# Do Stronger Energy Codes Move Development to Neighboring Jurisdictions?

MEEA
MIDWEST ENERGY EFFICIENCY ALLIANCE

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# Abstract

Building energy codes are an important policy lever to address efficiency goals. As buildings consume around 40% of the world's energy, energy codes can be a cost-effective way to reduce energy consumption, lower energy bills, increase resilience in the face of climate change, improve indoor air quality, and meet decarbonization goals. However, one barrier to adoption is the view that higher efficiency energy codes can negatively impact municipalities by deterring new development and pushing it to neighboring jurisdictions with weaker energy codes. An assessment was needed to understand the real impacts of stronger energy codes on development to address the validity of these concerns. This paper attempts to answer the question: "Do more efficient energy codes move development to neighboring jurisdictions?"

Preliminary analysis from March 2020 found that energy code adoption has no direct correlation on the number of building permits pulled in counties along three Midwestern state borders. Expanding upon these data, this paper and its analysis focus on the state of Illinois and its neighboring states, using 10 years of residential single-family building permit data to compare results of bordering counties in each state. Using both exploratory data analysis and regression, we determine that there is likely not a strong or direct correlation between Illinois's energy code updates and the number of single-family permits applied for in Illinois counties that border other states relative to their cross-border counterparts. Lastly, this paper explores other potential drivers and deterrents of development aside from strong energy efficiency requirements.

# Introduction

Building energy codes contain minimum energy efficiency requirements for residential and commercial buildings. As buildings consume around 40% of the world's raw materials and energy (GlobalABC 2020), energy codes can be a cost-effective way to reduce energy consumption, lower energy bills, increase building resilience in the face of climate change, improve indoor air quality, and meet decarbonization goals. As such, building energy codes are an important policy lever to address efficiency goals.

Yet, one barrier to adoption is the viewpoint that adoption of higher efficiency energy codes can deter new construction, pushing development to neighboring jurisdictions with weaker energy codes. Despite these claims, analysis suggests that energy codes have little to no impact on development. As this misconception can be a barrier to energy code adoption advancement and the subsequent energy efficiency gains that updated codes offer, further analysis was needed to understand if stronger energy codes do substantially decrease development upon adoption.

In March 2020, MEEA conducted a preliminary analysis which found that energy code adoption has no direct correlation on the number of residential single-family building permits pulled in counties along three Midwestern state borders (MEEA 2020). This paper expands on that research, focusing on the state of Illinois and neighboring states to assess whether regular energy code updates have impacted development.

# Background on Energy Codes Adoption

The United States is a patchwork of energy code adoption policies, with differing adoption timelines and processes. Many states are responsible for statewide energy code adoption, but certain states are considered home rule, which relinquishes adoption authority to individual municipalities in that state. Regardless of timelines, processes, or authority, most adopting jurisdictions choose to adopt model energy codes rather than create their own. The most recognized model energy codes and standards, the International Energy Conservation Code (IECC) and ASHRAE Standard 90.1, respectively, are updated every three years as new technologies and construction methods become available. These model codes and standards also increase in energy efficiency over time; ASHRAE 90.1-2022 is estimated to achieve 9.8% gross site energy savings and 9.3% gross carbon emissions nationally over the ASHRAE 90.1-2019 (US DOE 2024b). Similarly, the 2021 IECC is estimated to achieve 9.38% site energy savings and 8.66 % carbon emissions nationally relative to the 2018 IECC edition (PNNL 2019).

Throughout energy code adoption processes, governing bodies may incorporate amendments or updates to the energy codes; supporters of weakened requirements may claim that more stringent codes will increase the cost of construction and encourage development to occur elsewhere.[1] This results in buildings that are constructed to use more energy than if they had been built to unamended model codes.

