Energy Code Decarbonization Pathway to Accommodate the Ninth Circuit Court Ruling

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ABSTRACT

Energy codes provide the most direct and effective means of eliminating carbon emissions from new and remodeled buildings by prohibiting fossil fuel combustion equipment, but the legality of this strategy was thrown into question with the recent Ninth Circuit Court ruling against the City of Berkeley, California. An alternative approach was proposed for the Washington State Energy Code, permitting use of gas-fired heating and water heating equipment where the applicant demonstrates annual building energy use no greater than that of a heat pump-equipped building. The energy code's existing "additional efficiency credits" system was proposed as the vehicle for demonstrating the specific energy reductions used to achieve this equivalency. To adapt the additional efficiency credits system for this new use, the energy use of five prototypical buildings was evaluated, utilizing either electric heat pump systems or gas systems for space heating and water heating. The difference in site energy was then calculated for each prototype and each Washington state climate zone to determine the difference in efficiency between the heat pump and gas systems. Finally, those results were used to translate the efficiency difference into an additional number of efficiency credits that gas-based buildings would be required to obtain when complying with the prescriptive pathway. This study will provide a comprehensive summary of the modeling work undertaken to support the code change and will further evaluate how the Washington State Energy Code approach could be used in other energy codes, including the IECC.

INTRODUCTION

Several U.S. states and jurisdictions, as well as national code-setting bodies, such as ASHRAE, have set goals to fully eliminate CO_2 emissions from new buildings, necessitating the elimination of fossil fuel-burning equipment in new construction. However, some of these efforts face legal challenges following the Ninth Circuit Court of Appeals holding in *California Restaurant Association v. City of Berkeley* that states and local jurisdictions are preempted from prohibiting fossil fuel use in buildings where such a prohibition would have the effect of preventing the use of fossil fuel-burning equipment subject to federal appliance efficiency standards. The court's ruling challenges how motivated jurisdictions can best maintain continued progress towards decarbonization while still complying with the court's interpretation of federal preemption under the Energy Policy and Conservation Act of 1975 (EPCA).

EPCA authorizes the U.S. Department of Energy to update appliance efficiency standards for specified consumer products and commercial equipment. Once a standard is established, EPCA then prohibits states and local governments from setting standards regulating the energy efficiency or energy use of those appliances that are already subject to a federal minimum efficiency standard. The U.S. Department of Energy maintains standards for most major fossil-fuel-burning appliances, such as furnaces, boilers, water heaters, and clothes dryers, and has separate standards for gas burning appliances and for appliances that use electricity.

In *California Restaurant Association v. City of Berkeley*, the court ruled on a Berkeley ordinance that prohibited new gas connections to buildings as a matter of public health and safety. The California Restaurant Association argued that this ordinance had the effect of preventing the people in those buildings from using otherwise lawful gas appliances that were subject to minimum federal efficiency standards, and that therefore Berkeley was preempted from adopting such an ordinance. The Ninth Circuit agreed that Berkeley's ordinance was preempted.

Specifically, the court held that the term "energy use" implied a right of consumers to purchase and "use" any products covered by federal efficiency standards, and that any regulation of that energy use was therefore preempted.

However, the court did not examine one of EPCA's exemptions to preemption for appliances regulated in building codes that meet seven specified criteria, as this exemption was not raised in earlier court proceedings. Specifically, 42 U.S.C. section 6297, subsection (f)(3)(C), allows building codes to regulate appliances as long as the code provides at least one pathway to use equipment that just meets the minimum federal efficiency standards, and that pathway is equal to other compliance pathways "…on a one-for-one equivalent energy use or equivalent cost basis." The Ninth Circuit has previously applied this subsection to uphold Washington's energy code against claims of preemption in *Building Industry Association of Washington v. Washington State Building Code Council*, 683 F.3d 1144 (9th Circ. 2012), but no court has interpreted the meaning of this specific phrase. It could refer to site energy use, source energy use, consumer energy costs, societal costs, or some other metric. This leaves an opportunity for states and local jurisdictions to craft an energy code that conforms to the preemption exemption while creating lawful pathways to build zero-carbon buildings.

