The role of building energy codes in the clean energy transition

A report prepared for the City of Las Cruces

Builders work on a home in Rio Rancho in 2018. (Greg Sorber/Albuquerque Journal)

COALITION OF SUSTAINABLE COMMUNITIES

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Information from multiple topic experts, listed in the Appendix.

Executive Summary

The coronavirus pandemic has highlighted how unemployment and infection rates have disproportionately impacted low income households and minority communities in New Mexico. At the same time, we are on a trajectory to face significant impacts from a rapidly changing climate. Higher temperatures will lead to increased utility bills for cooling and will place a higher burden on lower income families and those with fragile health conditions. This is especially true in southern New Mexico, where climate models predict a significant increase in the number of days over 100°F by 2050.

Energy efficiency continues to be one of the least cost options for reducing utility bills and greenhouse gas emissions. Implementing stricter energy efficiency standards for new and renovated buildings provides economic benefits to building occupants, particularly lower income households. Buildings consume almost 40% of the U.S.'s primary energy and emit over 30% of U.S. greenhouse gas emissions, mostly due to natural gas heating and electricity to power air conditioning and appliances. Upfront investment in buildings has long term impacts; most buildings have lifetimes of at least 40 years, and the average person spends over 90% of their time inside buildings.

Building energy codes, along with appliance standards and government and utility energy efficiency programs, are known to reduce energy use in buildings. The primary building energy code standards are the International Energy Conservation Code (IECC) for residential and commercial buildings and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1, for commercial buildings. Both standards are released in staggered, 3-year cycles, and the IECC references the ASHRAE Standard 90.1. New Mexico adopts versions of the IECC codes at the state level, but local New Mexico jurisdictions that have their own capacity for building inspection can adopt their own energy codes, as long as they are stricter than the state's codes. New Mexico has missed over a decade of energy savings opportunities, as it still uses the outdated 2009 IECC codes. The state is currently in the process of adopting some version of the 2018 IECC codes.

Like most regulated industries, builders often push back against new code updates since they will require learning new rules and taking on new building costs. However, there are clear safety and economic benefits for occupants from each code update. Analysis from Pacific Northwest National Laboratories shows significant net benefits for updating to the 2018 IECC codes from the 2009 IECC. For the City of Las Cruces, the results indicate that a single-family unit would have an incremental cost of $2,453 to implement 2018 IECC codes, relative to 2009 IECC codes. This is 1.1 % of the median sales price for a new single-family home in Las Cruces in 2018 ($225,000). The energy efficiency measures would result in an annual energy savings of $514, having a simple payback of under 5 years, and also result in a life-cycle cost savings of $8,888.

Updated energy codes for new construction have important equity impacts by reducing utility bills for the poorest occupants. Lower income families are more likely to rent and live in multifamily housing units, where there is less incentive for developers and owners to invest in energy efficiency since they often don't pay the utility bills. When a jurisdiction has older codes, it is more likely that the cheaper housing stocks will be the ones built to the lower standards. Unlike wealthier families, who can commission the construction of a green building, lower income families are left to choose from housing stock that may be built to the minimal code requirements.

While adopting the new codes more frequently incurs implementation costs and potential new construction costs, skipping code cycles has numerous drawbacks and far greater economic costs to future occupants and society. Each round of new code incorporates feedback from builders and inspectors, improving upon issues from the prior round of codes. Skipping code cycles typically means a much greater jump in technology and training needed to "catch up" to the newest codes, while the occupants of new construction will have missed out on the energy efficiency gains, increased safety, and financial savings of the missed cycles. Many energy efficient technologies have greater up-front costs but larger lifetime economic returns (such as an LED bulb versus an incandescent bulb). Without updated codes, a low-cost builder might avoid technologies that will provide the future occupants significant long-term benefits.
It is in the best interest of all jurisdictions to update to the latest codes each cycle, so that there will be no competitive advantage for builders constructing homes to lower standards.

Any local jurisdiction that has its own capacity to issue building permits and inspect buildings has a number of options to go beyond the minimum standards set by the state. Advanced energy codes and stretch codes are usually sets of legally binding requirements that a city or county has adopted, with more stringent requirements. Stretch codes are often standards anticipated to be included in future codes, easing the transition to a new code update. Las Cruces could consider the introduction of stretch codes that include requirements from the 2021 IECC, once it is released. Or, if the state adopts a version of the 2018 IECC codes that includes too many roll-backs and exemptions, Las Cruces could consider adopting the same set of codes without the modifications.

Green Building Codes are an example of advanced codes that not only increase standards for energy, but also water conservation, resource use, and additional green building practices. Complementing building energy codes with water efficiency standards is especially crucial for New Mexico. The City of Santa Fe has residential building codes that require a Home Energy Rating Score (HERS) and Water Efficiency Rating Score (WERS) for all new homes.

Rather than mandating requirements that are stricter than the most recent IECC codes, local jurisdictions can implement voluntary incentives that motivate builders to move beyond the base codes. For example, a city might provide exemptions to certain zoning restrictions, such as allowing increased density or commercial construction in a residential zone, or reduce permitting fees if a developer commits to meeting a set of more stringent codes. Albuquerque offered a Green Path, which expedited permitting times for builders submitting plans that met stricter energy requirements. New Mexico offers a Sustainable Building Tax Credit for new buildings that meet certain green building standards.

Cities and Counties can also pass ordinances that require energy use disclosure for all homes listed for sale or rent. This would alert buyers and renters about potential operational costs between building choices, providing an incentive for builders and homeowners to increase or update the energy efficiency of a building. Requiring the disclosure of building operational costs in a transparent and easily understandable way, like energy ratings on appliances, is also the first step in pushing markets to monetize the value of greater energy efficiency in homes.

New Mexico will likely adopt a version of the 2018 IECC codes before the end of 2020. However, jurisdictions should view the latest IECC codes as a minimum standard. Las Cruces has an opportunity to increase the future benefits to its communities, especially lower income households, by considering going beyond the state codes, and providing incentives for builders to adopt advanced energy codes. Utility bill savings decrease energy burdens and increase disposable income for households that can then be spent within the local community. Stricter energy codes also increase the skills and knowledge of the local building industry, which could create opportunities beyond their local markets.

1. Introduction

We find ourselves at a convergence of environmental, health, and economic crises in the United States and the world. The Intergovernmental Panel on Climate Change's 2018 report warns that in order to keep global mean temperature rise (currently at 1.0°C above pre-industrial times) below 1.5°C, global greenhouse gas (GHG) emissions should drop by 45% below 2005 levels by 2030[1]. A 1.5 degree rise will result in significantly increased droughts, severe storm events, and sea level rise, having the severest impacts for those vulnerable communities that don't have the resources needed to adapt. Global temperature rise is distributed unevenly across the globe, and could result in 2.5 to 5°C average rise across the Southwestern U.S., which is already significantly hotter and drier than other regions[2]. To make matters worse, the ongoing coronavirus pandemic has resulted in disproportionately higher rates of infection and mortality in the U.S. among senior populations and communities of color[3]. The resulting economic downturn is also hitting communities of color the hardest, as they are over-represented in lower wage labor and service jobs more vulnerable to lay-offs[4].

