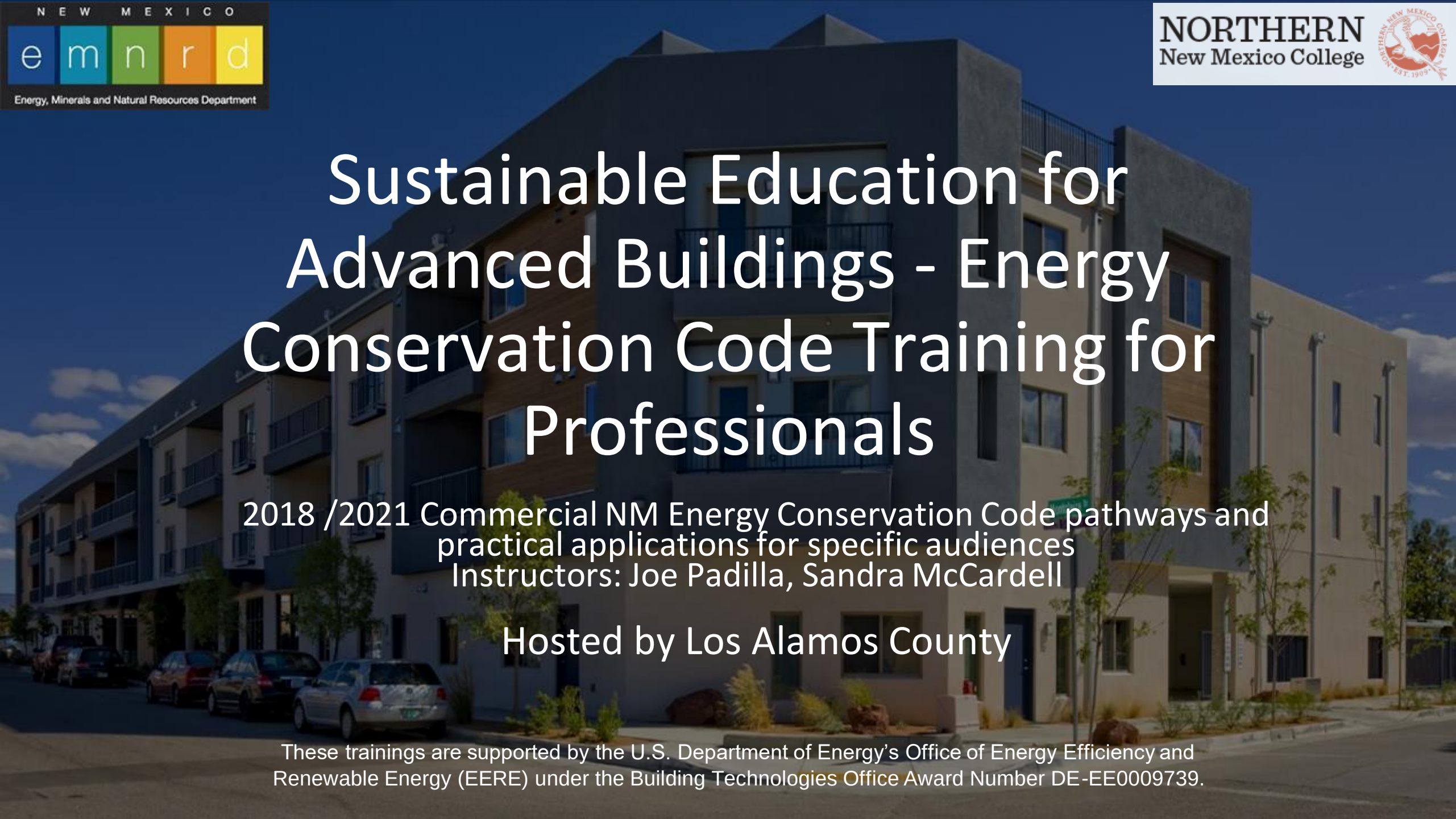

Sustainable Education for Advanced Buildings - Energy Conservation Code Training for Professionals

2018 /2021 Commercial NM Energy Conservation Code pathways and practical applications for specific audiences

Instructors: Joe Padilla, Sandra McCardell

Hosted by Los Alamos County

These trainings are supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Building Technologies Office Award Number DE-EE0009739.

Commercial NM Energy Conservation Codes pathways and practical applications

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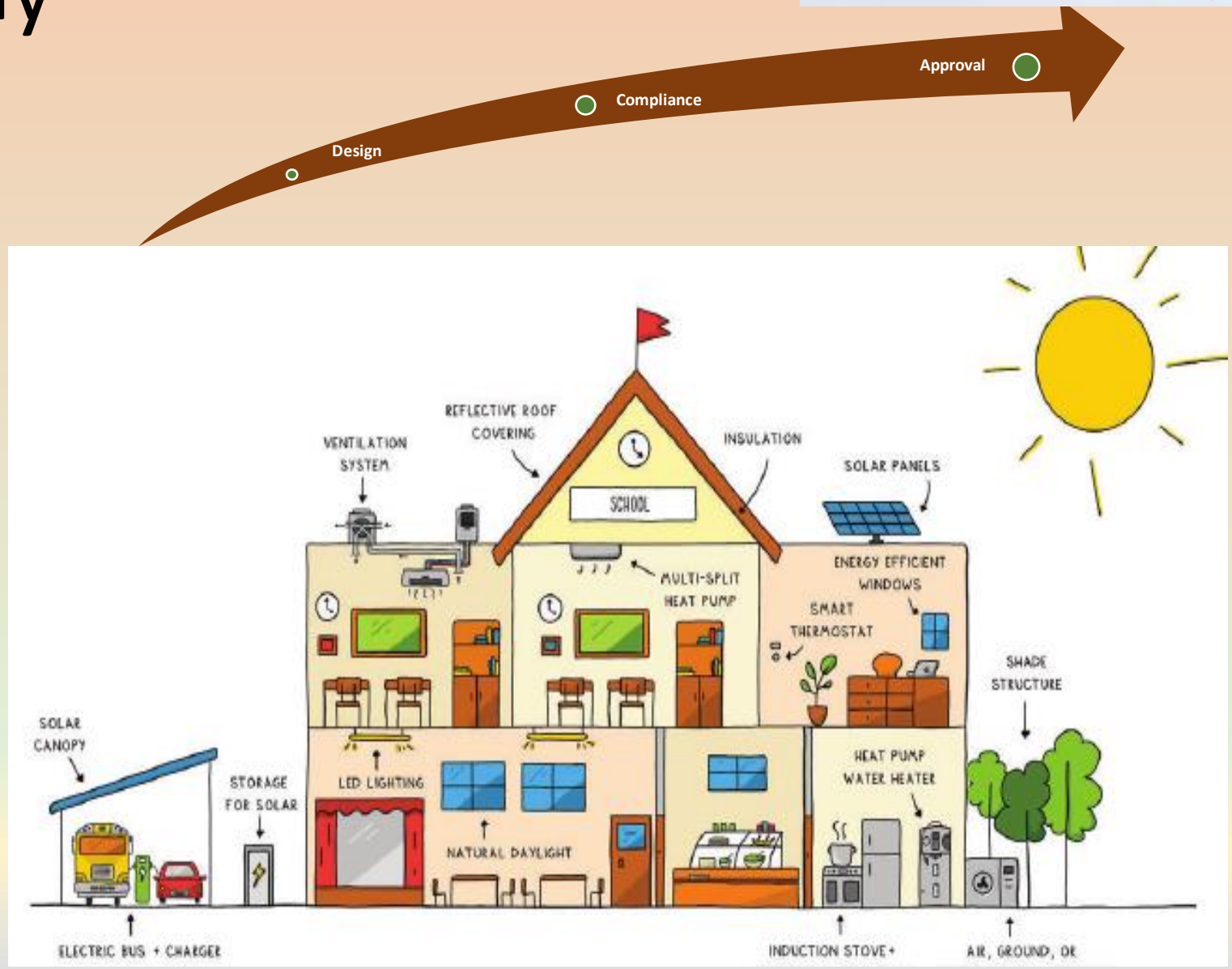
- Spring 2024 courses provide an overview of the new (IECC 2021) Commercial Energy Codes adopted in New Mexico – Apply as of July 30, 2024
- Code structure and applicability
  - Alternative Pathways to compliance under IECC 2021 and ASHRAE 90.1 2019
  - Prescriptive pathways and performance pathways

- Course Objectives / Outcomes
  - Introduction to the importance of energy efficiency & energy efficiency codes
  - Understanding of the long-term cost savings of energy efficiency & why NM adopted the EE code
  - Introduction to compliance paths and the idea of modeling software
  - Understand where to find more information and resources for the energy codes

Agenda for the day

- Sign ins / Introductions: 30 mins, 9 am – 9:30 am
- Section 1: General Introduction: Brief history , energy code impact, building energy performance, climate change, reasons for codes & standards, general code information - 60 min, 9:30 am – 10:30 am
- Break 10:30 am – 10:40 am
- Section 2: New Mexico Code, IECC 2021 and ASHRAE 90.1 2019 structure and applicability – 90 mins, 10:40 am – 12:10 pm
- Lunch Break 12:10 pm – 12:45 pm
- Section 3: Prescriptive and performance pathways and Implementation – 30 mins, 12:45 pm – 1:15 pm
- Section 4: Resources / Discussion – 30 mins, 1:15 pm – 1:45 pm



NBI Building Electrification Technology Roadmap for Schools, December 2023, p.9

Section 1 – General Information

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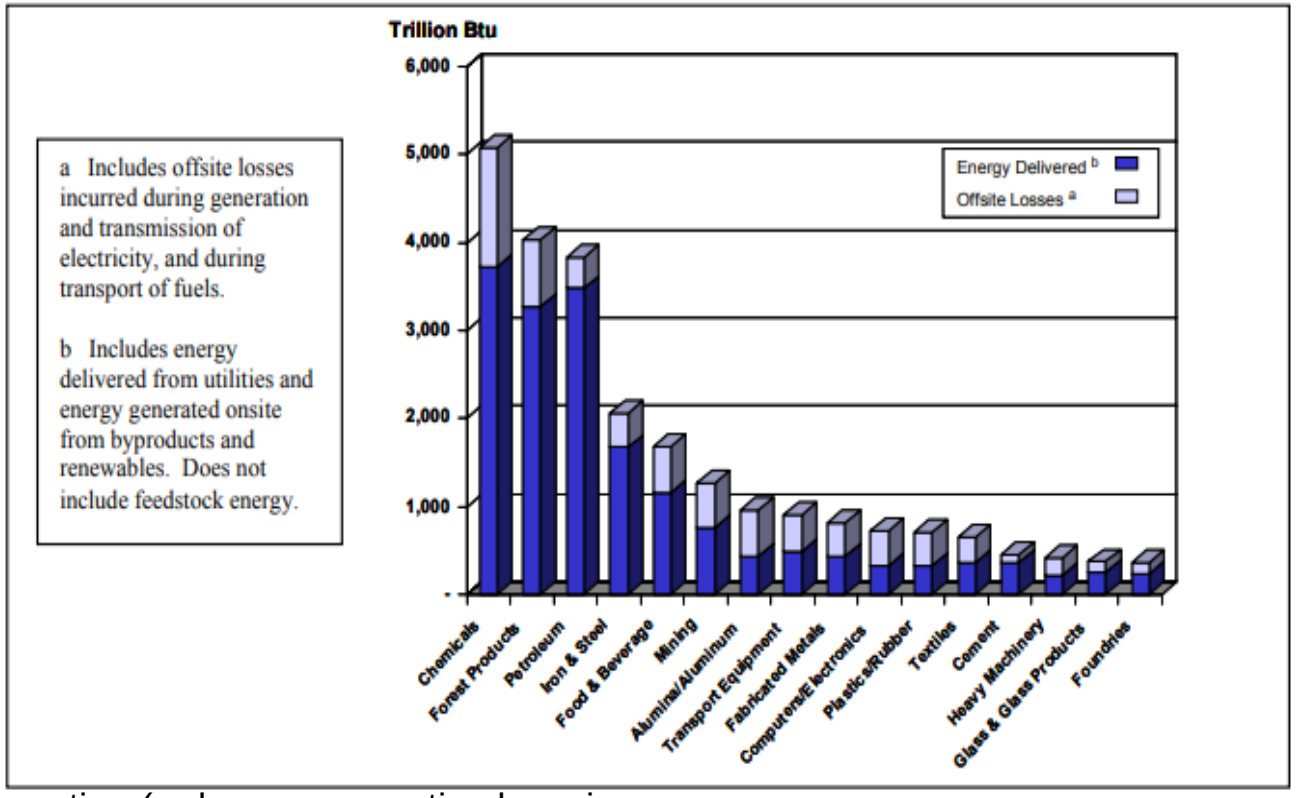
Energy: Accomplish your business / institutional goals using only the energy (and other inputs) you need

- Benefits:
  - Save money over the long run for heating, cooling, lighting
  - More robust construction
  - Reduced greenhouse gas emissions & pollution
  - Reduced demand for energy imports & leaving more energy in the ground for the future
  - Increased Resilience
  - Better understanding of this major input
  - Lower risk
  - Lowered costs, more thoughtful design…. Etc.

- (For every 100 units of coal mined, inefficiencies in the process mean that only 10 units do real work)

Figure 4. Primary Energy Use in Manufacturing and Mining



Energy Efficiency (less energy for same task) / Energy Conservation (reduce consumption by using less) / Energy Effectiveness (Producing the desired effect or state by using only the energy needed)

Energy comes from “harnessing” the power of nature

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Climate Change

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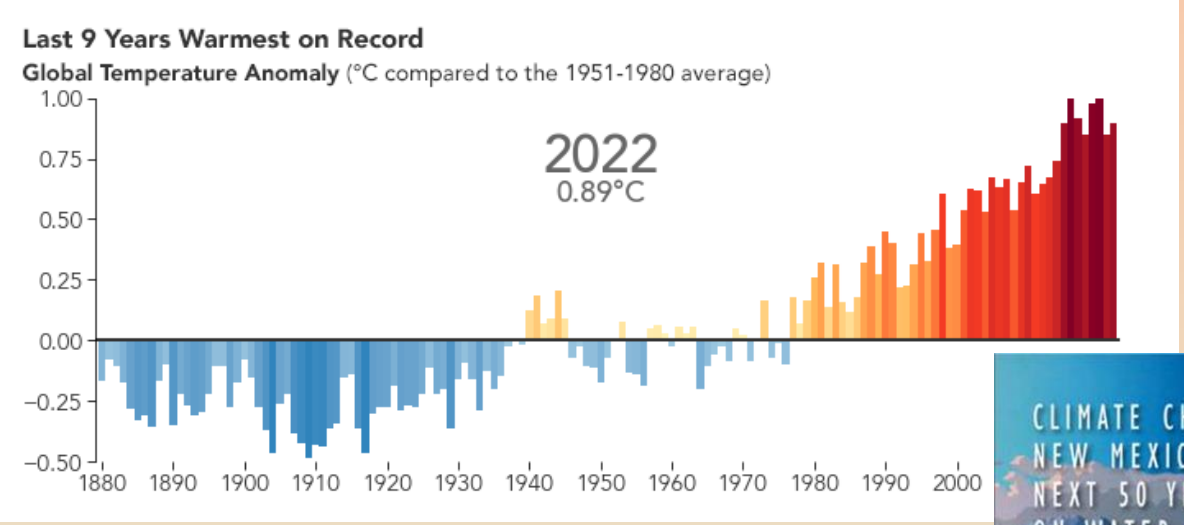
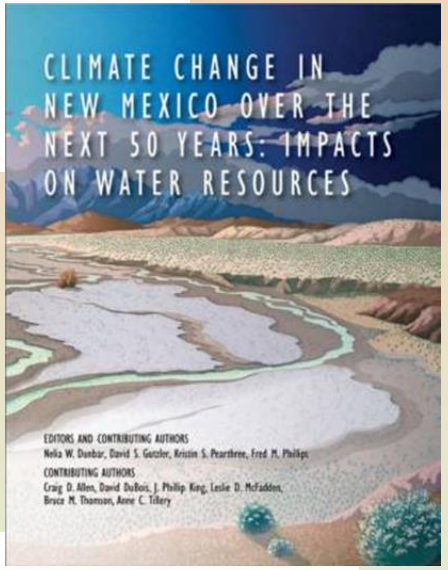
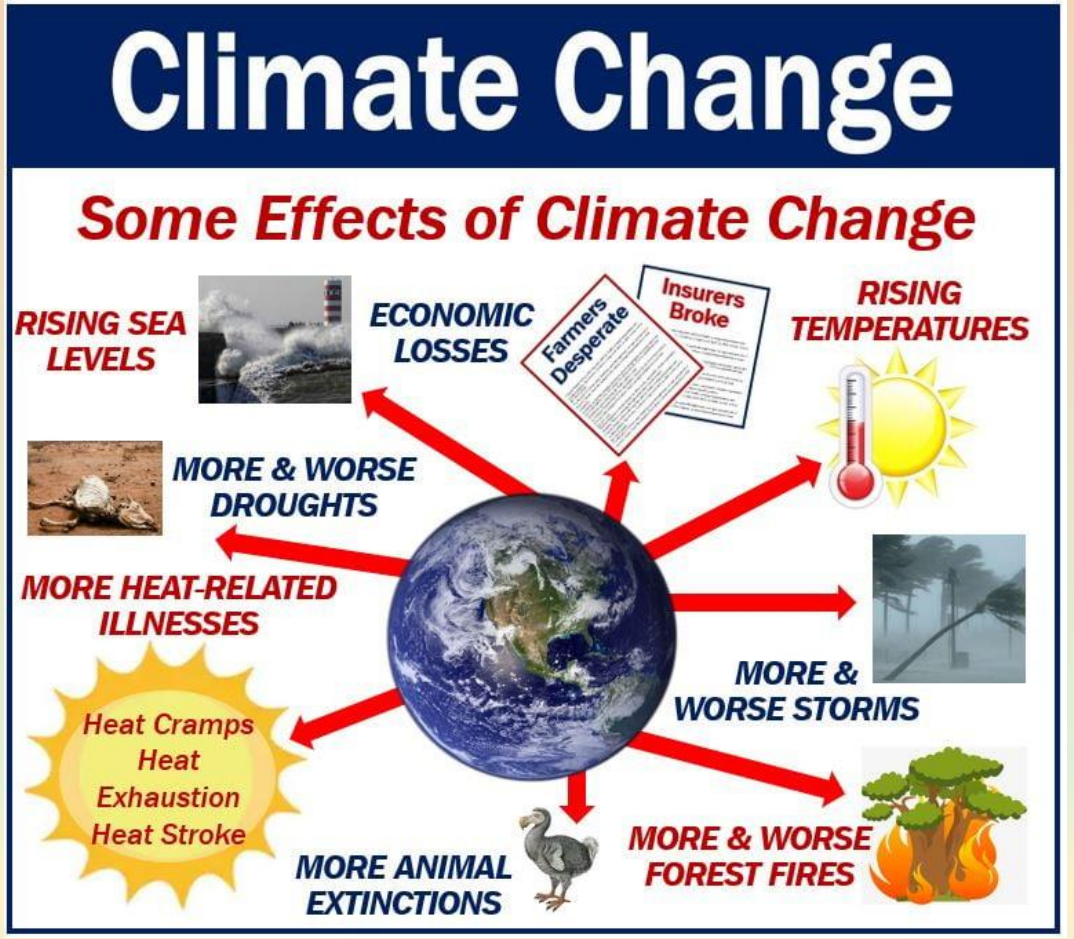


https://earthobservatory.nasa.gov/world-of-change/global-temperatures



https://350newmexico.org/confronting-climate-change-in-new-mexico/



https://marketbusinessnews.com/financial-glossary/climate-change/

Albuquerque NM temperature change 2000 - 2017

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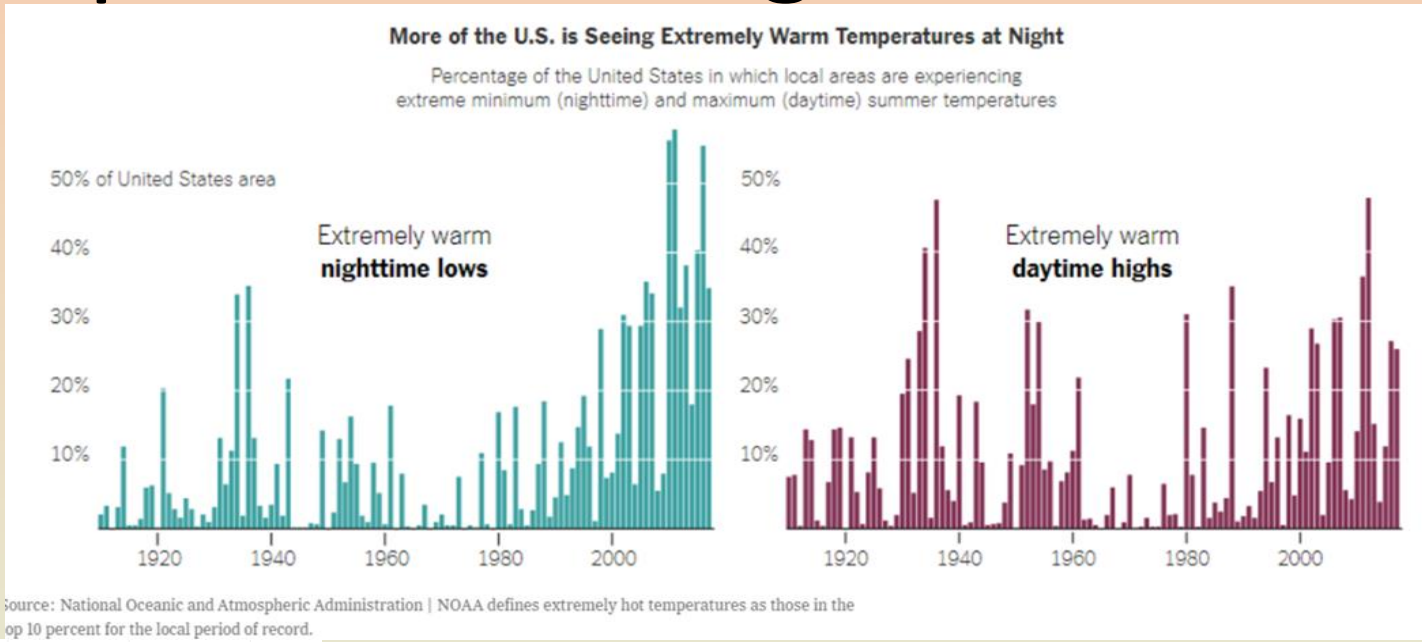
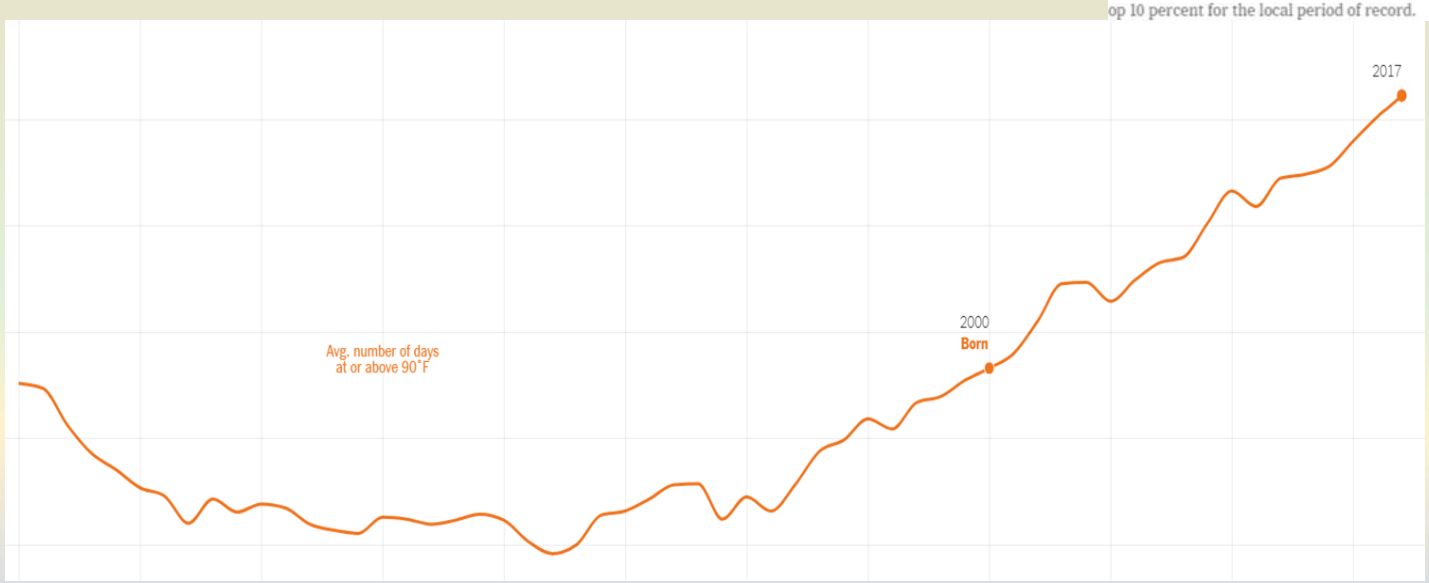




https://www.nytimes.com/2019/02/28/learning/teach-about-climate-change-with-these-24-new-york-times-graphs.html

Design temperatures will keep changing and building resilience / new technologies & techniques will become critical

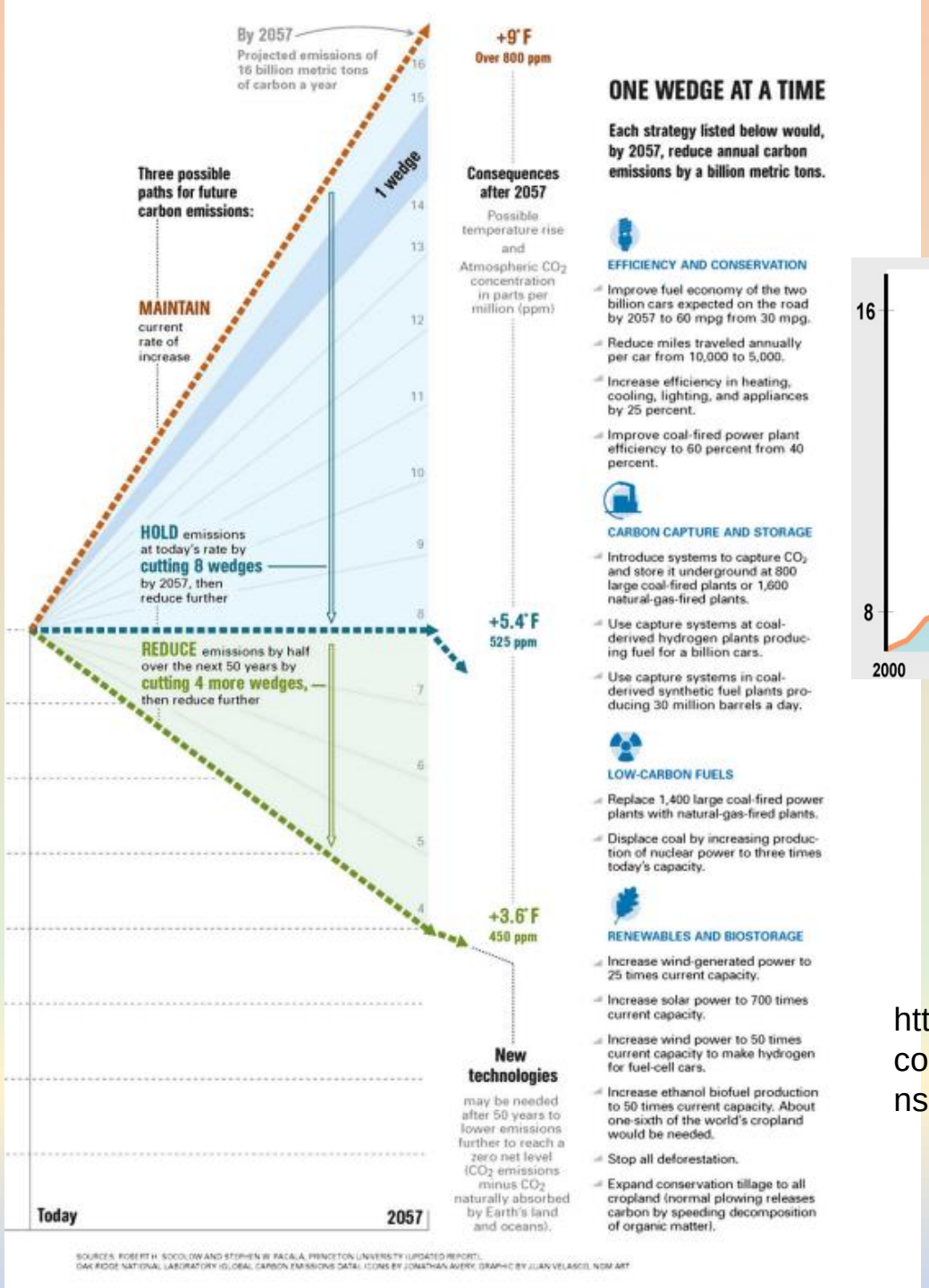
https://www.nytimes.com/interactive/2018/08/30/climate/how-much-hotter-is-your-hometown.html

You are part of the solution AND a new way of working

PROJECT DRAWDOWN

SOLUTION	SECTOR(S)
Abandoned Farmland Restoration	Land Sinks
Alternative Cement	Industry
Alternative Refrigerants	Industry / Buildings
Bamboo Production	Land Sinks
Bicycle Infrastructure	Transportation
Biochar Production	Engineered Sinks
Biogas for Cooking	Buildings
Biomass Power	Electricity
Bioplastics	Industry
Building Automation Systems	Electricity / Buildings
Building Retrofitting	Electricity / Buildings
Carpooling	Transportation

https://drawdown.org/solutions/table-of-solutions Project Drawdown



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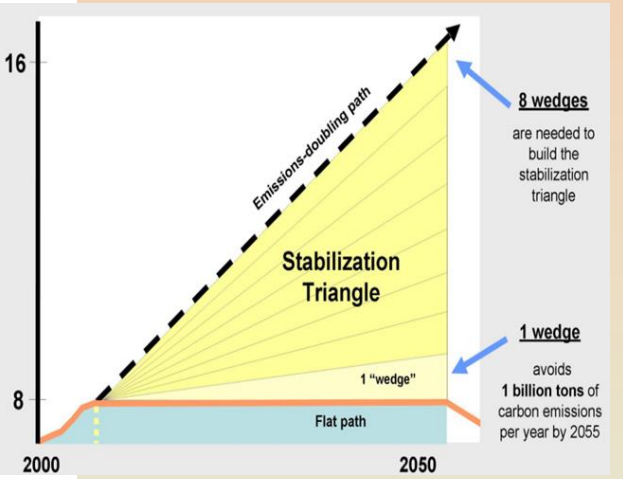

https://cmi.princeton.edu/wp-content/uploads/2020/01/Wedges_Figure2_8-scaled.jpg

https://cmi.princeton.edu/wp-content/uploads/2022/09/Carbons-New-Math.pdf

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What is the importance of “sustainability”?

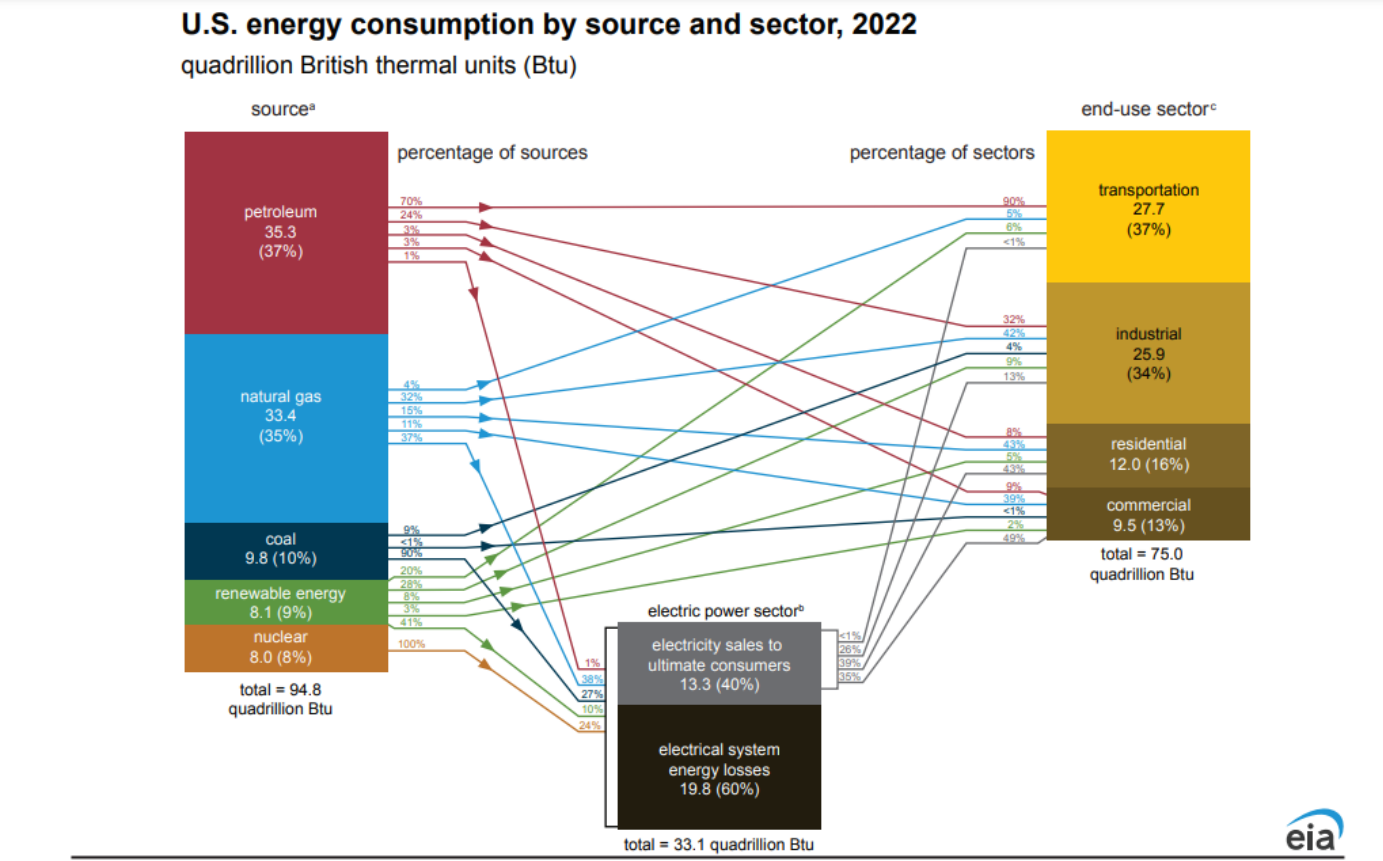
Sustainability and the importance of the building sector

- SUSTAINABILITY:
- Ability to maintain or support process continuously over time
  - Should not negatively affect the environment, neighbors, or people in the building
  - Minimize the use of non-renewable resources AND long-term operating costs
  - Goes beyond energy

- https://www.eia.gov/totalenergy/data/monthly/pdf/flow/total_energy_2022.pdf

https://www.nrel.gov/news/features/2023/nrel-researchers-reveal-how-buildings-across-the-united-states-do-and-could-use-energy.html#:~:text=Buildings%20are%20responsible%20for%2040,building%20stock%20is%20also%20essential.

