Funded by: Natural Resources Canada

Tuesday May 27 | Calgary, AB

# CODES WORKSHOP FOR RESIDENTIAL BUILDERS

free event

## Building Better: Practical Applications of National Energy Codes for Alberta's Future

Calgary

SAIT

enbix

ALBERTA ecotrust

# NBC 9.36

Workshop-lifting Ideas

# Learning Outcomes

1

## Apply

Legislative frameworks and building energy fundamentals

2

## Identify

Relevant NBC and NECB sections that drive energy efficiency measures.

3

## Understand

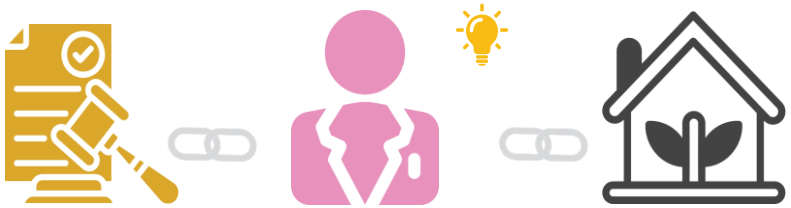
The new tiered energy code requirements.

# Outline

- ❑ Introduction
- ❑ Legislative Framework
- ❑ Energy fundamentals for buildings
- ❑ NBC 9.36 Code Compliance
- ❑ Tiered Energy Code

# Introduction – CAF Project Overview

Goal – create a **holistic program** where **higher performance tiers** of the energy codes are **encouraged & implemented** effectively and confidently by **The City** and **industry partners** to meet the **GHG emissions reduction targets**

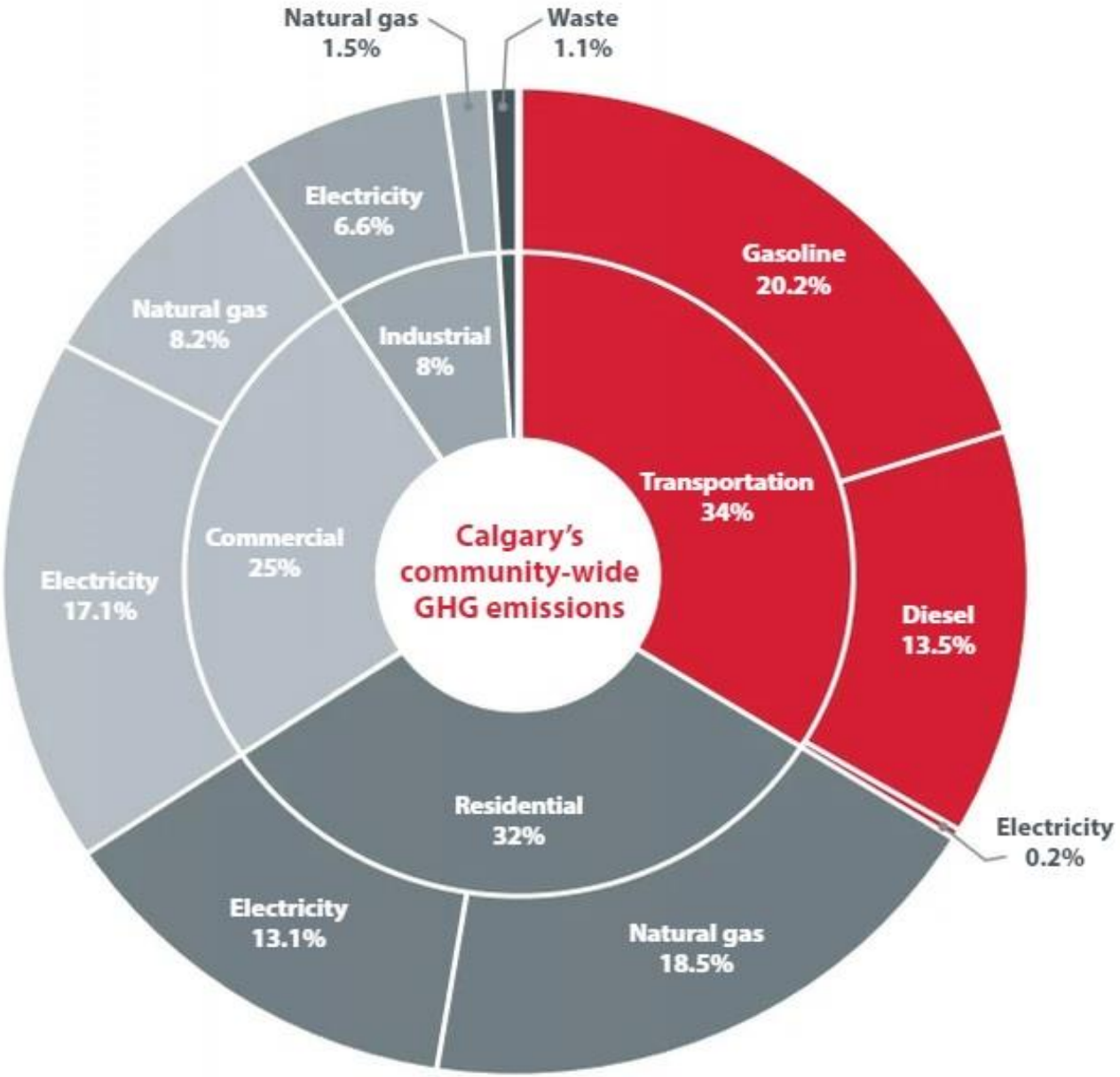


# Calgary's Climate Commitments

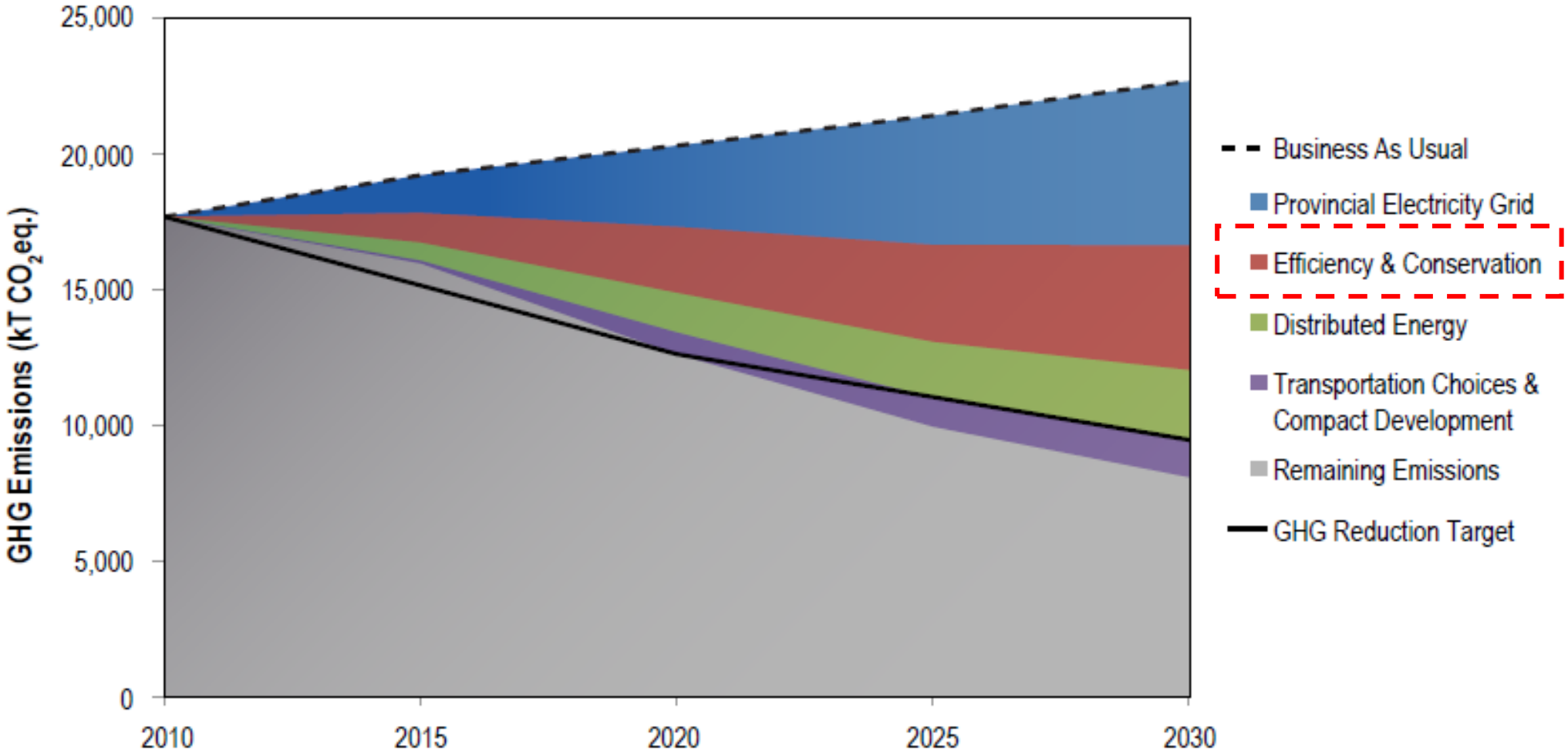
On November 15, 2021, Calgary City Council declared a Climate Emergency, committing to:

- Reducing GHG emissions significantly, reaching net-zero by 2050
- Invest and accelerate high-priority emissions reduction and climate risk opportunities

# challenge


Natural gas
1.5%
Waste
1.1%
Electricity
6.6%
Gasoline
20.2%
Natural gas
8.2%
Industrial
8%
Transportation
34%
Commercial
25%
Calgary's
community-wide
GHG emissions
Diesel
13.5%
Electricity
17.1%
Residential
32%
Electricity
0.2%
Electricity
13.1%
Natural gas
18.5%

# challenge


25,000
20,000
15,000
10,000
5,000
0
GHG Emissions (kT $CO_2$eq.)
2010
2015
2020
2025
2030
Business As Usual
Provincial Electricity Grid
Efficiency & Conservation
Distributed Energy
Transportation Choices & Compact Development
Remaining Emissions
GHG Reduction Target

## problem in a nutshell?

we currently have a large number of underperforming buildings, a GHG and image problem, and no comprehensive set of tools or guidelines to fix this…

## problem in a nutshell?

we currently have a large number of underperforming buildings, a GHG and image problem, and no comprehensive set of tools or guidelines to fix this…

or do we?

## Sections 615.4(1) and 615.5(2)

Province of Alberta

MUNICIPAL GOVERNMENT ACT

CITY OF CALGARY CHARTER, 2018 REGULATION

**615.4(1)** The City must, in accordance with this section, establish a plan for the purpose of addressing and mitigating the effects of climate change.

**615.5(2)** The City must, in accordance with this section, establish a plan for adapting to effects of climate change.

The City must have both climate adaptation and mitigation plans…

## Sections 615.4(5) and 615.7(7)

Province of Alberta

MUNICIPAL GOVERNMENT ACT

CITY OF CALGARY CHARTER, 2018 REGULATION

**(5)** A climate change mitigation plan must be reviewed no later than 5 years after it is established and at least once every 5 years thereafter.

**(7)** A climate change adaptation plan must be reviewed no later than 5 years after it is established and at least once every 5 years thereafter.

… and update and report on them

# Section 617(b) and 640

Province of Alberta

MUNICIPAL GOVERNMENT ACT

CITY OF CALGARY CHARTER, 2018 REGULATION

**Section 617(b) of the Act is to be read as follows:**

(b) to maintain and improve the quality of the physical environment within which patterns of human settlement are situated within the boundaries of the City, including the promotion of environmental sustainability and stewardship,

**Section 640 of the Act is to be read as follows:**

(vii) any other matters necessary to regulate and control the issue of development permits that to the council appear necessary.

The City has discretion to consider environmental criteria in approving development

Province of Alberta

MUNICIPAL GOVERNMENT ACT

CITY OF CALGARY CHARTER, 2018 REGULATION

In the *Safety Codes Act*, in section 66, the following is added;

**(4)** Notwithstanding subsection (1), the City may make bylaws

relating to environmental matters, including, without limitation,

matters relating to energy conservation and heat retention, but

only to the extent those bylaws are consistent with all regulations made under this section and section 65.01 and all

codes declared in force by those regulations.

NOT ANY MORE...

This is the first time The City – within the limits highlighted – may pass bylaws in those areas controlled by the Building Code

## In summary

Province of Alberta

MUNICIPAL GOVERNMENT ACT

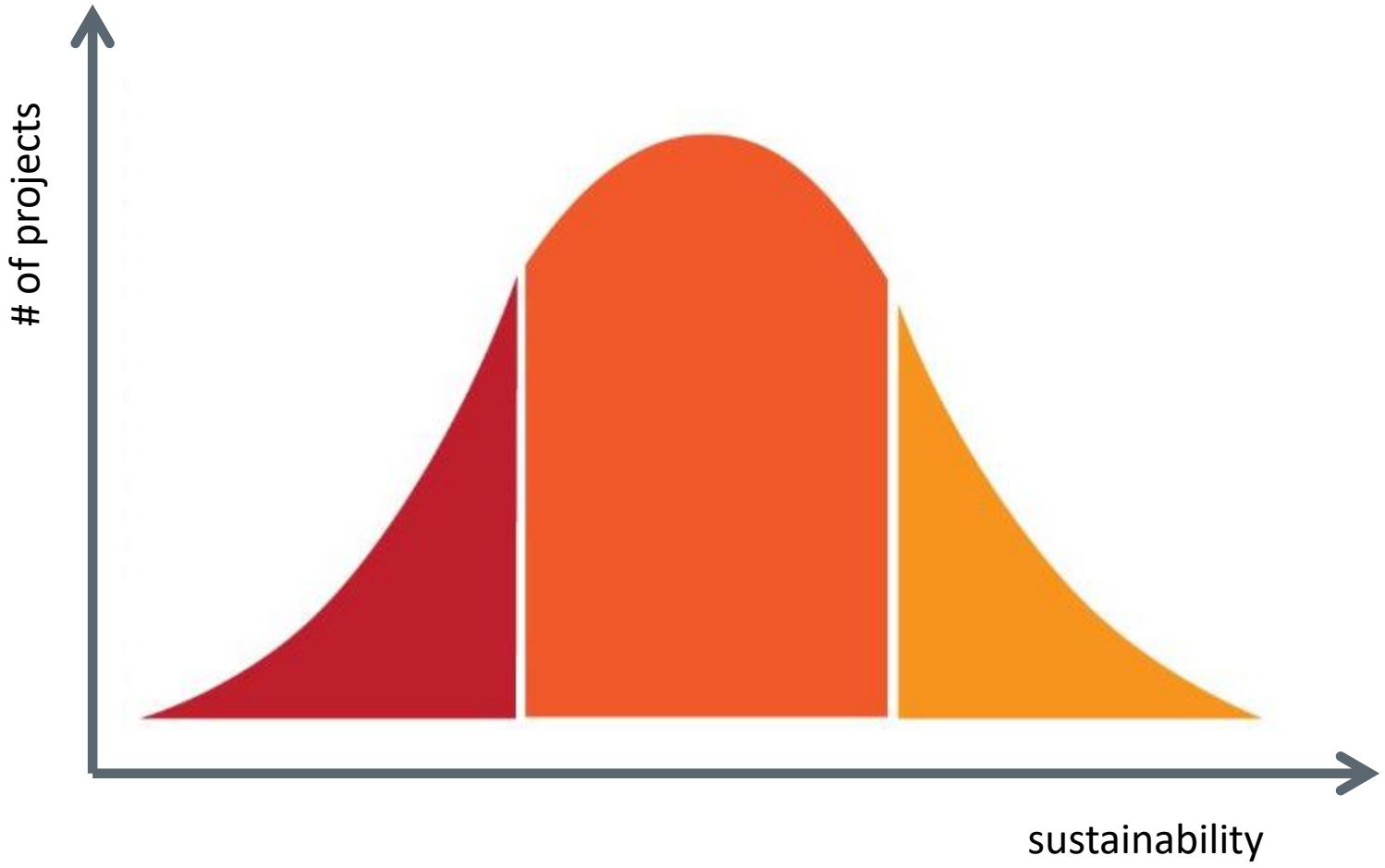
CITY OF CALGARY CHARTER, 2018 REGULATION

Since 2018, the City of Calgary;

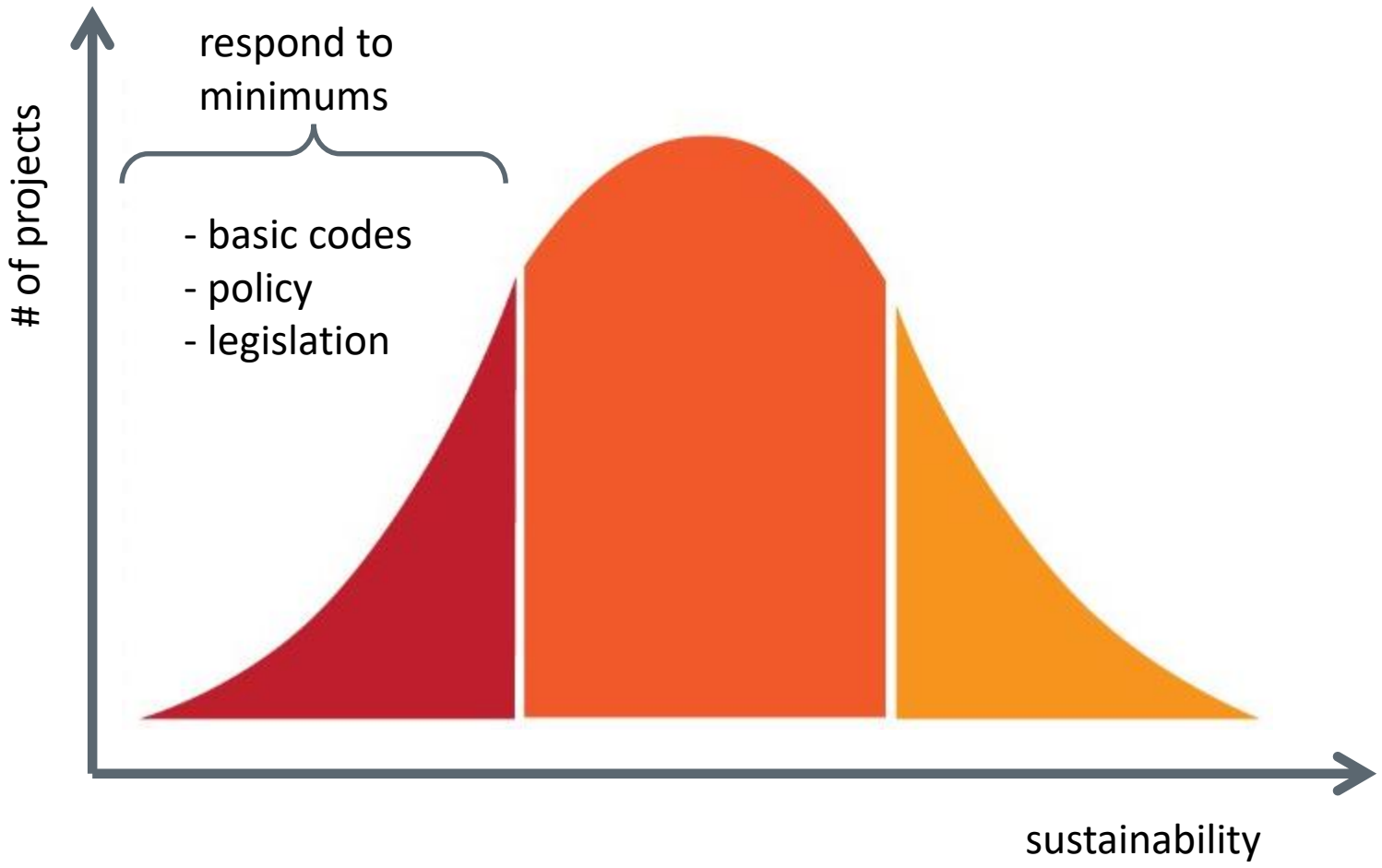
- has an obligation to create and update climate change mitigation and climate change adaptation plans
- can use environmental considerations in approving development and development permits
- may put in place incentives to encourage higher tiers of energy performance

so how can this work in a system?