In response to a the Ninth Circuit's decision in *California Restaurant Association v. City of Berkeley*, 89 F.4th 1094 (9th Cir. 2023), the state of Washington amended its Energy Code to provide a viable code compliance path using fossil fuel heating and water heating equipment. Use of this path for a building with fossil fuel heating and water heating maintains the overall energy efficiency of a building with heat pump equipment. This paper will provide a brief overview of the legal drivers for the change in the Energy Code, then examine in detail the modeling approach used to support the new compliance path, including how Washington assessed the number of additional efficiency credits required for five building types.

PROPOSED CODE SOLUTION

This "*one-for-one equivalent energy use"* phrase provided the basis for the code proposal – allowing less-efficient gas equipment usage in trade for improved energy efficiency in other aspects of the building. Heat pumps are significantly more efficient at producing heat than fossil fuel combustion equipment. As an example, EPCA-minimum efficiency for many gas-fired boilers is 80%, meaning that only 80% of the energy consumed by the equipment is converted to useful heat. Electric resistance heating converts a full 100% of the incoming electricity to heat. However, an electric heat pump converts 250 – 300% of its annual incoming electricity to heat, because "squeezing" heat out of the ambient air is much more efficient than other methods of generating heat. The basics of this technology are well established, essentially operating within every domestic refrigerator, but applications to whole buildings are a somewhat more recent development, becoming commonplace largely over the past decade.

Creating equivalent gas and heat pump compliance paths could be relatively straightforward for the performance (energy modeling) path that allows different combinations of components and design strategies to achieve a set energy use target. That path could in theory satisfy the EPCA requirement for an equivalent code. However, energy modeling is expensive and in many states is used only for a small fraction of all projects. In addition, at least one federal district court has disqualified this approach (*Air-Conditioning, Heating, and Refrigeration Institute v. City of Albuquerque*, 835 F. Supp. 2d 1133 (2010)). Therefore, it was decided that EPCA-compliant pathways for both the performance and prescriptive paths were required.

It would be difficult to devise an energy code with separate prescriptive requirements for gas-heated and electric heat pump-heated buildings, each of which resulted in equivalent annual energy use. Fortunately, Washington state and certain national efficiency standards already include robust "additional efficiency credits" systems, which require commercial and multifamily projects to select a certain number of above-code features from a list of options. This credit system was able to serve as the basis for Washington state's development of a "fossil fuel compliance path" (FFCP) to parallel the existing heat pump compliance pathway in the main body of the code.

HOW WASHINGTON STATE DEVELOPED APPROACH TO AN EPCA COMPLIANT CODE

In the wake of the Ninth Circuit Court's Berkeley decision, the Washington State Building Code Council (SBCC) solicited code change proposals to mitigate the risk of federal preemption challenges to the state energy code. Several proposals were submitted and subsequently evaluated by the SBCC's Energy Code Technical Advisory Group (TAG) in a series of public meetings. Two proposals for the commercial energy code were further refined through the TAG process and forwarded to the SBCC for a final decision. The selected proposal (SBCC Meeting, 2023) was incorporated into the 2021 Washington State Energy Code-Commercial (WSEC, 2021), which went into effect statewide on March 15, 2024.

Whereas the original version of the energy code required use of heat pumps for space heating and water heating, the selected code change established a "fossil fuel compliance path" (FFCP) to permit use of fossil fuel appliances. Heat pumps are significantly more efficient than fossil fuel boilers and furnaces, and therefore the FFCP requires buildings using fossil fuel appliances to compensate for the reduced efficiency by incorporating additional efficiency measures selected from a list of options. Consistent with EPCA's building code exception to preemption, the compliance pathways would need to be equivalent on a one-for-one basis in terms of energy use or energy cost. As outlined below, considerable analysis was required to determine the appropriate number of efficiency credits that would ensure that buildings using fossil fuel appliances use the same annual energy as heat pump buildings.

