NET ZERO ENERGY SERIES: CODE AND NET ZERO EMISSIONS

BUILT ENVIRONMENT AND ENERGY ADVISORY COMMITTEE (BEEAC)

Thursday June 18 2020 | 10:00 AM EDT

Metropolitan Washington
Council of Governments

EST
2007

Above Green

MIDDLEBURG, VA

PRESENTER

Bala Srini

PRINCIPAL

Background

ARCHITECTURE, PROJECT MANAGEMENT, ENVELOPE COMMISSIONING, SUSTAINABLE DESIGN, NET ZERO ENERGY

Credentials

LEED AP BD+C, FITWEL, BUILDING ENCLOSURE COMMISSIONING PROVIDER (BECxP)

bala@abovegreen.com

About Us

Above Green is a full service and national firm that helps architects, builders, and developers create eco-conscious offices, luxury apartments, hotels, and restaurants. Based outside the beltway in Washington, D.C.'s wine country they provide sustainable design consulting services for rating systems, including, LEED, IgCC, and SITES. All services including energy modeling, commissioning, and construction administration are provided in-house. The entire process is taken care of so everything you need to get certified is done for you.

CERTIFIED WOMAN OWNED

Above Green is a certified Small, Women and Minority-Owned (SWaM) business through the State of Virginia. This rigorous certification means that we are approved to do business with any government agency with set asides. This also qualifies us for work with private companies that have diverse supplier requirements.

USGBC SILVER MEMBER

We are a Silver Member of the USGBC, and we are engaged with the National Chapter of the USGBC. This level of membership enables us to save our clients up to 30% on project registration and certification fees.

CERTIFIED B CORPORATION

Above Green is a Certified B Corporation. There are only 1,000 companies in the world with this designation, which requires adherence to rigorous standards of corporate performance, accountability, and transparency. Our own bylaws include provisions that make social good, environmental responsibility, and employee health an important part of our business model.

USGBC PROVEN PROVIDER

Above Green has earned the designation of Proven Provider thru the USGBC's program. This designation is only for experienced consulting organizations that demonstrate consistent excellence in administering LEED projects. This program enables us to streamline LEED documentation and a shorter timeline on the review process for our projects.

NET ZERO ENERGY SERIES: CODE AND NET ZERO EMISSIONS

A deep dive into the policy trends and current codes in our tri-state region compared nationally. We will explore how far are current energy codes from net zero.

LEARNING OBJECTIVES

1. Definitions and Major Building and Energy Codes
2. Programs, policies, goals, codes and stretch codes; Regional and National adoptions
3. Energy Code status with Net Zero
4. Energy Code Impact Analysis
5. Code Recommendations

BUILDING CODE

ICC (International Code Council)

ICC develops codes I codes and are published on a 3 year life-cycle
(..2009, 2012, 2015, 2018, 2021,...) International Building Code (IBC)
International Residential Code (IRC)
International Fire Code (IFC)
International Plumbing Code (IPC)
International Mechanical Code (IMC)
International Fuel Gas Code (IFGC)
International Energy Conservation Code (IECC)
ICC Performance Code (ICCPC)
International Wildland Urban Interface Code (IWUIC)
International Existing Building Code (IEBC)
International Property Maintenance Code (IPMC)
International Private Sewage Disposal Code (IPSDC)
International Zoning Code (IZC)
International Green Construction Code (IgCC)
International Swimming Pool and Spa Code (ISPSC)

Source: iccsafe.org

By 2060, the world is projected to add **2.5 trillion sq.ft (230 billion sq.m)** of buildings, or an area equal to the entire current global building stock.

This is the equivalent of adding an entire New York City to the planet every 34 days for the next 40 years.

=

every X 34 days

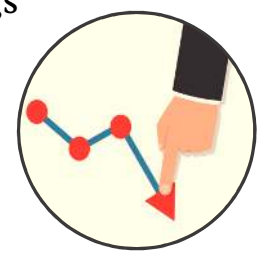
next X 40 years

Source: UN Environment, Global Status Report 2017

ENERGY CODE

DOE estimates that through 2040, building energy codes will: (cumulative 2010-2040)

$126 billion
energy cost savings

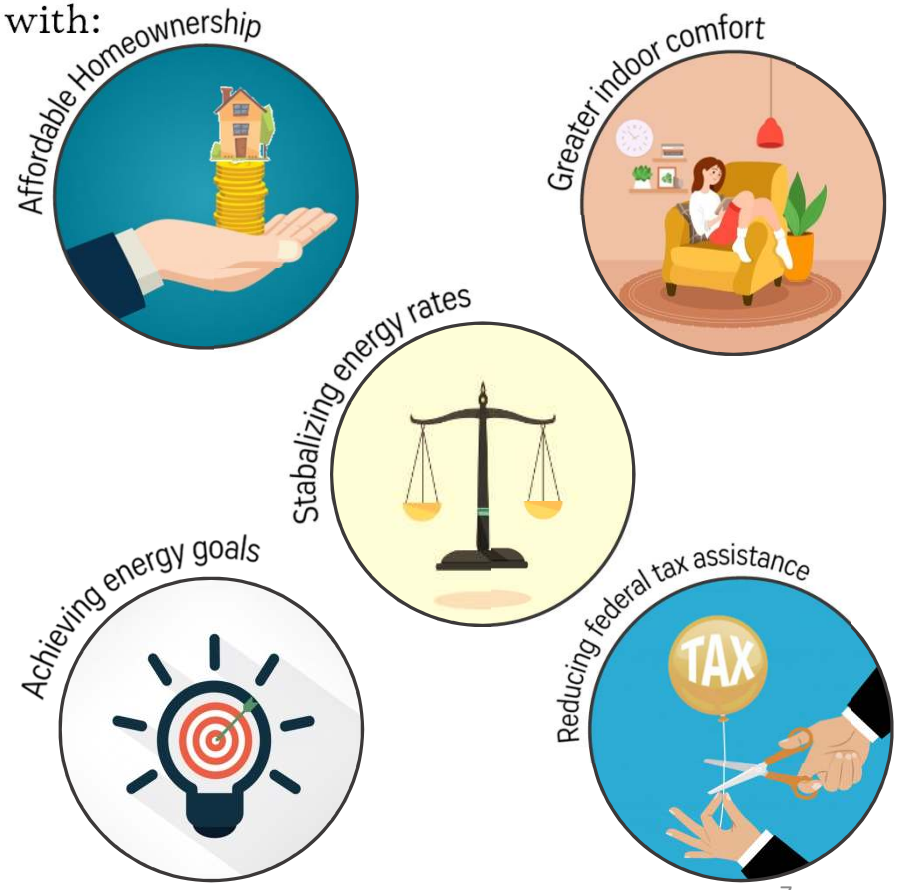


841 Million Metric Tons
of avoided CO2 emissions

2/3rd Americans live in a jurisdiction covered by either the 2018 IECC or the 2012 or 2015 editions

Following 2021 IECC would provide a boost of energy efficiency and lay the groundwork for a glide path to net-zero energy construction.

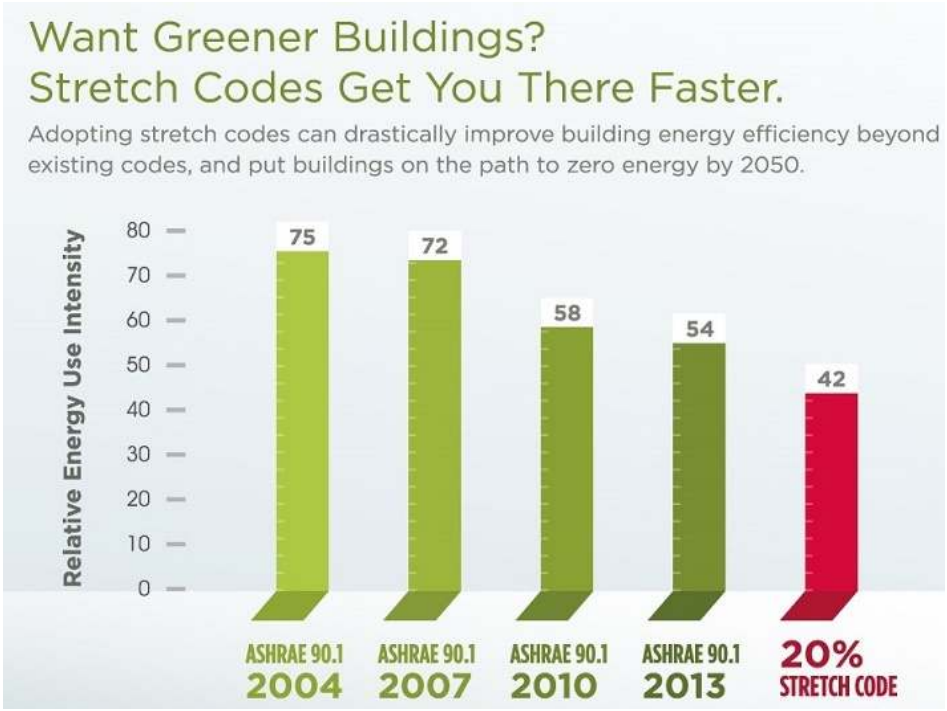
Making steady 2021 and future IECC efficiency gains will benefit economies and communities with:



Source: energycodes.gov & iccsafe.org

"I DO NOT CHANGE THE BUILDING CODES EVERY WEEK. I DO IT EVERY OTHER WEEK."

