STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

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Code being amended: ☐ Commercial Provisions ☒ Residential Provisions

6/23/25 revision:
Original proposal text in red.
Substantive revisions from original proposal in yellow highlight.
Renumbering to align with 2024 IECC and fix references in R503.1.2.3 in blue.

Code Section # R403.3, R403.3.2, Table R406.3___

Brief Description: This proposal mandates that ducts located outside the conditioned space need to be either deeply buried or comply with provisions for ductwork in conditioned space. This proposal mandates that ducts shall be located inside the conditioned space as part of the R406 table credit. The air handler is assumed to be required inside as part of R403.3.3.

Proposed code change text: (Copy the existing text from the Integrated Draft, linked above, and then use underline for new text and ~~strikeout~~ for text to be deleted.)

R403.3 Duct systems. *Duct systems* shall be installed in accordance with Sections R403.3.1 through R403.3.89. ~~*Duct systems* shall be located in *conditioned space* in accordance with Section R403.3.3.~~

Exception: *Ventilation ductwork* that is not integrated with *duct systems* serving heating or cooling systems.

R403.3.1 Duct system design. *Duct systems* serving one or two *dwelling units* or *sleeping units* shall be designed and sized in accordance with ANSI/ACCA Manual D. *Duct systems* serving more than two *dwelling units* or *sleeping units* shall be sized in accordance with the ASHRAE Handbook of Fundamentals, ANSI/ACCA Manual D or other equivalent computation procedure.

R403.3.23 ~~Reserved.~~ Ductwork located outside conditioned space. Supply and return *ductwork* shall not be located outside *conditioned space* except as permitted by Sections R403.3.4 and R403.3.5. ~~shall be insulated to an *R*-value of not less than R-8 for *ducts* 3 inches (76 mm) in diameter and larger and not less than R-6 for *ducts* smaller than 3 inches (76 mm) in diameter.~~

> **Exception**: *Ductwork* buried beneath a building ~~shall be~~ insulated to an *R*-value of not less than R-8 for *ducts* 3 inches (76 mm) in diameter and larger and not less than R-6 for *ducts* smaller than 3 inches (76 mm) in diameter ~~as required per this section~~ or haveing an equivalent *thermal distribution efficiency*. *Ductwork* within a concrete slab or in the ground ~~shall be~~ insulated to R-10 with insulation designed to be used below grade. Underground

ductwork utilizing the *thermal distribution efficiency* method shall be listed and labeled to indicate the *R*-value equivalency.

R403.3.~~3~~4 Duct systems located in conditioned space. For duct systems to be considered as being located inside a *conditioned space*, the *space conditioning equipment* shall be located completely on the conditioned side of the *building thermal envelope*. The *ductwork* shall comply with the following, as applicable:

1. The *ductwork* shall be located completely on the conditioned side of the *building thermal envelope*.
2. All heating, cooling and ventilation system components shall be installed inside the *conditioned space* including, but not limited to, forced air ducts, hydronic piping, hydronic floor heating loops, convectors and radiators. Combustion equipment shall be direct vent or sealed combustion.
3. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts is permitted to be located outside the *conditioned space*, provided they are insulated to a minimum of R-8.
   3.1. Metallic ducts located outside the *conditioned space* must have both transverse and longitudinal joints sealed with mastic.
   3.2. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool.
4. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:
   4.1. A *continuous air barrier* installed between unconditioned space and the duct.

   Insulation installed in accordance with Section R402.2.7.
   4.2. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.

R403.3.~~4~~5 *Ductwork* buried within ceiling insulation. Where supply and return *ductwork* is partially or completely buried in ceiling insulation, such *ductwork* shall comply with the following:

1. The supply and return *ductwork* shall be insulated with not less than R-8 insulation.
2. At all points along the *ductwork*, the sum of the ceiling insulation *R*-value against and above the top of the *ductwork*, and against and below the bottom of the *ductwork*, shall be not less than R-19, excluding the *R*-value of the duct insulation.