Analysis of Equivalency

Before the fossil fuel compliance path could be implemented, extensive analysis was required to determine the level of energy equivalence and on how to translate the existing energy code language and compliance credits. The main source of new data to establish equivalency between building using fossil fuel equipment and electric heating equipment was whole building energy modeling. Prototype building models previously used for Washington State Energy Code evaluations were utilized to create all-electric and all-gas versions. The steps of the analysis from energy equivalence to code criteria are as follows:

- Using whole building energy modeling, determine the difference in annual site energy use between buildings using fossil fuel equipment and buildings using electric heat pumps for both space heating and water heating, for a representative set of building types and for each Washington state climate zone
- Reviewing the previous calculations and factors used, convert additional efficiency credit table values of the Washington State Energy Code from “carbon emissions” to “site energy use.”
- Reviewing the analysis results from the simulated models, for each occupancy type, determine the additional number of efficiency credits that would be required for the annual energy use of a gas-heated building to equal that of a heat pump building.
- Identify and revise sections of the Washington State Energy Code to conform to this change.

As it happened, two separate energy modeling and analysis teams, one led by Rocky Mountain Institute and another led by the City of Seattle, embarked on this process simultaneously, and their results largely matched. Where there were significant differences, the team members conferred and re-ran calculations with appropriate modifications, after which the results from the two analyses aligned even more closely. Although unplanned, this duplication of modeling work added a significant level of confidence to the accuracy of the results.

METHODOLOGY

For the Washington FFCP approach, energy modeling of prototypical buildings was used to evaluate energy use with two fuel options for space heating and water heating for each building; one based on electric heat pump equipment and one based on natural gas combustion equipment. The annual energy use for each gas-using building was compared with the annual energy use of an all-electric configuration to determine the whole building energy difference and what amount of energy savings would be needed to reach equivalency.

The models were developed from a set of pre-existing EnergyPlus models developed for 2018 WSEC-C evaluations, which in turn were originally modified from the Department of Energy (DOE) standard non-residential building prototypes. Models were simulated in Energy Plus version 22.1 and were evaluated in two ASHRAE Climate Zones, 4C and 5B in Washington State, utilizing Seattle and Spokane weather files. Five building prototypes were developed to determine site energy use and efficiency credit differences. Due to time limitations, the analysis only evaluated five of the standard sixteen building prototypes, to focus on the major segments of building construction, representing approximately 60% or more of new construction, based on reviewing a sample set of building records (City of Seattle). The models were mapped to specific building sectors as shown in Table 1 below:

Table 1: Building Prototypes included in the Energy Modeling analysis.

WSEC Occupancy Group	Brief Description*	Building Model Utilized
Group R-1	R-1 = Hotel	Hotel Small
Group R-2	R-2 = Multifamily	MF Apartment Midrise
Group B	B = Office	Office Medium
Group E	E = School	School Primary
Group M	M = Retail	Retail Stand Alone
All Other	X = all other	Average of All Models

**Complete details of the occupancy groups' building types are included in the 2021 WSEC*

From this mapping and from simulated runs from Washington's two climate zones, the incremental energy savings for gas configurations were determined on a whole building basis. These savings were then converted into the additional energy efficiency credits a building would need to substantiate using the available efficiency credits in WSEC section 406.

Key Assumptions

Models were modified to generate the different heating components necessary to accommodate the two different fuel options. For the electric option, heat pumps (HP) were evaluated for space heating and heat pump water heaters (HPWH) for hot water. Central gas systems were modeled as boilers and unitary air heating systems modeled as furnaces.

Efficiency values for each heat pump unit were derived from minimum efficiency criteria tables as outlined in Section C403 of the 2021 WSEC-Commercial provisions. For all HPWH models, the heat pumps were configured along with an electric heating element in the secondary swing tank. For centralized systems, electric resistance was included in the secondary swing-tank, which provided heating to compensate for the recirculation loop pipe losses in the buildings. HPWH efficiency for unitized and central systems was determined at two different values as shown in Table 2:

Table 2: Heat Pump Water Heater efficiencies modeled in the prototypes.