TERMINOLOGIES



stretch code

STRETCH CODE:

- **voluntary appendix to a mandatory statewide minimum code**
- allows municipalities to adopt a uniform beyond code option to achieve greater levels of efficiency.

Regions with Stretch Codes in Action:

- Washington DC
- Massachusetts
- State of New York
- Vermont
- Santa Monica, California

Source: bcapcodes.org, newbuildings.org, nrdc.org

TERMINOLOGIES

reach code

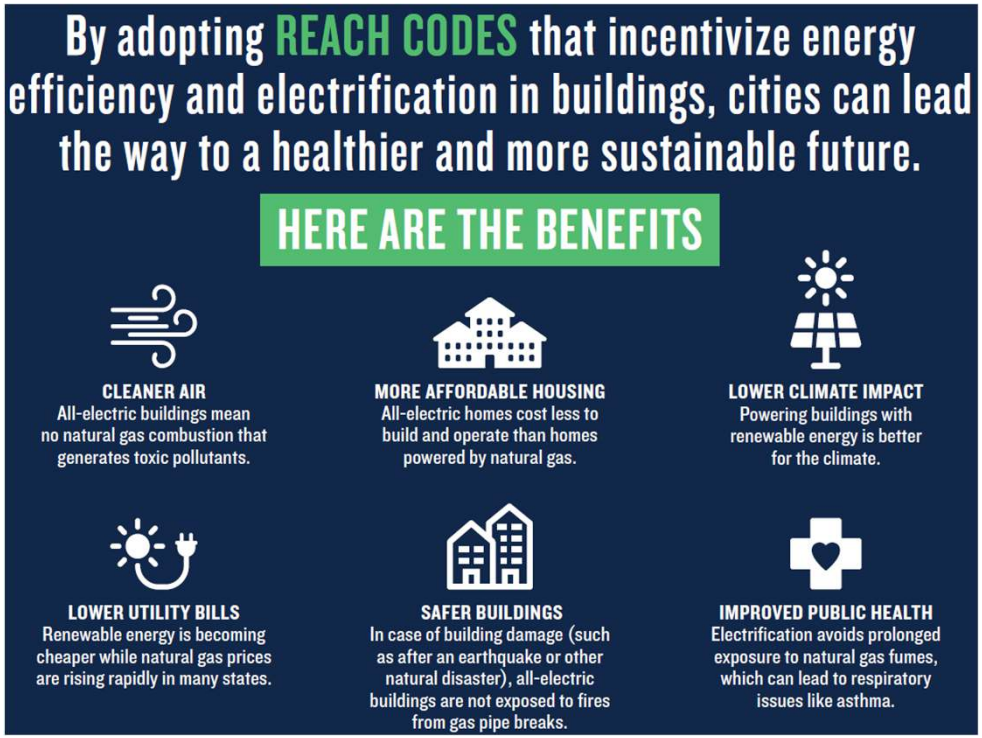
REACH CODE:

- **statewide optional construction standards** for energy efficiency that exceed the requirements of the state's mandatory codes.
- optional path for high performance construction and jurisdictions can be assured that the innovative construction methods are sound.

Regions with Reach Codes in Action:

- Oregon
- Silicon Valley

San José's proposed reach code;



Source: bcapcodes.org, newbuildings.org, nrdc.org

TERMINOLOGIES

Seattle SDCI - Metered Energy Display Designer Guide

	Code Requirements
Energy Display System Vendor Options (Seattle Energy Code Section C409.4.3, C409.4.2)	■ Simultaneously view current consumption rate for each whole building energy source and the average and peak hourly consumption values for any day, week month or year ■ Provide weather-normalizing data in the comparison time periods ■ Facilitate the use of energy use trends and identification of anomalies ■ Support at least hourly data intervals and data storage for 36 months

Source: wbdg.org, seattle.gov

outcome - based

OUTCOME-BASED ENERGY CODES (ADVANCED CODES)

- **An outcome-based performance path** emphasizes the building's ability to achieve the expected energy performance as it is continually operated and maintained.
- **Outcome-based codes** establish a target energy use level and provide for measurement and reporting of energy use to assure that the completed building performs at the established level.

- City of Seattle incorporated "Target Performance Path"
- 2015 IgCC & 2018 IECC

LEED & ENERGY CODE CYCLE

	Code Cycle	Code Cycle	Code Cycle	Code Cycle	Future Updates
LEED	V3 2009	V4 2016	-	V4.1 2019	NO TIMELINE
ASHRAE 90.1	2007	2010	2013	2016	2019
IECC	2009	2012	2015	2018	2021
IgCC	-	2012	2015	2018	2021
ASHRAE 189.1	2009	2011	2014	2017*	2020

- *- ASHRAE Standard 189.1-2017 is available only outside of United State & Canada. ASHRAE is a standard not code but referenced in several codes for compliance*

Source: usgbc.org, iccsafe.org

ENERGY STAR BASELINE

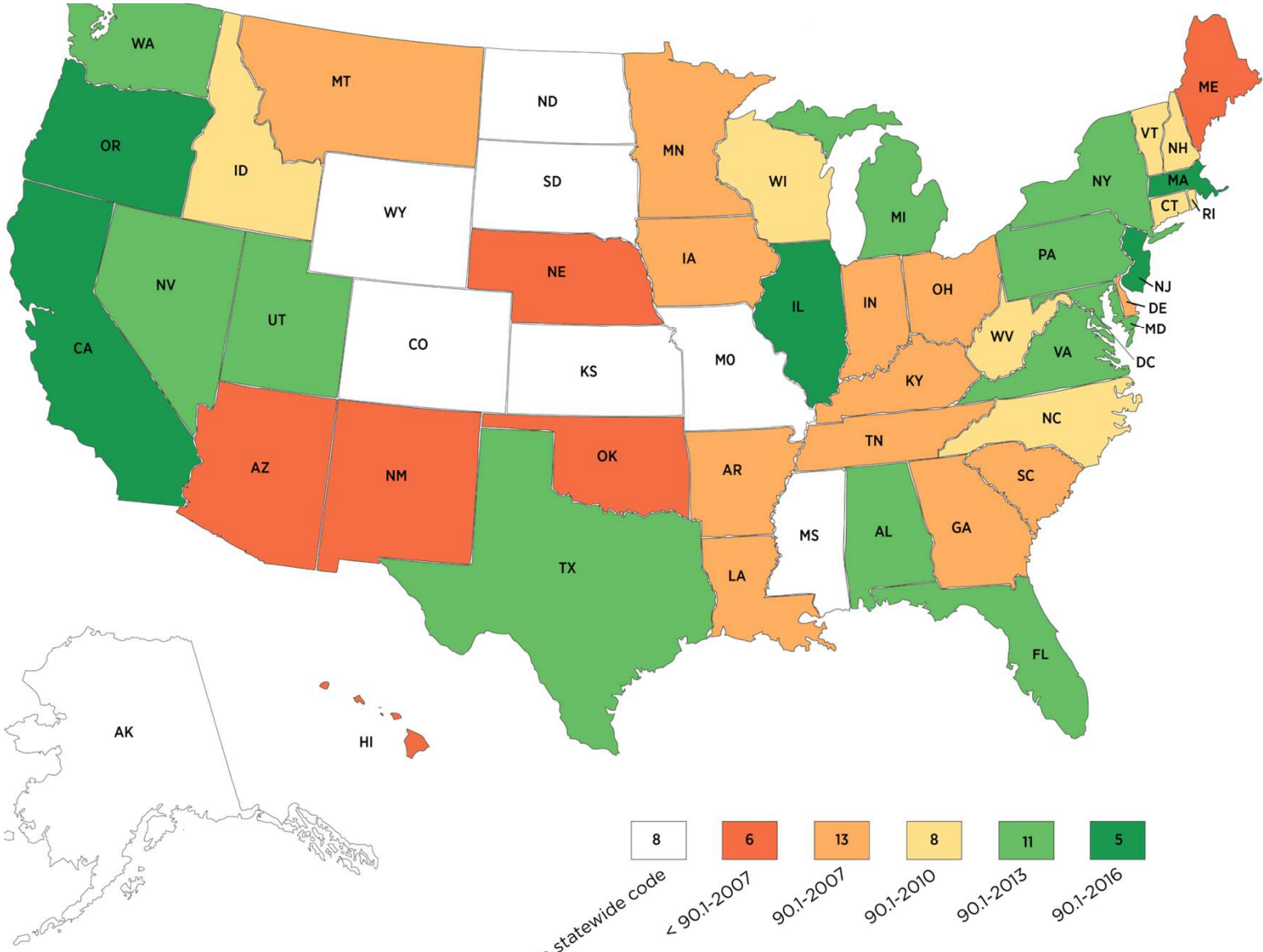
COMMERCIAL BUILDING ENERGY CONSUMPTION SURVEY	YEAR DATA	ADOPTED
CBECS	1995	2000
CBECS	1999	2004
CBECS	2003	2009
CBECS	2012	2018