There is no single solution that will transform our carbon intensive economy to a cleaner one. In 2019, Governor Michelle Lujan Grisham released Executive Order 2019-003, calling for reducing New Mexico's greenhouse gas (GHG) emissions by 45% of 2005 levels by 2030. The executive order calls for the adoption of market-based standards to reduce emissions, the adoption of low and zero-emission standards for vehicles, and energy codes for buildings. This executive order comes in parallel with NM Senate Bill 489, The Energy Transition Act, which, among other things, updates the state's Renewable Portfolio Standard (RPS), calling for 50% production by renewable energy by 2030, for both investor owned utilities (IOUs) and electric cooperatives (Coops), and 100% carbon-free energy by 2045 for IOUs and 2050 for Coops.

The path towards restructuring our economy toward one that is drastically less carbon intensive must come with greater economic opportunities for the most vulnerable and historically disenfranchised communities, and involves ramping up the rate and scale of a variety of policies. These should be policies that regulate and stimulate markets and provide benefits, new training, and job opportunities for the most vulnerable populations, and ensure that these same populations are shielded from interim transition cost burdens.

The building industry is front and center among the most critical areas that need to be rapidly addressed; it has the potential for providing significant benefits for the lowest income New

[1] IPCC, I. P. O. C. C. 2019. Special report on global warming of 1.5 C (SR15).

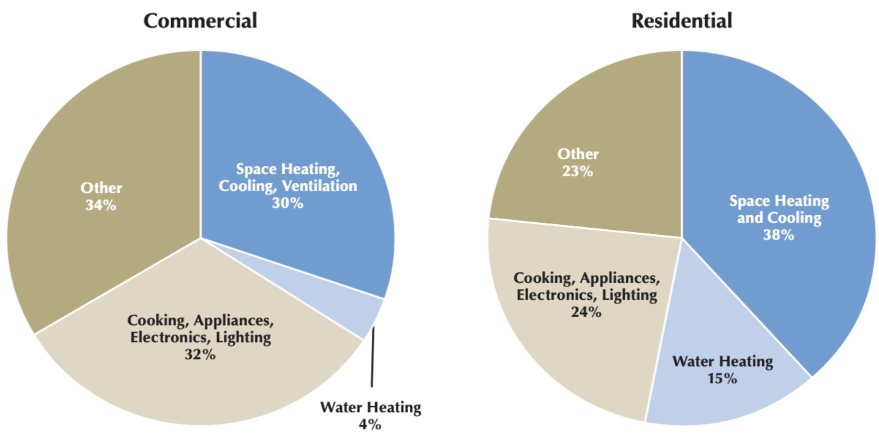
[2] Garfin, Gregg, et al. "Southwest: the third national climate assessment." Climate change impacts in the United States: The third national climate assessment. US Global Change Research Program, 2014. 462-486.

[3] CDC. COVID-19 in Racial and Ethnic Minority Groups

[4] Maxwell. 2020. The Economic Fallout of the Coronavirus for People of Color. Center for American Progress.

Mexicans. Upfront investment in buildings has long term impacts. Most buildings have lifetimes of at least 40 years[5], and the average person spends over 90% of their time inside buildings[6]. Reducing energy consumption in buildings implies significant cost savings for building occupants and owners, and environmental benefits for society from the reduction of greenhouse gas emissions.

Buildings consume almost 40% of the U.S.'s primary energy[7] and over 30% of U.S. greenhouse gas emissions[8], mostly due to natural gas heating and electricity to power air conditioning and appliances.



"Other" in both the commercial and residential sector includes items such as data servers, medical imaging equipment, ceiling fans, and pool pumps which are categorized as "miscellaneous electric loads" by EIA.

Figure 1: Carbon Dioxide Emissions from residential and commercial buildings, 2016[9]*.*

Energy efficiency continues to be one of the most important components for speeding the transition to a low-carbon economy and reducing energy costs for utility customers. Energy efficiency can be defined as delivering the **same** desired energy service, such as a comfortable temperature in a home or quality lighting, using **less** energy. Energy efficiency in buildings can look like higher insulation, a tighter building envelope with improved ventilation, and high efficiency lighting and appliances. Improving the building envelope will become even more critical for keeping homes comfortable and reducing cooling costs as average temperatures continue to increase. The figure below shows the predicted rise for more days with maximum temperatures exceeding 100°F in Las Cruces.

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[5] O'Connor, J. 2004. Survey on actual service lives for North American buildings. In Woodframe housing durability and disaster issues conference, Las Vegas (pp. 1-9).

[6] Klepeis et al. 2001. The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants. J Expo Sci Environ Epidemiol 11, 231–252

[7] EIA. April 2020. US Energy Flow.

[8] EIA. U.S. Energy-Related Carbon Dioxide Emissions, 2018

[9] Leung, Jessica. 2018. *Decarbonizing U.S. Buildings*. Arlington, VA: Center for Climate and Energy Solutions.

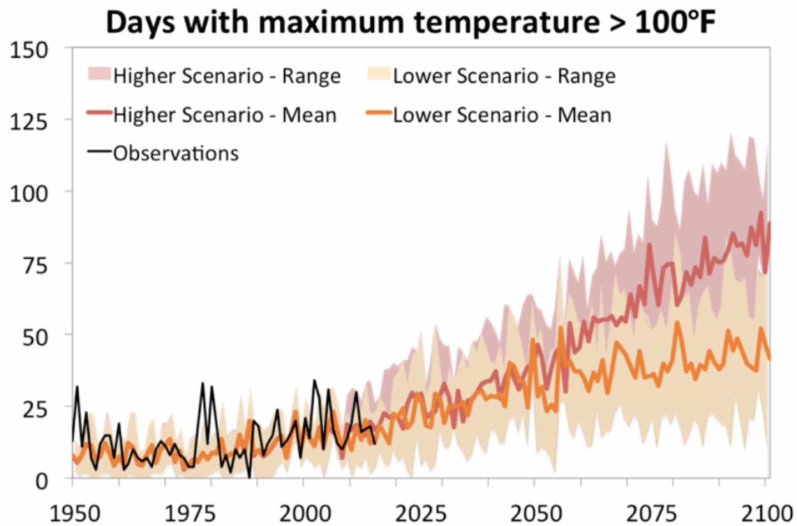

Figure 2: Days with max temp > 100F for Las Cruces, NM[10]

The black line shows historical observations. The orange line and shaded yellow area and the red line and pink shaded area show the average and range of climate projections over two different scenarios. Las Cruces is projected to see a significant increase in the number of days over 100°F by 2050, for either climate scenario[11].