- Buildings:
  - 40% of total energy use in US
    - 75% of electricity use
    - 35% of carbon emissions



Sustainability, green buildings, and rating systems

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- GREEN BUILDINGS:
  - Sustainable materials
  - Use energy effectively
  - Renewable energy systems
  - Site-adapted

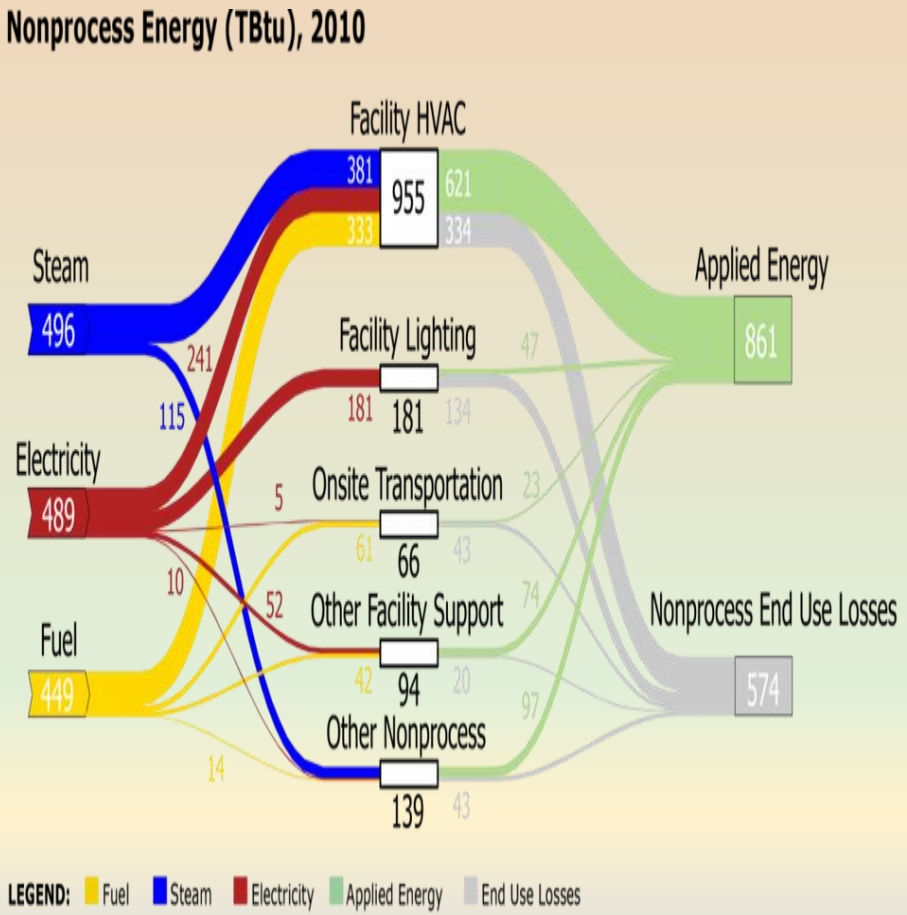
https://gharpedia.com/blog/12-green-building-materials-that-are-alternatives-to-traditional-concrete/

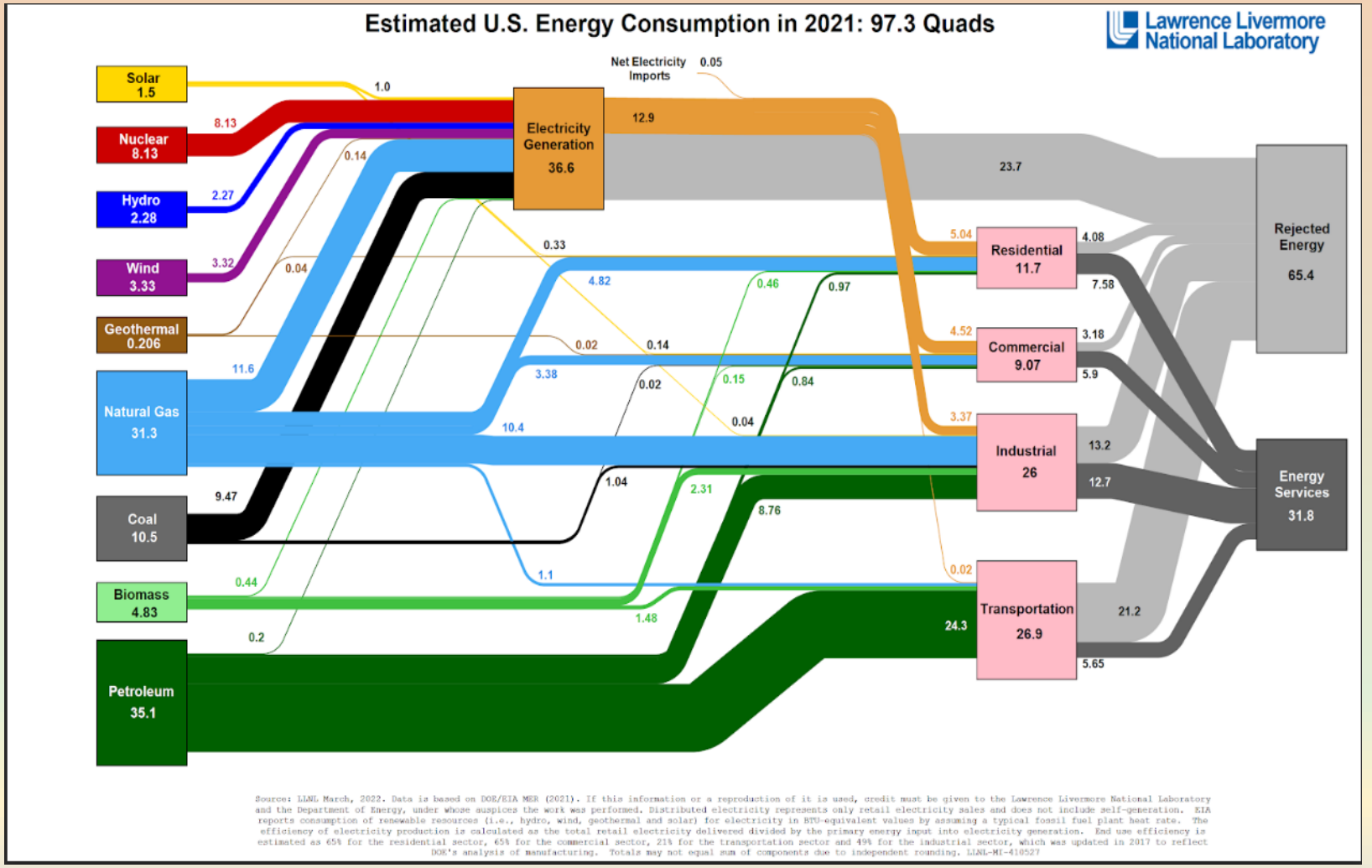
- RATING SYSTEMS:
- LEED
  - Developed by the industry
  - Originally focused only on construction
  - Incentivizes excellent performance
  - Tied to SBTC
    - https://www.emnrd.nm.gov/ecmd/tax-incentives/sustainable-building-tax-credit-sbtc/
- EPA Portfolio Manager
  - Free software to track & assess energy & water use
  - Comparisons to other buildings
  - LOTS of resources
  - MPG for building

https://www.dpsdesign.org/blog/integrating-sustainability-and-stewardship-into-design

https://www.dpsdesign.org/blog/enmus-golden-student-success-center-awarded-leed-gold-building-certification

Where is energy used in in the US, & in buildings?

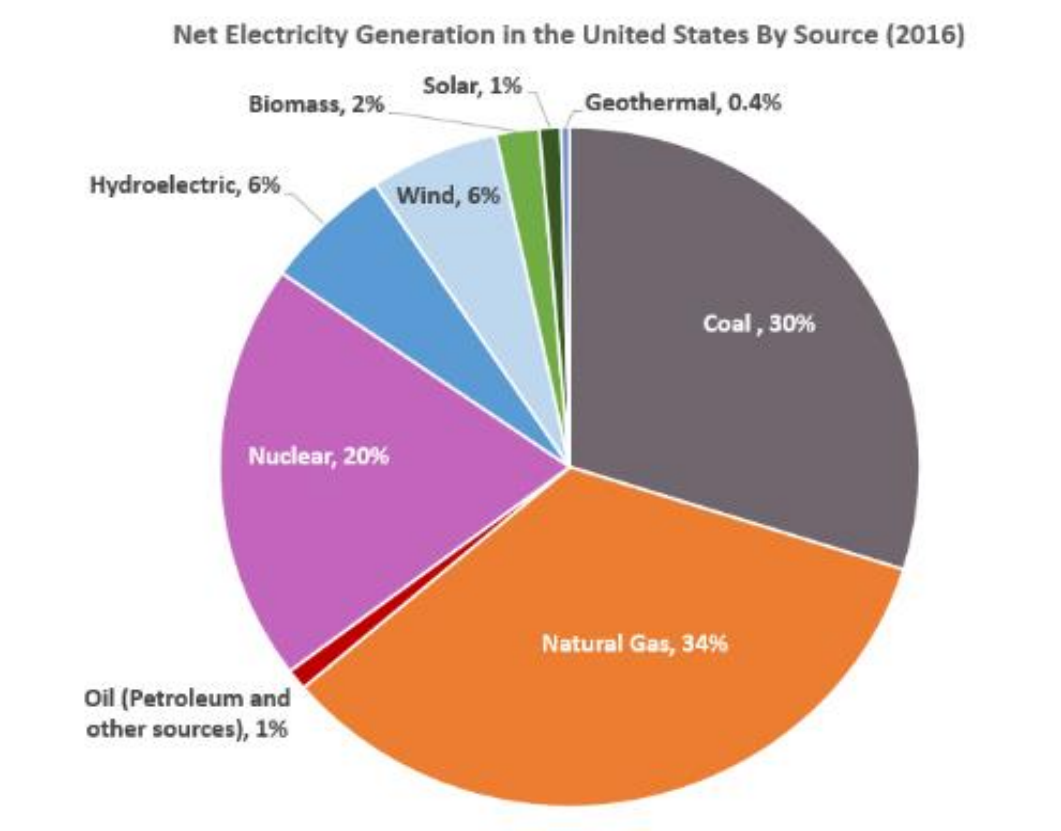


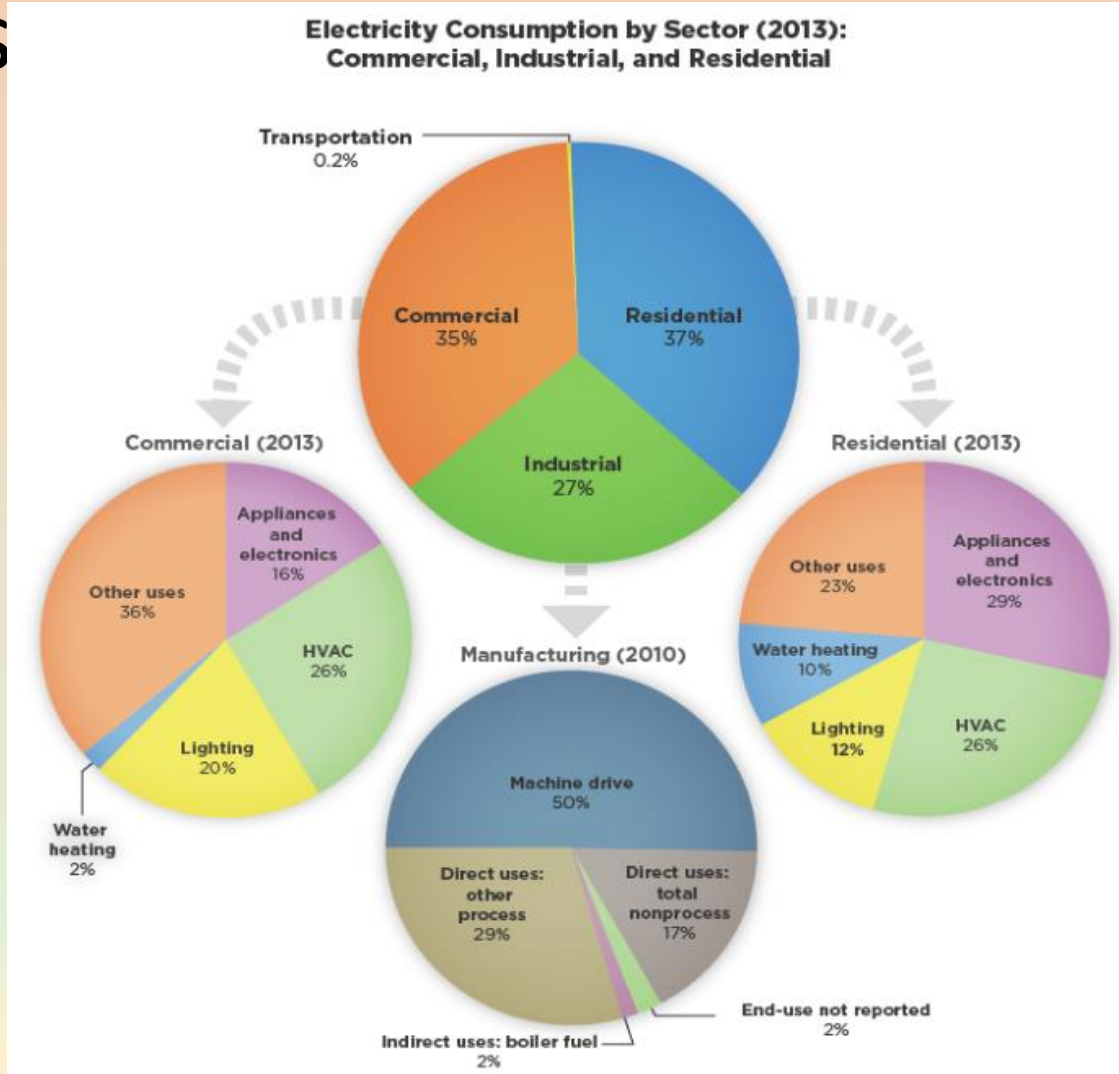


- http://energy.gov/eere/amo/static-sankey-diagram-nonprocess-energy-us-manufacturing-sector

https://www.vox.com/energy-and-environment/2017/4/13/15268604/american-energy-one-diagram

Different Sources Provide Energy, & Use by Sector Varies Greatly

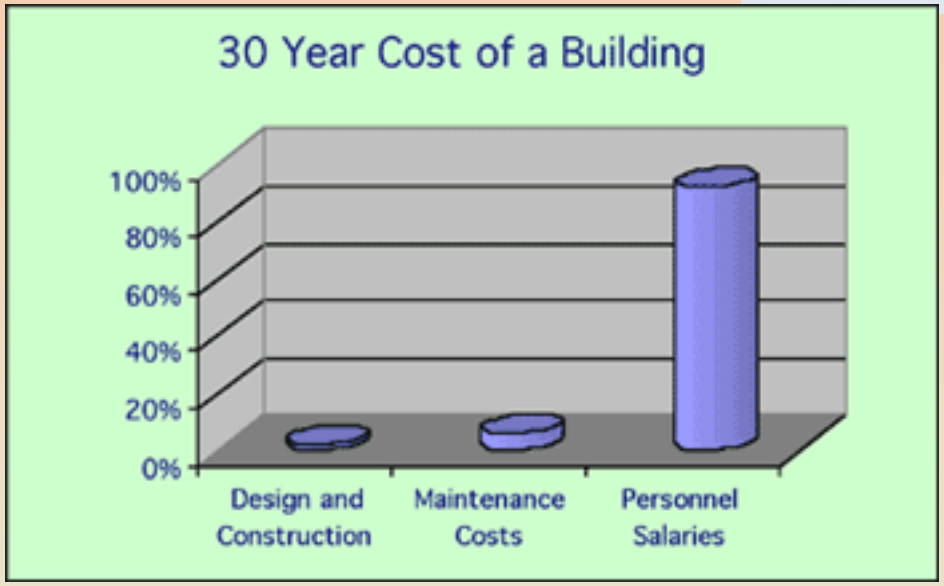




Sources: The high-level sector breakdown and detailed commercial and residential breakdowns come from the U.S. Energy Information Administration's Annual Energy Outlook 2014 EXIT. These data reflect projections for 2013. Energy uses within the industrial sector are not available with the same breadth, precision, or timeliness, so the best available source was the U.S. Energy Information Administration's Manufacturing Energy Consumption Survey EXIT, which was last conducted in 2010.

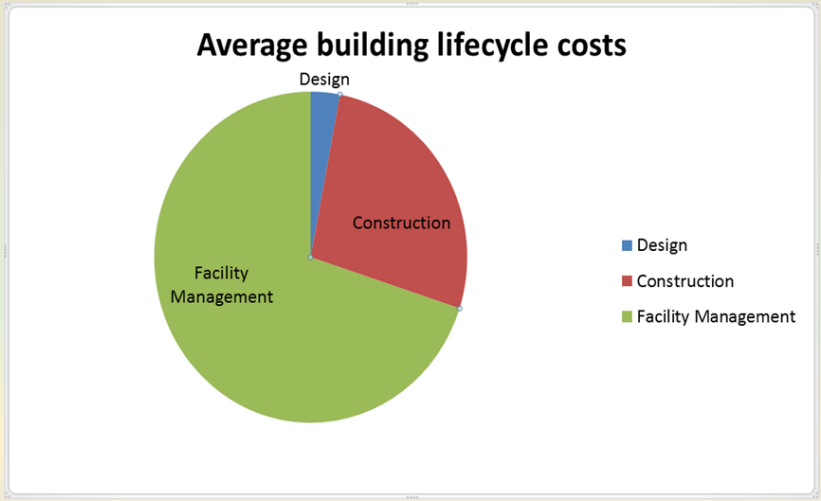
- https://www.epa.gov/energy/electricity-customers

Lifecycle Cost



Building-Related Costs at Design & Construction:
- Purchase land
- Planning Costs
- Design Costs
- Permitting and approval costs
- Energy Modeling Costs
- Construction Costs
- Fuel Costs
- Financing Costs

Operation, Maintenance, and Repair Costs
- Replacement Costs
- Residual Values—Resale or Salvage Values or Disposal Costs
- Finance Charges—Loan Interest Payments
- Non-Monetary Benefits or Costs
- Utility costs
- Ongoing Operations Costs
- Costs of Occupancy
- People Costs



https://shop.leica-geosystems.com/blog/bim-and-disto-tools

Comparison – Buying a Car

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	Purchase Cost	Miles driven/year	Fuel Cost / gal	MPG	Fuel $ /yr	Mtce Costs	Depreciation/yr, 5 yrs	Operations Cost / year incl. dep	Cost / 5 years
Base scenario									
"Standard" vehicle	$ 30,000	$ 15,000	$ 3.25	18	$ 2,708	$ 5,000	$ 6,000	$ 13,708	$ 68,542
"Efficient" vehicle	$ 35,000	$ 15,000	$ 3.25	40	$ 1,219	$ 5,000	$ 5,833	$ 12,052	$ 60,260
High fuel cost scenario									
"Standard" vehicle	$ 30,000	$ 40,000	$ 4.75	18	$ 10,556	$ 5,000	$ 6,000	$ 21,556	$ 107,778
"Efficient" vehicle	$ 35,000	$ 40,000	$ 4.75	40	$ 4,750	$ 5,000	$ 5,833	$ 15,583	$ 77,917
Decreased cost for newer technology									
"Standard" vehicle	$ 30,000	$ 40,000	$ 4.75	18	$ 10,556	$ 5,000	$ 6,000	$ 21,556	$ 107,778
"Efficient" vehicle	$ 31,000	$ 40,000	$ 4.75	40	$ 4,750	$ 3,000	$ 5,167	$ 12,917	$ 64,583

(Short) History of Construction & Codes

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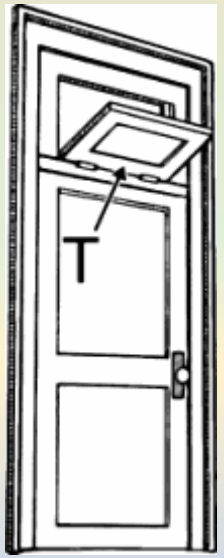
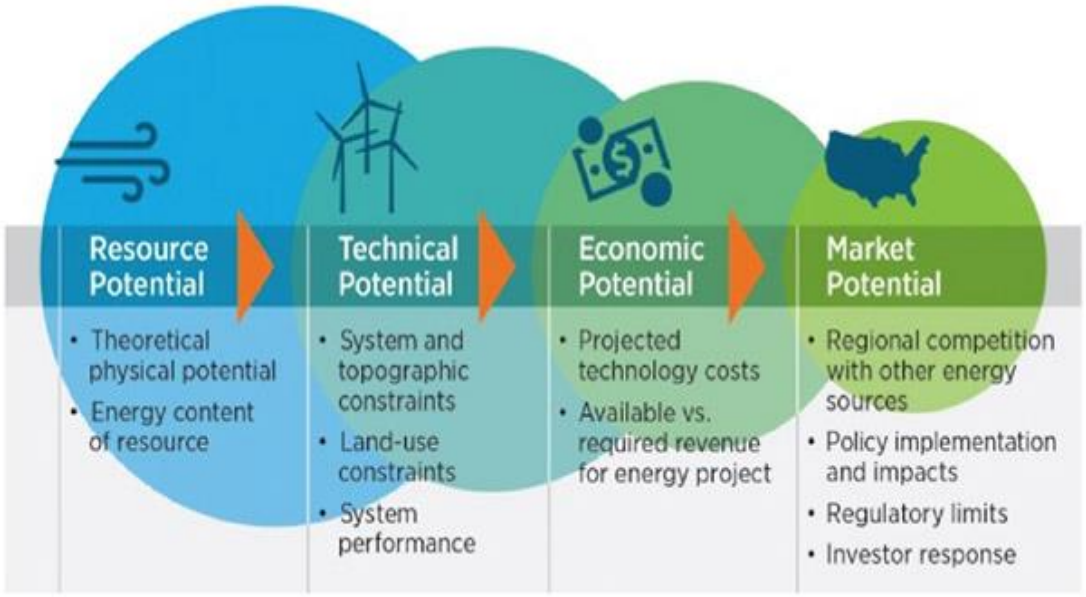
- Shelters for brief habitation
- Settled communities, agriculture
- Specialized structures
- Adaptations to climate & geography
- Increasing size, height, span, material durability
- Energy available for construction & operations, controlling interior environment



Some Reasons for Regulation = Codes & Standards

- Response to external forces
- Public safety
- Fairness
- Policy Objectives
- Economic development

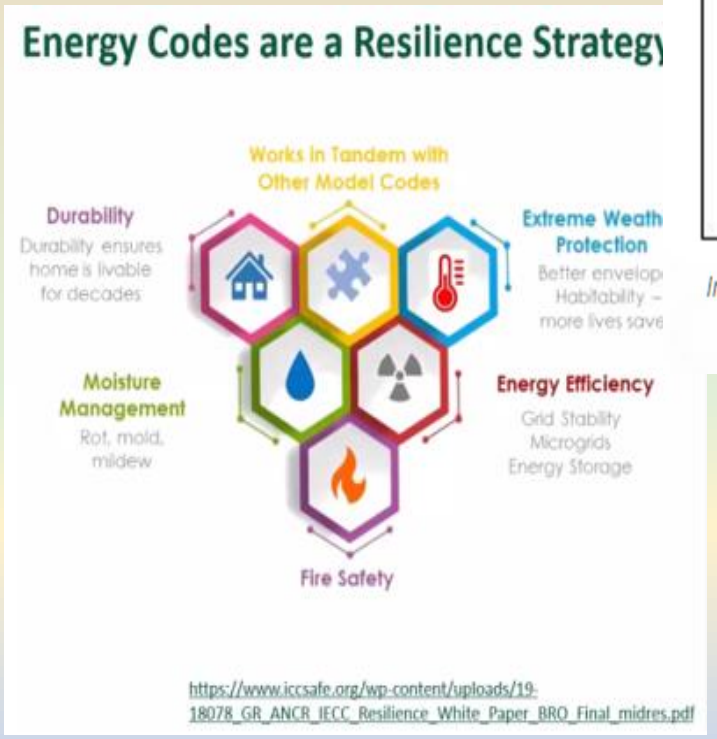


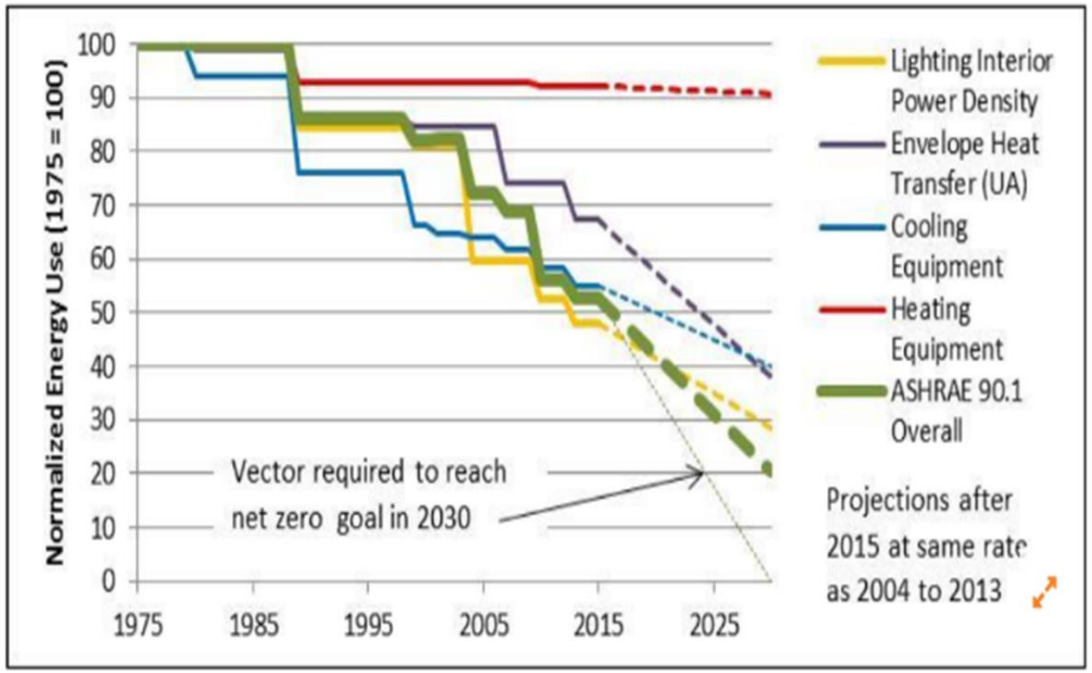
https://www.nrel.gov/gis/re-econ-potential.html

Impact of Energy Codes goes Beyond Energy

- 2010 – 2040:
  - $138 Billion Saved
  - 900 MMT Avoided CO2e
  - 13.5 Quads Energy Reduced
- Over next 30 years, energy codes expected to save $126 billion nationwide.
- Early design focus on energy creates longstanding savings & reduces environmental impacts.

- *From <https://www.pnnl.gov/building-energy-codes>*





Improvement in ASHRAE Standard 90/90.1 (1975-2013) with Projections to 2030. Courtesy of Pacific Northwest National Laboratory 2015

Optimize retail building

10 Ways Energy Code Optimizes Office Building Savings

Saving energy saves money. America's model energy code—the International Energy Conservation Code—sets out minimum efficiency standards for new construction across the U.S. Based on savings found in the field, here are the 10 biggest financial savings opportunities for office buildings in the 2018 IECC.

TOTAL CUMULATIVE SAVINGS POTENTIAL

Small office (1,000-5,000 sq. ft.)	Medium office (5,000-25,000 sq. ft.)	Large office (25,000-250,000 sq. ft.)
$15,000	$50,000	$203,000

Estimated savings are based on average present value of savings found in a field study of 123 office buildings averaging 10,000 sq. ft.–25,000 sq. ft. in size in Climate Zones 2A and 5A.

View the 2021 IECC code.

This material is based upon work supported by the Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE), under Award Number DE-EE0007619.

IMT INSTITUTE FOR MARKET TRANSFORMATION

All tenant savings should be outlined in the lease.

- Green boxes indicate landlord savings.
- Orange boxes indicate tenant savings.

Design lighting to meet power density requirements. Higher efficiency fixtures and lamps will ensure limits are met.
Potential savings: *(per sq. ft.)* $0.06–$0.25
See: IECC 2018 C405.3-4

Have the lighting and mechanical systems in your building commissioned.
Potential savings: *(per sq. ft.)* $0.60–$0.71
See: IECC 2018 C408

Design building to have no more than 30% glazing.
Potential savings: *(per sq. ft.)* $0.10–$0.22
See: IECC 2018 C402.4.1

Install insulation in the building envelope that meets minimum code requirements.
Potential savings: *(per sq. ft.)* Up to $0.14
See: IECC 2018 C402.2

Purchase and install windows that meet minimum code requirements. Site-built windows must obtain an NFRC certificate.
Potential savings: *(per sq. ft.)* $0.25–$0.30
See: IECC 2018 C402.4

Program ventilation system to provide minimum required air delivery during off-business hours.
Potential savings: *(per sq. ft.)* $0.02–$0.49
See: IECC 2018 C403.4.2

Ensure thermostat controls are programmed to avoid simultaneous heating and cooling, are set back during off-business hours, and adjust start time of HVAC system.
Potential savings: *(per sq. ft.)* $0.02–$0.07
See: IECC 2018 C403.4.3

Provide controlled electrical outlets to turn off equipment when not needed.
Potential savings: *(per sq. ft.)* $0.10–$0.30
See: No code section in IECC 2018

Provide occupancy and daylight sensors to turn off interior and exterior lighting when not needed.
Potential savings: *(per sq. ft.)* $0.66–$1.02
See: IECC 2018 C405.2
*Also a tenant savings.

Install insulation on hot water pipes to prevent heat loss.
Potential savings: *(per sq. ft.)* Up to $0.40
See: IECC 2018 C404.4

Home Utility Bill Example

	Monthly House Costs	Utilities	Percentage	Savings %	Savings $	Savings over 12 months	Total Family Income	Percent of family income saved	Energty Burden %
Housing Cost Scenario									
Residence #1, avg energy burden	$ 2,500	$ 700	28%	20%	$ 140	$ 1,680	$ 150,000	1%	6%
Rtesidence #2, high energy burd3en	$ 1,500	$ 700	47%	20%	$ 140	$ 1,680	$ 54,000	3%	16%

Figure 1: Share of Income Spent on Housing, by Income, New Mexico

Source: US Census 2019 5-Yr Community Survey Public Use Microdata and author calculations

https://www.homewisdom.org/homeownership-is-affordable-housing-nm#:~:text=The%20typical%20New%20Mexico%20homeowner%20spends%20about%2015%20percent%20of,higher%20incomes%20than%20typical%20renters.

https://maps.nrel.gov/slope/stories/nm

Average Energy Burden (% income) for Census Tracts in New Mexico

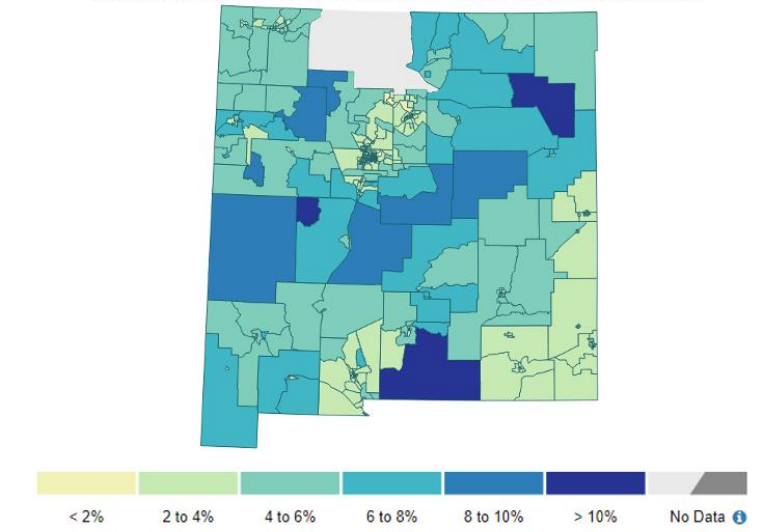
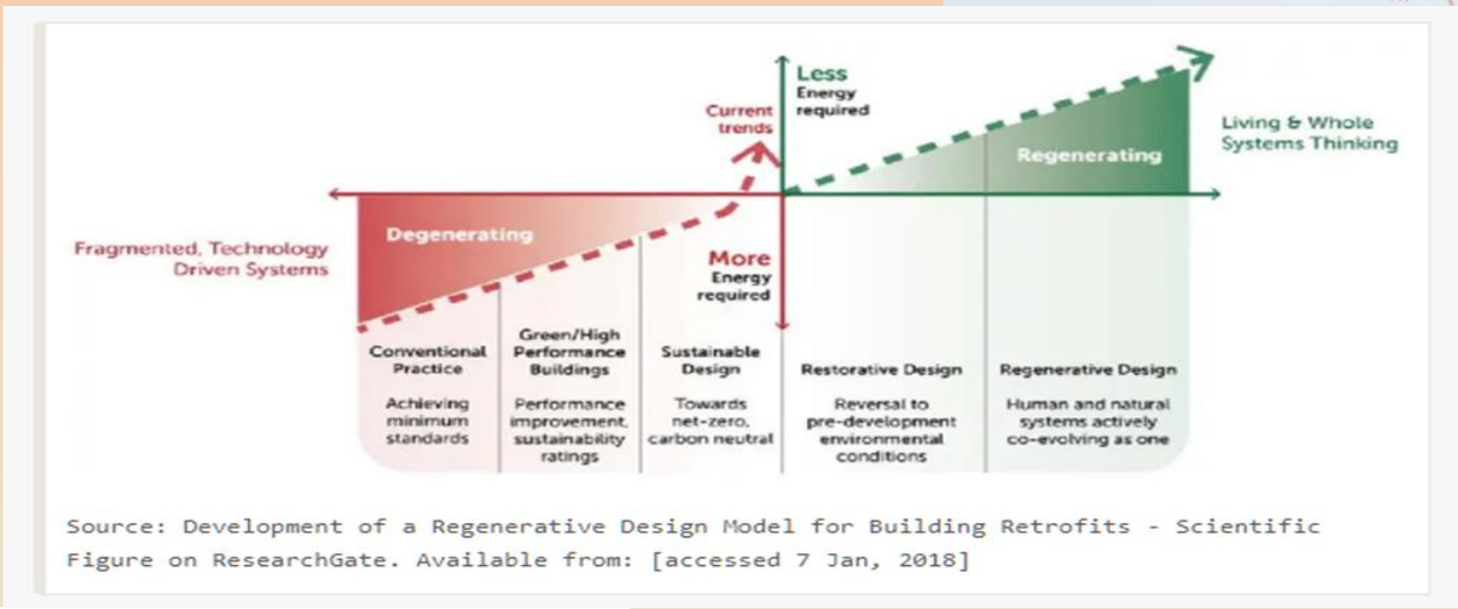
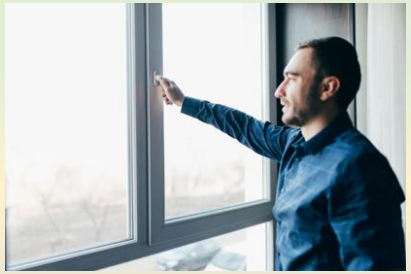
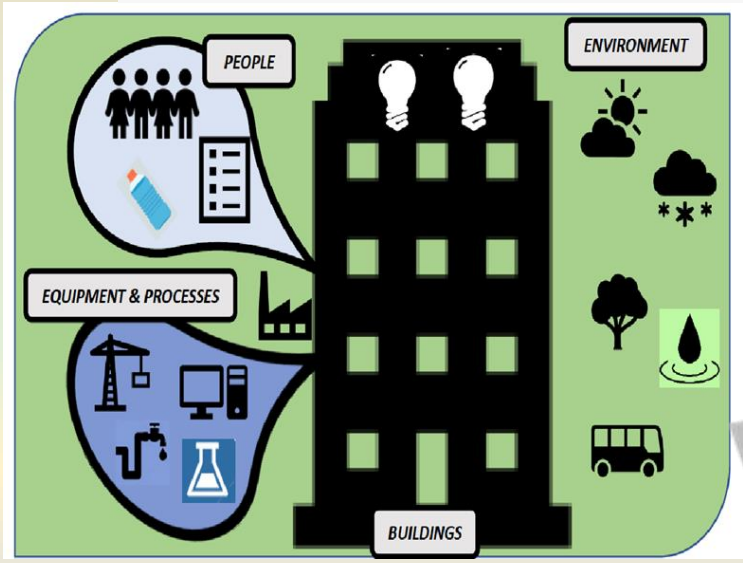


Figure 7. Energy burden as a percentage of income by census tract (LEAD Tool 2021). Grey indicates lack of data available for Rio Arriba County.

