

# Fossil Fuel Compliance Path

Washington state version in Seattle Energy Code



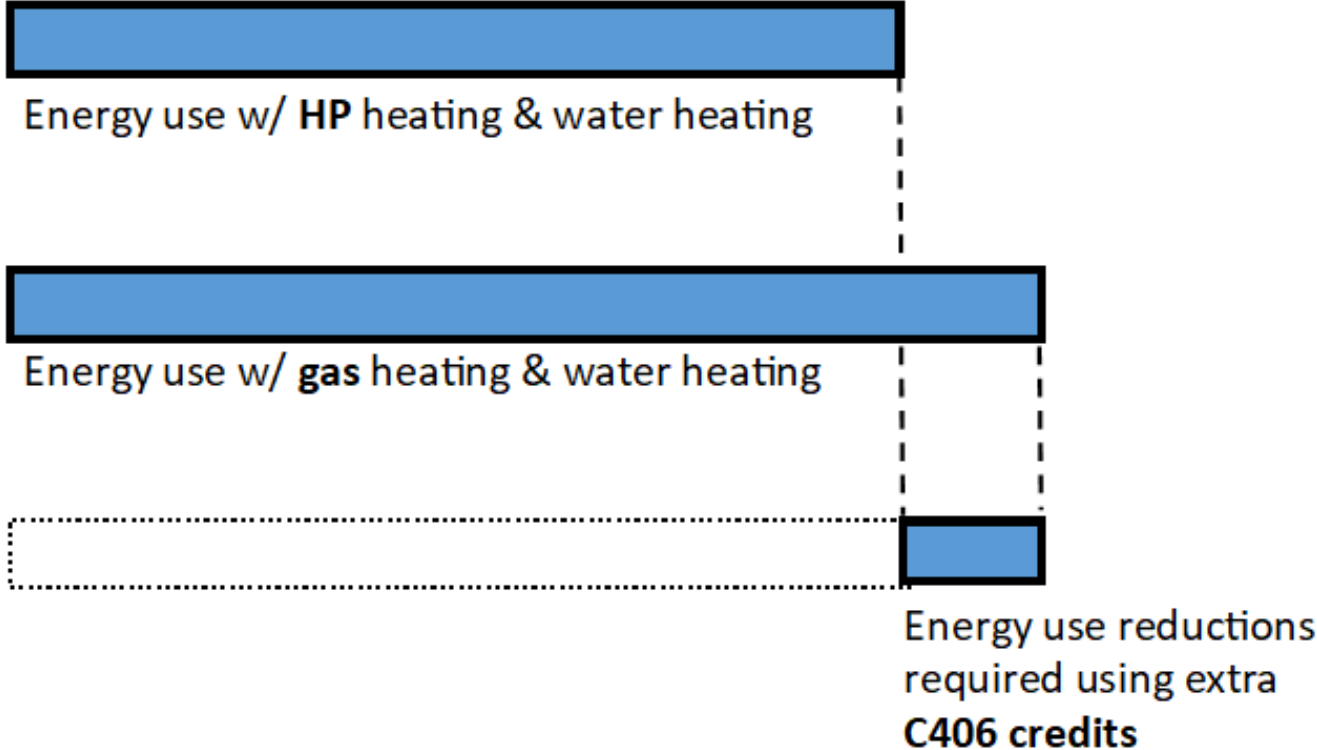
**Seattle** Department of  
Construction & Inspections

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# Basic concept

**Compliance path explicitly permitting gas heating & water heating, while maintaining overall energy efficiency of heat pump buildings.**

- 1. Calculate difference in annual energy use between buildings using gas & using heat pumps
- 2. Require sufficient additional C406 credits from buildings with gas equipment to equalize annual energy use.