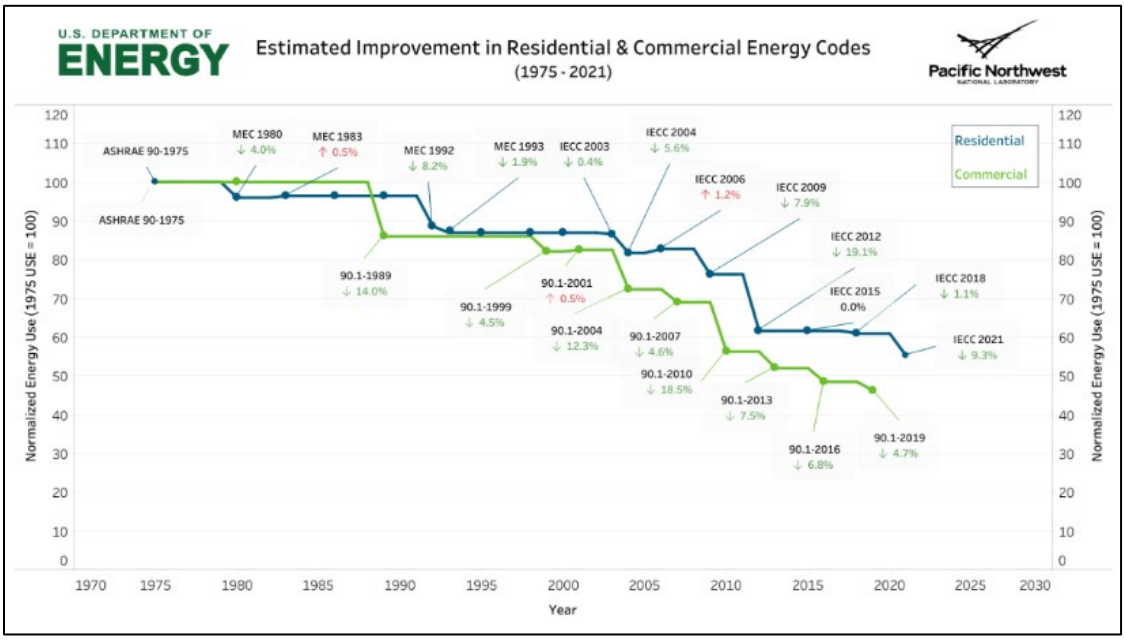
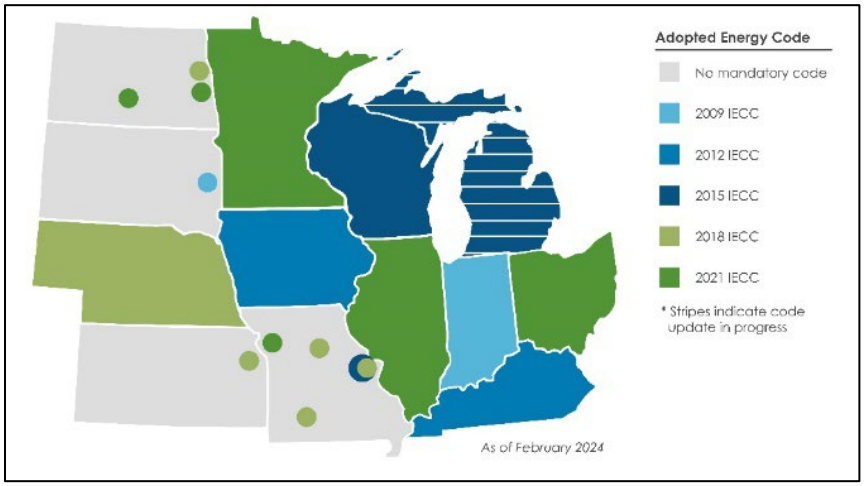



*Figure 1. Estimated Improvement in Residential & Commercial Energy Codes. Source: US DOE 2024a*

## Background on Midwest Energy Code Adoption

The Midwest has a mix of home rule and statewide adopting authorities, and as illustrated in the maps below, code adoptions across the Midwest vary. There are instances where states simply choose not to adopt the most recent model code, and even more common where a current model code is adopted with weakening amendments. For example, residential energy codes are updated less frequently and with less stringency in the Midwest compared to commercial energy codes. The maps on the left show the model code version adopted; the maps on the right show the effective efficiency of the adopted code due to amendments.

[1] The Kansas City, MO City Council is considering weakening the residential energy code from the in-place 2021 IECC that has been effective since July 1, 2023. Some filed comments specify a 22% decrease in permits as evidence the local homebuilding industry is moving outside of city limits due to the energy code (Woods 2024). The matter is still undetermined as of June 2024.