A recent modeling study by the American Council for an Energy-Efficient Economy (ACEEE) showed that there are cost-effective opportunities in the U.S. to reduce energy demand by 40-60% by 2050, relative to business as usual, through different policies that will impact energy efficiency, as shown in the figure below[12]:

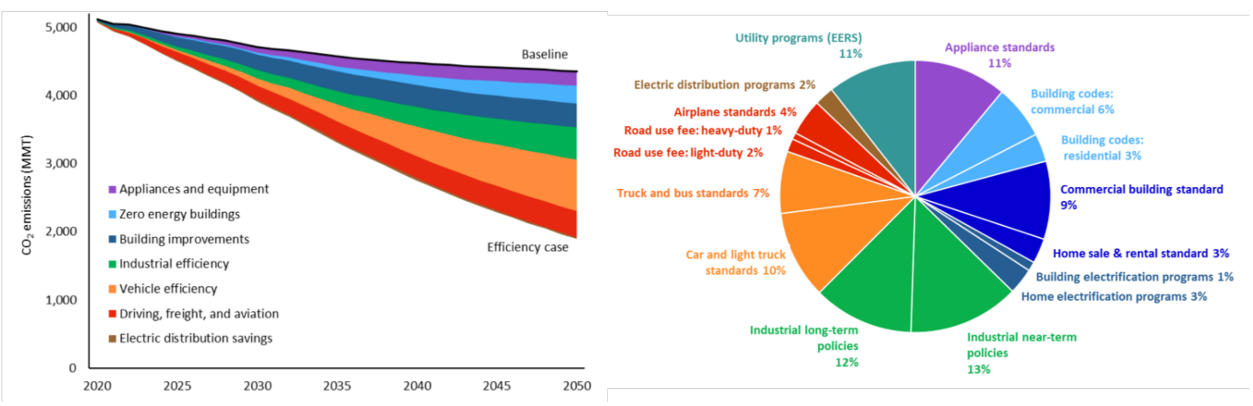

Figure 3: Potential GHG emission reductions in the US through 2050 due to the implementation of energy efficiency policies[13]

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[10] U.S. Climate Resilience Toolkit. Catalyzing Investment and Building Capacity in Las Cruces

[11] U.S. Climate Resilience Toolkit. Catalyzing Investment and Building Capacity in Las Cruces

[12] Nadel, S, and U Lowell,. 2019. *Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050*. Washington DC: American Council for an Energy-Efficient Economy.

[13] Nadel, S, and U Lowell,. 2019. *Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050*. Washington DC: American Council for an Energy-Efficient Economy.

The study indicates that the efficient design of new homes and commercial buildings, including transitioning their energy use to renewable energy, could cut building emissions by 80% by 2050. As seen in the figure, 9% of the total potential savings by 2050 are due to building energy codes in residential and commercial buildings. The study assumed that the building energy codes are released every 3 years, adopted within 5 years, and result in a 10% savings with each iteration.

Historical increases in building energy efficiency have been primarily driven by policies and programs in three areas: building energy codes, appliance and equipment standards, and utility and government energy efficiency programs. Energy efficiency in new buildings is primarily driven by building energy codes and appliance standards. Following the end of the Great Recession in 2009, construction permits for residential buildings in New Mexico averaged 4,000 per year, between 2009 to 2019, corresponding to an average of 4,700 permits for new residential units per year[14]. With over 900,000 housing units in New Mexico, this corresponds to an increase of about 0.5% of the housing stock each year. Over a ten-year period this would result in about 5% of the housing stock coming from new builds. Updated building energy codes will help ensure that the new construction is built to improved standards, but will also require complementary policies and programs to address low energy efficiency in older buildings.

As can be seen in the figure below, rates of construction vary significantly by county in New Mexico, with Dona Ana County having over 25% of its housing stock built within the last 20 years, the second highest proportion of any county. This highlights the importance of leadership in standards for new construction within Dona Ana County, along with utility and government programs that can increase energy efficiency in the existing building stock.

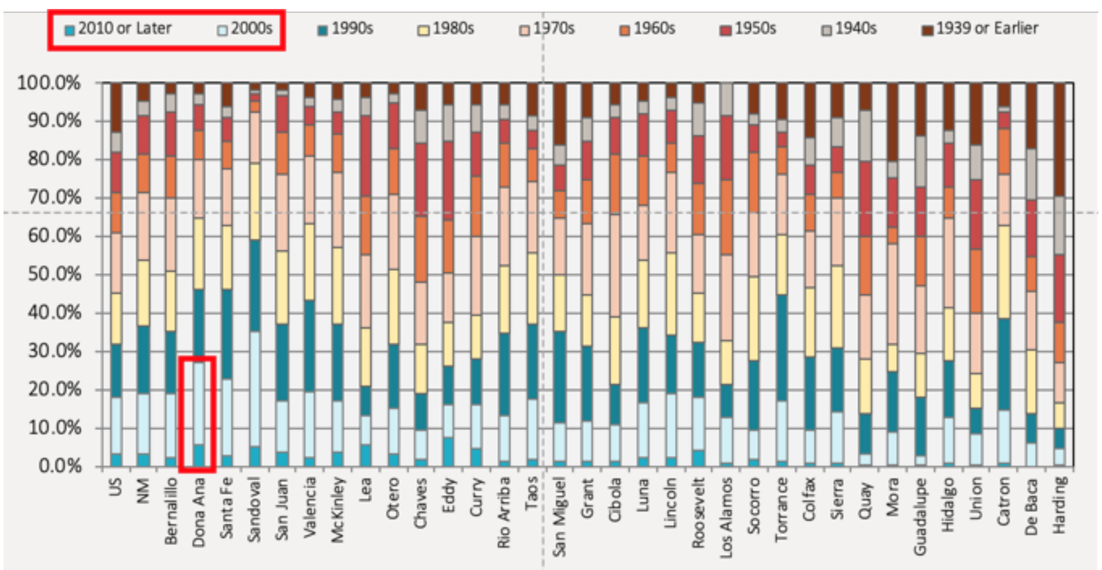

Figure 4: Composition of age of housing stock for New Mexico counties[15].

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[14] US Census. Building Permits Survey

[15] MFA. 2018 New Mexico Affordable Housing Needs Assessment

Key Points

- Buildings consume almost 40% of the U.S.'s primary energy and emit over 30% of U.S. greenhouse gas emissions. Building energy efficiency is one of the least cost methods for reducing greenhouse gas emissions, and utility bills.
- Most buildings have lifetimes of at least 40 years, and the average person spends over 90% of their time inside buildings.
- Three areas for reducing energy consumption in buildings are energy codes, appliance standards, and government and utility energy efficiency programs.
- Building energy codes are critical for reducing greenhouse gas emissions and utility bill costs from natural gas and electricity, especially as Southwestern cities like Las Cruces will experience more and more days above 100°F.

2. Background on Energy Codes

Building energy codes are critical levers for increasing energy efficiency in the use of new or remodeled buildings. These codes not only ensure a minimum standard of energy consumption, primarily through requirements that reduce heating, cooling, and lighting loads, but they also impact safety and comfort through requirements for air ventilation and reducing moisture accumulation and mold. Building energy codes focus on three primary areas: the building envelope, mechanical systems, and lighting systems. The building envelope includes roof, wall, and floor insulation; window, door, and skylight performance; and air leakage. Mechanical systems look at efficiency of space heating and cooling, water heating equipment, ventilation, system controls, and duct and pipe insulation. Lighting systems focus on efficiency of lighting equipment and requirements for lighting controls. Building energy codes do not address lifecycle issues related to embodied energy in building materials due to their manufacturing, transportation, and end of life.

The oil embargo in 1973 led the federal government to recognize the need to reduce dependence on foreign energy, setting the stage for both energy supply and demand policies. In 1975, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) published the first version of what was to become *ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings*. This code currently defines energy efficiency standards for commercial construction relating to the building envelope, heating, cooling, and other mechanical and lighting systems. It wasn't until Congress passed the Energy Policy Act of 1992 (EPAct 1992) that there was a federal mandate for states to adopt building energy codes for commercial and high-rise multifamily residential buildings that at least met ASHRAE Standard 90.1[16].

