

## BUILDINGS OVERVIEW

The building sector is responsible for about 40% of U.S. carbon dioxide emissions.<sup>1</sup> About half of that amount is used for heating and cooling. Luckily, there are more and more technologies available every day to decrease the amount of energy that buildings use, and widespread deployment of these technologies can make a substantial contribution to reducing GHG emissions.

Many of these solutions can be deployed in concert with one another. A net-zero building is one that produces as much energy as it uses in a year by combining distributed generation (such as rooftop solar) with maximum efficiency measures (such as daylighting, maximum insulation, dynamic glass, passive solar design, and advanced heating and cooling).

The energy efficiency of older buildings and homes can be improved through retrofitting. Retrofits not only reduce GHG emissions but also save money: the average payback time on a building retrofit is five to seven years.<sup>2</sup> Project Drawdown declares that, “Improving building energy efficiency is one of the most cost-effective and fastest ways to reduce electricity demand and associated fuel imports, while indirectly slashing carbon emissions as well as improving local air quality and public health.”<sup>3</sup>

Building-related solutions are generally fishery friendly because the location of their deployment is within the developed footprint (i.e., they are deployed in homes and buildings, rather than in waterbodies or waterways). Solutions that reduce the total amount of energy needed to maintain economic function and current standards of living are particularly friendly because they alleviate pressure on energy resources altogether, reducing the total amount of energy that must be produced to meet expectations. However, solutions that involve electrification of previously non-electric components, such as heat pumps and energy storage batteries, will drive up the total amount of electricity production needed compared to today. The impact of widespread electrification on fisheries will depend on the fishery friendliness of the source(s) of energy used to generate this electricity.

Building-related solutions tend to yield a number of social and environmental co-benefits that are widely dispersed across communities. Although some solutions have sizable up-front costs, they tend to save substantial money over their lifetime through reduced electric bills. They also create jobs in local communities, including disadvantaged communities. Some save water, which can be a vital concern in water-limited areas. Others reduce the urban heat island effect, reduce waste, and improve human health and air quality inside buildings and in surrounding areas.

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<sup>1</sup> Environmental and Energy Study Institute. “Buildings and built infrastructure.” <https://www.eesi.org/topics/built-infrastructure/description>

<sup>2</sup> Project Drawdown. Building retrofitting. <https://drawdown.org/solutions/building-retrofitting>

<sup>3</sup> Project Drawdown. Building retrofitting. <https://drawdown.org/solutions/building-retrofitting>

Green building techniques and energy efficiency upgrades can be incentivized through financing and contracting models that mitigate the risk and burden of high up-front investment, and through incentives such as tax credits and rebates, which are already in place in many states.

Other policy catalysts include:

- Building codes (state and local): Building codes can establish baseline standards that must be adhered to in the construction of new buildings. Some states and municipalities have passed legislation adopting the International Energy Conservation Code.<sup>4</sup>
- Decoupling utility revenue from sales: When utilities earn revenues based on the volume of sales, they have an incentive to encourage ratepayers to use as much energy as possible; energy efficiency runs counter to this goal. At least 26 states have begun to decouple their utilities' revenues from the volume of sales, for instance by adopting a set rate of return for the utility and then adjusting utility bills to ensure the recovery of that return. Decoupling is "one leg of a three-piece policy stool" that also includes demand-side management to provide consumer incentives to use less energy and some form of performance incentive for utilities to invest in energy efficiency.<sup>5</sup>
- Energy efficiency resource standard (EERS) or energy efficiency targets: States can require utilities to reduce energy demand by a certain percentage by a certain date, through implementation of demand reduction strategies. Some states have also included energy efficiency as an eligible resource under the states' renewable portfolio standard. Twenty-three states have mandatory EERS and 9 states and the District of Columbia have voluntary programs or goals.<sup>6</sup>
- Lead by example programs: States can lead by example through state procurement policies, which can be instituted either through legislation or executive order. These policies can apply to state agencies, universities, local governments, and school districts, and they can require these units to meet certain targets for energy efficiency, water efficiency, and renewable energy use.<sup>7</sup>
- Low-income energy efficiency: Low-income households would benefit the most from the cost savings associated with energy efficient homes, but often, they can least afford to make the upgrades. The federal Weatherization Assistance Program (WAP) helps low-income households attain energy savings through home weatherization. Some states have coupled the WAP with the federal Low Income Heating and Energy Assistance Program (LIHEAP) by making household heating assistance conditional upon receiving an energy audit and enrolling in WAP.<sup>8</sup>