# It's now the primary code path

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## CHAPTER 4 [CE] COMMERCIAL ENERGY EFFICIENCY

### SECTION C401 GENERAL

**C401.1 Scope.** The provisions in this chapter are applicable to commercial buildings and their building sites.

**C401.2 Application.** Commercial buildings shall comply with the fossil fuel compliance path according to Section C401.3, or with one of the following:

1. Prescriptive ~~((compliance))~~ path. The prescriptive compliance option requires compliance with ~~((Sections C402 through C406, and Sections C408, C409, C410, C411, and C412))~~ all of Chapter 4, other than Sections C401.3 and C407.
2. Total building performance path. The total building performance option requires compliance with Section C407.
3. Appendix F is not adopted by The City of Seattle. ~~((adopted by the local jurisdiction, the requirements of Appendix F, Outcome-Based Energy Budget, Sections C408, C409, C410, C411, C412 and any specific sections in Table C407.2 as determined by the local jurisdiction. The Proposed Total UA of the proposed building shall be no more than 20 percent higher than the Allowed Total UA as defined in Section C402.1.5.))~~
4. Target Performance Path. The requirements of Section C401.5.

# The fossil fuel compliance path

**C401.3 Fossil fuel compliance path.** Buildings complying with the fossil fuel compliance path shall comply with the prescriptive compliance path of this code as defined in Item 1 of Section C401.2, and as modified by this Section C401.3.

**C401.3.1 Modification of code requirements.** For use of this compliance path only, the following changes shall be made to this code:

1. Section C403.1.4 – Space heating. Strike the phrase “...or fossil fuel combustion...” from the first sentence of Section C403.1.4.
2. Section C404.2.1 – Service water heating. Revise the first sentence of Section C404.2.1 to read: “Service hot water shall be provided by fossil fuel water heating equipment, electric air-source heat pump water heating equipment, electric resistance water heating equipment, or a combination of these equipment types meeting the requirements of this section.”
3. Section C406.2.5 – Renewable energy. When determining renewable energy credits in Equation 4-17 of Section C406.2.5, strike the phrase “...limited to 50 percent of the required credits in Section C406.1” in the definition of the factor  $AEC_{RRa}$ .
4. Table C406.2(1) – Efficiency measure credits. Use Table C406.2(2) credit values in place of Table C406.2(1) credit values.T

**C401.3.2 Fossil fuel equipment.** Fossil fuel combustion appliances are permitted for HVAC heating, and shall comply with the applicable efficiency standards referenced in Section C403.3.3.2. Fossil fuel combustion appliances are permitted for service water heating, and shall comply with applicable efficiency standards referenced in Table C404.2.

# Credits & exceptions

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**C401.3.3 Additional efficiency credits.** The number of additional efficiency credits required by Table C406.1 shall be increased by the number required in Table C401.3.3, modified as permitted in this section, and is in addition to the energy efficiency credits and load management credits required by Section C406.

## Exceptions:

1. Low energy space  
50% table credits
2. Small additions  
50% table credits
3. Semi-heated space  
50% table credits
4. Garages and other  
unconditioned  
spaces – No credits

**EXCEPTION:** The required number of space heating additional efficiency credits are permitted to be reduced in the following instances:

1. Low energy spaces in accordance with Section C402.1.1.1 and equipment buildings in accordance with Section C402.1.2 that are served by space heating systems shall comply with sufficient measures from Table C406.2(1) or Table C406.2(2) to achieve a minimum of 50 percent of the efficiency credits required for new construction by Table C401.3.3, modified as permitted in this section.
2. Building additions that have less than 1,000 square feet of conditioned floor area and that comply with sufficient measures from Table C406.2(1) or Table C406.2(2) to achieve a minimum of 50 percent of the additional efficiency credits required for additions by Table C401.3.3, modified as permitted in this section.
3. Semi-heated spaces in accordance with Section C402.1.1.2 that comply with sufficient measures from Table C406.2(1) or Table C406.2(2) to achieve a minimum of 50 percent of the space heating additional efficiency credits required by Table C401.3.3, modified as permitted in this section.
4. Unconditioned spaces, open parking garages and unheated enclosed parking garages are not required to achieve the additional efficiency credits for space heating required by Table C401.3.3.