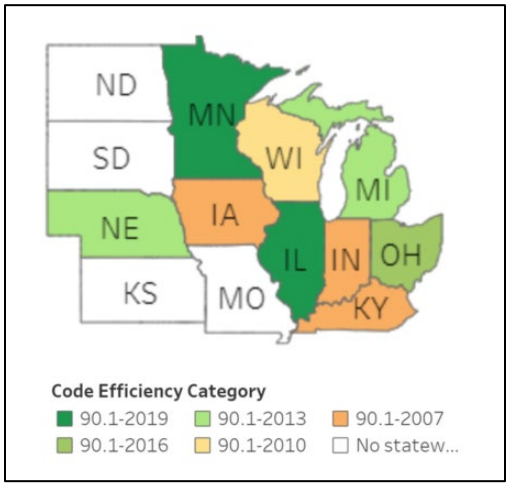
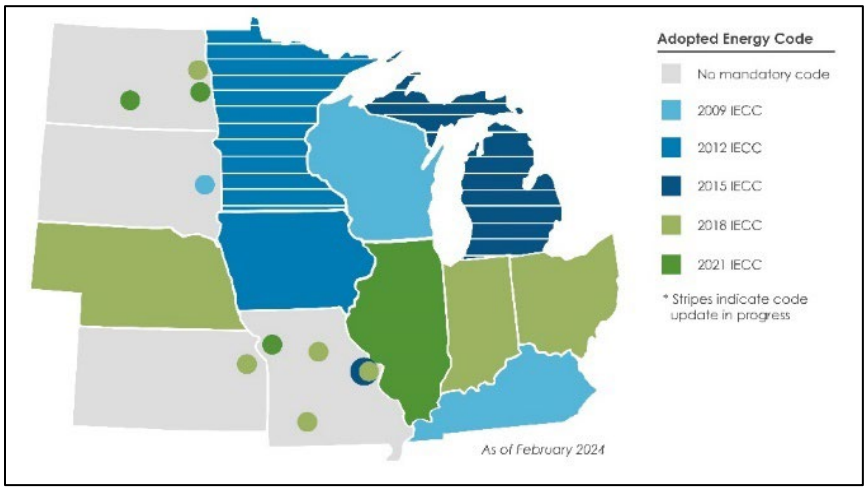




*Figure 2, left. Commercial Model Energy Code Adoption in the Midwest. Source: MEEA Feb 2024.*
*Figure 3, right. State Commercial Energy Code Efficiency, Midwest. Source: US DOE 2024a.*



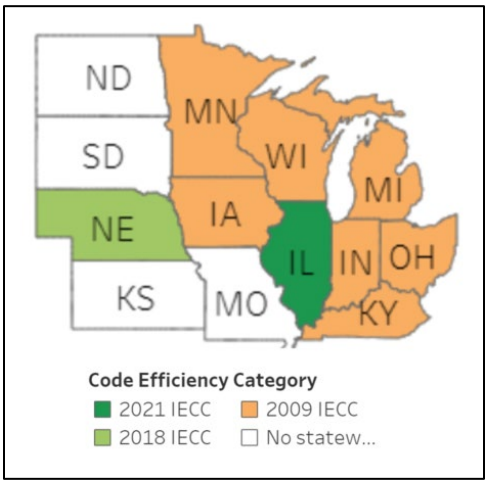




*Figure 4, left. Residential Model Energy Code Adoption in the Midwest. Source: MEEA Feb 2024.*
*Figure 5, right. State Residential Energy Code Efficiency, Midwest. Source: US DOE 2024a*

## Using Permit Data to Assess Energy Codes' Impacts on Development

In this paper, we will focus on permit data to determine whether adopting efficient energy codes has lasting negative impacts to development, using Illinois as an example.

## Background on Illinois and Surrounding States

Illinois is a good candidate for studying whether updated energy code adoption shifts new residential building permits to neighboring jurisdictions with weaker energy codes because it is the only Midwest state required to adopt the newest national model energy codes, effectively putting it on a three-year adoption cycle. While Illinois updates on a regular cycle, the neighboring states do not follow regular code adoption updates.[2] The five bordering states have weaker energy codes and have a wide range of rural and urban densities. This combination offers unique comparisons between Illinois and its neighboring states to understand the effect that building energy code adoption has on building permits across state lines.