   Exception: Sections of the supply *duct*~~*work*~~ that are less than 3 feet (914 mm) from the supply outlet ~~shall not be required to comply with these requirements~~.

R403.3.~~4~~5.1 Effective *R*-value of deeply buried ducts. Where complying using Section R405, sections of *ductwork* that are installed in accordance with Section R403.3.4 surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the *ductwork* is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

R403.3.~~5~~6 Sealing. *Ductwork*, *air-handling units* and filter boxes shall be sealed. Joints and seams shall comply with the *International Mechanical Code* or *International Residential Code*, as applicable.

Exceptions:

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

R403.3.~~5~~6.1 Sealed *air-handling unit*. *Air-handling units* shall have a manufacturer's designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.

R403.3.~~6~~7 Duct system testing. Each *duct system* shall be tested for air leakage in accordance with WSU RS-33, using the maximum duct leakage rates specified.

A written report of the test results shall be signed by the party conducting the test and provided to the code official. *Duct system* leakage testing at either rough-in or post construction shall be permitted with or without the installation of registers or grilles. Where installed, registers and grills shall be sealed during the test. Where registers and grilles are not installed, the face of the register boots shall be sealed during the test.

Exceptions:

1. A duct air leakage test shall not be required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems.
2. Testing shall not be required where there is not more than 10 feet (3048 mm) of total *ductwork* external to the *space conditioning equipment* and both the following are met:
   2.1. The *duct system* is located entirely within *conditioned space*.
   2.2. The *ductwork* does not include *plenums* constructed of building cavities or gypsum board.
3. Where the *space conditioning equipment* is not installed, testing shall be permitted. ~~The total measured leakage of the supply and return *ductwork* shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of *conditioned floor area*.~~
4. Where tested in accordance with Section R403.3.8, testing of each *duct system* is not required.

R403.3.~~7~~8 Duct system leakage. The total measured *duct system* leakage shall not be greater than the values in Table R403.3.7 based on the *conditioned floor area*, number of ducted returns, and location of the *duct system.* For *buildings* complying with Section R405, where *duct system* leakage to outside is tested in accordance with WSU RS-33, the leakage to outside value shall not be used for compliance with this section, but shall be permitted to be used in the calculation procedures of Section R405.

TABLE R403.3.~~7~~8
MAXIMUM TOTAL DUCT SYSTEM LEAKAGE

EQUIPMENT AND DUCT CONFIGURATION	DUCT SYSTEMS SERVING MORE THAN 1,000 FT² OF CONDITIONED FLOOR AREA		DUCT SYSTEMS SERVING 1,000 FT² OR LESS OF CONDITIONED FLOOR AREA
	cfm/100 ft²		cfm
	Number of Ducted Returns[a]		
	< 3	≥ 3	Any
Space conditioning equipment is not installed[b,c]	3	4	30
All components of the duct system are installed[c]	4	6	40
Space conditioning equipment is not installed, but the ductwork is located entirely in conditioned space[c,d]	6	8	60
All components of the duct system are installed and entirely located in conditioned space[c]	8	12	80

For SI: 1 cubic foot per minute per square foot = 0.0033 LPM/m2, 1 cubic foot per minute = 28.3 LPM.

a. A ducted return is a duct made of sheet metal or flexible duct that connects one or more return grilles to the return-side inlet of the air-handling unit. Any other method to convey air from return or transfer grilles to the air-handling unit does not constitute a ducted return for the purpose of determining maximum total duct system leakage allowance.

b. Duct system testing is permitted where space conditioning equipment is not installed, provided that the return ductwork is installed and the measured leakage from the supply and return ductwork is included.

c. For duct systems to be considered inside a conditioned space, where the ductwork is located in ventilated attic spaces or unvented attics with vapor diffusion ports, duct system leakage to outside must comply with Item 2.1 of Section R403.3.3.

d. Prior to the issuance of a certificate of occupancy, where the air-handling unit is not verified as being located in conditioned space, the total duct system leakage must be retested.

