SECTION 03

The Obstacles to Utility Decarbonization

IN THIS SECTION, WE COVER:

Roadblocks to the Net-zero Transition

Utilities face six obstacles on the path to decarbonization.

The ongoing energy transition is like no other—it requires a complete fossil fuel fade within the three decades to 2050, compared to previous energy transitions that occurred over centuries.

For utilities, this presents an unprecedented challenge. It entails divesting existing fossil fuel-fired power plants (which may still be in service), scaling up carbon-free generation, and modernizing the grid, all while meeting rising electricity demand from electrification and a growing population.

01 Lack of Transmission Infrastructure

02 Funding and Regulatory Needs

03 Technological Costs

04 Intermittency of Renewables

05 Socio-Economic Divide

06 Workforce Development

Obstacle 01

Lack of Transmission Infrastructure

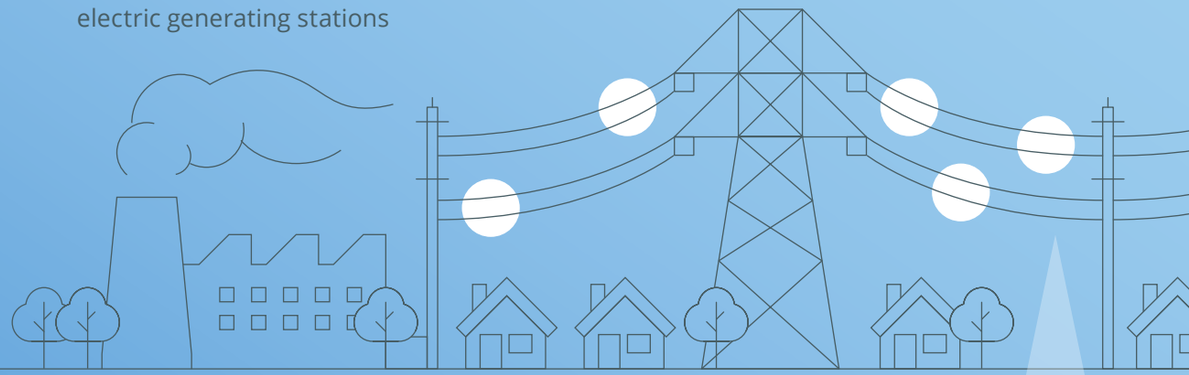
Decarbonizing the U.S. economy requires the electrification of the majority of sectors. This includes replacing gas cars with EVs and gas-powered heating with electric pumps.

Ultimately, electrification will result in higher electricity consumption. While utilities can ramp up generation capacity to meet this rising demand, new installations will be rendered impractical by decaying grid infrastructure.

The U.S. Electric Grid

Over 9,200
electric generating stations

Over 600,000 miles
of transmission lines and 5.5M miles of distribution lines[11]



The majority of high-voltage transmission lines are in densely populated regions. However, different forms of renewable energy are most efficient in different regions of the U.S., some of which are relatively remote.

Current age: 70% of lines are **over 25 years old**

Expected life: **50 years**

Source: American Society of Civil Engineers[11]

Transmission Lines Needed for Wind and Solar by 2030

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Obstacle 02

Funding and Regulatory Needs

Utilities are under pressure to fund decarbonization while providing an uninterrupted supply of electricity to consumers—an unrealistic task without substantial financial and regulatory support.

Decarbonization expenditures for utilities include, but are not limited to:

- Investments in new generation
- Fossil fuel plant retirements
- Research and technology development
- Clean energy replacement costs
- Disaster-resilient grid infrastructure

Additionally, utilities are also expected to fund grid modernization and transmission expansion, which is not only an economic burden but also a regulatory one.