In 1994, the International Code Council (ICC) was established to create comprehensive residential and commercial energy codes. Four years later, the International Energy

[16] ASE. (2013). The History of Energy Efficiency. Washington DC: Alliance to Save Energy.

Conservation Code (IECC) was introduced by the ICC. The IECC standards apply to new and renovated commercial and residential buildings and set requirements for energy performance over building lifetimes, with the goal of reducing lifetime costs while increasing comfort and safety. The IECC references the latest ASHREA Standard 90.1 in its commercial section. The following figure shows the projected savings from subsequent implementation of IECC codes for residential buildings and ASHRAE codes for commercial buildings. Of note is the large jump in efficiency gains post 2009 IECC.

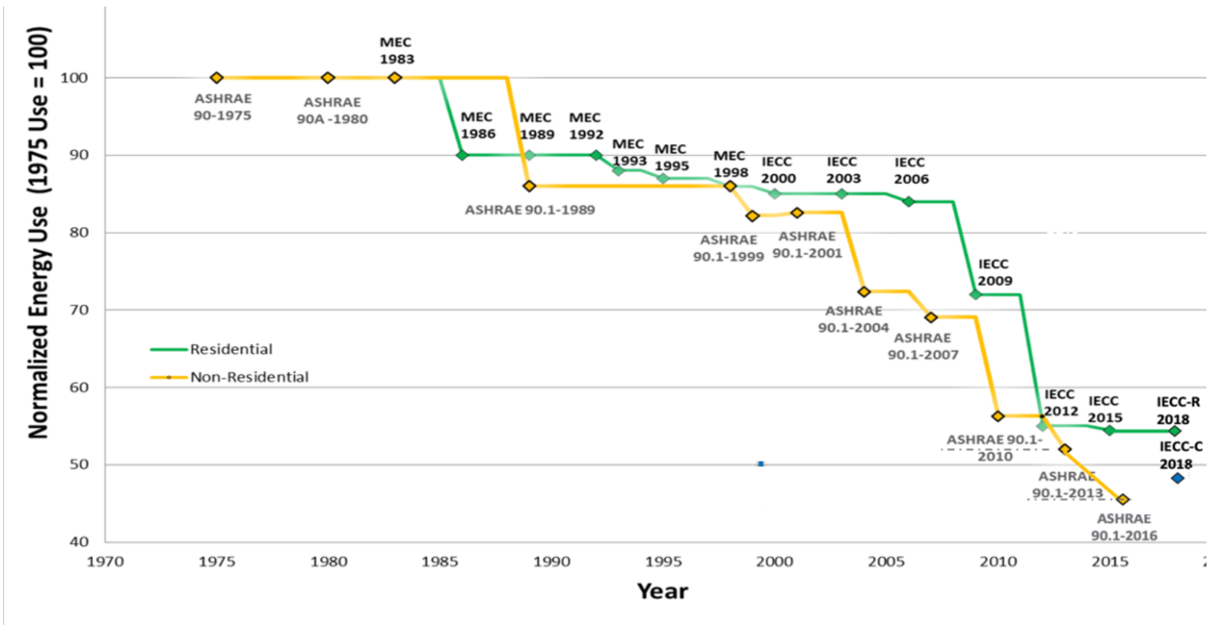

Figure 5: Residential and Commercial Energy Code Stringency (calculated on a code-to-code basis)[17]

Each of these codes are released in staggered 3-year cycles. For example, the latest IECC code, IECC 2018, references ASHREA 90.1-2016. IECC 2021 will be released in 2021.

Code Adoption

Adoption of building energy codes is largely driven by state and local jurisdictions. The IECC and ASHRAE Standard 90.1 serve as the technical baseline standard for most jurisdictions to regulate the design and construction of new buildings. Although federal law requires that states adopt the newest release of codes, or justify non-compliance, there is no means at the federal level for enforcing state action. The figure below shows the substantial variance in state adoption of IECC codes for residential buildings.

[17] Pacific Northwest National Labs

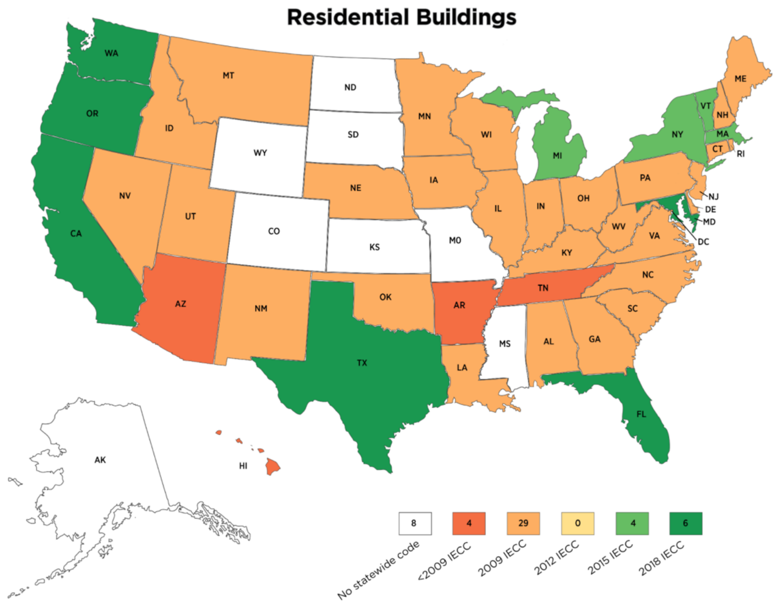

Figure 6: State adoption of IECC Residential Energy Codes, as of 2020[18]

The most recent catalyst for the widespread adoption of building energy codes across states was the American Recovery and Reinvestment Act (ARRA) of 2009, which technically required states to adopt codes (2009 IECC and ASHRAE 90.1 -2007) prior to receiving stimulus funding through the State Energy Program (SEP). Under ARRA, states were also required to achieve 90% compliance with codes (2009 IECC and ASHRAE 90.1-2007) by 2017.

Code status in New Mexico

In New Mexico, codes are proposed by the Construction Industries Division (CID) of the Regulation and Licensing Department (RLD). As part of the process, the new code or code amendments are reviewed by the general construction technical advisory council and a code change committee. Once approved, comments are solicited at public hearings. The final version is prepared by CID staff and sent to the Construction Industry Commission (CIC) for approval. The CIC is composed of nine members appointed by the governor. If approved, the changes are sent to State Records and Archives and they become effective after a thirty-day waiting period.

Local New Mexico jurisdictions that have their own capacity for building inspection can adopt their own building codes, as long as they are stricter than the state's codes. The current commercial energy code in New Mexico is 2009 IECC with New Mexico amendments. ASHRAE 90.1-2010 is an acceptable compliance path through Chapter 5 of the 2009 IECC, effective since 2012. The residential energy code is based on 2009 IECC with New Mexico Amendments[19]. The Construction Industries Division is in the process of modifying and adopting the 2018 IECC codes[20], to be presented for public comment on July 29,2020.

