United States House of Representatives
Select Committee on the Climate Crisis

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"Solving the Climate Crisis: Cleaner, Stronger Buildings"

Questions for the Record

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The Honorable Garret Graves

1. **Considering capital stock rollover rate, if the U.S. adopted net-zero building codes today, how long would it take for all homes in the U.S. to be built to today's standards?**

There are roughly 137 million homes in the United States. While some are built to achieve net zero, the overwhelming majority currently are not. To get all the homes in the U.S. to net zero would be a daunting task given the need to not only accommodate and rehouse existing families, but to also provide new housing to newly-formed households. This challenge would be further exacerbated by the current low rate of production and slow replacement rate. Finally, the funding needed to finance the increased up-front costs associated with zero net energy would make such an undertaking effectively prohibitive.

While there are no statistics that indicate how long it would take to replace the existing housing stock, inferences can be made. According to NAHB's forecast, 250,000 single-family starts per year are currently built to replace older homes. According to the latest American Community Survey tables from the Census Bureau (for calendar year 2017), there are slightly under 93 million single-family homes in the U.S. If all single-family homes were built to a net-zero standard going forward, and if the rate of 250,000 per year remains constant (which is unlikely; for one thing, building to a net-zero standard would likely increase costs and slow down housing production & replacement), it would take just over 370 years to achieve a 100 percent net-zero stock of single-family homes in the U.S. The attached article provides additional detail about actual replacement statistics.

2. **How does residents' behavior act as a barrier to the builder's taking the opportunity to make improvements in the structural envelope of a building to enhance its energy efficiency?**

Builders can implement a host of techniques and install numerous products to improve the energy efficiency of the homes they build. Just because a home is built well, does not mean it will perform well. Predicted energy savings are based on idealized occupant behavior. The habits of real people and families can vary dramatically from these hypothetical conditions. The best of intentions to save energy can quickly be negated when occupants are not conforming to the anticipated behavior. For example, seemingly trivial things such as opening windows, setting thermostats significantly above/below set points, operating humidifiers, using a large number of electric devices (plug loads), etc. can significantly impact overall energy savings. In addition, not only can energy efficient designs be more sensitive to

occupant behavior, but the impacts of that behavior can also impact other performance attributes of the home.

Regarding building envelopes, the focus should be on much needed innovation in cost-effective window technologies. Further, increases in requirements for opaque assemblies (i.e., structural envelope) will come at substantial costs with little benefit in energy savings. The levels of insulation and air sealing for opaque assemblies required in the latest model energy codes have already past the inflection point where the upfront cost outweighs the long-term benefit.

3. **Mr. Rutland, in your testimony you noted that new building codes often reflect national averages that aren't always true for local conditions. Can you give some examples of how attempts to use building standards that are good for California or Massachusetts can do more harm than good for a home built in, say, Alabama?**

The model building codes are meant to be a starting point for the state and local governments to use when developing their building codes and are intended to be amended to fit state and local conditions. But because they are created to be generally applicable, they can over or understate risks and, hence, include provisions that may be inapplicable, unrealistic or unnecessary for certain areas. For example, the hazard maps for wind, snow, and earthquakes in model building codes and national standards incorporate a variety of modeling assumptions and simplifications that enable the maps to be generated on a national scale. As such, they can overstate hazards in certain areas of the country.

A good example is the risk of earthquakes in the Central and Eastern US, where the defining events in Memphis (1811-1812) and Charleston (1886) happened before seismographs and other accurate methods of measuring earthquake magnitudes existed. Absent real data, the magnitude of these events that is assumed in the modeling that generates the modern seismic hazard maps is conservatively estimated. Because the modeling process itself adds more conservatism since the mapped ground motions are intended to represent an event with a low probability of being exceeded, more structures are drawn into the risk area and, hence, must comply with additional code requirements. This raises the cost of construction and harms housing affordability by forcing homes to be over-designed for events that are extremely unlikely to occur over the life of a home in those areas. Similar challenges can be faced when addressing risks for flooding and other hazards, as well as for certain water and energy efficiency features, among others.

4. **What are some of the biggest hurdles states face in adopting and implementing newer building codes?**

There are four major hurdles that states may encounter when adopting new building codes, and especially when attempting to update to every new edition of the model codes:

- Lengthy and Varied Code Adoption Processes. For states and local jurisdictions, adopting building codes and standards typically requires following a legislative or rulemaking process, including posting of notices, holding a legislative hearing, or hosting building code council meetings. In some states, the codes process is legislatively scheduled to only happen every other year and in many instances, the code adoption and amendment process can take 12 to 18 months or more. Not only are these processes time-consuming, they also come with a cost. Further, personnel are needed to examine and suggest revisions, data is needed to support proposals, and the public must be invited to participate.

- Code Official and Builder Training and Education. Every time a code is adopted, building officials and inspectors need training and education on the changes from the previous edition(s) so they can understand those changes and consistently enforce them. Builders and designers need training too. There can be significant costs for building departments to set up this training or for their staff to attend such training, let alone the cost for the design and construction community.

- Impact of New Codes on New Home Construction. Adopting updated codes can significantly increase cost of construction due to more stringent requirements. Especially in the realm of energy efficiency and mechanical/plumbing/electrical, changes, recent editions of the code have had the effect of requiring the use of specific insulation products, window types, ventilation systems or electrical systems in such a way that both raises the cost of construction and provides a financial boon to the manufacturers who angled to get their products into the code. Amidst the current housing affordability crisis, most State and local governments are seeking ways to reduce, not increase, the cost of housing for their constituents.

