements over what is required under Utah's REScheck compliance path. (See the sidebar on page 7.) But given the Utah code allowance for using REScheck – which may remain in Utah Code – many builders in the state would likely continue using REScheck as their preferred code compliance method. This would result in newly constructed homes that are not built to the energy efficiency standards laid out in the 2021 IECC. Utah's current residential code is an estimated 29% less energy efficient than the newest model code.[55]

ELECTRIC BUILDINGS

One approach to reducing local building emissions is to use electricity instead of natural gas furnaces and water heaters.

Utah Clean Energy submitted an electric-ready amendment of the 2021 IECC to the Uniform Building Code Commission. This would have required that all new residential low-rise multifamily homes include the ability easily swap out all natural gas appliances, as well as suppling garages with the necessary electrical outlets needed to quickly charge electric vehicles. Utah Clean Energy suggests that providing buildings with electric readiness up front is much less expensive than retrofitting buildings later. During 2022, after receiving a positive recommendation from Utah's Mechanical Advisory Committee, Utah's Uniform Building Code Commission voted to "table" the proposal over a concern about it making policy decisions and members' general opposition to government mandates.

Moving beyond this electric-ready approach, at least one Utah developer is building 100% electric apartments, many of which are affordable to households earning between 25% and 80% of the area median income. Further, the Redevelopment Agency of Salt Lake City now requires new construction projects funded at $900,000 or more to be completely electric.

But are electric buildings cost-effective? It depends. An analysis of 20-year total cost of ownership (capital and operating costs) of buildings at the University of Utah found that residential buildings would cost about 30% less (due to capital costs) while academic, laboratory and hospital buildings would be similar (from a savings of 1% to a premium of 5%).

Another study looked at the economics of new residential construction throughout Utah compares all-electric with the typical electric and natural gas configuration in all three of Utah's climate zones. Over a 15-year life-cycle cost period, the combined upfront costs and energy bills are estimated to be lower for low-rise multi-family and single-family homes in all climate zones. The savings were greater for multi-family units. It is important to note that the comparison was for 80% efficiency natural gas furnaces, while many builders are using higher efficiency units – 90% or greater; in terms of energy costs, all-electric homes would have a difficult time competing with homes that use high-efficiency natural gas furnaces.

It will be interesting to see in the coming years whether upgrades in electric and consumer preferences drive a move toward all-electric.

Sources:

- *Salt Lake City, SLCgreen blog, Salt Lake City RDA Passes Aggressive Air Pollution Reduction Policy for new RDA-funded Buildings, December 15, 2021, https://slcgreenblog.com/2021/12/15/rda-sustainability-policy/.*
- *Redevelopment Agency of Salt Lake City, Sustainable Development Policy, https://slcrda.com/wp-content/uploads/2021/12/Sustainable-Development-Policy-FINAL.pdf.*
- *PointEnergy Innovations, Final Report: University of Utah Low Emissions Feasibility Study, February 28, 2020.*
- *Energy+Environmental Economics, The Economics of All-Electric New Construction in Utah An evaluation of residential new construction costs and energy bill impacts for single-family and low-rise multifamily properties across the state, February 2022, www.ethree.com/wp-content/uploads/2022/02/Economics-of-All-Electric-New-Construction-in-Utah-02.2022.pdf.*

COSTS AND BENEFITS OF THE LATEST RECOMMENDED CODE

Studies Overview

This report explores five studies for commercial and residential cost/benefit tradeoffs of updating to the newest building code standard:

- Cost-Effectiveness of ANSI/ASHRAE/IES Standard 90.1-2019 for Utah – PNNL
- IECC Code Comparison Study – Nexant
- Cost-Effectiveness of the 2021 IECC for Residential Buildings in Utah – PNNL
- 2021 IECC Residential Cost Effectiveness Analysis – Home Innovation Research Labs
- 2021 IECC Residential Cost Effectiveness Analysis – ICF

The first three studies compare current Utah code with the most recent energy efficient standard. The first of them focuses on commercial buildings while the second two focus on residential buildings. The final two on the list are national studies of the updates from the 2018 residential IECC to the 2021 residential IECC. While national in scope, these studies help inform the discussion by providing a more granular assessment of the building code changes on a cost/benefit basis. It is important to note that the two nationally focused studies (the Labs and ICF studies) do not take into account the Utah's amendments to the 2015 IECC or the modest energy efficiency improvements from the 2015 IECC to the 2018 IECC. Further, none of the studies' analyses are based on Utah's commonly used REScheck compliance method.[56] As such, all understate the energy-efficiency improvements and commensurate air quality improvements that would occur in Utah under a full implementation of the 2021 IECC standards.

Studies' Findings Overview

The PNNL study of Utah commercial buildings shows clear improvement in efficiency – and commensurate air quality – as well as cost savings, both in initial construction savings and utility savings. While the initial construction result seems counterintuitive, the envelope efficiency costs are lower than the savings gained from a decrease in HVAC costs.

Residential changes show mixed results across the four studies included in this report. Three show substantial cost savings, while one does not. However, the outlier seems to have methodological errors. (See the sidebar on page 19.)

All the studies show the air quality benefit of 2021 IECC adoption – either directly or implicitly – through the decreased use of natural gas from energy-efficiency improvements.