Illinois's 2009 Energy Efficient Building Act modified the previous Energy Efficient Commercial Building Act to require the latest version of the IECC as the building energy code for both commercial and residential buildings (EEBA 2024). The building codes, including the energy code, are overseen by the Capital Development Board's (CDB) Division of Building Codes & Regulations. The Illinois Energy Code Advisory Council (IECAC) meets regularly to evaluate energy code issues and provide advice to the board. The CDB reviews and adopts the latest model code within a year of its release. The rule adopting the new code must then be approved by the General Assembly's Joint Committee on Administrative Rules (JCAR) (IGA 2024).

## Methods

The best available data, in terms of reach and accessibility, to understand building permits over a large geographic scale is the Building Permits Survey (BPS) conducted by the U.S. Census.[3] We limited our research to single-family residential homes. To answer the research question of how residential construction might be affected by energy codes, we used this dataset to compare the number of residential single-family building permits between 2007 and 2022 in Wisconsin, Indiana, Missouri, Kentucky and Iowa counties bordering Illinois with the number of permits in corresponding Illinois border counties. The study period spans four Illinois energy code adoption updates in 2009, 2013, 2016, and 2019. The research seeks to quantify the change in permit counts in jurisdictions across state lines that have either weaker or stronger energy codes, and determine if code updates in Illinois correlate to long-term loss of development in Illinois counties.

The data from each of these counties was downloaded into Excel files and processed in data processing software R. The first round of analysis included exploratory data analysis, in which differences over time between Illinois border counties and their respective adjacent county in the neighboring state are compared. The difference between each pair of matched counties was calculated; proceeded by the mean

[2] Missouri is the only compared state with no state energy code, and its cities do not have automatic code updates.

[3] https://www.census.gov/library/visualizations/interactive/bps-new-privately-owned-housing-unit-authorizations.html

and median of those differences. Comparing the annual difference between Illinois and its matched county, we can determine if there is a significant difference in single-family permits on a state-wide level.

Figures 7 through 11 compare the annual number of single-family permits in Illinois to each of its neighboring states individually, allowing for a state-by-state examination in trends over time.

This visualization was followed by a regression analysis to determine if there was a statistically significant difference in the number of permits before and after the code update, controlling for time invariant variables. The regression formula is as follows:

$$SF_{t-1} = \boldsymbol{\beta} * Year_t + \boldsymbol{\alpha} * State_k + \boldsymbol{\gamma} * SFNon_{t-1} + \epsilon$$

- Where $SF_{t-1}$ is the lagged annual number of single-family permits in Illinois
- **β** is a vector of coefficients for each $Year_t$ , from 2010 – 2022
- **α** is a vector of coefficients for each of the *k* non-Illinois states, contained in $State_k$, which are Wisconsin, Indiana, Kentucky, Iowa, and Missouri
- **γ** is a vector of coefficients for the lagged annual number of single-family permits in non-Illinois states
- **ε** is the error term

## Considerations

There are a number of considerations to be acknowledged when looking at permit data for the purpose of understanding the impact of energy code adoption on development. While this research focuses on annual single-family residential permits at the county level and energy code adoption, other factors may impact development or building permitting. Geographic-specific factors, such as schools, property taxes, and access to local amenities like restaurants, recreation, jobs and shopping, are driving forces in a home buying decision. Additionally, developers and future homeowners may prefer one location over the other to the extent that any increase in housing cost would not be a deterrent for purchasing a home in that location. Local and statewide politics can also have an influence on where a person decides to live. Cost per square foot varies by location, independent of energy code requirements, and may impact decisions on where a person can afford to build.[4] A recent U.S. Department of Housing and Urban Development (HUD) and Department of Agriculture (USDA) report provides insight into impacts of new home construction, "HUD and USDA recognize the current affordable housing shortage across the United States, caused by high mortgage interest rates, increased construction costs driven in part by COVID-related supply chain shortages, and an inadequate supply of new housing sufficient to meet demand due

[4] RS Means calculates these costs: https://www.rsmeans.com/estimating-square-foot-cost

to a range of regulatory barriers such as local land use laws and zoning regulations that may limit the production of affordable housing" (HUD 2024).[5]