# Additional credits for each building type

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**TABLE C401.3.3  
ADDITIONAL CREDITS REQUIRED**

Measure Title	Applicable Section	R-1	R-2	B	E	M	All other
New building – Additional efficiency credits required for space heating systems using the fossil fuel pathway	C401.3.3.1	7	24	101	38	111	56
New building – Additional efficiency credits required for service water heating systems using the fossil fuel pathway	C401.3.3.2	198	212	27	17	79	107
Building additions – Additional efficiency credits required for space heating systems using the fossil fuel pathway	C401.3.3.1	4	12	51	19	56	28
Building additions – Additional efficiency credits required for service water heating systems using the fossil fuel pathway	C401.3.3.1	99	106	14	9	40	54

Turns out that it takes a *lot* of credits to match heat pump efficiency with gas heating

# Adjustment for “exempt” heating capacity (separately for both space heating and water heating)

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**Formula:  $CR = A \times (B-C)/D$**

$$\text{Adjusted Credits} = \text{Credits required by Table C401.3.3} \times \left( \text{Heating capacity complying with an exception} - \text{Fossil fuel heating capacity} \right) / \text{Total heating capacity}$$

Ensures that *credits* won't be required for spaces where *heat pumps* aren't required

Example: Dwelling units with electric resistance heating

# New C406 credit table: Energy, not emissions



**Table C406.2(2)**  
**Efficiency Measure Credits for use with Fossil Fuel Compliance Path**

Measure Title	Applicable Section	Prorating Flag	Occupancy Group					
			Group R-1	Group R-2	Group B	Group E	Group M	All Other
1. Dwelling unit HVAC control	C406.2.2	Heat	NA	8	NA	NA	NA	NA
2. Improved HVAC TSPR <sup>a</sup>	C406.2.2.1	Heat	NA	9	12	19	24	NA
3. Improve cooling and fan efficiency	C406.2.2.2	Heat	12	8	14	8	10	10
4. Improve heating efficiency	C406.2.2.3	Heat	2	3	3	11	18	8
5. Improved low-carbon district energy system (10% better)	C406.2.2.4		3	3	4	12	19	9
6. Improved low-carbon district energy system (20% better) <sup>b</sup>	C406.2.2.5		10	11	13	36	57	26
7. High performance DOAS	C406.2.2.6	Heat	34	34	23	43	44	23/ (A) 40 <sup>c</sup>
8. Fault detection & diagnostics (FDD)	C406.2.2.7	Heat	2	2	2	6	9	4
9. 10% reduced lighting power	C406.2.3.1	Heat	7	4	18	16	20	15
10. 20% reduced lighting power <sup>d</sup>	C406.2.3.2	Heat	13	8	36	32	40	29
11. Lamp efficacy improvement	C406.2.3.3	Heat	5	6	NA	NA	NA	NA
12. Residential lighting control	C406.2.4.1	Heat	NA	8	NA	NA	NA	NA
13. Enhanced lighting control	C406.2.4.2	Heat	1	1	6	6	11	6
14. Renewable energy	C406.2.5		7	12	12	12	10	11



# ...and finally

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80% of credits can be renewables

Area-weighting OK

## Electrification readiness:

1. Spare branch circuit sized for HP
2. Service conduits for upgrade to HP
3. Space in elec room
4. Space for future transformers & other electrical equipment

**C401.3.4 Renewable energy credit limit.** No more than 80 percent of the efficiency credits required by Sections C401.3.3.1 and C401.3.3.2 are permitted to be Renewable Energy credits defined in Section C406.2.5.

**C401.3.5 Discrete area-weighted project compliance.** In addition to the area-weighted credit requirements in Section C406.1.2, where a building includes multiple occupancies, the additional required credits per Table C401.3.3 shall be determined separately for each occupancy group. Additional required credits shall be prorated on an area-weighted basis for each occupancy group in the same manner as required project credits per Section C406.1.