Whole Building Approach – Buildings as Systems







Energy Effectiveness
Strategic Objectives, Energy and Water at the Heart of Enterprise – S. McCardell
https://link.springer.com/book/10.1007/978-3-319-90255-5

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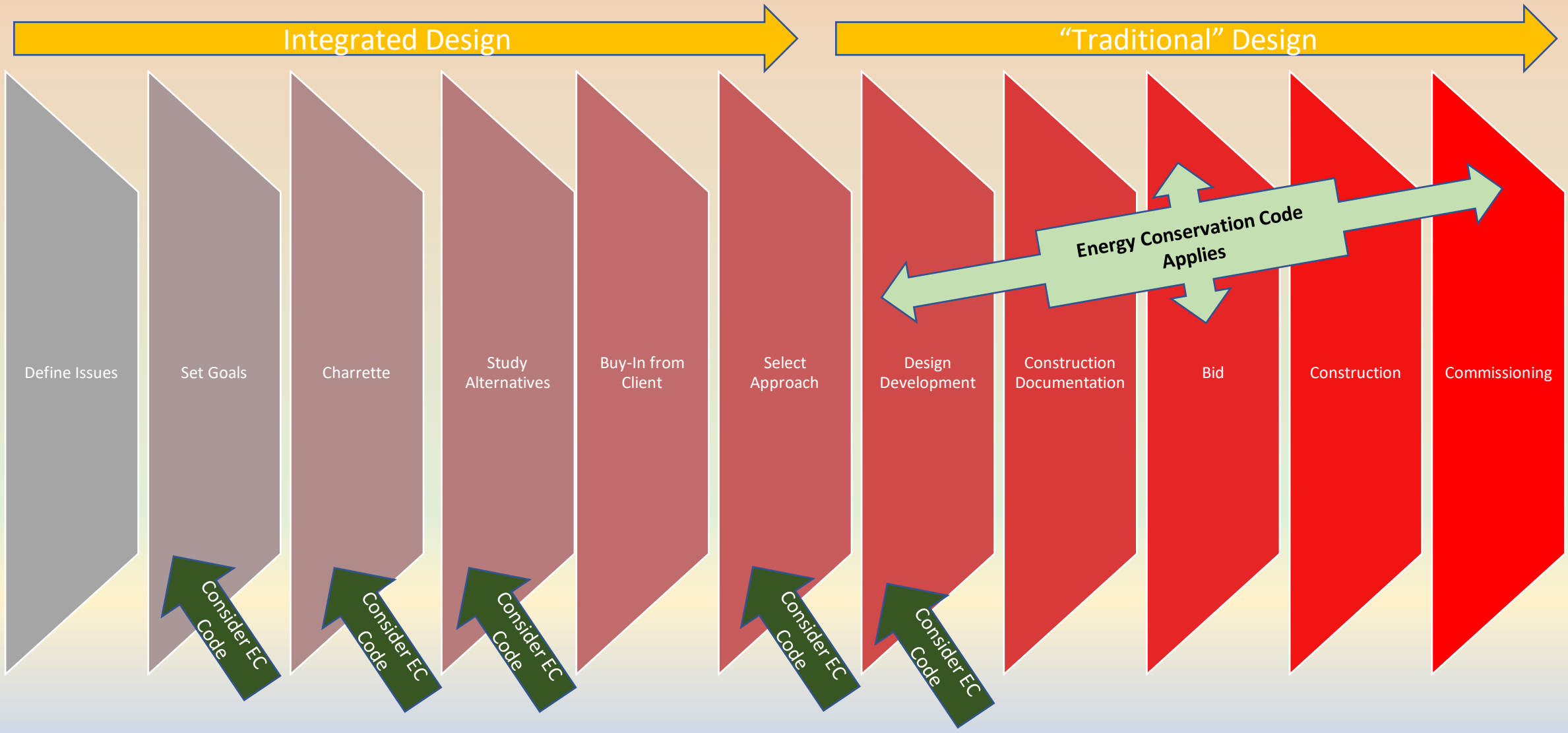
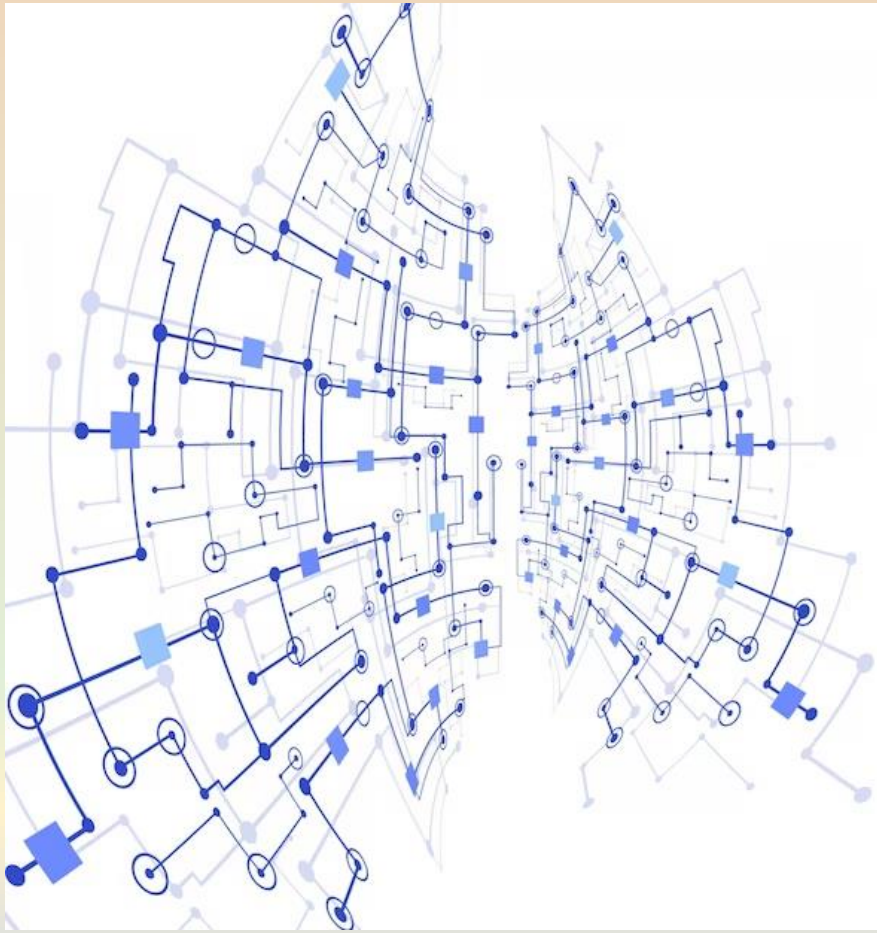
Integrated "Whole Building" Design Process



Why is it important to be familiar with energy codes?

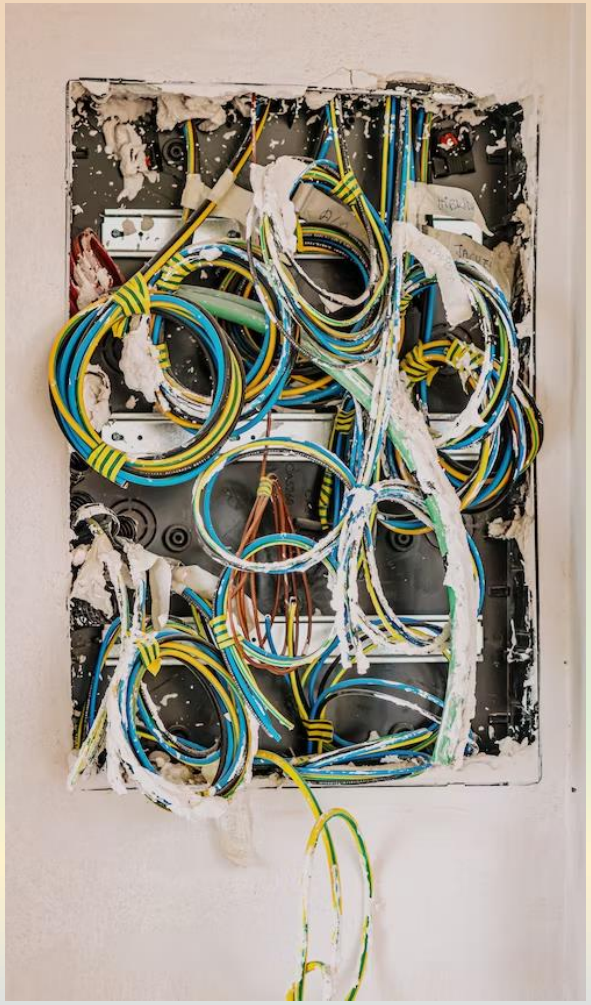


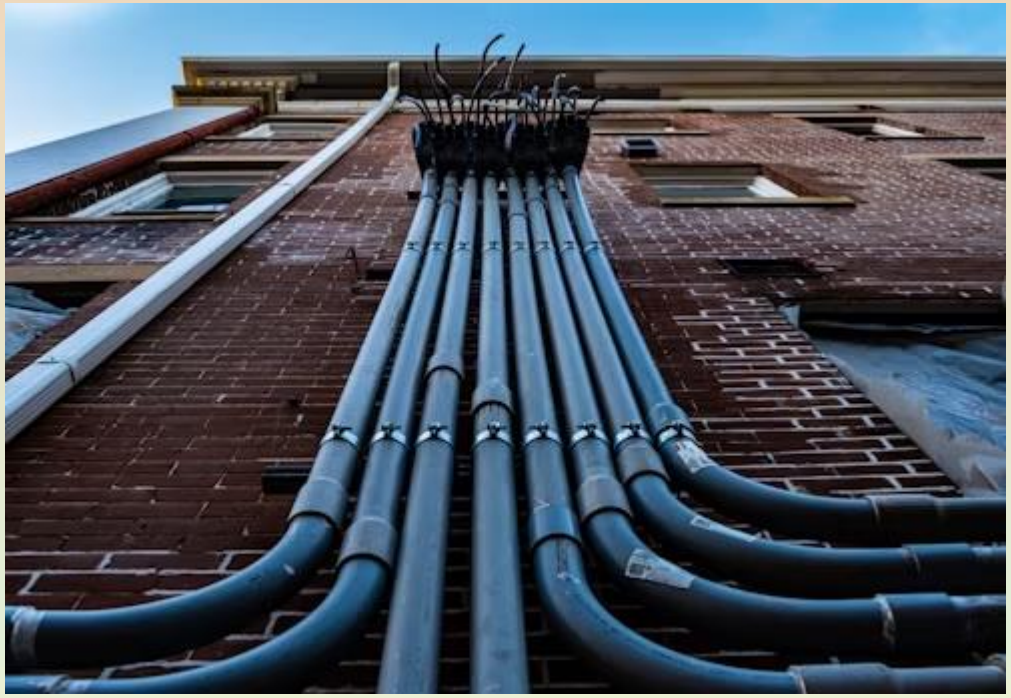
Controls will now be more widely required, electrification too

People are looking at ESG goals, CO2, other parameters related to climate change for houses, companies, etc.

Building Integration, Heating/Cooling critical to future buildings

- Intention to have more local renewable energy
- Intention to reduce use / installation of fossil fuel equipment
- Building controls and management required (and that's a good thing!)
- Balance between air flow for health and reducing energy use





Change has been fast! Heat Pumps and Electrification

- 2023:

Heat pumps are hot, but commercial retrofits face cold realities

Government decarbonization strategies call for widespread deployment of heat pumps for building heating and cooling, but experts warn of retrofit costs, disruption and other concerns.

Published Oct. 20, 2023

Nish Amarnath
Editor

Leon Neal via Getty Images

- 2024

Commercial Heat Pump Systems: Efficiency & Types

Table of Contents

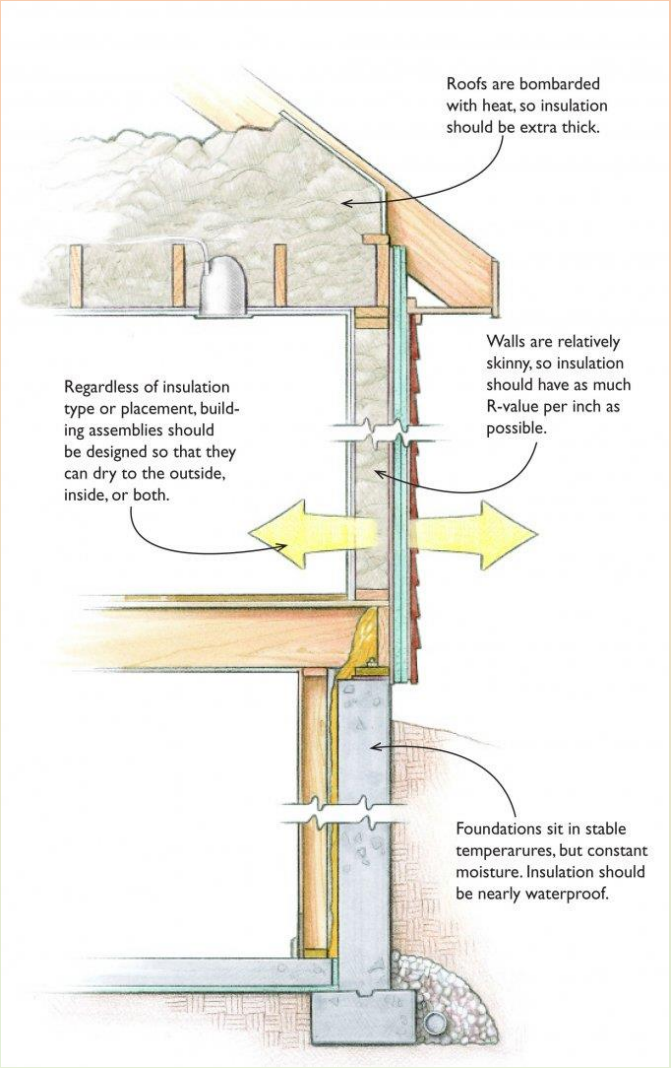
In the tapestry of modern technology, HVAC industry's **commercial heat pump systems** with variable refrigerant flow and air handlers stand out as products that are a testament to innovation in **energy efficiency**. Once overshadowed by traditional heating methods, these systems, including air handlers, have surged to prominence in the industry, offering businesses and buildings a greener footprint without sacrificing performance. They've become the go-to for savvy enterprises in the industry looking to cut costs and carbon emissions in buildings with air handlers support simultaneously.

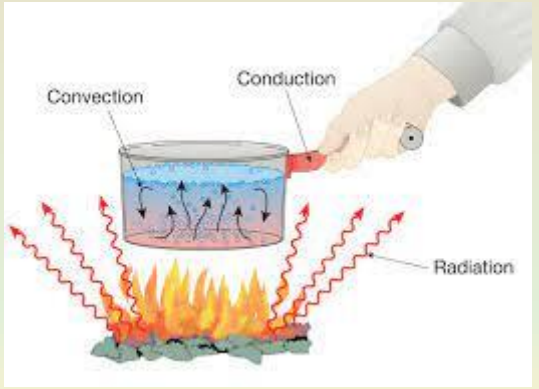
https://www.facilitiesdive.com/news/commercial-heat-pump-retrofits-cold-costs/697325/

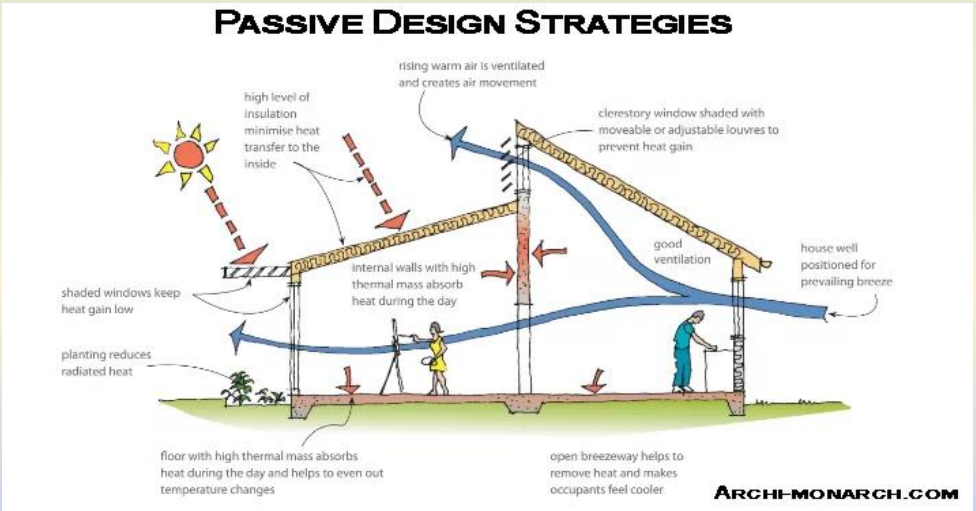
https://evolutionmechanical.net/blog/commercial-heat-pump-systems/

Building Envelope

- Insulation & Fenestration
  - Insulation is the skin of the building
  - Fenestration are the eyes
  - Together they form the building thermal envelope
- Heat Transfer is the major challenge
  - Conduction (physical contact)
  - Convection (airflow)
  - Radiation (exchange of electromagnetic waves)
- Passive Design / Passive solar





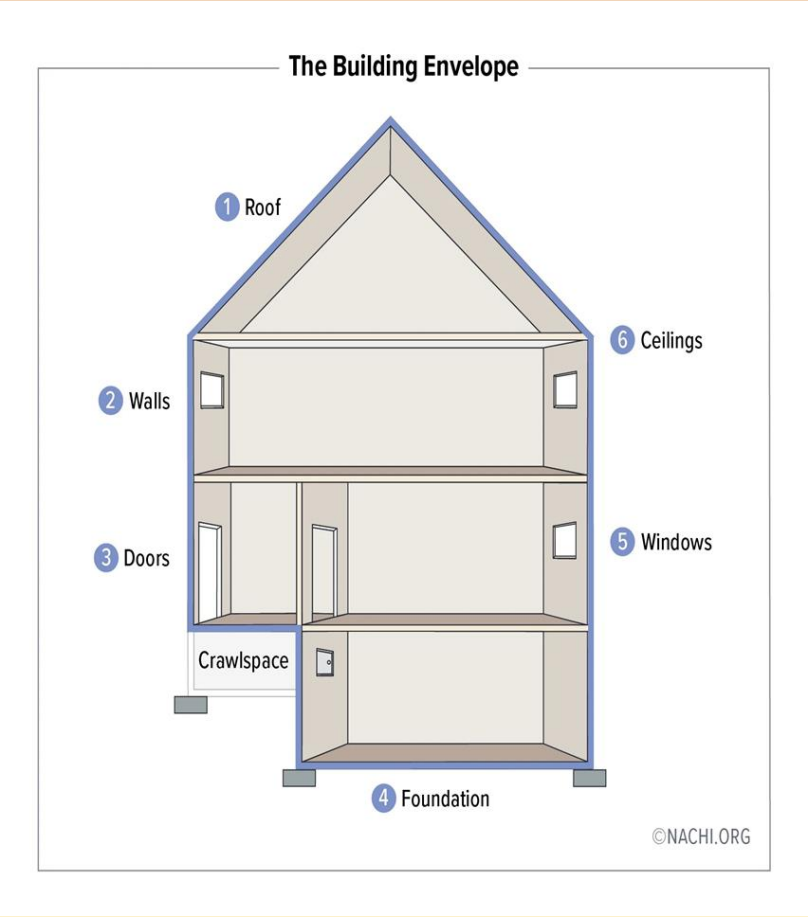


https://www.greenbuildingadvisor.com/green-basics/the-building-envelope

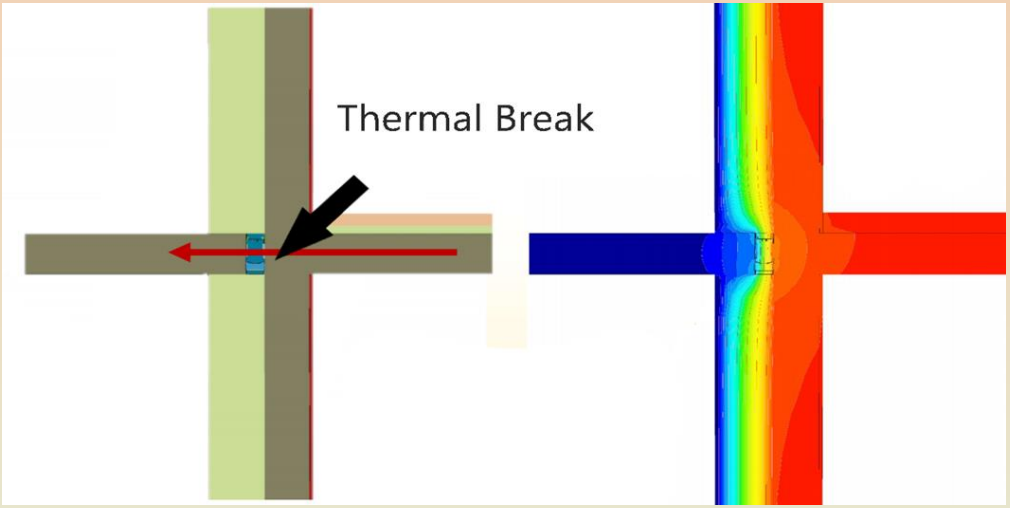
https://www.simscale.com/docs/simwiki/heat-transfer-thermal-analysis/what-is-heat-transfer/

https://archi-monarch.com/introduction-of-passive-design/

What is a Building's Thermal Envelope?



https://www.nachi.org/gallery/infrared-1/the-building-envelope



https://www.freepik.com/premium-photo/home-housing-people-technology-concept-close-up-man-hands-pointing-finger-tablet-pc-computer-regulating-room-temperature-house-background_29193419.htm#query=thermal%20imaging%20building&position=13&from_view=search&track=ais&uuid=

- https://blog.passivehouse-international.org/what-is-a-thermal-bridge/

Air leakage

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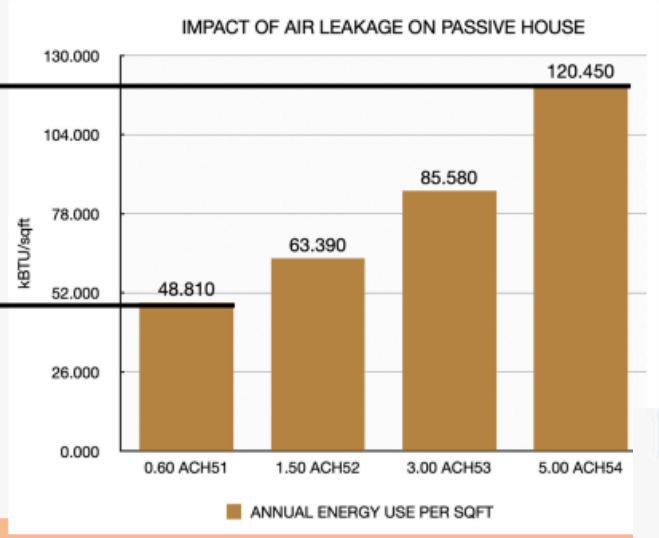
IMPACTS TO ENERGY USE

Building air-leakage

Super insulated
IECC 2021 Code Air-tightness

-60%
Annual Energy

Super Insulated
Passive House Air-tightness



B PUBLIC PREFAB

No amount of insulation can overcome air-leakage.

- (Slides courtesy B Public Prefab, Santa Fe NM)

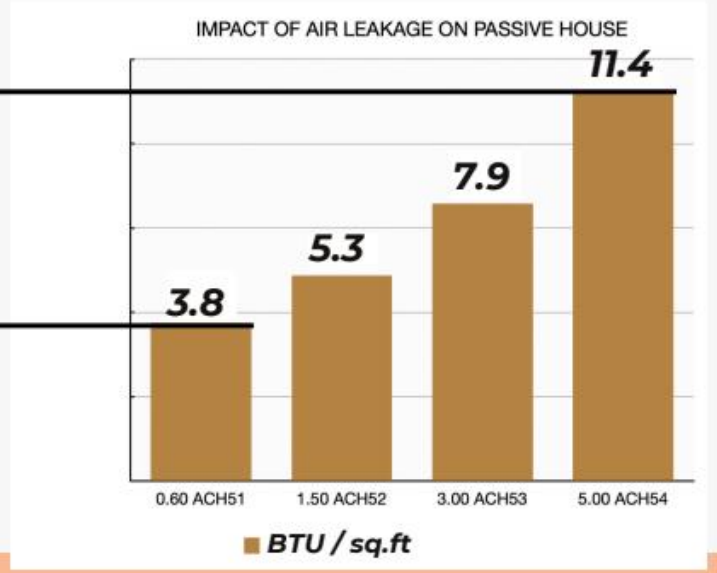
IMPACTS TO ENERGY USE

Building air-leakage

Super insulated
IECC 2021 Code Air-tightness

-67%
Peak Load

Super Insulated
Passive House Air-tightness

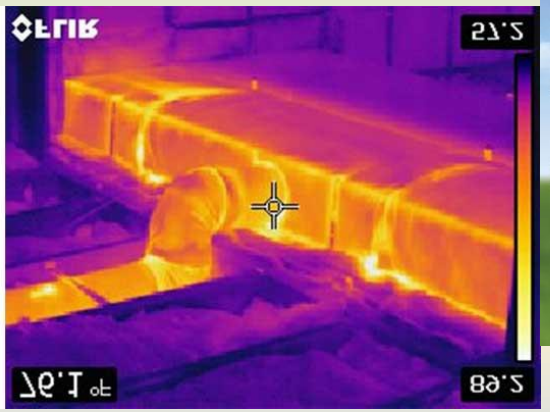


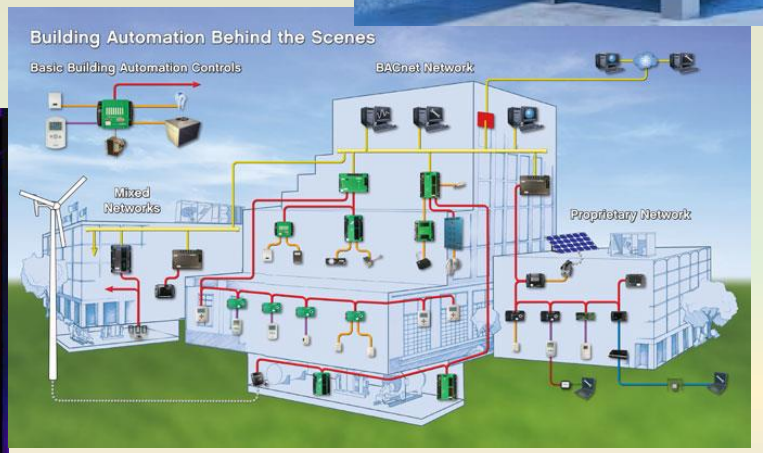
B PUBLIC PREFAB

Heating system is 67% smaller!!!

Mechanical Systems

- Choice of equipment
- Appropriate controls
- Functional ducts & pipes
- Correct sizing
- Potential for reuse





https://www.aei.org/carpe-diem/home-appliances-good-old-days-now-theyre-cheaper-better-energy-efficient-ever/

https://aeroseal.com/ken/3-types-duct-leakage-impact-hvac-performance/

http://www.kmccontrols.com.hk/products/Understanding_Building_Automation_and_Control_Systems.html

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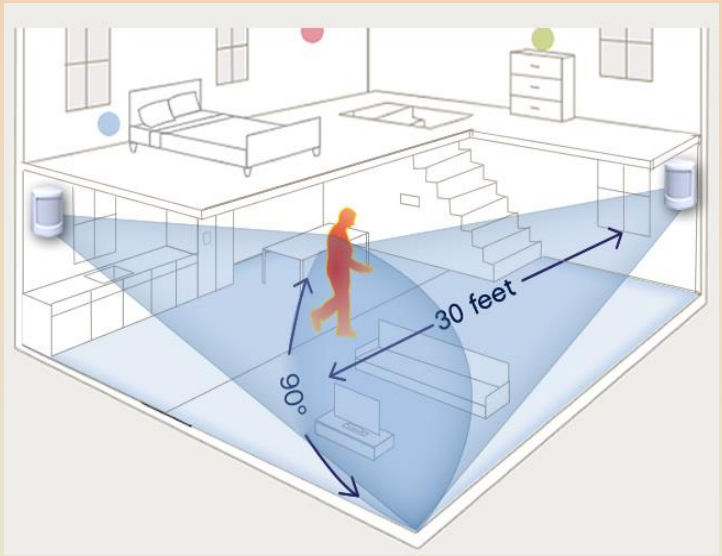
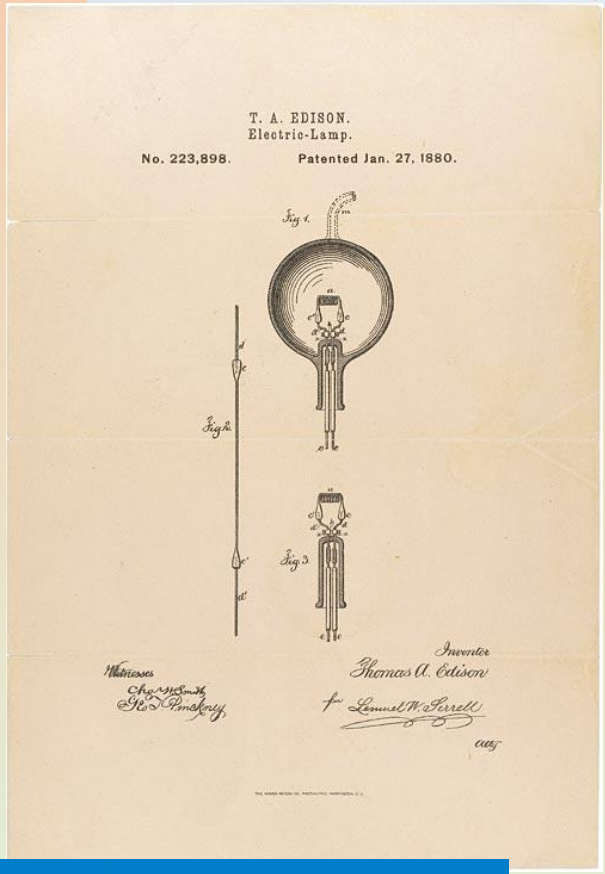
Electrical Power and Lighting

- Efficient fixtures & bulbs
  - Energy star fixtures
  - High efficacy bulbs
  - Motion sensors, daylight sensors, timers
- Operations guidelines
- Outdoor lighting efficiency
- Monitoring & Controls

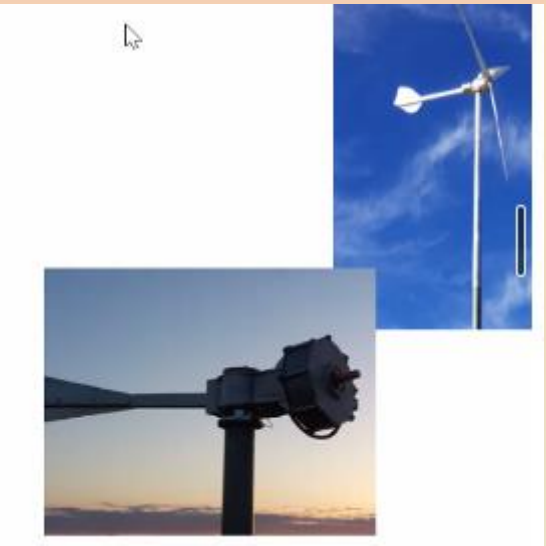


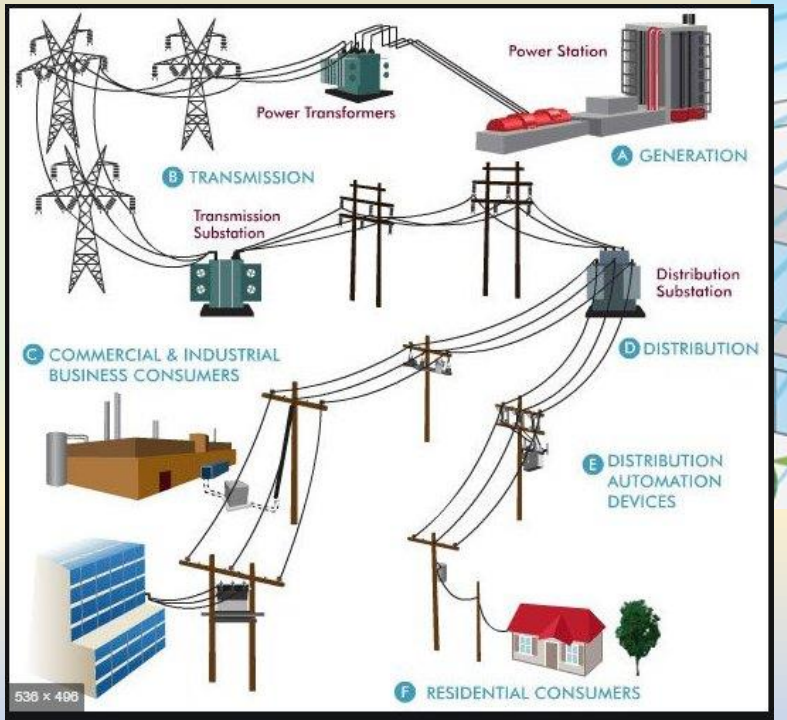

T. A. EDISON.
Electric-Lamp.
No. 223,898. Patented Jan. 27, 1880.

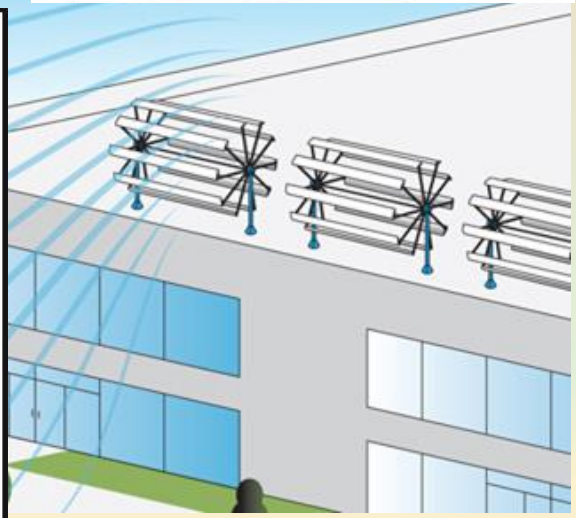
https://www.archives.gov/milestone-documents/thomas-edisons-patent-application-for-the-light-bulb

On-Site Power Generation

- Photovoltaic Systems
  - Distributed generation
  - Multiple installation methods
  - Reduces pollution from power plants
  - Reduces line losses







https://www.quora.com/What-is-transmission-and-distribution-T-D-loss

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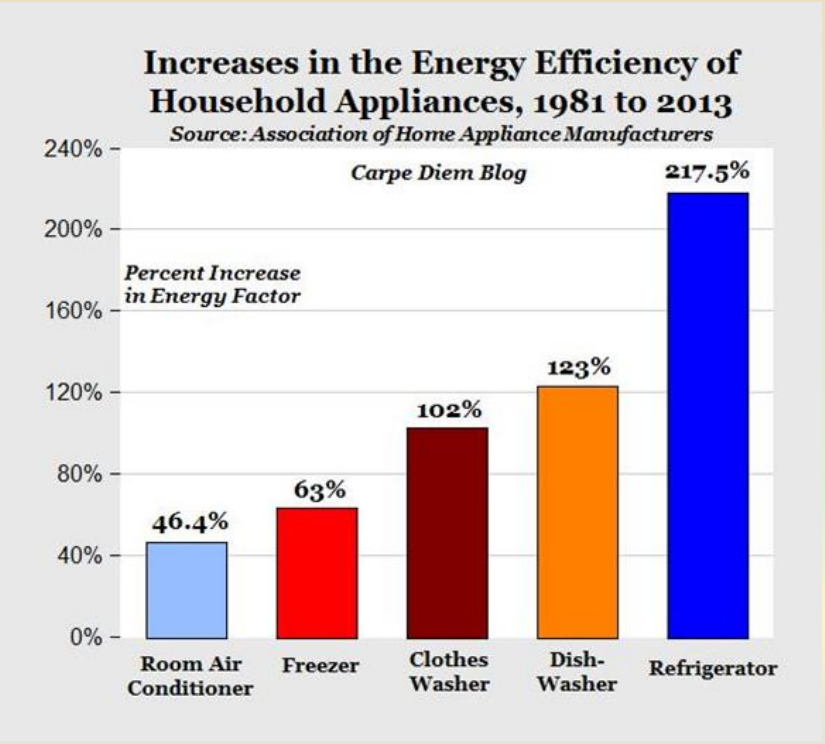
Appliances

- Energy Star
- Minimum efficiency levels
- Check out the tax breaks!