Another consideration for this research is that while the energy code in Illinois is adopted at a certain time, the code goes into effect later than that date, and that timeline between adoption and enforcement varies per year and per state. In addition to the delay between passing and going into effect, local jurisdictions have the discretion to determine how long to extend permitting of the previous code, which can vary from jurisdiction to jurisdiction. As a result, it is reasonable to examine a year or more past code adoption for an impact. This is a place where further data could be gathered at the municipal level to understand actual effective dates and gain a more granular perspective. Another future enhancement to this analysis would be the use of qualitative research to better understand attitudes around development and energy codes to give additional context to the quantitative data. We recommend conducting interviews or focus groups with city staff, code officials, and representatives from the construction industry.

While this research examines permitting across state lines between two states, each state has unique contextual factors which make comparison across the region difficult. These factors can be difficult to quantify and are not included in the current iteration of this analysis. Examining national trends can help to contextualize state data. For example, between 2007and 2010, the United States suffered a housing crisis that significantly slowed the construction industry. In 2020, the COVID-19 pandemic also affected building construction due to shutdowns and rising building materials prices. Besides those two deviations, the U.S. has seen a steady growth in number of building permits each year.

## *Border County Analysis Results*

The first visual examination of the permitting data highlighted differences over time. Comparing the change in the number of permitted single-family homes by year and between Illinois counties and its corresponding border county, there is no significant difference over time. Figure 6 shows the mean and median difference year over year between Illinois and its neighboring states. Both the mean and median changes, shown with the green and blue line respectively, hover around zero, and zero is contained within the standard deviation, shown in light green shading, for all years, illustrating that there is not a significant difference in the number of permits between Illinois and neighboring states over time. (Note that the standard deviation is noticeably higher in 2008 due to the housing market crash that year.)

[5] The analysis was conducted to understand the impacts of updating their minimum energy codes, ultimately finding that they did not negatively impact affordability or availability of housing. On April 26, 2024, HUD and USDA adopted the 2021 IECC and ASHRAE 90.1-2019 as the minimum energy efficiency standards for affordable housing built through their programs.

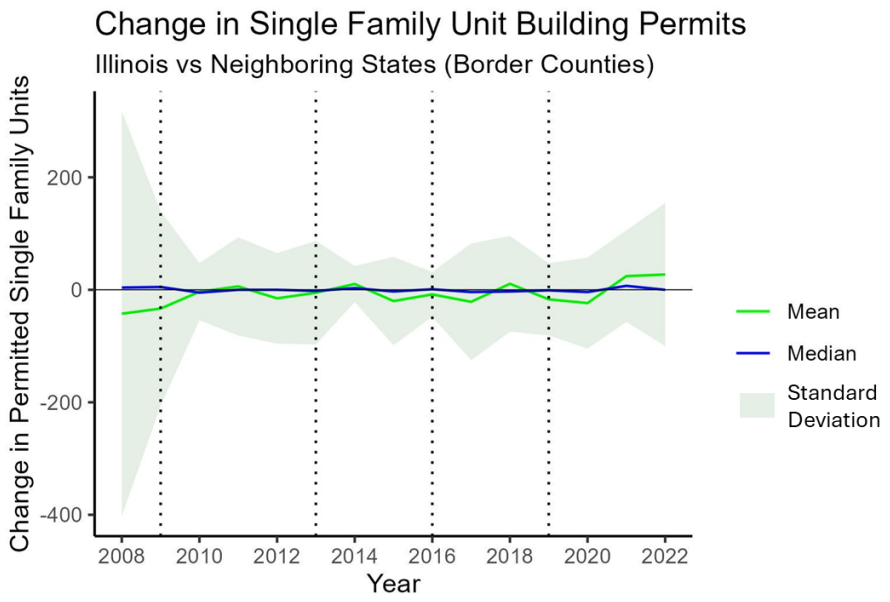



*Figure 6. Change in Single-Family Building Permits, Illinois vs. Neighboring Border Counties*

The following figures display the number of single-family permit numbers along the state borders. The shaded area around the trend lines represent 95 percent confidence intervals; there is a 95 percent chance that the actual values of single family permits lie within the shaded region. Illinois updated its energy codes in 2009, 2013, 2016, and 2019, so we could expect to see a shift around those years if single-family construction moved to the neighboring counties. Below we provide description of each state-by-state comparison. Below, we discuss each border state individually.