DHW System	Efficiency	WSEC Source
HPWH unitized (stand-alone without pump)	UEF ≥2.24 (WA 2021)	Table C404.2

HPWH central	COP 2.31 for CZ4c COP 1.63 for CZ5b	Table 403.3.2(15) by OA temperature

Space heating systems were modeled as air to water HPs in the medium office prototype, as split system HPs in the apartment midrise and as packaged HPs in all other prototypes. Air-to-water HP efficiency varied by climate zone, with CZ-4C utilizing equipment at a COP of 2.77 t and an outside air (OA) dry bulb (DB) temperature of 47°F, and with CZ-5B utilizing equipment at a COP of 1.95 and an OA DB temperature of 17°F. A central boiler was evaluated in the medium office prototype for the gas system at 84% efficiency, and furnaces in all other models at 80% efficiency.

The medium office prototype was updated to better reflect the anticipated heating energy use of buildings. Envelope assumptions in all modeled buildings were updated to better represent heating loads, including changes in air leakage coefficients and window U-factors, and to account for thermal bridging of the window and wall intersections. Internal gains were reduced, thus requiring more heating, with reductions in elevator power, office equipment power density, occupancy schedule value peaks, and lighting schedule value peaks. Additionally, the office domestic hot water flow rate at peak was reduced to better align with expected office water heating demand. Detailed modeling assumptions are available at the Washington State Building Code Council website (Bulger et al. 2023).

RESULTS

Gas vs. electric energy use comparison in select prototypes

The modeled buildings resulted in site energy use intensity values for gas and electricity. Results for space heating and water heating were broken out to determine the additional efficiency required for both systems. Figure 1 summarizes the site energy use of four of the five building prototypes modeled.

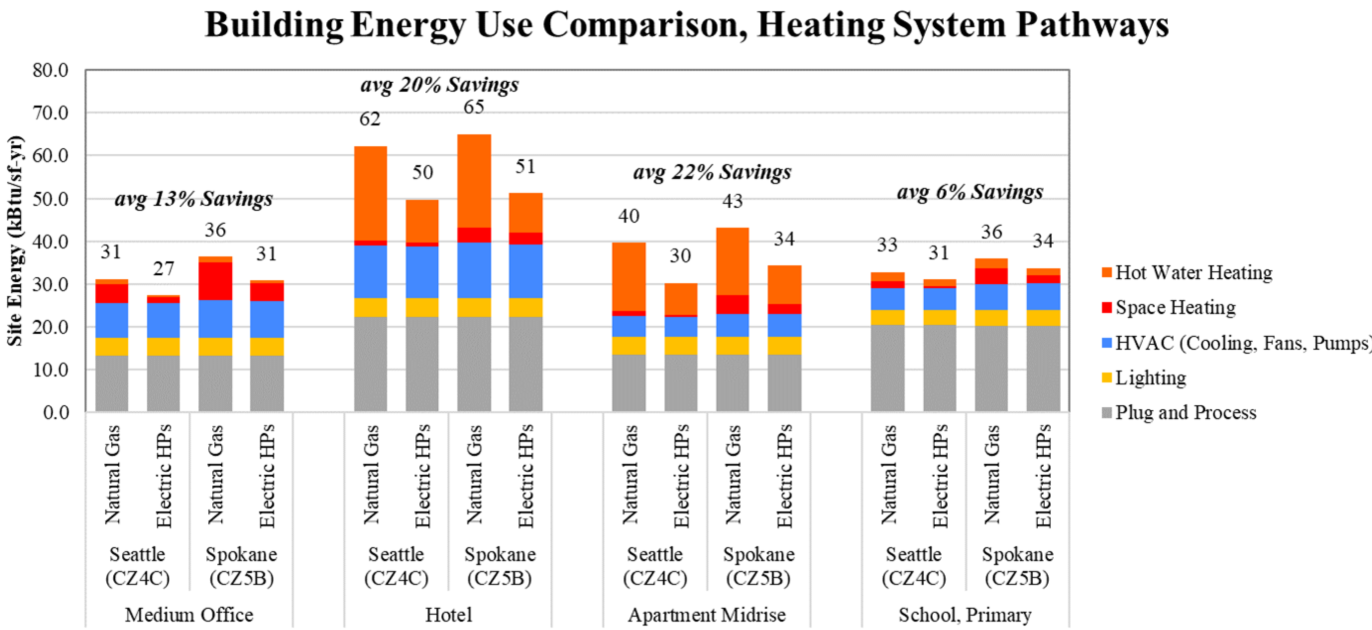

Figure 1: Site energy use comparison of four building prototypes

Table 3 lists the additional efficiency credits weighted by climate zone with 75% of statewide construction estimated to occur in CZ-4C and 25% of construction in CZ-5B.