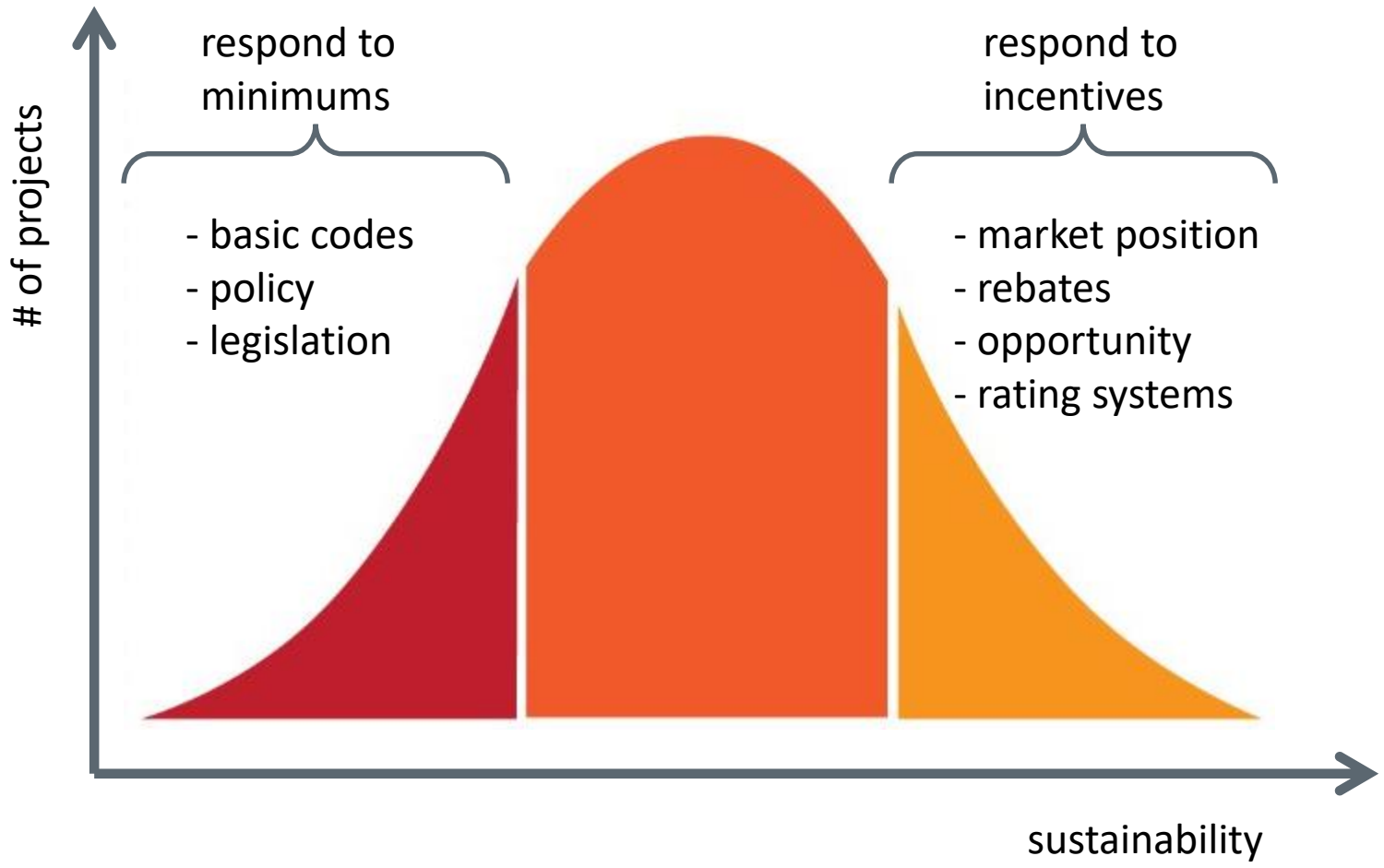
## how to motivate? for sustainability?



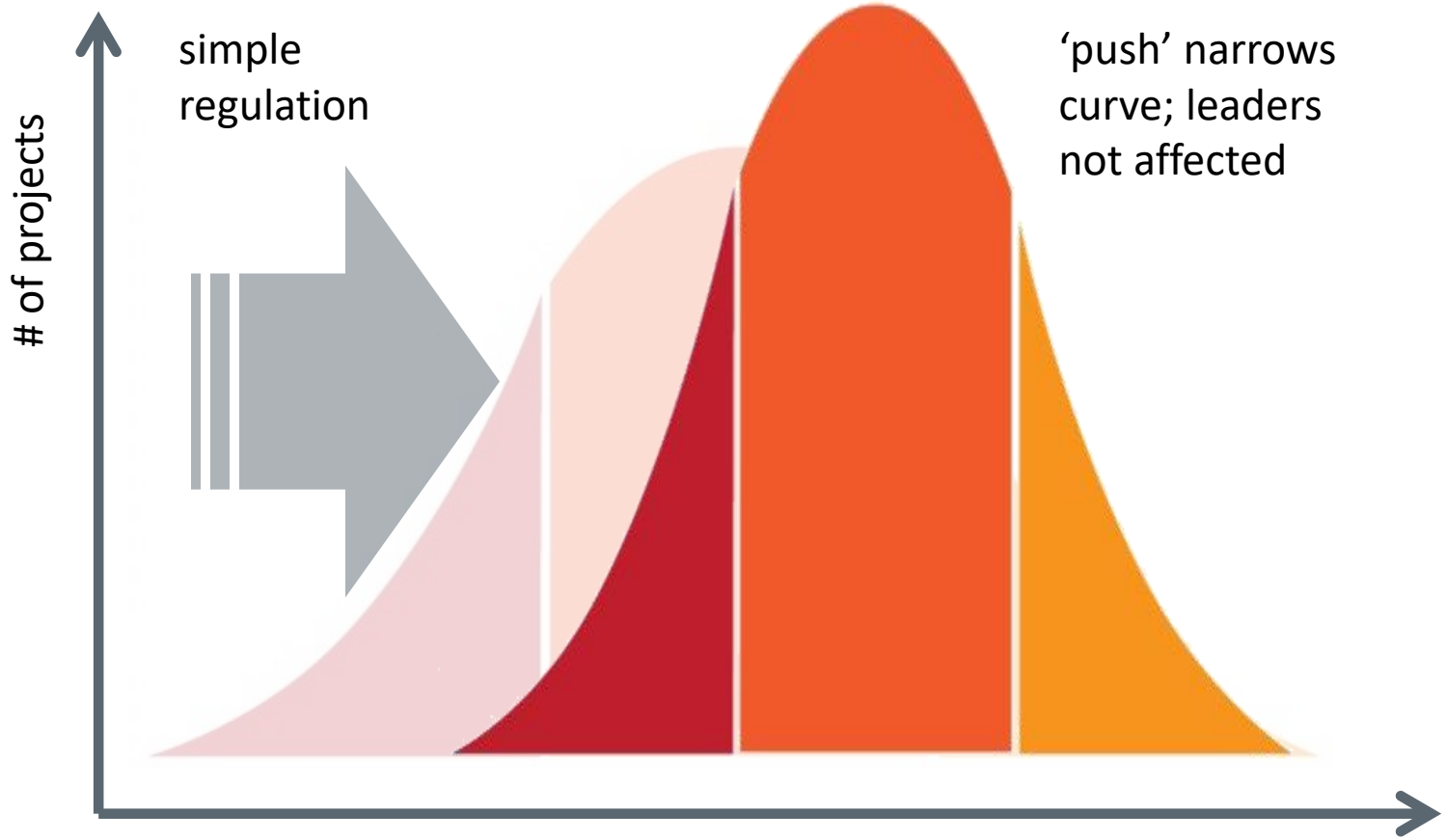
## how to motivate?



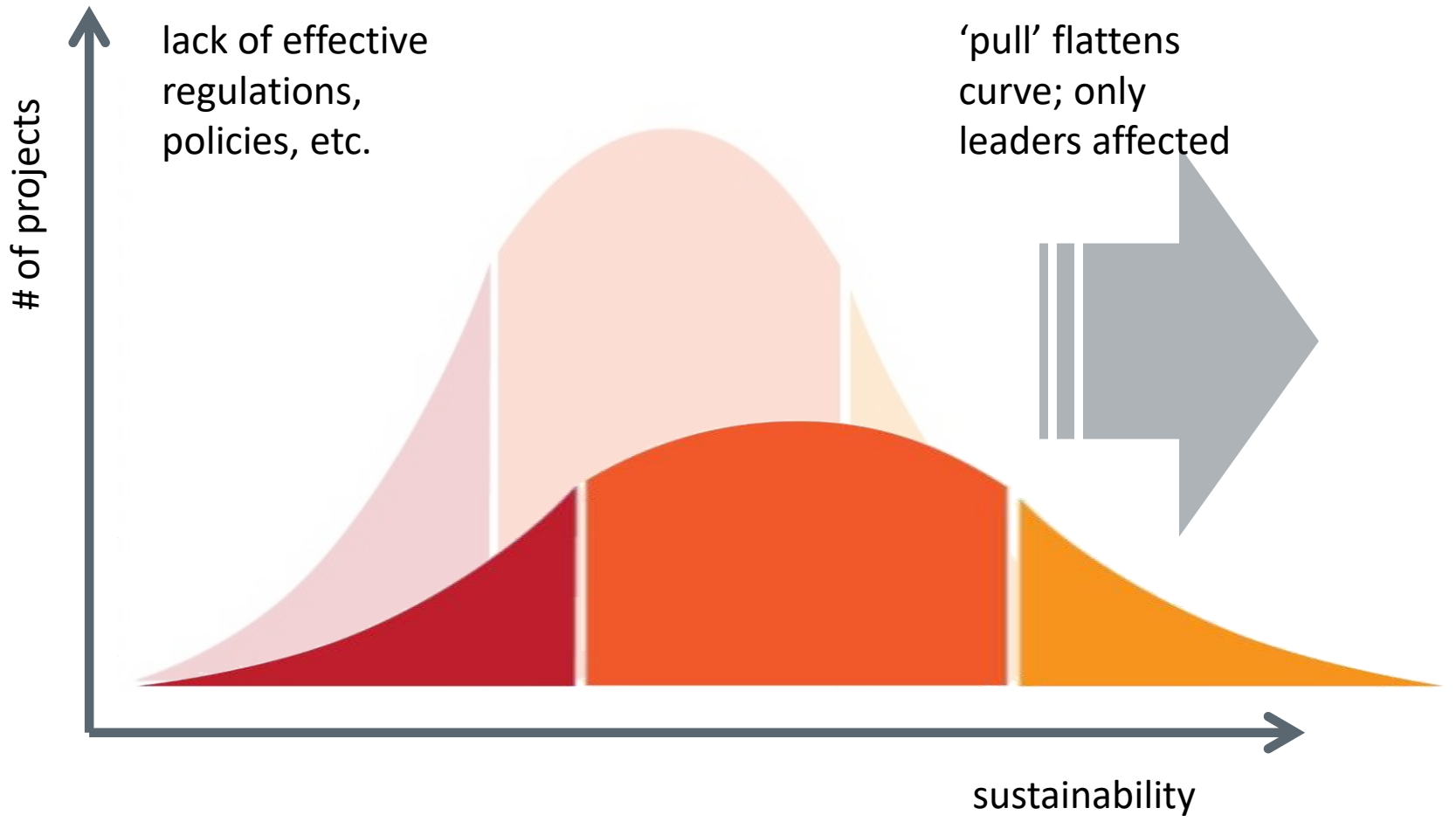
## how to motivate?



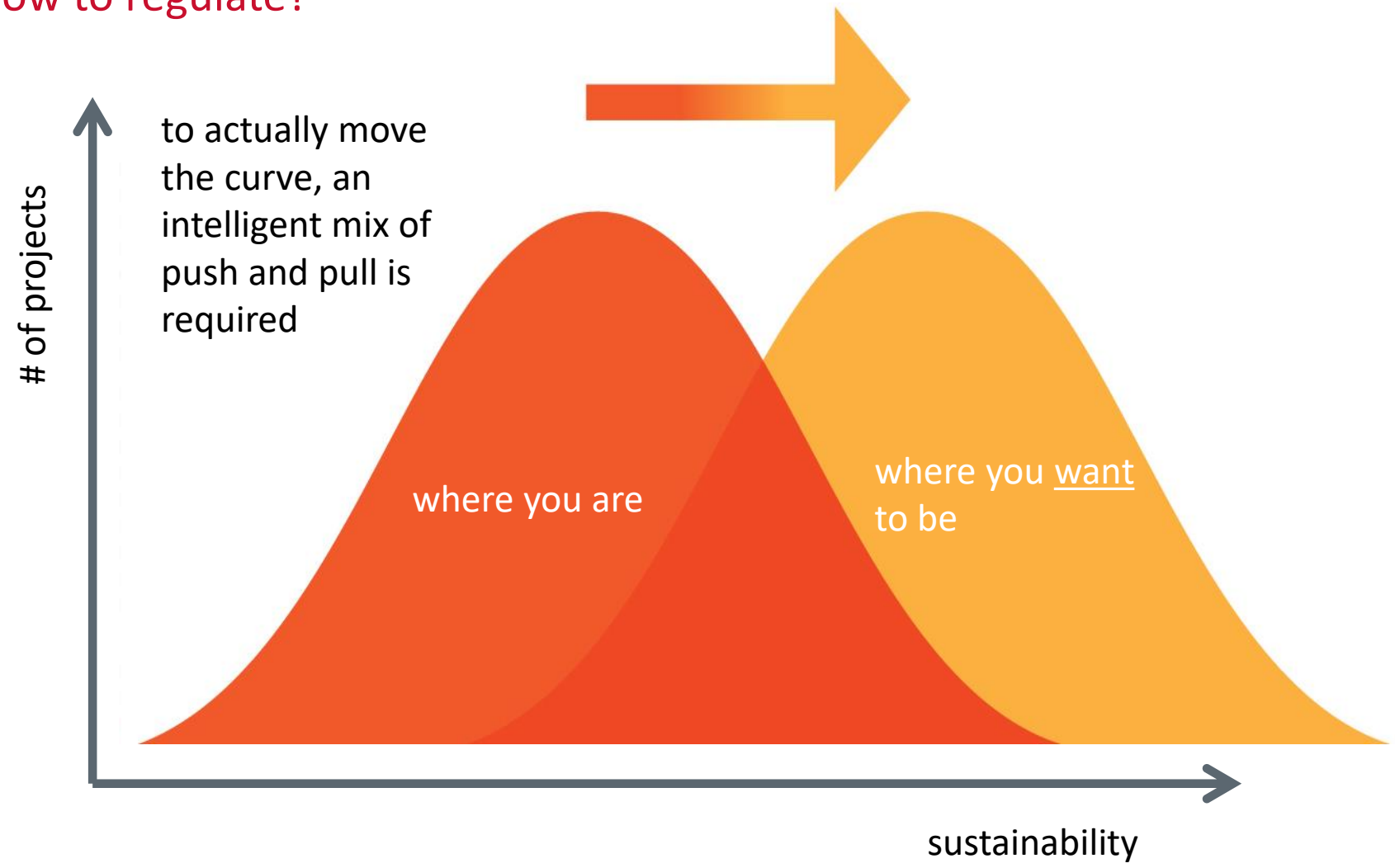
## do you regulate?



## what about incentives?



## how to regulate?



climate change adaptation and mitigation plans + Development incentives/ enticements + Verification standards/ regulations = Better buildings

mandated under charter/policy (OBJECTIVES)

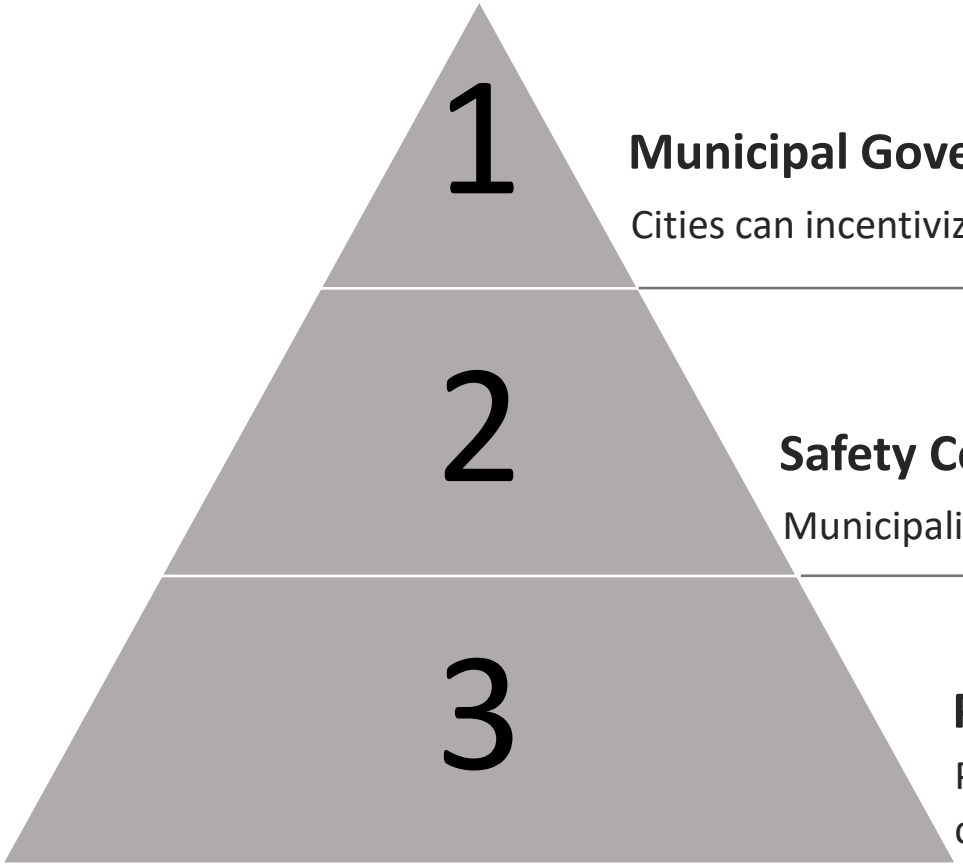
at the discretion of Council/ Administration (PULL)

federal tiered energy codes, reviews, etc. (PUSH)

benefits to everyone ($, health, quality, etc.)

Let’s look at some legislative realities….

# Legislative Framework




**Municipal Government Act**

Cities can incentivize but not mandate higher tiers

**Safety Codes Act**

Municipalities cannot exceed provincial standards

**Provincial Authority**

Province of Alberta has sole authority over building codes

Under Alberta's Safety Codes Act (Section 66) and Municipal Government Act, cities cannot impose higher building standards than provincial minimums. However, they can promote voluntary adoption through incentives.