1. Where a single space heating or service water heating system serves multiple occupancies, the number of additional required credits shall be prorated on an area-weighted basis for each occupancy served.
2. Additional required credits for envelope systems shall be prorated on an area-weighted basis for all occupancies.
3. Occupancies are permitted to be subdivided into discrete areas, with required and achieved credits for each area prorated on an area-weighted basis as required for the occupancy group.

**C401.3.6 Electrification readiness.** Additionally, the following provisions shall be required for new construction for each fossil fuel space heating or service water heating appliance installed:

1. Provide a spare electrical branch circuit conduit to the location of a future replacement heat pump appliance to support an equivalent heating capacity.
2. Provide spare electrical service entrance conduits for the purpose of upgrading the main electrical service to support all heat pump appliances throughout the building.
3. The main electrical room has sufficient space to accommodate increasing the main electrical service's size to support all heat pump appliances throughout the building.
4. Additional accommodations for the equipment comprised of transformer(s) and other equipment necessary to support an electrical service upgrade. These accommodations shall include adequate space on the site. If the equipment is located in a transformer vault, that vault must include not only the space to support electrical service upgrade but also include accommodations for additional cooling for larger transformer(s).

# Also can be used for existing buildings

**C503.4.6 Addition or replacement of HVAC heating appliances.** New HVAC heating systems shall comply with Section C403.1.4. Where one or more HVAC mechanical heating appliances are added or replaced, the added or replaced appliances shall comply with Section C401.3, Section C403.1.4 or with an alternate compliance option in Table C503.4.6. When complying with the alternate compliance option in Table C503.4.6, added or replaced HVAC heating appliances must select HVAC heating appliances from one of the Proposed Heating Type Options and the applicable Heating Efficiency Tables. Additions, alterations, or replacements shall not be made to an existing HVAC heating system that will cause the existing system to become out of compliance. Where use of heat pump equipment for space heating is required by this section, it is permissible to utilize the Fossil Fuel Compliance Path in Section C401.3 to attain the credits required for building additions shown in Table C401.3.3.

1. Exempt buildings and occupancies. Replacement heating equipment serving any of the following building categories is permitted to use the same fuel type as the existing equipment, provided the replacement equipment complies with the minimum efficiency in Table C503.4.6 and the same or lower capacity than the existing, and that the requirements of Section C503.4.6.2 are met.
  1. Affordable housing.
  2. Group I-1, I-2, and I-3 occupancies.
  3. Buildings with more than 50 percent of conditioned floor area occupied by organizations recognized as nonprofit by the State of Washington or by federal tax law.
  4. Buildings with no more than 20,000 square feet of conditioned floor area.
2. Retention of portion of existing system capacity. For buildings not exempted by Exception 1 above, a maximum of 50 percent of the existing fossil fuel or electric resistance heating capacity is permitted to be retained or replaced to serve as supplemental heat for the new heat pump heating system provided that the supplemental heat is controlled