Table 3: Additional efficiency credits weighted by climate zones for the building prototypes.

	Space Heating Credits			Domestic HW Credits		
Building Model	CZ4C	CZ5B	Weighted Average	CZ4C	CZ5B	Weighted Average
Office Medium	93	126	**101**	28	25	**27**
Apartment Midrise	17	45	**24**	219	159	**212**
School Primary	33	54	**38**	20	10	**17**
Retail Stand Alone	98	149	**111**	83	66	**79**
Hotel Small	6	11	**7**	196	202	**198**

Additional efficiency credits required to equalize energy use

Under the current code, the additional efficiency credits a building needs are calculated based on requiring one additional credit for each 0.1% energy use. For example, for 10% on-site energy savings, the building would need 100 additional efficiency credits, on a whole building basis. For the building types examined, the additional energy efficiency required to make a fossil fuel heated building as efficient as a heat pump building, using the FFCP, requires a relatively large number of credits. Figure 2 below shows Group B buildings, for example, requiring 42 credits with heat pump heating and water heating, but 219 credits when using fossil fuel equipment.

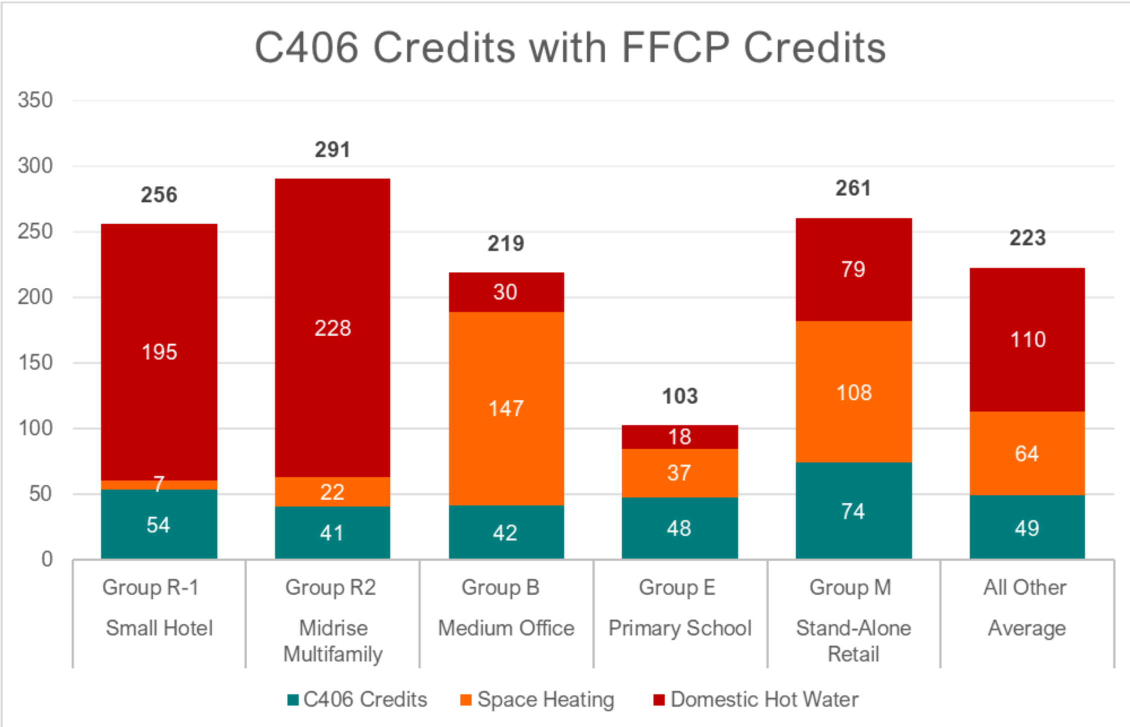

Figure 2: Additional efficiency credits for Fossil Fuel Compliance Path (FFCP)

