THE ENERGY CODES, CARBON & AFFORDABILITY

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INTRODUCTION

The Massachusetts Legislature, through a series of enacted laws designed to address the climate crisis, has set the state on a path of carbon neutrality by 2050 with a set of carbon reduction sub-limits between now and then. This matters very much to the home building and home remodeling world as the latest legislative action (The 2021 "Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy") includes that the building sector do its part in reaching carbon neutrality. This specifically requires the DOER to create energy codes that increasingly move towards all-electric buildings and away from fossil fuel use.

While the goal of carbon neutrality is seemingly carved in stone, how we get there is not. When it comes to our energy codes the decarbonization goal should be approached in a thoughtful, commonsense way that emphasizes effectiveness of reducing carbon as well as cost - both in compliance costs and energy costs to operate a home.

Additionally, it's not just our buildings (along with many other things like transportation, etc.) that are being regulated towards carbon neutrality, the electrical grid that delivers the needed energy for our homes is also expected to reach carbon neutrality by 2050.

While Massachusetts has determined that we need to address the climate crisis, our Legislature as well as the Healey Administration have openly acknowledged that we also have a housing affordability crisis and have taken steps to significantly increase our housing production. These two crises are on some level in direct conflict with each other as our aggressive energy codes are adding significant up-front costs to build homes and putting downward pressure on housing production.

After living with the 2023 Stretch Energy Code for close to two years, and the Specialized Energy Code in some municipalities for nearly as long, we can evaluate how well, or not, the new codes are doing. We've done this through a careful analysis of homes utilizing fossil fuels (natural gas or propane in these cases) and comparing the data of those same homes as if they were constructed as all-electric. The goal and stated benefit of the new codes are: very small added construction costs in exchange for a reduction in carbon emissions and lower annual energy costs. However, the general result is surprising. The added construction costs are significant (around $20k or so in hard costs for a typical single-family home) and the benefits are suspect.

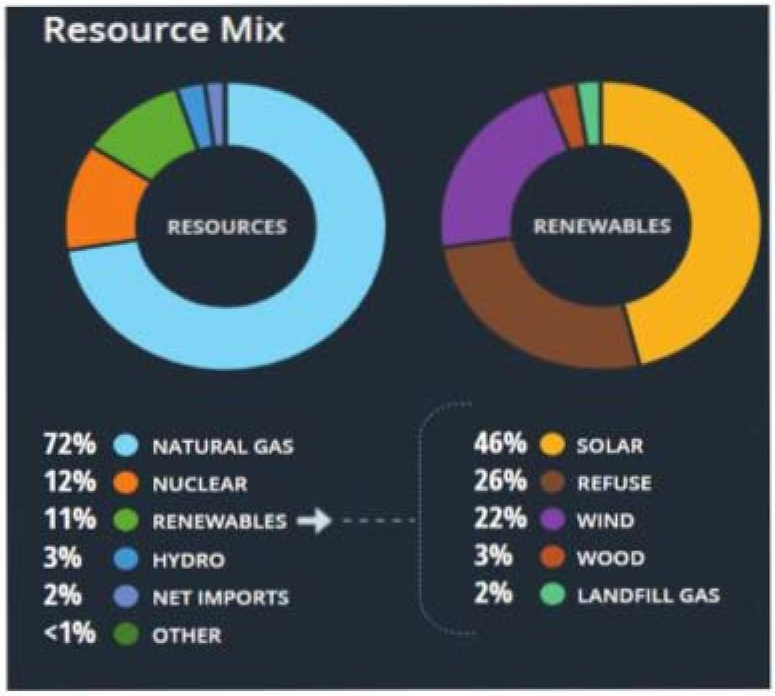
So, are the Energy Codes reducing energy costs and carbon emissions?

The short answer is no. If we look at homes that are either using natural gas or propane and compare the same home that utilizes an all-electric approach (as the energy codes incentivize) we find that neither of those things are happening.