Operations / People

- Monitoring
- Commissioning
- Training
- Manuals
- Maintenance

- https://www.clipartmax.com/middle/m2H7i8N4b1m2H7m2_hb-building-commissioning-graphic-rev1-healthy-buildings-building-commissioning/

Albuquerque BRAIN

- Integrated real-time knowledge through monitoring brings a whole new field of utility understanding and control

- (Courtesy Saif Ismael, Energy & Sustainability Director, City of Albuquerque)

Section 2 – Code Structure & Applicability

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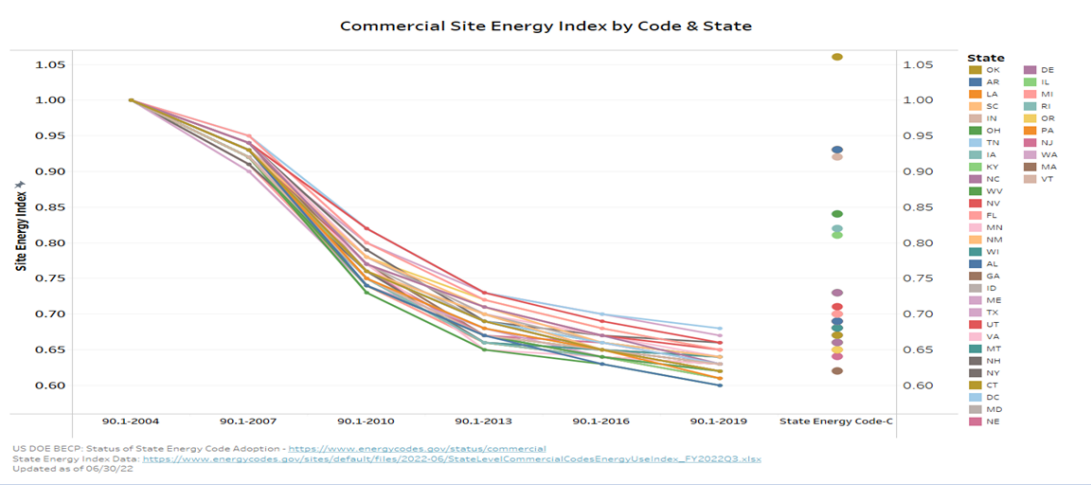
Code Overview: International Energy Conservation Code

- One of many codes developed by the ICC
- Model code template, tailored for local jurisdictions easily
- Widely adopted, 3 Year Cycle
- Energy Savings have been demonstrated for each additional code
- Key changes in the IECC 2021 code improve efficiency by 9.4 percent and reduce greenhouse gases by 8.7 percent over the 2018 IECC; these changes include new provisions that increase efficiency and encourage greater flexibility in design and construction as well as changes to existing requirements that provide clarification
- ASHRAE 90.1 2019 is another pathway for compliance



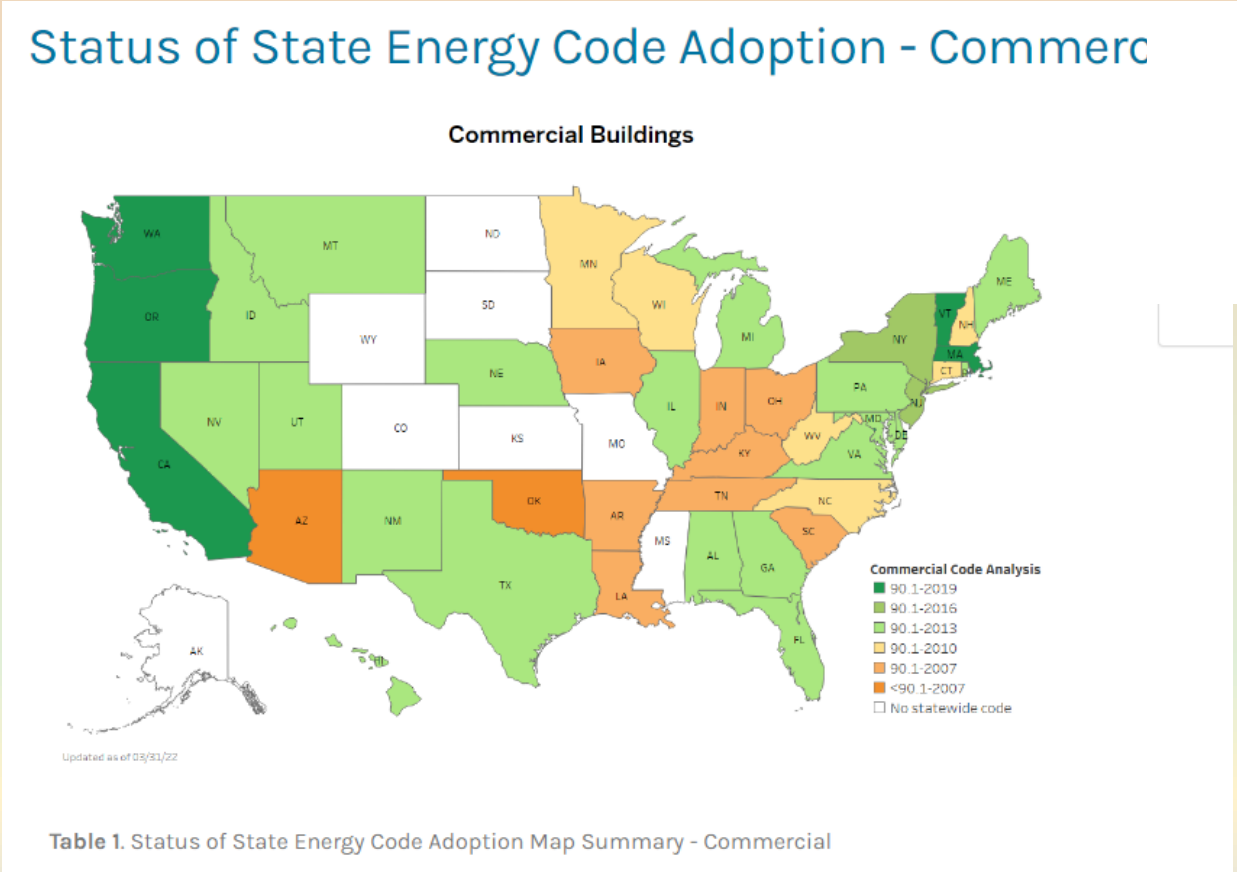


Table 1. Status of State Energy Code Adoption Map Summary - Commercial

https://www.energycodes.gov/status/commercial
https://www.energycodes.gov/infographics

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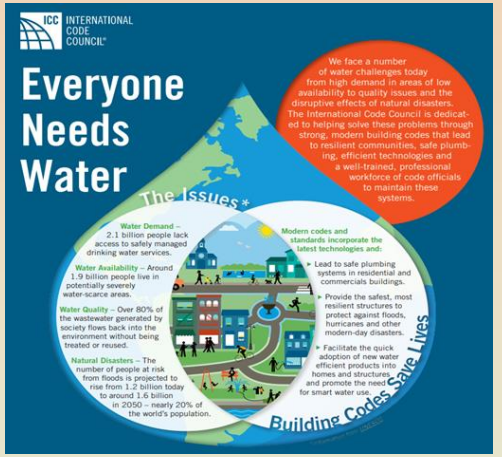
What are Energy Codes and what do they do?

- Enforceable law
- Move the bar forward
- Set of requirements for constructing a building legally
  - Minimum consistent levels
  - Holistic
  - Addresses all aspects:
    - Building Envelope
    - Mechanical
    - Service Water Heating
    - Lighting
    - Electric Power
- Improve resilience, improve ability to shelter in place
- Interpreted by code officials
- IECC 2021 applicable as of 7/30/2024
- ANSI/ASHRAE/IES Standard 90.1-2019

https://codes.iccsafe.org/

Code Overview:
Other codes (Not adopted as part of NM Energy efficiency code)

- International Green Construction Code, IGCC
  - Adopted by some cities
- Water Conservation Code
  - Used in many parts of the SW
- Green Plumbing & Mechanical Code
  - Models for adoption, though many lo jurisdictions create their own
- Air quality ordinances
- Ground water protection laws
- Zoning laws
- See UPCODES for other codes, https://up.codes/codes/general



Another Approach to Codes….

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Code of Hammurabi – 1754 BC

Almost 3800 years old!
(3775 to be exact)

Contained 282 Laws – contract, wages, inheritance, construction…

- Code #229. If a builder build a house for some one, and does not construct it properly, and the house which he built fall in and kill its owner, then that builder shall be put to death. #230. If it kill the son of the owner the son of that builder shall be put to death.

A side view of the stele "fingertip".

https://www.youtube.com/watch?v=rmxc8u4HHRI

NM Building Codes

- Statewide Code
  - Adopted by Construction Industries Commission
  - Enforced by Construction Industries Division or local authorities
  - Sets the minimum
  - Multiple Existing Building Codes
  - 2009 NM Earthen Building Materials Construction Code
  - 2009 NM Non-Load Bearing Baled Straw Construction Building Code
  - (and more)
  - 2009 NM Plumbing Code
  - 2009 NM Swimming Pool, Spa, & Hot Tub Code
  - 2009 NM Mechanical Code
  - 2009 NM Solar Energy Code
  - Local jurisdictions may adopt different codes if they have inspectors & they exceed state requirements
  - City of Albuquerque – Energy Conservation Code
  - City of Santa Fe – Green Code for residential building

NM Residential Code

TITLE 14 HOUSING AND CONSTRUCTION
CHAPTER 7 BUILDING CODES GENERAL
PART 6 2021 NEW MEXICO RESIDENTIAL ENERGY CONSERVATION CODE

14.7.6.1 ISSUING AGENCY: Construction Industries Division (CID) of the Regulation and Licensing Department.
[14.7.6.1 NMAC - Rp, 14.7.6.1 NMAC, 01/30/2024]

14.7.6.2 SCOPE: This rule applies to all residential contracting work performed in New Mexico on or after January 30, 2024, that is subject to the jurisdiction of CID, unless performed pursuant to a permit for which an application was received by CID before that date.
[14.7.6.2 NMAC - Rp, 14.7.6.2 NMAC, 01/30/2024]

14.7.6.3 STATUTORY AUTHORITY: Sections 60-13-9 and 60-13-44 NMSA 1978.
[14.7.6.3 NMAC - Rp, 14.7.6.3 NMAC, 01/30/2024]

14.7.6.4 DURATION: Permanent.
[14.7.6.4 NMAC - Rp, 14.7.6.4 NMAC, 01/30/2024]

14.7.6.5 EFFECTIVE DATE: January 30, 2024 unless a later date is cited at the end of a section. From the date of publication of this rule in the New Mexico register, until month July 30, 2024, permits may be issued under either the previously-adopted rule, or this rule. After month July 30, 2024, permits may be issued only under this rule.
[14.7.6.5 NMAC - Rp, 14.7.6.5 NMAC, 01/30/2024]

14.7.6.6 OBJECTIVE: The purpose of this rule is to establish minimum standards for energy conservation for residential construction in New Mexico.
[14.7.6.6 NMAC - Rp, 14.7.6.6 NMAC, 01/30/2024]

- https://www.rld.nm.gov/wp-content/uploads/2024/01/2021-New-Mexico-Residential-Energy-Conservation-Code-NMAC-14.7.6-effective-7.30.24.pdf

Additional SEAB Courses on Residential Codes through EMNRD

- 2021 NMRECC (IECC) Residential Prescriptive Compliance Path, SIPs, and Other Advanced Building Systems
- Date and Time: May 15, 1:00 p.m. – 5:00 p.m. (MST)
  - Registration Link: https://forms.office.com/r/58BB0AB8u0
  - Zoom Link: https://nmsu.zoom.us/j/87573141672
- Date and Time: May 16, 3:00 p.m. – 7:00 p.m. (MST)
  - Registration Link: https://forms.office.com/r/U5VpfbjRVe
  - Zoom Link: https://nmsu.zoom.us/j/83966194901
- 2021 NMRECC (IECC) Residential Total U-factor Table R402.1.2 option, Earthen Building Systems, and Passive Solar
- Date and Time: May 3, 8:00 a.m. – 12:00 p.m. (MST)
  - Registration Link: https://forms.office.com/r/rRahhXwkjC
  - Zoom Link: https://nmsu.zoom.us/j/81094935884
- Date and Time: May 15, 8:00 a.m. – 12:00 p.m. (MST)
  - Registration Link: https://forms.office.com/r/3ZztLP6zhM
  - Zoom Link: https://nmsu.zoom.us/j/87519167167
- https://www.emnrd.nm.gov/ecmd/seab/

New Mexico Commercial Energy Conservation Code

- Resource page: https://www.srca.nm.gov/parts/title14/14.007.0009.html

- Applies to all commercial contracting on or after January 30, 2024; through July 30, 2024 the previous code may also be used
- Adjusts several provisions of the IECC 2021 Code
- New version adopted this year

Approved NM Version of IECC 2021 Code

Key points:

- Following IECC 2021, structure is easier to follow
- Code official can approve worksheets, computer programs, etc.
- Referenced standards
- Climate Zone Table
- Some electrical requirements loosened
- Focus on E/V charging spaces

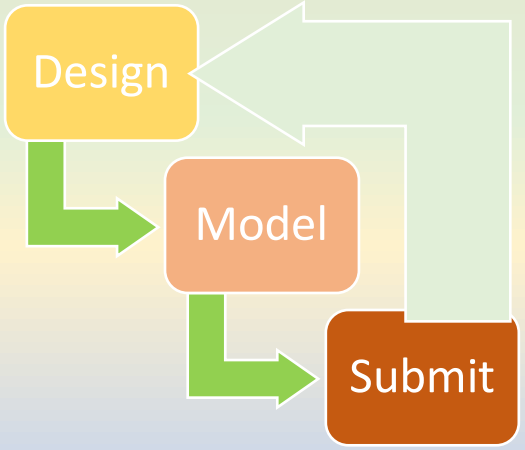
NM Energy Conservation Code Applicability / requirements

- **https://www.srca.nm.gov/parts/title14/14.007.0009.html**
- **SCOPE:** This rule applies to all commercial contracting work performed in New Mexico on or after January 30, 2024, that is subject to the jurisdiction of CID, unless performed pursuant to a permit for which an application was received by CID before that date.
- All buildings in NM
  - Residential =detached 1&2 BR & townhouses, R-2, R-3, r-4 buildings < 3 stories
  - Commercial = all others

- Energy codes are instituted to achieve policy and resilience goals
- Rebates and federal funds are intended to move the market
  - Install more energy efficient products
  - Build more energy efficient buildings
  - Develop new products
- 3-year cycle for adoption short-circuited due to requirements for federal funds and state policy interest, etc.
- (Means more work!)

The Energy Code "Ecosystem" - Key Players & General Responsibilities:

- Design Team / Project Team (Applicant):
  - Owner
  - Architectural team
  - Engineering team
  - Modeler
  - Commissioning Agent



- Program Administrator / Regulatory Authority (CID)
- Code Official (CID or local jurisdiction)
  - Plan Checkers
  - Building Officials
- Building Inspector

Code Overview: Roles of Stakeholders

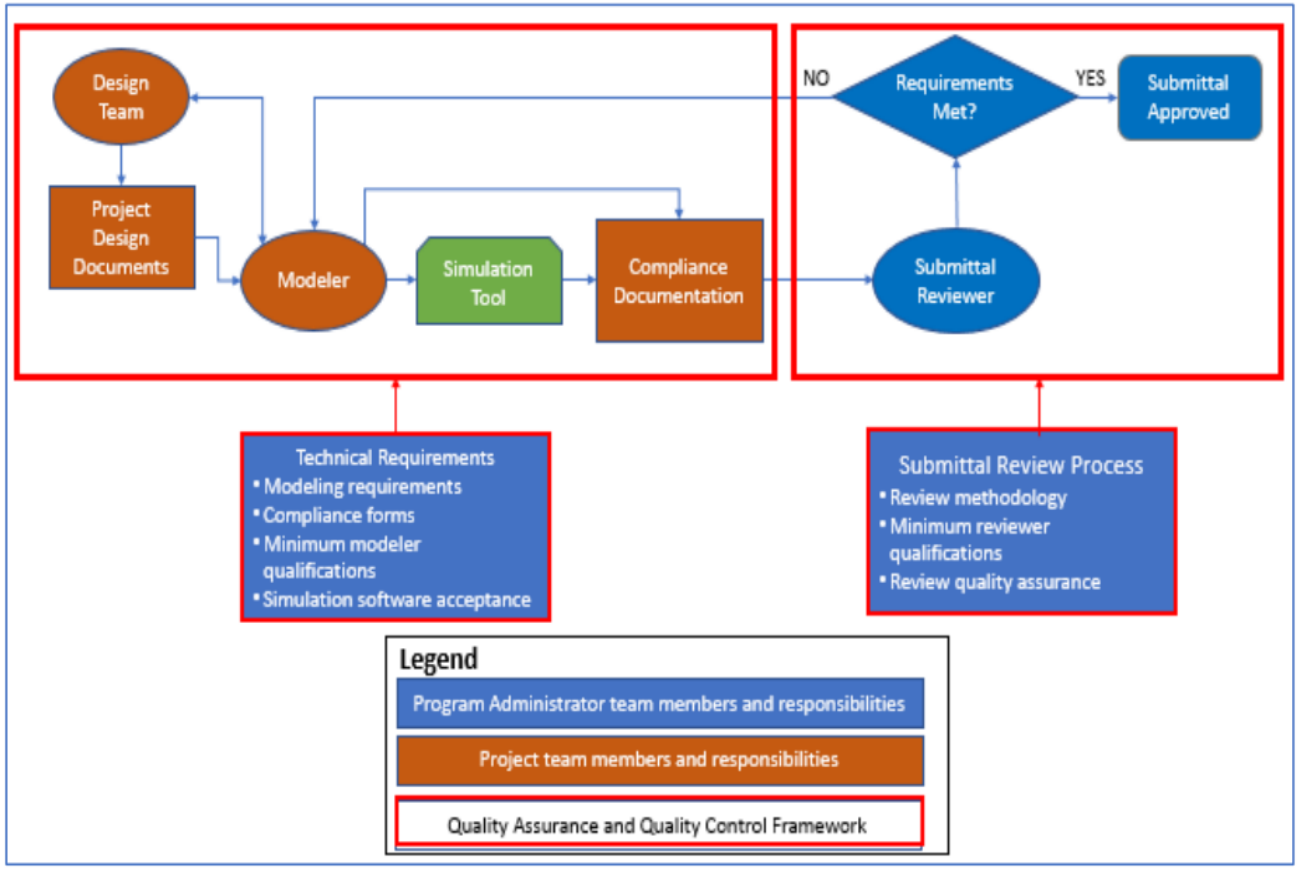


Figure 5. Compliance Documentation Process

Performance-Based_Code_Compliance_Roadmap_Final.pdf

- SHARED GOALS:
  - Complete and accurate submissions with a minimum of work on either side
  - Buildings that meet code or better

Program Administrator & Team:

- Define Technical Requirements
- Develop Submittal Review Process incl. qualifications
- Administer Protocols

Building Officials:

- Review & Approve Submittals

- Applicant
  - Team consists of owner, architect/engineers, energy modeler, contractors, & others
  - Design team completes design & compliance documents
  - Energy modeler (in performance path) models performance with simulation tool
  - Compliance documents & simulation verified for compliance & adjusted if needed
  - Compliance documents submitted to Program Administrator for approval

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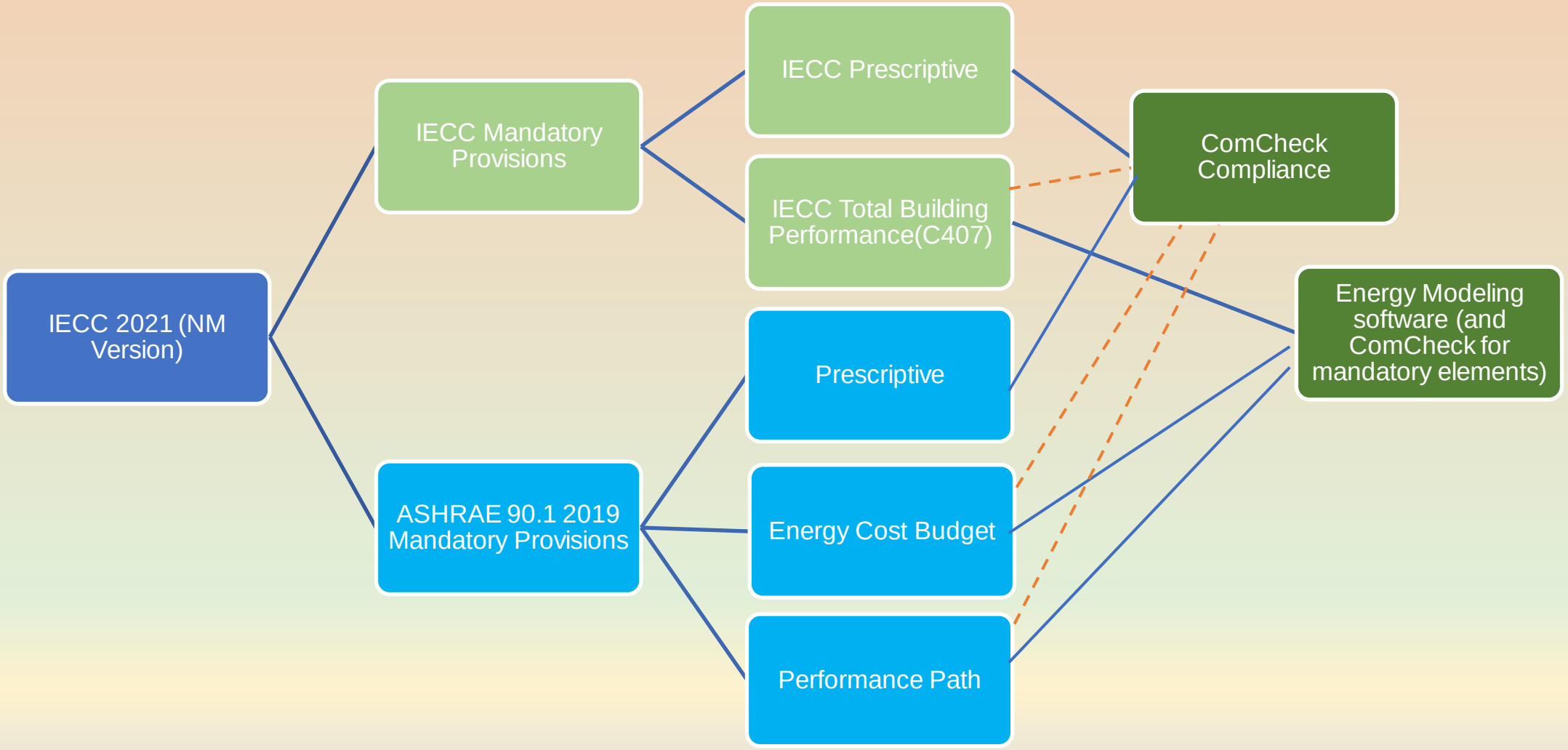
Commercial Code Structure



Pathways for Code Compliance

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ASHRAE 90.1 2019

IECC 2021

IECC 2021

- Follow Tables in the Code for Prescriptive Requirements and Reference Standards
- Follow Energy Modeling Process

C103.6.2 Compliance documentation.

Energy code compliance documentation and supporting calculations shall be delivered in one document to the building owner as part of the project record documents or manuals, or as a standalone document. This document shall include the specific energy code edition utilized for compliance determination for each system, documentation demonstrating compliance with Section C303.1.3 for each fenestration product installed, and the interior lighting power compliance path, building area or space-by-space, used to calculate the lighting power allowance.

For projects complying with Item 2 of Section C401.2, the documentation shall include:

1. The envelope insulation compliance path.
2. All compliance calculations including those required by Sections C402.1.5, C403.8.1, C405.3 and C405.5.

For projects complying with Section C407, the documentation shall include that required by Sections C407.3.1 and C407.3.2.

ASHRAE 90.1 2019

- Prescriptive
- Energy Cost Budget
- Performance Path

"The goal of the 2019 version of 90.1 was to provide clearer guidance for exceeding efficiency goals," said Drake Erbe, Member ASHRAE, chair of the Standard 90.1 committee

IECC 2021

Structure Diagram

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C1-C2 Scope, definitions, administration & enforcement

C3 Climate zones, design conditions & general materials requirements

C4 Energy Efficiency Requirements

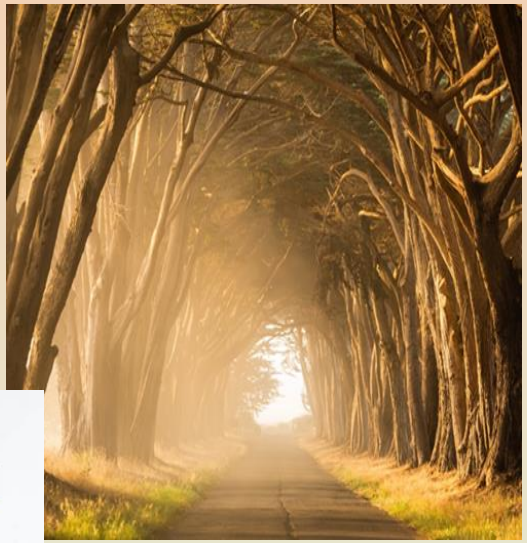
- C401 General
- C402 Building Envelope
- C403 Mechanical Systems
- C404 Service Water Heating
- C405 Electrical Power & Lighting Systems
- C406 Additional Efficiency Requirements
- C407 Total Building Performance
- C408 Maintenance Info & System Commissioning

- C5 Existing Buildings
- C6 Referenced Standards
- CA Board of Appeals
- CB Solar Ready Zones
- CC Net Zero Energy
- Index

New Structure - Section by Section Review

NORTHERN New Mexico College

IECC 2021



Scope / General:

- C101 Scope / Requirements
- C102 Alternative Materials, Design, Construction, Equipment

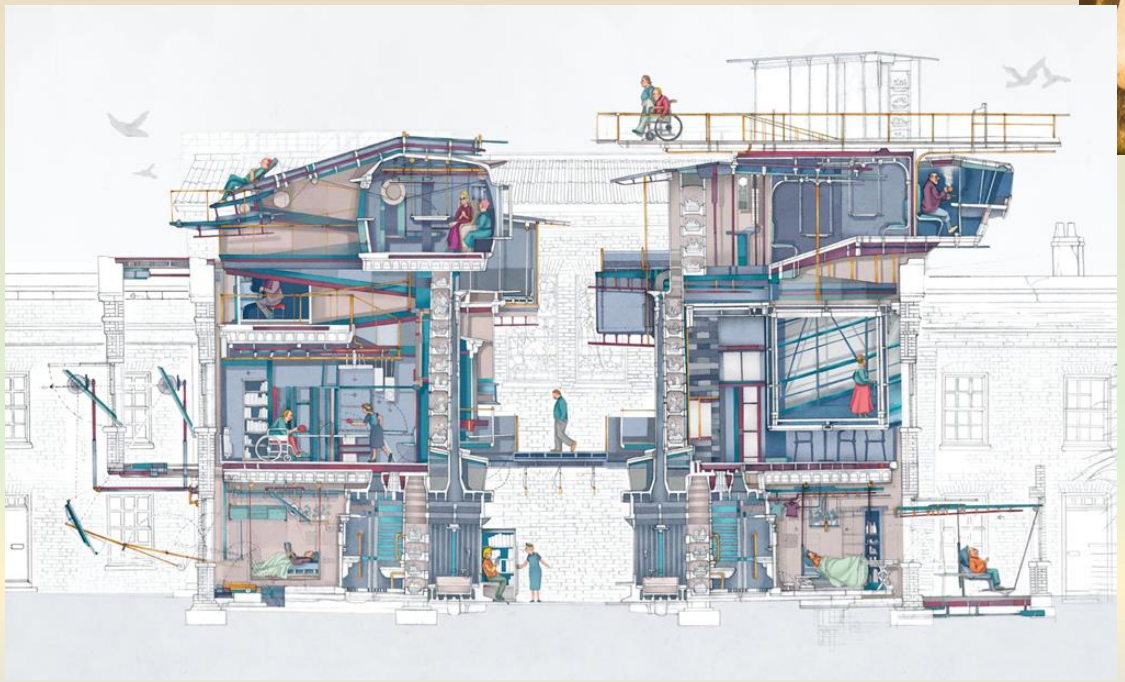
Admin & Enforcement

- C103 Construction Documents
- C104 Fees
- C105 Inspections
- C106 Notice of Approval
- C107 Validity
- C108 Referenced Standards
- C109 Stop Work Order
- C110 Board of Appeals

Chapter 2 – Definitions

Chapter 3 – General Requirements

- C301 Climate Zones
- C302 Design Conditions
- C303 Materials, Systems & Equipment



https://docs.google.com/spreadsheets/d/1AEPSxrT5cDfrtXZ3iWwRKyb23HXSAbao/edit?usp=sharing&ouid=108211945263546518369&rtpof=true&sd=true

https://architizer.com/blog/inspiration/industry/young-architect-guide-drawings-alone/#media-1

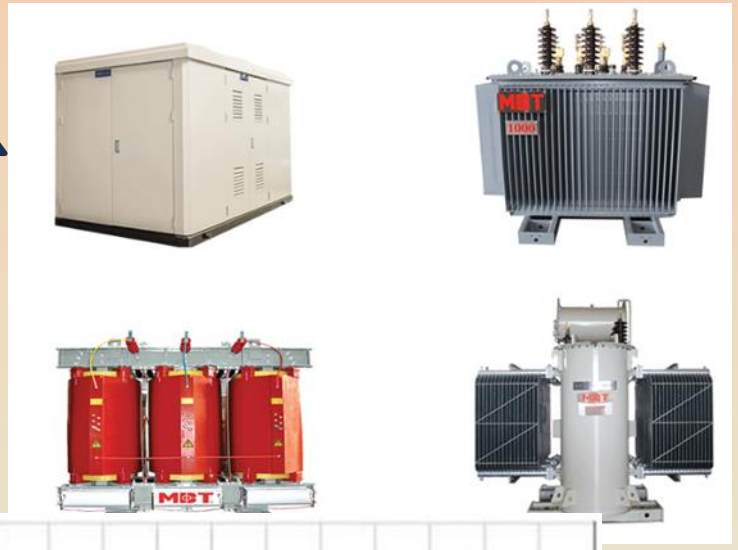
New Structure - Section by Section Review 2

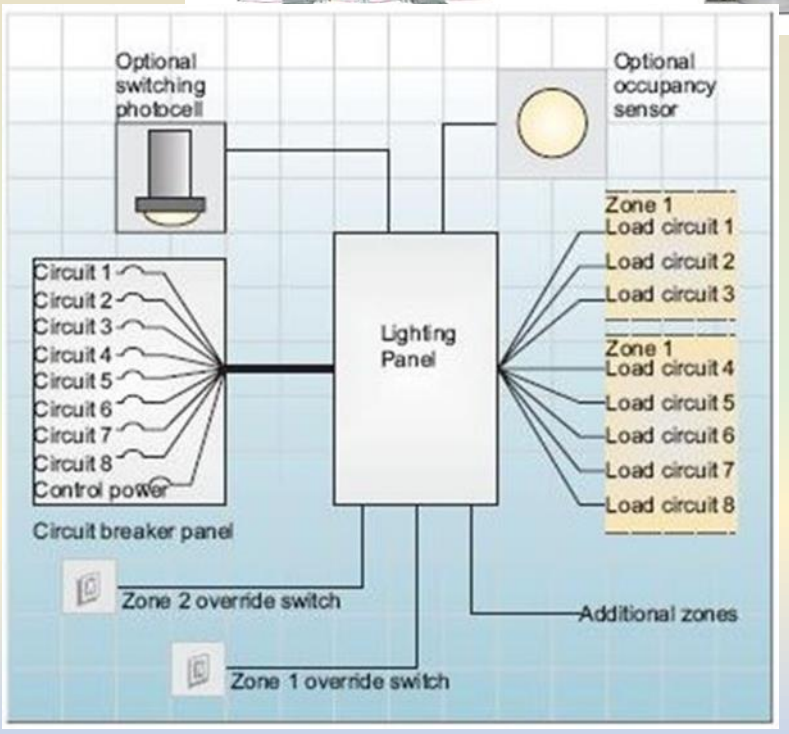
NORTHERN New Mexico College

IECC 2021

Chapter 4:

- C401 General
- C402 Building Envelope Requirements (Incl. Tables)
- C403 Building Mechanical Systems (Incl. Tables)
- C404 Service Water Heating (Incl. Tables)
- C405 Electrical Power and Lighting Systems





New Structure - Section by Section Review 3

NORTHERN New Mexico College

IECC 2021

Chapter 4 continued:

- C406 Additional Efficiency Requirements
- C407 Total Building Performance
- C408 Maintenance Information & System Commissioning

Chapter 5 – Existing Buildings

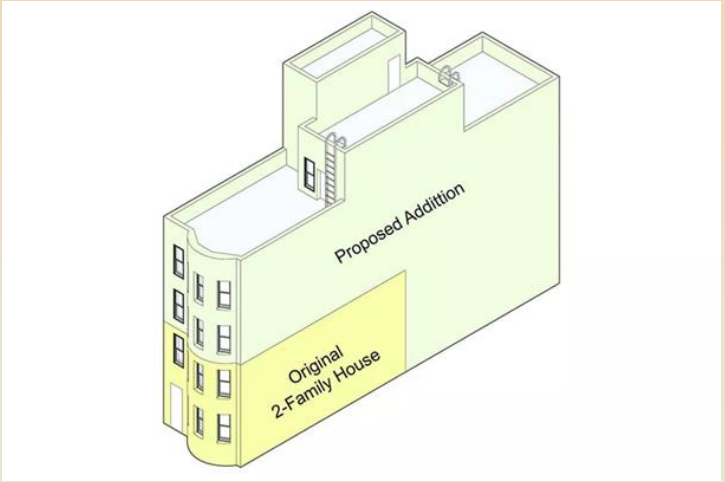
Chapter 6 – Referenced Standards

Appendix CA - Board of Appeals – Commercial

Appendix CB – Solar-Ready Zone – Commercial

Appendix CC – Zero Energy Commercial Building Provisions

Index



Important to Note

IECC 2021

- C101.5 Code Official may approve computer software, worksheets, compliance manuals, other materials that fit intent
- C102.1 Code official may approve alternative material, design, method of construction
- C105.1 Subject to inspection, must remain visible & accessible
- NM table of Climate Zones is to be used, not IECC
- C401.1 Scope – apply to buildings and building sites
- C408.2 NM adjusted Commissioning process & regulations, plus checklist
- Appendix CB Solar ready zone, not less than 40% of roof area, to include electrical energy storage system ready area
- Appendx CC Zero Energy, model for applying new RE generation and adding electric power to the grid

IECC 2021 C103.2 Information on Construction Documents

- 1.Energy compliance path.
- 2.Insulation materials and their *R*-values.
- 3.Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
- 4.Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
- 5.Mechanical system design criteria.
- 6.Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
- 7.Economizer description.
- 8.Equipment and system controls.
- 9.Fan motor horsepower (hp) and controls.
- 10.Duct sealing, duct and pipe insulation and location.
- 11.Lighting fixture schedule with wattage and control narrative.
- 12.Location of *daylight* zones on floor plans.
- 13.Air barrier and air sealing details, including the location of the air barrier.