PNNL Commercial Study

The U.S. Department of Energy commissioned the Pacific Northwest National Laboratory to perform a commercial study, released in July 2021, to look at the life-cycle cost savings and simple payback for each of Utah's climate zones.[57] It compared Utah's current ASHRAE Standard 90.1-2016 to the newest Standard 90.1-2019.

The report shows an average life-cycle cost savings of $3.51 per square foot for publicly owned buildings and $3.07 per square foot for privately owned buildings. This savings is the result of a decrease in average construction costs of $1.068 per square foot and an annual utility savings of $0.042 per square foot.

The decrease in construction costs is due in part to a change in lighting requirements, but the big savings come from heating, ventilating and air-conditioning (HVAC) changes.[58] Due to the improved building envelope and other measures, smaller HVAC systems are required to maintain heating and cooling. The estimated cost savings from these HVAC systems is greater than the amounts spent on improving the building envelope.

The cost of a small hotel was estimated to see an increase in construction costs per square foot, though mid-rise apartments saw a small savings and offices, retail space and schools saw large savings. As a result, the simple payback was immediate for all buildings in all climate zones except for small hotels, which averaged a simple payback of 9.6 years.[59]

The report shows that nearly all of the savings in emissions are from natural gas usage reduction – the portion pertaining to local air quality.[60] These improvements result in an estimated savings in energy costs and emissions, as shown in Figure 4, with a reduction of nitrogen oxide emissions by over five tons in the first year – as well as reductions in sulfur oxide emission.

In addition, this study included an estimated economic benefit in terms of an increase in employment under the updated code. The study points to two benefits: 1) a reduction in utility bills, with savings to be spent elsewhere, and 2) lower construction costs, resulting in an increase in construction-related activities elsewhere.

Commercial code updates result in significant benefits.

Figure 4: Societal Benefits of ASHRAE Standard 90.1-2019

Utah's Statewide Impact	First Year	30 Years Cumulative
Energy cost savings*	$608,200	$263,000,000
Air emissions reduction (metric tons)		
Nitrogen oxides (NOx)	5	3,748
Sulfur oxides (SOx)	3	2,377
Carbon dioxide (CO_2)	7,603	5,352,000
Employment		
Jobs from reduction in utility bills	57	1,809
Jobs from increase in construct activities	160	5,092

** 2020 dollars.*

Source: PNNL.

Residential code updates result in significant savings, with an 11-year payback in Utah.

Figure 5: Overview of Residential Cost Savings and Payback (Compared to the 2015 IECC)

Climate Zone	Life-Cycle Cost Savings	Simple Payback
3B (Washington County)	$3,671	10.6 years
5B (most of Utah)	$5,902	11.1 years
6B (northern Utah)	$5,739	7.7 years
State average	$5,783	10.9 years

Source: PNNL.

Utah residential code updates show energy cost savings on average of $325 per year, or about 16%.

Figure 6: Total First Year Energy Cost Savings, Utah (Compared to the 2015 IECC)

Climate Zone	Energy Cost Savings	Energy Cost Savings
3B (Washington County)	$224	13%
5B (most of Utah)	$332	17%
6B (northern Utah)	$228	15%
State average	$325	16%

** State average is weighted by population in each climate zone.*

Source: PNNL.

PNNL Residential Study

The U.S. Department of Energy commissioned the Pacific Northwest National Laboratory to perform a residential study, released in July 2021, to look at life-cycle cost savings and simple payback for each of Utah's climate zones. It compared Utah's current code with the 2021 IECC.

The report showed a life-cycle (30-year) cost savings for the average Utah home of $5,783 by following the 2021 IECC, ranging from $3,671 to $5,902 depending on the climate zone. Simple payback averaged 10.9 years. (See Figure 5.)

PNNL notes that there is a small incremental cost for each of the code change improvements. These costs result in an estimated energy cost savings in natural gas and electricity of $325 per year, or between $224 and $332 depending upon the Utah climate zone. This results in a state average energy use reduction of 16.4%. (See Figure 6.)

This study shows that updating the building code would create a positive cash flow for homebuyers in three years on average after accounting for increased down payment and mortgage costs minus annual energy savings – though Utahns in climate zone 6B would see a positive cash flow in two years.

Like PNNL's commercial study, the report shows that most of the savings in emissions are from natural gas usage reduction.[61] These improvements resulted in an estimated savings in energy costs by type of energy usage – about a one-quarter decrease in heating costs and about one-half decrease in water heating. (See Figure 7.)

Heating and other systems show significant energy cost savings under residential code updates.

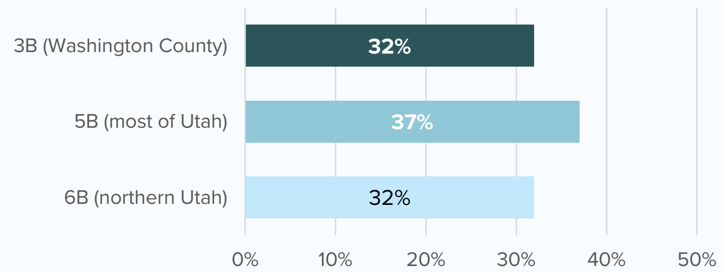
Figure 7: Percent Savings by Fuel Type and System Type (Compared to the 2015 IECC)

Climate Zone	Natural Gas		Electricity					Total
	Heating	Water heating	Cooling	Lighting	Fans	Vents	Other	
3B (Wash. Co.)	24%	53%	13%	13%	16%	50%	1%	13%
5B (most of Utah)	32%	50%	12%	13%	19%	50%	1%	17%
6B (northern Utah)	25%	49%	9%	13%	11%	50%	1%	15%

Source: PNNL. Utah Foundation calculations.