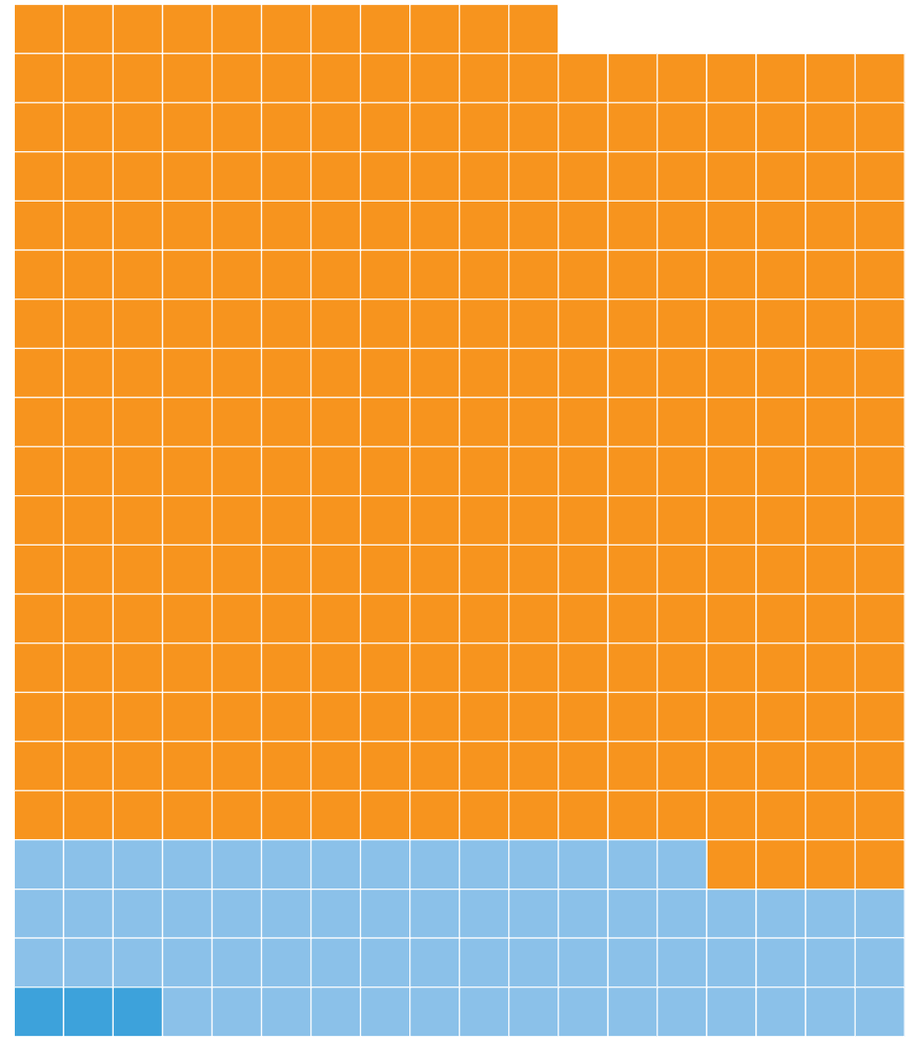
Since the grid is interconnected and transmission lines are shared across the nation, utilities face changing regulations from different states and local municipalities. Upgrading the grid and advancing decarbonization on a national scale requires government support through streamlined regulations and funding.

The Biden Administration's grid and infrastructure bills provide $68 billion for new grid infrastructure,[14,15] but it's only a fraction of the capital needed by 2030, let alone the $2.2 trillion needed by 2050.

This funding is volatile in nature and is dependent on the administration in power over the next few years.

$68B Funding provided

Funding the Net-zero Grid



$330B Investment needed by 2030*

The investment needed rises to $2.2T by 2050, averaging $79B annually from 2023 to 2050.[12]

Inflation Reduction Act **$3B**

Bipartisan Infrastructure Bill **$65B**

*Investment needed for transmission expansion for wind and solar generation in a high-electrification scenario with base siting availability. Includes both capital required for 200,000 GW-km of transmission expansions and for end-of-life line replacements.

Source: Congressional Research Service,[15] Utility Dive,[14] Princeton[12]

Obstacle 03

Technological Costs

Fossil fuels have been the dominant source of electricity for decades, and both public and private infrastructure are currently well-suited to older technologies.