CURRENTLY COMPARES TO THIS 2012 DATA

Source: energystar.gov

CODE ADOPTION STATUS

COMMERCIAL ENERGY CODE ADOPTION



Updated as of December 2019
Source: energycodes.gov

STATUS OF STATE ENERGY CODE ADOPTION MAP SUMMARY - COMMERCIAL

STATE	CURRENT CODE (AS OF DECEMBER 2018)	STATE MAP LEGEND
Arizona	Home rule	Less energy efficient than 90.1-2007
California	2019 California Energy Code	More energy efficient than 90.1-2016
Colorado	2003 IECC for jurisdictions that have adopted codes (Home Rule)	No statewide code or home rule
District of Columbia*	2012 IECC with amendments and 90.1-2010	Between 90.1-2007 and 90.1-2010
Maryland**	2015 IECC with amendments and 90.1-2013	Between 90.1-2010 and 90.1-2013
Massachusetts	2015 IECC with amendments and 90.1-2013	More energy efficient than 90.1-2013
New York	2015 IECC and 90.1-2013 with amendments	Between 90.1-2010 and 90.1-2013
Texas	2015 IECC and 90.1-2013	Between 90.1-2010 and 90.1-2013
Virginia	2015 IECC and 90.1-2013	90.1-2013 or equivalent
Washington	2015 Washington State Energy Code	More efficient than 90.1-2013

** - DC adopted as of May 29, 2020 – DC Energy Conservation Code 2017 with ASHRAE 90.1 2013 & substantial portions of ASHRAE 189.1 2014, residential provisions of 2015 IECC & amended 2012 IgCC*

*** - MD state has adopted 2018 I codes*

Source: energycodes.gov

NEW YORK

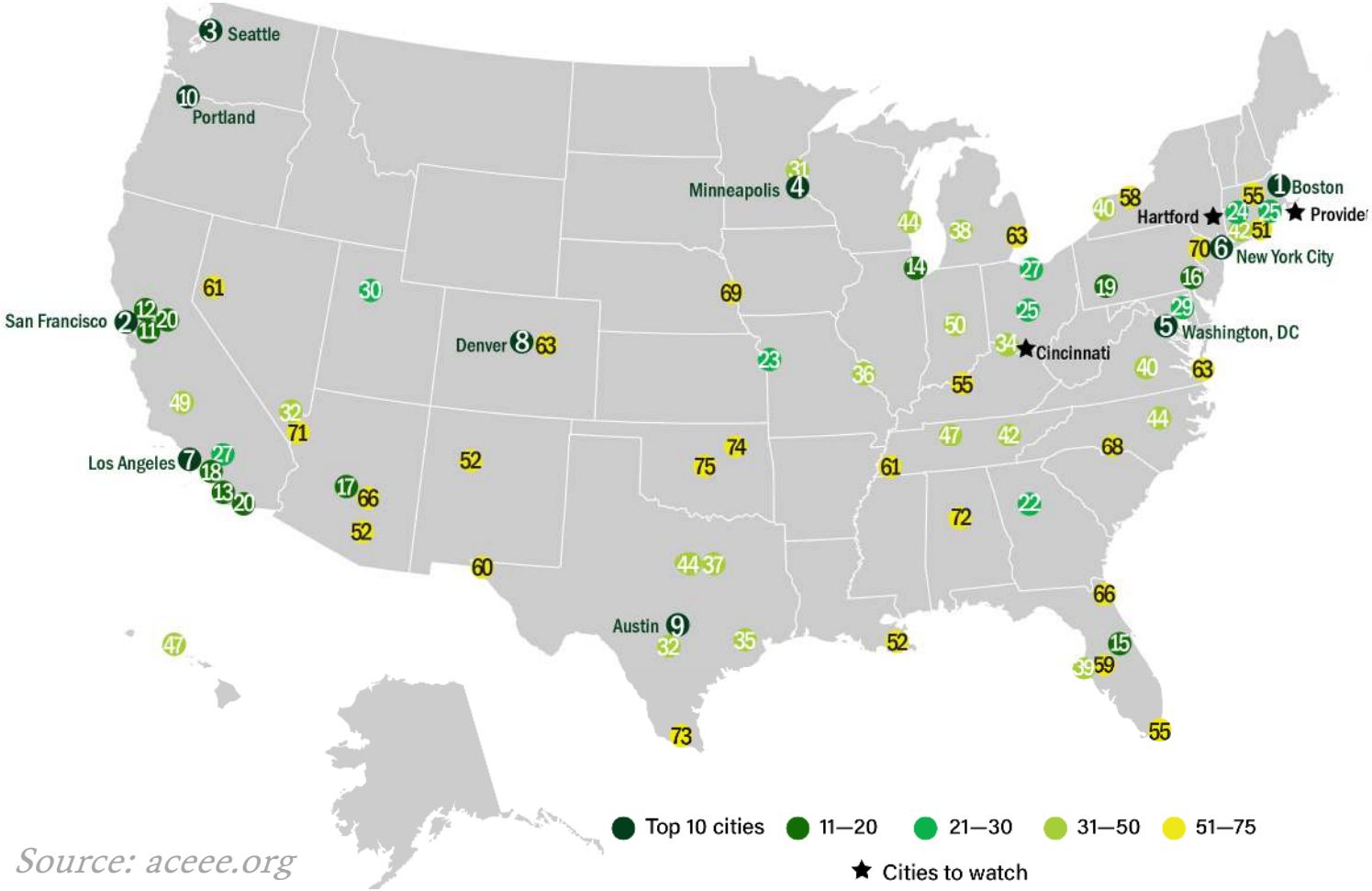
ADOPTED CODE	STRETCH CODE	CLIMATE ACTION GOALS
2014 Construction Codes	NYStretch Energy Code to be adopted from 2020	By 2020: Adopt NYC Energy Conservation Code
2020 NYC Energy Conservation Code *		By 2030: Reduce GHG 40% below 1990
(above code is based on 2018 IECC)		By 2030: 70% of state's power from renewable sources
2015 IRC with amendments		By 2040: Achieve 100% carbon neutrality
2009 IMC with amendments		By 2050: Reduce GHG 90% below 1990

** - effective date 12 May 2020*

Source: nyc.gov

ACEEE'S CITY CLEAN ENERGY SCORECARD 2019

Ranks 75 large U.S. cities on what they are doing to save energy in five key areas