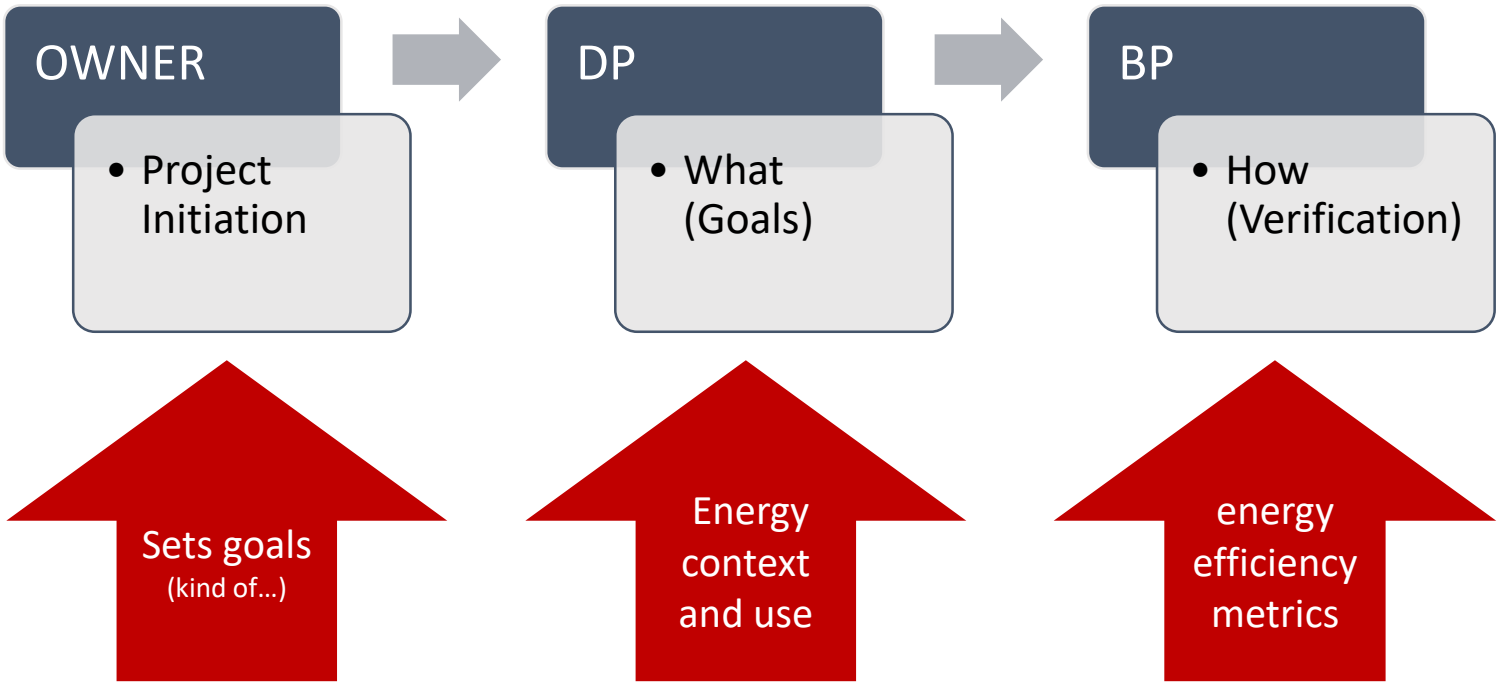
# or, look at the process

**OWNER**
- Project Initiation

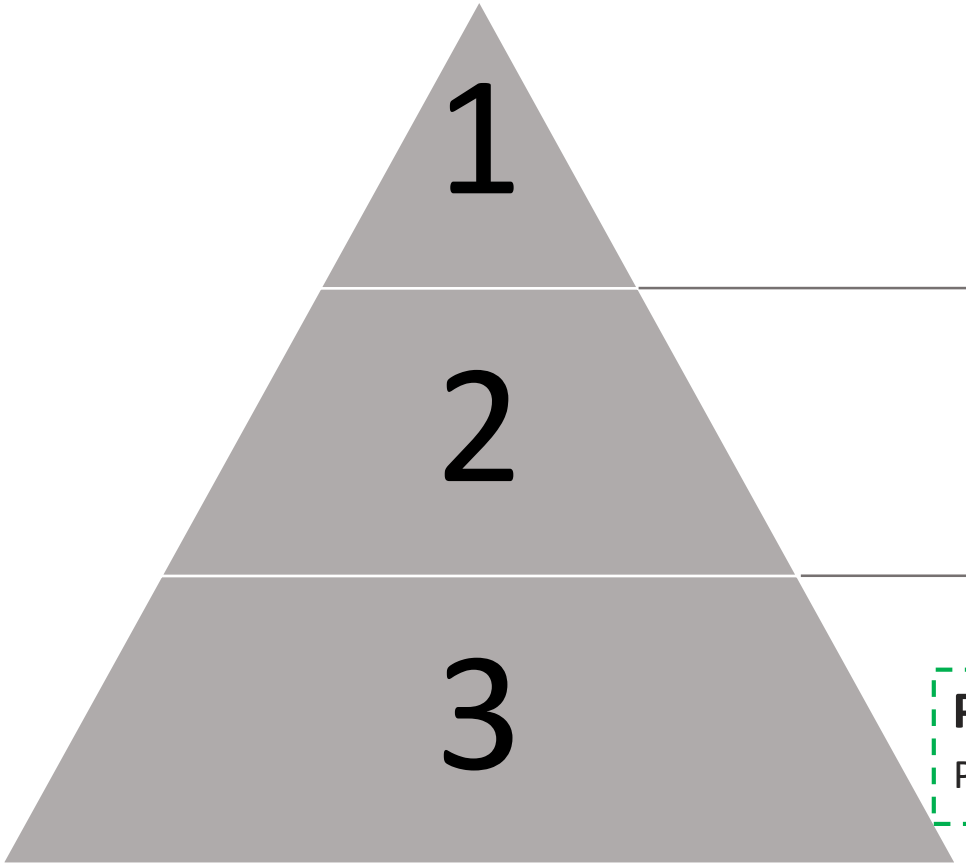
**DP**
- What (Goals)

**BP**
- How (Verification)

# Process


OWNER
• Project Initiation
DP
• What (Goals)
BP
• How (Verification)
Sets goals
(kind of…)
Energy context and use
energy efficiency metrics

# Legislative Constraints

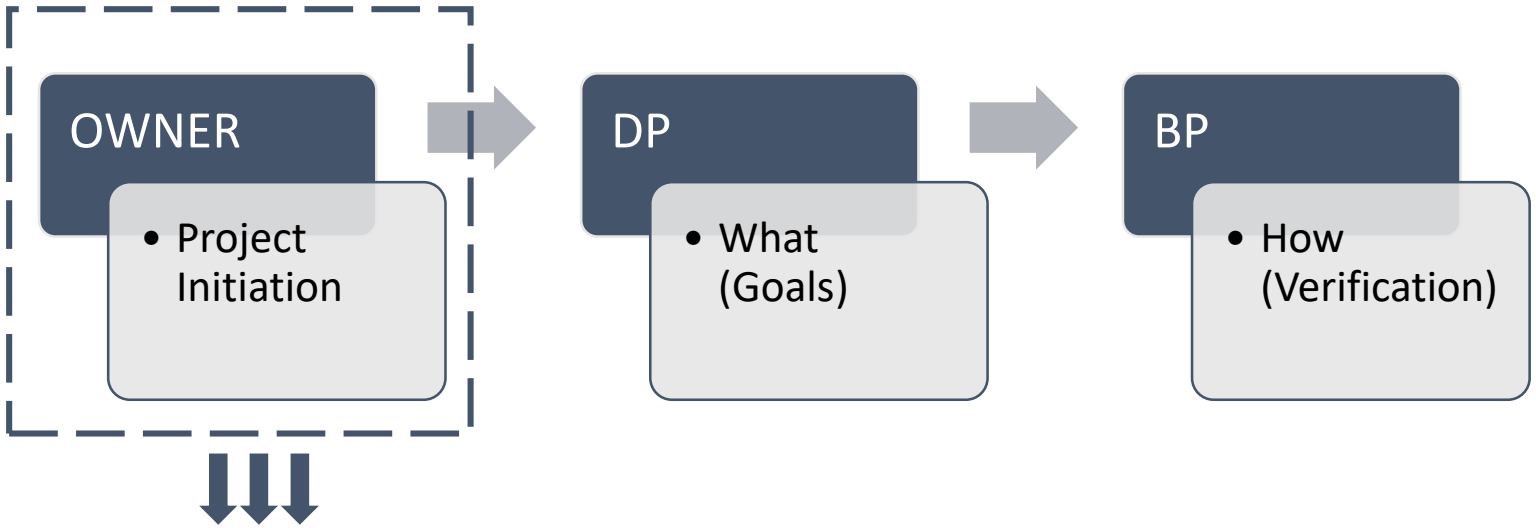



**Provincial Authority**

Province of Alberta has sole authority over building codes

The province sets the MINIMUM standard. The **OWNER** is ultimately responsible for compliance with codes

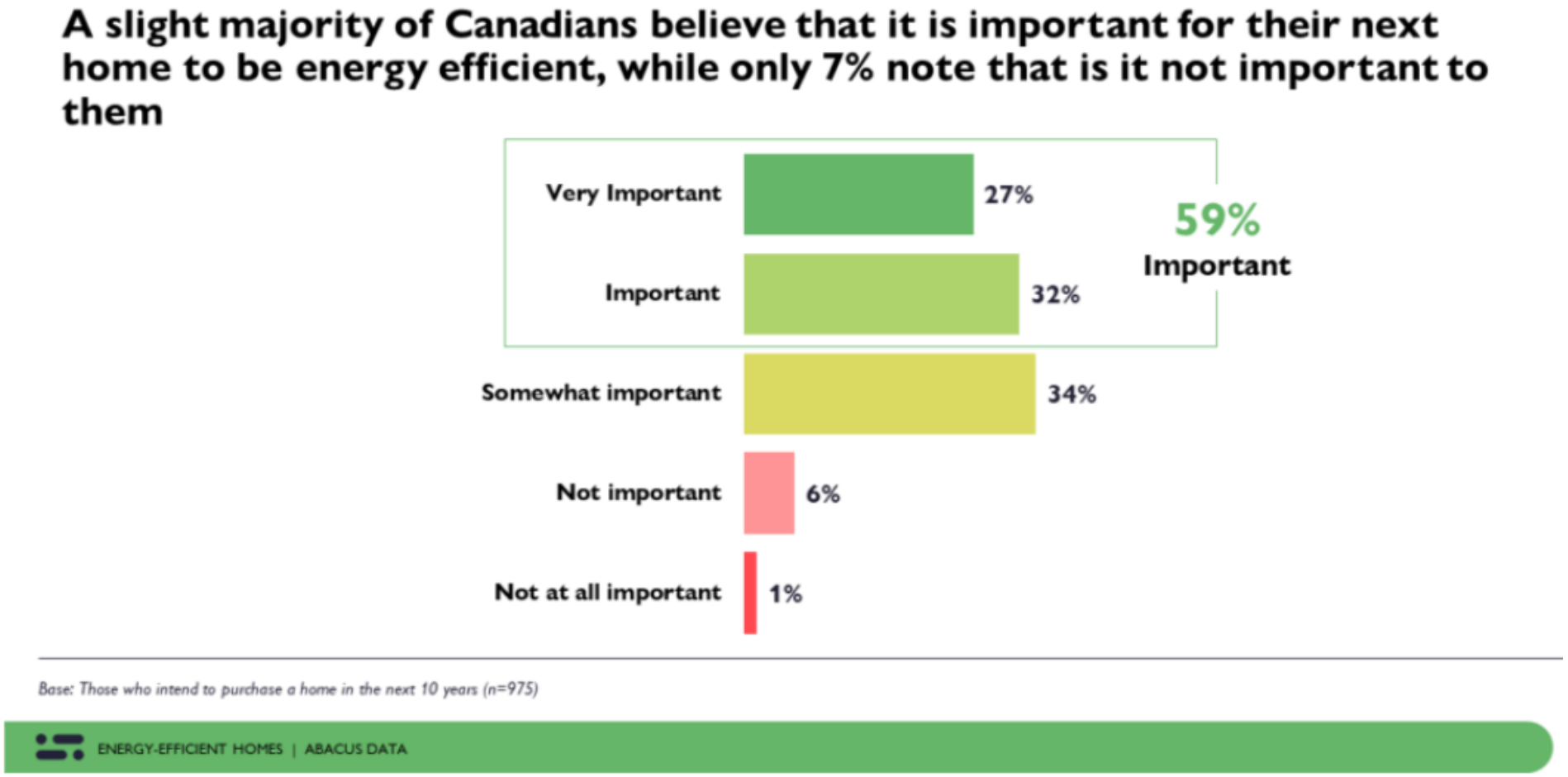
# Process




- Can build to a superior standard, so long code minimum requirements are met.

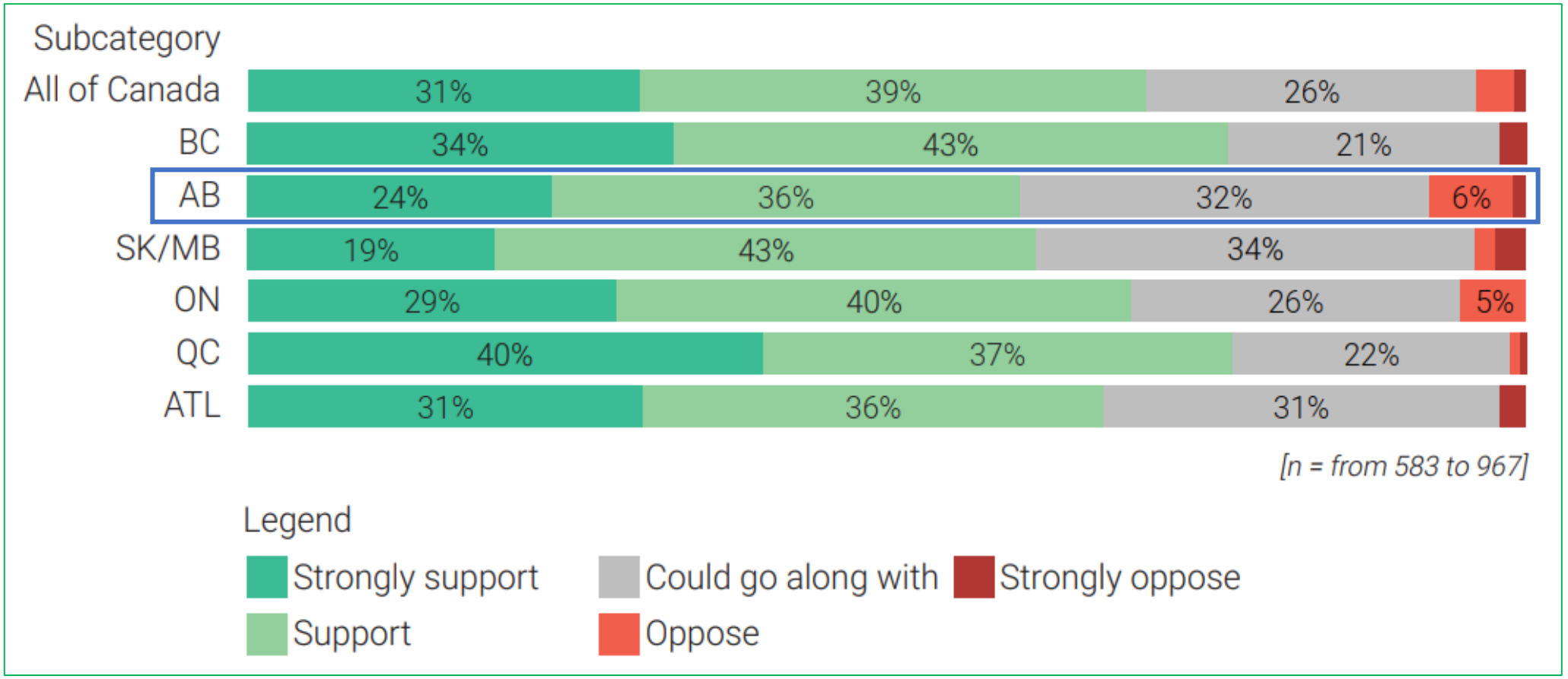
VOLUNTARY!!!

# Q: Does energy efficiency matter to you?




Source: www.abacusdata.ca

# Q: Do you support energy efficiency legislation?




Source: Efficiency Canada. The Municipal Guide to Net-Zero Energy Ready Building Codes https://www.efficiencycanada.org/wp-content/uploads/2023/02/Municipal_Guide.pdf

# Q: What are the most important features you look for in a home?

## TOP 10 MOST-DESIRED FEATURES OF 2024

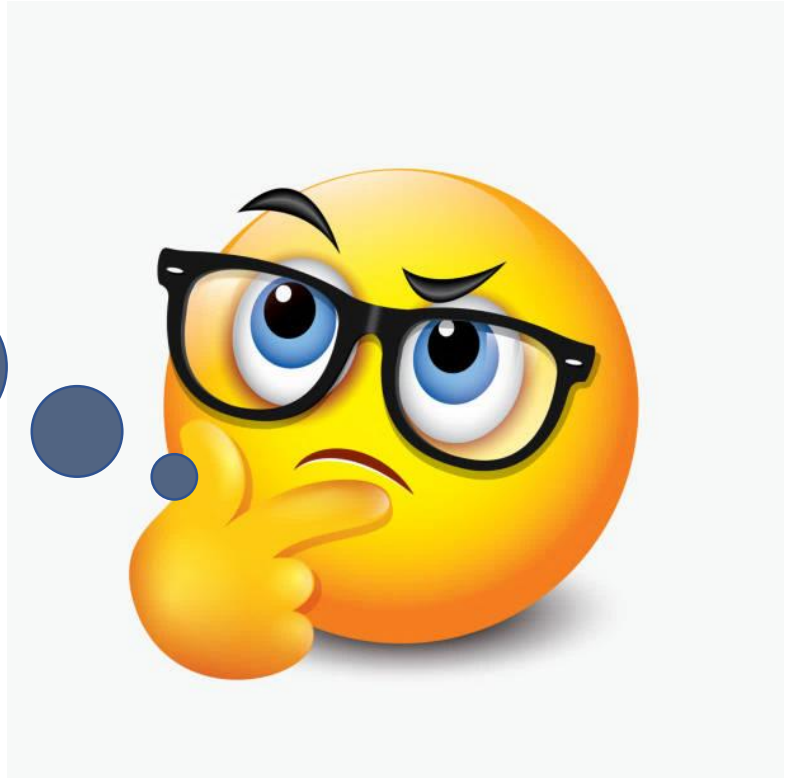
The top 10 overall “Must Have” home features identified by the 2024 study participants:

1. Walk-In Closets (Primary Suite)
2. Kitchen Island
3. High-Efficiency Windows
4. Walk-In Closets (Interior Of Home)
5. Energy-Efficient Appliances
6. Overall Energy-efficient Home
7. HRV/ERV Air Exchange System
8. Linen Closets
9. Kitchen: Hardwood / Wood-Look Floor
10. 2-Car Garage

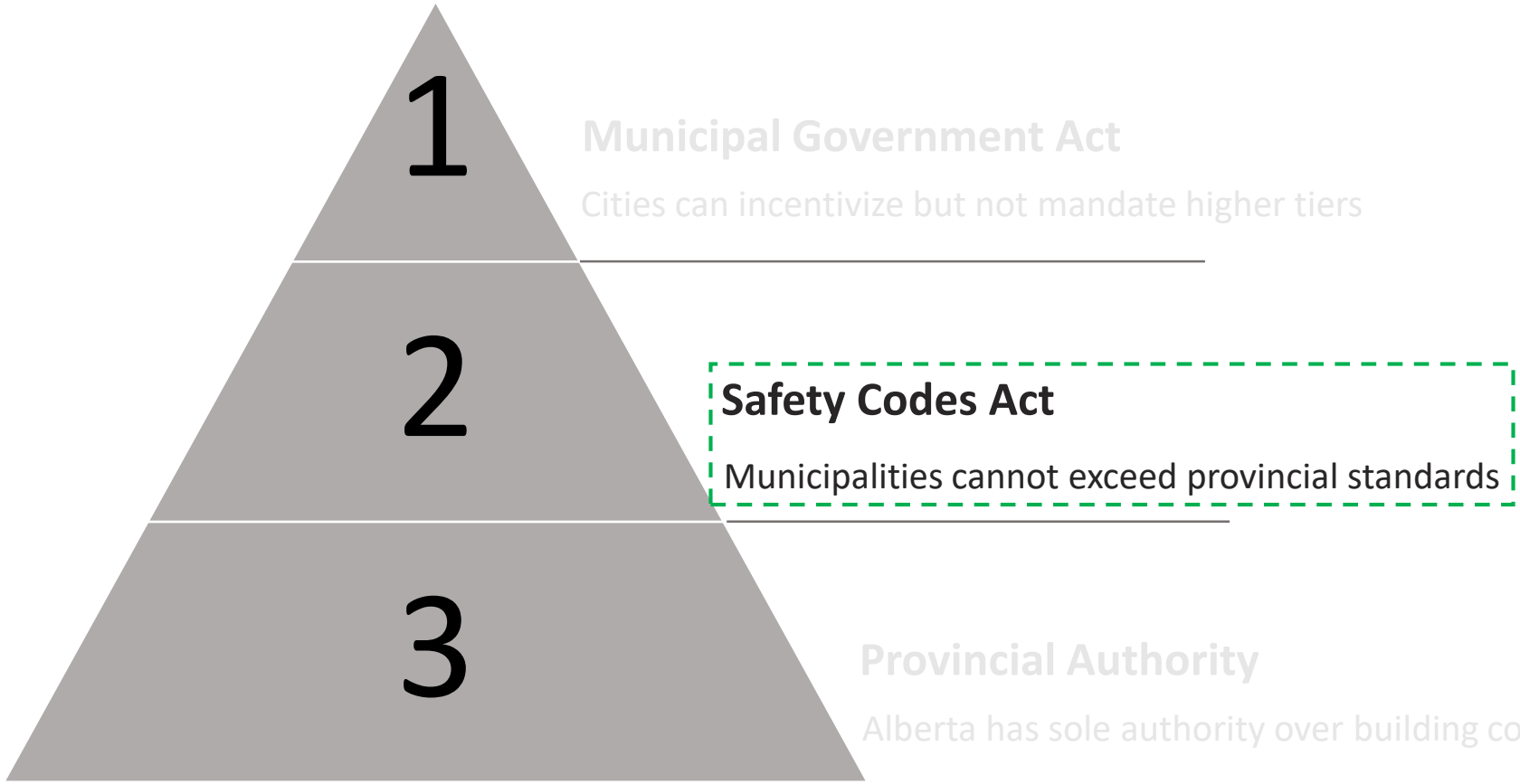
Source: CHBA National customer Survey 2024

How can you encourage owners to voluntarily build to a higher standard?