## Indiana and Illinois

The general trend of total permits in the border counties of both states followed a similar pattern across all years regardless of code updates, suggesting that the regular Illinois code updates have not had a noticeable impact on development. Indiana has had the efficiency equivalent of the residential 2009 IECC since 2012, including an update to a weakened model 2018 IECC in 2020.

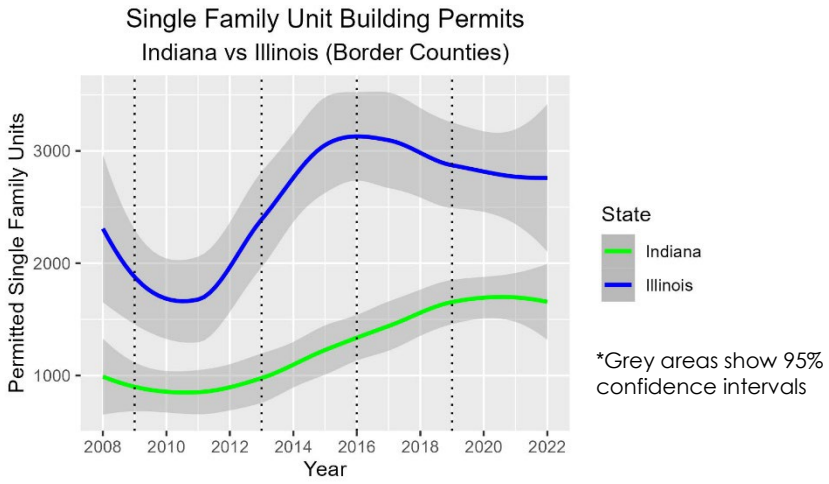



*Figure 7: Indiana and Illinois border counties annual building permits. The dotted lines represent the years Illinois passed/implemented an updated energy code.*

## Iowa and Illinois

While Illinois experienced a steady gradual decrease in building permits over the study period, Iowa saw an increase until 2012 and then a precipitous decline over the rest of the years. Iowa has not updated its residential energy code since 2014 (2012 IECC).

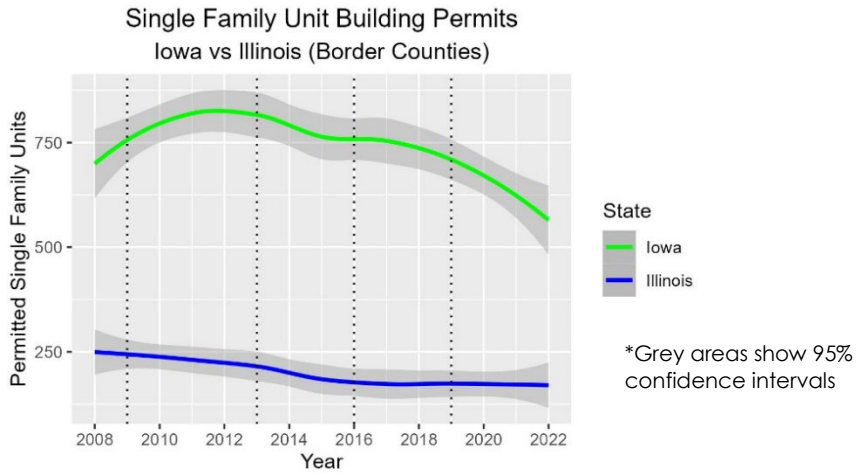



*Figure 8: Iowa and Illinois border counties annual building permits. The dotted lines represent the years Illinois passed/implemented an updated energy code.*

## Kentucky and Illinois

Kentucky building permits saw a substantial increase between 2008 and 2015, and then a sharp and steady decline through 2022. Kentucky last updated its residential energy code to the 2009 IECC in 2014. Illinois permits remained steady in the counties bordering Kentucky, regardless of energy code adoption updates.