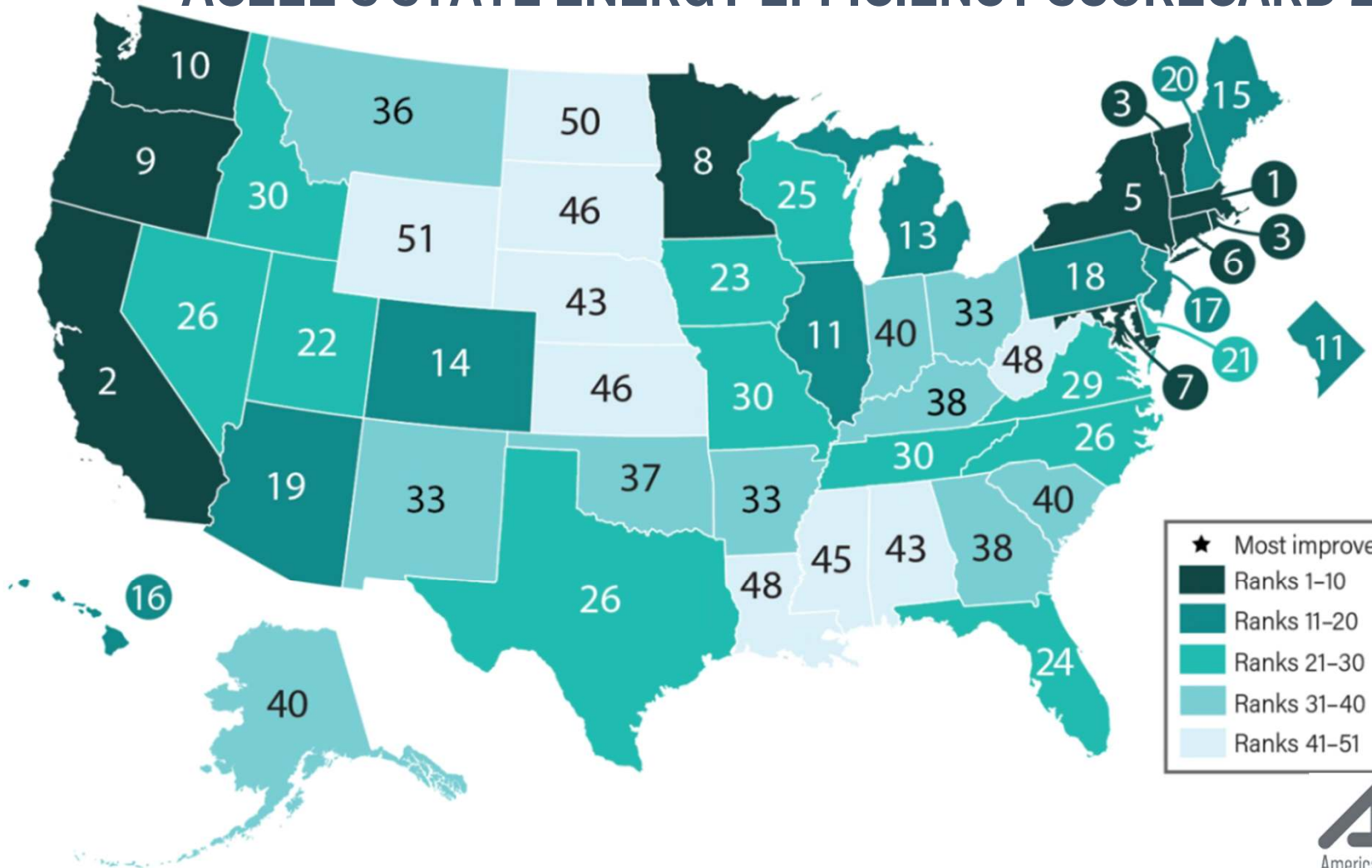
Top 10 cities

1. Boston
2. San Francisco
3. Seattle
4. Minneapolis
5. Washington
6. New York City
7. Los Angeles
8. Denver
9. Austin
10. Portland

Source: aceee.org

ACEEE
American Council for an Energy-Efficient Economy

ACEEE'S STATE ENERGY EFFICIENCY SCORECARD 2019



ACEEE
American Council for an Energy-Efficient Economy

Source: aceee.org

WASHINGTON D.C.

ADOPTED CODE	STRETCH CODE	CLIMATE ACTION GOALS
DC Construction Codes supplement of 2017	DC Net-Zero Energy Program*	By 2032: Reduce GHG 50% below 2006
2012 IgCC with amendments	Building Energy Performance Standards (BEPS)	By 2032: 100% renewable energy
2017 DC Energy Conservation Codes *ASHRAE 90.1 2013 & substantial portions of ASHRAE 189.1 2014*		By 2050: Reduce GHG to net zero
2015 IECC with amendments		By 2032: district wide energy use reduction by 50%
2015 IBC with amendments		
2015 IRC with amendments	**- with 2017 DC Construction Code, DCRA offers a rolling set of incentives to projects pursuing an approved net-zero energy (NZE) standard under the DC Net-Zero Energy Program*	
2015 IEBC with amendments		

- *Source: iccsafe.org*

MARYLAND

ADOPTED CODE	STRETCH CODE	CLIMATE ACTION GOALS
Building Code 2018 of MD adopts I Codes 2018	No Stretch Code	By 2030: Reduce GHG 40% below 2006
2018 IBC with amendments		By 2040: 100% Clean electricity
2018 IgCC with amendments		
2018 IECC with amendments		
2018 IRC with amendments		
2018 IMC with amendments		
2018 IEBC with amendments		

Source: iccsafe.org

Montgomery County approved to adopt 2018 I-Codes but yet to announce effective & sunset dates

MONTGOMERY COUNTY

Source: montgomerycountymd.gov

ADOPTED CODE	STRETCH CODE	CLIMATE ACTION GOALS
County Building Code, Chapter 8	No Stretch Code	By 2027: Reduce GHG 80% below 2005
2015 IBC with amendments		By 2035: Reduce GHG 100% below 2005
2012 IgCC with amendments		
2015 IECC with amendments		
2015 IEBC		
Maryland Accessibility Code		
2015 NFPA 101 Fire and Life Safety Code		

VIRGINIA

ADOPTED CODE	STRETCH CODE	CLIMATE ACTION GOALS
2015 VA Uniform Building Code is based on the 2015 I-codes.	No Stretch Code	By 2030: 30% renewable energy
2015 IBC with amendments		By 2050: 100% carbon-free electricity goal
2015 IECC with amendments		
2015 IRC with amendments		
2015 IMC with amendments		
2015 IEBC with amendments		

Source: iccsafe.org

ADOPTED CODE	STRETCH CODE	CLIMATE ACTION GOALS
2015 Virginia Uniform Statewide Building Code	No Stretch Code	By 2022: 50% electricity for government operations from renewable sources
2015 IBC with amendments		By 2025: 100% electricity for government operations from renewable sources
2015 IEBC with amendments		By 2025: Cut generating fleet carbon dioxide emissions 55%
2015 IECC with amendments		By 2035: All its electricity is generated from renewable sources
2015 IMC with amendments		By 2050: The county will achieve carbon neutrality
2014 NFPA National Electrical Code		
2014 NFPA National Fire Code		

Source: building.arlingtonva.us

ARLINGTON

Source: energycodes.gov

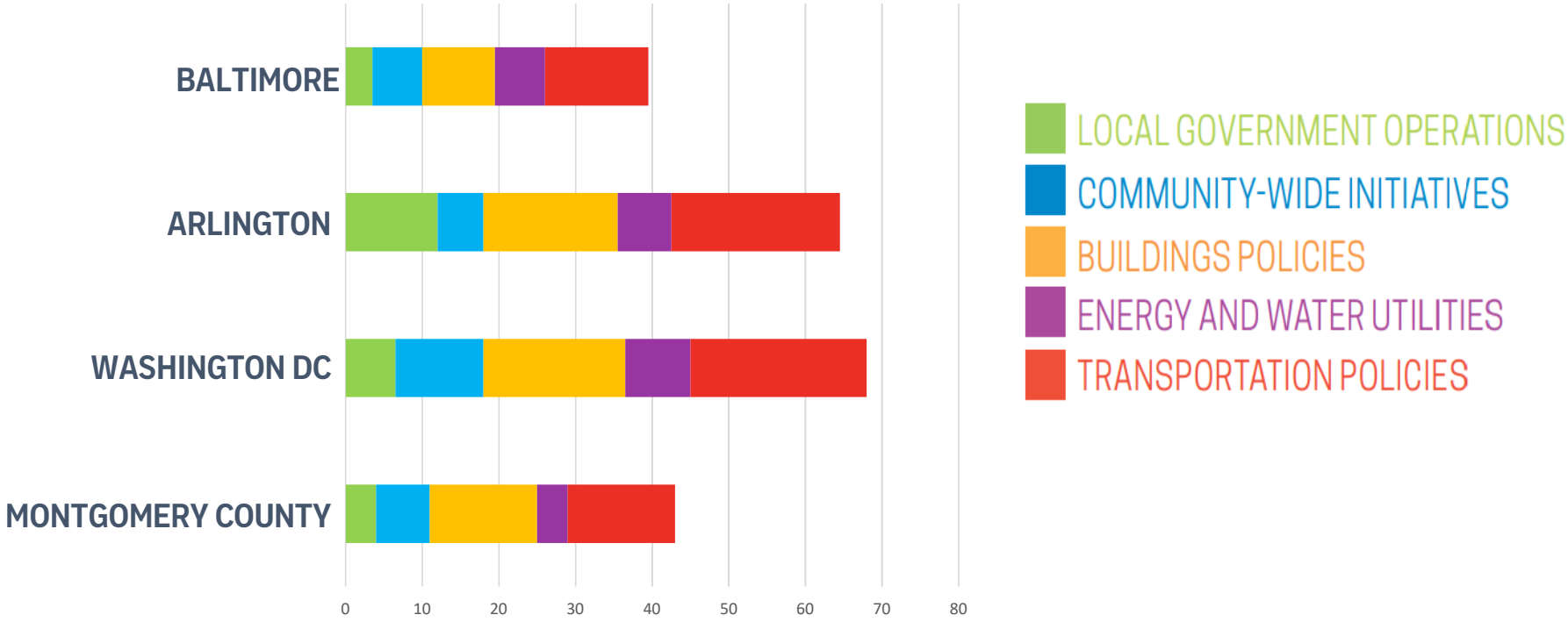
DISPARITY IN ADOPTED CODES

As of January 1, 2020

MONT. COUNTY	ROCKVILLE	GAITHERSBURG
2015 International Residential Code (IRC)	2018 International Residential Code (IRC)	2018 International Residential Code (IRC)
2015 International Building Code (IBC)	2018 International Building Code (IBC)	2018 International Building Code (IBC)
2015 International Extg Bldg Code (IEBC)	2018 International Extg Bldg Code (IEBC)	2018 International Extg Bldg Code (IEBC)
2015 Fire & Life Safety Code	2017 National Electrical Code (NFPA 70)	2017 National Electrical Code (NFPA 70)
2015 International Mechanical Code (IMC)	2018 International Mechanical Code (IMC)	2018 International Mechanical Code (IMC)
2015 International Energy Conservation Code (IECC)	2018 International Energy Conservation Code (IECC)	2018 International Energy Conservation Code (IECC)
2012 International Green Construction Code (IgCC)	2015 International Green Construction Code (IgCC)	2018 International Green Construction Code (IgCC)
Montgomery County Code	City of Rockville Amendments	