Homeowners with homes built to 2021 standards could expect to see a one-third decrease in natural gas usage and commensurate local emissions reductions.

Figure 8: Percent Decrease in Natural Gas Usage – and Local Emissions Reduction (Compared to the 2015 IECC)



Note: For homes with natural gas usage for heating and water heating, only.

Source: PNNL. Utah Foundation calculations.

The Utah Foundation used the PNNL data in Figure 7 to calculate the reduction in natural gas usage overall and extrapolated the equivalent decrease in emissions. This works out to a one-third decrease in each new Utah home's emissions, from 32% in climate zones 3B and 6B to a decrease of 37% in climate zone 5B. (See Figure 8.)

The report showed a reduction in nitrogen oxide emissions of nearly 14 tons in the first year. In addition, the study included an estimated economy benefit in terms of an increase in employment under the updated code. The study points to two benefits: 1) a reduction in utility bills, with savings to be spent elsewhere, and 2) lower construction costs (due to energy efficient building savings), resulting in an increase in construction-related activities. (See Figure 9.)

Utah residential code updates show substantial savings and benefits over time.

Figure 9: Societal Benefits of IECC 2021 (Compared to the 2015 IECC)

Utah's Statewide Impact	First Year	30 Years Cumulative
Energy cost savings*	$2,208,000	$771,800,000
Air emissions reduction (metric tons)		
Nitrogen oxides (NOx)	14	6,666
Carbon dioxide (CO_2)	18,740	9,141,000
Employment		
Jobs from reduction in utility bills	57	1,809
Jobs from increase in construct activities	160	5,092

** 2020 dollars.*

Source: PNNL.

Nexant Study

In July 2021, Nexant released a study looking at the difference between Utah's current code and the IECC 2021 for Utah's climate zone 5B (which is the vast majority of homes in the state).[62] Unlike the PNNL residential study, the Nexant study included a comparison using

Updating Utah's building code would result in utilities savings from HVAC and lighting.

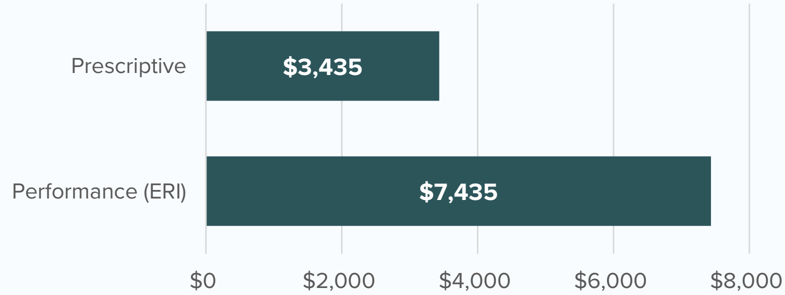
Figure 10: Utility Cost Savings of Shift from IECC 2015 to IECC 2021 (Compared to the 2015 IECC)

	Current Utah code - prescriptive	IECC 2021 - prescriptive		IECC 2021 - performance (ERI)	
	Cost	Cost	Savings	Cost	Savings
Heating	$365	$297	19%	$271	26%
Cooling	$151	$148	2%	$126	17%
Ducts	$152	$152	0%	$90	41%
Lighting	$564	$539	4%	$539	4%
Total	$1,232	$1,136	8%	$1,026	17%

Source: Nexant.

Utah homeowners could see a life-cycle cost savings of up to nearly $7,500 under the 2021 building code.

Figure 11: Life-Cycle Cost Savings of Shift from IECC 2015 to IECC 2021



Source: Nexant.

two compliances paths: the prescriptive (as was used in the PNNL study) and the Energy Rating Index performance path. The study compares each to the 2015 prescriptive path.

The study found a natural gas savings of almost 12% for the 2021 prescriptive path and 25% for the ERI performance path. The study found an electricity savings of nearly 5% over the 2021 prescriptive path and more than 10% over the performance path. This results in a total utility savings of $96 and $206, respectively, per year, for most Utah homeowners.

This results in a life-cycle cost savings of $3,435 for the prescriptive path and $7,435 for the performance path over a 30-year mortgage. (See Figure 11.)

The study shows that the percentage savings in natural gas costs leads to a similar emissions reduction: between 7% and 15% in nitrogen oxide decrease depending upon the path (prescriptive or ERI performance approach). This would be and even greater decrease over the REScheck approach

Similarly, the report looked at the future decrease in carbon dioxide emissions over 10 years. The report estimates a savings of 0.6 million tons of carbon dioxide with the 2021 prescriptive path and over 1.2 million tons with the 2021 performance path.[63]

Nitrogen oxide emissions decrease by up to 15% under the 2021 code (over the 2015 prescriptive approach)

Figure 12: Emissions Reduction of Shift from IECC 2015 to IECC 2021, Prescriptive and Performance/ERI Paths

	Current Utah code - prescriptive	**IECC 2021 - prescriptive**		**IECC 2021 - performance (ERI)**	
	Emissions	Emissions	Savings	Emissions	Savings
Nitrogen oxides*	29	27	7%	25	15%
Sulfur dioxide*	8	7	5%	7	10%
Carbon dioxide**	10	9	8%	9	16%

** Pounds per year.*

*** Tons per year.*

Source: Nexant.