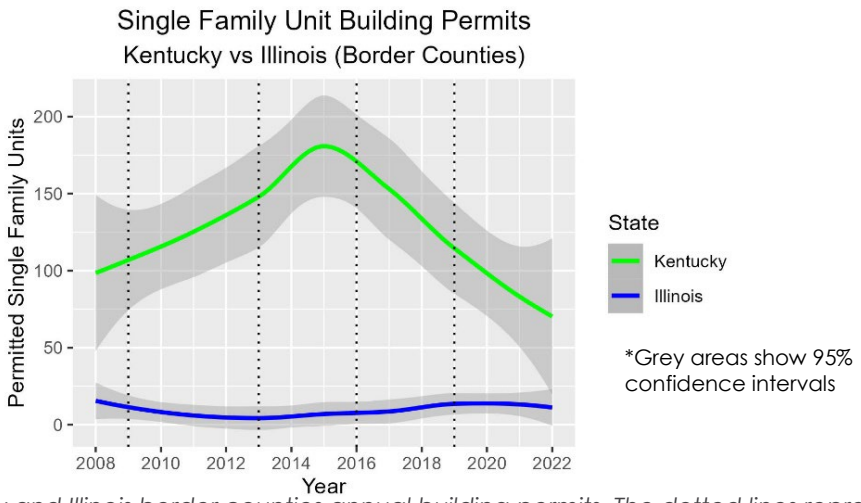



*Figure 9: Kentucky and Illinois border counties annual building permits. The dotted lines represent the years Illinois passed/implemented an updated energy code.*

## Missouri and Illinois

Missouri building permits increased in 2013 and 2016 (2012 IECC and 2015 IECC adoption in Illinois), with a slight decrease in Illinois at its 2009 update. Following these years, however, Illinois permits remained steady in the counties bordering Missouri, and both states began to drop after 2019.

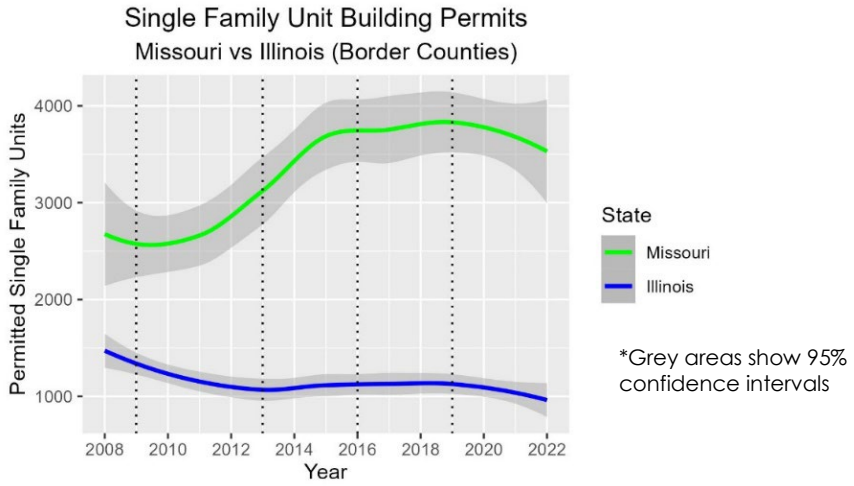



*Figure 10: Missouri and Illinois border counties annual building permits. The dotted lines represent the years Illinois passed/implemented an updated energy code.*

## Wisconsin and Illinois

The general trend of total permits in the border counties followed a similar pattern in both states regardless of code updates, although it appears to deviate after the 2019 code update; Illinois appears to continue an upward trend while Wisconsin begins to decrease. Wisconsin last updated its residential energy code in 2016 to an amended 2009 IECC.