Keep this in mind for later...



# Legislative Constraints




Under Alberta's Safety Codes Act and Municipal Government Act, cities cannot impose higher building standards than provincial minimums. However, they can promote voluntary adoption through incentives.

# Safety Codes Act (SCA)

**Purpose**

- Establishes REQUIREMENTS AND PROCEDURES for life safety, property protection, and energy efficiency (among other things…)

**Focus**

- **Minimum standards** for design and construction (Building Code, Fire Code etc.)
- **Permitting and Inspection** for building safety, fire protection, electrical, plumbing, gas etc.
- **Procedural and legislative** frameworks for codes and standards

# Safety Codes Act Regulates Energy Efficiency

**Safety Codes Act has Established**:

- ❑ 9.36 Energy Efficiency Standard for Houses and Small Buildings
- ❑ NECB is the Energy Efficiency Standard for Larger and Commercial Buildings
- ❑ Energy Codes and the Building Codes are Complementary Documents
  - They are equivalent in authority but different in scope and application.
- ❑ Tier 1 as the minimum energy code compliance

**National Building Code — 2023 Alberta Edition**

**1** The *National Building Code — 2023 Alberta Edition*, published by the National Research Council of Canada and as amended or replaced from time to time, is declared in force with respect to buildings.

**National Energy Code of Canada for Buildings 2020**

**2(1)** The *National Energy Code of Canada for Buildings 2020*, published by the National Research Council of Canada and as amended or replaced from time to time, is declared in force with respect to buildings with the variations set out in this section.

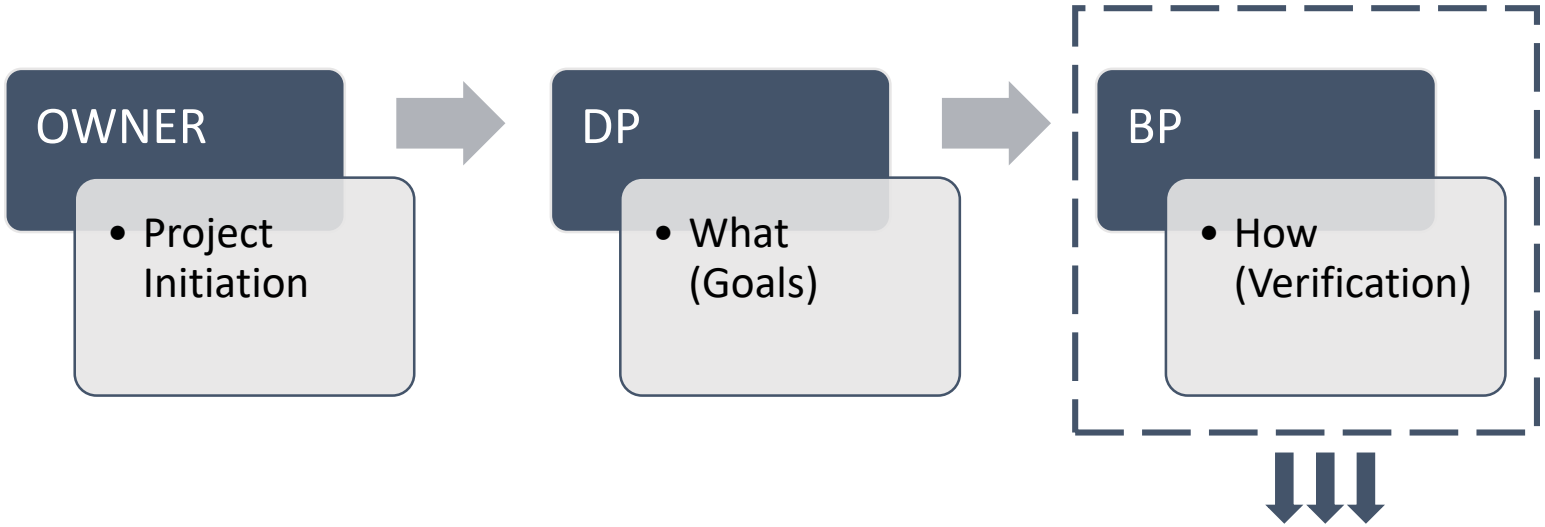
**(2) Clause 1.1.2.1.(1)(c) is repealed and the following is substituted:**

c) at least the tiered performance requirements specified as Energy Performance Tier 1 in Table 10.1.2.1. in Part 10.

**(3) Sentence 10.1.2.1.(1) is amended by striking out** "one of Energy Performance Tiers 1 to 4 specified in Table 10.1.2.1., each of" **and substituting** "at least Energy Performance Tier 1 specified in Table 10.1.2.1.,".

| Building Type | Compliance Options | | |
|---|---|---|---|
| | Part 9 - Prescriptive | Part 9 - Performance | NECB |
| - Houses, houses with secondary suites,<br>- Buildings containing only dwelling units with common spaces ≤ 20% floor area | ✔ | ✔ | ✔ |
| - Purely residential buildings<br>- Any building, where all non-residential portions (not F2) have a floor area ≤ 300 m² | ✔ | | ✔ |
| - Any building where non-residential occupancies have a floor area > 300m²<br>- Buildings containing F2 occupancies (any size) | | | ✔ |

# Process




- There are a number of ways to measure and verify building performance

TIERED CODES ARE SIMPLY THE EASIEST! (prepare for soapbox diatribe)

# What Are Tiered Energy codes ?

Progressive steps toward net-zero ready buildings


# Ambitions of Tiered Energy Codes

1 **Clear and Flexible Path to Net-Zero Ready**

Structured, progressive path  to energy-efficient buildings

2 **Supports City Climate Goals**

Aligns with Calgary’s building energy and emission targets

3 **Encourages Market Transformation**

Drives the adoption of high-performance building practices and technologies

4 **Scalable Energy Performance**

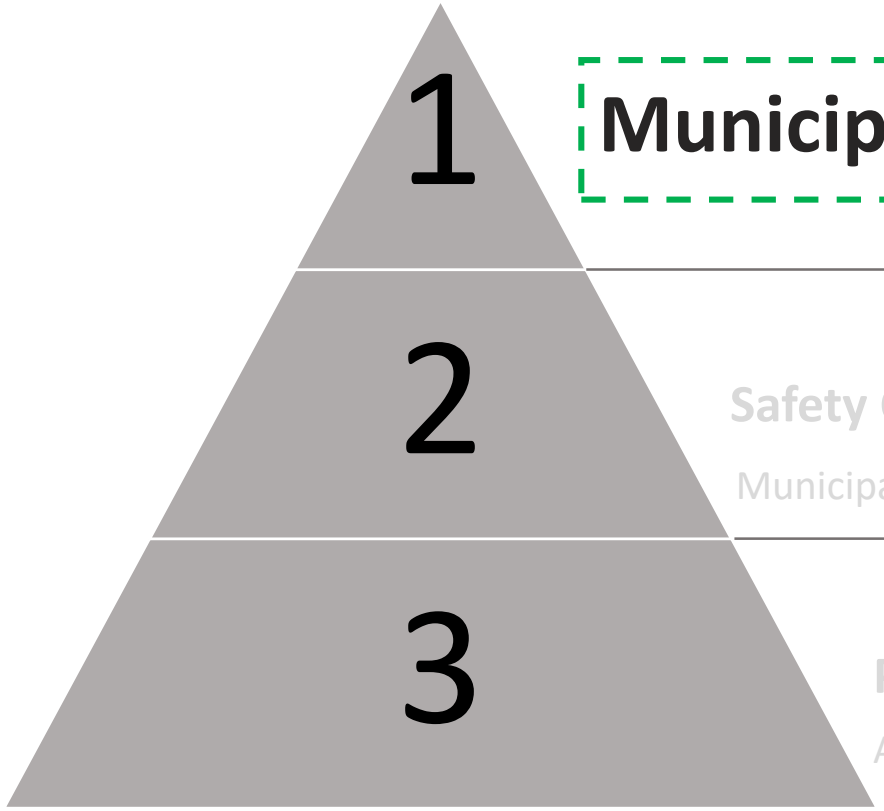
Gradual improvement allows time for industry to adapt.

5 **Verifiable Metrics and Measurement Tools**


# Scope Outside Tiered Energy Code

- Operation Energy ✓
- Life Cycle GHG Emissions (Embodied Carbon) (**For Now !!!**) ✗
- EV and Renewable Energy Requirements ✗
- Sustainable Objectives (Biodiversity | Resilient Infrastructure | Water and Waste Management etc.) ✗

# Legislative Constraints




**Municipal Government Act (MGA)**

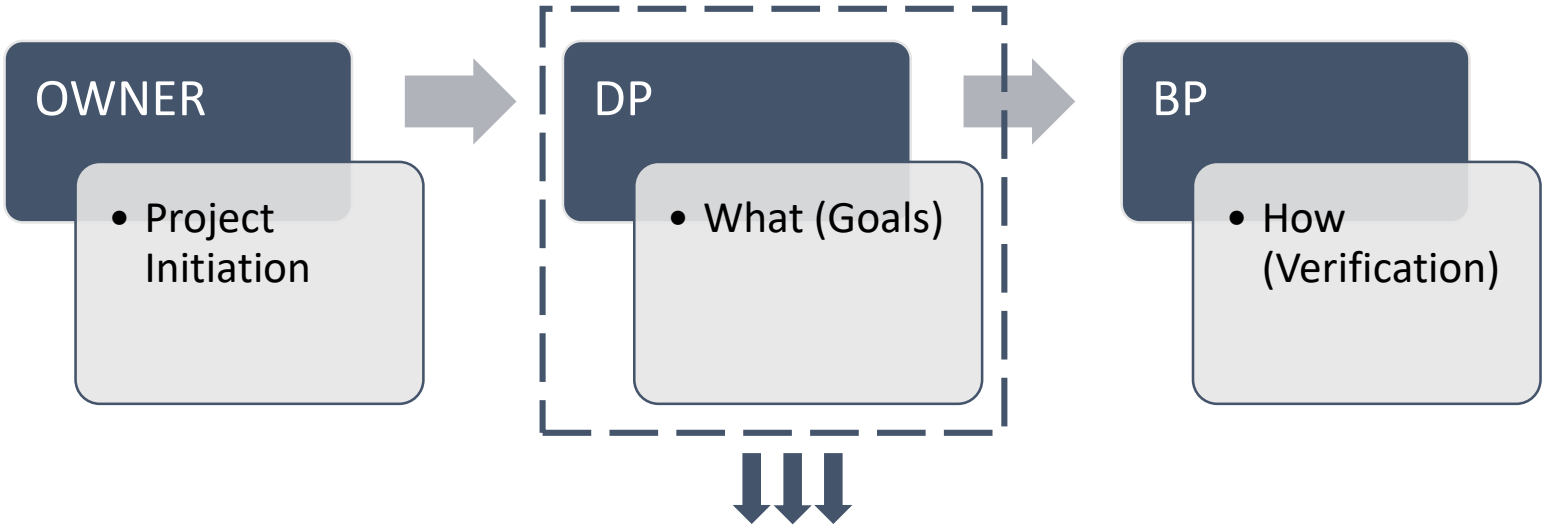
**Safety Codes Act**

Municipalities cannot exceed provincial standards

**Provincial Authority**

Alberta has sole authority over building codes

# Process




- Greenfield buildings often do not require DPs – but the DP concept is 'baked into' the community plans and LUB!

ALL buildings need to comply with Land Use Bylaw

# (simplified) Municipal Government Act (MGA)

**Purpose**

- ❑ Provides the legal framework for how municipalities operate and make decisions regarding land use, development planning, governance, and local bylaws

**Focus**

- ❑ Land use and zoning
- ❑ Development approvals
- ❑ Subdivision processes
- ❑ Municipal bylaws
- ❑ Infrastructure and services
- ❑ Property tax and assessment

# Limits on the city to override code

According to MGA Section 7, municipalities are allowed to pass bylaws.

> **General jurisdiction to pass bylaws**
>
> **7** Subject to section 7.1, a council may pass bylaws for municipal purposes respecting the following matters:

However, municipalities cannot pass bylaws about matters **already regulated** by the building code. SCA Section 66

> **Bylaws**
>
> **66(1)** Except as provided in this section, a bylaw of a municipality that purports to regulate a matter that is regulated by this Act is inoperative.

# Among the Bylaws/Areas **Not** Regulated By The SCA

- ❑ Zoning
- ❑ Setbacks
- ❑ Building Heights or FAR
- ❑ Site Coverage
- ❑ Incentives

# Process

OWNER

- Project Initiation

DP

- (

P

- How (Verification)

INCENTIVES

- n build to a superior standard, so long code minimum requirements are met.

VOLUNTARY!!!

# Opportunities Under The (MGA)

| | |
|---|---|
| Land Use Bylaws **(Sec. 640)** | **Bonus Density \| Zoning Relaxations** |
| ★ Municipal Development Plans **(Sec. 632)** | **City can set policies requiring new developments to meet higher-tier performance.** |
| ★ Fast-Tracking Permits **(Sec. 683.1)** | **Expedite permit approvals and reduce fees for energy-efficient projects** |

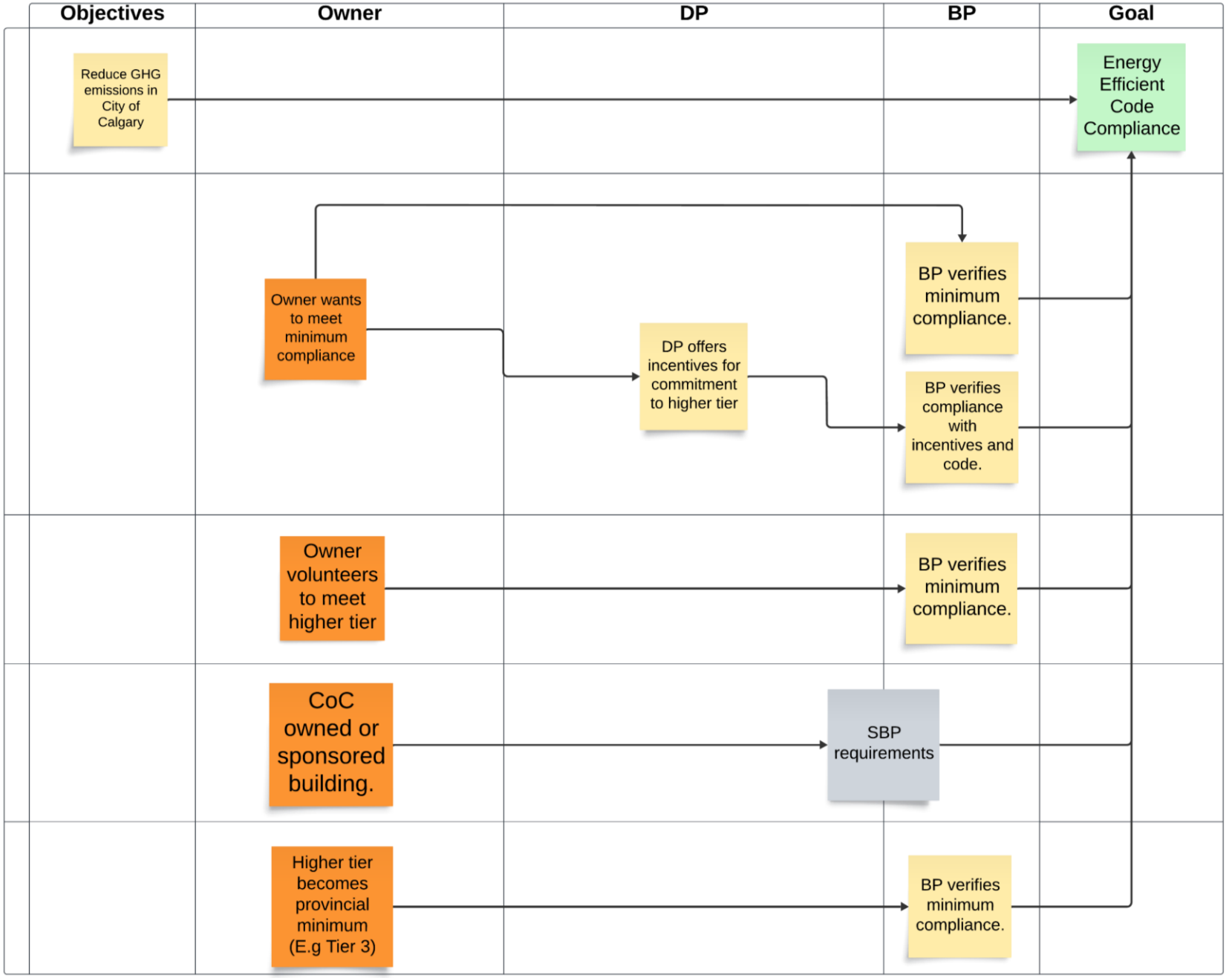
**Recognized under the City of Calgary Charter 2018 Regulation**

# Opportunities Under The (MGA)

| | |
|---|---|
| Community Revitalization Levy **(Sec. 381.2)** | **City can provide levy rebates or allocate funds for projects committing to higher tiers** |
| Tax Incentives for Non-Residential Property **(Sec. 364.2)** | **City can offer temporary property tax reductions for high-performance commercial buildings.** |
| ★ Clean Energy Improvement Tax **(Sec. 390.3)** | **City has the Clean Energy Improvement Program (CEIP) program that allows property owners to finance energy upgrade through property taxes.** |

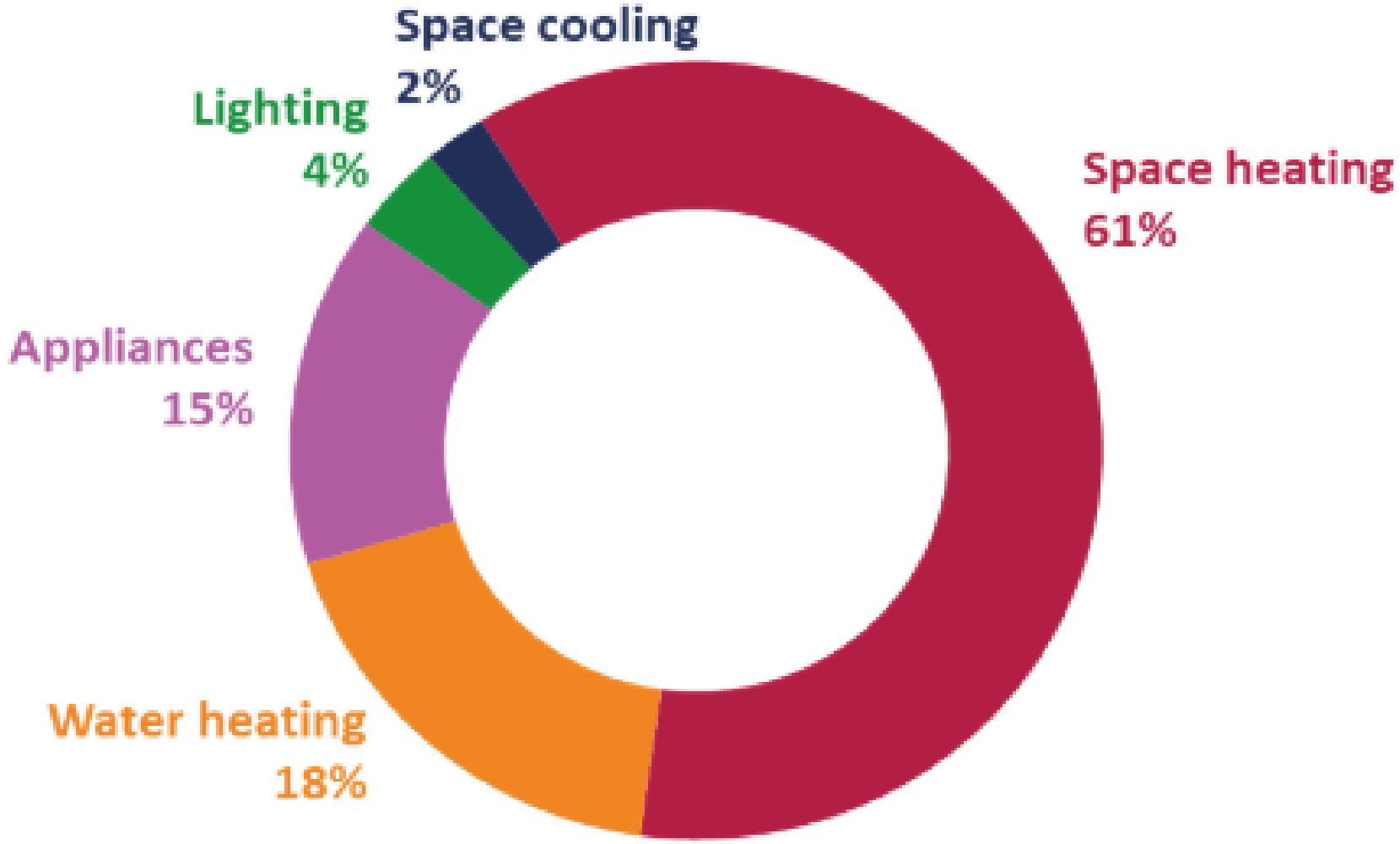
**Recognized under the City of Calgary Charter 2018 Regulation**