CHECKING THE MATH OF THE HOME INNOVATION RESEARCH LABS STUDY

ICF – a global consulting and digital services company – "checked the math" of the Home Innovation Research Labs study. It did this by mirroring the report, though ICF added a life-cycle cost savings whereas Labs relied only on a simple payback approach. Afterwards, ICF – in a separate comparison report – showed numerous concerns and issues with the Home Innovation Research Labs report.

First, the Labs report stated that it applied a gross profit margin of 19% to all costs. That is higher than historical average. Furthermore, the Labs analysis instead applied a 24% margin – not the stated 19%. ICF used the historical average of 17.5% for its study.

Additionally, the ICF study revised six code changes to $0 in incremental cost. These totaled $2,376 in the Labs report. ICF determined the six code changes to be "administrative with negligible incremental effort," "already met in practice based on existing code requirements or market conditions," and "clarifications to exiting requirements, not new requirements."

ICF also revised cost estimates. The ICF estimates were often lower than the Labs' – and in-line with estimates from a national Pacific Northwest National Laboratory residential study. The Labs report was often two-to-three times higher than other estimates. IFC also found several other methodological issues.*

Given these apparent flaws, the ICF report appears to be more reliable.

** Other issues with the methodology are: simplistic economic metrics; costs included for code changes that save energy but not modeled; outlier energy saving estimates; weighting factors and permutations; annual energy use/costs errors; dimmer quantity error; duct option analysis omits some foundation types; misleading cost effectiveness of additional efficiency package options.*

Source: ICF, Comparison of 2021 IECC Residential Cost Effectiveness Analyses, 2022, https://energyefficientcodes.org/wp-content/uploads/2022/05/ICF-2021-IECC-Cost-effectiveness-Analysis.pdf.

2021 IECC Residential Cost Effectiveness Analysis: Home Innovation Research Labs

The National Association of Homebuilders (NAHB) commissioned Home Innovation Research Labs (formerly NAHB Research) to conduct a cost analysis of the 2021 IECC.[64] The NAHB's Labs study looked at energy use savings and simple payback using the prescriptive compliance option. It compared the 2018 IECC with the 2021 IECC.

The Labs study found that:

- Incremental construction cost ranges from $6,548 to $9,301 depending on the additional efficiency package option selected for compliance.
- Energy use cost savings ranges from 6.4% to 11.6% depending on the additional efficiency package option selected for compliance.
- Simple payback for complying with the 2021 IECC ranges from 32 years to 67 years.

These findings have been disputed for methodological issues.[65] See the sidebar.

2021 IECC Residential Cost Effectiveness Analysis - ICF

The IFC study looked at life-cycle cost savings and simple payback for each of the climate zones. Like the Labs report, it compared the 2018 IECC with the 2021 IECC.[66]

The ICF report used six representative climate zones. This Utah Foundation study is only reporting three – those most similar to Utah's three climate zones.[67]

The study shows each change from the 2018 IECC to the 2021 IECC by the expected cost. Envelope costs account for much of the initial cost increase, while the changes to duct and

Most of the costs under IECC 2021 are from the thermal envelope and the efficiency package options – all of which affect local emissions.

Figure 13: Incremental Construction Costs for 2021 IECC (Compared to 2018 IECC), Summary

Code update	3B (Washington Co.)	5B (most of Utah)	6B (northern Utah)
Thermal envelope			
Ceiling insulation	$233	$204	$204
Slab insulation	$709	n/a	n/a
Wall continuous insulation	n/a	$2,680	n/a
Window U-factor	$67	n/a	n/a
Total thermal envelope	$1,009	$2,884	$204
Duct and ventilation tests	$31	$78	$78
Lighting	$33	$42	$42
Total, without additional efficiency package options	$1,073	$3,004	$324
Efficiency package options*			
HVAC option	$2,567	$1,143	$1,143
Water heater option	$1,178	$549	$549
Ventilation option	$1,707	$1,707	$1,707
Duct option	$2,545	n/a	n/a

** Efficiency package options without thermal envelope, duct and ventilation tests, and lighting.*

*** The duct option is not applicable for homes with basements, such as the model homes for climate zones 5B and 6B.*

Source: ICF.

ventilation tests and the lighting changes are under $100 for each climate zone. (See Figure 13.)

There are significant energy savings – and commensurate local emissions reductions – relative to the 2018 IECC. For the thermal envelope, efficiency improvements are small in climate zone 6B, but are around 5% in Utah's other zones. The savings from the efficiency packages varies widely, with the HVAC package providing over 8% savings in climate zones 5B and 6B, while the water heater option provides nearly an 8% savings in climate zone 3B. (See Figure 14.)

The thermal envelope and some of the efficiency packages show significant efficiency improvements.