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[18] DOE. Building Energy Codes Program. Status of Energy Code Adoption

[19] Building Codes Assistance Project. State Codes Status: NM

[20] 2018 IECC Compliance Guide for Homes in New Mexico

Pathways to Code Compliance

Implementation of energy codes includes a wide array of stakeholders. Architects, engineers, inspectors, contractors, and sub-contractors will need to understand the building energy codes. A local jurisdiction requires builders to submit plans to its building department, or equivalent, where staff will review the designs for code compliance before issuing a permit for construction. Inspectors will then visit the sites and ensure that the construction matches the approved plan. Building materials manufacturers and suppliers, owners and occupants, and facility managers will all benefit from proper implementation of the most recent code.

IECC allows a builder or developer to select a prescriptive path or performance path, both of which have a set of shared requirements. When choosing a prescriptive path, the code specifies a minimum set of requirements that must be adhered to, such as insulation values (R-values), thermal transmittance (U-values) and controls for HVAC systems. Prescriptive codes are easy to follow for builders, but they also place constraints on skilled builders who might tackle an insulation or design challenge in a more creative way.

Performance paths specify a standard of overall building energy performance, but allow the builder to choose how best to meet the standard. One route for the performance path is to choose simulated performance, which requires that the proposed home has been modeled with software showing that the annual energy costs are less than or equal to a standard reference design. Another performance option, that was introduced in the 2015 IECC, is using the Energy Rating Index (ERI). The codes designate a minimum ERI score for each climate zone that a building must meet. The ERI ranges from 0 (net zero energy) to 100 (the approximate efficiency of a home built to the 2006 IECC code). Each point higher in the ERI represents one percent less efficient and each point lower is one percent more efficient. The buildings are evaluated by a third party ERI evaluator, and must meet a specified ERI threshold. The ERI is similar to the proprietary Home Energy Rating Score (HERS), and most HERS raters can evaluate a home for the ERI.

Key Points

- IECC and ASHRAE Standard 90.1 are updated in 3-year staggered cycles. IECC codes set energy standards for residential and commercial, and reference ASHRAE Standard 90.1.
- ASHRAE Standard 90.1 sets standards for commercial buildings.
- IECC offers builders the choice of prescriptive and performance paths for compliance.
- New Mexico’s energy code requirements are adopted by the state and are based upon a modified version of IECC codes. They have not been updated since 2009.
- A new standard, based on 2018 IECC, will be released for public comment on July 29, 2020.
- Cities and counties that have their own capacity for issuing building permits and conducting inspections can adopt energy codes that are more stringent than the state codes.

3. Building Energy Code Impacts

Building energy codes are a critical tool for reducing energy use in new and renovated buildings. However, despite hundreds of studies carried out by professional evaluators and academic researchers to determine the effectiveness of various energy efficiency policies, there continue to be large uncertainties about the magnitude of program impacts[21]. Although analyses show that energy codes lead to reductions in energy use, the gains are often considerably smaller than the predicted impacts from the engineering modeled calculations.

It is important to appreciate the nuance here: it isn't that the codes don't result in observable energy saving impacts, it is that the impacts are often smaller than the engineering models predicted in advance of the policy.

Accurately assessing the impacts of energy codes on energy usage is difficult. The most common approaches rely on statistical methods for evaluating changes in electricity and natural gas consumption in new buildings, following the implementation of a regional or state energy code update. Several empirical studies over the last decade have estimated the impacts from energy codes range from 3 to 7% in energy savings, with the largest energy savings coming from the reduction of heating using natural gas[22]. These studies use statistical methods that allow the analyst to tease apart the impacts of co-founding variables that might also be impacting energy use changes, such as weather, economic downturns, or energy price changes.

The energy efficiency gap between modeled and predicted impacts may not lie in the efficacy of the energy code requirements. Large changes in energy demand result from the ability of builders to construct the building according to the specifications (which highlights the need for quality training and inspections), and how the building is actually operated and maintained once it is built. Occupant behavior and maintenance of equipment significantly impact building performance. Building energy codes don't provide standards for the majority of appliances and other plug-loads that will be used inside a building, which can account for over a quarter of a building's energy use[23].

Another much-debated phenomena that impacts energy efficiency impacts is known as the "rebound effect"[24]. The rebound effect is based upon the economic theory of demand elasticities: that as prices of a commodity decrease people will consume more of it, and as prices increase, they will consume less. Thus, the theory goes, that as the cost of an energy service decreases due to energy efficiency, its usage will increase. For example, as more energy efficient lighting is installed, users might be less inclined to turn off lights when they aren't

[21] Gillingham, Kenneth, Amelia Keyes, and Karen Palmer. 2018. "Advances in Evaluating Energy Efficiency Policies and Programs." *Annual Review of Resource Economics* 10: 511–532.

[22] Gillingham, Kenneth, Amelia Keyes, and Karen Palmer. 2018. "Advances in Evaluating Energy Efficiency Policies and Programs." Annual Review of Resource Economics 10: 511–532

[23] Quadrennial Technology Review, 2015. Chapter 5: Increasing Efficiency of Building Systems and Technologies

[24] Gillingham et al, 2014. The Rebound Effect and Energy Efficiency Policy

needed, or install more security lighting. This is one reason why control systems for lighting and temperature are important, reducing the negative impact of human behavior.

Modeled Cost Implications of IECC 2018

The U.S. Department of Energy (DOE) commissions an analysis of the estimated economic costs and savings for each release of a new set of IECC building codes. Pacific Northwest National Laboratories performed an analysis looking at the incremental costs and benefits that would result if New Mexico updated its current residential building codes (based upon 2009 IECC) to 2012, 2015, and 2018 IECC codes[25]. The table below shows the predicted incremental annual economic savings and life-cycle cost savings to the occupants due to the energy code requirements, as well as the incremental construction costs for updating from 2009 IECC to 2018 IECC, for each climate zone in New Mexico.

Potential New Code	Climate Zone	Single-Family Prototype (~2400 ft2)	Multifamily Prototype (1200 ft2 Dwelling Unit)	All Residential Dwelling Units
Annual Energy Cost Savings ($/dwelling unit)	3	$514	$131	$468
	4	$385	$96	$361
	5	$324	$81	$314
	6	$442	$92	$412
	7	$501	$103	$465
	State	$402	$106	$377
Life-Cycle Cost Savings ($/dwelling unit)	3	$8,888	$1,588	$8,012
	4	$6,493	$987	$6,040
	5	$5,714	$865	$5,512
	6	$7,026	$613	$6,476
	7	$8,405	$893	$7,722
	State	$6,878	$1,173	$6,397
Incremental Construction Costs ($/dwelling unit)	3	$2,453	$1,176	$2,300
	4	$1,982	$1,020	$1,903
	5	$1,470	$826	$1,443
	6	$2,646	$1,247	$2,526
	7	$2,646	$1,247	$2,519
	State	$1,987	$1,052	$1,908

Table 1: Annual Energy Cost Savings, Life-Cycle Cost Savings, and Incremental Construction Costs to upgrade from New Mexico's current code (equivalent to 2009 IECC) to the 2018 IECC[26].

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[25] Taylor, Z T. 2019. *Preliminary Cost-Effectiveness of the Residential 2018 IECC for the State of New Mexico*. Washington: Pacific Northwest National Laboratory. Memorandum.

[26] Taylor, Z T. 2019. *Preliminary Cost-Effectiveness of the Residential 2018 IECC for the State of New Mexico*. Washington: Pacific Northwest National Laboratory. Memorandum.