R403.3.~~8~~9 Unit sampling. For buildings with eight or more *dwelling units* or *sleeping units*, the *duct systems* in the greater of seven or 20 percent of the *dwelling units* or *sleeping units* shall be tested, including a top floor unit, a ground floor unit, a middle floor unit and the unit with the largest *conditioned floor area*. Where the buildings have fewer than eight *dwelling units* or *sleeping units*, the *duct systems* in each unit shall be tested. Where the leakage of a *duct system* is greater than the maximum permitted *duct system* leakage, corrective action shall be made to the *duct system* and the *duct system* shall be system retested until it passes. For each tested *dwelling unit* or *sleeping unit* that has a greater total *duct system* leakage than the maximum permitted *duct system* leakage, an additional three *dwelling units* or *sleeping units*, including the corrected unit, shall be tested.

R403.3.~~9~~2 Building cavities. *Building* framing cavities shall not be used as ducts or plenums. Installation of ducts in exterior walls, floors or ceilings shall not displace required envelope insulation.

Table R406.3

4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS		
All HVAC ~~equipment and associated~~ *duct system*~~(s)~~ ~~installation~~ shall comply with ~~the requirements of~~ Section R403.3.~~2~~3~~4~~. All ~~*duct systems*~~ *ductwork* shall be located ~~*in conditioned space*~~ in accordance with Section R403.3.~~3~~4 items 1 and 2 only. Electric resistance heat, hydronic heating and ductless heat pumps are not permitted under this option. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the *ductwork*.	0.5	N/A

Purpose of code change:

Installing the ductwork in the conditioned space saves energy by eliminating leakage that is often wasted to unconditioned space.

Your amendment must meet one of the following criteria. Select at least one:

- ☐ Addresses a critical life/safety need.
- ☐ The amendment clarifies the intent or application of the code.
- ☒ Addresses a specific state policy or statute. (Note that energy conservation is a state policy)
- ☐ Consistency with state or federal regulations.
- ☐ Addresses a unique character of the state.
- ☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

- ☒ Single family/duplex/townhome
- ☒ Multi-family 1 – 3 stories
- ☐ Multi-family 4 + stories
- ☐ Commercial / Retail
- ☐ Institutional
- ☐ Industrial

Your name	Nicholas O'Neil	Email address	noneil@energy350.com
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Economic Impact Data Sheet

Is there an economic impact: ☒ Yes ☐ No

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants, and businesses. If you answered "No" above, explain your reasoning.

Locating ductwork in the conditioned space will reduce labor and materials costs by right sizing the ductwork. Reduced linear footage of ductwork and smaller-diameter duct sizes are required if the HVAC contractor uses Air Conditioner Contractors of America (ACCA) Manual D to size the thermal distribution system when they calculate ACCA Manual J and S design loads for heating and cooling system sizing per WSEC-R.

There is additional thermal comfort because the ductwork does not have to reheat or re-cool between HVAC cycles, thereby reducing the runtime of the air-handler and potential behavioral energy saving when occupants do not change the thermostat settings.

Provide your best estimate of the **construction cost** (or cost savings) of your code change proposal? (See OFM Life Cycle Cost **Analysis tool** and **Instructions;** use these **Inputs**. **Webinars on the tool can be found Here and Here**)

$ 0.56/square foot (For residential projects, also provide $Click here to enter text./ dwelling unit)

Show calculations here, and list sources for costs/savings, or attach backup data pages

Conditioned basements and conditioned crawlspaces were not evaluated, typically they would include the air handlers and ductwork inside the conditioned space, so there would be no incremental cost for homes with these foundation types to meet this provision. Slab homes were considered in the analysis by locating the air handler in a newly constructed mechanical closet and the ductwork inside to meet the requirements.