Montgomery County approved to adopt 2018 I-Codes but yet to announce effective & sunset dates

ACEEE'S CITY CLEAN ENERGY SCORECARD 2019

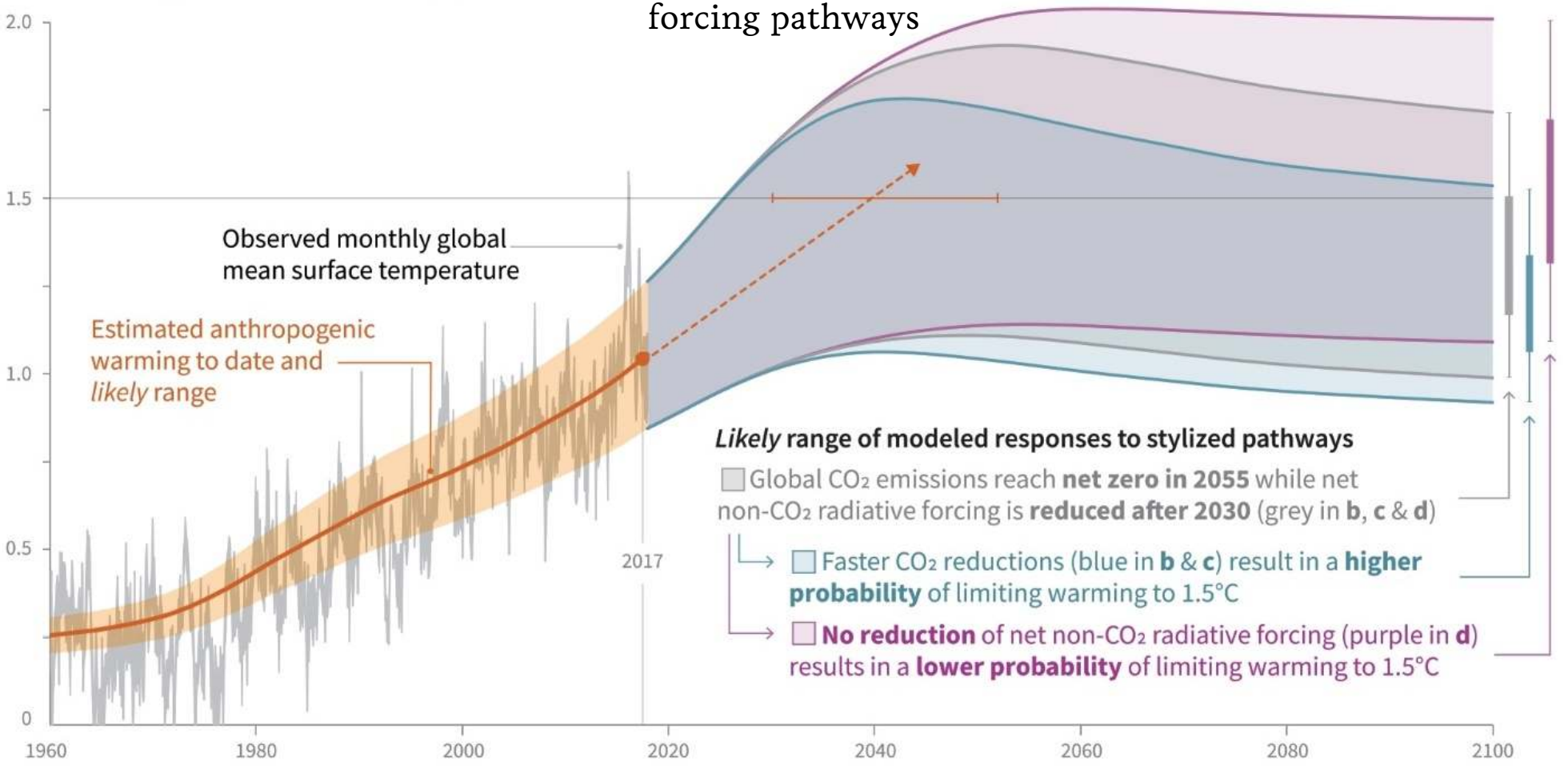


Source: aceee.org

TOWARDS NET ZERO?