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<sup>4</sup> Center for the New Energy Economy. 2019. "Building energy codes." <https://spotforcleanenergy.org/wp-content/uploads/2021/07/99d6ca2eb711a47873a449b422e645b1.pdf>

<sup>5</sup> Center for the New Energy Economy. 2016. "Decoupling & DSM performance incentives." <https://spotforcleanenergy.org/wp-content/uploads/2017/05/51022ccdce064ea3af9112299fd502c8.pdf>

<sup>6</sup> Center for the New Energy Economy. 2019. "Energy efficiency resource standard." <https://spotforcleanenergy.org/wp-content/uploads/2021/07/6a18dcfbae62d00c280c4a9d659ad65d.pdf>

<sup>7</sup> SPOT. 2019. "Lead by example programs." <https://spotforcleanenergy.org/wp-content/uploads/2021/07/40892b4c4b7478d210f7cee183c98bae.pdf>

<sup>8</sup> Center for the New Energy Economy. 2016. "Low income energy policies." <https://spotforcleanenergy.org/wp-content/uploads/2016/03/545b88fd3e0f82b8ac1a9b3ae67fb6ee.pdf>

- Property Assessed Clean Energy (PACE) programs: States can pass legislation to enable municipalities to develop PACE programs, which allow commercial building owners, industrial property owners, and homeowners to obtain financing for energy efficiency and renewable energy improvements through their property tax payments. Financing is provided by municipal bonds or private third-party lenders and a loan is transferred to a new owner if a property changes hands.<sup>9,10</sup>
- Energy savings performance contracting: In this type of arrangement, building owners can pay for energy efficiency improvements over time through their utility bills. Effectively, the savings generated are used to pay back the utility for the cost savings. The best candidates for this kind of arrangement are large institutions, where risk is low and repayment can be extended over a long period of time.<sup>11</sup>

The US Green Building Council is a nationwide organization dedicated to promoting green building techniques through professional trainings, public education, and the LEED (Leadership in Energy and Environmental Design) rating and certification system, which awards certified, silver, gold, and platinum status to buildings based on their inclusion of green and energy-saving features in building design. LEED certification is available to all building types (even homes), including new construction and retrofits. On its own, LEED certification provides a market and status incentive. Some U.S. federal agencies, states, and local governments also require or reward LEED certification through tax credits, zoning allowances, reduced fees, and expedited permitting. On the other hand, Maine and some other timber-producing states have banned state buildings from seeking LEED certification, due to concerns over how the LEED program defines sustainable wood products.<sup>12</sup>

The U.S. Energy Star program, which is administered by the Department of Energy and the Environmental Protection Agency, has a Residential New Construction Program and a Commercial Buildings Program, which allow homes and buildings to earn certification by meeting certain standards related to building envelope, heating and cooling systems, water management, lighting, and appliances. In order to earn certification, homes and apartments must be 20% more efficient on average than comparable residences built to code, and buildings must perform better than at least 75% of similar buildings nationwide.

In the case of homes and building spaces that are rented or leased (the most common use structure for commercial space), retrofitting suffers from a “split incentives barrier,” in which

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<sup>9</sup> Center for the New Energy Economy. 2016. “Commercial property assessed clean energy.” <https://spotforcleanenergy.org/wp-content/uploads/2016/05/32c1e5155f58039fd5d4602f69695008.pdf><https://spotforcleanenergy.org/wp-content/uploads/2016/05/1d0749191435ccd415dc8bb65d2d6256.pdf>

<sup>10</sup> Center for the New Energy Economy. 2016. “Residential property assessed clean energy.” <https://spotforcleanenergy.org/wp-content/uploads/2016/05/32c1e5155f58039fd5d4602f69695008.pdf>

<sup>11</sup> Center for the New Energy Economy. 2019. “Energy savings performance contracting.” <https://spotforcleanenergy.org/wp-content/uploads/2021/07/33d54abeb609d166a45ea3f2aa237221.pdf>