Figure 14: Energy Cost Savings (Compared to 2018 IECC), Summary

Code Update	3B (Wash. Co.)	5B (most of Utah)	6B (northern Utah)
Thermal envelope			
Ceiling insulation	0.6%	0.5%	0.6%
Slab insulation	4.5%	1.6%	n/a
Wall continuous insulation	n/a	2.7%	n/a
Window U-factor	0.4%	n/a	n/a
Total thermal envelope	5.5%	4.8%	0.6%
Efficiency package options*			
HVAC option	6.4%	8.3%	8.5%
Water heater option	7.8%	1.5%	1.2%
Ventilation option	0.7%	1.6%	2.5%
Duct option	4.1%	n/a	n/a

** Energy cost savings of additional efficiency package options relative to 2021 without packages.*

Source: ICF.

Simple payback varies widely by type of 2021 code change.

Figure 15: Simple Payback of 2021 IECC, in Years (Compared to the 2018 IECC)

Code Update	3B (Wash. Co.)	5B (most of Utah)	6B (northern Utah)
Thermal envelope			
Ceiling insulation	20	19	15
Slab insulation	8	20	n/a
Wall continuous insulation	n/a	43	n/a
Window U-factor	9	n/a	n/a
Efficiency package options*			
HVAC option	21	6	6
Water heater option	8	18	21
Ventilation option	135	61	30
Duct option	31	n/a	n/a

Source: ICF.

The individual code changes vary widely in terms of simple payback. Slab insulation and the water heater option have a simple payback of eight years in climate zone 3B, while the HVAC option has a simple payback of only six years for climate zones 5B and 6B. (See Figure 15.) It should be noted that the International Code Commission provides the IECC recommendations as a package, so while one code recommendation may have a long simple payback period, when combined with other options, the payback becomes acceptable in terms of Commission and U.S. Department of Energy combined cost/benefit analyses.

ICF determined that the 2021 IECC is cost effective in all climate zones under the life-cycle cost method compared to the 2018 IECC. The study also shows that each climate zone has multiple cost-effective compliance options. ICF also points out that following the 2021 IECC in practices would likely be even more cost effective because a) this analysis uses the prescriptive path while "builders may be able to find more cost-effective ways to achieve the same level of performance" using the Total Building Performance Option or the Energy Rating Index Option, and b) ICF's cost estimates are likely low since it used only publicly available cost sources while builders are likely to receive lower prices when buying in bulk.

In Utah, the improvements without energy efficiency options are cost effective in all climate zones, and all of the efficiency package options are cost effective in all climate zones except the ventilation option in 5B. (See Figure 16.)

Nearly all improvements under the code are cost-effective.

Figure 16: Life-Cycle Cost of 2021 IECC Improvements (Compared to 2018 IECC)

Source: ICF.

Code Update	3B (Wash. Co.)	5B (most of Utah)	6B (northern Utah)
Without additional efficiency package options	$2,784	$691	$1,758
HVAC option	$1,711	$3,300	$4,796
Water heater option	$4,790	$550	$1,508
Ventilation option	$49	($1,680)	$9
Duct option	$2,959	n/a	n/a

Most 2021 changes would likely result in significant efficiency improvements, thereby yielding emissions reductions.

Figure 17: Estimated Air Quality Benefit (Compared to 2018 IECC)

Code Update	3B (Wash. Co.)	5B (most of Utah)	6B (northern Utah)
Thermal envelope			
Ceiling insulation	>1%	>1%	>1%
Slab insulation	5%	2%	n/a
Wall continuous insulation	n/a	3%	n/a
Window U-factor	>1%	n/a	n/a
Total thermal envelope	6%	5%	>1%
Efficiency package options*			
HVAC option	6%	8%	9%
Water heater option	8%	2%	1%
Ventilation option	>1%	2%	3%
Duct option	4%	n/a	n/a

** Energy cost savings of additional efficiency package options relative to 2021 without packages*

Source: ICF, Utah Foundation.

This IECC study does not directly look at the decrease in air emissions in moving from the 2018 IECC to the 2021 IECC. However, with the thermal envelope and the efficiency package options reduction in energy usage, one would expect a commensurate savings in emissions. (See Figure 17.)

Utah construction costs would increase under one percent under the 2021 code, with an out-of-pocket cost of under $500.

Figure 18: Total 2021 IECC Estimated Costs

Climate Zone	Total construction cost*	Total construction cost on $600K home	Incremental down payment and other first costs
3B (Washington Co.)	$3,089	0.5%	$343
5B (most of Utah)	$4,291	0.7%	$474
6B (northern Utah)	$2,559	0.4%	$287

** 5B and 6B are for heated basement homes. 3B is for a slab home; a 3B heated basement home would be less.*

Note: Mortgage interest 3%; loan term 30 years; loan fees 1%; down payment 12%; property tax 0.6%. See PNNL report for additional methodology.

Source: PNNL and the Utah Foundation.

The Cost and Benefits: An Example

Using data and methodology from the Pacific Northwest National Laboratory, the Utah Foundation looked at the cost of upgrading from Utah's current building efficiency code to the 2021 IECC. For a $600,000 home, the total construction costs would increase by between 0.4% and 0.7%, depending upon the climate zone. (See Figure 18.) These changes would result in an out-of-pocket increase for a new homebuyer of between $287 and $474 (amortized over a 30-year mortgage; see other particulars in the notes to Figure 18.)