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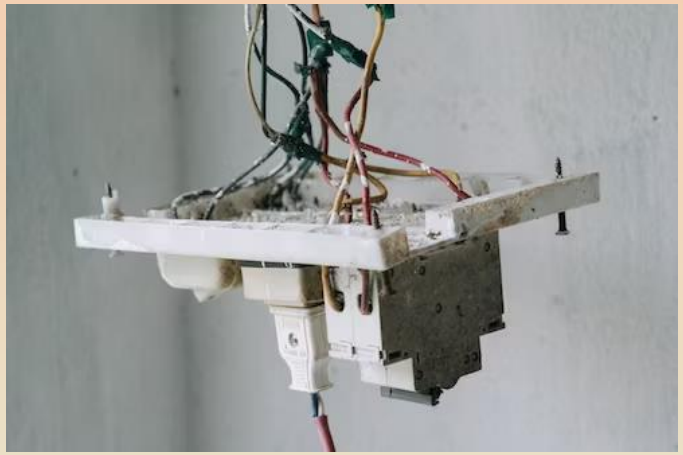
Selected Key Elements – C402 Building Envelope

- Continuous air barrier throughout thermal envelope, inside or outside
- Penetrations of air barrier to be caulked, gasketed, otherwise sealed
- R value ID mark to be on each piece of insulation (must be visible), or installer to provide certification including R value.
- Roof solar reflectance & thermal emittance also specified
- Vestibules required
- Fenestration building assembly requirements ; alternative is Total Building Performance option
- Fenestration products to have U-factor marked or determined by NFRC 100
- Building envelope performance verification by review of construction documents, inspection of air barrier components, final commissioning report
- Thermal envelope to be tested by specified methods, whole or partial building

Selected Key Elements - Electricity is a KEY focus going forward for all codes



- C103.1 Renewable Energy
- C402.4 Controls systems required for most lighting, operable windows, daylighting
- C403 Data center energy usage more tightly controlled
- HVAC fault collection performance and controls required, efficiency improved
- Heat pumps and water-chilling packages as well as other heating / cooling systems added with specifications, required controls
- C405 Specified lighting efficiency &occupancy / daylight / time / light reduction controls characteristics – indoor / outdoor
- Lighting capacity and power max specified
- Escalators have automatic controls & energy recovery systems
- Automatic receptacle controls required
- Measurement required for each end-use category in C405.12.2
- C406.5 On-site renewable energy
- C408 Commissioning, includes functional lighting test, equipment, controls, performance, manuals
- ASHRAE – Ligthing changes, Data center changes, modeling updates, clearer renewables specs, controls detail

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Selected Key Elements – E/V Charging (NM only)

IECC 2021

- C405.13.1 EV spaces and EV Capable spaces
  - Connections specified
  - Spacing specified
  - Location specified
  - System capacity specified
  - Energy management system required

TABLE C405.13.1 REQUIRED EV POWER TRANSFER INFRASTRUCTURE

Occupancy	EVSE Spaces	*EV Capable Spaces
Group A	5%	10%
Group B	5%	5%
Group E	5%	5%
Group F	2%	5%
Group H	1%	0%
Group I	5%	10%
Group M	5%	10%
Group R-1	5%	15%
Group R-2	5%	15%
Group R-3 and R-4	2%	5%
Group S exclusive of Parking Garages	1%	0%
Group S-2 Parking Garages	5%	10%

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Selected Key Elements – Energy Monitoring

- New buildings over 25K sq.ft "shall be equipped to measure, monitor, record and report energy consumption data…"
- The table shows energy use categories to be monitored
- Data should be stored for 36 months, accessible to building operation & maintenance personnel, graphic interface

TABLE C405.12.2 ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	Any single load that is not included in an HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

Selected Key Elements - HVAC

- C403.2.1 Zone isolation required if building over 25K sq.ft
- C403.2.3 Fault detection & diagnostics required if over 100K sq.ft
- C403.3.2 Efficiency requirements stated for most equipment
- C403.4 Heating / Cooling controls required, with individual thermostats in zones, or timeclocks
- C403.7.6.1 temperature setpoint controls
- C403.7.6.2 Ventilation controls
- C404.6.1 Circulation systems

- C403.12.1 Requirements for duct and plenum insulation & sealing for conditioned / unconditioned spaces
- C405.2.1 Occupancy sensors in specified space types. Or time switch controls

Selected Key Elements – C406 Other Energy Efficiency Options

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10 credits from the following based on use group of the building

1.More efficient HVAC performance in accordance with Section C406.2.
2.Reduced lighting power in accordance with Section C406.3.
3.Enhanced lighting controls in accordance with Section C406.4.
4.On-site supply of renewable energy in accordance with Section C406.5.
5.Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6.High-efficiency service water heating in accordance with Section C406.7.
7.Enhanced envelope performance in accordance with Section C406.8.
8.Reduced air infiltration in accordance with Section C406.9
9.Where not required by Section C405.12, include an energy monitoring system in accordance with Section C406.10.
10.Where not required by Section C403.2.3, include a fault detection and diagnostics (FDD) system in accordance with Section C406.11.
11.Efficient kitchen equipment in accordance with Section C406.12.

C407 – Total Building Performance

- Criteria for compliance
- Systems & loads:
  - Heating systems
  - Cooling Systems
  - Service water heating
  - Fan systems
  - Lighting power
  - Receptacle loads
  - Process loads
- Annual energy cost <= 85% of annual cost of standard reference design
  - Identical thermal blocks
  - C407.5 Specifications for calculation software

IECC 2021

TABLE C407.2
REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
Envelope	
C402.5	Air leakage—thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commisioning

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ASHRAE 90.1-2019

ASHRAE 90.1 2019

- Purpose:

  "This new version focuses on energy-saving measures which we hope will reward designs for achieving energy cost levels above the standard minimum and result in more efficient buildings and more innovative solutions."

  - Utilization of on-site, renewable energy resources

- Scope
  - This standard provides
    - Minimum energy-efficient requirements for the design and construction , and a plan for operation and maintenance of
      - New buildings and their systems
      - New portions of buildings and their systems
      - New systems and equipment in existing buildings
      - New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes and
    - Criteria for determining compliance with these requirements .

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ASHRAE 90.1 2019 Changes / Additions - 1

ASHRAE 90.1 2019

- Commissioning requirements added
- Verification, testing, commissioning expanded
- Building envelope
  - Fenestration product categories added
  - Min criteria for SHGC and U-factor upgraded
  - Air leakage section revised
  - Vestibule section updated
- Lighting
  - Lighting power allowance for space-by-space & building area modified and updated
  - New & simplified lighting method
  - Lighting controls in garages updated
  - Daylight responsive requirements updated
  - Side lighting requirements updated

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ASHRAE 90.1 2019 Changes / Additions - 2

ASHRAE 90.1 2019

- Mechanical
  - New standards for computer rooms
  - Pump definitions, requirements, efficiency tables added
  - Equipment efficiency tables added & updated
  - New furnace tables
  - All tables updated to DOE requirements
- Fans & Fan systems
  - Fan efficiency grade replaced by fan energy index (FEI)
  - New requirements for ceiling fans
  - Fan motor requirements updated to increase design options
  - Energy recovery requirements included
- Energy Cost Budget
  - Numerous changes for continuity
- Performance Rating Method
  - Rules & baseline efficiency requirements clarified re: thermal blocks
  - Heating & cooling specs without fan for baseline packaged equipment
  - Rules for modeling impact of automatic receptacle controls added
  - More specific infiltration modeling baseline rules
  - Plant & coil sizing rules updated
  - Building performance factors updated

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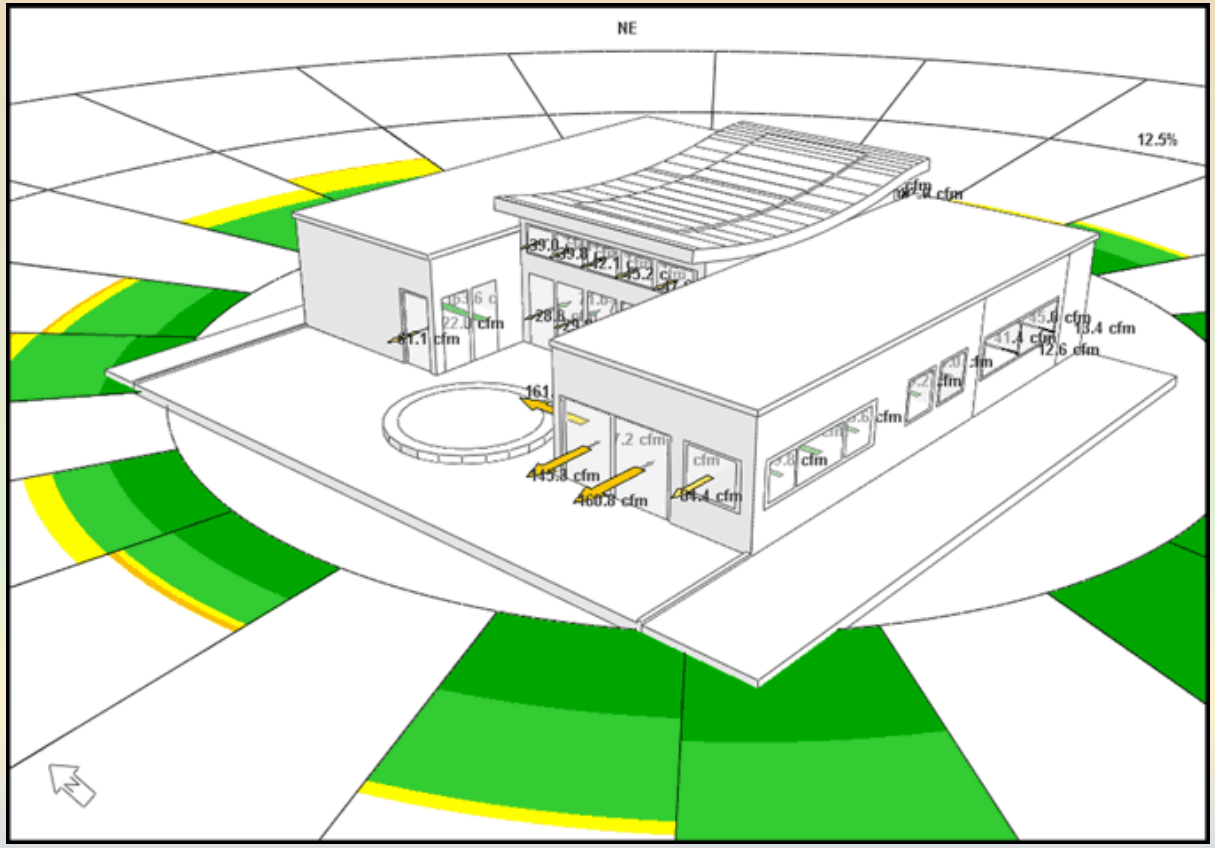
ASHRAE 90.1 2019 Changes / Additions - 3

ASHRAE 90.1 2019

- Changes to both compliance paths:
  - Clearer and more specific rules regarding how to treat renewables
  - Extensive updates to rules for lighting modeling
  - Changes & clarifications to improve internal consistency & standardize structure & language in submittal documentation, compliance paths, terminology



Structure - ASHRAE 90.1 2019

ASHRAE 90.1 2019

4.2.1.1 New Buildings

New *buildings* shall comply with Sections 4.2.2 through 4.2.5 and either the provisions of

1. a.Section 5, *"Building Envelope";* Section 6, "Heating, Ventilating, and Air Conditioning"; Section 7, *"Service Water Heating";* Section 8, "Power"; Section 9, "Lighting"; and Section 10, "Other *Equipment*," or
2. b.Section 11, *"Energy Cost Budget* Method," or
3. c.Normative Appendix G, *"Performance Rating Method."*

When using Normative Appendix G, the Performance Cost Index (PCI) of new *buildings, additions* to *existing buildings*, and/or *alterations* to *existing buildings* shall be less than or equal to the Performance Cost Index Target (PCI_t) when calculated in accordance with the following:

PCIt=[BBUEC+(BPF×BBREC)]/BBP

$$PCI_t = [BBUEC + (BPF \times BBREC)] / BBP$$

where

PCI = Performance Cost Index calculated in accordance with Section G1.2.

BBUEC = baseline *building* unregulated *energy* cost, the portion of the annual *energy* cost of a *baseline building design* that is due to *unregulated energy use.*

BBREC = baseline *building* regulated *energy* cost, the portion of the annual *energy* cost of a *baseline building design* that is due to *regulated energy use.*

BPF =*building* performance factor from Table 4.2.1.1. For *building* area types not listed in Table 4.2.1.1 use "All others." Where a *building* has multiple *building* area types, the required BPF shall be equal to the area-weighted average *of the building* area types.

BBP =*baseline building performance.*

PNA = proposed renewable energy contribution not allowed for compliance.

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ASHRAE 90.1 is Well Organized & Supported (But Complicated)

ASHRAE 90.1 2019

Performance Based Energy Codes

- Two types of approaches for demonstrating compliance; prescriptive and performance paths.
- The two performance-based approaches:
  - Energy Cost Budget (ECB) method, Section 11
  - Performance Rating Method (PRM), commonly known as Appendix G.
  - Provide more flexibility by allowing a designer to "trade off" compliance if the impact can be offset by exceeding other prescriptive requirements.
  - Demonstrated using computer simulation to compare a proposed building design to a reference building design commonly referred to as a baseline.
- The main differences between the ECB and PRM approaches in Standard 90.1 are the characteristics of the baseline building design.

ECB

- Baseline a clone of the proposed design with components adjusted to "just meet" current prescriptive requirements.
- In compliance when the annual energy cost of the proposed design is no greater than the annual energy cost of the baseline ("Dependent" baseline.)

APPENDIX G

- I**ndependent** baseline, characteristics of baseline standard practice
  - Credit is available for exceeding prescriptive requirements
  - Also for exceeding standard practice that is not regulated by the code.
  - Examples: optimized window area and orientation, selection of more efficient HVAC and service water heating equipment type, right sizing HVAC equipment, efficient use of thermal mass, etc.
- Stable baseline with efficiency levels set at values not intended to be updated with new codes
  - Performance must exceed baseline by amount related to code year

https://www.energycodes.gov/performance_based_compliance

ASHRAE 90.1 2019 – 4.2.2 Compliance Documentation

ASHRAE 90.1 2019

- Construction details
- Supplemental information (calculations, product info, etc.)
- Manuals – operations & maintenance
- Labeling of material & equipment
- Inspections
- Verification, testing, commissioning reports

ASHRAE 90.1 2019 Performance Rating Method

ASHRAE 90.1 2019

- Quantifies energy efficiency & performance of building designs that exceed minimum
- Written originally for LEED, EPA, utility programs, International Green Construction Code, etc.
- Does NOT offer alternative compliance path for min standard compliance; that is Section 11.

ASHRAE Navigation

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ASHRAE 90.1 2019

- ASHRAE 90.1 – all versions –
  - Not a Code but a Standard, a way to show compliance
  - Were developed by an engineering organization – it is very detailed
  - Used by above-code programs such as LEED etc.
  - Tend to give higher performance than IECC 2018
  - Provide alternative pathways
    - Prescriptive
    - Energy Cost budget
    - Performance
  - DOE and other providers provide numerous resources for these approaches

- Organization:
  - Introduction to the Standard
    - Descriptions & Pathways
  - Appendix G (for Performance)
    - General Features & Layout
      - Rules & definitions
    - Areas of Focus
    - Calculations
    - Documentation
    - Modeling Requirements / Appendix G
      - BEM Tools
    - Compliance Forms
    - Reference Manual
    - Submittal Review Manual
      - Structure, process, strategy, checks
    - Quick start and process

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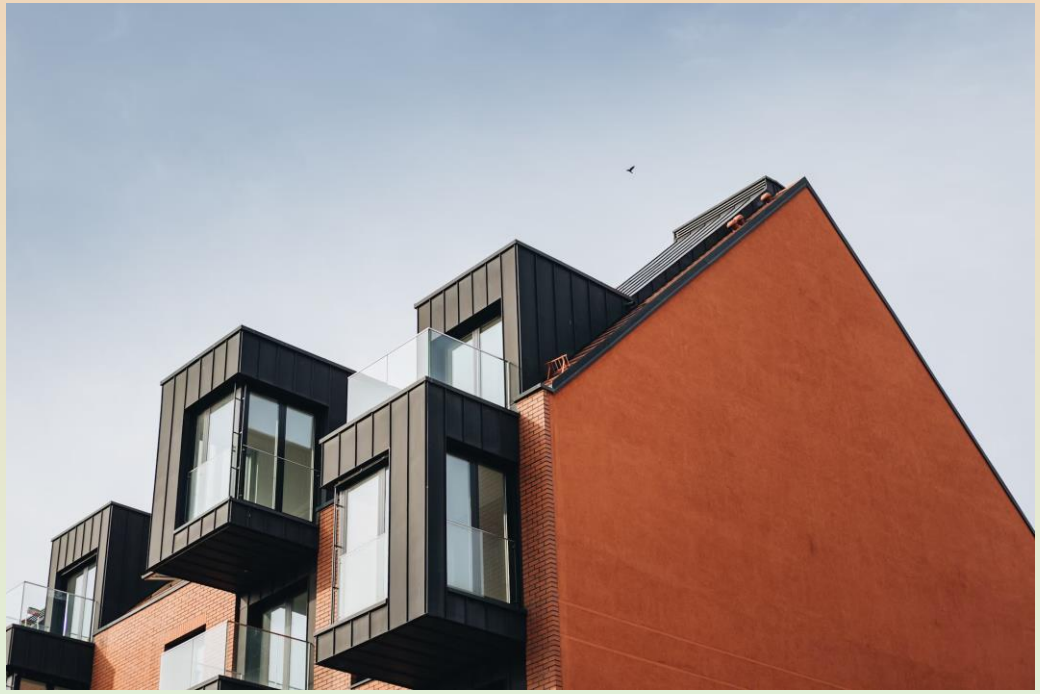
ASHRAE 90.1 2018 Sections

ASHRAE 90.1 2019

- Section 5 – Building Envelope

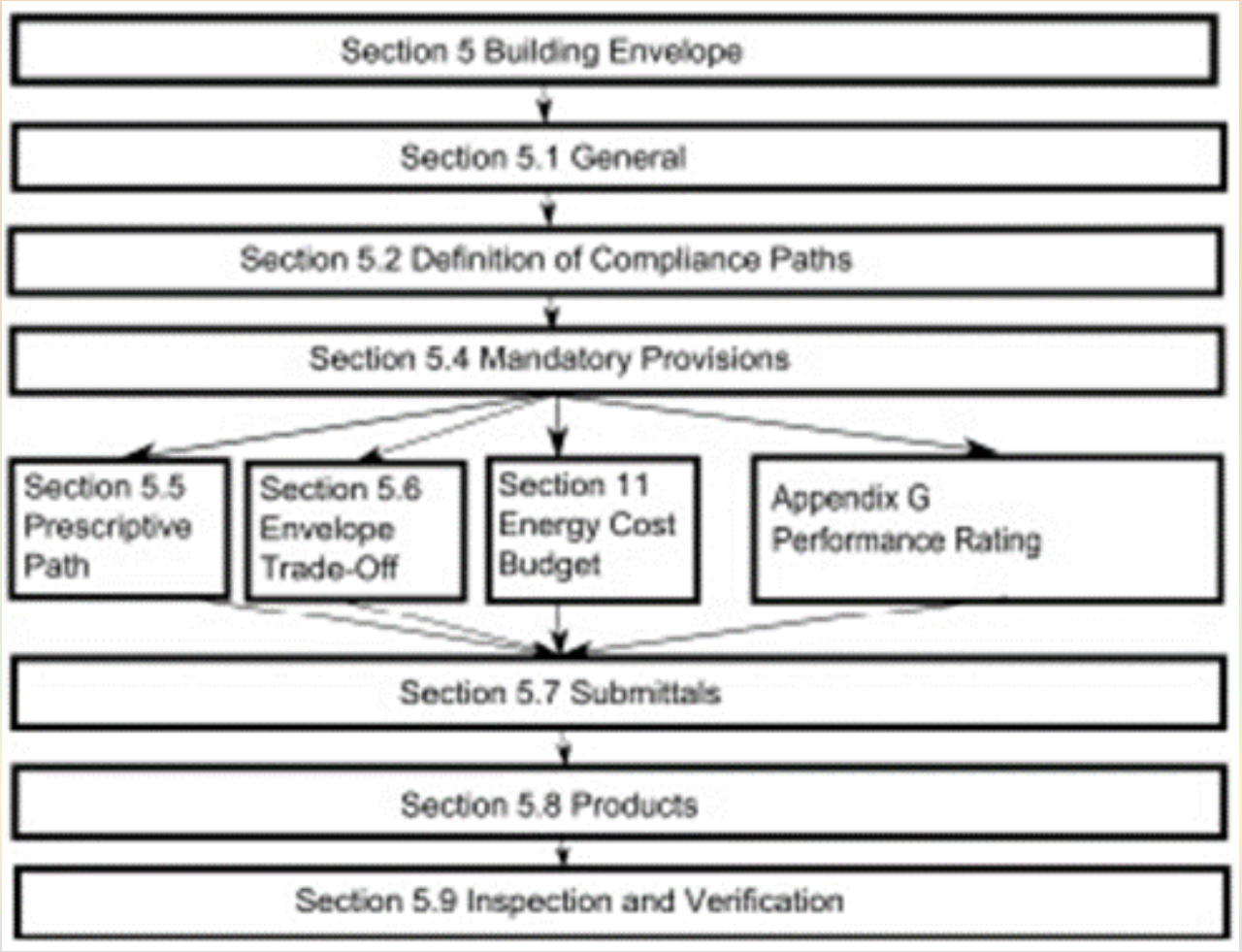


5.6.1

The *building envelope* complies with the standard if

a.the *proposed design* satisfies the provisions of Sections 5.1, 5.4, 5.7, 5.8, and 5.9 and

b.the *proposed envelope performance factor* of the *proposed design* is less than or equal to the *proposed envelope performance factor* of the *base design*.



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ASHRAE 90.1 2018 Sections

ASHRAE 90.1 2019

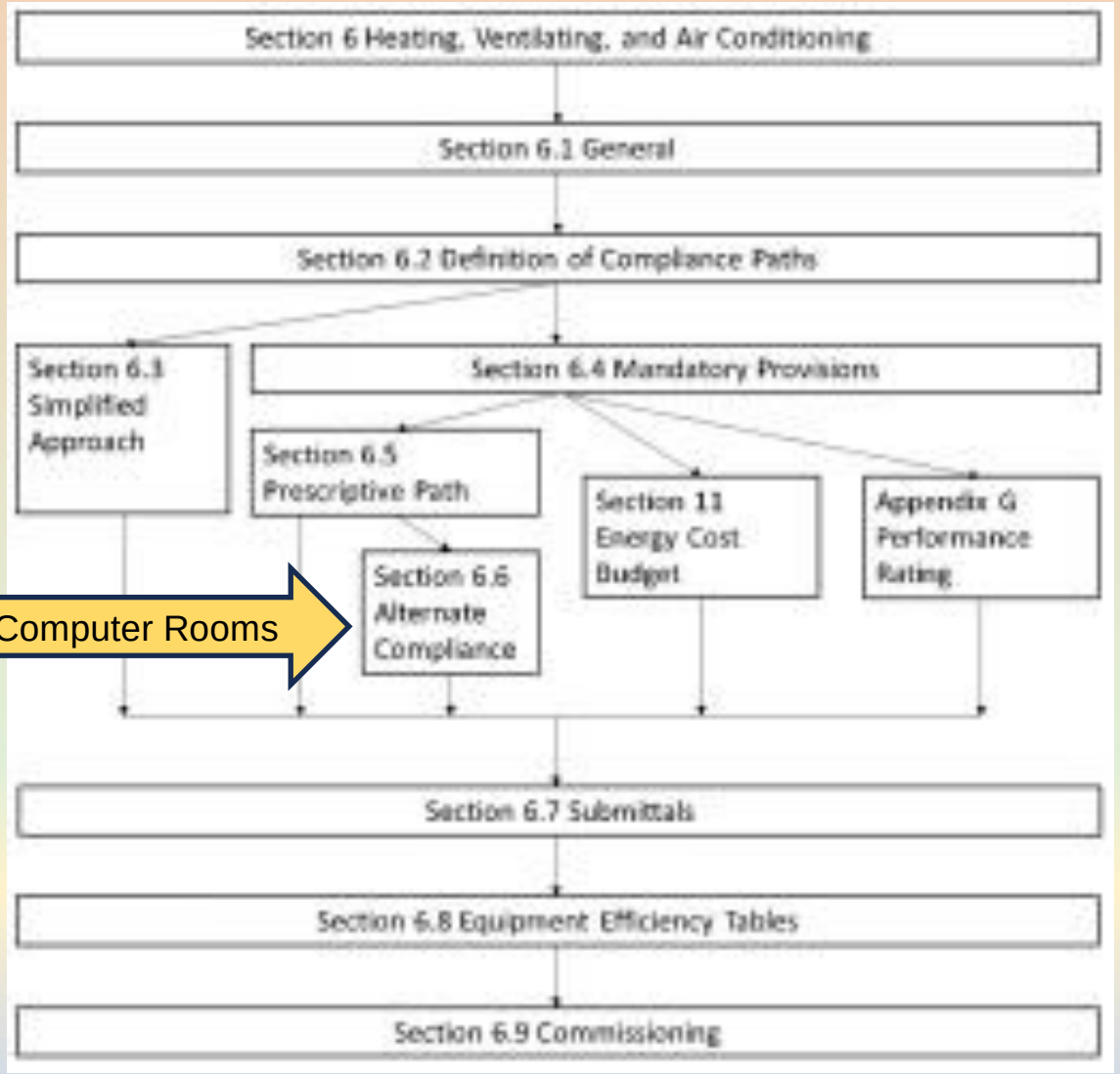
- Section 6 – Heating, Ventilating, and Air Conditioning

6.3 The simplified approach is an optional path for compliance when the following conditions are met:

a.The *building* is two stories or fewer in height.

b.*Gross floor area* is less than 25,000 ft^2.

c.Each *HVAC system* in the *building* complies with the requirements listed in Section 6.3.2.



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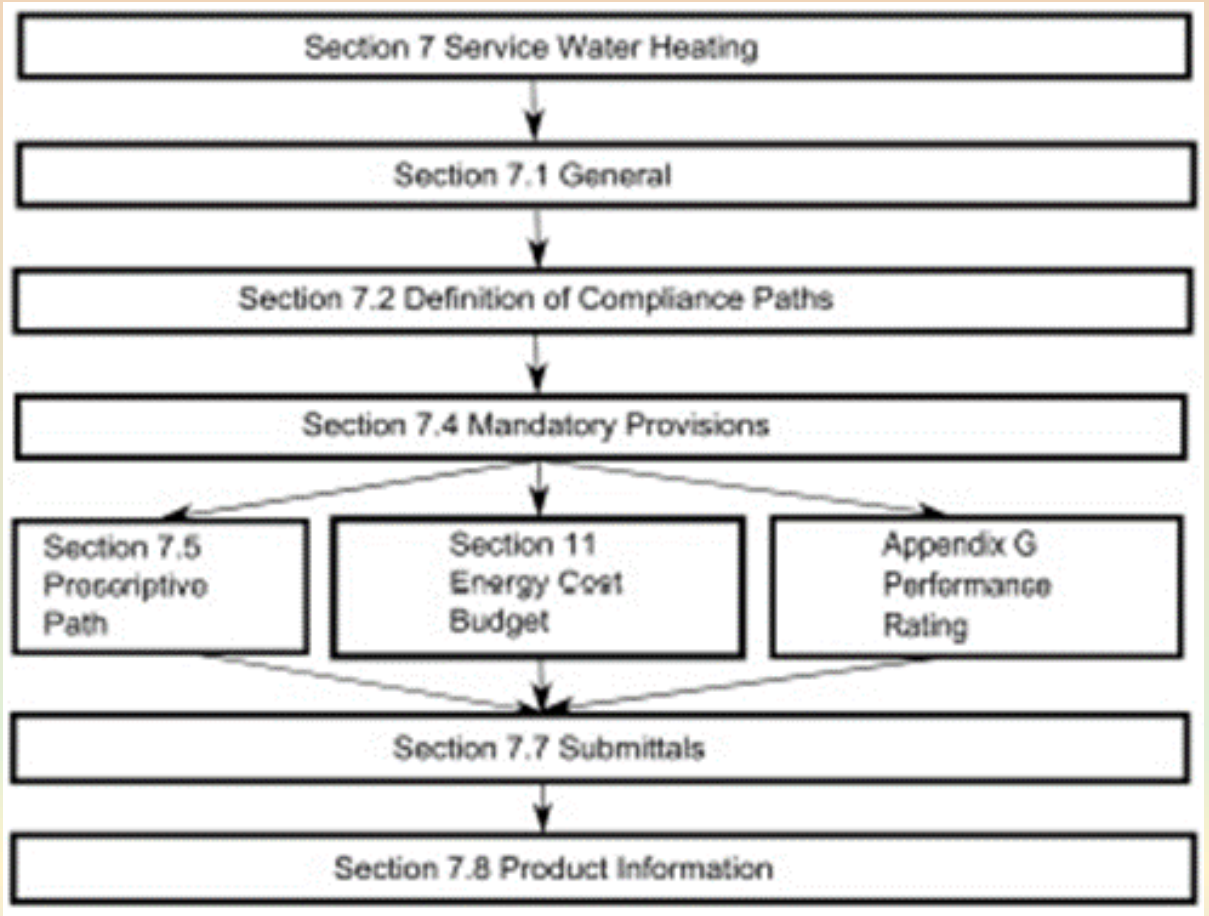
ASHRAE 90.1 2018 Sections

ASHRAE 90.1 2019

- Section 7 – Service Water Heating



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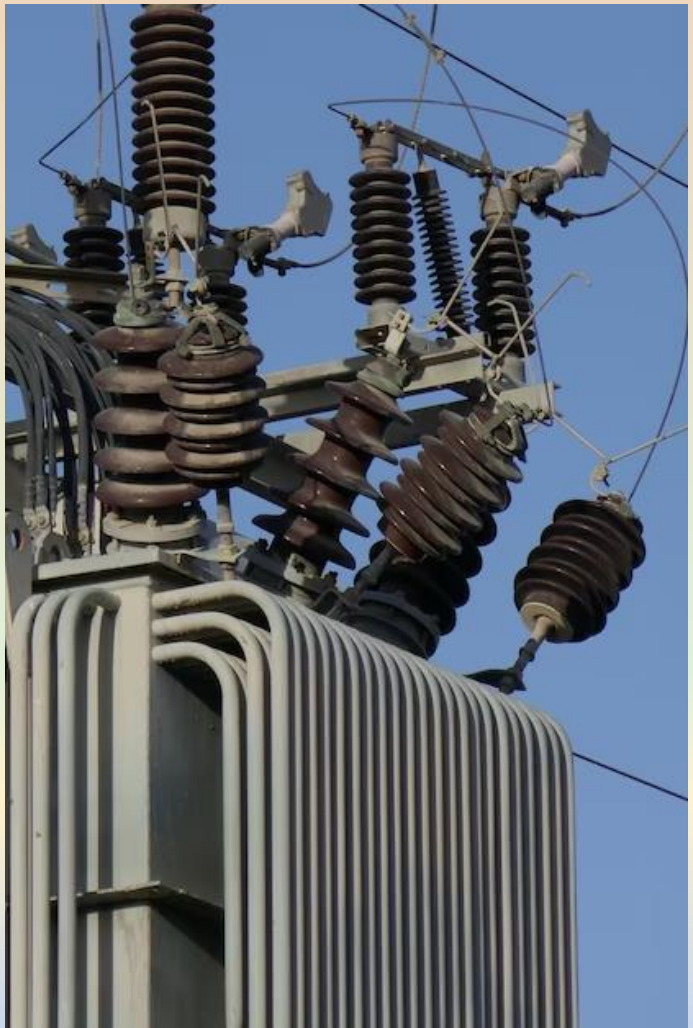
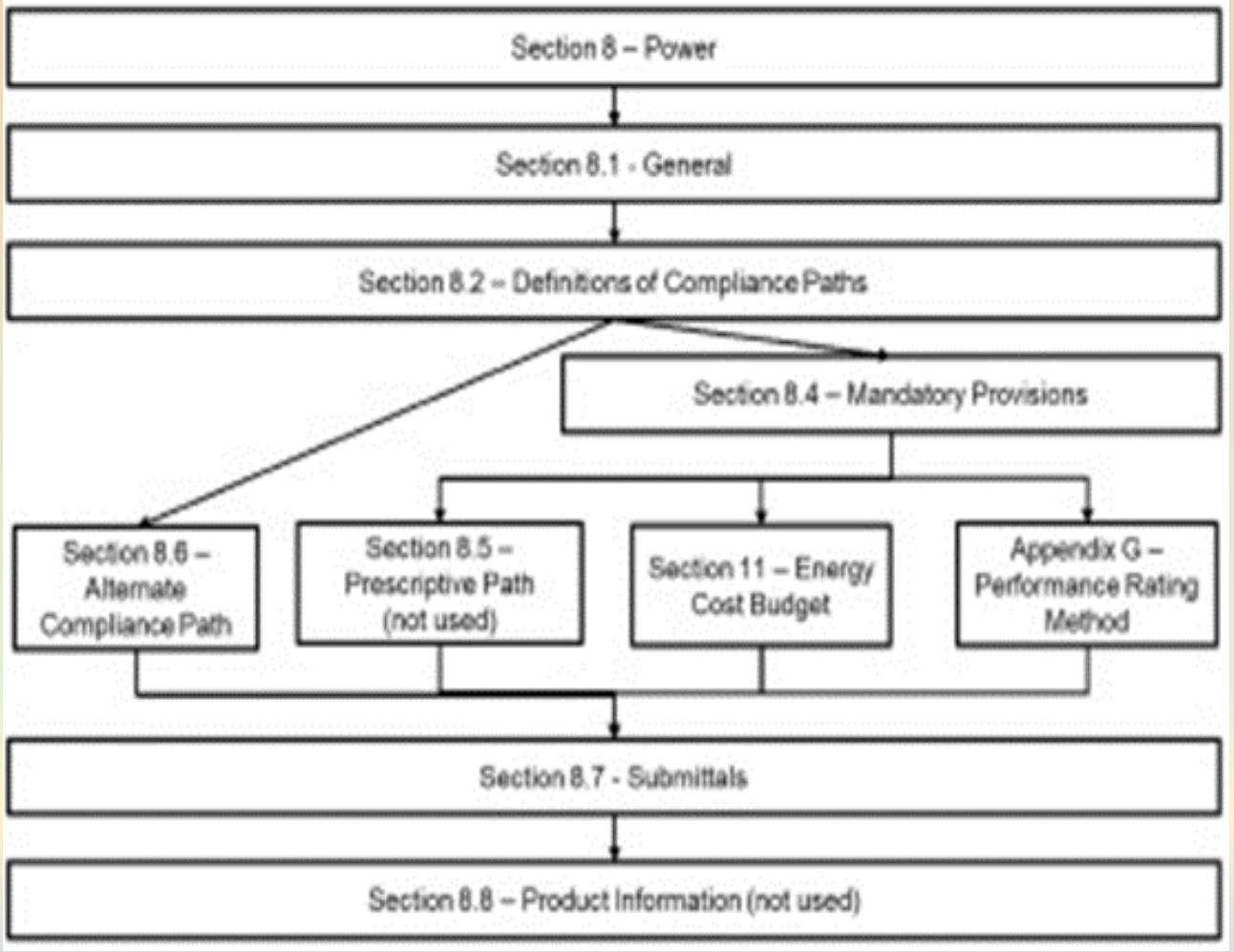
ASHRAE 90.1 2018 Sections

ASHRAE 90.1 2019

- Section 8 - Power





ASHRAE 90.1 2018 Sections

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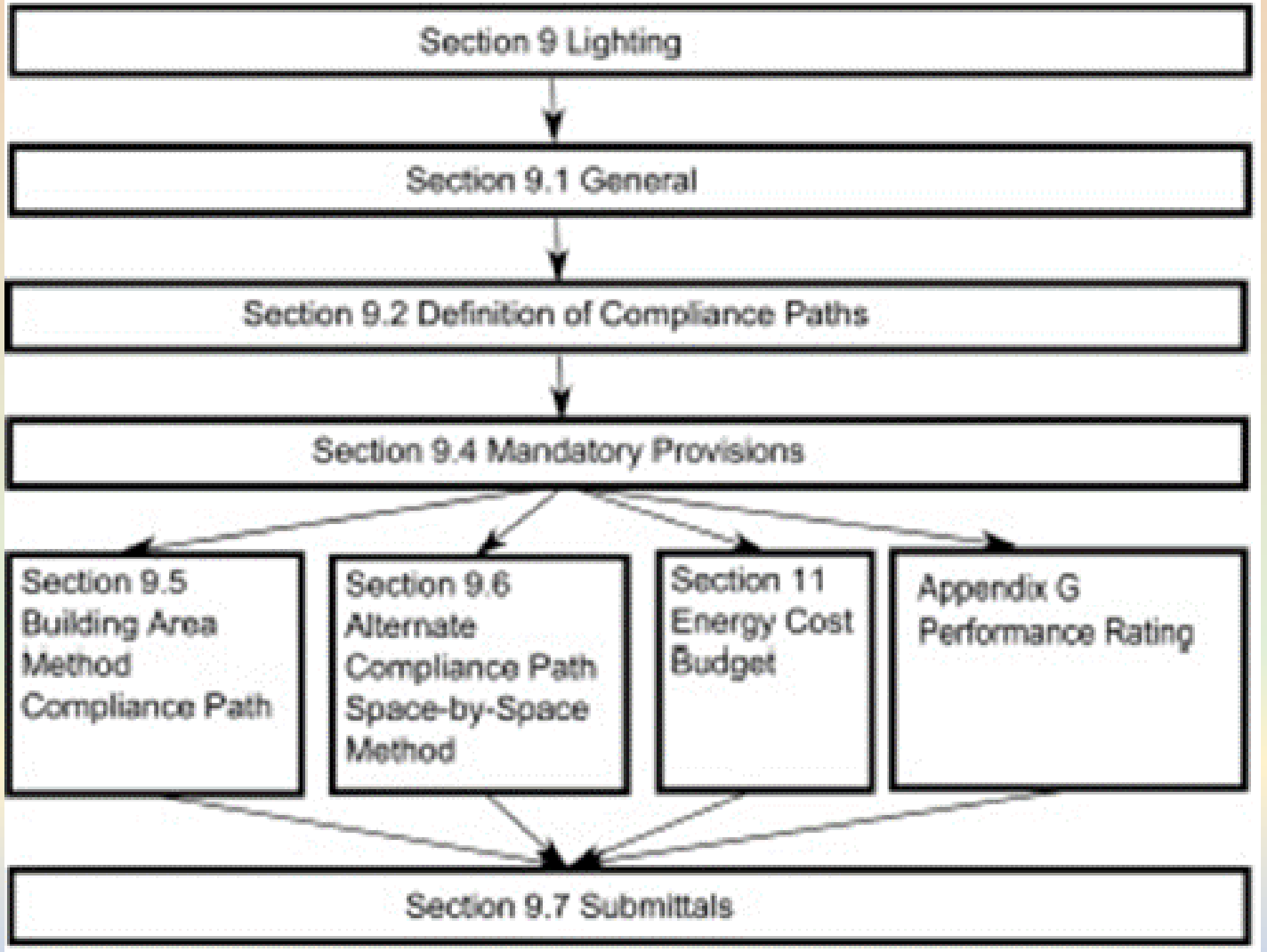
ASHRAE 90.1 2019

- Section 9 - Lighting

The 90.1 standard limits maximum lighting power density. Unless opting to use complex building modeling, designers can choose one of two compliance paths, either the Building Area Method (single maximum power allowance in W/sq. ft.