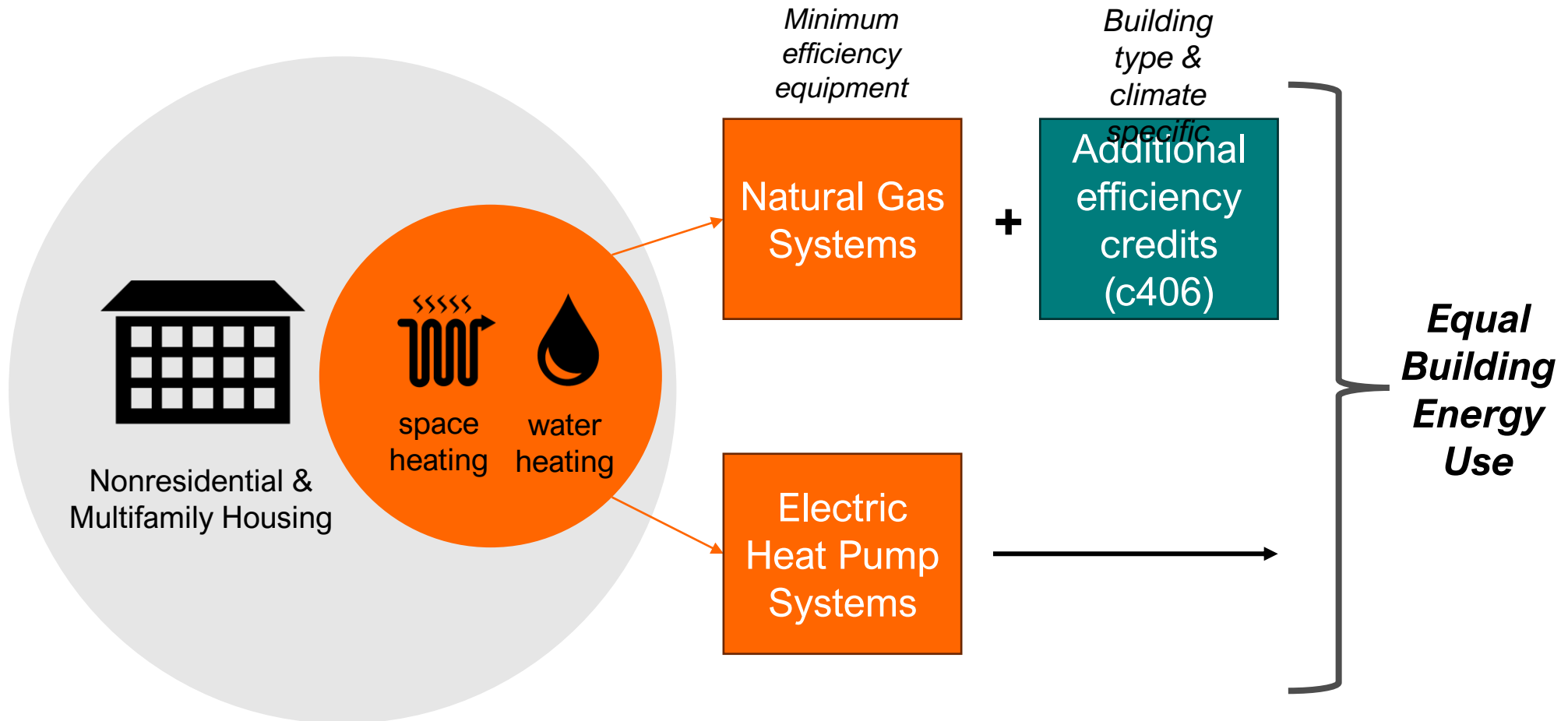
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Washington State Nonresidential Prescriptive  
Compliance Evaluation for Gas and Heat Pump Pathway