The analysis shows significant net benefits for updating to the 2018 IECC codes. For the City of Las Cruces (Climate Zone 3B) the modeling results indicate that a single-family unit would have an incremental cost of $2,453 to implement 2018 IECC codes, relative to 2009 IECC codes, but would result in an annual energy savings of $514, having a simple payback of under 5 years. It would also result in a life-cycle cost savings of $8,888.

Keep in mind that the incremental costs are for model prototype buildings for different climates, and thus provide a rough idea of the costs and benefits for implementation of the new code. Each construction project will be unique, and thus the costs might vary widely. However, it is worth noting that the estimated incremental construction cost for Las Cruces (Climate Zone 3B) for a single-family home is $2,500, which is only 1.1 % of the median sales price for a new single-family home in Las Cruces in 2018 ($225,000)[27].

Implications for Lower Income Households

Increasing energy efficiency in homes of lower income families can provide significant economic benefits. One study found that households earning less than 200% of the Federal Poverty Income spent an average of 16% of their income on energy costs, compared to an average of 3.5% for non-low-income households[28]. The portion of a household's income spent on energy is defined as the household energy burden. A separate study defining low income households as those earning 80% of the median area income found they had an average energy burden of 7.2%, compared to an average of 3.5% across all major U.S. cities[29]. This same study found that raising the efficiency of low income housing up to the standards of the average household would eliminate 35% of their excess energy burden, bringing it down to 5.9%. In other words, if low income families were living in houses with only average efficiency standards, it could significantly lower their energy costs. This is especially important for Las Cruces, which has an average energy burden of 5.4%, compared to a national average of 3.5%[30].

The increased energy burden for lower income households stems not only from their lower incomes, but also due to the fact that they are more likely to be living in homes with poorer insulation standards and less efficient appliances. When a jurisdiction has older codes, it is more likely that the cheaper housing stocks will be the ones built to the lower standards, since lower income families are more price sensitive to up-front costs.

In addition, lower income families are much more likely to rent and live in multifamily housing units. Thus, unlike wealthier families who can commission the construction of a green building, built to higher standards, lower income families are left to choose from housing stock that may

[27] NAHB: Cost of Constructing a Home

[28] Weatherization Assistance Program Technical Memorandum Background Data and Statistics On Low-Income Energy Use and Burdens, 2014

[29] Drehobl, A., & Ross, L. (2016). *Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low Income and Underserved Communities*. ACEEE.

[30] Greenlink. Energy Burden Map of Las Cruces, New Mexico

be built to the minimal code requirements. Therefore, having the most updated energy codes is an equity issue.

There are minimal energy code requirements for builders who are using certain financing mechanisms to construct houses for low- and moderate-income households, though updating to the latest IECC codes would raise the efficiency standards. For example, the Federal Housing Administration (FHA) insures mortgages for low- and moderate-income borrowers, but requires that buildings meet certain minimum standards, including energy efficiency. The Department of Housing and Urban Development (HUD) also requires that each property insured with an FHA mortgage meet one of the nationally recognized building codes or a state or local building code based on a nationally recognized building code.

Developers of a multifamily housing project may be able to put together financing that will subsidize the extra upfront costs that come with building to a higher energy efficiency standard. However, building affordable single-family homes that meet the latest energy codes may result in other unfavorable outcomes to keep costs down. A study looking at single family homes in California found that energy code changes over time resulted in energy reductions for lower income homes. However, a primary driver for the reduced energy consumption was the reduction in square footage, likely caused by an increase in construction costs[31].

Building energy code updates are just one of various policies that will be needed to significantly reduce the energy burdens on low income households. There are a variety of drivers that can lead to high energy costs, as shown in the table below:

Driver	Examples
Physical	1. Inefficient and/or poorly maintained HVAC systems 2. Poor insulation, leaky roofs, and inadequate air sealing 3. Inefficient large-scale appliances (e.g., refrigerators, dishwashers) and lighting sources 4. Weather extremes that raise the need for heating and cooling
Economic	1. Chronic economic hardship due to persistent low income 2. Sudden economic hardship (e.g., severe health event or unemployment) 3. Inability or difficulty affording the up-front costs of energy efficiency investments
Policy	1. Insufficient or inaccessible policies and programs for bill assistance, weatherization, and energy efficiency for low-income households 2. Certain utility rate design practices, such as high customer fixed charges, that limit the ability of customers to respond to high bills through energy efficiency or conservation
Behavioral	1. Lack of access to information about bill assistance or energy efficiency programs 2. Lack of knowledge about energy conservation measures 3. Increased energy use due to age or disability

[31] Bruegge, Chris, Tatyana Deryugina, and Erica Myers. 2019. “The Distributional Effects of Building Energy Codes.” *Journal of the Association of Environmental and Resource Economists* 6(S1): S95–S127.

Table 2: Drivers of high energy cost burden for low income households.[32]

While updated building codes will ensure that new homes and multi-family housing are built to stricter energy standards, other programs are critical to improve access to information, purchase of updated appliances, and renovation of existing homes.

An additional challenge for New Mexicans is the high proportion of households that live in manufactured homes, with 17% of households in the state, and 22% in Dona Ana County. The City of Las Cruces has closer to 10% of households living in manufactured homes[33]. The IECC codes do not cover manufactured housing. The DOE has developed an Energy Star certificate for manufactured homes that meet certain energy efficiency standards, but there is no requirement for new manufactured homes installed in New Mexico to meet them. Local jurisdictions could explore incentives such as tax credits to increase purchase of manufactured homes that are Energy Star certified.

Federal programs that can address some of the challenges faced by low income households include utility bill assistance from the Low Income Home Energy Assistance Program (LIHEAP) and the Weatherization Assistance Program (WAP), which provides grants for energy efficiency upgrades for low income households. However, there is a need to increase the proportion of project funding from utility energy efficiency programs, since the federal weatherization program only reaches a small percent of the households in need.

New Mexico's Mortgage Finance Authority (MFA) funds the Energy$mart weatherization program that works with about 750 low-income families each year using funds from both utilities and federal money. However, more than 200,000 households are eligible, and MFA's current waiting list has over 2,300 households. In the 2020 New Mexico legislative session there were two bills asking for appropriations to increase funding to these programs, but neither passed.

Key Points

- Building energy codes reduce energy consumption in new and renovated buildings, and result in utility bill savings, which can have significant impacts on low-income households.
- Modeling studies estimate annual energy savings of $514 for a single family home in Las Cruces, having a simple payback of under 5 years, and a life-cycle cost savings of $8,888.
- Updating building energy codes has equity implications. A high proportion of low income families live in multi-family buildings; stricter energy codes are one of the most important measures to ensure future occupants benefit from constantly evolving energy efficiency standards.

[32] Drehobl, A., & Ross, L. (2016). *Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low Income and Underserved Communities*. ACEEE.

[33] U.S. Census Data, American Community Survey 2018

- Government and utility energy efficiency programs are critical for reducing energy burdens on low income households living in existing buildings, especially mobile homes.
- Governments could consider tax credits and other incentives to increase the purchase of manufactured homes that are Energy Star certified.

4. IECC Code Compliance

Benefits from Updating Codes

The IECC code is updated every three years. However, there are economic reasons why jurisdictions may be resistant to adopting the newest set of energy codes. Code adoption comes with costs borne by different parties. They include government costs for holding stakeholder hearings, facilitating new code adoption, and training staff and inspectors. Adopting new code will result in time and costs for builders, architects, and engineers to learn how to meet the new code requirements[34] as well as the increased building costs.