For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value for the space type in Table C405. 4.2(2) that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces.



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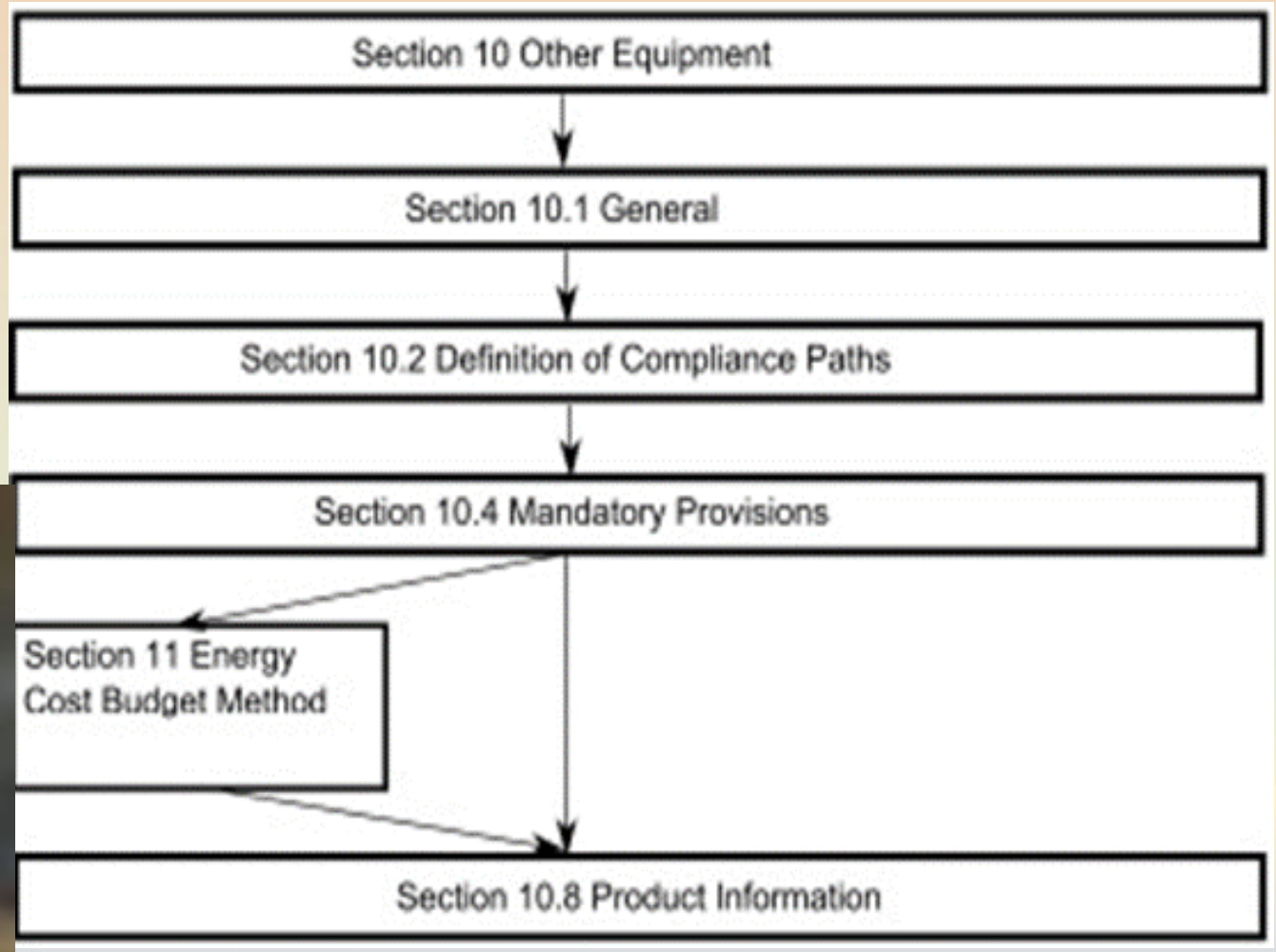
ASHRAE 90.1 2018 Sections

ASHRAE 90.1 2019

- Section 10 – Other Equipment

Examples:
- Motors
- Elevators
- Escalators
- Air curtains
- Whole building energy monitoring
- Pumps



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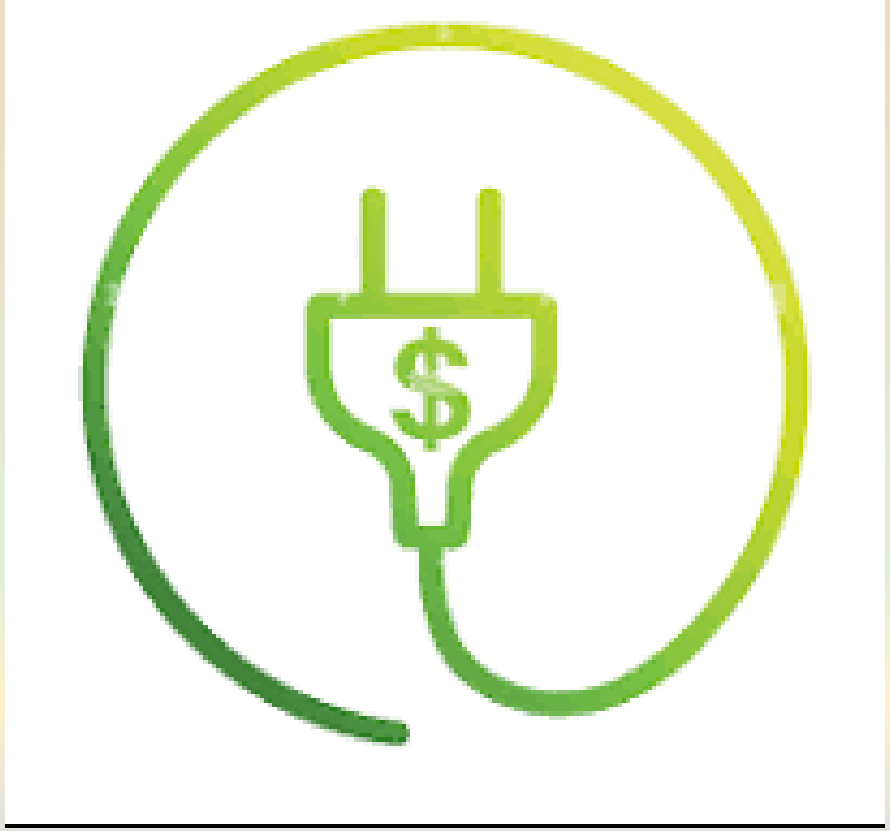
ASHRAE 90.1 2018 Sections

ASHRAE 90.1 2019

- Section 11 – Energy Cost Budget



Section 11 Energy Cost Budget

Section 11.1 General

Section 11.2 Compliance Including Section 5.4, 6.4, 7.4, 8.4, 9.4, 10.4

Section 11.4 Simulation General Requirements

Section 11.5 Calculations of Design Energy Cost and Energy Cost Budget

Section 11.7 Documentation Requirements

Lunch break!

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Figure 2. Major fuel consumption breakdown by end-use.

Image source: fairbanksenergy.com

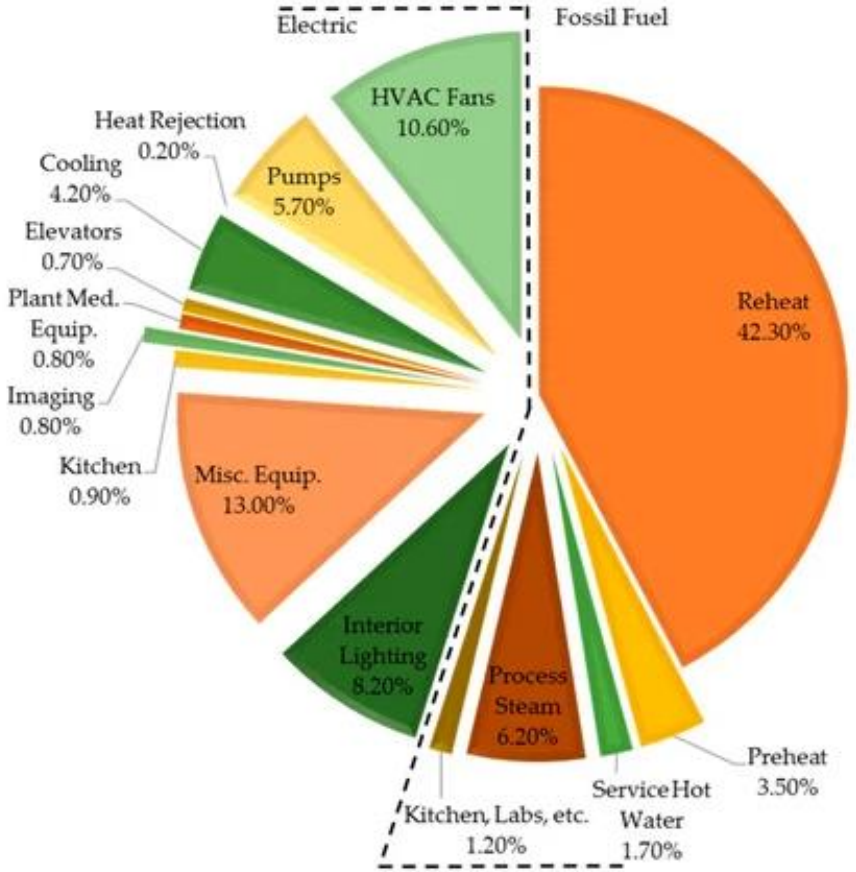
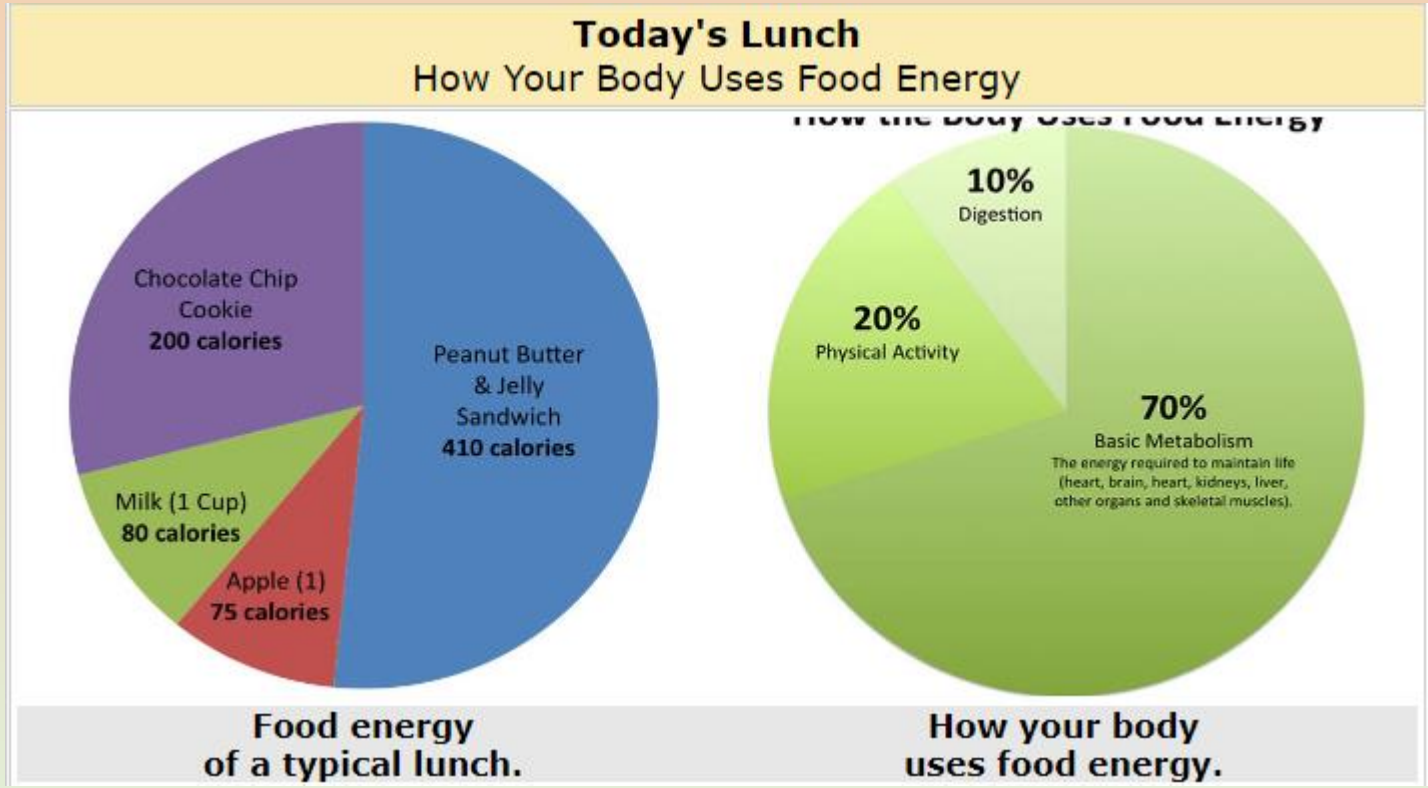


Image source: MDPI.com



- https://journeynorth.org/tm/monarch/therm/j_2.html
- https://blog.mantisinnovation.com/energy-consumption-by-sector-charts-and-data-points

Section 3 – Prescriptive vs Performance

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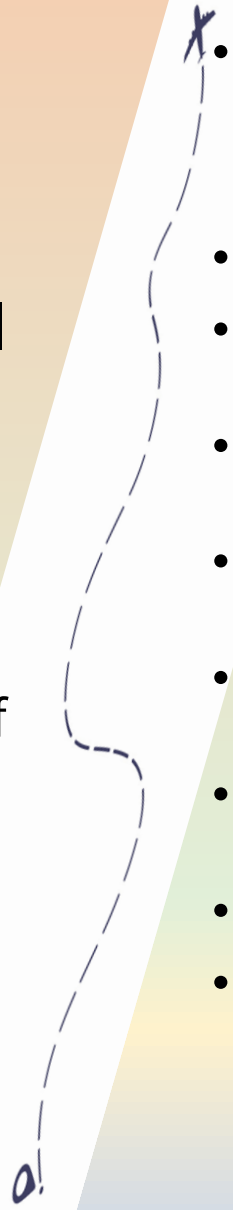
Prescriptive Path

- Establishes criteria for energy related characteristics of individual building components, for example:
  - Minimum R-values of insulation
  - Maximum U-factors and solar heat gain coefficients of fenestration
  - Maximum lighting power allowance
  - Occupancy sensor requirements for lighting control
  - Economizer requirements for HVAC systems.



- Comprehensive checklist of components that could affect energy consumption
  - For example, insulation must have certain minimal thermal properties depending on the climate zone
- Straightforward but inflexible.
- Building envelope as well as equipment and system operations.
- Have proven effective at reducing the amount of energy consumed
- Can be a reasonable option for projects with a small scale, a basic layout
- Some residential and small-scale commercial projects still benefit more from the simplicity
- An efficient and code compliant final product is possible here without needing to create an energy model.
- Less time needed for documenting code compliance.
- Easier for code officials to enforce.

SIDEBAR – Tradeoffs in Residential Energy Conservation Code

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2018 NEW MEXICO RESIDENTIAL ENERGY CONSERVATION CODE
Residential Applications Manual

- The Tradeoff Worksheet is used to show compliance using the Total UA alternative as described in Section R402. 1.5 of the IECC 2018 and thus demonstrates compliance with the NMRECC 2018. It is a compliance demonstration method for the external portions of the building, the building thermal envelope.Feb 1, 2023
- Still to be updated for new code
- ResCheck or ComCheck provide other methodologies

2018 NEW MEXICO RESIDENTIAL ENERGY CONSERVATION CODE

TRADEOFF WORKSHEET

Project ID | Building Floor Area | Date
Builder Name
Builder Address
Submitted by | Phone
Building Address
Town | Climate Zone (3-7): 5

(numeric value only, no alpha character)

PROPOSED HOUSE (Area and R_o as designed)	CODE HOUSE
Ceiling	**Ceiling**
Description | Insulation R-Value | Area, ft² | x | U_{assem} | = | UA	Same As Your House | $U_{req.}$ from NMRECC
	Area, ft² | x | $U_{req.}$ | = | UA
Total -	- | x | 0.026 | = |
Walls (Frame or Mass)	**Walls (Frame or Mass)**
Frame Wall Description | Insulation R-Value | Area, ft² | x | U_{assem} | = | UA	Same As Your House | $U_{req.}$ from NMRECC
	Frame Walls
	Area, ft² | x | $U_{req.}$ | = | UA
Total	- | x | 0.06 | = |
Mass Wall Description | Insulation R-Value | Area, ft² | x | U_{assem} | = | UA	^applies to mass walls with >50% external insulation, see 2018 IECC for other options
	Mass Walls
	Area, ft² | x | $U_{req.}$^ | = | UA
Total	- | x | 0.082 | = |
Skylights (Maximum AWU=0.75 in CZ 4 through 7)	**Skylights**
Description | U-Factor | * Area, ft² | = | UA | AWU Compliant?	Solar Heat Gain Coeff. (SHGC) | = | NA
= 0.00	Area, ft² | x | $U_{req.}$ | = | UA
= 0.00	
Total -	- | x | 0.55 | = |
Doors & Windows (Maximum AWU=0.48 in CZ 4 & 5 and 0.4 in 6 & 7)	**Doors and Windows**
Description | U-Factor | * Area, ft² | = | UA | AWU Compliant?	Solar Heat Gain Coeff. (SHGC) | = | NA
= 0.00	Area, ft² | x | $U_{req.}$ | = | UA
0.00	
= 0.00	
Total -	- | x | 0.3 | = |
Crawlspace Wall (when applicable)	**Crawlspace Wall**
Description | Insulation R-Value | Area, ft² | x | U_{assem} | = | UA	Area, ft² | x | $U_{req.}$ | = | UA
Total	x | 0.055 | = |
Floor Over Crawlspace (when applicable)	**Floor Over Crawlspace**
Description | Insulation R-Value | Area, ft² | x | U_{assem} | = | UA	Area, ft² | x | $U_{req.}$ | = | UA
Total	x | 0.033 | = |
Basement Wall (when applicable)	**Basement Wall**
Description | Insulation R-Value | Area, ft² | x | U_{assem} | = | UA	Area, ft² | x | $U_{req.}$ | = | UA
Total	x | 0.05 | = |
Totals	**Totals**
Total Roof, Wall, Foundation	Total Roof, Wall, Found.

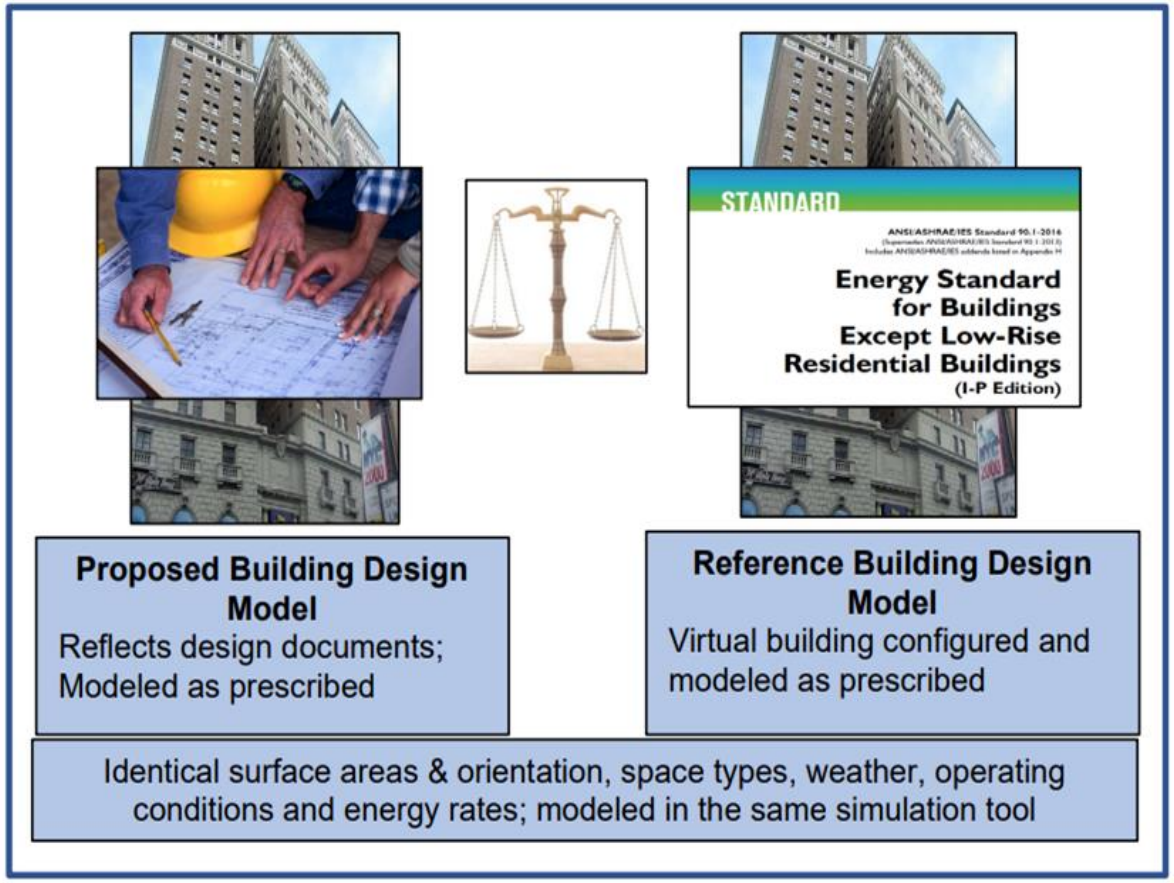
If the total for PROPOSED HOUSE is less than the total for CODE HOUSE, PROPOSED HOUSE is in compliance.

Performance Rating Method advantages

- Prioritize energy saving measures based on which likely to be most cost-effective
- Frees creativity and innovation from prescriptive
- Gives estimate of operational costs
- Familiarity with workflow also used for beyond code targets incl. utility incentives

- Decision on Pathway:
  - Per IMT, building owner in consultation with jurisdictional authority and design & construction teams
  - Engineers key decision makers, especially if energy modeling

“Reference Building Approach” for modeling (Appendix G in ASHRAE 90.1 2019)



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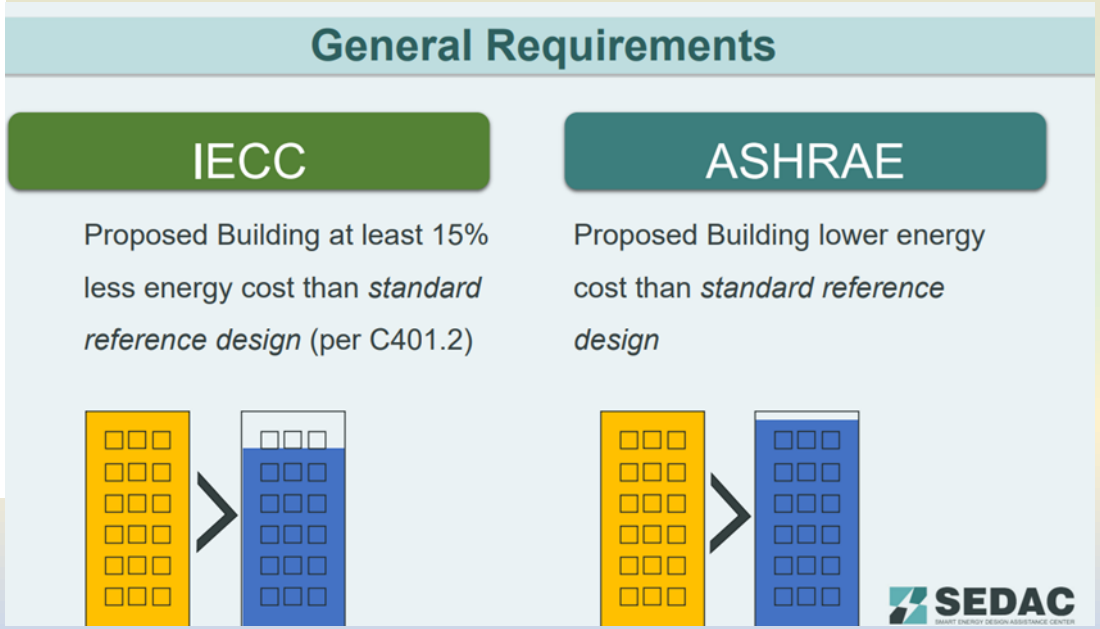
ASHRAE 90.1 2019

- Compares energy cost
- Proposed design model with specified systems and components
- Virtual building model with systems & components as prescribed
- Energy Prices from approved source such as DOE, EIA report, https://www.eia.gov/state/seds/



https://smartenergy.illinois.edu/wp-content/uploads/2021/09/90.1-2019-vs-2018-IECC-Envelope.pdf

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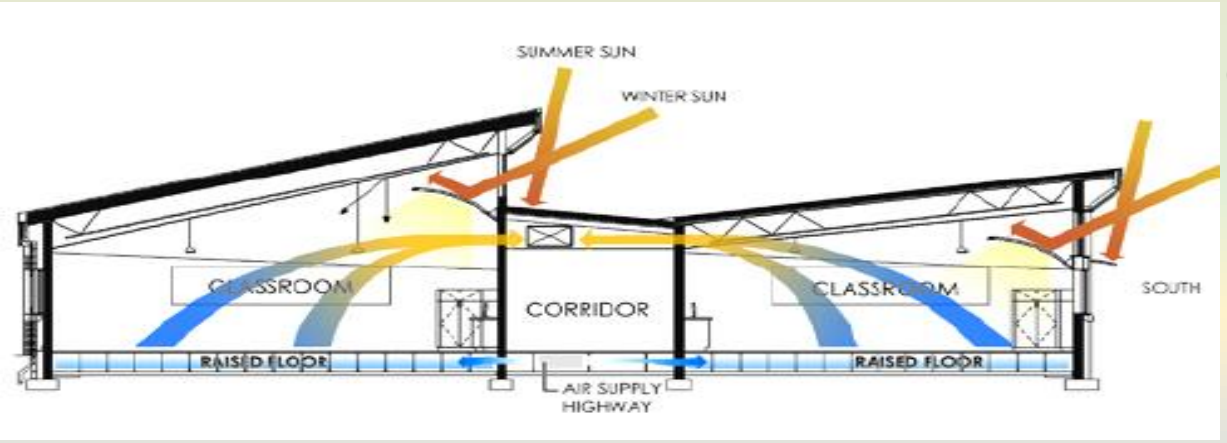
When to use the IECC Performance Path

- IECC Performance
  - Mandatory sections from C402, C403, C404, C405
  - C407 Total Building Performance
  - Building energy cost at least 15% lower than reference
- Performance path generally used for:
  - Large buildings
  - Stringent prescriptive requirements
  - High performance buildings (ASHRAE)
  - Mostly for school / university, office, hotel, multifamily
  - Most likely the wave of the future



https://www.researchgate.net/figure/Whole-building-approach-in-a-multistory-design_fig7_224610487

STRUCTURE

- Ø *407.1 Scope*
- Ø *407.2 Mandatory Requirements*
- Ø *407.3 Performance-Based Compliance*
  - o *Energy prices from approved source*
  - o *Code Officials may require time-of-use pricing*
  - o *Reduction in energy cost from on-site renewable energy < 5% of total*
  - o *Off-site renewable energy purchases same in proposed and reference design*
- Ø *407.4 Documentation*
  - o *Compliance Report*
  - o *Code Official may require specified additional documents*
- Ø *407.5 Calculation Procedure*
  - o *Specifications for both designs*
  - o *HVAC Systems Map & Specifications, Zones*
- Ø *407.6 Calculation Software Tools*
  - o *Specifications*
  - o *Code Official may approve tools for specified application*

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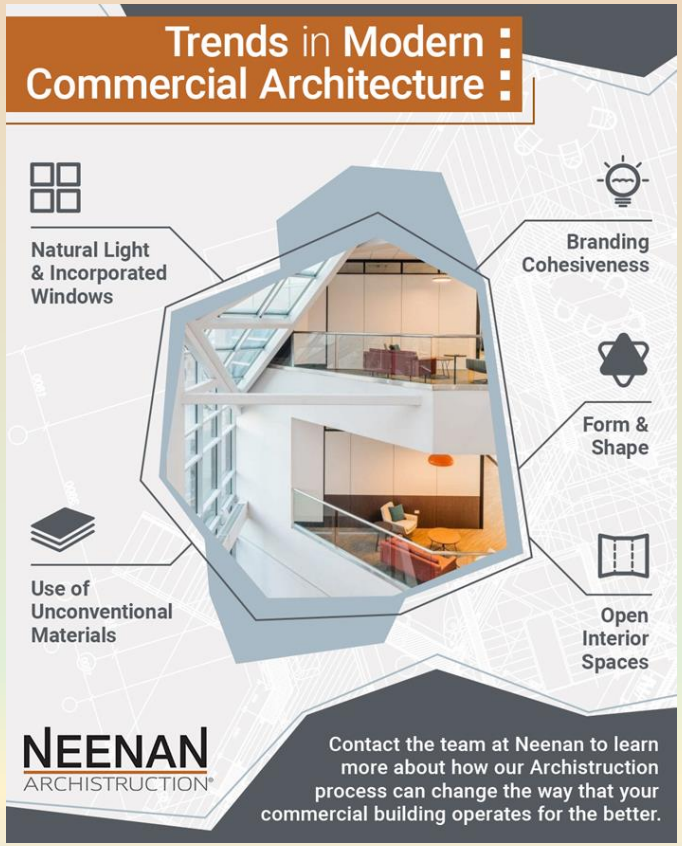
ASHRAE 90.1 - When Would You Use This Commercial Compliance Path?

ASHRAE 90.1 2019



- Detailed & Complicated
- Highest performance
- Well supported

For Large and Complex Buildings

Design to achieve high standard of performance

Performance Path Tradeoffs

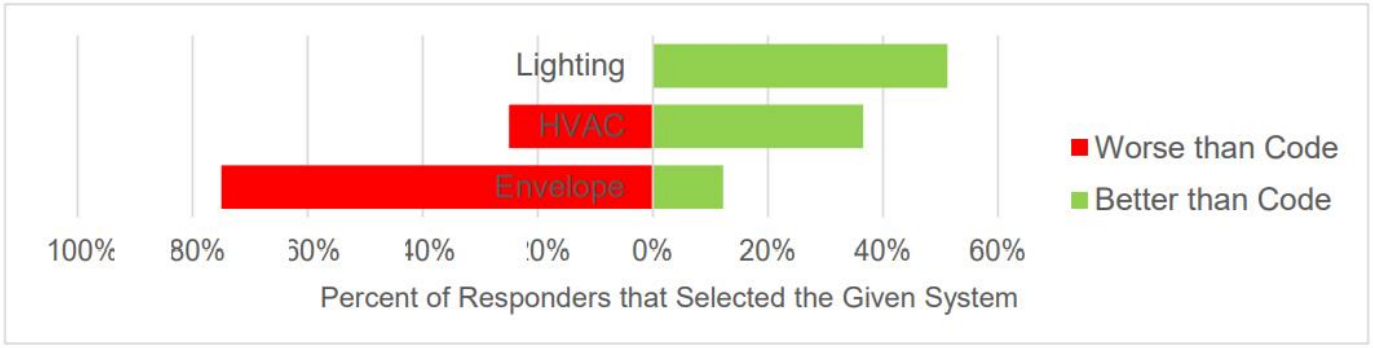
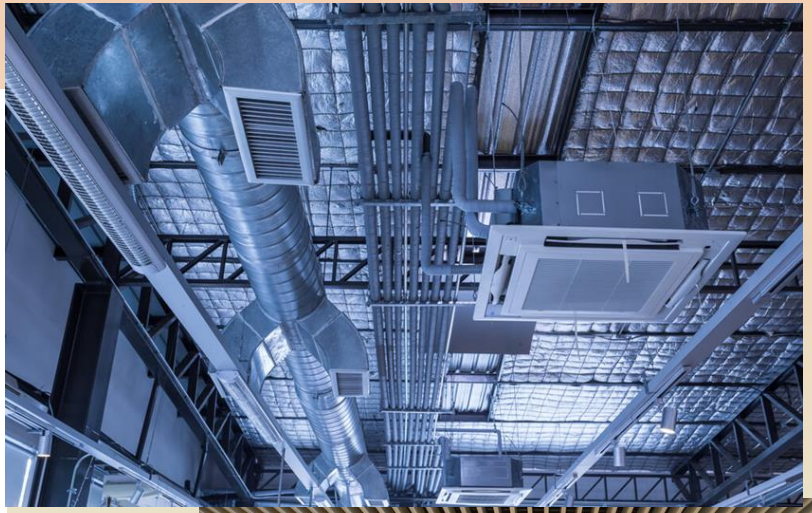


Figure 4. Common Systems Traded Off on Performance Projects

The building envelope has much longer useful life than most other building systems, and many stakeholders viewed the ability of projects with poor envelopes to demonstrate compliance with energy code via performance path as a critical flaw of the modeling rules. Addendum CR to 90.1 2019 addressed this concern by introducing an "envelope backstop" that limits the building envelope trade-offs for projects following 90.1 Section 11 and Appendix G.