LIMITING GLOBAL WARMING TO 1.5°C

Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

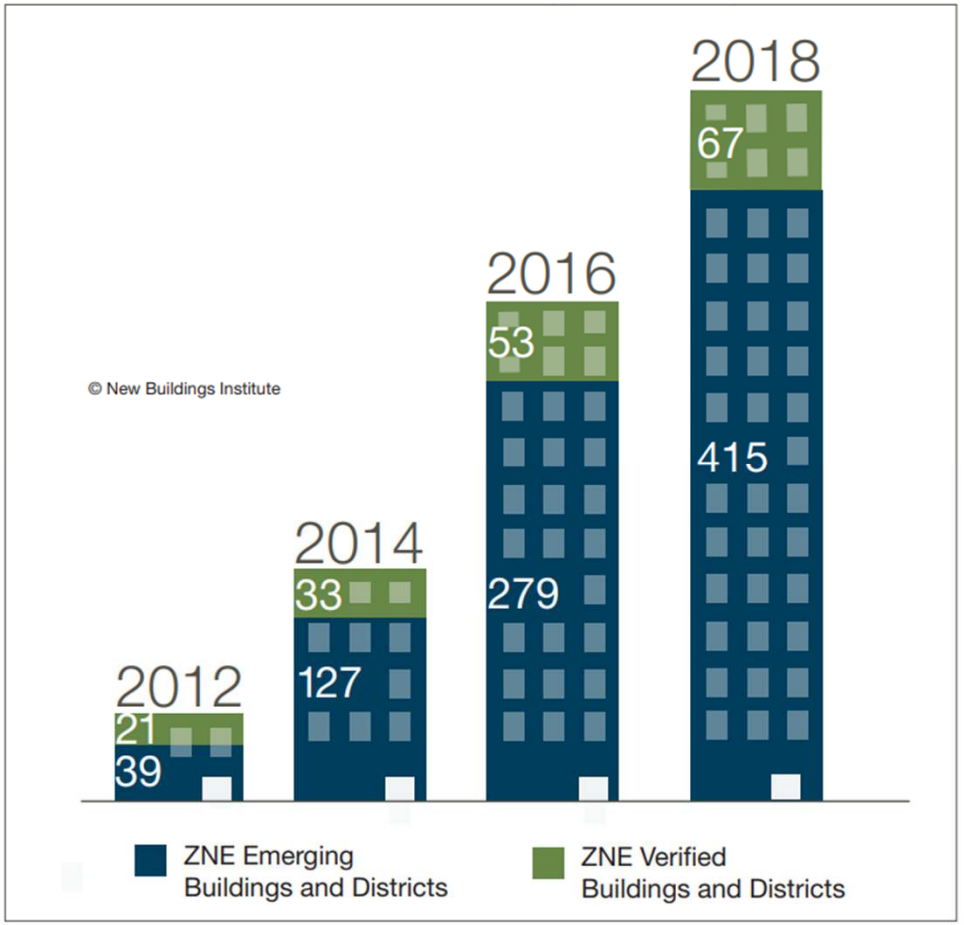


Source: IPCC 2018 special report

ZERO ENERGY BUILDINGS

Energy Codes – Policy Goals and a Zero Net Energy (ZNE) Codes Roadmap

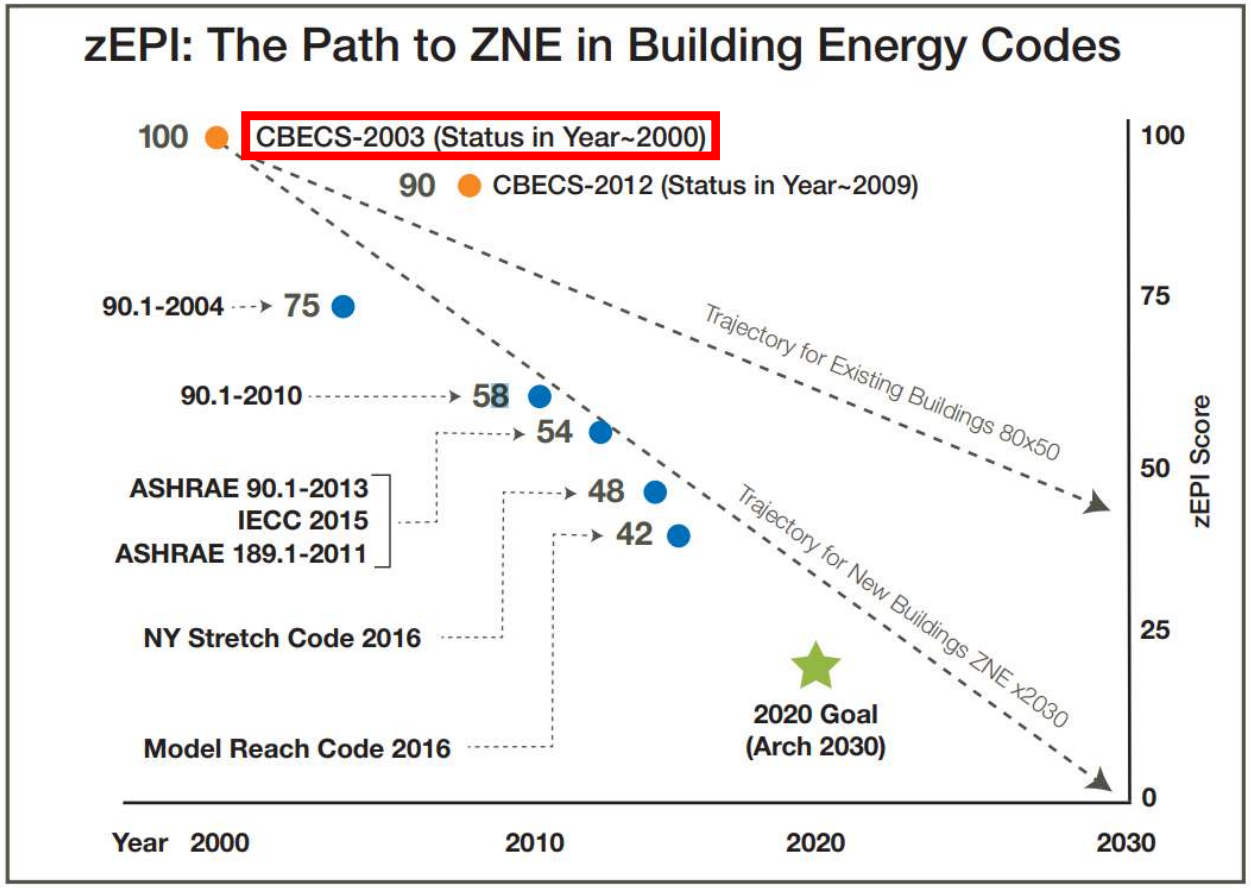
- To achieve policy objectives for ZNE buildings, ZNE goals must be supported and/or required by building codes
- In the six years since NBI produced the first Getting to Zero List in 2012, the number of ZE projects has increased more than 700%



TRENDS FROM NBI'S GETTING TO ZERO DATABASE

Source: 2018 Getting to Zero Status Update and List of Zero Energy Projects, New Building Institute

zEPI (ZERO ENERGY PERFORMANCE INDEX) SCALE TO ZNE (ZERO NET ENERGY)

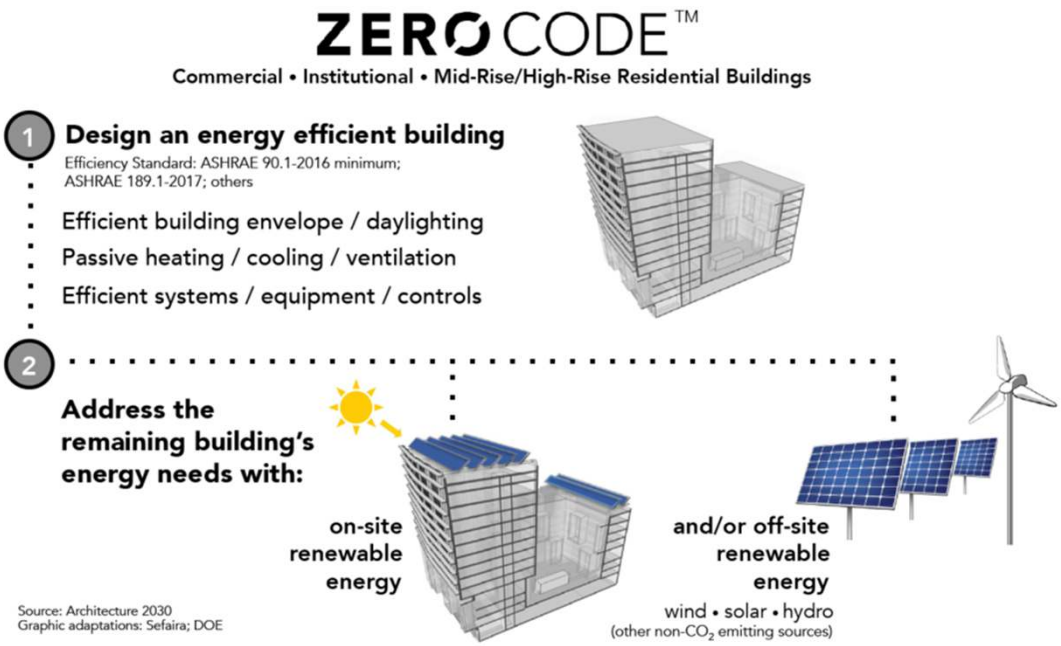


- simple metric measuring a building's progress toward zero energy.
- ASHRAE 189.1-2011 & 2012 IgCC had zEPI part of the code compliance
- **Energy Rating Index (ERI)** Residential 2015 IECC/IRC an additional path to energy code compliance using an Energy Rating Index (ERI)
- Project Cost Index (PCI) baseline is ASHRAE 90.1 2016 and scores scale on 1 to 0

Source: newbuildings.org

ZERO CODE

- **ZERO Code** integrates cost-effective energy efficiency standards with on-site and/or off-site renewable energy resulting in **zero-net-carbon buildings. (ZNC)**
- ZERO CODE was developed by Architecture2030
- New standards that exceed ASHRAE Standard 90.1-2016 have been incorporated into the ZERO Code, such as the 2018 International Green Construction Code (IgCC) and ASHRAE Standard 189.1-2017
- **Flexibility** built in this code
- The ZERO Code is supported by **Energy Calculators** that ease the implementation process and reduce errors when applying the prescriptive compliance path.



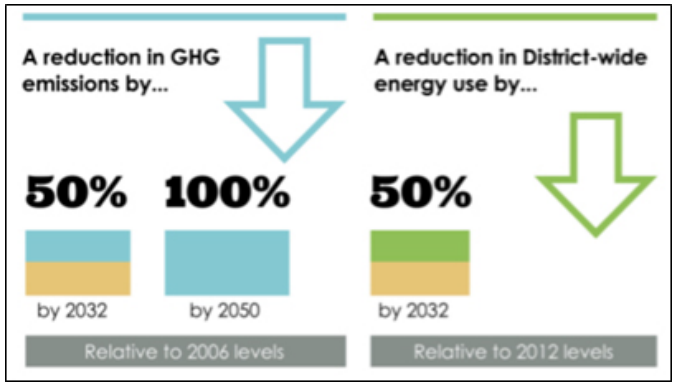
(includes prescriptive and performance paths)

Source: zero-code.org

BUILDING ENERGY PERFORMANCE STANDARDS (BEPS)

- Best program for Existing Building Stock
- Step by step compliance – with flexibility – short term & long term goals
- DC BEPS program – DC will set the building energy performance standards for buildings 50,000sf or greater before Jan 1st, 2021 based on the median performance
- Buildings 50,000sf or greater with energy performance below the standards have to improve their energy performance by 20% over the next 5 years.

- District's Building Energy Performance Standards (BEPS) is a key component towards the vision for a Sustainable DC:



- Clean Energy DC Omnibus Amendment Act of 2018, to amend the Renewable Energy Portfolio:
  - 100% by 2032

Source: DC DOEE

CODE IMPACT ANALYSIS

BUILDING ENERGY CODE SAVINGS CALCULATOR

The Energy Code Calculator is a tool developed by Energy Efficient Codes Coalition (EECC) in an effort to estimate the energy and carbon savings of updating energy codes.