Formula to exempt heating capacity that complies with an exception in the base code

The Washington State Energy Code exempts portions of certain building types from the heat pump requirements, allowing use of electric resistance heating for small or infrequent loads. One significant example occurs in multifamily dwelling units, in which habitable rooms are permitted to utilize small electric resistance heaters. Certain small water heaters are also exempt. Clearly, additional efficiency credits should not be required where electric resistance heating was already allowed in the base code. Therefore, a formula was developed to ensure that additional credits are not required where heat pump heating or water heating was not required in the base code.

The formula (corrected) is the following:
CR = A x (C - B)/D

Where:
CR = Additional credits required, rounded to the nearest whole number.
A = Baseline HVAC heating credits from Table C401.3.3
B = Installed space heating capacity in kBTU/h of space heating appliances that comply with any of the exceptions to Section C403.1.4
C = Total installed fossil fuel or electric resistance space heating capacity in kBTU/h of all HVAC heating appliances
D = Total capacity in kBTU/h of all types of space heating appliances

Potential challenges to the FFCP

Following the inclusion of the FFCP within the Washington State Energy Code, a lawsuit brought by a homebuilders' organization was modified to indicate that "Even as amended, these regulations effectively eliminate natural gas or propane use in commercial buildings and multifamily complexes…" The homebuilders' argument is based on the large scope of additional efficiency work required to make a gas-heated building as efficient as a heat pump-heated building, which makes the fossil fuel-heated building a more expensive choice. However, the EPCA preemption exemption requires alternative compliance pathways to be equivalent in energy use or energy cost; it does not require states to equalize construction costs between compliance pathways.

Parallel approach for residential energy code in Washington state

The residential portion of the Washington State Energy Code uses a similar but less complex strategy. In Washington state, the residential energy code applies to single-family houses, townhouses, and a minor category of low-rise multifamily buildings; all other buildings are governed by the commercial energy code. The system used in the residential energy code requires eight energy efficiency credits for medium-sized homes. In addition, the Washington state code requires additional credits from a "fuel normalization table," which awards three credits to heat pump-heated homes, but no credits to a gas-heated home. This allows installation of gas equipment, but requires construction of a considerably more energy-efficient home to make up for the loss in heating efficiency. These new code provisions may not greatly impact current construction practices in the state, as a recent study (NEEA, 2023) showed that the great majority of houses were already meeting their efficiency credit requirements using heat pumps.

Format and location of the new FFCP in the commercial energy code

The code development process included an extensive discussion regarding the best format for this code change in the commercial energy code. The selected option placed most of the FFCP requirements into a single section in the code, including directions to make certain changes to other portions of the code when using the FFCP, and the addition of a new FFCP credits table in Section C406. The option that was *not* selected made changes to many existing sections spread throughout the code. The principal argument in favor of the first option, keeping all the FFCP requirements in one place, was that it made it easier for anyone considering use of that path to find and understand all the relevant requirements. In addition, if future legal or legislative developments were to eliminate the need for this compliance path, or to render it undesirable for other reasons, it would be easier to extract from the code.

Performance path in the 2021 WSEC

The FFCP is an alternative path for WSEC prescriptive code compliance. The performance path was also revised to comply with the Ninth Circuit Court decision. The original metric for the performance path was carbon emissions, with a site energy backstop, and prohibited most uses of fossil fuel or electric resistance heating and water heating equipment. The revised performance path requires meeting a “regulated site energy” target and a “total site energy” target. The “regulated site energy” target excludes all renewable energy contributions and unregulated load savings, while the “total site energy” performance target incorporates those elements. This path permits use of fossil fuel equipment, but the relatively high energy usage of such equipment will require the building to compensate by including additional energy efficiency features elsewhere.