- Consistency within the Codes and with Other State/Local Requirements. Code provisions have a way of changing back and forth from cycle to cycle as new data on hazards, new research, or field experience is brought to the process. Also, because codes are developed in silos (i.e. structural design, energy efficiency, and fire prevention are all covered in different codes and debated by different committees), there are often conflicts between and even within the codes and standards when significant new requirements are introduced. Sometimes it takes a cycle or two to resolve the conflicts such that one aspect of building performance is not negatively impacted by changes in another aspect of construction. For example, the upcoming 2021 *International Residential Code* has finally incorporated changes to address moisture and durability issues created by significant increases in insulation levels and building air tightness required by the 2012 energy codes.

  Similarly, given the number of statutes, standards, codes, ordinances and other requirements imposed at the state and local levels, there is a need to ensure that any new code or code provision is consistent or at least compatible with the regulations that are already on the books. Because many of the codes overlap with zoning, stormwater, and other mandates, completing such a review can be significant.

5. Could you explain the change in cost to construct a fossil-free building? In your opinion, would most homeowners be able to afford those upgrades?

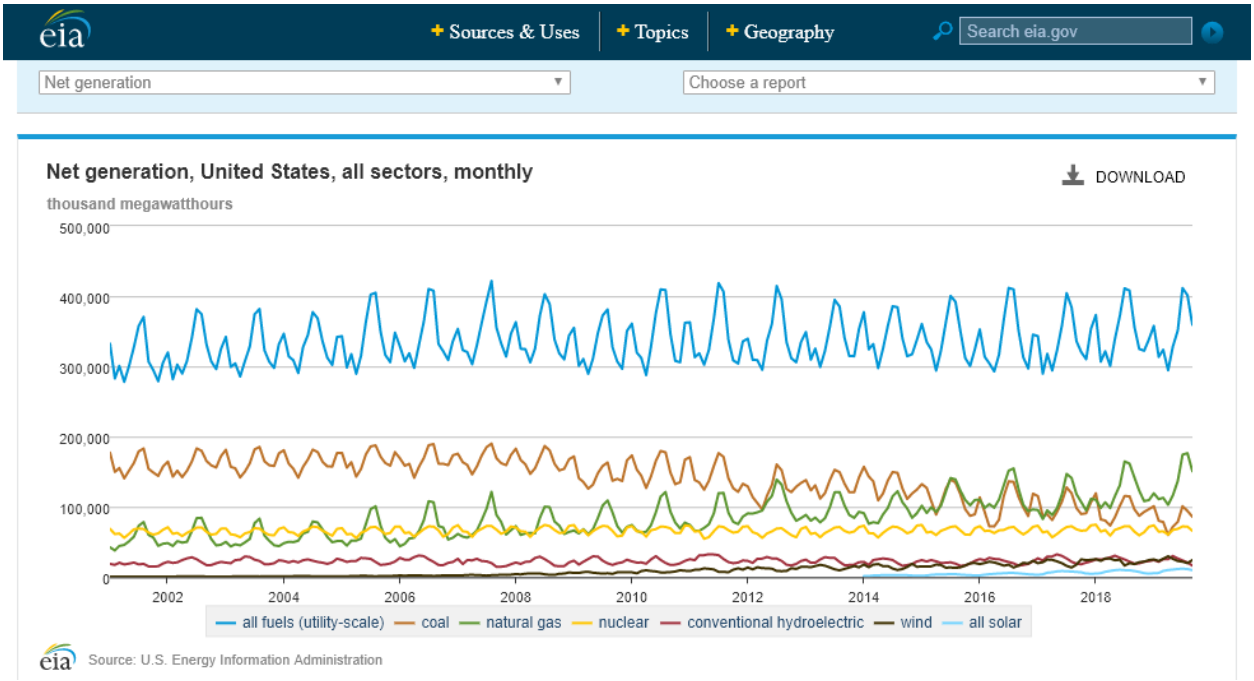
A building that uses near-zero or zero fossil fuel resources to operate would involve a combination of multiple modifications requiring detailed coordination at the design and construction phases. Many of these technologies have not been adopted by the market and require further development and evaluation before mainstream implementation is possible. Unless the market is given time to absorb these innovations at a reasonable pace, the outcomes could be counter-productive, leading to substandard performance and potentially public's rejection of these technologies. Moreover, the industry and the market have not yet determined the optimum balance of technologies that would achieve fossil-free or near-free solutions. Although various combinations of future technologies can be envisioned, they would vary greatly by climate and market.

Unlike LED lights that have become ubiquitous, most building innovations that would enable fossil-free living are not one-for-one substitutes where the older version gets simply replaced with a next-generation gadget. Instead, this type of change would impact the entire building system, which would require a

"ground-up" re-envisioning of the design and building process and the operation/occupancy. Any such modification would come at a significant premium that would include both the price of the products/systems/material and the added costs of installation. The increased costs will lead to significant impact on the price of the home that many home buyers will not be able to afford. This price increase will particularly impact the home buyers in the affordable and move-up segments of the market.

The other side of the fossil-free living equation is where the building's power comes from. Even for buildings with some on-site generation, the grid-supplied power will remain an integral element of the building's function. Fossil fuels remain a large source of electricity generation in the country. As long as the electricity mix produced at the utility level includes a portion of fossil fuel generation, the building will not be a fossil-fuel-free building.

Electricity generation by source is shown below.



For more information on NAHB's economic report on older homes:
http://eyeonhousing.org/2019/01/more-homes-needed-to-replace-older-stock/