Here's a typical example of a 2500 sq. ft. single-family home. The data below is from a projected HERS rating for the same home but utilizing different HVAC scenarios:

HVAC System Type	Installed costs	Est. Annual Energy Cost	CO2 lbs/year
96% AFUE Gas Furnace	$	$1,476	6,542
Air Source Heat Pump COP 3.0*	$$	$1,613	8,405
Hybrid Air Source Heat Pump COP 3.0 w/Gas Backup	$$	$1,405	7,921
Ground Source Heat Pump COP 3.0	$$$	$823	4,315
Domestic Water Heater Type	**Installed costs**	**Est. Annual Energy Cost**	**CO2 lbs/year**
Electric Resistance	$	$1,294	4,432
Tankless (Gas)	$$	$152	1,539
Heat Pump Water Heater (COP 4.0)	$$$	$324	1,108
*Coefficient of Performance (COP) drops (less efficient) with drop in outside temp.			

As you can see, an all-electric home utilizing air source heat pump technology for both HVAC and domestic water heating results in higher annual energy costs as well as higher carbon emissions. Installed costs for the all-electric option are also higher. Other than the ground source heat pump option (which is unfortunately very expensive to install), the best performance for annual energy cost and lowest carbon emissions is the home using gas (it also has the lowest installed cost). The Hybrid (aka dual fuel) system is a happy medium option.



This snapshot is from the website for ISO New England (iso-ne.com) which is the entity that operates the electrical power generation for all New England. It shows the resource mix for October 8th, a mostly sunny day with moderate winds. As you can see, the largest resource used to generate our electricity is by far natural gas.

Here's why annual energy costs are higher for the all-electric home. An all-electric home uses heat pumps to both heat and cool a home. While the heat pumps work quite efficiently when cooling a building during the warmer months, they rapidly decrease in efficiency when outside temps drop during the heating season. This is the big disadvantage of heat pumps as opposed to a traditional gas-fired furnace which maintains the same efficiency (typically 95-96% AFUE) regardless of the outside temperature. This drop in cold-weather efficiency along with the fact that Massachusetts has among the highest electricity rates in the country (typically among the top 4 most expensive in the U.S.) result in higher energy costs for homeowners. And there's no reason to think rates will come down. They have outpaced even our high inflation in recent years and with the enormous costs anticipated to bring the grid capacity up to the level needed to handle the push to convert all the sectors that use fossil fuels to use electricity in its place, rates can only remain very high and are likely to be worse than they currently are.

And here's why the carbon emissions go up for an all-electric home compared to the home using gas as illustrated in the above table. Look at a typical daytime power generation resource mix for a fall day – October 8, 2024 at 3pm.

You can see that natural gas dominates. The all-electric home simply moves the carbon emissions from the home to the electricity generation plant where it needs to produce far more BTUs than is needed at the home because so much of that energy is lost in the conversion and transmission process. More BTUs means more carbon.

About the grid

Meeting an increased demand for electricity, especially at peak demand, while reducing emissions is a particularly challenging prospect. It is both very complex and expensive. Below are some of the many challenges:

- According to an ISO New England study an additional 97 Gigawatts of capacity needs to be added to meet the coming demand – that is exponentially more than the current capacity of roughly 18 gigawatts.
- Currently, peak demand for electricity is during the summer. However, sometime in the next decade the peak demand is expected to shift to the winter months, largely due to the transition of heating our homes and businesses through electricity. Also, the growing number of EV's, which require more charging during the winter months (batteries do not like the cold), will further add to the peak demand.
- While an all-electric home reduces on-site carbon emissions, the electricity used to power that home is largely generated inefficiently by fossil fuels.
- Per the U.S. Energy Information Administration (EIA), more than 60% of the energy used for electricity generation is lost in the conversion process.
- Also, according to the EIA's latest World Energy Outlook report, despite the rapid buildout of renewable and alternative energy sources, fossil fuels are expected to remain a dominant part of the energy mix at power plants through midcentury.
- Efforts to decarbonize the grid will rely heavily on renewable energy, primarily wind and solar which means a larger portion of electricity generation will be increasingly weather-dependent and will contribute to a decrease in grid reliability.