However, while adopting the new codes more frequently incurs implementation costs and potential new construction costs, skipping code cycles has numerous drawbacks and far greater economic costs to future occupants and society. Each round of new code incorporates feedback from builders and inspectors, improving upon issues from the prior round of codes. Skipping codes typically means a much greater jump in technology and training needed to "catch up" to the newest codes. The occupants of new construction will have missed out on the energy efficiency gains, increased safety, and financial savings of the skipped cycles.

In the last decade we have seen rapid cost declines in efficient lighting and temperature and mechanical controls. Skipping even one code cycle, which would result in codes not being updated for at least six years, may produce significant missed opportunities for builders to incorporate the latest cost-effective technologies. Keep in mind that many energy efficient technologies may have greater up-front costs but larger lifetime economic returns (such as an LED bulb versus an incandescent bulb). Without updated codes, a low-cost builder might avoid technologies that will provide the future occupants significant long-term benefits.

Many builders work in multiple jurisdictions and will need to increase their skills to match the jurisdiction with the latest codes. The result is that the jurisdiction with the most outdated codes is inadvertently allowing some buildings to be built to a lower standard by those builders who haven't had to learn the latest code updates. Thus, builders with outdated knowledge can build cheaper buildings to a lower standard than those builders who have adjusted to the most recent code. It is usually impossible for consumers to know the efficiency and safety differences between homes built to different code standards, since many of the critical elements, such as insulation levels, aren't readily observable. It is in the best interest of all jurisdictions to update

[34] Brinker, Christine. 2018. *Trends and Observations in Energy Codes. Colorado Edition*. Southwest Energy Efficiency Project.

to the latest codes each cycle, so that there will be no competitive advantage for builders constructing homes to lower standards[35].

One area that hinders the market valuation of energy efficient homes is that many realtors, building appraisers, and mortgage lenders don't account for a building's operational costs in its valuation. Unlike when buying a new appliance, which has federally mandated information regarding its energy consumption, there should be requirements that new homes provide estimates of their annual heating and electricity consumption, allowing buyers, appraisers, and lenders to know the true value of a building.

Adoption of new code is only valuable if it translates to building practices that meet the new standards. Compliance studies carried out in several states by the DOE found that builders were doing well complying with the standards, though the level of compliance varied with requirements. For example, they found that builders often met insulation requirements, exceeded requirements for windows, and were inconsistent meeting lighting requirements[36]. As well, it was found that levels of compliance will be dependent on the training of builders to meet the new code, and will require the will and resources for code enforcement in local jurisdictions. One study estimated costs for energy code enforcement, which involved plan review and inspection, ranged from $50 - $200 for residences and $150 - $1,000 for commercial buildings[37]. The same study found that the time needed for both plan review and inspection for a home could take from 1 to 3 hours. In some cases, such as builders who choose the performance path and an ERI rating, external evaluators are used, reducing the work of government inspectors. The study didn't look at how these costs and times changed with the adoption of newer codes.

Going beyond the IECC

Adoption of the latest IECC building codes should be viewed as the minimum standard that a state should commit its communities to follow. However, each local government entity that has its own capacity for inspection can adopt and pass codes that go beyond the state's codes. This is especially important when the state lags far behind in updating the codes, as New Mexico has done over the past 11 years.

The 2019 Clean Energy Scorecard released by the American Council for an Energy-Efficient Economy (ACEEE), shows 30 cities implementing stricter versions of state codes[38]. A city or county with a building inspections division can require stricter building standards through the adoption of advanced energy codes such as "stretch" codes and Green Building Codes.

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[35] Brinker, Christine. 2017. *Top 9 Reasons to Update to a Newer Energy Code*. Southwest Energy Efficiency Project

[36] DOE. (2015, December). Building Energy Codes Program Single Family Residential Energy Code Field Study.

[37] Vine, Edward, Alison Williams, and Sarah Price. 2017. "The Cost of Enforcing Building Energy Codes: An Examination of Traditional and Alternative Enforcement Processes." *Energy Efficiency* 10(3): 717–728

[38] ACEE. 2019 City Clean Energy Scorecard. Washington DC

Advanced energy codes are a set of legally binding requirements that a city or county has adopted, with more stringent requirements than the state's building energy codes. Requirements can't be adopted that are less stringent than the state's codes. Stretch codes are often standards anticipated to be included in future code releases. For example, New York state passed a model stretch code that local jurisdictions could decide to adopt, leading to overall 11% greater energy savings than the 2018 IECC and ASHRAE Standard 90.1 - 2016 energy codes[39]. The stretch codes include stricter requirements for building envelope, lighting, electric vehicle and solar PV readiness, which will likely all be included in the next cycle of state codes. Las Cruces could consider the introduction of stretch codes that include requirements from the 2021 IECC, once it is released. Or, if the state adopts a version of the IECC codes that includes too many roll-backs and exemptions, Las Cruces could consider adopting the 2018 IECC codes without the modifications.

Adoption of Green Building Codes not only increases standards for energy, but water conservation, resource use, and additional green building practices[40]. Models of Green Building Codes include ASHRAE 189.1, the International Green Conservation Code (IgCC) and the U.S. Green Building Council's LEED standards[41].

The City of Santa Fe has shown leadership in adopting advanced codes for both energy and water efficiency[42]. In order to ensure that new buildings don't increase water demand, the city implemented a water banking and offset program. Water credits are accrued through low-flow toilet retrofits and purchase of water efficient appliances. New building permits are only issued if the developer demonstrates that the water demands of the proposed building will be entirely offset through conservation and the use of water credits from the bank. In 2009, Santa Fe adopted a residential green building code that required all new residences to get a Home Energy Rating Score (HERS) that meets a minimum threshold. In 2017 the City amended the building code to require that all new homes also have a minimum Water Efficiency Rating Score (WERS).

Rather than mandating requirements that are stricter than the most recent IECC, local jurisdictions can implement voluntary incentives that motivate builders to move beyond the base codes. For example, a city might provide exemptions to certain zoning restrictions, such as allowing increased density or commercial construction in a residential zone, or reduce permitting fees if a developer commits to meeting a set of more stringent codes. Local governments might also provide tax credits.

In 2007 the City of Albuquerque implemented its Green Path program, which provided expedited plan review if buildings met a specified LEED standard and HERS rating. New Mexico

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[39] NYStretch Energy Code-2020 - NYSERDA

[40] DOE/SWEEP. Going Beyond Code: A Guide to Creating Effective Green Building Programs for Energy Efficient and Sustainable Communities. Washington DC: US Department of Energy.

[41] NBI. (2018). *Moving Energy Codes Forward: A Guide for Cities and States*. Portland, OR: New Buildings Institute.

[42] City of Santa Fe Green Building Codes

offers a Sustainable Building Tax Credit, which requires commercial buildings to achieve a certain LEED status. Residential buildings must receive a specified HERS rating[43]. Between 2007 and 2015, there were 448 buildings in Dona Ana County that were awarded the tax credit.