7/14/2023

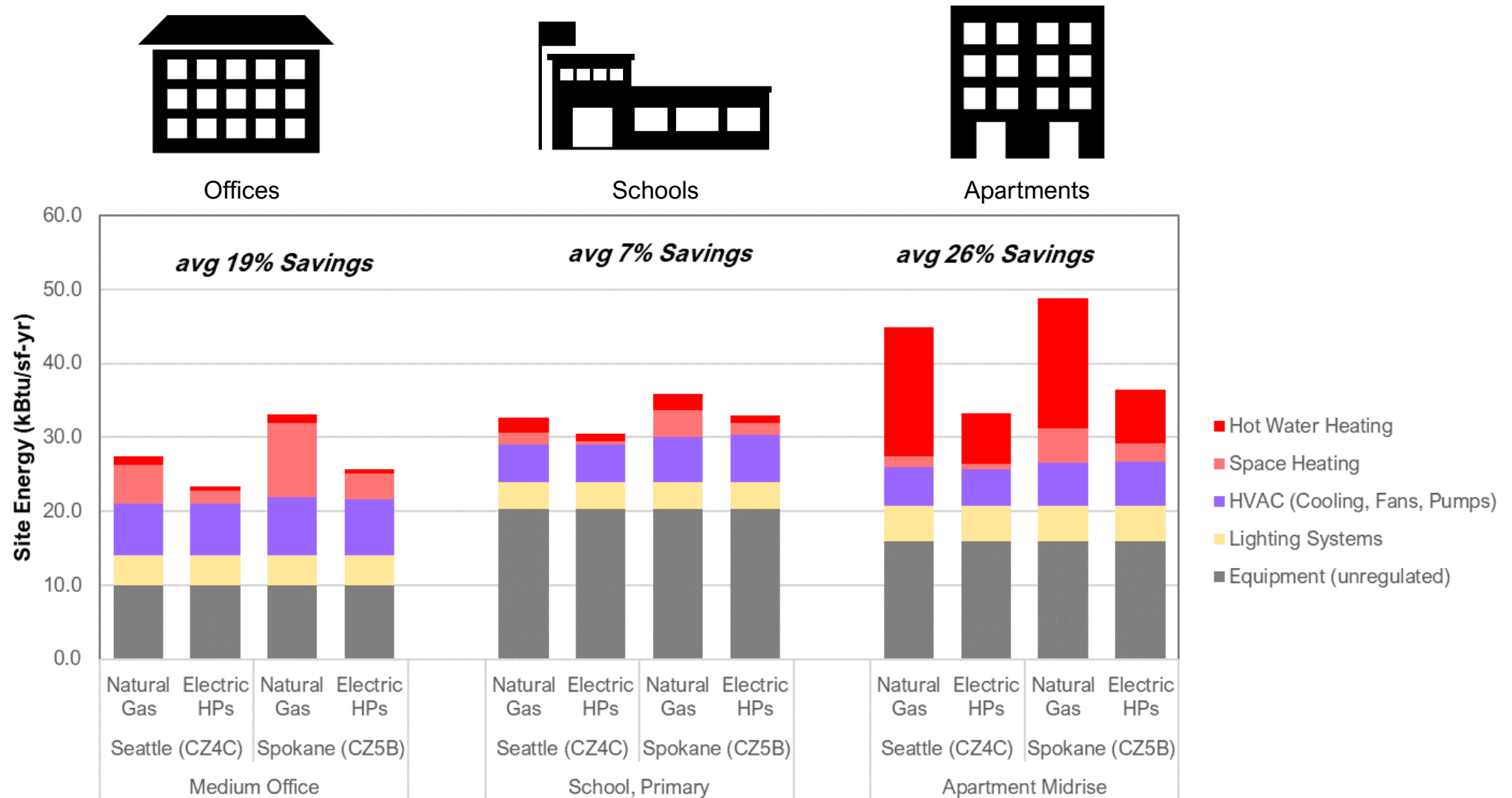


# Framework for Heating System Compliance Pathways





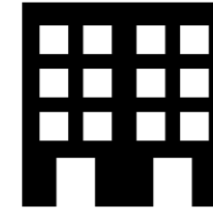
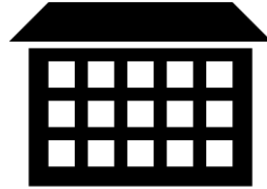
# Building Energy Equivalence, Initial Findings



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## General Assumptions

- Annual Energy Simulations
- EnergyPlus 22.1
- DOE based Prototypes
- WA Energy Code Minimum Efficiencies, New Construction



### Site Energy (kBtu/sf)

Equipment (unregulated)
Lighting Systems
HVAC (Cooling, Fans, Pumps)
Space Heating
Hot Water Heating