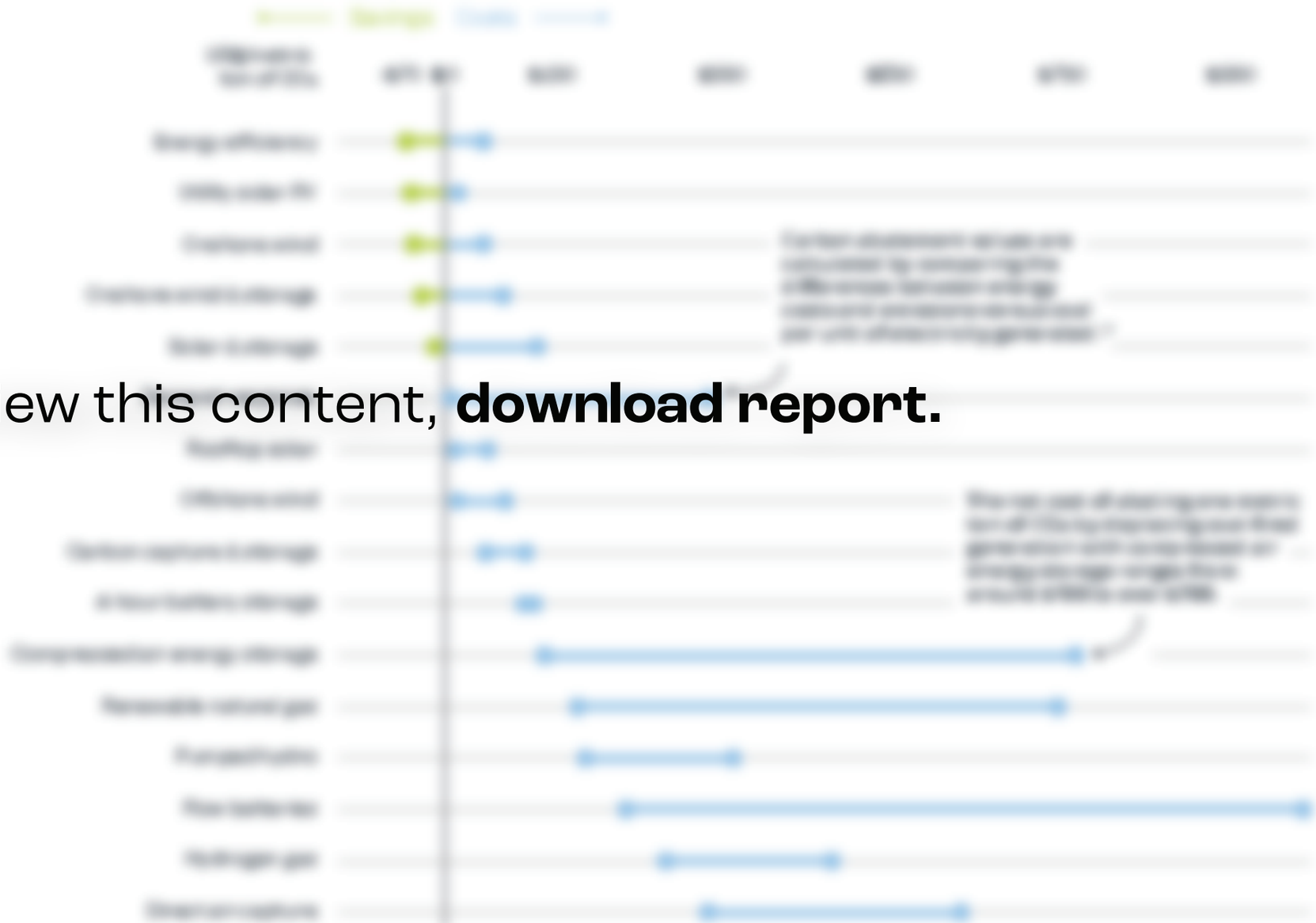
As a result, it is expensive for utilities to adopt new technologies at the pace required to achieve net-zero emissions. Technology adoption among utilities typically occurs in a 10-year cycle due to safety, reliability, and regulatory issues.