COSTS AND BENEFITS: A MOVING TARGET

The calculations in Figures 18 and 19 are subject to significant changes that have occurred since 2020. Building construction costs have increased in recent years. This would increase the costs in Figure 18 related to "Total construction cost" and "Incremental down payment and other first costs." It would also result in higher total "Annual costs" in Figure 19. Furthermore, mortgage interest rates have more than doubled since 2021. This would increase the mortgage payments by nearly one-half. On the other hand, energy prices are skyrocketing. This would increase the "Annual energy cost savings" in Figure 19. To the degree that costs increase from building construction costs, mortgage interest and otherwise, the annual cash flow savings decreases. To the degree that energy costs increase, the annual cash flow savings increases.

Utah homebuyers would recoup their out-of-pocket cost in two to three years from annual cash flow savings under the 2021 code, with a sharp decrease in the home's local emissions.

Figure 19: Annual Cash Flow Savings and Local Emissions Reduction, IECC 2021 (Compared to the 2018 IECC)

Climate Zone			Costs			Benefits
	Annual mortgage increase (A)	Annual expenses* (B)	Annual costs (A + B)	Annual energy cost savings (C)	Annual cash flow savings (C - (A + B))	Estimated decrease in local emissions
3B (Washington Co.)	$106	$16	$122	$231	$109	32%
5B (most of Utah)	$64	$26	$90	$342	$252	37%
6B (northern Utah)	$99	$15	$114	$297	$183	32%

** Cost of mortgage interest deductions, mortgage insurance, and property taxes.*

Note: Mortgage interest 3%; loan term 30 years; loan fees 1%; down payment 12%; property tax 0.6%. See PNNL report for additional methodology.

Source: PNNL and the Utah Foundation.

These same homebuyers would see an annual cash flow savings of between $109 and $252. (See Figure 19.) As noted previously in Figure 8, these homes would see a decrease in natural gas usage – and a commensurate decrease in the homes' direct emissions – of about one-third when compared with the current Utah code.

COMMISSION RECOMMENDATIONS TO THE LEGISLATURE

The Utah Mechanical Advisory Committee reviewed proposed amendments to the model IECC code through June of 2022. The Committee suggested numerous amendments to the Uniform Building Code Commission. Three might be considered the most significant.

The Committee did not accept the increased ceiling insulation per the 2021 IECC.[68] Instead, it recommended that the state stay with Utah 2015 as amended. While this is not a step in the right direction in terms of heating efficiency, the consequences are potentially less far-reaching than other types of changes; it is easy to increase ceiling insulation at a later date, particularly when compared with wall insulation and most other envelope improvements. However, the Committee also rejected the 2021 IECC energy efficiency recommendations related to the frame wall insulation and the home slab insulation and depth, opting to stay with the 2015 IECC recommendations.

The committee received suggestions that would have reduced the energy efficiency to less than what the current code yields, such as reducing the requirement of wood frame wall insulation in climate zone 3B. The Committee rejected these recommendations.

Under the Energy Rating Index, the Committee proposed an Index target that is less efficient than the 2021 IECC. (See Figure 20.)

Perhaps most importantly, the Committee included the REScheck allowance used in current Utah code. In discussing this, they noted that the mechanical systems trade-off using the Utah 2012 REScheck creates a loophole that allows the installation of a

The recommended ERI performance path falls short of the 2021 code guidance.

Figure 20: Maximum Energy Rating Index, 2021 IECC and Mechanical Advisory Committee Recommendation

Climate Zone	2021 IECC	Committee recommendation
3B (Washington Co.)	51	57
5B (most of Utah)	55	61
6B (northern Utah)	54	61

Source: IECC and the Utah Mechanical Advisory Committee.

> **The REScheck “loophole” creates transparency issues. While, on the surface, Utah can claim credit for bringing its code up to the latest standard, in reality the loophole is used with such frequency as to undermine any code update.**

poorly insulated and less efficient building envelope. This was due not to the Committee’s own preferences, but to a political expectation that the Utah Legislature would want to keep the current loophole.

However, the Committee suggested (and Uniform Building Code Commission agreed) that if the Utah Legislature wants to retain this loophole in Utah code, it should be amended from a 5% efficiency improvement beyond the 2012 REScheck to:

- 8% efficiency improvement beginning July 1, 2023,
- 10% efficiency improvement beginning July 1, 2025, and
- 12% efficiency improvement beginning July 1, 2027.[69]

The Uniform Building Code Commission accepted most of the Committee’s amendments, then made further amendments to the model IECC code.[70]

The energy efficiency building code adoption process in Utah is not free of political considerations. The Uniform Building Code Commission used to decide on whether Utah would follow the model code. In 2011, the Legislature changed it into an advisory body that sends the model code with recommendations to the Legislature for consideration.[71] With that as the arrangement, the Commission’s job should be to send the Legislature its best recommendations on what form the new code should take and let the Legislature make its own amendments, with accountability to voters. However, while the Mechanical Advisory Committee and the full Commission did consider each of the code particulars, they also included the REScheck “loophole” out of deference to the presumed expectations of the Legislature. (See the sidebar on page 7.) This seems to short-circuit the decision-making process by moving a political decision into the advisory phase. Similar questions recently arose within the Commission structure. The Mechanical Advisory Committee is a responsive body that discusses code amendments provided by advocacy and lobbying groups for the purpose of advising the full Commission. However, in June 2022, a lobbying group went directly to the full Commission seeking amendments to portions of the IECC model code before the Mechanical Advisory Committee presented its recommendations. The Utah Foundation has been told that this is not standard procedure, raising questions about the influence of special interests.