# Thought Model



# The Basics of Building Energy Use

# Energy use in residential buildings



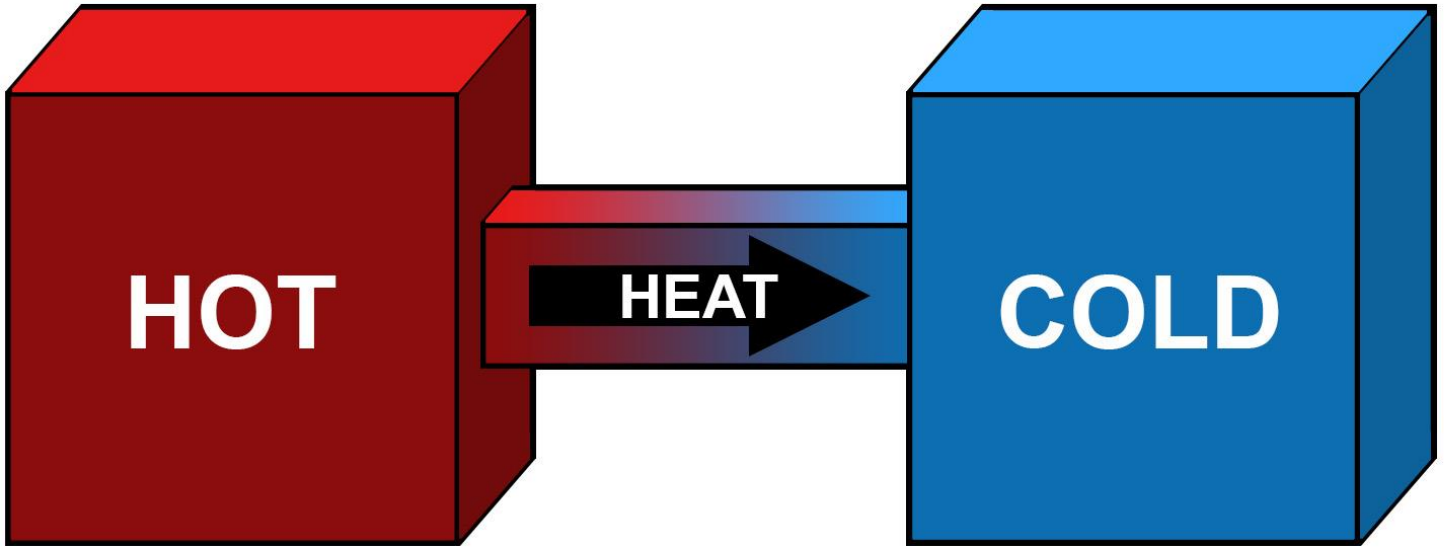

Source: Natural Resources Canada. https://oee.nrcan.gc.ca/publications/statistics/trends/2020/residential.cfm

# Energy Fundamentals

(time for some boring but important physics)

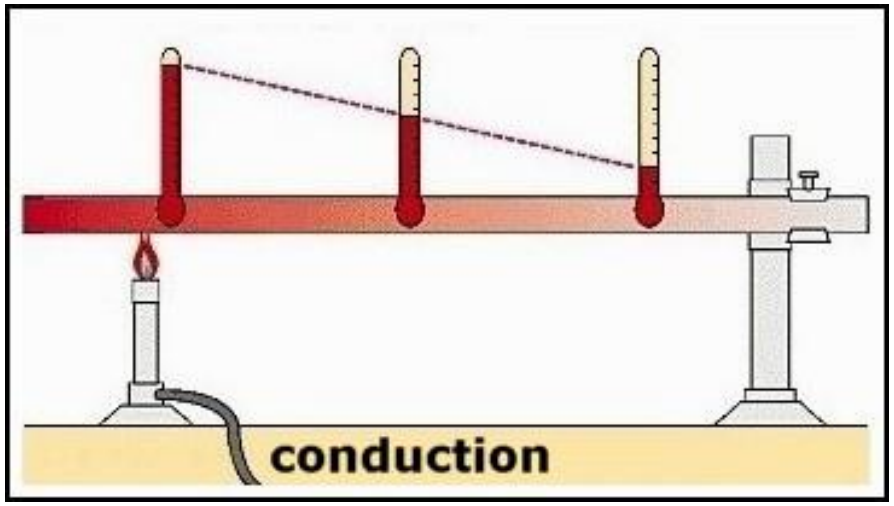
# Basic Science of Energy Flow

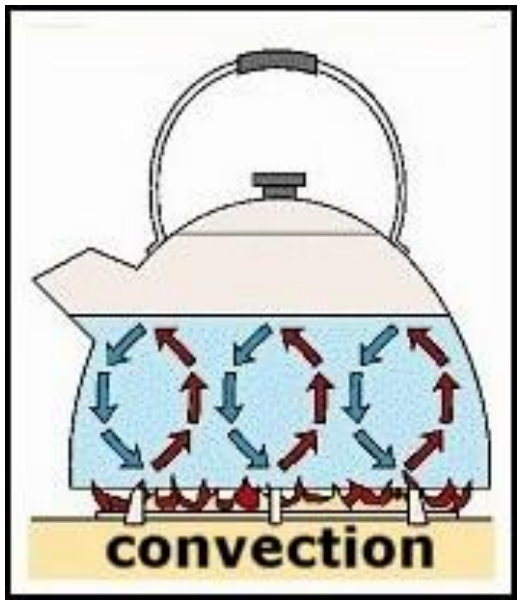
It’s all about energy and heat.

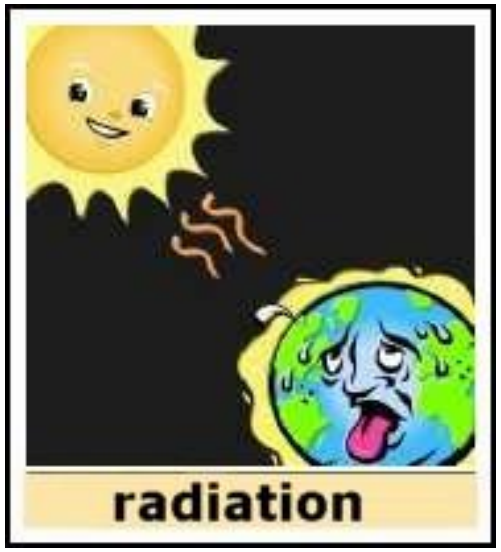


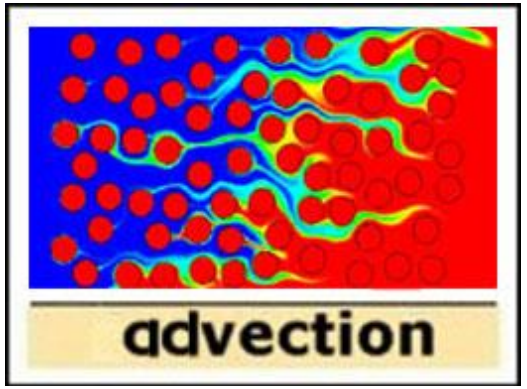

**Second Law of Thermodynamics**: As energy is transferred or transformed, it eventually ends up as **heat**.

# Mechanism of Heat Loss in Buildings

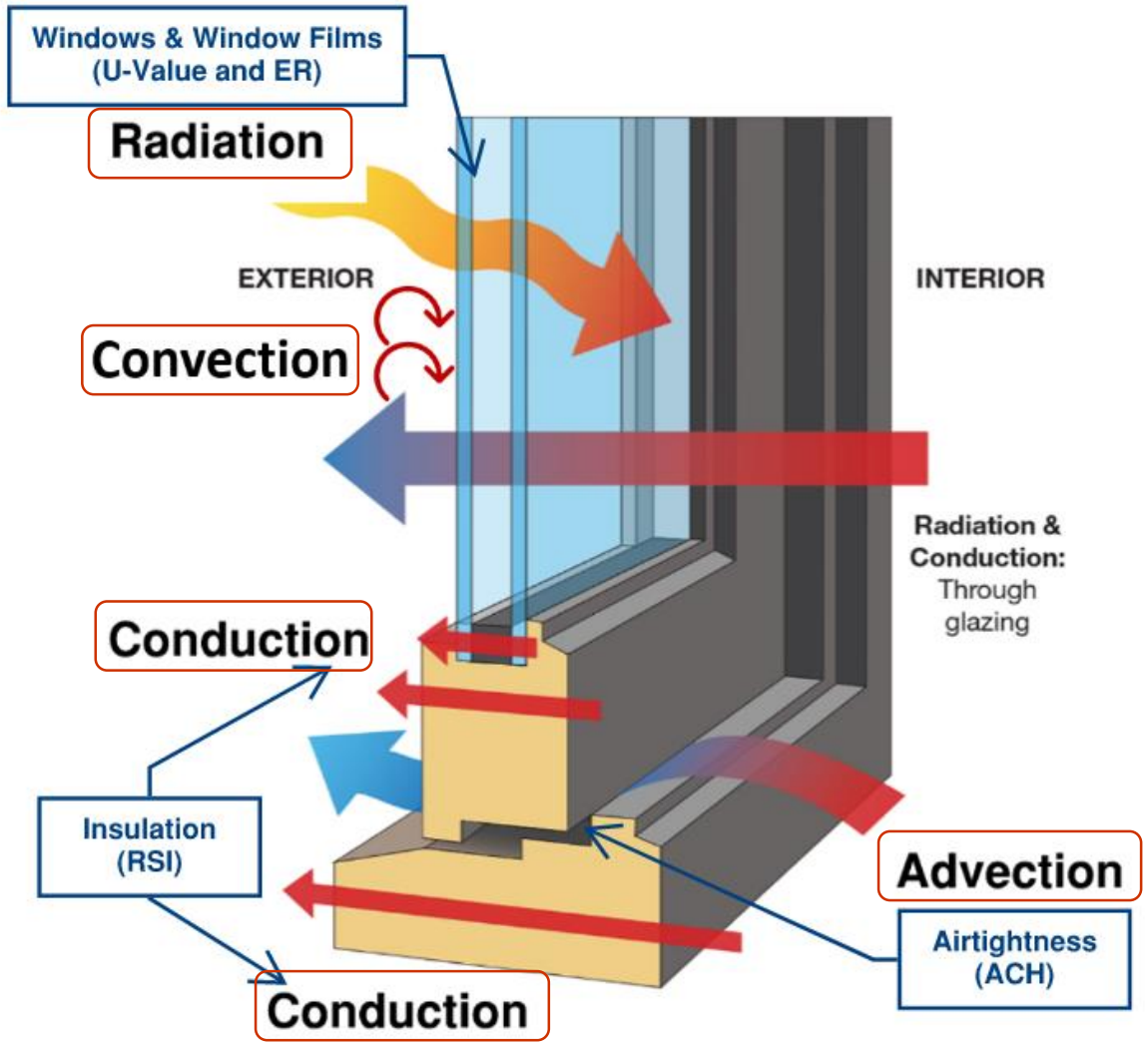


# Mechanism of Heat Loss in Buildings



# Understanding Thermal Resistance

- Insulation resists heat flow. Its effectiveness is measured by:
  - R-value (Imperial)
  - RSI (Metric) - $(m^2.k)/W$
- More insulation = higher R/RSI, but placement and continuity matter.

**Rsi = $m^2.k/W$**

**R = $ft^2 \cdot °F \cdot hr/Btu$**

# Understanding (U) Thermal Transmittance

- Indicates how easily heat flows through a building component.
- Its effectiveness is measured by:
  - U-value (Imperial)
  - USI (Metric) - $W/(m^2.K)$
- Lower U-Value ⇒ Better insulation performance

**Usi = $W/m^2.k$**

**U = $Btu/ft^2 \cdot °F \cdot hr$**

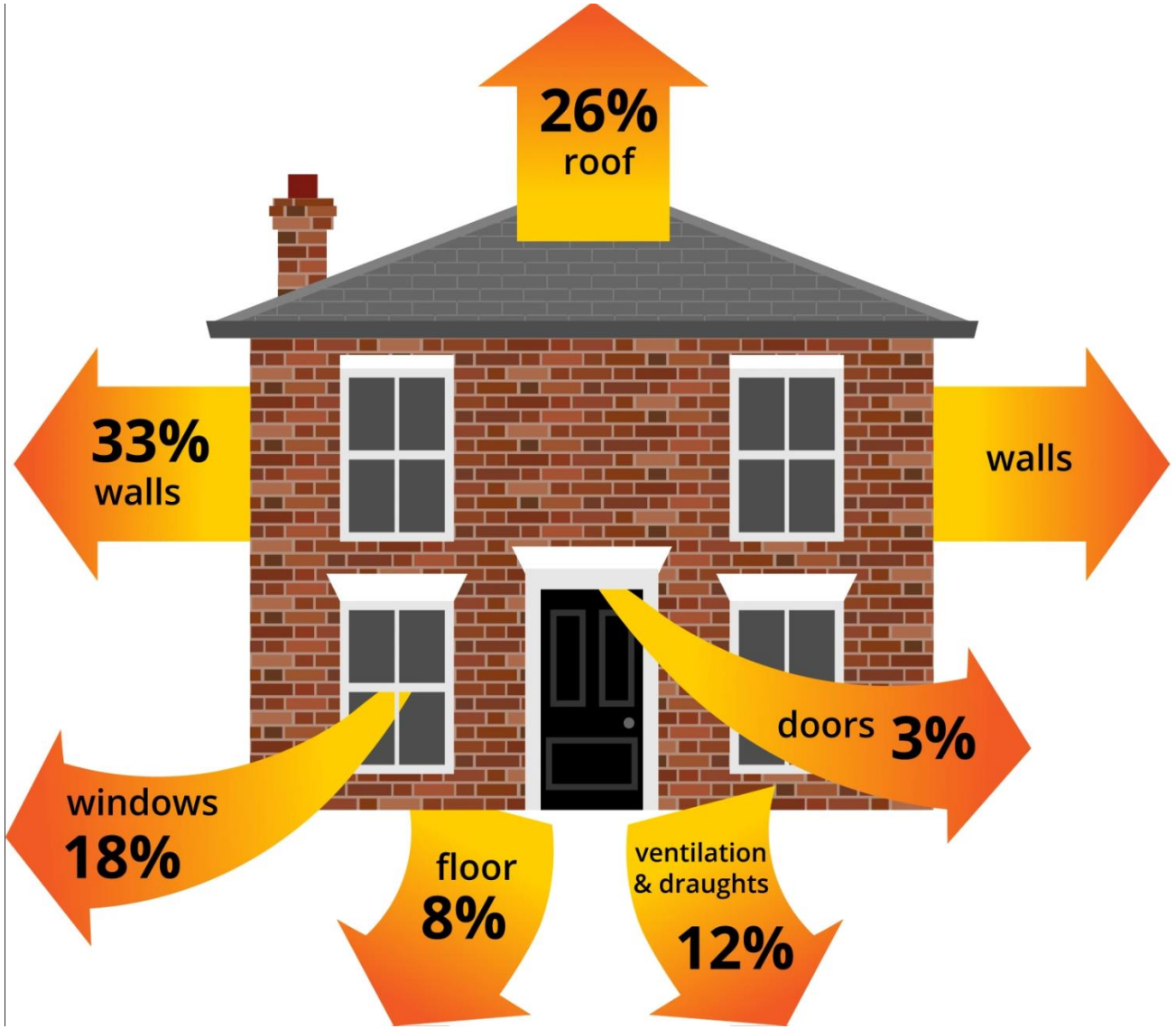
# Relationship Between Thermal Resistance and Thermal Transmittance

- Both are inversely proportional to one another

## U-Value = 1/R-Value

**The code talks in Usi and Rsi. However, imperial units are widely used in market products (U and R Values).**

# Energy use in residential buildings – NOT constant!




Source: https://greenworld4u.co.uk/wall-insulation/

A quick group discussion...

**Question:**

What are the greatest barriers to energy efficiency?

**Question:**

What incentives, regulations, or programs are most relevant to improving energy efficiency in residential buildings?

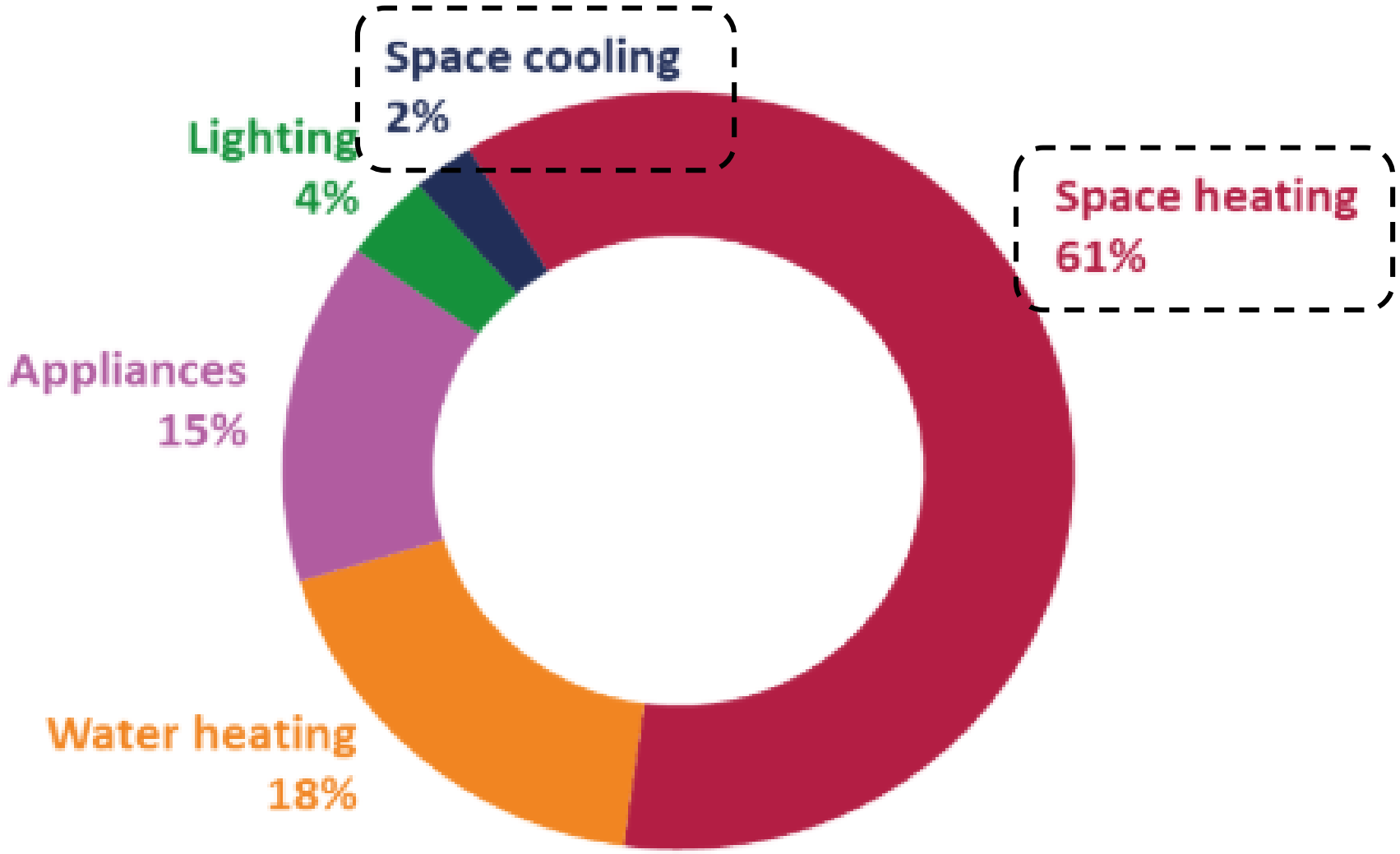
# NBC Acceptable Solutions

# Section 9.36: Energy Efficiency (Scope)

- **Sets requirement for**:
  - Building envelope (e.g. insulation, air barrier) – 9.36.2
  - HVAC – 9.36.3
  - Service water heating systems – 9.36.4
  - Energy Performance Compliance – 9.36.5
  - Airtightness of Building Envelope – 9.36.6
  - Tiered Energy Performance Compliance: Performance – 9.36.7
  - Tiered Energy Performance Compliance: Prescriptive Path – 9.36.8