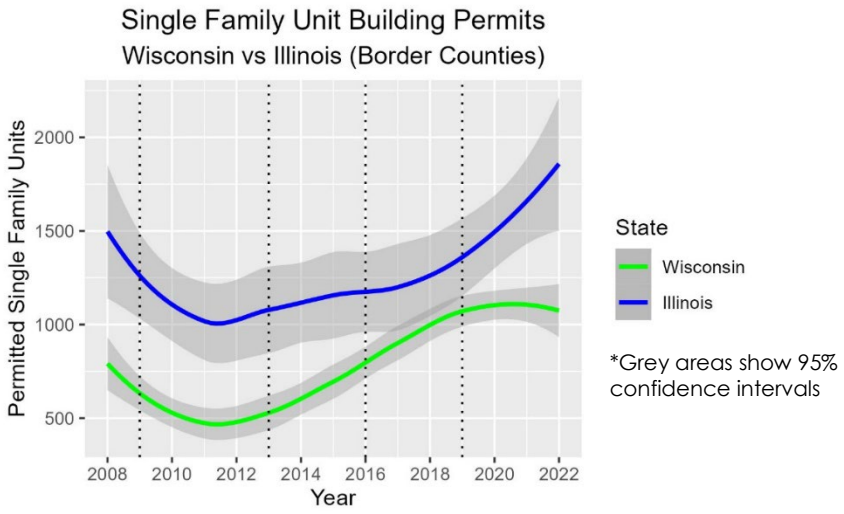



*Figure 11: Wisconsin and Illinois border counties annual building permits. The dotted lines represent the years Illinois passed/implemented an updated energy code.*

## *Regression Results*

A regression analysis was conducted using the single-family permit data for Illinois's and adjacent states' border counties to determine if there is a significant difference in year over year change. The analysis yielded a result showing that year-over-year change in Illinois housing permits is strongly correlated with year-over-year change in adjacent states, with a p-value of less than .001[6] (see full table of results below in Table 1). This correlation is meaningful because it illustrates that the year-over-year change in permits in Illinois and neighboring states are fluctuating in the same direction, indicated by a positive coefficient of 0.177; if permits were deterring development, we would expect to see Illinois fluctuating in the opposite direction from neighboring states.

Another key finding from the regression is that there were no consistent state level differences in year-over-year permit changes. Between 2010 and 2020, the model did not detect any significant differences, and saw the average fluctuate randomly each year. 2021 and 2022 had a significant correlation, positive and negative respectively, yet there is not sufficient indication to suggest that this change is due to the code update passed in 2019. If we were to detect an impact from Illinois code updates, we would expect to see Illinois drop significantly in the years following a code update (i.e., 2014, 2017, 2020); yet the lack of state level differences suggests that Illinois and neighboring states display similar development patterns.

[6] Note that data for 2007-2009 were removed due to the housing market crash of 2008, which would impact the correlation.

**Table 1: Model Regression Results.**

| Dependent variable | lagSF Estimate | lagSF Standard Error |
|---|---|---|
| Year2010 | -2.2 | (9.5) |
| Year2011 | -10.4 | (9.5) |
| Year2012 | 9.1 | (9.5) |
| Year2013 | 10.0 | (9.5) |
| Year2014 | 4.4 | (9.5) |
| Year2015 | -6.2 | (9.5) |
| Year2016 | 3.7 | (9.5) |
| Year2017 | -3.4 | (9.5) |
| Year2018 | -6.7 | (9.5) |
| Year2019 | -15.4 | (9.5) |
| Year2020 | -9.8 | (9.5) |
| Year2021 | 32.3*** | (9.5) |
| Year2022 | -19.3** | (9.6) |
| state_nonILIN | 9.9 | (6.8) |
| state_nonILKY | 1.2 | (11.6) |
| state_nonILMO | -3.1 | (6.6) |
| state_nonILWI | 7.5 | (7.6) |
| lagSF_nonIL | 0.2*** | (0.03) |

| | | | |
|---|---|---|---|
| Observations | 533 | Residual Std. Error | 52.8 (df = 515) |
| R2 | 0.1 | F Statistic | 4.7*** (df = 18; 515) |
| Adjusted R2 | 0.1 | Note: | *p<0.1; **p<0.05; ***p<0.0 |

# Conclusions

The data analysis described in this paper indicate that there is not a clear negative or positive impact of energy code adoptions in counties on state lines, suggesting that the adoption of stronger building energy codes in Illinois does not cause development to shift into neighboring states. Given the lack of a clear relationship between permit data trends in Illinois border counties with permit data trends from adjacent states' bordering counties, we can conclude that energy codes are likely not a primary driver of development or a lack thereof. It is critical that policymakers and other decision-makers fully understand this relationship to sufficiently support both community goals and housing needs objectives. More research may be needed to understand statistical significance, evaluate the relationship more granularly, and gain a more comprehensive understanding of perceptions of energy codes and building.

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