<sup>12</sup> Gloede, Katie. “The wood wars continue.” *Architect Magazine*. March 31, 2015. [https://www.architectmagazine.com/technology/the-wood-wars-continue\\_o](https://www.architectmagazine.com/technology/the-wood-wars-continue_o)

the owner of the home or building must pay for upgrades but tenants reap the benefits of such upgrades in the form of reduced energy bills. As a result, there is little incentive for owners to invest in upgrades.<sup>13</sup> Proponents of energy efficiency are developing ways around this. For instance, green leases (also called aligned leases, high-performance leases, or energy-efficient leases) are rental agreements in which tenants and landlords commit to special arrangements that make sustainability enhancements work for both parties; they can take a number of different forms and are tailored to specific objectives and circumstances. In other instances, utilities can step in to fill the gap, such as in Seattle's pilot Energy Efficiency as a Service program, in which participating building owners who make upgrades will be charged for electricity as if the upgrades had not been made, but will then be able to sell the avoided electricity to the utility through a power purchase agreement.<sup>14</sup>

Indirectly, states can incentivize adoption of energy efficiency solutions in buildings and homes through demand response and load management programs such as time-variant electricity pricing, also called time-of-use pricing, which charges a higher price per kWh at times of peak demand). These programs create monetary incentives for households and building owners/tenants to invest in energy efficiency upgrades or in building automation and smart thermostats that adjust energy use to avoid high usage during times of peak demand.

An economy-wide carbon pricing system, such as a carbon fee and dividend, would have a similar effect. Some observers predict that if fossil fuel-powered energy was properly priced (e.g., by imposing a price on carbon that reflects its full social and environmental impact), construction of new net-zero buildings would become much more common on its own due to market factors, without the need for additional policy measures or incentives.<sup>15</sup> Empirical research has shown that when energy prices increase, there is greater investment in energy-saving measures such as building efficiency upgrades.<sup>16</sup>

The Database of State Incentives for Renewables & Efficiency (DSIRE) program, hosted by North Carolina University, and the State Policy Opportunity Tracker (SPOT) provide comprehensive listings of state financial incentives and regulatory policies for energy efficient practices, appliances, and building components, including appliance/equipment efficiency standards, bond programs, building energy codes, tax incentives, grants, financing mechanisms, rebates, and more.

- More information:
  - [American Council for an Energy Efficient Economy](#)
  - [U.S. Green Building Council](#)
  - [Wikipedia: LEED](#)

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<sup>13</sup> Sheff, John. (February 10, 2021). "The time is now to finally crack the split incentive barrier." <https://facilityexecutive.com/2021/02/the-time-is-now-to-finally-crack-the-split-incentive-barrier/>

<sup>14</sup> Seattle City Light. Energy efficiency as a service. <https://powerlines.seattle.gov/eeas/>

<sup>15</sup> Project Drawdown: Net-zero buildings. <https://drawdown.org/solutions/net-zero-buildings>

<sup>16</sup> Wang, Rong, et al. 2019. Induced energy-saving efficiency improvements amplify effectiveness of climate change mitigation. *Joule* 3(9):P2103-2119. DOI:<https://doi.org/10.1016/j.joule.2019.07.024>

- [International Energy Agency \(IEA\): Buildings – A source of enormous untapped efficiency potential](#)
- [Center for Climate and Energy Solutions \(C2ES\): Decarbonizing U.S. buildings](#)
- [Energy Star Commercial Buildings](#)
- [Energy Star Residential New Construction](#)
- [DSIRE: Table of State Programs](#)
- [SPOT: Commercial building energy codes](#)
- [SPOT: Residential building energy codes](#)
- [SPOT: Decoupling and DSM performance incentives](#)
- [SPOT: Energy efficiency resource standard](#)
- [SPOT: Lead by example programs](#)
- [SPOT: Low-income energy efficiency](#)
- [SPOT: Commercial property assessed clean energy](#)
- [SPOT: Residential property assessed clean energy](#)
- [SPOT: Energy savings performance contracting](#)
- [SPOT: Green/infrastructure bank](#)
- [SPOT: Revolving loan funds](#)
- [DOE: Demand response](#)

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