The calculations were based on the following assumptions for projected energy savings for future model energy codes:

RESIDENTIAL		COMMERCIAL	
IECC 2015	0.9%	ASHRAE 90.1-2013	8.7%
IECC 2018	0.5%	ASHRAE 90.1-2016	13.9%
IECC 2021	5%	ASHRAE 90.1-2019	5%
IECC 2024	5%	ASHRAE 90.1-2022	5%
IECC 2027	5%	ASHRAE 90.1-2025	5%
PassiveHouse	50%	PassiveHouse	40%

Note: ASHRAE is not a code, but a standard referenced in several Codes

Source: energyefficientcodes.org

NEW YORK CODE IMPACT ANALYSIS

CURRENT TREND

PROJECTED RESIDENTIAL ENERGY CODE	PROJECTED EFFECTIVE DATE
IECC 2015	Current
IECC 2018	2020
IECC 2021	2023
PROJECTED COMMERCIAL ENERGY CODE	**PROJECTED EFFECTIVE DATE**
ASHRAE 90.1-2016	Current
ASHRAE 90.1-2016	2020
ASHRAE 90.1-2019	2023

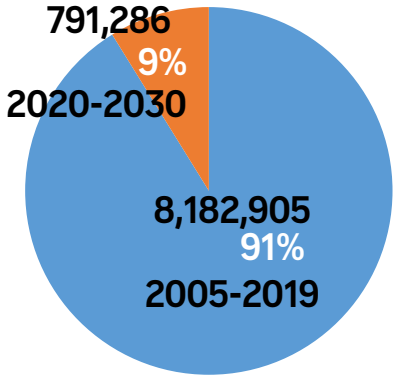
AGGRESSIVE TREND

PROJECTED RESIDENTIAL ENERGY CODE	PROJECTED EFFECTIVE DATE
IECC 2015	Current
IECC 2018	2020
IECC 2021	2021
IECC 2024	2024
IECC 2027	2027
PassiveHouse	2030
PROJECTED COMMERCIAL ENERGY CODE	**PROJECTED EFFECTIVE DATE**
ASHRAE 90.1-2016	Current
ASHRAE 90.1-2019	2020
ASHRAE 90.1-2022	2021
ASHRAE 90.1-2025	2024
PassiveHouse	2027
PassiveHouse	2030

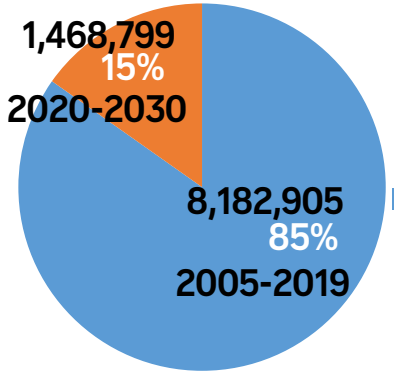
Tools used Energy Code Calculator from EECC

NEW YORK CODE IMPACT ANALYSIS

AMOUNT OF CO_2 ($MTCO_2e$) AVOIDED OVER THE YEARS

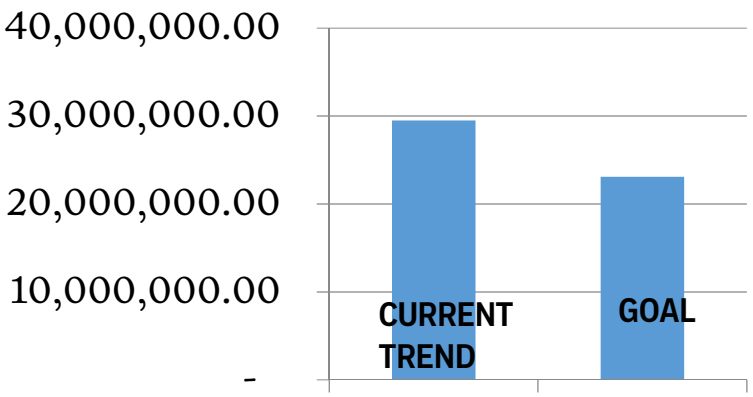


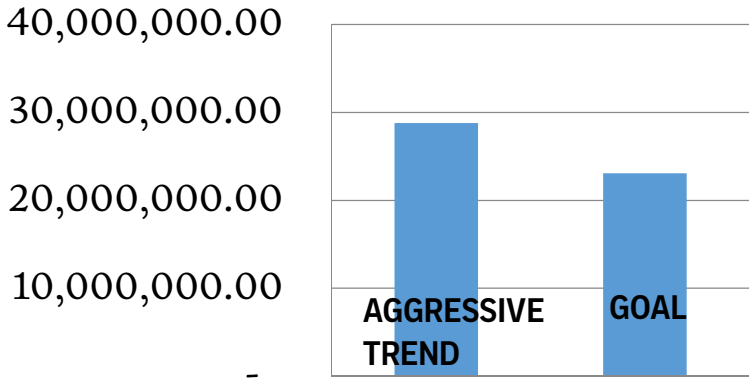
CURRENT TREND



AGGRESSIVE TREND

CO2 LEVELS ($MTCO_2e$) IN 2030





Tools used Energy Code Calculator from EECC

SAN FRANCISCO CODE IMPACT ANALYSIS

CURRENT TREND

PROJECTED RESIDENTIAL ENERGY CODE	PROJECTED EFFECTIVE DATE
IECC 2018	Current
IECC 2021	2021
PROJECTED COMMERCIAL ENERGY CODE	**PROJECTED EFFECTIVE DATE**
ASHRAE 90.1-2016	Current
ASHRAE 90.1-2019	2021

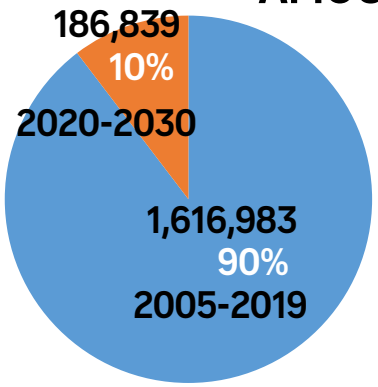
AGGRESSIVE TREND

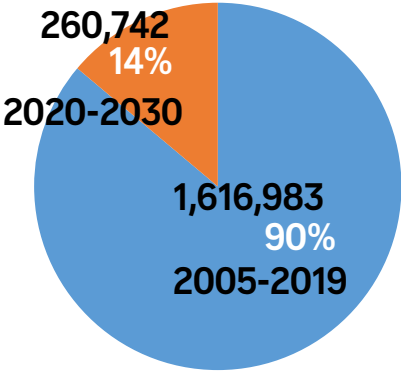
PROJECTED RESIDENTIAL ENERGY CODE	PROJECTED EFFECTIVE DATE
IECC 2018	Current
IECC 2021	2021
IECC 2024	2024
IECC 2027	2027
PassiveHouse	2030
PROJECTED RESIDENTIAL ENERGY CODE	**PROJECTED EFFECTIVE DATE**
ASHRAE 90.1-2016	Current
ASHRAE 90.1-2019	2021
ASHRAE 90.1-2022	2024
ASHRAE 90.1-2025	2027
PassiveHouse	2030

Tools used Energy Code Calculator from EECC

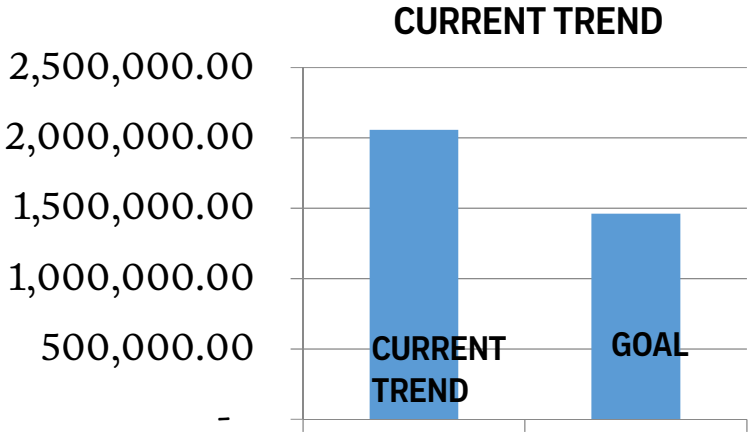
SAN FRANCISCO CODE IMPACT ANALYSIS

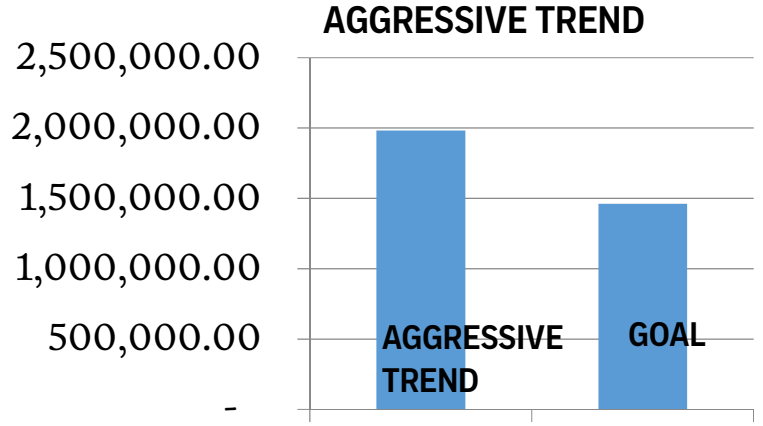
AMOUNT OF CO_2 ($MTCO_2e$) AVOIDED OVER THE YEARS





CO2 LEVELS ($MTCO_2e$) IN 2030





Tools used Energy Code Calculator from EECC

MONTGOMERY COUNTY CODE IMPACT ANALYSIS

Current Trend

Projected Residential Energy Code	Projected Effective Date
IECC 2015	Current
IECC 2018	2020
IECC 2021	2023
Projected Commercial Energy Code	**Projected Effective Date**
ASHRAE 90.1-2013	Current
ASHRAE 90.1-2016	2020
ASHRAE 90.1-2019	2023