# 9.36.2 Building Envelope

# Energy use in residential buildings




Source: Natural Resources Canada. https://oee.nrcan.gc.ca/publications/statistics/trends/2020/residential.cfm

# Summary of Code Changes

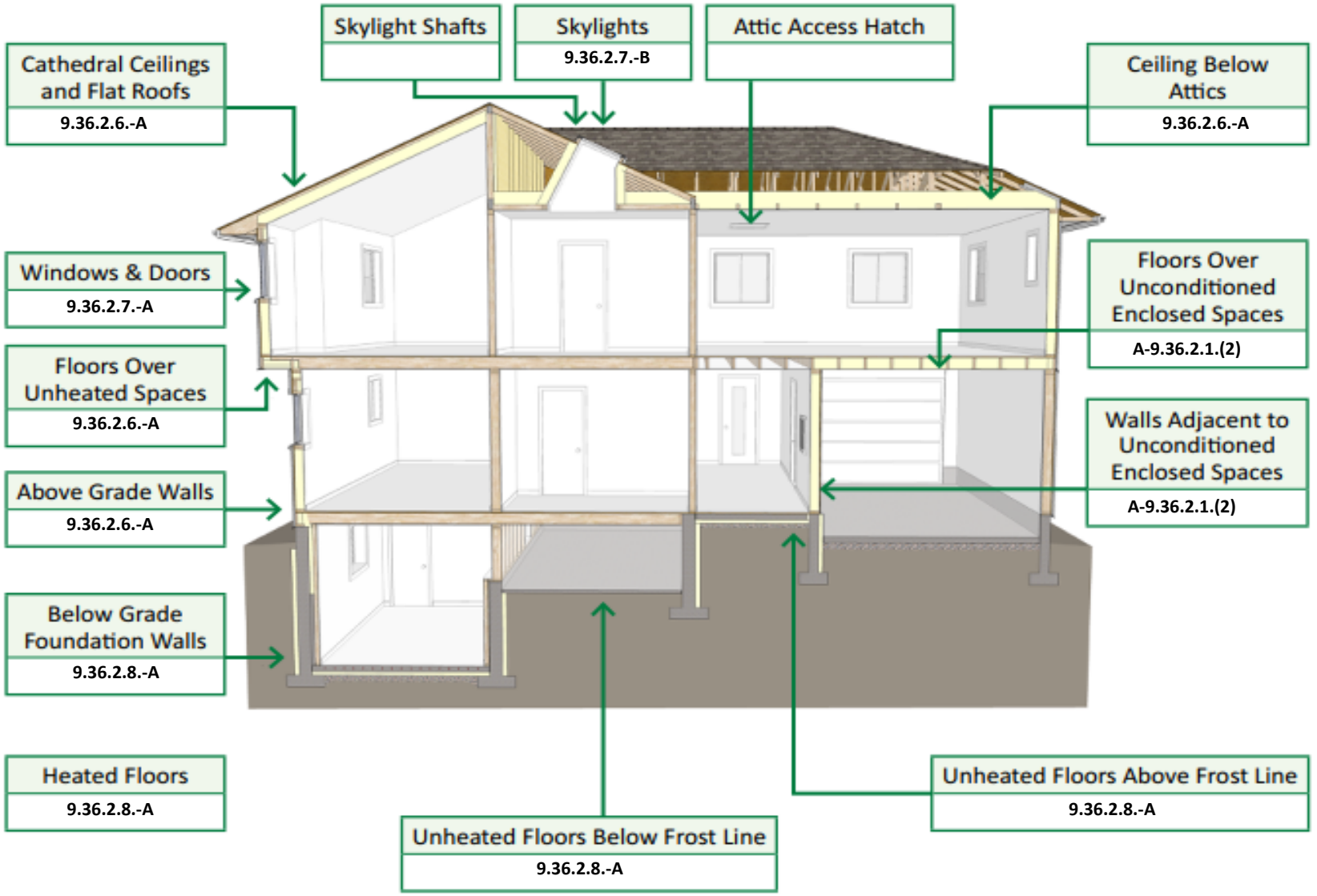
| | |
|---|---|
| **9.36.2.1.(2)** | Garage walls/floors insulation and airtightness requirement. |
| **9.36.2.1.(7)** | Exemption for Part 10 assemblies. |
| **9.36.2.5.(6)** | Update to ensure wall effeictive RSI with penetrations meet specified values. |
| **9.36.2.5.(7)** | Exception effective RSI requirments of walls with penetration. |
| **A-9.36.2.1.(6)** | Update to log wall insulation requirements. |
| **A-9.36.2.4.(1)** | Update to thermal resistance value of common building materials |

# Building Envelope – Prescriptive Compliance

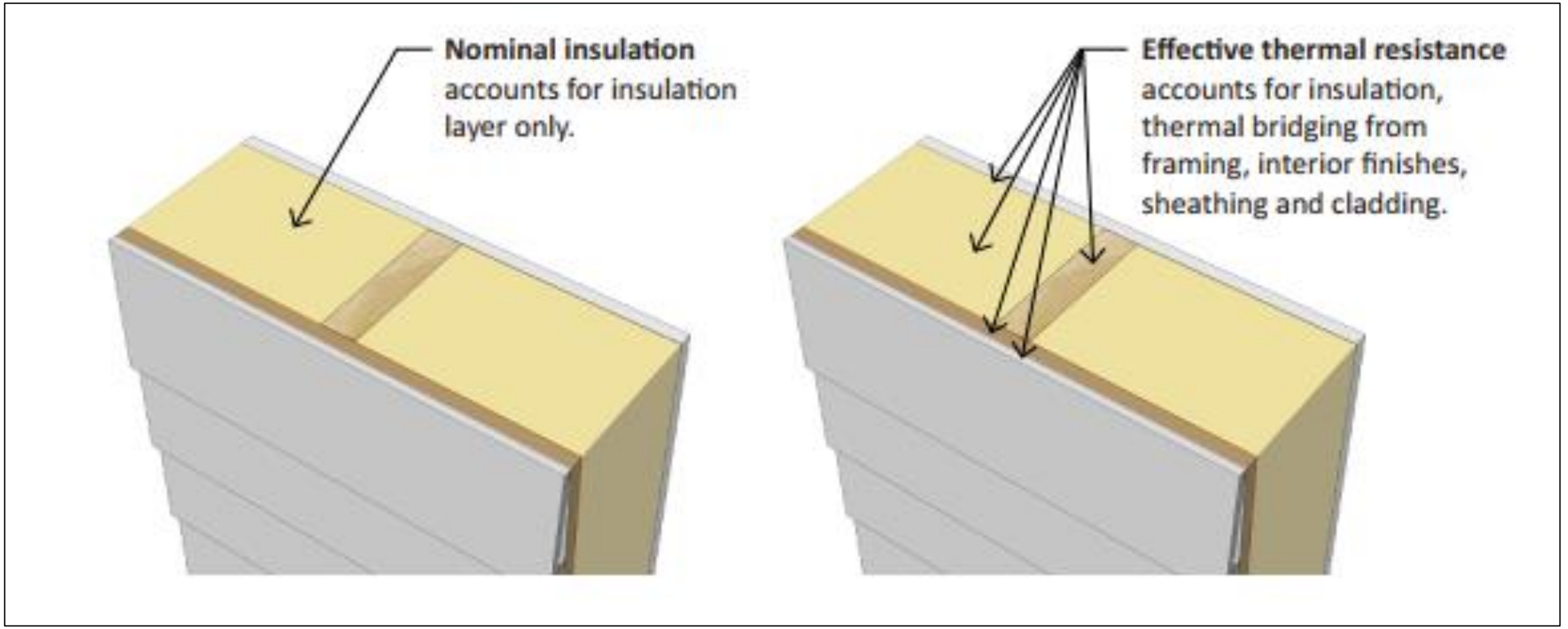
Fundamental Concepts

- Building envelope broken into several subsystems – all have unique requirements
- All values are effective thermal resistance (RSi) - this needs to be calculated
- NO FDWR ratio in prescriptive
- Lots of ways to get the required values.

# Building Envelope – Prescriptive Compliance



# 9.36.2.4. Effective Thermal Resistance of Assemblies



# 9.36.2.4. Effective Thermal Resistance of Assemblies

| Assembly | Nominal R-value | Effective R-value |
|---|---|---|
| Conventional 2x6 wood stud @ 16” o/c; R-20 batt insul; gyp bd interior; ply sheathing; wood siding | 20 (RSI 3.52) | 17.2 (RSI 3.02) |
| Advanced 2x6 framing, studs @ 24” o/c, R-20 batt insul; gyp bd interior; ply sheathing; wood siding | 20 (RSI 3.52) | 18.2 (RSI 3.20) |
| 2x4 wood studs @ 16” o/c; R12 batt insul; plus R-10 XPS, gyp bd interior; ply sheathing; wood siding | 22 (3.87) | 22.4 (RSI 3.94) |
| 2x6 steel studs @ 16” o/c, ; R-20 batt insul.; gyp bd interior; ply sheathing; wood siding | 20 (RSI 3.52) | 11.35 (RSI 1.99) |

# 9.36.2.6. Thermal Characteristics of Above-ground Opaque Assemblies

- Thermal resistance requirements for walls, roofs, and floors vary by climate zone and HRV presence.
- HRVs can reduce heating loads by capturing heat from outgoing air and transferring it to incoming fresh air.
- This reduces the RSI requirement for walls in colder zones (as seen in Table 9.36.2.6-B).

# 9.36.2.6. Thermal Characteristics of Above-ground Opaque Assemblies (without HRV)

**Table 9.36.2.6.-A**
**Effective Thermal Resistance of Above-ground Opaque Assemblies in Buildings without a Heat-Recovery Ventilator**
Forming Part of Sentence 9.36.2.6.(1)

| Above-ground Opaque *Building* Assembly | Heating Degree-Days of *Building* Location,(1) in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|
| | Zone 4<br>< 3000 | Zone 5<br>3000 to 3999 | Zone 6<br>4000 to 4999 | Zone 7A<br>5000 to 5999 | Zone 7B<br>6000 to 6999 | Zone 8<br>≥ 7000 |
| | Minimum Effective Thermal Resistance (RSI), (m²xK)/W | | | | | |
| Ceilings below attics | 6.91 | 8.67 | 8.67 | 10.43 | 10.43 | 10.43 |
| Cathedral ceilings and flat roofs | 4.67 | 4.67 | 4.67 | 5.02 | 5.02 | 5.02 |
| Walls(2) | 2.78 | 3.08 | 3.08 | 3.08 | 3.85 | 3.85 |
| Floors over unheated spaces | 4.67 | 4.67 | 4.67 | 5.02 | 5.02 | 5.02 |

# 9.36.2.6. Thermal Characteristics of Above-ground Opaque Assemblies (with HRV)

**Table 9.36.2.6.-B**
**Effective Thermal Resistance of Above-ground Opaque Assemblies in Buildings with a Heat-Recovery Ventilator**
Forming Part of Sentence 9.36.2.6.(1)

| Above-ground Opaque *Building* Assembly | Heating Degree-Days of *Building* Location,(1) in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|
| | Zone 4<br>< 3000 | Zone 5<br>3000 to 3999 | Zone 6<br>4000 to 4999 | Zone 7A<br>5000 to 5999 | Zone 7B<br>6000 to 6999 | Zone 8<br>≥ 7000 |
| | Minimum Effective Thermal Resistance (RSI), (m²×K)/W | | | | | |
| Ceilings below attics | 6.91 | 6.91 | 8.67 | 8.67 | 10.43 | 10.43 |
| Cathedral ceilings and flat roofs | 4.67 | 4.67 | 4.67 | 5.02 | 5.02 | 5.02 |
| Walls(2) | 2.78 | 2.97 | 2.97 | 2.97 | 3.08 | 3.08 |
| Floors over unheated spaces | 4.67 | 4.67 | 4.67 | 5.02 | 5.02 | 5.02 |

With HRV heating load is reduced.

# Thermal Characteristics of Fenestration and Doors – 9.36.2.7. -A

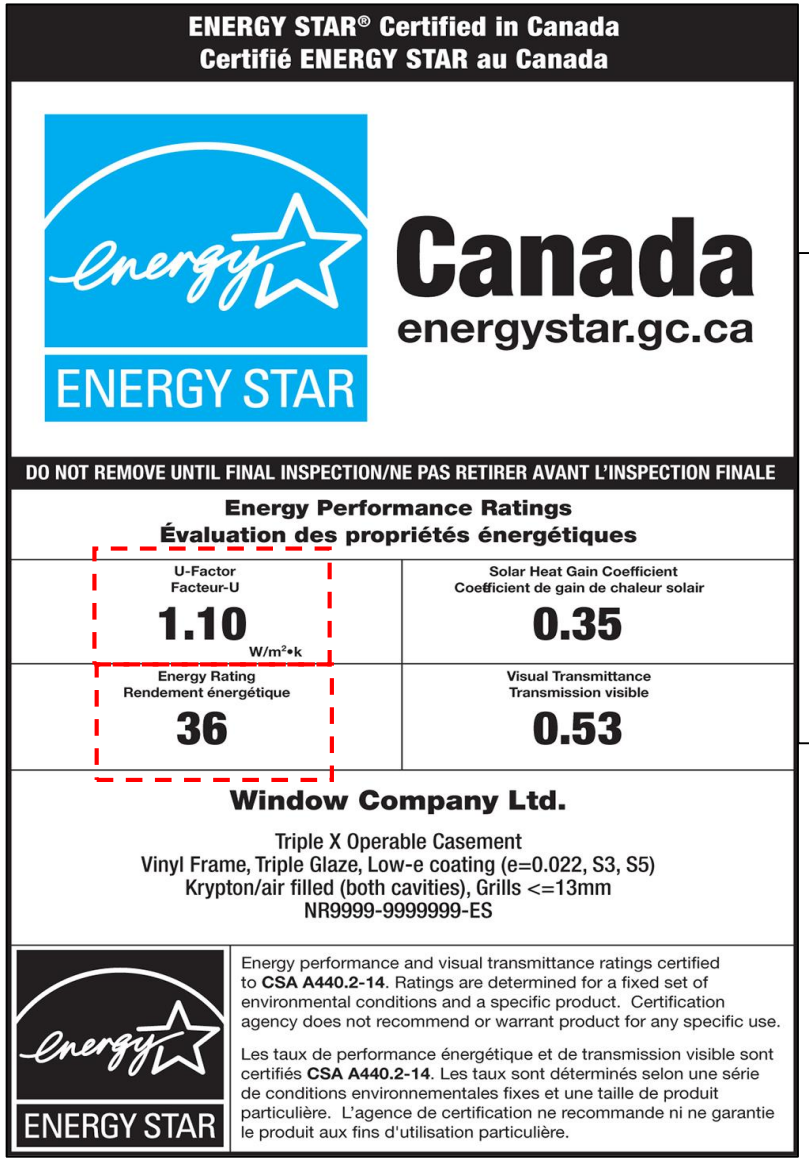



**Table 9.36.2.7.-A**
**Required Thermal Characteristics of Fenestration and Doors**
Forming Part of Sentence 9.36.2.7.(1)

| Components | Thermal Characteristics(1) | Heating Degree-Days of *Building* Location,(2) in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|---|
| | | Zone 4<br>< 3000 | Zone 5<br>3000 to 3999 | Zone 6<br>4000 to 4999 | Zone 7A<br>5000 to 5999 | Zone 7B<br>6000 to 6999 | Zone 8<br>≥ 7000 |
| Fenestration(3) and doors | Max. U-value, W/(m²×K) | 1.84 | 1.84 | 1.61 | 1.61 | 1.44 | 1.44 |
| | Min. Energy Rating | 21 | 21 | 25 | 25 | 29 | 29 |

# 9.36.2.9. Airtightness

Even with great insulation, your home can still lose heat if air leaks through gaps in the walls, roof, or around doors.

**What the code says:**

- ❑ Building envelope shall be constructed to be airtight
- ❑ All openings and joints shall be sealed to limit air leakage.
- ❑ Vehicular access doors must have weather stripping
- ❑ Fireplaces must be sealed when not in use

# 9.36.2.9. Airtightness

Three ways to achieve airtight envelop

- Prescriptive
  - 9.25.3 and
  - 9.36.2.10.
- Two testing options:
  - CAN/ULC-S742
  - ASTM E2357

# 9.36.2.9. Airtightness

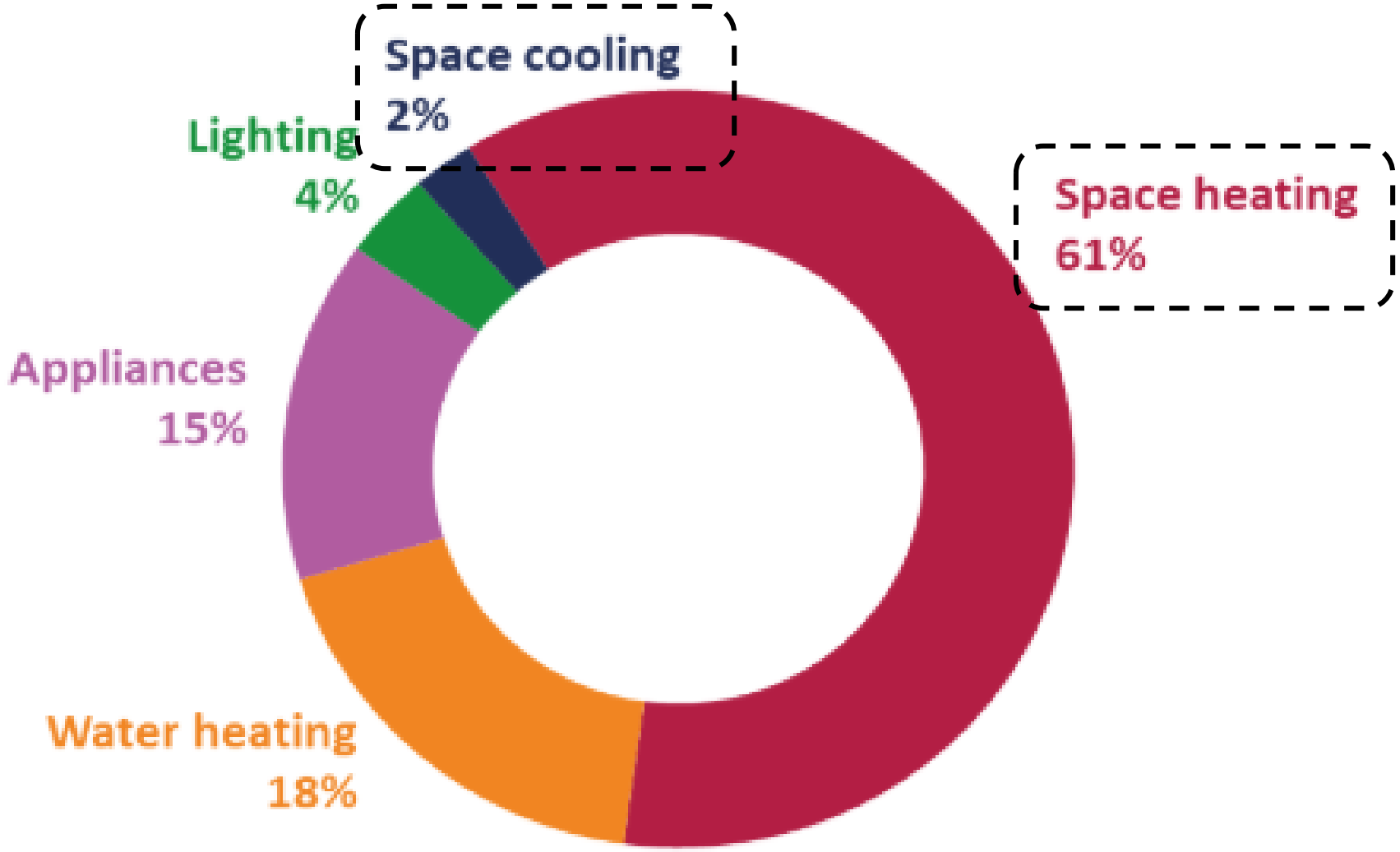
Three ways to achieve airtight envelop

- ❑ Prescriptive
  - 9.25.3 and
  - 9.36.2.10.
- ❑ Two testing options:
  - CAN/ULC-S742
  - ASTM E2357

QUALITY???

