

Imagining the climate-proof home in the US: using the least energy possible from the cleanest sources

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Solar energy use will become more common as power use becomes smarter and more automated

Dealing with the climate crisis involves the 5 overhauling of many facets of life, but few of these changes will feel as tangible and personal as the transformation required within the home.

The 128m households that dot America 10 gobble up energy for heating, cooling and lighting, generating around 20% of all the planet-heating emissions produced in the US. Americans typically live in larger, more energy hungry dwellings than people in other 15 countries, using more than double the energy of the average Briton and 10 times that of the average Chinese person.

This sizable contribution is now coming under the scrutiny of Joe Biden's administration, 20 which recently put forward a raft of measures to build and upgrade 2m low-emissions homes. "Decarbonizing buildings is a big task but it's an essential task," said Michael Regan, administrator of the Environmental Protection 25 Agency.

Rapid change will be needed to avoid disastrous climate change. To get to zero emissions by the middle of the century, the sale of fossil fuel boilers will have to end 30 within five years, all new buildings will have to run on clean electricity by 2030 and half of all existing buildings will have to be fully retrofitted by 2040, a recent landmark International Energy Agency report warned.

35 "The appliances we use at home have tended to be overlooked but they are contributing a significant amount to climate change and we need to address that," said Mike Henchen, an expert in carbon-free buildings at RMI. "That 40 will touch people's lives – our homes are our refuges, the places we know best. But

hopefully the change will also make people's homes more comfortable, safer and healthier, as well as reduce the climate impact."

45 So what will the climate-adapted homes of the future look like?

Designing the home to use less – and cleaner – energy

Changes on both the outside and inside of our 50 structures will shape the future of climate-proof homes. According to Alejandra Mejia Cunningham, building decarbonization advocate at the Natural Resources Defense Council, homes will have to follow three 55 interlocking mantras: "using the least energy possible from the cleanest sources at the right time".

Solar panels on roofs will become more common while, in rented or apartment 60 accommodation, community solar schemes could provide an alternative. Solar panels can also be married with home batteries to help store excess energy which, along with proper insulation, will help keep a house functioning 65 even during the sort of lengthy power blackouts Texas experienced earlier this year.

Such a scenario opens up the possibility of utility companies operating an automated network of homes, as is the case in parts of 70 Vermont, to manage demand and supply, rather than rely on hulking centralized infrastructure. "Having solar panels, batteries and water heaters all orchestrated and distributed makes the home a part of the 75 energy system and can provide a lot of savings," said Henchen.

Power use will become smarter and more automated, with technology helping spread energy use throughout the day to work in 80 tandem with a grid powered by variable wind and solar, rather than cause big surges in

demand that require the burning of gas or coal.

New tools for heating and cooling the home

85 Another energy efficient move will be to properly insulate homes. In fact new homes could be pre-fabricated in factories and fitted on site to reduce gaps where heat can escape.

90 Deep reductions in emissions will involve revamping the major appliances in the home, such as the water heater, furnace and air conditioning unit. As these items become older, they become wasteful and they will need to be replaced by more efficient 95 appliances that run off clean electricity.

Some of these replacements will be relatively innocuous, such as the installation of heat pumps, which will be in the basement or on the side of the house. Heat pumps work on 100 principles similar to a refrigerator, shifting heat from outdoors indoors and vice versa. They can heat and cool your home and can also heat your water with an efficiency rate four times greater than a gas-powered 105 version.

The changes you'll notice in everyday life

Other changes will be more obvious in day-to-day life, such as replacing incandescent lightbulbs with LEDs, installing low-flow 110 shower heads and phasing out gas stoves in favor of electric induction stovetops.

Such a change may be unnerving to dedicated home cooks but proponents point to the swifter heat-up time, reduced indoor air 115 pollution and negated risk of injuries to the hands of curious children .

“People will get used to technology like induction cooktops. There are already top chefs out there giving out the message that 120 they don’t have a worse performance than gas,” said Rohini Srivastava, a buildings expert at the American Council for an Energy-Efficient Economy.

The phase-out of gas will also remove the 125 need for a carbon monoxide detector in the home, although in the western US, air purifiers may become a standard feature in an age of growing wildfire smoke.

At what cost?

130 All of this will cost money – about \$70,000 for the average American household to decarbonize, according to Rewiring America. And broader, systemic changes will need to take place to make housing denser and 135 centered around transit lines and walkable communities to reduce car use, as well as a concerted effort to make homes resilient to the storms and fires spurred by the climate crisis.

140 Climate advocates are calling for a slate of government support to aid this transition – San Francisco is currently working out how to make the \$5.9bn switch to electrify all its homes currently powered by gas – but stress 145 that the public will need to view the changes as painless.

“The only way we will be able to do this is if the home feels just as comfortable and user-friendly as it has always been” said 150 Cunningham. “You need to be able to take hot showers, be cool in summer and warm in winter and not know the difference in terms of how that is all powered.”

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