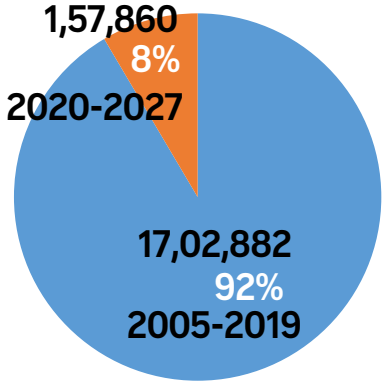
Aggressive Trend

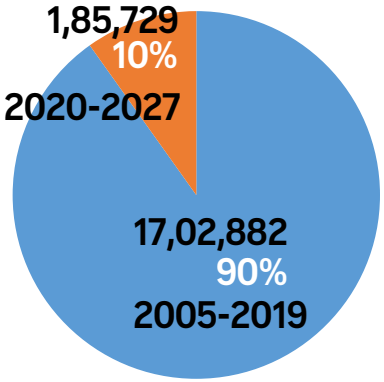
Projected Residential Energy Code	Projected Effective Date
IECC 2015	Current
IECC 2018	2020
IECC 2021	2021
IECC 2024	2024
IECC 2027	2027
PassiveHouse	2030
Projected Commercial Energy Code	**Projected Effective Date**
ASHRAE 90.1-2016	Current
ASHRAE 90.1-2019	2020
ASHRAE 90.1-2022	2021
ASHRAE 90.1-2025	2024
PassiveHouse	2027
PassiveHouse	2030

Tools used Energy Code Calculator from EECC

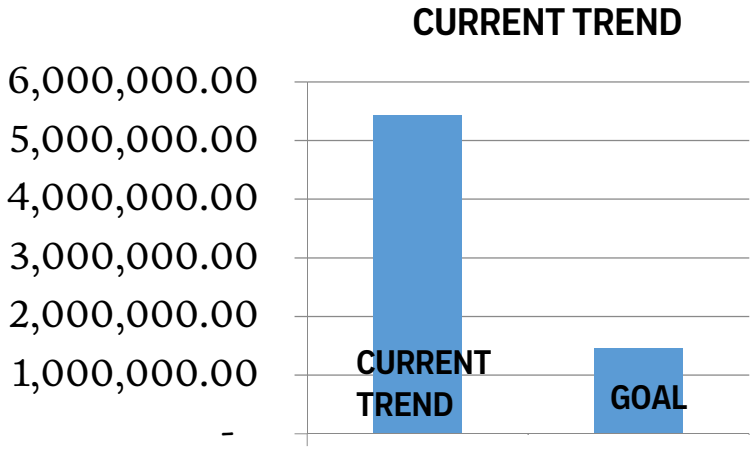
MONTGOMERY COUNTY CODE IMPACT ANALYSIS FOR YEAR 2027

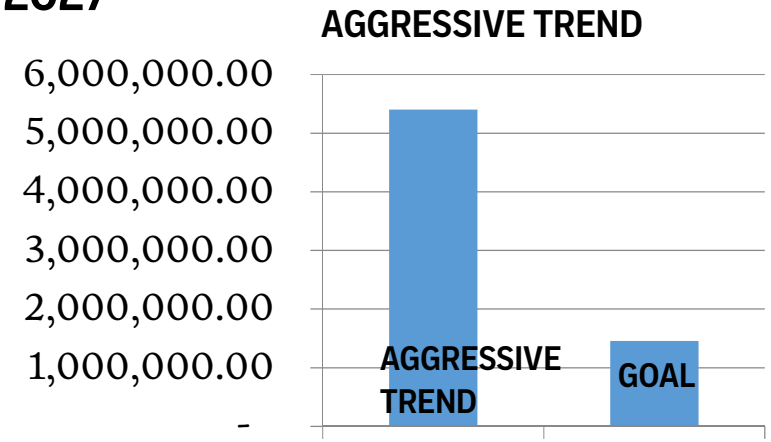
AMOUNT OF CO_2 ($MTCO_2e$) AVOIDED OVER THE YEARS





CO2 LEVELS ($MTCO_2e$) IN 2027

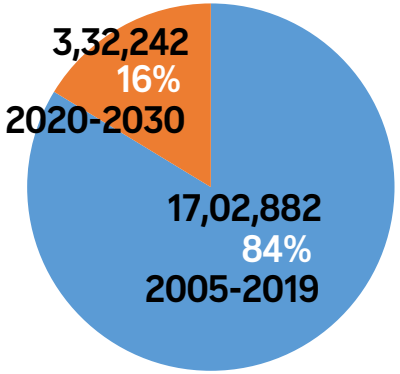


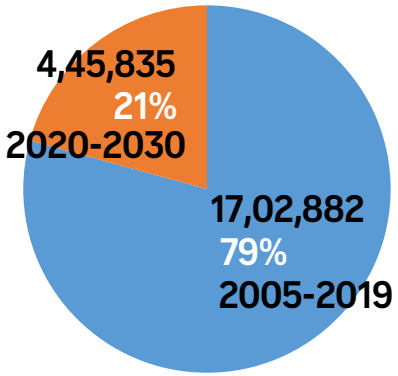


Tools used Energy Code Calculator from EECC

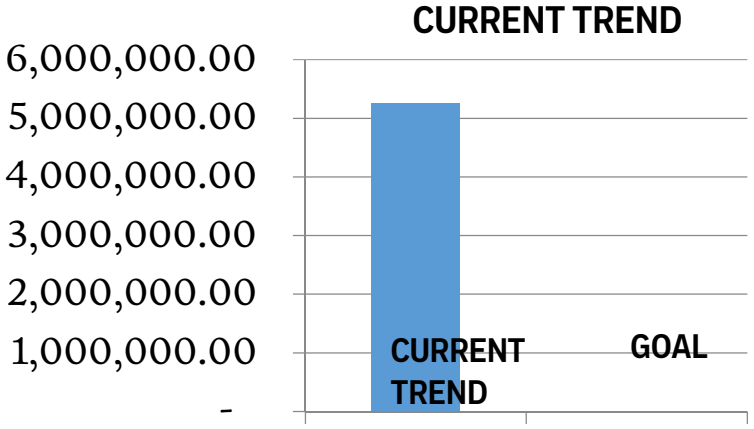
MONTGOMERY COUNTY CODE IMPACT ANALYSIS FOR YEAR 2035

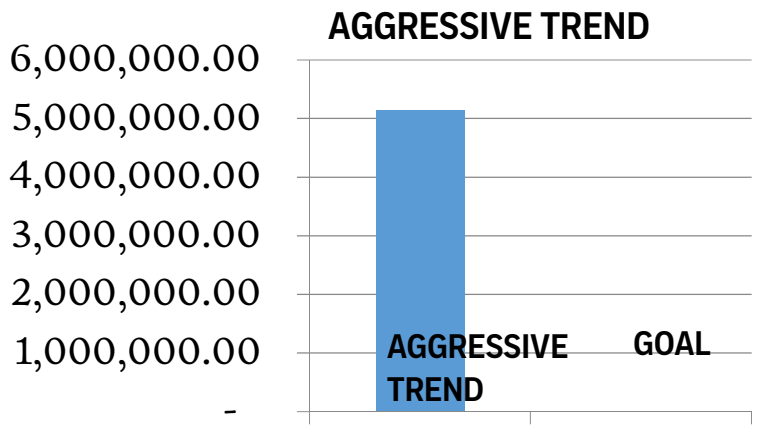
AMOUNT OF CO_2 ($MTCO_2e$) AVOIDED OVER THE YEARS





CO2 LEVELS ($MTCO_2e$) IN 2035





Tools used Energy Code Calculator from EECC

MONTGOMERY COUNTY CODE IMPACT ANALYSIS

FACTS

- Montgomery County is about to adopt 2018 I-Codes and 2018 IgCC
- Montgomery County has Energy Benchmarking requirements, LEED requirements, Green Building Property Tax benefit programs and Climate Change Goals
- County is also working now for the Building Performance Standards (BPS)

ANALYSIS RESULTS

- There is a big difference of 90% (2005 – 2019) and 10% (2020 to 2027) CO2 emissions avoided
- Aggressive trend of code adoption doubles the CO2 emissions avoided for years 2020 to 2035
- Currently the county is on 2015 codes – we are 3 to 5 years behind in adoption
- Diverse code adoption status seen within the county within various cities like Rockville and Gaithersburg. A Regional approach to code adoption among various jurisdiction, cities and states will help to reach the goals.

RECOMMENDATIONS

CODE RECOMMENDATIONS

- **Energy Codes – Aggressive code adoptions every code cycle**
- Stretch codes with incentives to promote going beyond the adopted code
- Develop Construction Standards for Net Zero
- All building end use energy measures
- Metrics to go beyond component efficiency
- Outcome based performance path
- Post occupancy metering and reporting
- Plan for Retrofitting Existing Buildings
- Benchmarking reporting, transparency & labeling – Adopt new policy standards like DC's Building Energy Performance Standards (BEPS)
- Workforce development
  - ICC's Energy Code Ambassador Program
  - provide guidance and peer to peer support to building officials, builders and contractors on energy code issues.

QUESTIONS?

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