# 9.36.3 HVAC Requirements

# Energy use in residential buildings




Source: Natural Resources Canada. https://oee.nrcan.gc.ca/publications/statistics/trends/2020/residential.cfm

# Summary of Code Changes

**9.36.3.10** Update to HVAC equipment performance requirements

# HVAC Performance Requirements – 9.36.3.10.

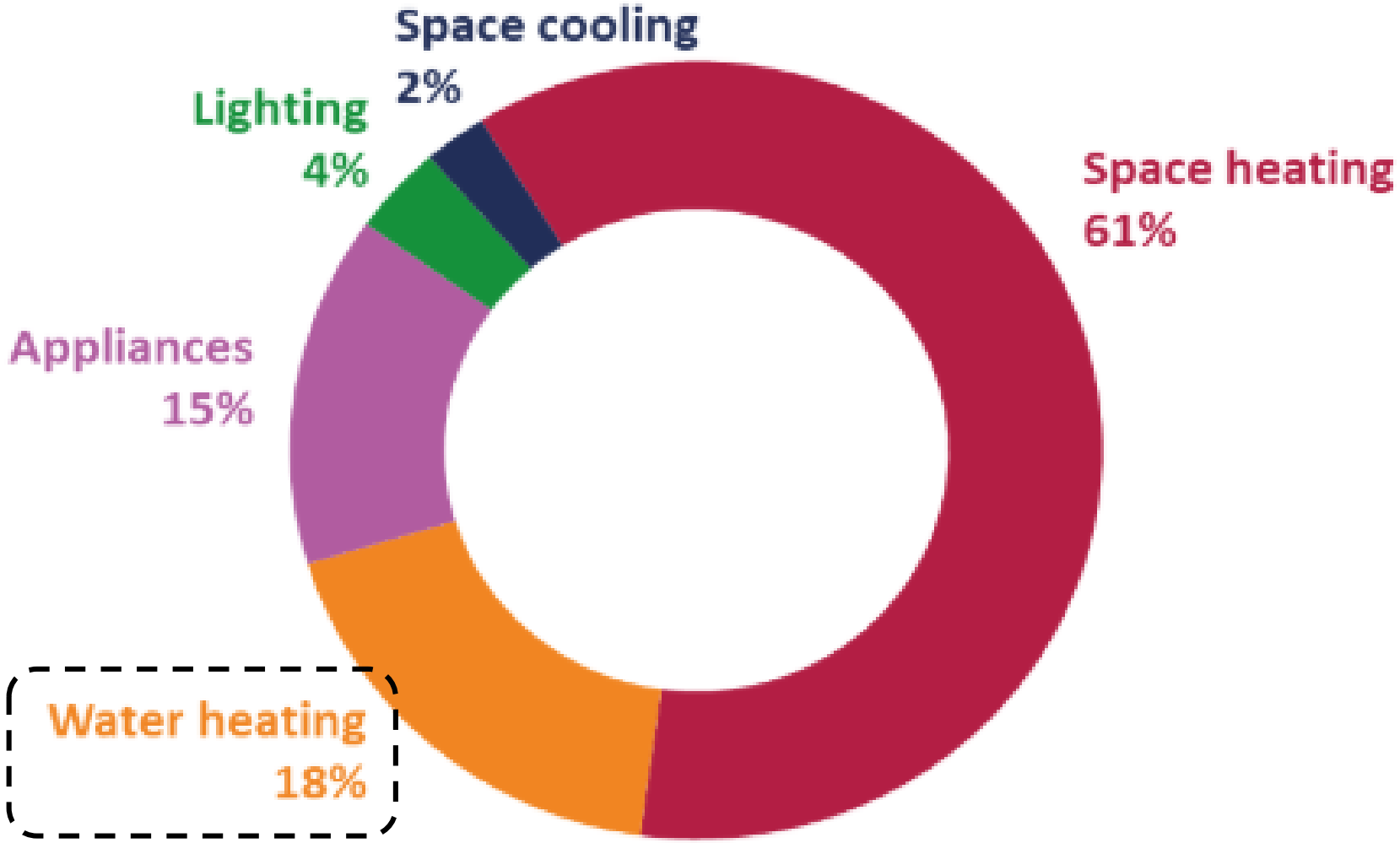
**Table 9.36.3.10.**
**HVAC Equipment Performance Requirements**
Forming Part of Sentences 9.36.3.9.(2) and 9.36.3.10.(1)

| Type of Equipment | Heating or Cooling Capacity, kW | Performance Testing Standard | Minimum Performance[1] |
|---|---|---|---|
| **Air-Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated** | | | |
| Split system | < 19 | CSA C656 | SEER = 14.5<br>EER = 11.5<br>HSPF V = 7.1 |
| | | DOE 10 CFR, Part 430, Subpart B, Appendix M1 | SEER2 = 14.3<br>HSPF2 V = 6.0 |
| Single-package system | < 19 | CSA C656 | SEER = 14<br>EER = 11<br>HSPF V = 7.0 |
| | | DOE 10 CFR, Part 430, Subpart B, Appendix M1 | SEER2 = 13.4<br>HSPF2 V = 5.4 |
| Heat pumps, split and single-package | ≥ 19 | See Tables 5.2.12.1.-A to -P of Division B of the NECB | |
| Air conditioners, all electrical phases, split and single-package | ≥ 19 | See Tables 5.2.12.1.-A to -P of Division B of the NECB | |
| **Single-Package Vertical Air Conditioners (SPVAC) and Heat Pumps (SPVHP)** | | | |
| SPVAC and SPVHP in cooling mode | < 19 | CAN/CSA-C746 | EER = 11 |
| SPVAC and SPVHP in heating mode | < 19 | | $COP_h \geq 3.3$ |

These Are the Minimum Efficiencies

# 9.36.4 Service Water Heating Systems

# Energy use in residential buildings




Source: Natural Resources Canada. https://oee.nrcan.gc.ca/publications/statistics/trends/2020/residential.cfm

# Summary of Code Changes

| | |
|---|---|
| **9.36.4.3** | Update to service water equipment performance |
| **9.36.4.4** | Recirculating hot water pipes to have minimum 12mm  insulation |
| **9.36.4.6** | Update to indoor swimming pool equipment control requirements. |

# 9.36.4.2. Equipment Efficiency

**Table 9.36.4.2.**
**Service Water Heating Equipment Performance Requirements**
Forming Part of Sentences 9.36.4.2.(1) and (2)

| Type of Equipment | Input[1] | Performance Testing Standard | Performance Requirement[2] |
|---|---|---|---|
| **Storage-Type Service Water Heaters** | | | |
| Electric | ≤ 12 kW ($V_r$ > 50 L but ≤ 270 L) | CAN/CSA-C191 | SL ≤ 35 + (0.20 $V_r$) (top inlet) |
| | | | SL ≤ 40 + (0.20 $V_r$) (bottom inlet) |
| | ≤ 12 kW ($V_r$ > 270 L but ≤ 454 L) | | SL ≤ (0.472 $V_r$) – 38.5 (top inlet) |
| | | | SL ≤ (0.472 $V_r$) – 33.5 (bottom inlet) |
| | >12 kW | ANSI Z21.10.3/CSA 4.3 or DOE 10 CFR, Part 431, Subpart G, Appendix B | SL ≤ 0.30 +(102.2 $V_s$) |
| Heat pump water heaters | ≤ 24 A and ≤ 250 V | CAN/CSA-C745 | EF ≥ 2.1 |
| Gas-fired[3] | ≤ 22 kW and first-hour rating < 68 L | CAN/CSA-P.3 | UEF ≥ 0.3456 – (0.00053 $V_s$)[4] |
| | ≤ 22 kW and first-hour rating ≥ 68 L but < 193 L | | UEF ≥ 0.5982 – (0.00050 $V_s$)[4] |
| | ≤ 22 kW and first-hour rating ≥ 193 L but < 284 L | | UEF ≥ 0.6483 – (0.00045 $V_s$)[4] |
| | ≤ 22 kW and first-hour rating ≥ 284 L | | UEF ≥ 0.6920 – (0.00034 $V_s$)[4] |
| | > 22 kW but ≤ 30.5 kW and $V_r$ ≤ 454 L | | UEF ≥ 0.8107 – (0.00021 $V_s$)[4] |
| | > 22 kW | DOE 10 CFR, Part 431, Subpart G, Appendix A | $E_t$ ≥ 90% and SL ≤ 0.84 [(1.25 Q) + (16.57 $\sqrt{V_r}$)] |
| Oil-fired | ≤ 30.5 kW and first-hour rating < 68 L | CAN/CSA-B211 for EF or CAN/CSA-P.3 for UEF | EF ≥ 0.68 – (0.0005 $V_r$) or UEF ≥ 0.2509 – (0.00032 $V_s$) |
| | ≤ 30.5 kW and first-hour rating ≥ 68 L but < 193 L | | EF ≥ 0.68 – (0.0005 $V_r$) or UEF ≥ 0.5330 – (0.00042 $V_s$) |
| | ≤ 30.5 kW and first-hour rating ≥ 193 L but < 284 L | | EF ≥ 0.68 – (0.0005 $V_r$) or UEF ≥ 0.6078 – (0.00042 $V_s$) |
| | ≤ 30.5 kW and first-hour rating ≥ 284 L | | EF ≥ 0.68 – (0.0005 $V_r$) or UEF ≥ 0.6815 – (0.00037 $V_s$) |
| | > 30.5 kW but ≤ 40.99 kW and $V_r$ ≤ 454 L | | UEF ≥ 0.6740 – (0.00035 $V_s$) |
| | > 40.99 kW | DOE 10 CFR, Part 431, Subpart G, Appendix A | $E_t$ ≥ 80% and SL ≤ (1.25 Q) + (16.57 $\sqrt{V_r}$) |

# 9.36.5 Energy Performance Compliance

# Summary of Code Changes

| | |
|---|---|
| **9.36.5.2** | Definition of “Proposed House”. |
| **9.36.5.3** | Update to performance compliance methods. |
| **9.36.5.4** | Update to internal heat gain load schedule used in energy model. |
| **9.36.5.4.(5)** | Space heating temperature set-points updated. |
| **9.36.5.8.** | Update to service water system calculations. |

# Summary of Code Changes – Cont'd

| | |
|---|---|
| **9.36.5.11.(9)** | Changes to airtightness used in energy model calculation for proposed house. |
| **9.36.5.12.(2)** | Update to drain water recovery requirments. |
| **9.36.5.14.(2)** | Changes to airtightness used in energy model calculation for reference house. |
| **9.36.5.15.(13)** | Update to model HRV power for pool zones using 4.18 W/L/s. |
| **A-9.36.5.3** | Exception to whole building airtightness compliance. |

# 9.36.5. – Performance Compliance

## What goes into the energy model?

1. Building geometry (shape and size)
2. Envelop details (walls, floor, window, airtightness and roof insulation)
3. HVAC and hot water system details
4. Location, climate and sun exposure
5. Assumption about occupancy
6. Internal loads (including lighting)

Some exceptions:

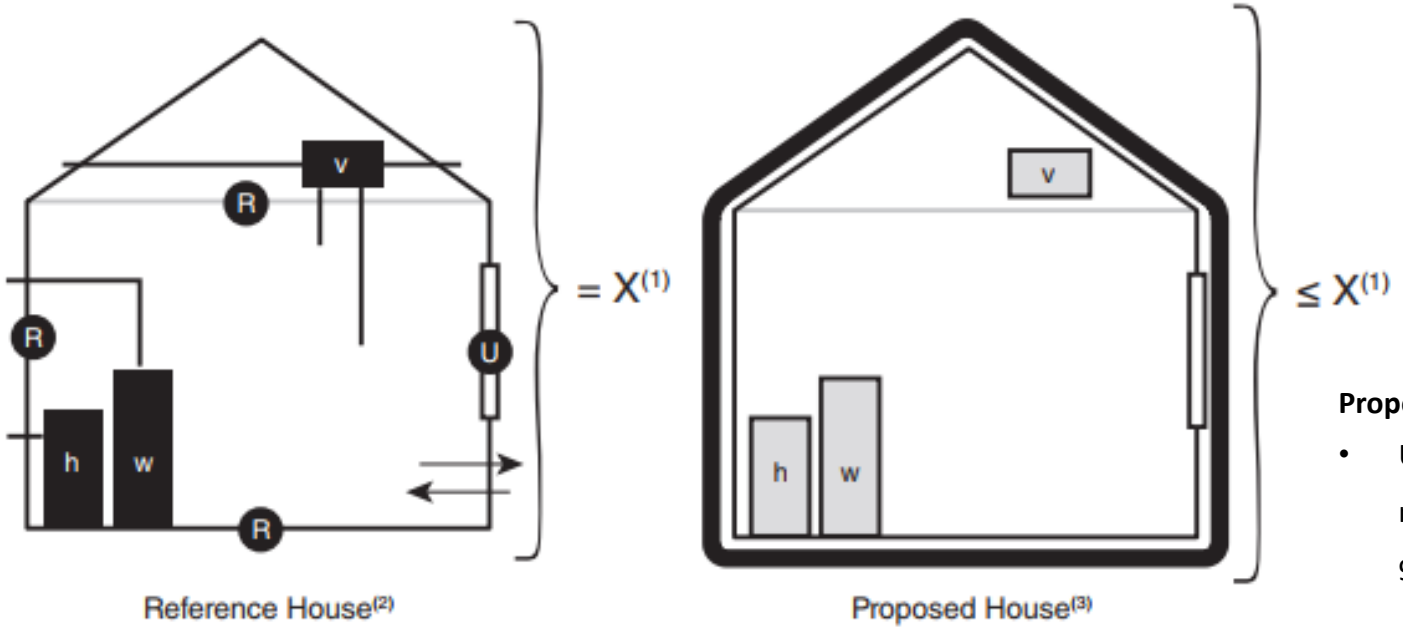
a) Unconditioned space lighting and ventilation

b) Exterior lighting

# 9.36.5.3. - Compliance Requirements

**Reference House**

- Comply with **prescriptive** subsections **9.36.2. to 9.36.4**.




**Proposed House**

- Uses **performance option** to meet the goals of Sections 9.36.2 to 9.36.4

To comply, **Proposed House ≤ Reference House energy.**

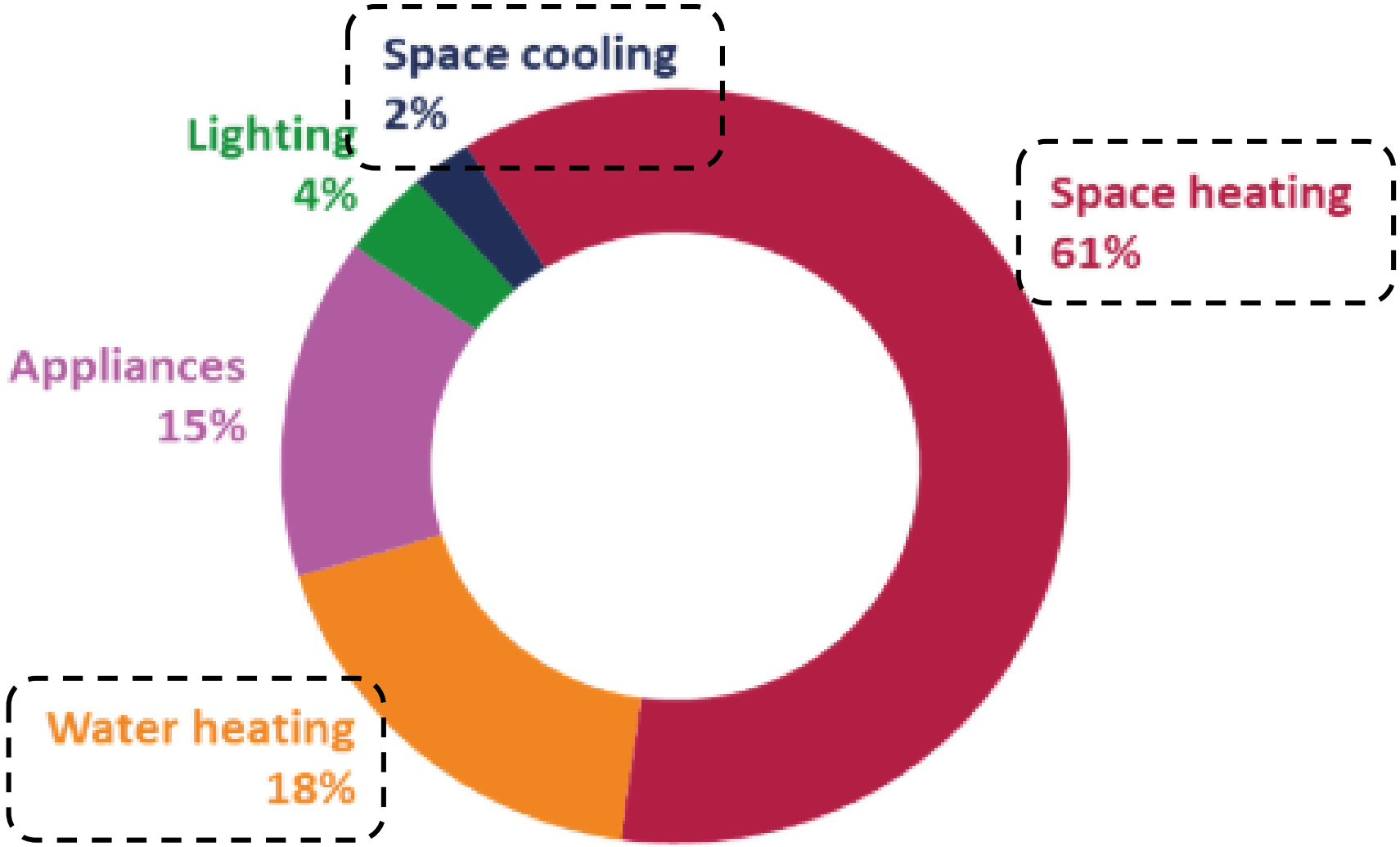
# Energy Modelling Submittals

Information Required on Drawings and Specifications – Div C **NBC 2.2.8.2**

- ❑ Effective R / RSI (with areas) for above & below grade assemblies
- ❑ Overall U-value, SHGC & areas for all windows, doors and skylights
- ❑ FDWR – vertical fenestration + door area ÷ gross wall area
- ❑ HVAC & DHW equipment list: fuel, type, capacity, rated efficiency

# 9.36.6 Airtightness of Building Envelope

# Energy use in residential buildings




Source: Natural Resources Canada. https://oee.nrcan.gc.ca/publications/statistics/trends/2020/residential.cfm

# Summary of Code Changes

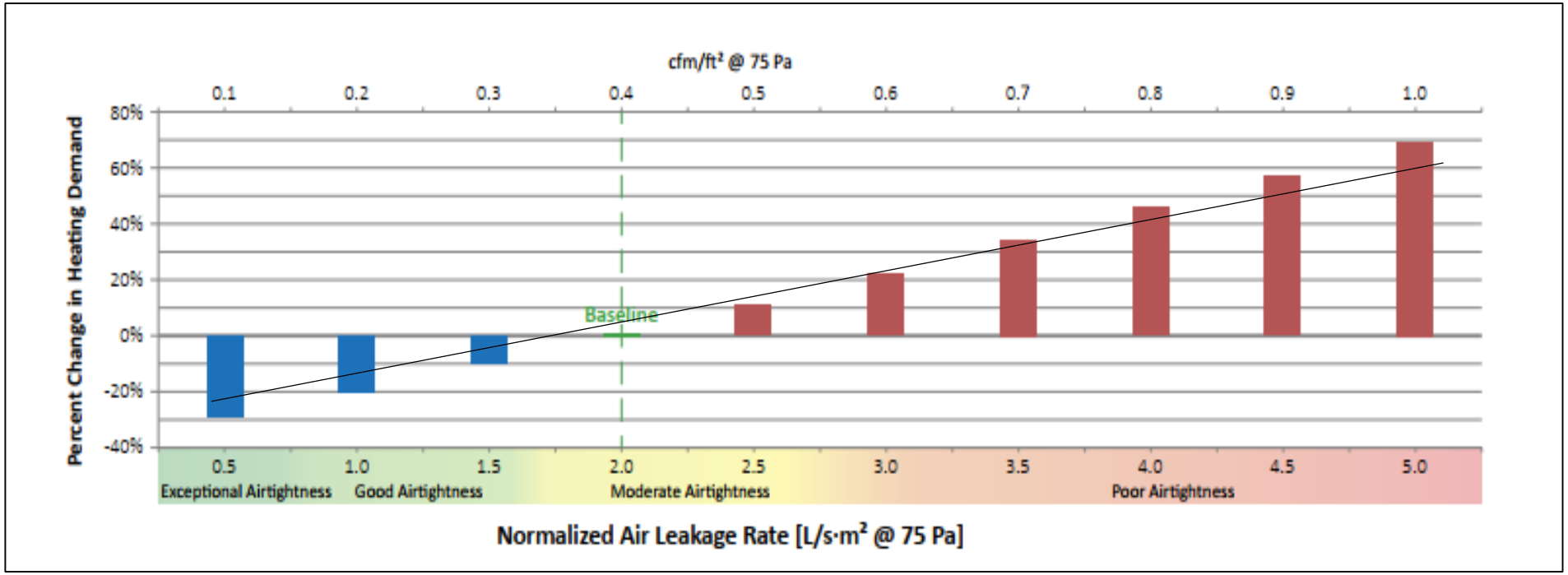
| | |
|---|---|
| **9.36.6** | New airtightness subsection included. |
| **A-9.36.6.2.(1)(a)** | Zone pressure allowed to vary by max 5 Pa |
| **A-9.36.6.2.(1)(b)** | Adjacent zones can be inside or outside the same unit. |
| **A-9.36.6.4.(2)** | Lowest airtightness level to be used across zones for overall compliance |

# Why Build Airtight

- Moisture problems from condensation.
- Heat loss
- Increased energy consumption
- Indoor air quality.