- https://www.cundall.com/services/lighting-design
- https://www.achengineering.com/what-is-the-importance-of-an-efficient-hvac-system-in-the-cleanroom/
- https://en.wikipedia.org/wiki/Glass

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General ComCheck info

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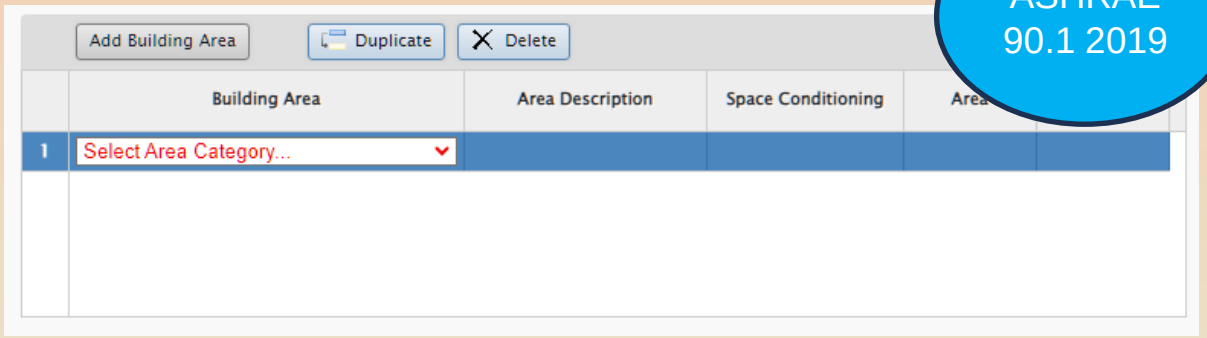
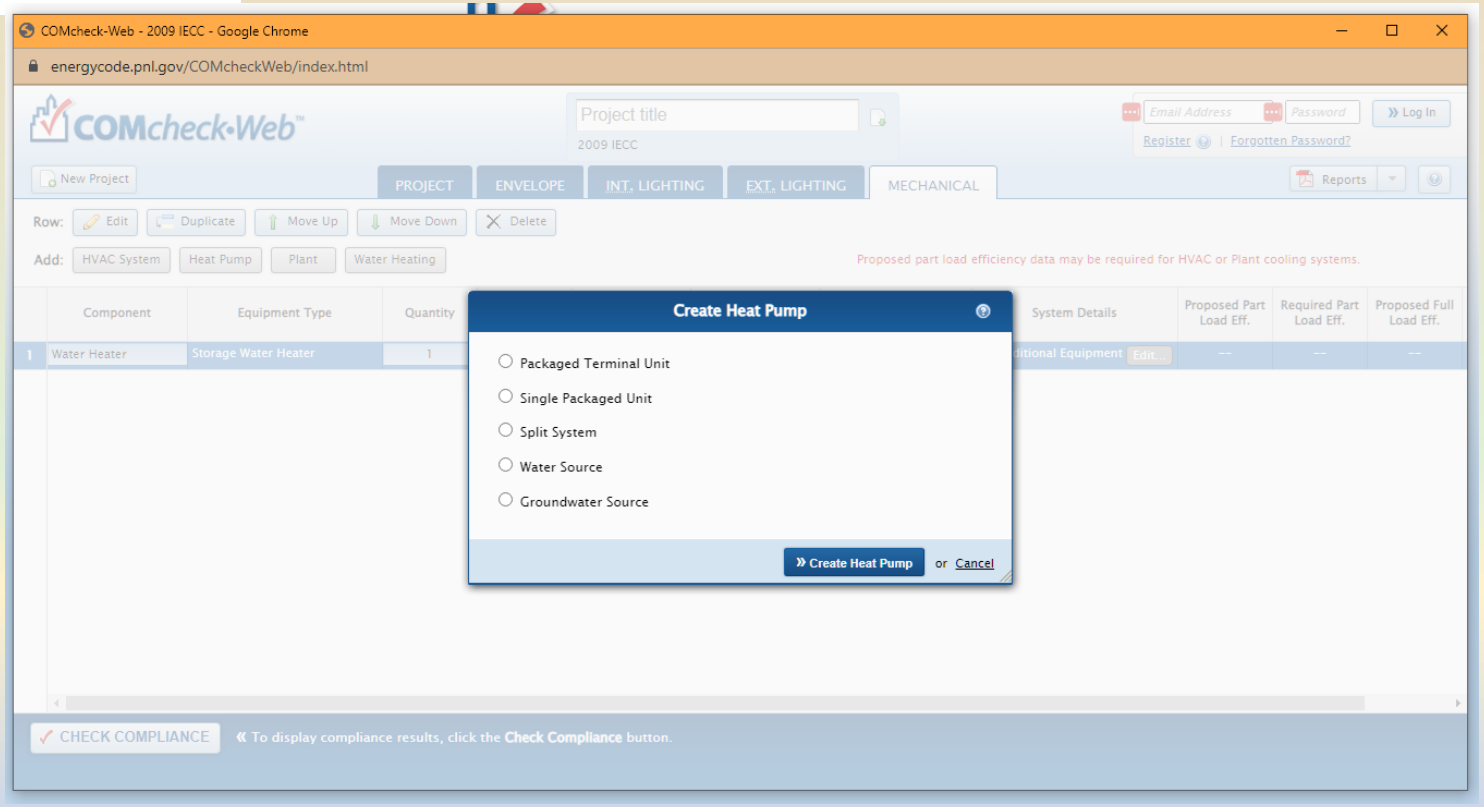
ASHRAE 90.1 2019

COMcheck-Web™

https://energycode.pnl.gov/COMcheckWeb/





COMCheck Reports

IECC 2021

ASHRAE 90.1 2019

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Pacific Northwest NATIONAL LABORATORY

Reports

- Click on Reports – top right of screen
- Choices, choose any or all
  - Envelope Compliance Certificate
  - Interior Lighting Compliance Certificate
  - Exterior Lighting Compliance Certificate
  - Mechanical Compliance Certificate
- First pages are the Compliance Certificate
- Follow-on pages are the Inspection Checklists by phase of inspection
  - Plan Review
  - Footing/Foundation
  - Rough-in
  - Final

COMcheck makes process easy with each code section's documentation requirements in a checklist – can fill in location of information in plans/specs.

Section # & Req.ID	Plan Review	Complies?	Comments/Accumptions
C103.2 [PR1][1]	Plans and/or specifications provide all information with which compliance can be determined for the building envelope and document where exceptions to the standard are claimed.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met. Location on plans/spec: Plan doc page 21, section 3a
C103.2 [PR2][1]	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the mechanical systems and equipment and document where exceptions to the standard are claimed. Load calculations per acceptable engineering standards and handbooks.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	

Pacific Northwest NATIONAL LABORATORY

Reports – Inspection Checklist

COMcheck Software

Inspection Checklist

Energy Code: 90.1 (2013) Standard

Requirements: 25.0% were addressed directly in the COMcheck software

Text in the "Comments/Assumptions" column is provided by the user in the COMcheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

90.1 (2010) Standard	Rough-In Electrical Inspection	Complies?	Comments/Assumptions
8.4.2 [EL10][2]	At least 50% of all 125 volt 15- and 20-Amp receptacles are controlled by an automatic control device.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
9.4.1.1 [EL1][2]	Automatic controls to shut off all building lighting.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met. **Location on plans/spec:** Spec G, page 3, section 32
9.4.1.2 [EL2][2]	Independent lighting controls installed per approved lighting plans and all manual controls readily accessible and visible to occupants.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met. **Location on plans/spec:** Spec G, page 3, section 32
9.4.1.3 [EL11][2]	Parking garage lighting is equipped with required lighting controls and daylight transition zone lighting.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met. **Location on plans/spec:** Spec G, page 3, section 32
9.4.1.4 [EL12][2]	Primary sidelighted areas >=250 ft2	☐Complies	

1 High Impact (Tier 1) 2 Medium Impact (Tier 2) 3 Low Impact (Tier 3)

Project Title: Florida 2020 Testing 2018 Report date: 07/20/21
Data filename: Page 3 of 8

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Energy Modeling – 2 Types

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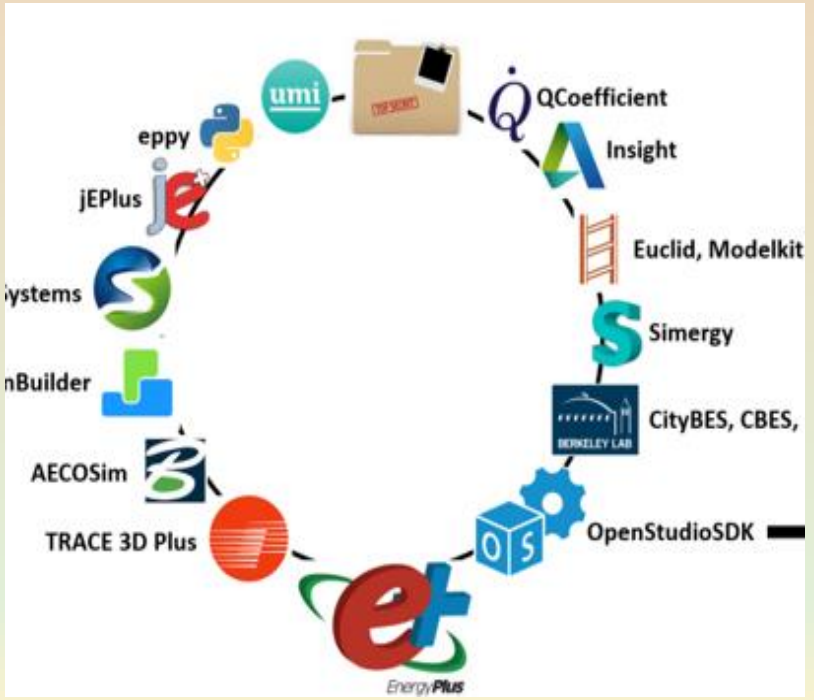
ASHRAE 90.1 2019

- Prescriptive:
  - Fenestration / insulation 402.1.1 – no tools needed
    - U Factor and UA Alternatives:
      U factor 402.1.3; total building 42.1.4; Total building UA tradeoff – Comcheck
- Simulated performance:
  - Comcheck or spreadsheets to ensure mandatory requirements are met
  - Whole building modeling software
- Review & Compliance checks relate to path chosen; MANY possibilities & Code Officials must review referencing the path chosen.
- Training is an enormous issue



- Must be approved by [illegible] Official
  - IRS list for tax deductions:
    - DesignBuilder
    - DeST
    - DOE-2.2
    - EnergyGauge
    - EnergyPlus
    - eQuest
    - Hourly Analysis Program (HAP)
    - IES Virtual Environment
    - OpenStudio with EnergyPlus
    - TAS
    - Trace 3D Plus
    - Trace 7000
    - TRNSYS
  - Most used: eQuest #1, ISVirtual Environment, Trane Trace

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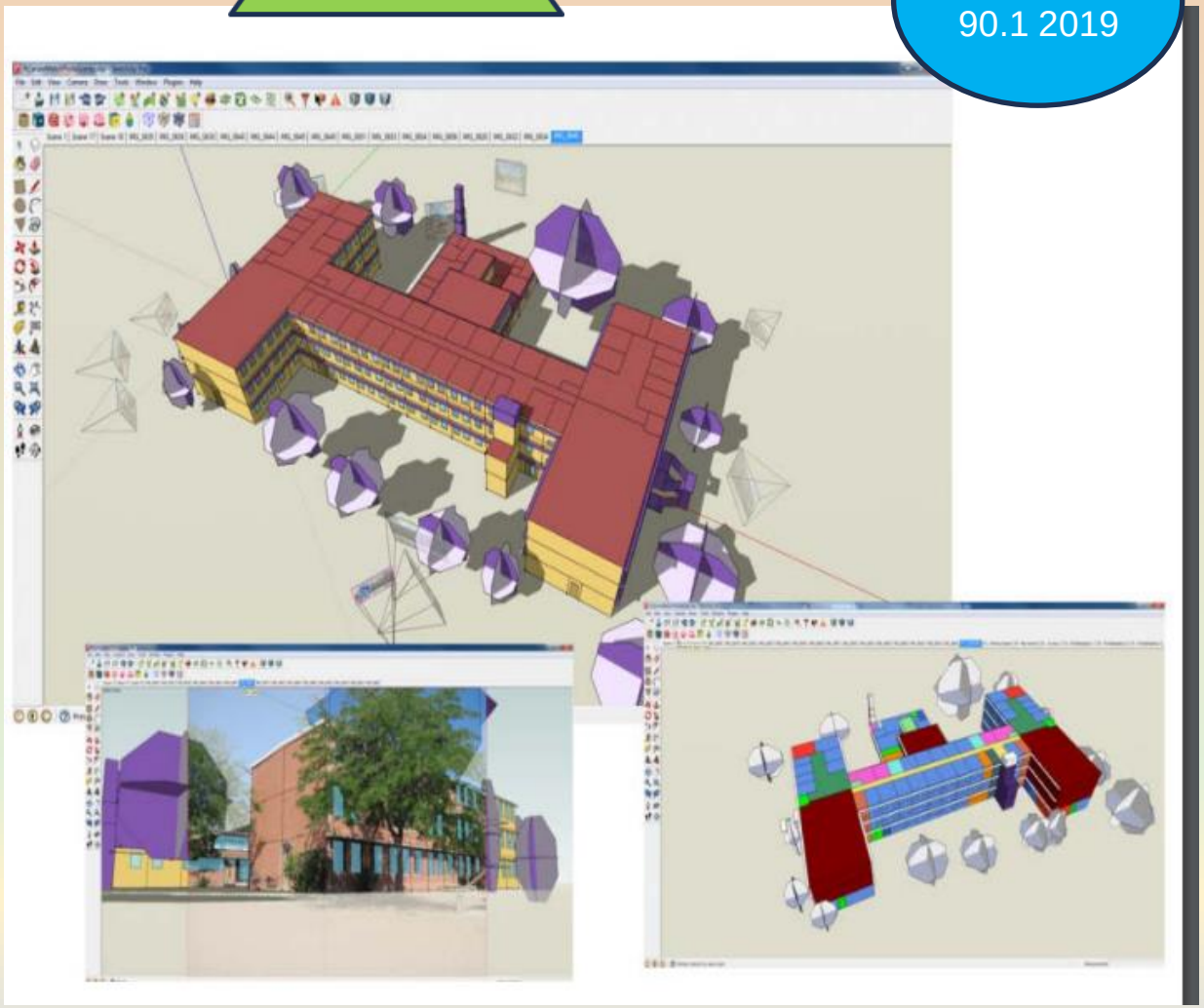
Energy Modeling Software

IECC 2021

ASHRAE 90.1 2019

Approved / in Compliance Pkg:

- Design Builder
- EnergyPlus
- eQuest
- Openstudio
- Trace 3DPlus
- Trace 700
- IESVE (In progress)
- Carrier HAP V5 (In progress)



https://www.energy.gov/sites/prod/files/2019/07/f65/1_NREL-energy-modeling-tools.pdf

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Dashboard

Compliance Summary

Compliance Path	Appendix G, Above Code Performance
Energy Modeling Outcome	In Progress
Design Professional Sign-off	No
Modeler Sign-off	No

Tabs Navigator	Design Professional Sign-off			Modeler Sign-off		
	Status	Name	Date	Status	Name	Date
Instructions	N/A	-	-	N/A	-	-
Documentation Process Overview	N/A	-	-	N/A	-	-
Contact Information	Complete	Sam Smith	8/21/2020	Complete	Jones Blake	8/15/2020
General Information	Complete	Johnson Avery	8/15/2020	Complete	Jones Blake	8/13/2020
Energy Sources	Complete	Johnson Avery	8/25/2020	Complete	Jones Blake	8/21/2020
Operating Schedules	Complete	Johnson Avery	8/21/2020	Complete	Jones Blake	8/14/2020
Proposed Envelope Assemblies	Complete	Johnson Avery	8/15/2020	Complete	Jones Blake	8/15/2020
Envelope Areas	Complete	Johnson Avery	8/25/2020	Complete	Jones Blake	8/13/2020
Infiltration	Complete	Johnson Avery	8/21/2020	Complete	Jones Blake	8/21/2020
Lighting Space Types	In Progress	Johnson Avery		In Progress	Jones Blake	
Interior Lighting Counts	In Progress	Johnson Avery		In Progress	Jones Blake	
Interior Lighting Model Inputs	In Progress	Johnson Avery		In Progress	Jones Blake	
Exterior Lighting	In Progress	Johnson Avery		In Progress	Jones Blake	
Ventilation - Multifamily	N/A	-	-	N/A	-	-
Proposed HVAC	In Progress	Johnson Avery		In Progress	Jones Blake	
Baseline HVAC App G	In Progress	Johnson Avery		In Progress	Jones Blake	
Budget HVAC Section 11	N/A	-	-	N/A	-	-
Service Water Heating	Complete	Johnson Avery	8/25/2020	Complete	Jones Blake	8/20/2020
Plug, Process and Other Loads	Complete	Johnson Avery	8/15/2020	Complete	Jones Blake	8/12/2020
Renewable Energy	N/A	-	-	N/A	-	-
Exceptional Calculations	N/A	-	-	N/A	-	-
Results from eQuest	N/A	-	-	In Progress	-	
Compliance Calculations	N/A	-	-	In Progress	-	
Submittal Checklist	In Progress	Johnson Avery		In Progress	Jones Blake	

... Documentation Process Overview | Contact Information | General Information | Dashboard | Energy Sources

ASHRAE 90.1 2019

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Review Checks

1. All fuels applicable to the baseline/budget or proposed design must be listed on the Energy Sources tab of the Compliance Form. Table 1 includes the list of fuels and description of utility rates for each.

Energy Type	Energy Consumption Units	Demand Units	Utility Rate Type
Electricity	kWh	kW	Fixed Rates per unit of consumption
Natural	therm	kBtu/hr	Fixed Rates per unit of consumption

Th res for each fuel is further described in Tables 2-4 of the Energy Sources tab. Table 2 ng rates that have uniform charges, Table 3 for time of user charges, Table 4 for tables also list Source of Data for each rate which may include Actual Rates, EIA

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Energy Type	Energy Consumption Units	Demand Units	Season 1					Source of Data
			Start Date	End Date	Monthly Meter Charge ($/Month)	$/Unit Demand	$/Unit Energy	
Electricity	kWh	kW	Jan-01	Dec-31	$25.0	n/a	$0.138	Actual Rates
Natural Gas	therm	kBtu/hr	Jan-01	Dec-31	$32.0	n/a	$1.131	Actual Rates

ASHRAE 90.1 2019

Table 6: Building Envelope Checks Overview

	Check Type	Proposed Design	Baseline/Budget Design
Above-grade wall	CF inputs reflect design documents	BE01-P	NA
	CF inputs reflect requirements of 11/G	NA	BE01-B
	Simulation inputs consistent with CF	BE06-P	BE06-B
	Simulation outputs consistent with CF	BE19	BE19
Below-grade Walls	CF inputs reflect design documents	BE02-P	NA
	CF inputs reflect requirements of 11/G	NA	BE02-B
	Simulation inputs consistent with CF	BE07-P	BE07-B
	Simulation outputs consistent with CF	BE19	BE19
Roof	CF inputs reflect design documents	BE03-P, BE11-P	NA
	CF inputs reflect requirements of 11/G	NA	BE03-B, BE11-B
	Simulation inputs consistent with CF	BE08-P, BE12-P	BE08-B, BE12-B
	Simulation outputs consistent with CF	BE19	BE19
Exterior Floor	CF inputs reflect design documents	BE04-P	NA
	CF inputs reflect requirements of 11/G	NA	BE04-B
	Simulation inputs consistent with CF	BE09-P	BE09-B
	Simulation outputs consistent with CF	BE19	BE19
Slab-on Grade	CF inputs reflect design documents	BE05-P	NA
	CF inputs reflect requirements of 11/G	NA	BE05-B
	Simulation inputs consistent with CF	BE10-P	BE10-B
	Simulation outputs consistent with CF	BE19-P	BE19
Fenestration	CF inputs reflect design documents	BE13-B, BE15-B	NA
	CF inputs reflect requirements of 11/G	NA	BE13-P, BE15-P
	Simulation inputs consistent with CF	BE14-P, BE16-P	BE14-B, BE16-B
	Simulation outputs consistent with CF	BE19	BE19
Infiltration	CF inputs reflect design documents	BE17-P	NA
	CF inputs reflect requirements of 11/G	NA	BE17-B
	Simulation inputs consistent with CF	BE18-P	BE18-B
	Simulation outputs consistent with CF	BE19	BE19
Orientation	CF inputs reflect design documents	BE20-P	NA
	CF inputs reflect requirements of 11/G	NA	BE20-B
	Simulation inputs consistent with CF	BE21-P	BE21-B
Interior/Exterior Shading	CF inputs reflect design documents	BE22-P	NA
	CF inputs reflect requirements of 11/G	NA	BE22-B
	Simulation inputs consistent with CF	BE23-P	BE23-B

LEGEND

PASS/FAIL/NA outcome is determined automatically in the Quality Control Checks tab of the Compliance Form

Review / Approval Process – Performance Path

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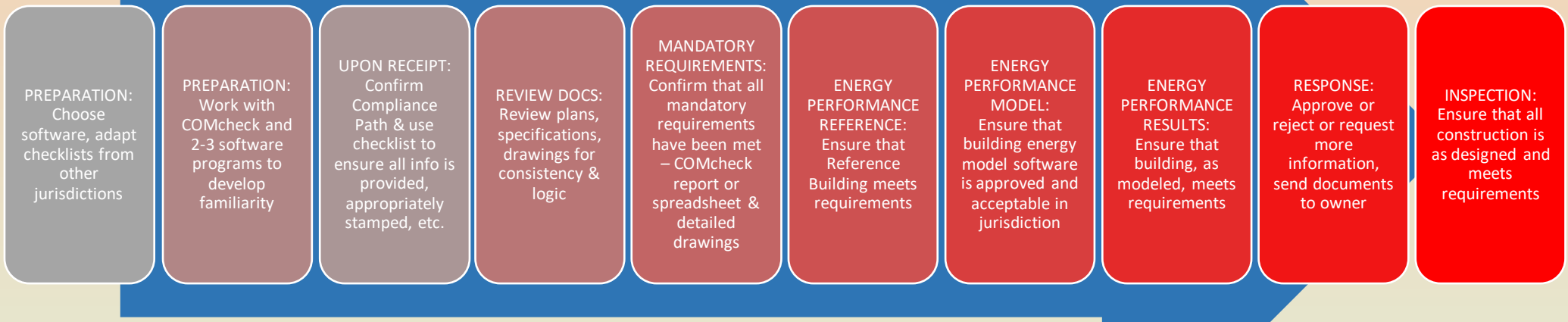
ASHRAE 90.1 2019



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- Key Elements to Remember:
  - Code Official can specify documents, software, other requirements as long as they conform to regulations
  - Biggest sources of mistakes come from untrained energy modelers and inconsistent data input
  - Code Officials can require cross-referencing all designs, specifications, construction details (For example, COMCheck table noting where information can be found)
  - Request assistance where necessary

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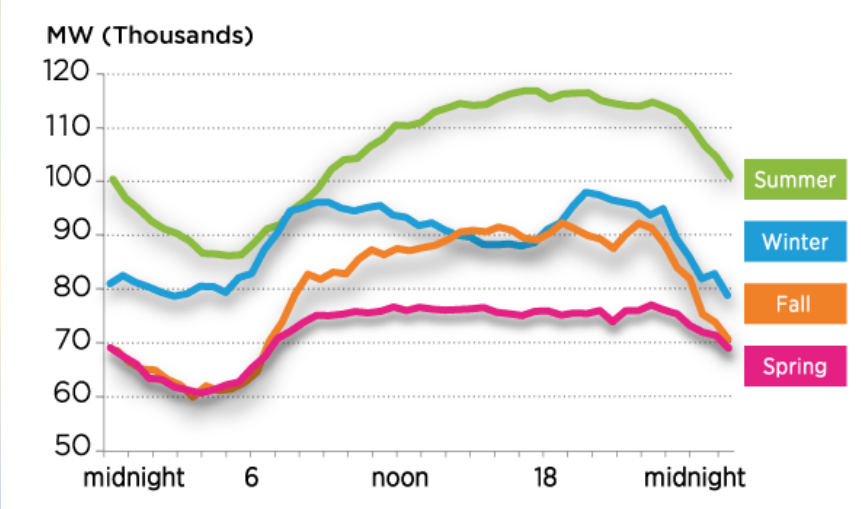
Regulated and Unregulated Energy Use

ASHRAE 90.1 2019

- Regulated:
  - **Model Input Documentation**
  - Energy used for heating, cooling, ventilation, interior and exterior lighting, service water heating, motors, transformers, vertical transportation, refrigeration equipment, computer room cooling equipment and other building systems, components and processes with requirements prescribed in 2.7
  - Standard 90.1 Sections 5 through 10
  - (Prescriptive)



Unregulated:

- All the things that are plugged into convenience outlets:
  - personal computers, printers, coffee machines, and refrigerators
  - Grills, ovens, fryers, steam trays, and other cooking equipment in restaurants and cafeterias;
  - Compressed air systems in manufacturing and warehouse facilities; and
  - Specialized equipment in laboratories, hospitals, and manufacturing plants.
- Non Refrigeration Related Process Loads:
- Manufacturing,, industrial, or commercial process other than serving commercial refrigeration equipment, conditioning spaces and maintaining comfort and amenities for the occupants of a building.
  - Computer equipment in the data center would be unregulated while the HVAC system used to condition the data center is regulated.
- If chiller/boiler is used to provide chilled water or hot water to meet process loads and are covered by conditions in Standard 90.1-2016 Table 6.8.1-3 and Table 6.8.1-6, then the baseline equipment used to model the chilled water and hot water should use the efficiency specified in Standard 90.1-2016 Table G3.5-3 and Table G3.5-6, else it should be modeled as same as proposed.

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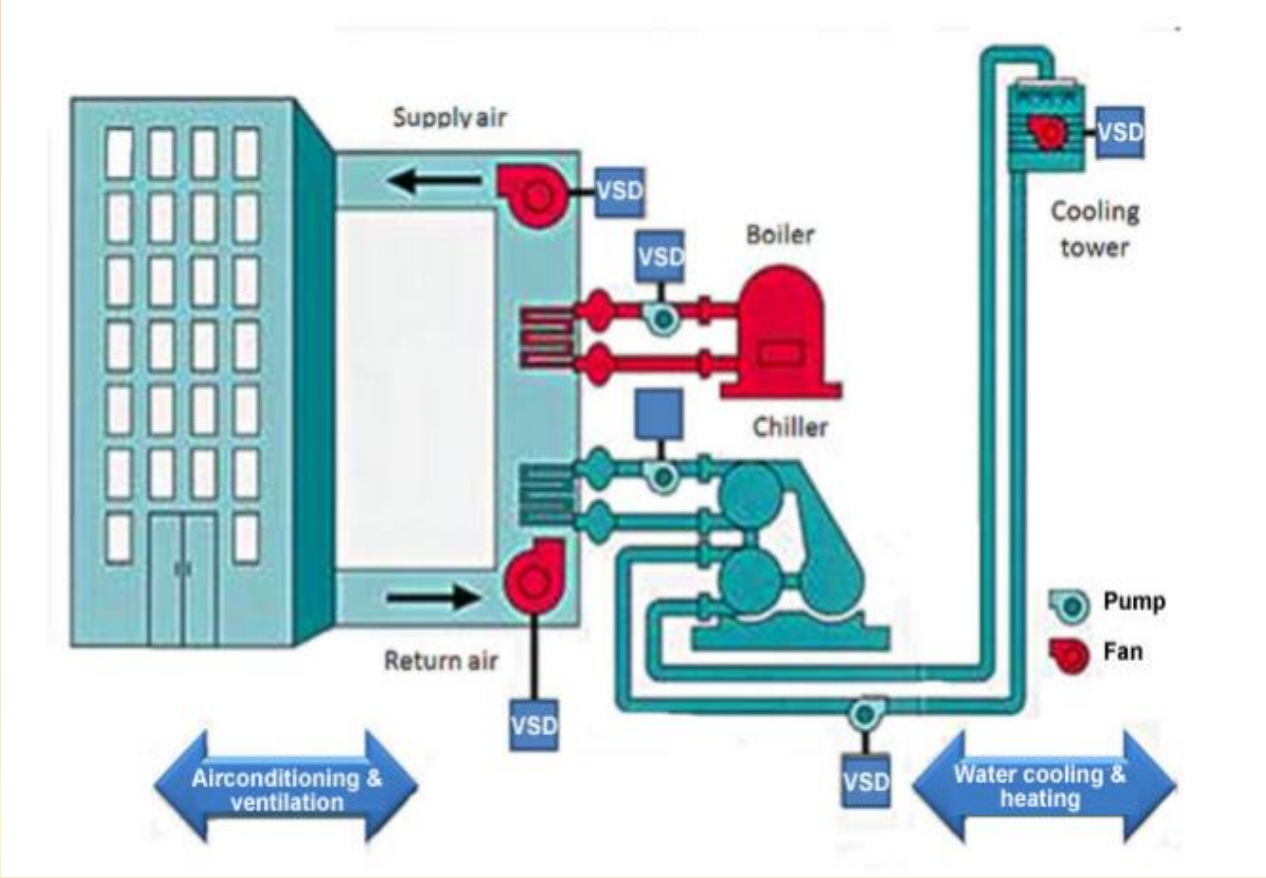
Unmet Load Hours

ASHRAE 90.1 2019

- U*nmet load hours* (UMLH) is a criterion for sizing equipment, for qualifying natural ventilation systems, and for other purposes
  - For a thermal zone, it represents the number of hours during a year when the HVAC system serving the thermal zone is unable to maintain the setpoint temperatures for heating and/or cooling.
- UMLH can occur because fans, airflows, coils, furnaces, air conditioners, or other equipment is undersized.
- UMLH can also occur due to user errors, including mismatches between the thermostat setpoint schedules and HVAC operating schedules, or from other input errors.
- It is the user's responsibility to address causes of UMLH in the proposed design.



Thermal Blocks, HVAC Zones, and Space Functions

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ASHRAE 90.1 2019

- A space is a subcomponent of an HVAC zone that has values identified for lighting, outdoor air ventilation, occupancy, receptacle loads, and hot water consumption requirements.
  - A space could be conditioned, semi-heated, or unconditioned. An HVAC zone may contain more than one space type.
- A Heating Ventilation and Air Conditioning (HVAC) zone is a space or collection of spaces within a building having space conditioning requirements that are similar enough to be maintained with a single thermal controlling device.
  - An HVAC zone is a thermal and not a geometric concept: spaces need not be contiguous to be combined within a single HVAC zone.
  - However, daylighting requirements may prevent combining non-contiguous spaces into a single HVAC zone.
  - If individual spaces are not modeled but combined into a zone, the space type breakdown (floor area of each space) should be provided.
- A thermal block is a collection of one or more HVAC zones grouped together for simulation

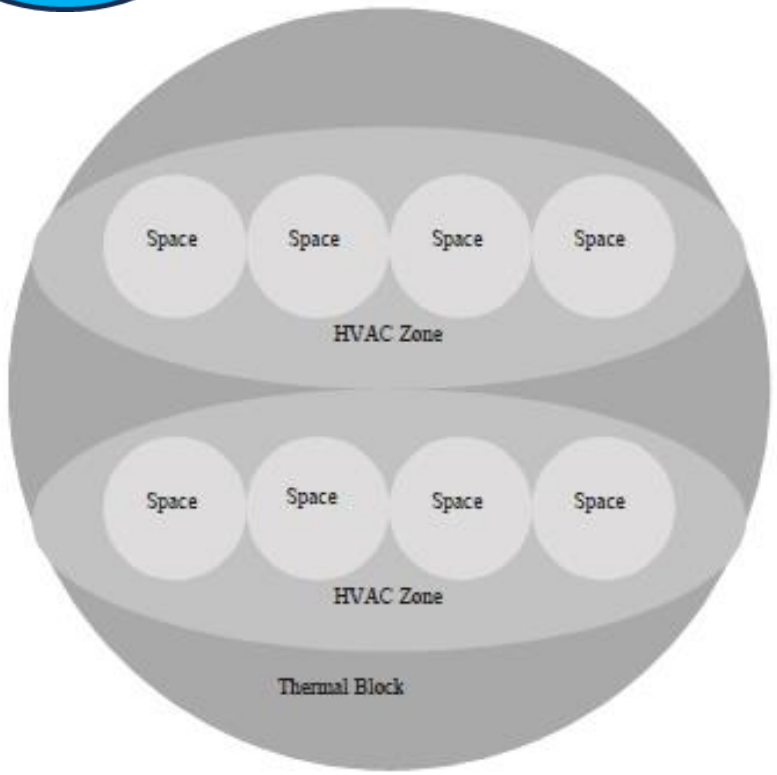

Figure 2. Hierarchy of Space, HVAC Zones, and Thermal Block

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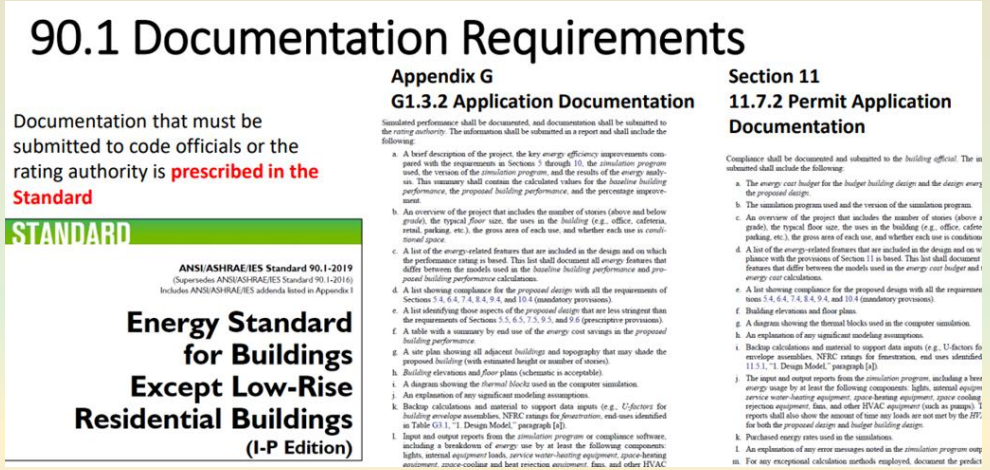
Compliance form

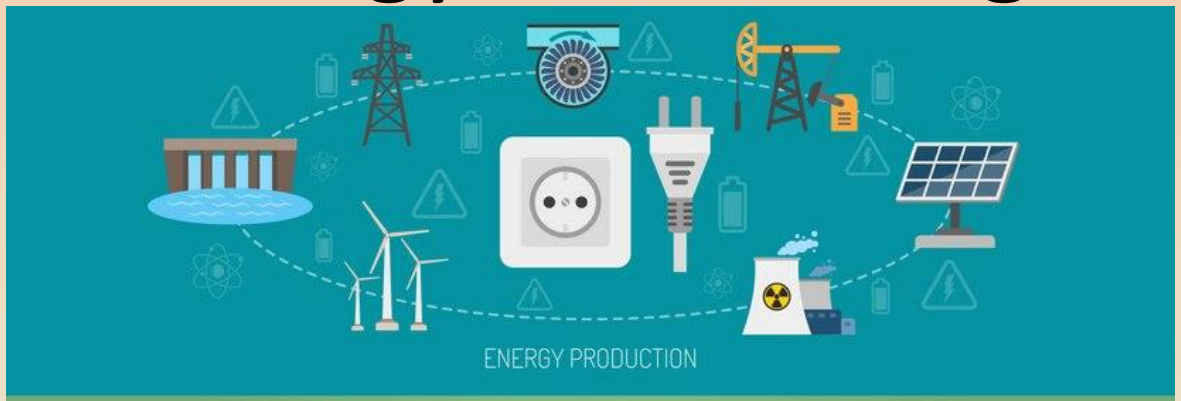
ASHRAE 90.1 2019

- This spreadsheet-based compliance form meets the documentation requirements of Standards 90.1-2016 and 2019 Section 11 Energy Cost Budget Method and Appendix G Performance Rating Method. It helps the modeler establish simulation inputs for the baseline/budget and proposed design models and includes a submittal checklist to ensure that all necessary supporting documentation is included in the submittal. It standardizes compliance documentations and simplifies submittal reviews by code officials and administrators of above code program implementers.
- What's new:
- This release of the ASHRAE Standard 90.1 Performance Based Compliance Form includes additional Building Performance Factors (BPFs) for the 2016 and 2019 editions for site energy, source energy, and greenhouse gas emissions. The new BPFs for these metrics are for reference only and are not used to determine compliance in the default versions. Only energy cost is used to determine compliance with Standard 90.1. In addition, the source energy BPFs used for the ENERGY STAR New Construction program for 2016 and 2019 have been updated to align with the source energy BPFs in the default 90.1 version of the Compliance Form. This revision also includes a small number of bug fixes which are documented on the "Revisions Log" tab.
- **Version:** V2.7
- **Release Date:** September 16, 2022
- Download:
- 90.1 Section 11 and Appendix G Compliance Form V2.7.zip*
- * Zip file contains a blank compliance form and a sample project:
- 90.1 Section 11 and Appendix G Compliance Form V2.7.xlsm
- Sample 90.1 Section 11 and Appendix G Compliance Form V2.7a.xlsm

- https://www.energycodes.gov/ashrae-standard-901-performance-based-compliance-form



Energy Monitoring



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- **8.4.3.1 Monitoring**
- Measurement devices shall be installed in new *buildings* to monitor the electrical *energy* use for each of the following separately:

ASHRAE 90.1 2019

a.Total electrical *energy*
b.HVAC systems
c.Interior lighting
d.Exterior lighting
e.Receptacle circuits

- For *buildings* with tenants, these *systems* shall be separately monitored for the total *building* and (excluding shared *systems*) for each individual tenant.
- **Exception to 8.4.3.1**
- Up to 10% of the load for each of the categories (b) through (e) shall be allowed to be from other electrical loads.