One last note. The REScheck “loophole” dicussed herein creates transparency issues. While, on the surface, Utah can claim credit for bringing its code up to the latest standard, in reality the loophole is used with such frequency as to undermine any code update.

COMPLIANCE ISSUES

A change to the energy efficiency requirements in Utah’s building codes could result in a moderate improvement in air quality, given the decrease in emissions. But what if the codes are not enforced?

The Utah Legislature created the Uniform Building Codes Training Fund to see uniform enforcement of the code around the state.[72] As part of the Fund, the State provides builders and code officials with enforcement trainings.[73] The State’s *Building Talks: Utah’s Energy Code Training Program*, is one such program. The State partners with Dominion Energy and Rocky Mountain Power to provide builders and code officials with energy efficiency education.

But more might be done. Utah’s 2014 Building Team Committee cited a need to “increase understanding and enforcement of [the] current energy code”[74] through the efforts of the

OTHER PROGRAMS FOR CLEANER BUILDINGS

C-PACE

Utah is one of 30 states with a commercial property assessed clean energy (C-PACE) program. This financing program "authorizes local governments to offer commercial, multifamily and industrial property owners a way to access private-sector financing for energy efficiency, renewable energy, and water conservation improvements to their buildings."

Sustainable Real Estate Solutions, Inc., administers Utah's program, working directly with local governments to finance and construct efficient buildings. C-PACE has financed $91 million in Utah's public buildings.

Utilities

ThermWise® is a suite of seven customer-focused programs (Home Energy Plan, Energy Comparison Report, Appliance Rebates, Builder Rebates, Business Rebates, Weatherization Rebates, and Low-Income Efficiency) which aim to reduce natural gas usage in Utah homes and businesses. These programs are designed and offered by Dominion Energy, first becoming available to residents of the state beginning in 2007.

Over the fifteen-year history of the ThermWise® programs, customer participation rates and natural gas saving results have been some of the strongest in the nation. As of the end of 2021, nearly 48% of Utahns had participated in at least one of the ThermWise® rebate programs. In terms of natural gas savings, Dominion Energy estimates that the equivalent usage of over 129,000 homes (using 80 dekatherms of natural gas per year) is saved annually because of the ThermWise® programs. For instance, the program offers a $800 rebate for a dual-fuel (electric heat pump and natural gas furance) heating system. Non-Dominion Energy customers should contact their local gas provider for energy efficiency programs and incentives. In part because of these programs, annual natural gas usage – and commensurate air emissions – has decreased by more than one-third since 1984.*

Through its Wattsmart program, Rocky Mountain Power provides cash incentives and discounts for energy upgrades. Services and incentives are available for homes and businesses. Non-Rocky Mountain Power customers should contact their local electric provider for energy efficiency programs and incentives.

Of the U.S. Department of Energy funded compliance-study participants, 57% reported participating in at least one utility energy efficiency program, while 21% reported participating in both an electricity and natural gas efficiency rebate program.

** In 1984, per customer natural gas usage was over 125 Dth per year, while by 2021 usage decreased to less than 80 Dth.*

Sources:

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Office of Energy Development, ICC Chapters and AIA Utah. They also recommended support from the Division of Occupational and Professional Licensing, the Utah Home Builders Association and ASHRAE Utah.

A study from the Department of Energy sought to understand compliance in two states – one of which was Utah. The Institute for Market Transformation performed the Utah Residential Energy Code Field Study. It collected data from a random sampling of 127 new-construction homes in 35 cities across nine counties during 2020.[75]

The study found that builders' (and building inspectors') practices showed strong code compliance for lighting and envelope tightness. Nearly all of the homes exceeded the code requirement for high efficiency lighting – such as LED lights. Further, most homes had an envelope tightness of that was better than the code requirement of 3.5 air changes per hour, with an average of just over 3.0 air changes per hour.

Two areas where many homes were not in compliance were with insulation and duct tightness – both of which are a focus of the 2021 IECC. With ceiling insulation, the average was just under R-40. While Washington County code requires R-38, most of the state requires R-49 – which is more energy efficient. When considering the U-factor of installed insulation, the performance average is 0.031, which falls outside of the requirement for Washington County's 0.030 and 0.026 for the rest of the state. The U-factor looks at how the insulation is installed, suggesting that not only is more insulation needed (under the R-value), but it needs to be installed better. With exterior wall insulation, the R-value was acceptable on average, though the U-factor for many homes was less than required, again meaning that insulation needs better installation to improve efficiency. Finally, outside the envelope duct tightness is better than Utah code requires – about 4.6 cubic feet per minute per 100 square feet of space as opposed to 7.0 cubic feet per minute under code. However, interior duct tightness is far leakier, at 11.1 cubic feet per minute.