The average size home was estimated at 1,344 sqft and 2,200 sqft, which represent 2% and 11% of the slab home foundation configurations in WA respectively. Based on cost data from the June 2022 ICF report on individual Code Provisions of the 2021 IECC, the necessary changes to a slab home to move the air handling unit and associated ductwork inside is the construction of a mechanical closet and removal of attic platforms for supporting air handling units and ductwork. We utilized costs from the 2022 report and doubled them to include effects of inflation and supply chain economics present in the current market. Once weighted by the prevalence of slab home foundation types, the total cost of moving the air handler inside was estimated at $0.37/sqft as shown in the analysis below.

Analysis	**Ducts-inside**	
Size sqft	1,344	2,200
Building type weight	2%	11%
Lump Sum costs w/ 12% markup	$370.60	$370.60
Final costs/sqft	$0.28	$0.17
Final weighted cost/sqft (2022$)	$0.18	
Final weighted cost/sqft (2025$)	**$0.37**	

Additional sources of cost information for locating ducts inside can be found here:
https://www.energy.wsu.edu/documents/aht_aceee%20ducts%20inside[1].pdf
https://www.energy.gov/sites/prod/files/2014/01/f6/1_1g_ba_innov_ductsconditionedspace_011713.pdf

Provide your best estimate of the **annual energy savings** (or additional energy use) for your code change proposal?

Instructions: Send this form as an email attachment, along with any other documentation available, to: sbcc@des.wa.gov. For further information, call the State Building Code Council at 360-407-9255.

All questions must be answered to be considered complete. Incomplete proposals will not be accepted.

0.50 KWH/ square foot (or) 1.7 KBTU/ square foot

(For residential projects, also provide Click here to enter text.KWH/KBTU / dwelling unit)

Show calculations here, and list sources for energy savings estimates, or attach backup data pages

Energy savings from locating the air handler and associated ductwork in the conditioned space is currently worth 0.5 energy credits as noted in the 2021 energy credits "4 High Efficiency HVAC Distribution System" option. However, credit modeling for this option during the 2021 WSEC cycle was based on moving the air-handler inside.

Leakage from the air handler and ductwork along with thermal conduction losses waste energy when not located in the conditioned space. This is because the HVAC system box has the greatest pressures and temperatures when compared to leakage of a floor, wall, or ceiling supply or return register. Additionally, remaining leakage from ductwork inside the conditioned space will assist with conditioning the home compared to leakage of that ductwork in unconditioned space.

Reviewing data from the CA IOU modeling that was used to inform IECC 2024 proposals on a similar topic, the energy savings for homes in Washington (after weighting by fuel choice and slab home size) is 1.7 kBtu/sqft. This proposal assumes a split in home size consistent with findings from the 2023 Washington Residential Code Evaluation and does not consider multi-family building types as shown in the analysis below.

Analysis	**Ducts-inside**	
Home size (sqft)	1,344	2,200
Building type weight[a]	2%	11%
Gas home Savings (kBtu)	5,383	
Electric home Savings (kBtu)	2,881	
Fuel choice Savings (kbtu)	3,406	
Savings/sqft	2.5	1.5
Weighted Savings/sqft (kBtu)	**1.7**	
Weighted Savings/sqft (kWh)	**0.50**	

a. Based off. July 2023. Washington Residential Code Evaluation. Figure 12: Fuel Choice for Primary Space Heating.

List any **code enforcement** time for additional plan review or inspections that your proposal will require, in hours per permit application:

The time required for plan review and field inspections is reduced because the air handler location is preplanned, and the location and right-sized system design are required to be shown on the approved plans. Verifying QA and WSEC-R and IRC/IMC-WA compliance is simpler because the AHJ may have better access to the air handler located in the conditioned space for the purpose of inspection and installation.

Small Business Impact. Describe economic impacts to small businesses:

N/A

Housing Affordability. Describe economic impacts on housing affordability:

There is an expected cost increase to slab homes as described above, as well as reduced space inside to allow for a mechanical closet to incorporate the air-handler and associated ductwork.

Other. Describe other qualitative cost and benefits to owners, to occupants, to the public, to the environment, and to other stakeholders that have not yet been discussed:

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