Medium Office			
Seattle (CZ4C)		Spokane (CZ5B)	
Natural Gas	Electric HPs	Natural Gas	Electric HPs
9.9	9.9	9.9	9.9
4.2	4.2	4.2	4.2
6.9	6.8	7.8	7.6
5.2	1.8	10.0	3.5
1.2	0.6	1.2	0.6
<b>Total Site Energy</b>			
27.4	23.4	33.1	25.7
<b>Heating Systems</b>			
6.4	2.4	11.2	4.1
<b>Heating % of Total</b>			
23%	10%	34%	16%
<b>EUI Savings (kBtu/sf)</b>			
	4.1		7.4
<b>Relative Energy Savings</b>			
	15%		22%

- DOAS with four-pipe-fan coils.
- **Natural gas:** HW boiler and DHW boiler
- **Electric hp:** Air to Water HP and Central WSHP

School, Primary			
Seattle (CZ4C)		Spokane (CZ5B)	
Natural Gas	Electric HPs	Natural Gas	Electric HPs
20.3	20.3	20.3	20.3
3.6	3.6	3.6	3.6
5.0	5.1	6.1	6.3
1.6	0.5	3.7	1.6
2.1	1.0	2.1	1.0
<b>Total Site Energy</b>			
32.7	30.5	35.8	32.9
<b>Heating Systems</b>			
3.7	1.5	5.8	2.7
<b>Heating % of Total</b>			
11%	5%	16%	8%
<b>EUI Savings (kBtu/sf)</b>			
	2.2		2.9
<b>Relative Energy Savings</b>			
	7%		8%

- Central DOAS with PTAC/PTHPs
- **Natural gas:** Furnaces and DHW boiler
- **Electric hp:** Air Source HPs and Central WSHP

Apartment Midrise			
Seattle (CZ4C)		Spokane (CZ5B)	
Natural Gas	Electric HPs	Natural Gas	Electric HPs
15.9	15.9	15.9	15.9
4.7	4.7	4.7	4.7
5.3	5.0	5.8	6.0
1.4	0.7	4.8	2.5
17.5	6.9	17.5	7.3
<b>Total Site Energy</b>			
44.9	33.3	48.8	36.5
<b>Heating Systems</b>			
19.0	7.6	22.3	9.9
<b>Heating % of Total</b>			
42%	23%	46%	27%
<b>EUI Savings (kBtu/sf)</b>			
	11.7		12.3
<b>Relative Energy Savings</b>			
	26%		25%

- Central DOAS with PTAC/PTHPs
- **Natural gas:** Furnaces and In-Unit DHW boiler
- **Electric hp:** Air Source HPs and Central WSHP

# Analysis Key Assumptions

- All models based on Department of Energy building prototypes
- Modified originally from IECC code models for WA state code
- Simulated in EnergyPlus 22.1
- Weather files based on TMY3 files for Seattle and Spokane
- Medium Office building use assumptions updated in all cases to be more representative on: people usage, lighting usage, equipment usage, infiltration changes, hot water usage
- **Medium Office Systems**
  - DOAS with Four Pipe Fan Coils. Central water heating.
    - Central Heating
      - Boiler: 80%
      - Air to Water HP: COP 2.77
    - Domestic Hot Water:
      - Boiler: 81%
      - HPWH: COP 3.4
- **School Primary**
  - Central DOAS, per apartment Packaged Terminal Heat Pump/AC Unit. Central water heating.
    - Central Heating
      - Boiler: 80%
      - Air to Water HP: COP 2.77
    - Domestic Hot Water:
      - Boiler: 81%
      - HPWH: COP 3.4
- **Apartment Mid-Rise**
  - Central DOAS, per apartment Packaged Terminal Heat Pump/AC Unit. In-Unit Gas /Central Heat Pump Water Heater
    - Heating
      - Furnace: 80%
      - Air to Air HP: 3.81
    - Domestic Hot Water:
      - Boiler: 80%
      - HPWH: COP 3.4