Furthermore, innovating and developing new technologies that support decarbonization requires heavy investment in research and development. Characteristic mitigation technologies like carbon capture, utilization and storage (CCUS) technologies also remain expensive for the power sector, which produces "dilute" streams of CO_2 that are not highly concentrated.[1]

Sources: [illegible] Energy Agency, [illegible]

Carbon Abatement Values by Technology

Cost of (or savings from) abating one ton of CO_2 as compared to coal



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Obstacle 04

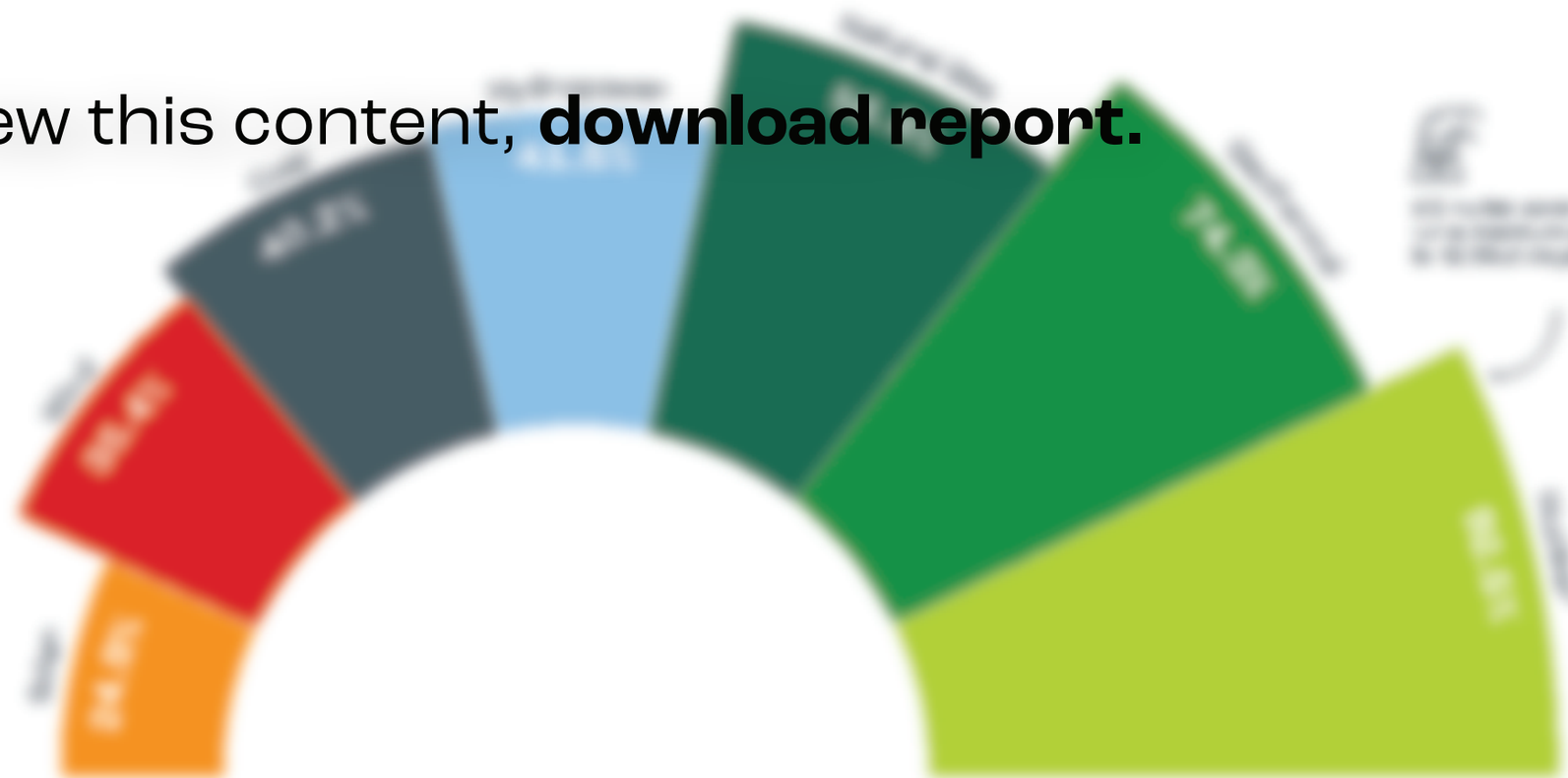
Intermittency of Renewables

Solar and wind farms are sometimes "intermittent" due to their inability to supply power consistently. This is because solar power relies on the availability of sunlight, and wind generation depends on wind speeds.