The study found that full compliance with Utah's energy code at the time the study was conducted (the 2015 IECC, as amended) would help customers cut energy bills by $1.3 million each year, with a savings of 17,000 metrics tons of carbon dioxide emissions annually. As the study used Pacific Northwest National Laboratory's methodology, this could be roughly translated into a nitrogen oxide reduction of more than 10 tons per year – resulting in improved local air quality.

OTHER LEGISLATION TOWARD CLEANER – OR LESS-CLEAN – BUILDINGS

During the 2016 General Session, the Utah Legislature followed prompting from Utah's Air Quality Board to pass an ultra-low NOx water heater requirement. The lower nitrogen oxide emissions can result in better air quality year-round – from less particulate matter to lower ozone levels. The 2016 Utah Legislature passed House Bill 250 and House Bill 316 to enable the rule requiring ultra-low NOx water heaters for replacement and new construction as of July 1, 2018.

The 2020 Utah Legislature passed House Bill 235, Voluntary Home Energy Information Pilot Program, to direct the Utah Office of Energy Development to design a home energy information pilot program and a home energy performance score system. Through the Office's Home Energy Information Advisory Committee, the program will aim to encourage household energy efficiency using an educational approach and a home energy scorecard which compares Utahns energy performance to similar homes – much like a Dominion Energy efficiency program.

The 2022 Utah Legislature passed Senate Bill 188, Energy Efficient Amendments, to encourage energy efficiency though a low-income assistance program for utility customers earning 200% of the federal poverty level. The aim is to reduce air pollutants from homes. The program will work through electric and gas utilities to provide bill payment assistance, energy efficient appliances, replacement of wood-burning appliances or fireplaces with efficient alternatives, or other energy efficiency improvements. The program is financed through a surcharge on retail customers' monthly utility bills.

Perhaps stepping in the wrong direction, the 2022 Utah Legislature passed House Bill 39, which could undermine the current building code requirement that aims to ensure heating and air conditioning equipment is correctly sized. The allowance could result in technicians putting in HVAC units that are too big or too small. When heating and cooling systems are not sized appropriately, they may operate less efficiency.

Sources:

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CONCLUSION

During the last decade, Utah was the fastest growing state in the Union. With new residents come new buildings with new emissions, making growth a challenge for air quality. But it also represents a unique opportunity. Over 12% of Utah's homes have been built since 2010 – a far greater proportion than the U.S. average. With a robust pace in new residential and commercial construction expected to continue, there is a unique opportunity to build in a manner that reduces each structure's pollution emissions. The payoff is long-term, with many of these buildings maintaining reduced emissions far into the future.

Residences and commercial buildings' air and water heating account for between 6% and 7% of winter inversion emissions on the Wasatch Front, where most Utahns reside. Percentages for natural gas combustion seemingly represent a small portion of the Wasatch Front pollution problem, since there are multiple relatively larger contributors, such as on-highway gasoline vehicles, on-highway diesel vehicles, off-highway diesel vehicles, solvents, and forest-fire smoke. And winter woodsmoke is not far behind natural gas combustion. In short, addressing air quality requires that Utah address multiple individual contributing sources with separate solutions in order to make a meaningful combined impact. And when it comes to the fuel combustion slices of the pie, building code upgrades offer policymakers significant potential leverage.

For Utahns living off the Wasatch Front, these emissions are a much smaller proportion of local emissions. Given the regional variations in air quality issues related to area source emissions, the State might explore whether relevant variations in building codes are appropriate.

The 2021 energy efficiency building codes are set for review by the Utah Legislature for adoption, rejection or amendment during the 2023 General Session. The main arguments for updating the energy efficiency standards in the building code include: lower utility costs for residents, better air quality, and an increase in Utah employment to provide new features for residences. The main points of opposition include: new homes are only a small part of the problem, home costs are too high already, and the government is getting too specific in its building mandates.

A study of updating the Utah commercial code suggests a substantial savings in energy costs and commensurate emissions reduction – and for most buildings a decrease per square foot in initial construction costs due primarily to the need for a smaller heating and air conditioning systems. Studies of updating Utah residential code show life-cycle cost savings that appear to justify a full implementation of the 2021 code. This report suggests that each home built to the 2021 code would see emissions related to natural gas usage decrease by about one-third compared to homes built to the current code.

The cost of implementing the 2021 energy efficiency standards would be between 0.4% and 0.7% of a new $600,000 home (under $5,000). In terms of household cash flow, initial costs would be recouped within two or three years. These homes would see a one-third reduction in local emissions – and a larger reduction during winter months.

In adopting the 2021 code, policymakers should consider the propriety of a standing loophole in Utah's approach to energy efficiency codes that is used with such frequency that it undermines any code update. It also creates transparency issues.

Along those lines, it should be noted that the independence of Utah's Uniform Building Code Commission has diminished since the 2000s. Observers say that energy efficiency code adoption that affects air quality has become a much more political process.

When it comes to air quality, building codes offer policymakers real leverage in making a direct, meaningful impact far into the future. As the 2021 energy efficiency standard moves through the process toward adoption, a careful consideration of the costs and benefits both financially and for public health is well-warranted. The same could be said for future code adoption.

As the 2021 code moves through the process toward adoption, a careful consideration of the costs and benefits both financially and for public health is well-warranted.

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