Cities and counties can also pass ordinances that require energy use disclosure for all homes listed for sale. This would alert buyers about potential operational costs between building choices, providing an incentive for builders and homeowners to increase or update the energy efficiency of a building. Multiple Listing Services (MLS), a database service used by realtors to list homes on the real estate market, now includes the option of listing a HERS rating for a house. There are some cities and counties in the U.S. that have passed ordinances to implement energy disclosure programs. Santa Fe has required HERS ratings for new homes since 2009, and the rating is required to receive a certificate of occupancy. Alaska, as well as a number of other cities and states, has a utility bill disclosure law that requires sharing average costs for home utility bills before the signing of a sales contract[44]. These types of requirements can protect renters and buyers. Mandating disclosure of building operational costs in a transparent and easily understandable way (like the Energy Star ratings for appliances) is the first step in pushing markets to monetize the value of greater energy efficiency in homes, crucial for the building industry.

And, of course, local governments can lead by doing, demonstrating the economic benefits of implementing stricter energy efficiency standards in new and existing government buildings.

Key Points

- Updating energy codes with each IECC cycle captures cost savings for occupants from new technologies and building techniques and ensures that apartments and less-expensive homes are built to provide minimum energy savings.
- Cities and counties have many options to go beyond the state's minimum energy code requirements, adopting advanced energy codes such as stretch codes and green building codes, as well as providing voluntary incentives for builders to build to more stringent standards.
- Cities and counties should pass ordinances requiring home and building operation costs to be disclosed to buyers and renters, similar to the energy ratings on appliances, providing incentives for builders to push the envelope on energy efficiency standards.

5. Conclusions

The eleven-year lag between the last update to New Mexico's building energy codes, from the 2009 IECC standards, has likely led to increased utility cost burdens to the occupants of many

[43] EMNRD. Sustainable Building Tax Credit Program.

[44] Cuppernell, E. (2015). Existing Home Energy Rating and Disclosure Laws, Programs and Best Practices. New York.

new homes built in the last decade. The greatest burdens are likely falling on the lowest income families who are missing out on the utility cost savings that each code update can deliver. This is especially true in Las Cruces, where there has been significant new construction in the last ten years, and where the average energy cost burden for community members is higher than the nationwide average.

The importance of keeping up with the latest energy codes is especially true for warm southern cities like Las Cruces, which are likely to see a significant increase in hotter days in the coming decades. Constructing buildings to high insulation standards can significantly reduce future air conditioning costs. When a jurisdiction has older codes, it is more likely that the cheaper housing stocks will be the ones built to the lower standards, since their occupants are more sensitive to higher up-front costs. Requiring the latest energy codes for new construction has important equity impacts by reducing utility bills for the poorest occupants.

Staying up to date with the latest energy efficiency codes comes with costs, primarily in the form of education for builders, architects, engineers, inspectors, and government staff. It is important that quality training is accessible to the relevant professions with each new code release.

The arguments by some home builder associations that new codes lead to prohibitive construction costs rarely matches available evidence. While building to higher standards and utilizing newer technology will almost always lead to cost increases, modeling studies conducted by national labs predict savings for the future occupants to exceed building costs by over four times. For the City of Las Cruces, the modeling results indicate that a single-family unit would have an incremental cost of $2,453 to implement 2018 IECC codes, relative to 2009 IECC codes, but would result in an annual energy savings of $514, having a simple payback of under 5 years, and result in a life-cycle cost savings of $8,888.

In the case of multi-family apartments, where developers may be more inclined towards efficiency cost shortcuts since building owners usually don't benefit from utility bill savings, regulation plays an even more important role. A high proportion of low income families live in multi-family buildings; stricter energy codes are one of the most important measures to ensure future occupants benefit from constantly evolving energy efficiency standards. An important intervention could be in working with realtors, lenders, and city councils to propose requirements for home and building operation costs to be disclosed to buyers and renters, similar to the energy ratings on appliances.

New Mexico will likely adopt a version of the 2018 IECC codes before the end of 2020. However, jurisdictions should view the latest IECC codes as a minimum standard. Las Cruces has an opportunity to increase the future benefits to its communities by considering going beyond the state codes, as well as providing incentives for builders to adopt advanced energy codes. While requiring stricter standards through adoption of advanced codes, it can also provide incentives that the building industry can support, such as providing exemptions to zoning restrictions and permitting fees, if additional standards are adopted. Increasing building code standards comes with additional economic development benefits. Utility bill savings decrease energy burdens and increase disposable income for households, which can then be spent within the local community. Stricter energy codes also increase the skills and knowledge of the local building industry, creating opportunities beyond their local markets.

6. Appendix A: Resources for Communicating Code Benefits

The resource library for the Institute for Market Transformation has a variety of educational fact sheets:

- How Cities Can Educate Lenders on Energy Efficiency
- Code Compliance in Cities: Assessing Progress and Identifying Improvements
- Energy Efficiency in Buildings: The Key to Effective and Equitable Clean Energy Action for Cities

The Building Codes Assistance Project provides flyers and sample letters describing benefits of energy codes:

- Flyer for Consumers
- Flyer for Policy Makers
- Sample letters and outreach materials advocating for building energy codes

Southwest Energy Efficiency Projects offers a variety of materials on building energy codes:

- Energy Code Implementation: A Planning Guide for Building Departments
- Commercial Building Benchmarking Programs in the Southwest
- Multifamily Energy Efficiency Retrofits: Barriers and Opportunities for Deep Energy Savings
- Top 9 Reasons to Update to a Newer Energy Code
- Energy Codes are Life Safety Codes

Resources for developing Advanced Energy Codes:

- Going Beyond Code: A Guide to Creating Effective Green Building Programs for Energy Efficient and Sustainable Communities.
- Moving Energy Codes Forward: A Guide for Cities and States. Portland, OR: New Buildings Institute.

7. Appendix B: Interviews

Staff of the Coalition of Sustainable Communities New Mexico conducted a series of interviews with persons in New Mexico knowledgeable about building energy codes. Among the questions posed were:

- How effective are energy codes?
- Are there more effective ways to incentivize energy efficiency among builders?
- What are the biggest challenges for builders to follow codes?
- Is the building industry fairly skilled here in New Mexico, or do you think integrating new codes will be challenging for the workforce?
- What do you think is the current level of compliance for builders? Do you think many builders design and build to higher energy standards than the current code?
- What design features do you think are most critical to get towards a zero emissions building?
- What are the biggest challenges to enforcing codes?
- What impacts do building codes have on the construction of affordable housing?
- Do the codes address water conservation?

The following topic experts generously gave their time to offer their insights:

- John Garcia, Executive Vice President, Home Builders Association of Central New Mexico, June 8, 2020
- Harold Trujillo, P.E., Energy Engineering Bureau Chief, Energy, Minerals and Natural Resources Department, June 2, 2020
- Bob Kreger, Homebuilder, June 8, 2020
- Peter Brill, CEO, Sarcon Construction, June 8, 2020
- Stephen Onstad, Home Designer and Energy Rater, June 8, 2020
- Steve Vollstedt, Home Energy Rater, June 8, 2020
- Amanda Hatherly, Director, New Mexico Energy$mart Academy, Santa Fe Community College, June 9, 2020
- Lisa Martinez, Former Director, Construction Industries Division, June 9, 2020
- Tammy Fiebelkorn, New Mexico Representative, Southwest Energy Efficiency Project, June 11, 2020
- Kim Shanahan, former executive officer of Santa Fe Area Home Builders Association, June 18, 2020
- Eric Biderman, Wingspan Construction, June 24, 2020