As a result, although solar and wind farms generate a tremendous amount of energy, their capacity factors—which measure how often power plants are running at maximum capacity—are relatively low.

Capacity Factor by Energy Source 2020

In a scenario where electricity demand is rising from electrification, this intermittent nature of wind and solar—class of the technology leaving sources of energy—presents a roadblock for utilities.



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Sources: U.S. Department of Energy[17]

Obstacle 05

Socio-Economic Divide

While transitioning to a net-zero economy, the economic, social, and technological inequalities between different regions and population groups within the U.S. will need to be addressed.

Income and Technology Gaps

Decarbonizing electricity generation requires the adoption of smart and energy-efficient technologies among utility customers to help reduce the load on the electric grid, while allowing utilities to better manage their resources.

However, not all utility customers live in urban areas with access to smart technologies, and those living in remote regions may not have access to the internet. Therefore, utilities adopting customer-centric technological solutions to decarbonize may risk alienating some customer groups, which is a barrier to reaching 'economy-wide' levels of decarbonization.

Awareness Gaps

In order to support decarbonization, utility customers need to understand and be aware of the technological changes required in the average household.

Closing these awareness gaps will require educational campaigns, targeted marketing, and knowledge dissemination from both utilities and administrations. Since not all customers are online, utilities also need to set up different channels of communication for different socio-economic groups.

Utilities will also need to have two-way communication with their customers to better understand their needs.

Obstacle 06

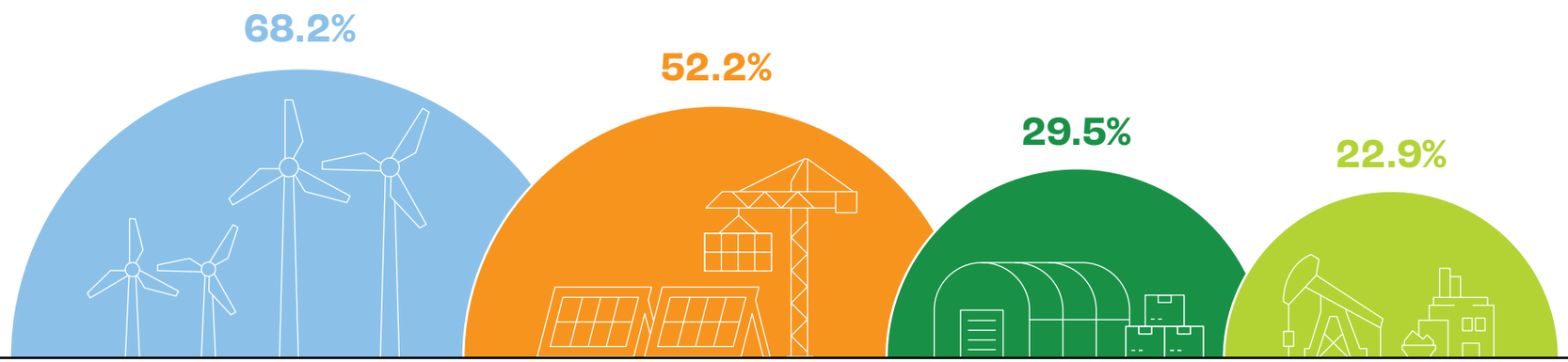
Workforce Development

As new technologies emerge and sectors transform or become obsolete, workers will need to be retrained to perform new tasks. Similarly, utilities will need a new and technically-trained workforce to deploy modern technologies on a commercial scale.

Not to mention, by decommissioning fossil fuel plants, utilities risk displacing communities and what their economy is based on. Educating and training fossil fuel plant employees to prepare them for new clean energy jobs will require significant investment from both utilities and the government, in addition to private investment.

The Demand for Green Jobs

Projected growth rate 2020-2030



Wind turbine service technicians have the fastest growth rate among all jobs in the U.S. through 2030.

Source: Bureau of Labor Statistics[19]

The Path Forward

While these obstacles are significant they are not insurmountable given that the industry is already moving forward with changes underway. There are solutions for utilities to overcome these obstacles through cross-industry collaboration, public-private partnerships, technological development, and community-specific solutions.

With this context, the 2022 Annual Utility Decarbonization Index highlights the current status of decarbonization for the largest utilities in the U.S..