Key Elements & Challenges: Regulatory Authority

- **Who:**
  - **Program Administrator / Regulatory Authority (CID)**

- Responsible For:
  - Setting review methodology
  - Setting reviewer qualifications
  - Set code official qualifications
  - Setting modeling requirements & compliance forms
  - Setting minimum modeler qualifications
  - Create or approve data input forms or processes , spreadsheets and/or software
  - Accepting simulation software
  - Quality Assurance

  (For all Compliance Paths)

  * Setting up an independent review Board (NEW)

- Elements:
  - Compliance Paths Provide Flexibility
  - Variety of compliance tools and documents required
  - Energy Modeling / Simulation tools for Performance Path
  - Ongoing Quality Control / Assurance Critical
- Challenges:
  - Multiple Compliance Paths Bring Complication
  - Variety of compliance tools and documents must be developed and/or approved
  - Ongoing training required for all stakeholders
  - Data input imprecise / prone to error
  - Tools, modelers and training needed for Performance path
  - QC / QA methodologies under development
  - Each state is different, therefore no “clear” models to follow
  - Potential pushback from industry
  - Number of experts in NM must be increased
  - Necessary liaison with other departments & organizations: Green builders, utilities, Agencies, etc.

Key Elements & Challenges: Code Officials, Inspectors

- Code Official (CID or local jurisdiction)
  - Plan Checkers
  - Building Officials
- Code official responsibilities:
  - Review input documentation for logic & coherence
  - Compare software inputs to designs
  - Compare both documents & software outputs to actuals
  - Approve / Disapprove submissions
  - Collect information for QA / QC
- Building Inspector
  - Responsible For
    - Reviewing what is in place for conformance with plans & model inputs
    - CID Approved List of Third Party Inspectors: https://api.realfile.rtsclients.com/PublicFiles/1ee897135beb4b1c82715d36398de4c5/f55af725-ffb3-405a-8633-299c66261be5/3rd%20Party%20Approved%20List%20-%202022.docx.pdf

- Code official challenges
  - Must be familiar with multiple compliance pathways
  - Must be familiar with multiple software programs & models
  - Must be neither “too stringent” nor “too forgiving”, but “just right”
  - Will be training owners & design teams in code & processes
  - Insufficient numbers of trained code officials
  - Processes not yet finalized

Key Elements & Challenges: Applicant - Design & Submission

- Building Professional / Design Team / Project Team (Applicant):
  - Owner
  - Architectural team
  - Engineering team
  - Modeler
  - Commissioning Agent
  - (Stakeholder / community members)

- Responsibilities:
  - Project Design meeting all relevant Codes, submit documents
  - Determine appropriate pathway to compliance
  - Impeccably complete all forms and input data
  - Coherence between all required documents, simulations, and designs
  - Submission via checklist or data input (ComCheck) for mandatory elements
  - Select energy modeler
  - Energy Model Choice & Input, Output, Analysis
  - PE Stamps
  - Plan for, select, include Commissioning Agent
  - Building commissioning and checklist completion
  - Coordinate with all others on team to adjust design elements if needed

- Owner / Contractor / Professional challenges:
  - Practice Holistic design
  - Develop feel for appropriate pathway
  - Become familiar with compliance forms, spreadsheets, software
  - Keep costs / time under control
  - Work with energy modeler & Commissioning Agent
  - Practice increased coordination with team

Section 4 – Resources

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Flood of changes in the building & energy fields!

- General Building & energy code resources
- International Code Council resources
- ASHRAE performance path resources
- Energy code training resources
- Grants & Rebates

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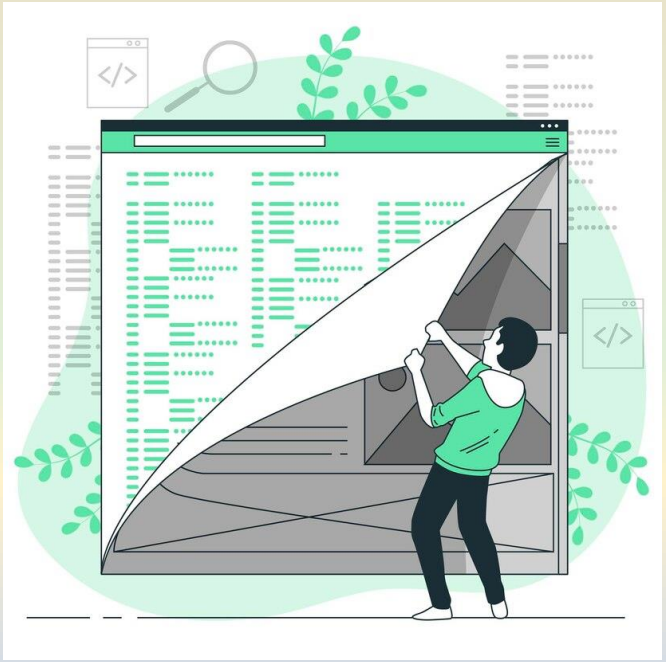
The Codes!

- New Mexico Code
- IECC 2021 (Annotated unofficially)
- ASHRAE 90.1 2018 (Annotated unofficially)



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Design references for Integrated Design

WBDG Whole Building Design Guide

Warehouse

by Ed Acker
Steven Winter Associates, Inc.
Updated: 09-16-2021

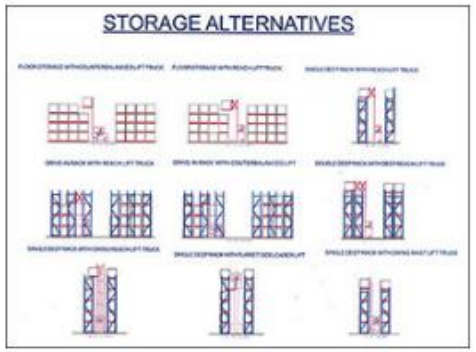
OVERVIEW

Warehouses are facilities that provide the proper environment for the purpose of storing goods and materials that require protection from the elements. Warehouses must be designed to accommodate the loads of the materials to be stored, the associated handling equipment, the receiving and shipping operations and associated trucking, and the needs of the operating personnel. The design of the warehouse should be planned to best accommodate business service requirements and the products to be stored/handled. The economics of modern commercial warehouses dictate that goods are processed in minimal turnaround time. Additionally, modern warehouses are becoming more sophisticated facilities that serve as hubs for high-tech tracking, repackaging, and quality control testing.

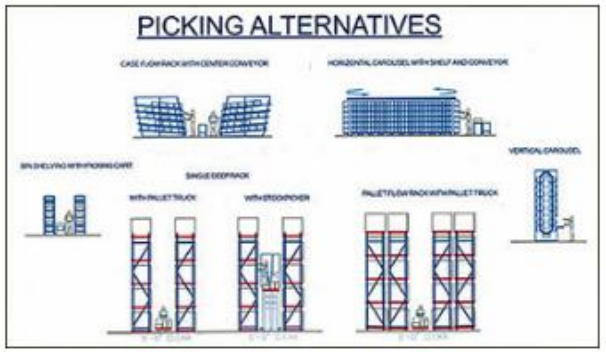
WITHIN THIS PAGE

There are different types of warehouses including:

- **Heated and unheated general warehouses**—provide space for bulk, rack, and bin storage, aisle space, receiving and shipping space, packing and crating space, and office and toilet space;
- **Refrigerated warehouses**—preserve the quality of perishable goods and general supply materials that require refrigeration. Includes freeze and chill space, processing facilities, and mechanical areas; and
- **Controlled humidity (CH) warehouses**—similar to general warehouses except that they are constructed with vapor barriers and contain humidity control equipment to maintain humidity at desired levels.



View enlarged storage alternatives



View enlarged picking alternatives

This 85,000 square foot flex warehouse, located on the east side of Baltimore, Maryland, was designed as a shell to meet LEED Silver and Baltimore's Green Building Standards.
Photo Credit: Arium | AE

RELEVANT CODES AND STANDARDS

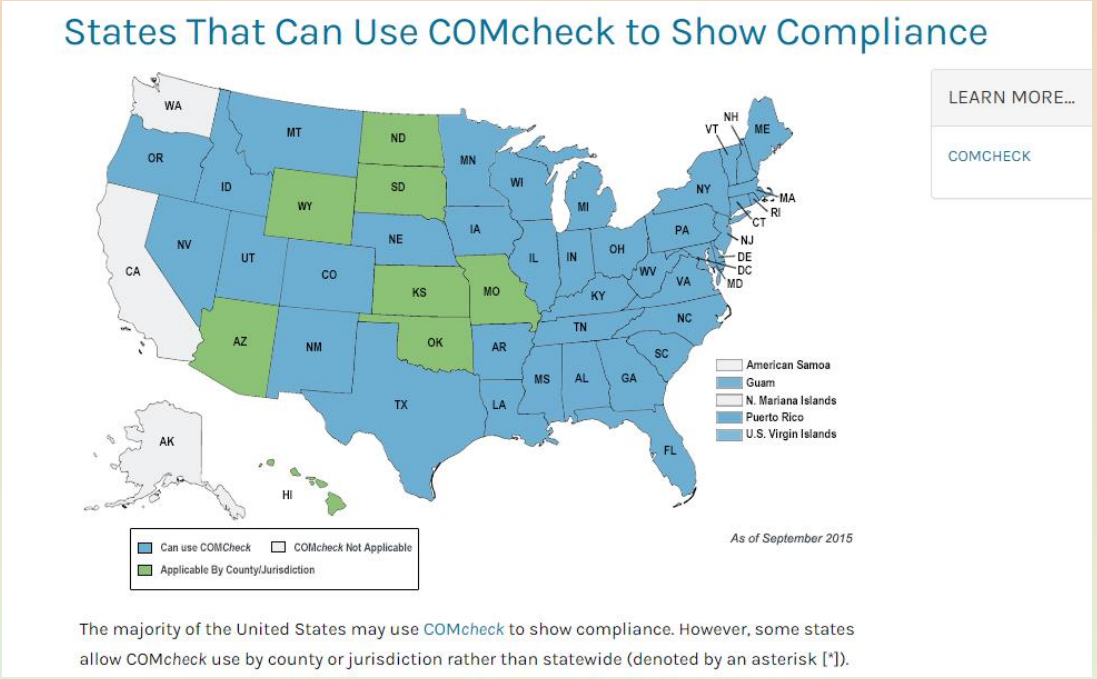
Warehouses must be designed to meet all local building, fire, and life-safety codes. When in doubt, consult with the local building official. The Occupational Safety and Health Administration (OSHA) also provides guidance for warehouse safety.

- Occupational Safety and Health Act of 1970 (29 U.S.C. § 651 et seq.)
- 29 C.F.R. Part 1903.1 et seq.—Inspections, Citations, and Proposed Penalties of Occupational Safety and Health Act of 1970

https://www.wbdg.org/building-types

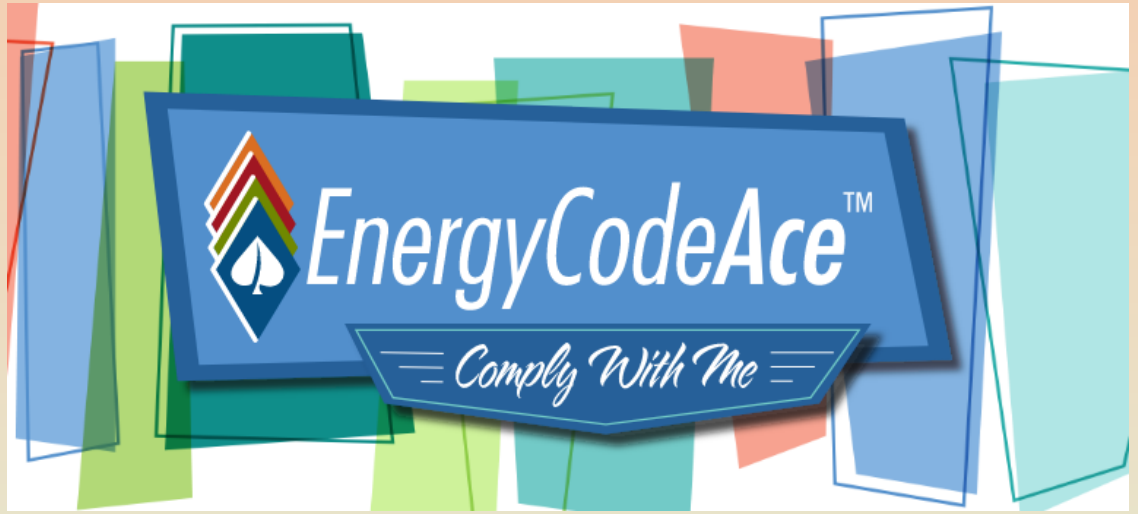
Compliance Documentation – COMcheck

- ComCheck
  - https://www.energycodes.gov/comcheck
  - Designed for prescriptive compliance & helps ID systems & components
  - Simplifies compliance for building officials, plan checkers, and inspectors
  - ComCheck does not have the NM Code programmed in at this point.
- LEED NC Spreadsheet & Energy Performance Calculator (ASHRAE) https://www.usgbc.org/resources/leed-v41-minimum-energy-performance-calculator (This is for ASHRAE)
- EPA EnergyStar MFNC (Multifamily buildings – "Residential" under code) https://www.energystar.gov/partner_resources/residential_new/homes_prog_reqs/multifamily_national_page
- NYC Forms to be completed https://www1.nyc.gov/site/buildings/codes/energy-code-forms.page
- CA Compliance Forms https://energycodeace.com/content/get-forms.
  - Approved software for commercial IES VE, EnergyPro, CBECC-Com
  - https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency-2
  - https://www.energy.ca.gov/publications/2019/2019-nonresidental-alternative-calculation-method-reference-manual



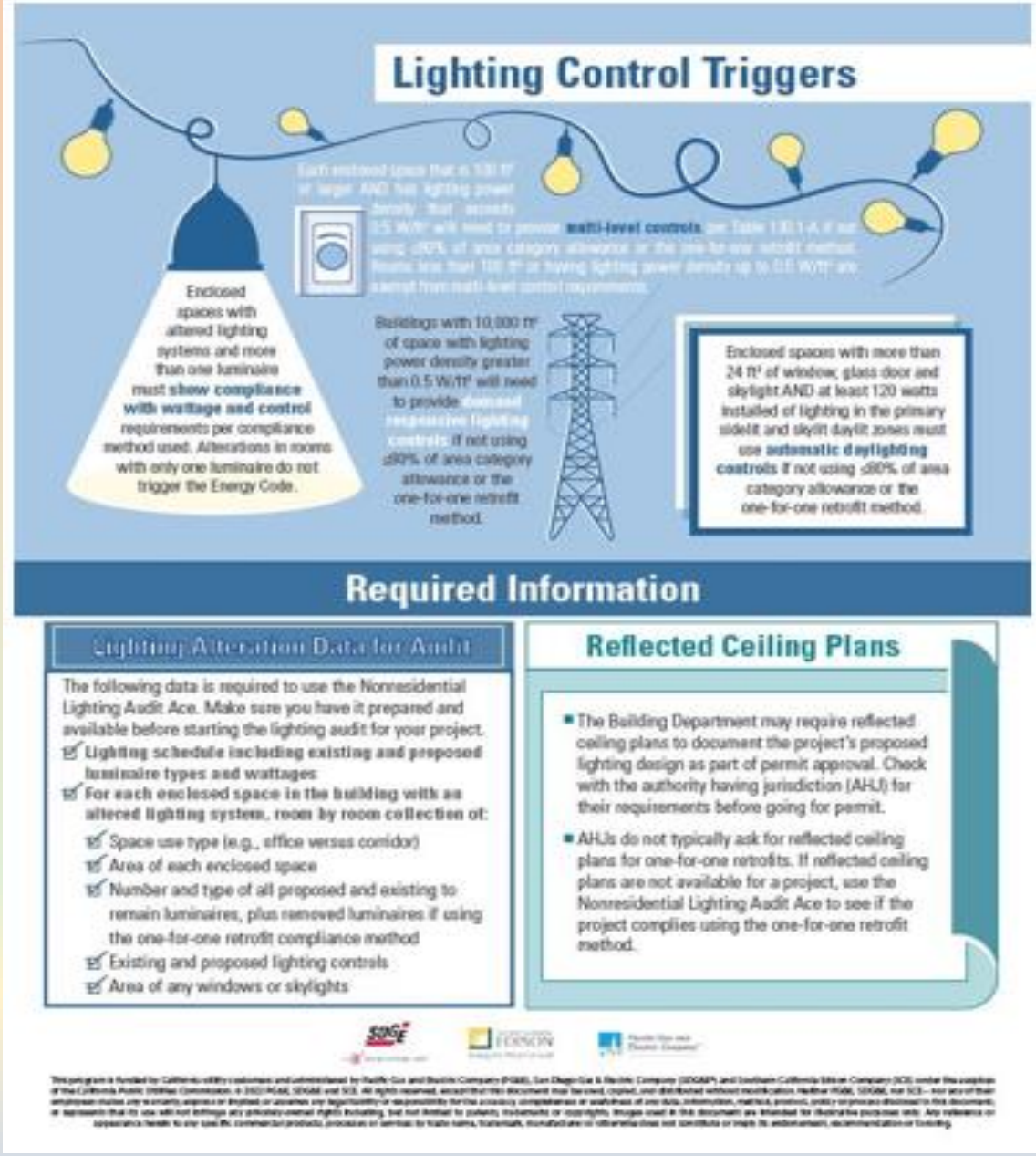
What is an Energy Code?

- Set of requirements for constructing a building legally
  - Minimum levels
  - Holistic
  - Addresses all aspects:
    - Building Envelope
    - Mechanical
    - Service Water Heating
    - Lighting
    - Electric Power



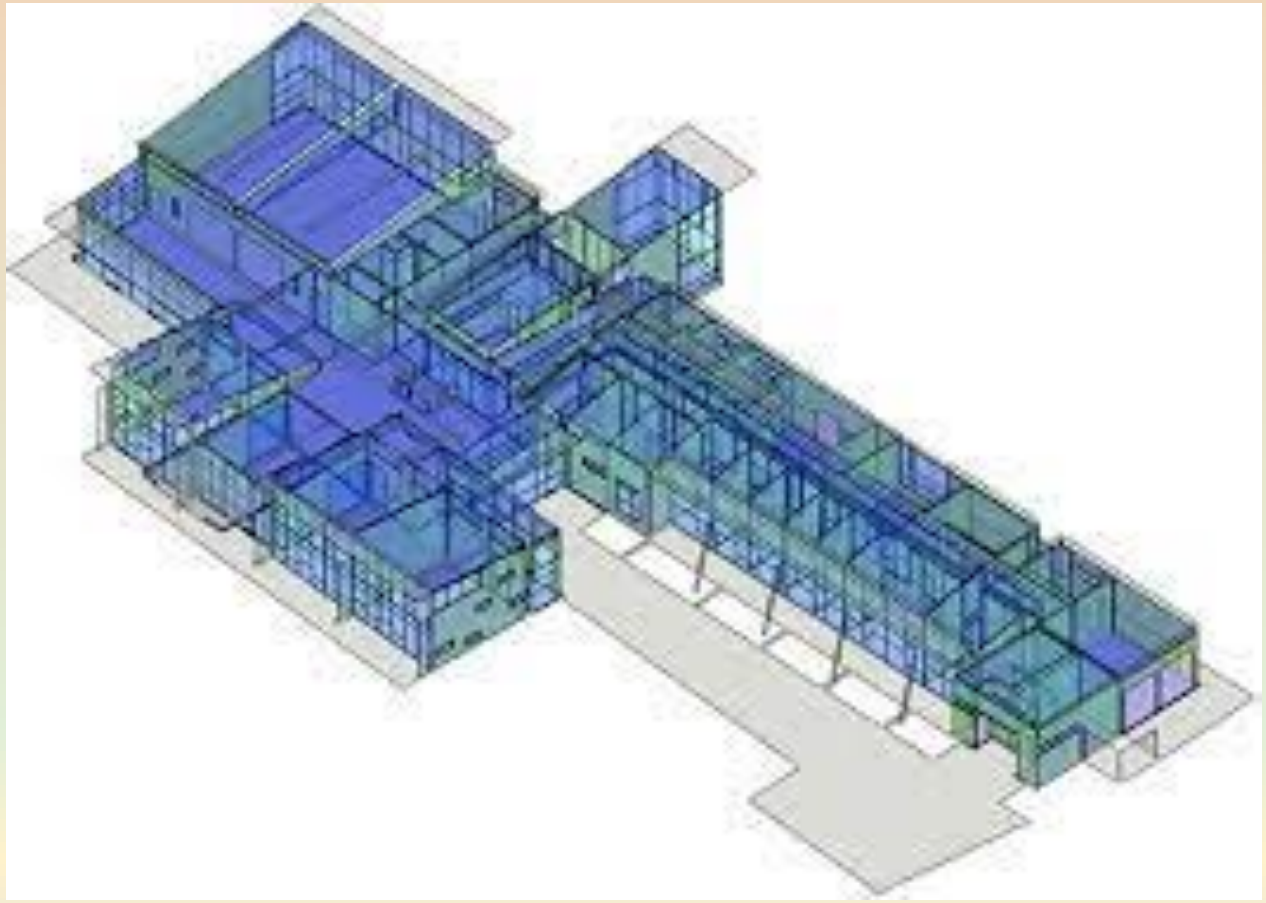
https://energycodeace.com/

EnergyCode ACE – Lighting Audit



Energy Modeling Resources

- Energy Model Qualifications – Recommendations https://www.energycodes.gov/sites/default/files/2022-07/2_Modeler_Quals_FINAL.pdf
- ASHRAE Building Energy Professional certification list https://certificants.ashrae.org/list?type=BEMP
- Additional Resources at https://www.energycodes.gov/performance_based_compliance
- Energy Modeler cost estimate $3K - $50K depending on building size & complexity and at what point modeler becomes involved



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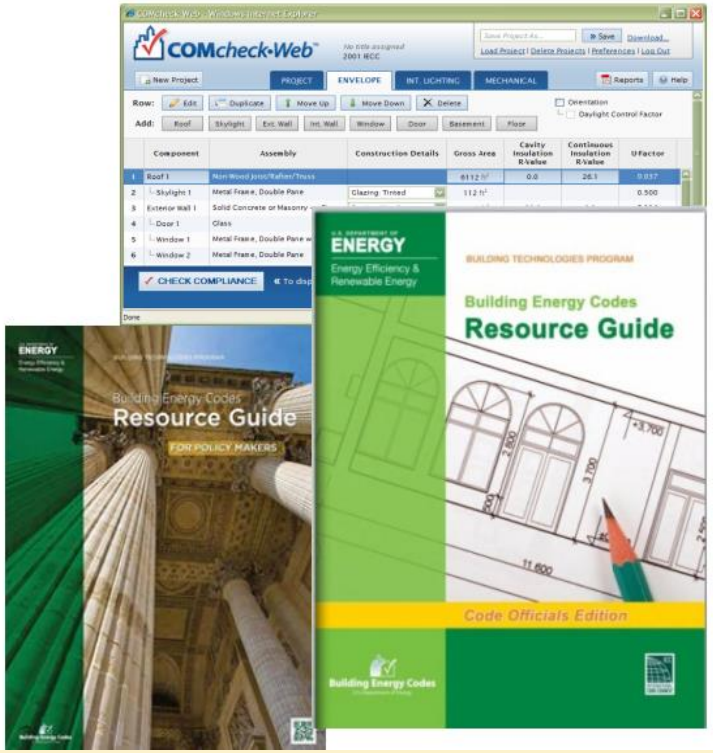
Resources - Cont'd

U.S. DOE: BECP Resources

- Compliance software
- Technical support
- Code Notes
- Publications
- Resource guides
- Training materials



- https://www.iccsafe.org/

ICC SUSTAINABILITY MEMBERSHIP COUNCIL

Sustainability Membership Council

https://www.iccsafe.org/membership/membership-councils/sustainability-membership-council/

The purpose of the Sustainability Membership Council (SMC) is to advocate for concerns and issues related to sustainability and energy efficiency that are of particular interest to Builders, Design Professionals, Industry, Policy Makers, Regulators, and other professionals; to assist the International Code Council (ICC) in increasing the participation of such individuals in the ICC code development process; and to advise the ICC on programs and policies, legislative matters, code adoption issues and such other matters as the SMC deems appropriate.

Xcel Energy

Tools https://www.energycodes.gov/performance_based_compliance

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Compliance Form — Proper enforcement of performance-based compliance submittals is necessary to ensure consistency and confidence in modeling results, yet, enforcement is a notoriously difficult process. This spreadsheet-based compliance form meets the documentation requirements of Standards 90.1-2016 and 2019 Section 11 Energy Cost Budget Method and Appendix G Performance Rating Method. It helps the modeler establish simulation inputs for the baseline/budget and proposed design models and includes a submittal checklist to ensure that all necessary supporting documentation is included in the submittal. It standardizes compliance documentations and simplifies submittal reviews by code officials and administrators of above code program implementers.
For questions about use or customization of the form please contact the Building Energy Codes Help Desk
Review Manual — The ASHRASE 90.1 Section 11 and Appendix G Submittal Review Manual (the Manual) is a comprehensive reference for reviewing modeling-based submittals. The Manual is a companion to the DOE/PNNL 90.1 Section 11 and Appendix G Compliance Form and supports 2016 and 2019 editions of ANSI/ASHRAE Standard 90.1. The forms can be downloaded here.
The Review Manual includes the following:
1.The review checks to verify that the proposed design reported in the Compliance Form reflects design documents; that the configuration of the baseline/budget model is established correctly, that the baseline/budget and proposed design is modeled as reported, that the simulation is error-free, and that the compliance outcome is established correctly;
2.Checks to verify compliance with the mandatory requirements of 90.1 relevant to the simulation inputs;
3.Examples and common mistakes;
4.The methodology for prioritizing the review;
5.Simulation reports for common BEM tools annotated with tips on performing specific checks.
In addition, the Manual provides recommendations to jurisdictions and rating authorities for establishing effective and efficient submittal review process including but not limited to the adoption of the DOE/PNNL 90.1 Section 11 and Appendix G Compliance Form.
ASHRAE Standard 90.1 Adopter Toolkit Navigator provides recommendations for organizing effective and efficient submittal review of projects that follow ASHRAE 90.1 Section 11 and Appendix G, and includes links to the tools and resources available to jurisdictions and beyond-code programs including the following:
- **Recommended Minimum Energy Modeler Qualifications** including work experience, professional credentials and completed trainings
- **Recommended Minimum Submittal Reviewer Qualifications** including work experience, professional credentials and completed trainings
- **Third Party Submittal Reviewer Scope of Work** is a template that may be used by jurisdictions and rating authorities who chose to engage external consultants for performing submittal review of projects documenting compliance with ASHRAE Standard 90.1 using Energy Cost Budget Method (Section 11) or Performance Rating Method (Appendix G). The template provides an overview of third party review process, suggested tasks and deliverables

Performance-Based Code Compliance: A Roadmap to Establishing Quality Control and Quality Assurance Infrastructure. This report was completed as part of a research project to facilitate performance-based compliance with commercial energy codes. It provides short, medium and long-term recommendations for streamlining enforcement and ensuring consistency in compliance outcomes. It incorporates input from over 70 stakeholders representing jurisdictions, rating authorities, developers of relevant standards and organizations.
Performance Rating Method Reference Manuals (PRM RM). These documents are intended to be a reference manual for the Appendix G PRM of Standard 90.1-2016. The PRM can be used to demonstrate compliance with the standard and to rate the energy efficiency of commercial and high-rise residential buildings with designs that exceed the requirements of Standard 90.1. The procedures and processes described in this manual are designed to provide consistency and accuracy by filling in gaps and providing additional details needed by users of the PRM. PNNL has created PRM RMs for Standard 90.1 2010 and 2016 .

Training webinar recordings available! BECP hosted two webinars on forms for performance-based code compliance:
•*Performance-based Compliance Documentation for ASHRAE 90.1 Section 11 and Appendix G* — September 29,2020. Learn more
•*Performance-based Compliance for Submittal Reviewers* — December 8, 2020. Learn more

Resources

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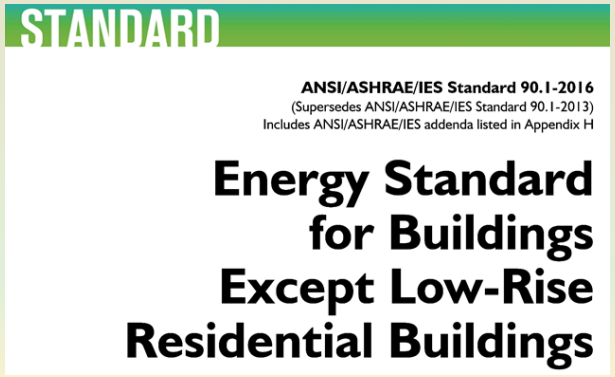
https://www.energycodes.gov/performance_based_compliance

- Compliance Form https://www.energycodes.gov/ashrae-standard-901-performance-based-compliance-form
- ASHRAE 90.1 Section 11 and Appendix G Submittal Review Manual https://www.energycodes.gov/sites/default/files/2022-09/90.1%20Secton%2011%20and%20Appendix%20G%20Review%20Manual%20V03.pdf
- Tools & Resources for Rating Authorities – ASHRAE 90.1 Section 11 or Appendix G https://www.energycodes.gov/sites/default/files/2022-07/1_90.1_Performance-Based_Compliance_Adopter_Toolkit_Navigator_FINAL.pdf
- Reference Manual https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26917.pdf
- WEBINAR Performance Based Compliance Documentation for ASHRAE 90.1 Section 11 and Appendix G https://www.energycodes.gov/technical-assistance/training/courses/performance-based-compliance-documentation-ashrae-901-section
- WEBINAR Performance-based Compliance for Submittal Reviewers https://www.energycodes.gov/technical-assistance/training/courses/performance-based-compliance-submittal-reviewers

$177 from ASHRAE



Qualifications of Energy Modelers https://www.energycodes.gov/sites/default/files/2022-07/2_Modeler_Quals_FINAL.pdf

Submittal Reviewer Qualifications https://www.energycodes.gov/sites/default/files/2022-07/3_Reviewer_Quals_FINAL.pdf

Third Party Submittal Reviewer SOW https://www.energycodes.gov/sites/default/files/2022-07/4_Third_Party_Reviewer_FINAL.pdf

Viewable version of the Standard https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.1_2016_IP

Where to go for detailed training, help and questions?

- Department of Energy Building Energy Codes Program https://www.energycodes.gov/
- Department of Energy Office of Energy Efficiency and Renewable Energy https://www.energy.gov/eere/office-energy-efficiency-renewable-energy
- https://www.iccsafe.org/advocacy/energy-efficiency-resources-model-policies/
- State of CO webinars https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes and
- Energy Adoption Toolkit https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes/energy-code-adoption-toolkit
- SouthWest Energy Efficiency Project https://www.swenergy.org/buildings/energy-codes
- Utilities
- State of New Mexico Energy Minerals Natural Resources Department https://www.emnrd.nm.gov/ecmd/energy-code-for-buildings/
- State of NM Circuit Rider Program https://swenergy.org/nm-energy-code-circuit-rider
- Smart Energy Design Assistance Center (SEDAC) https://smartenergy.illinois.edu/

Additional Resources

- NM Home Builders Association Codes Summary https://www.nmhba.com/building-code-information/
- 2023Lighting Controls Association https://lightingcontrolsassociation.org/2021/02/26/iecc-2021-decoded/
- Unirac https://unirac.com/certified-installer/
- B Public Prefab https://bpublicprefab.com/new-events/high-performance-prefab-rocky-mountain-installer-training-4af4j-2684c-xhka2-7jhed-b298h
- Mitsubishihttps://www.mitsubishicomfort.com/commercial/training
- Solar Tax Credits for Businesses https://www.energy.gov/sites/default/files/2023-03/Federal-Solar-Tax-Credits-for-Businesses-3-23.pdf
- Solar Tax Credit for homeowners https://www.seia.org/research-resources/25d-solar-tax-credit-what-homeowners-need-know
- SPEER Energy Efficiency as a Resources – Commercial Changes in the 2021 IECC https://www.youtube.com/watch?v=rmxc8u4HHRI
- State Incentives for Renewables & Efficiency
- https://www.dsireusa.org/
- New Mexico Decarbonization Roadmap https://gridworks.org/initiatives/new-mexico-building-decarbonization-roadmap/
- EMNRD https://www.emnrd.nm.gov/ecmd/energy-code-for-buildings/
- SEDAC Top 40 Requirements You Should Know
- https://smartenergy.illinois.edu/wp-content/uploads/2022/09/2021-IECC-Top-40.pdf

Thank You!

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