ALTERNATIVE APPROACHES FOR AN EPCA-COMPLIANT CODE

As state policies set goals to reduce and eliminate greenhouse gas emissions, jurisdictions continue to explore various methods to meet those goals. The battle in the national model codes over source energy vs. site energy, and which of those metrics better represents carbon emissions, has continued for more than two decades. States and jurisdictions poised to meet their policy goals are seeking other options. While this paper focuses on using site energy use[1] as a metric to establish an equivalent FFCP, other solutions are also available to jurisdictions.

California building energy efficiency standards use two metrics, Long-term System Cost (LSC) and Source Energy to evaluate measure impacts that quantify progress towards the principal goal of minimizing cost to society in providing reliable energy services. While LSC represents hourly long-term costs to the energy system over 30 years, Source Energy represents hourly long-term marginal source energy over 30 years. As such, California does not use a site energy approach.

Other approaches to decarbonizing buildings are not building codes at all, but instead directly regulating emissions. The Bay Area and South Coast Air Quality Management Districts have adopted or are in the process of adopting emission standards that would phase out the sale or installation of NOx-emitting space- and water-heating equipment, effectively prohibiting fossil fuel appliances. The California Air Resources Board (CARB) is exploring a statewide standard for zero-emission appliances to support GHG reductions. New York City Local Law 154 Section 24-177.1 b mandates a maximum carbon emissions fuel standard, without mandating or prohibiting any specific equipment types, limiting emissions from heating fuels to a maximum of 25 kilograms of carbon per million BTUs, whereas natural gas combustion generates ten times that amount. The law effectively prohibits new gas cooking and heating equipment, and goes into effect for most new low- and medium-rise buildings in 2026, followed by taller buildings in 2029.

[1] While site energy accounts only for the energy used directly by the property source energy accounts for all energy used to power the building, including the losses associated with energy production, transmission, and delivery.

CONCLUSIONS

The paper presents one response to the challenges that U.S states, jurisdictions and national model code efficiency standards face to eliminate CO_2 emissions from building operations in the current legal landscape. Washington State responded to the Ninth Circuit Court decision by proposing a fossil fuel compliance pathway (FFCP) to parallel the existing heat pump compliance pathway in the prescriptive code. Analysis was undertaken to determine the difference in annual site energy use between fossil fuel equipment and electric heat pumps for both space heating and water heating in representative building types, and to develop a second additional efficiency credits table for fossil fuel equipment. It was evident from the analysis that the additional efficiency required to make a gas heated building as efficient as a heat pump heated building was significant and potentially expensive.

The 2021 Washington State Energy Code, when originally drafted, required all newly constructed buildings to utilize heat pumps as their primary system for space heating and service water heating whether they followed the prescriptive or the performance path, with only minor exceptions. Washington leveraged the current all-electric requirements and additional efficiency credit requirements in the base code to create a parallel FFCP to respond to potential legal challenges following the Ninth Circuit decision. National model codes such as ASHRAE 90.1 and IECC may also leverage the additional efficiency credits to create similar pathways for buildings using fossil fuel equipment that would be equivalent in annual energy use to heat pump equipped buildings in future code cycles, to meet net zero goals.

FURTHER RESEARCH

The FFCP, as an amendment to the 2021 WSEC, went into effect for permit applications on March 15, 2024, so as of this writing it is not yet known how frequently this compliance path will be utilized. An analysis of the initial buildings to use this path could potentially daylight any issues with the FFCP and suggest future refinements.

The analysis presented here evaluated Washington state's two principal climate zones, but it would be beneficial to expand the FFCP to more climate zones if it is considered to be a viable path for jurisdictions elsewhere around the country. It would also be worthwhile to expand the analysis to include more building types, beyond the five types included in the FFCP.

Many states and localities require a cost-benefit analysis to support adopting an updated building code. Future research could help support this need by providing a cost-benefit analysis for the electric and gas compliance pathways in terms of energy savings, cost savings, and emissions reductions. This information could also support education and outreach to builders and building owners about the benefits of low carbon buildings.

Finally, this paper examines one response to the Ninth Circuit Court ruling. Additional research could identify more regulatory strategies that would comply with EPCA preemption requirements and satisfy the unique circumstances of other states or jurisdictions seeking to advance decarbonization measures.

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