About costs

Anyone who builds homes can tell you that these more stringent codes and the push towards all-electric buildings adds significant construction costs. Here are some of the issues related to cost:

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- Using an example of a typical single-family home, a 2023 study conducted by MIT and Wentworth Institute of Technology projected that the additional cost to comply with an energy code requiring a HERS score of 45 (all-electric building) would cost $19,188, and the cost to comply with a HERS score of 42 (mixed-fuel building) would be $23,343. The study further determined that these costs would reduce the share of Massachusetts households able to afford this home by over 33,000 households.

- Using that same single-family home and conservatively estimating the cost at 16,000 to bring it from a HERS 52 to a HERS 42, the annual cost savings in energy comes in at $381. So, the payback period for the additional cost is 42 years. Clearly, this is not a good deal for homeowners.

- According to NAHB, every $1,000 increase in housing prices results in 1,727 more Massachusetts households being priced out of the housing market.

- Largely because of our dismal housing production, housing prices have been constantly rising. In recent years the numbers have become downright absurd - The current median home price for MA is now $627,596, well above the national average of $412,300. Only Hawaii and California have higher median home prices. Median home prices for greater Boston are north of $900,000. As housing prices (and rents) have sharply risen, far outpacing both inflation and the rise in wages, fewer and fewer families are able to afford a home. This lack of affordable housing options here is driving a growing number of people to flee Massachusetts for more affordable states.

A Better Approach

Until the electrical grid is supplied with much less fossil fuels and closer to being carbon neutral, a judicious use of natural gas and propane in our homes would better accomplish the goal of reducing carbon emissions while also reducing energy costs for homeowners. Plus, it would reduce the growing strain on the grid during the soon-to-be peak period of winter. Think about what might happen during the coldest period of winter when many thousands of heat pumps are cranking away at their most inefficient and electricity consuming phase (say, 30 degrees and lower) while many thousands of people plug in their EVs for the night to charge. The grid very well may not be able to keep up. Rolling brownouts may become the norm.

The energy codes going forward could do better. For example: Allowing hybrid HVAC systems that utilize heat pump technology but also use a gas furnace when outside temperatures drop down to approximately 30 degrees. This reduces the most expensive phase of a heat pump which reduces both carbon emissions and homeowner utility costs.

It would also be helpful to remove the lower required HERS scores for homes with some fossil fuel usage, certainly hybrid systems, and broaden financial incentives (rebates) through Mass Save to include projects that meet a high level of energy efficiency even without being an all-electric home.

Conclusion

We are not challenging the goals or objectives of the legislature to reduce carbon emissions. However, as we've outlined above, the current energy codes are increasing costs to build homes while not achieving either a reduction in carbon emissions or reducing consumer costs and are likely to contribute to an all-but-guaranteed overloaded grid.

Costs matter. Massachusetts has been experiencing a housing crisis for many, many years, largely fueled (sorry for the pun) by decades of the under-production of housing which has hit new lows in recent years – 2023 was the lowest in history for Massachusetts other than the 4 years of the Great Recession and one year during the recession of the early 1990s. 2024 is on track to be much the same as 2023. Increasingly stringent energy codes are exacerbating the problem of housing production by adding costs that outweigh any benefits produced by such codes. This downward pressure on housing production directly contributes to the extreme housing costs we face.

It's clear that the bigger problem is not the relatively small amount of carbon emissions from the homes that we currently build to a very high level of energy efficiency, but the carbon emissions from our power generation that supplies electricity to the grid as well as the many older, energy inefficient buildings out there. Punishing the new construction housing market for its small contribution to our overall carbon emissions does far more harm than good.

The next iteration of the Stretch Energy Code and the Specialized Code should take into consideration that the current approach is somewhat flawed, albeit unintentionally. The HBRA of Massachusetts has the experience, knowledge and expertise to recommend changes that will reduce carbon output significantly faster than the current stretch code. These recommendations will save on construction costs and electric bills and reduce the risks to the grid.

Such an approach supports both the climate and housing goals of Massachusetts. Yes, we can, and should, do both.