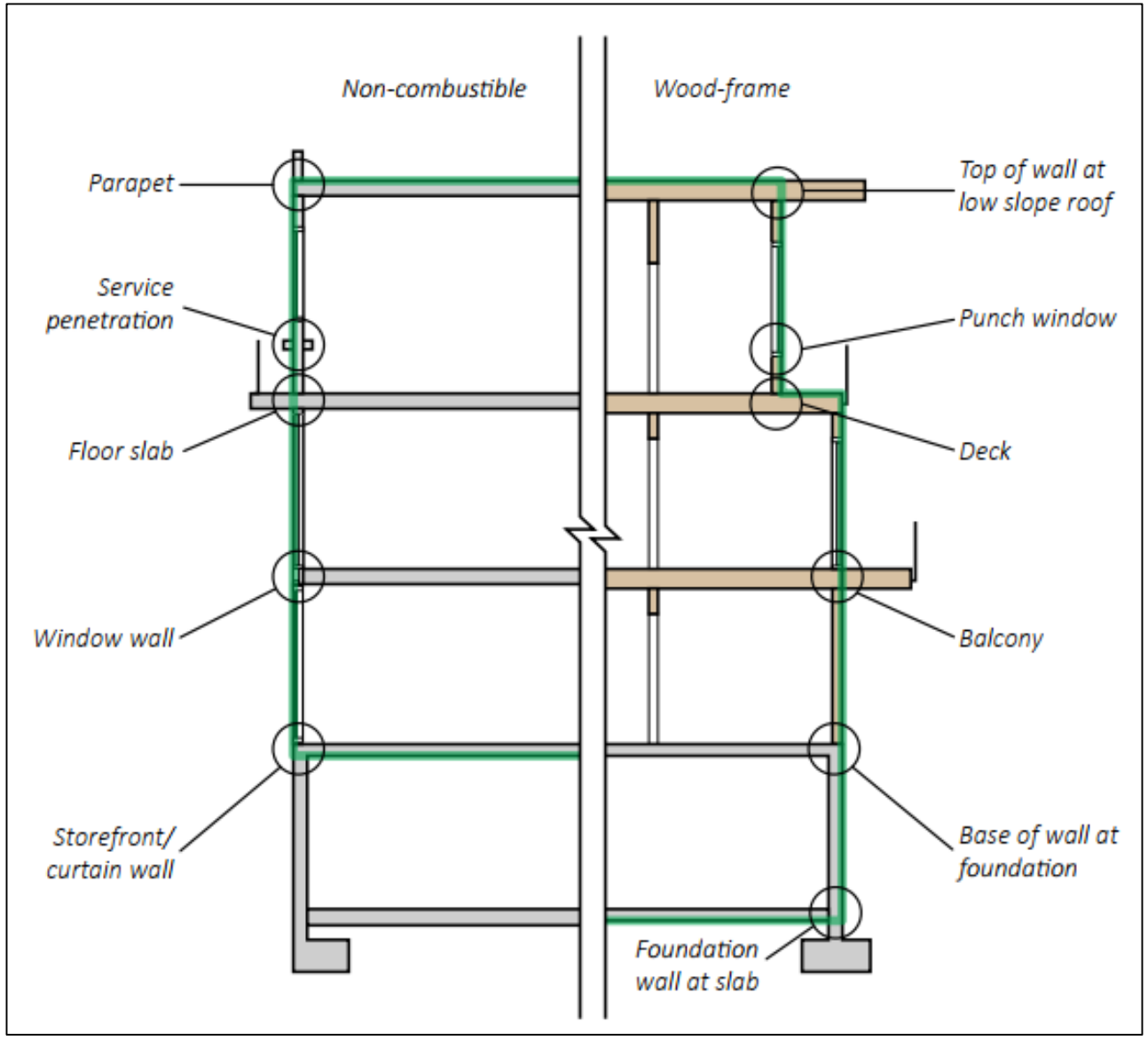
**Frost in the attic**

# Airtightness and Energy Implication




**Less Airtightness = More Air Leakage = More Energy Demand**

# Common Air Leakage Areas




**Watch out for Joints and Penetrations!**

NBC 9.36.6 Airtightness

# Determination of Airtightness Level

When is airtightness testing required?

- ❑ Not required for the prescriptive and trade-off path
- ❑ Required :
  - When needed as input into energy model calculations - **9.36.6.1**.
  - When earning energy conservation points (ECP) in the tiered energy prescriptive compliance path - **9.36.8.8**.

# Airtightness Levels – LEVELS???

**Table 9.36.6.4.-B**
**Airtightness Levels for Attached Zones Determined Using the Unguarded Method**
Forming Part of Sentences 9.36.6.3.(2), 9.36.6.4.(1) and (4), and 9.36.8.8.(1)

| Airtightness Levels | Airtightness Metrics | | |
|---|---|---|---|
| | $ACH_{50}$ | $NLA_{10}$, $cm^2/m^2$ | $NLR_{50}$, $L/s \times m^2$ |
| | Maximum Airtightness Values | | |
| AL-1B | 3.0 | 1.92 | 1.17 |
| AL-2B | 2.5 | 1.6 | 0.98 |
| AL-3B | 2.0 | 1.28 | 0.78 |
| AL-4B | 1.5 | 0.96 | 0.59 |
| AL-5B | 1.0 | 0.64 | 0.39 |
| AL-6B | 0.6 | 0.38 | 0.23 |

NBC 9.36.6 Airtightness

# 9.36.7 Tiered Energy Performance Compliance: Performance Path

# Summary of Code Changes

| | |
|---|---|
| 9.36.7. | New subsection: Tiered energy performance compliance |
| 9.36.7.3.(9) | Airtightness value used in energy model |

# 9.36.7.1. - Tiered Compliance (Performance): Scope and Application

- Applies to homes that choose to qualify for one of the Energy Performance Tiers through performance path.
- **It applies to:**
  - Houses with or without a secondary suite
  - HVAC and water systems that serve just the home or the suite (or both)
  - Homes that don’t share common living spaces with other buildings

# 9.36.7.3 - Compliance

- To comply:
  - Percent heat loss reduction must be met or exceeded.
  - Percent improvement must be met or exceeded, or
  - Percent house energy target not exceeded

# 9.36.7.2 Tiered Performance Compliance

**Table 9.36.7.2.**
**Energy Performance Tiers for Buildings and Houses**
Forming Part of Sentence 9.36.7.2.(1)

| Total Volume of *Conditioned Space* Within the *Building* or House | Energy Performance Metrics | Target Energy Performance | | | | |
|---|---|---|---|---|---|---|
| | | Applicable Energy Performance Tier | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| > 300 m³ and where volume is not determined | Percent heat loss reduction[1] | n/a | ≥ 5% | ≥ 10% | ≥ 20% | ≥ 40% |
| | Percent improvement[2] | ≥ 0% | ≥ 10% | ≥ 20% | ≥ 40% | ≥ 70% |
| | OR | | | | | |
| | Percent house energy target[3] | ≤ 100% | ≤ 90% | ≤ 80% | ≤ 60% | ≤ 30% |
| ≤ 300 m³ | Percent heat loss reduction[1] | n/a | ≥ 0% | ≥ 5% | ≥ 15% | ≥ 25% |
| | Percent improvement[2] | ≥ 0% | ≥ 0% | ≥ 10% | ≥ 30% | ≥ 60% |
| | OR | | | | | |
| | Percent house energy target[3] | ≤ 100% | ≤ 100% | ≤ 90% | ≤ 70% | ≤ 40% |

**Net-Zero Ready**

# 9.36.8 Tiered Energy Performance Compliance: Prescriptive Path

# Summary of Code Changes

| | |
|---|---|
| 9.36.8. | New subsection: Tiered energy prescriptive compliance |
| A-9.36.8.2.(1)(b) | Energy conservation measures for tiered energy prescriptive compliance |
| A-9.36.8.6.(4) | Energy Rating for windows and doors. |

# Tiered Compliance - Prescriptive

**Table 9.36.8.2.**
**Energy Performance Tiers**
Forming Part of Clause 9.36.8.2.(1)(a)

| Energy Performance Tier | Minimum Sum of Energy Conservation Points |
|---|---|
| 1 | (1) |
| 2 | 10 |
| 3 | Reserved |
| 4 | Reserved |
| 5 | Reserved |

**Tier 1 = Baseline (No Conservative Points)**

# Tiered Compliance - Prescriptive

**Table 9.36.8.2.**
**Energy Performance Tiers**
Forming Part of Clause 9.36.8.2.(1)(a)

| Energy Performance Tier | Minimum Sum of Energy Conservation Points |
|---|---|
| 1 | (1) |
| 2 | 10 |
| 3 | Reserved |
| 4 | Reserved |
| 5 | Reserved |

Identical process to prescriptive only the performance values change

**Tier 1 = Baseline (No Conservative Points)**

# Energy Conservative Measures & Points for Above-Ground Walls Thermal Resistance

**Table 9.36.8.5.**
**Energy Conservation Measures and Points for Above-Ground Walls(1)**
Forming Part of Sentences 9.36.8.5.(2), (6) and (7)

| Energy Conservation Measures for Above-Ground Walls – Minimum Effective RSI Values, (m²×K)/W | Heating Degree-Days of *Building* Location, in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|
| | Zone 4 < 3000 | Zone 5 3000 to 3999 | Zone 6 4000 to 4999 | Zone 7A 5000 to 5999 | Zone 7B 6000 to 6999 | Zone 8 ≥ 7000 |
| | Energy Conservation Points | | | | | |
| 2.97 | 2.0 | – | – | – | – | – |
| 3.08 | 3.2 | 1.4 | 1.6 | 2.1 | – | – |
| 3.69 | 7.4 | 5.4 | 6.2 | 6.7 | 5.4 | 5.2 |
| 3.85 | 8.2 | 6.0 | 6.9 | 7.4 | 6.2 | 6.0 |
| 3.96 | 8.9 | 6.8 | 7.7 | 8.2 | 7.0 | 6.8 |
| 4.29 | 10.2 | 8.1 | 9.2 | 9.7 | 8.6 | 8.4 |
| 4.40 | 10.8 | 8.7 | 9.9 | 10.3 | 9.3 | 9.1 |
| 4.57 | 11.4 | 9.3 | 10.6 | 11.1 | 10.1 | 9.9 |
| 4.73 | 11.9 | 9.7 | 11.1 | 11.5 | 10.6 | 10.4 |
| 4.84 | 12.3 | 10.2 | 11.6 | 12.1 | 11.2 | 10.9 |
| 5.01 | 12.9 | 10.7 | 12.2 | 12.7 | 11.8 | 11.6 |
| 5.45 | 14.0 | 11.9 | 13.6 | 14.0 | 13.3 | 13.1 |

# Energy Conservative Measures & Points for Fenestration and Doors Thermal Transmittance

**Table 9.36.8.6.**
**Energy Conservation Measures and Points for Fenestration and Doors**
Forming Part of Article 9.36.8.6.

| Energy Conservation Measures for Fenestration and Doors(1) | | Heating Degree-Days of *Building* Location, in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|---|
| Maximum U-values, W/(m²×K) | Minimum Energy Ratings(2) | Zone 4 < 3000 | Zone 5 3000 to 3999 | Zone 6 4000 to 4999 | Zone 7A 5000 to 5999 | Zone 7B 6000 to 6999 | Zone 8 ≥ 7000 |
| | | Energy Conservation Points | | | | | |
| 1.61 | 25 | 1.9 | 1.8 | – | – | – | – |
| 1.44 | 29 | 3.8 | 3.6 | 1.6 | 1.8 | – | – |
| 1.22 | 34 | 6.9 | 7.0 | 4.6 | 5.5 | 3.2 | 3.4 |

# Energy Conservative Measures & Points for Below-Grade Assemblies Thermal Resistance

**Table 9.36.8.7.**
**Energy Conservation Measures and Points for Opaque Building Assemblies Below-Grade or In Contact with Ground**
Forming Part of Sentences 9.36.8.7.(3) and (4)

| Energy Conservation Measures for *Foundation* Walls – Minimum Effective RSI Values, $(m^2 \times K)/W$ | Heating Degree-Days of *Building* Location, in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|
| | Zone 4<br>< 3000 | Zone 5<br>3000 to 3999 | Zone 6<br>4000 to 4999 | Zone 7A<br>5000 to 5999 | Zone 7B<br>6000 to 6999 | Zone 8<br>≥ 7000 |
| | Energy Conservation Points | | | | | |
| 2.98 | 1.7 | – | – | – | – | – |
| 3.09 | 1.8 | 0.2 | 0.2 | 0.2 | 0.2 | – |
| 3.46 | 2.2 | 0.6 | 0.8 | 0.6 | 0.7 | – |
| 3.90 | 2.6 | 1.2 | 1.4 | 1.1 | 1.3 | – |

Tiered Energy Compliance - Prescriptive

# Energy Conservative Measures & Points for Airtightness

**Table 9.36.8.8.**
**Energy Conservation Measures and Points for Airtightness**
Forming Part of Sentence 9.36.8.8.(2)

| Energy Conservation Measures for Airtightness – Airtightness Levels[1] | Heating Degree-Days of *Building* Location, in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|
| | Zone 4 < 3000 | Zone 5 3000 to 3999 | Zone 6 4000 to 4999 | Zone 7A 5000 to 5999 | Zone 7B 6000 to 6999 | Zone 8 ≥ 7000 |
| | Energy Conservation Points | | | | | |
| Airtightness Levels from Table 9.36.6.4.-A | | | | | | |
| AL-1A | – | – | – | – | – | – |
| AL-2A | 2.0 | 3.4 | 3.5 | 4.6 | 6.1 | 6.1 |
| AL-3A | 4.0 | 6.7 | 7.0 | 9.3 | 12.1 | 12.11 |
| AL-4A | 5.9 | 10.1 | 10.5 | 13.9 | 18.0 | 18.0 |
| AL-5A | 7.6 | 13.0 | 13.4 | 17.8 | 22.7 | 22.7 |
| Airtightness Levels from Table 9.36.6.4.-B | | | | | | |
| AL-1B | – | – | – | – | – | – |
| AL-2B | – | – | – | – | – | – |
| AL-3B | 2.2 | 3.0 | 3.5 | 4.6 | 4.1 | 4.6 |
| AL-4B | 4.0 | 6.0 | 6.9 | 9.1 | 8.2 | 9.3 |
| AL-5B | 6.0 | 9.1 | 10.4 | 13.6 | 12.3 | 14.2 |
| AL-6B | 7.7 | 11.6 | 13.3 | 17.4 | 15.6 | 18.2 |

# Energy Conservative Measures & Points for Ventilation Systems

**Table 9.36.8.9.**
**Energy Conservation Measures and Points for Ventilation Systems**
Forming Part of Sentence 9.36.8.9.(4)

| Energy Conservation Measures for Ventilation Systems – Sensible Heat-Recovery Efficiency, SRE(1) | Heating Degree-Days of *Building* Location, in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|
| | Zone 4<br>< 3000 | Zone 5<br>3000 to 3999 | Zone 6<br>4000 to 4999 | Zone 7A<br>5000 to 5999 | Zone 7B<br>6000 to 6999 | Zone 8<br>≥ 7000 |
| | Energy Conservation Points | | | | | |
| 60% ≤ SRE < 65% | 0.7 | 0.7 | 0.7 | 0.6 | 0.8 | 0.4 |
| 65% ≤ SRE < 75% | 2.1 | 2.1 | 2.2 | 1.7 | 2.3 | 1.2 |
| 75% ≤ SRE < 84% | 3.4 | 3.2 | 3.5 | 2.7 | 3.7 | 1.8 |

# Energy Conservative Measures & Points for Service Hot Water

**Table 9.36.8.10.**
**Energy Conservation Measures and Points for Service Water Heating Equipment**
Forming Part of Sentence 9.36.8.10.(3)

| Type of Equipment | Energy Conservation Measures for Service Water Heating Equipment – Energy Efficiency, EF or UEF[1][2] | Performance Testing Standard | Heating Degree-Days of *Building* Location, in Celsius Degree-Days | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Zone 4 < 3000 | Zone 5 3000 to 3999 | Zone 6 4000 to 4999 | Zone 7A 5000 to 5999 | Zone 7B 6000 to 6999 | Zone 8 ≥ 7000 |
| | | | Energy Conservation Points | | | | | |
| Gas- or oil-fired tankless condensing water heater | EF ≥ 0.95 or UEF ≥ 0.92 | CAN/CSA-P.3 | 8.9 | 5.4 | 4.9 | 3.1 | 3.1 | 3.1 |
| Gas- or oil-fired residential *storage-type service water heater* | EF ≥ 0.80 or UEF ≥ 0.83 | | 8.9 | 5.4 | 4.9 | 3.1 | 3.1 | 3.1 |
| Gas- or oil-fired residential-duty commercial *storage-type service water heater* | UEF ≥ 0.79 | | 4.6 | 2.7 | 2.4 | 1.5 | 1.5 | 1.5 |
| | UEF ≥ 0.85 | | 6.0 | 3.6 | 3.2 | 2.0 | 2.0 | 2.0 |
| Heat pump water heater | EF ≥ 2.35 | CAN/CSA-C745 | 6.4 | 3.9 | 3.8 | 3.0 | 3.0 | 3.0 |

# Energy Conservative Points for Building Volume

**Table 9.36.8.11.**
**Energy Conservation Points for Building Volume**
Forming Part of Sentence 9.36.8.11.(2)

| *Building* Volume (V), $m^3$ | Energy Conservation Points |
|---|---|
| $380 < V \leq 390$ | 1 |
| $370 < V \leq 380$ | 2 |
| $360 < V \leq 370$ | 3 |
| $350 < V \leq 360$ | 4 |
| $340 < V \leq 350$ | 5 |
| $330 < V \leq 340$ | 6 |
| $320 < V \leq 330$ | 7 |
| $310 < V \leq 320$ | 8 |
| $300 < V \leq 310$ | 9 |
| $V \leq 300$ | 10 |

Time for another discussion...

## Question(s)

1. How are higher tiers achieved most economically? (Energy/$)
2. What can help motivate these?

# Thank you

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