Budgetary and Policy Recommendations

September 2021

Edison Electric Institute
(and its Member Companies)

Bipartisan Policy Center

Center for Climate and Energy Solutions

Clean Air Task Force

ClearPath Action

Great Plains Institute

Information Technology Innovation Foundation

Nuclear Energy Institute

Third Way

CARBON FREE
TECHNOLOGY INITIATIVE

Overview:

- Background and motivation of the Carbon-Free Technology Initiative
- The need for dispatchable zero carbon power to meet climate goals
- Summary of innovation recommendations
- The recommendations in context

CARBON-FREE TECHNOLOGY INITIATIVE

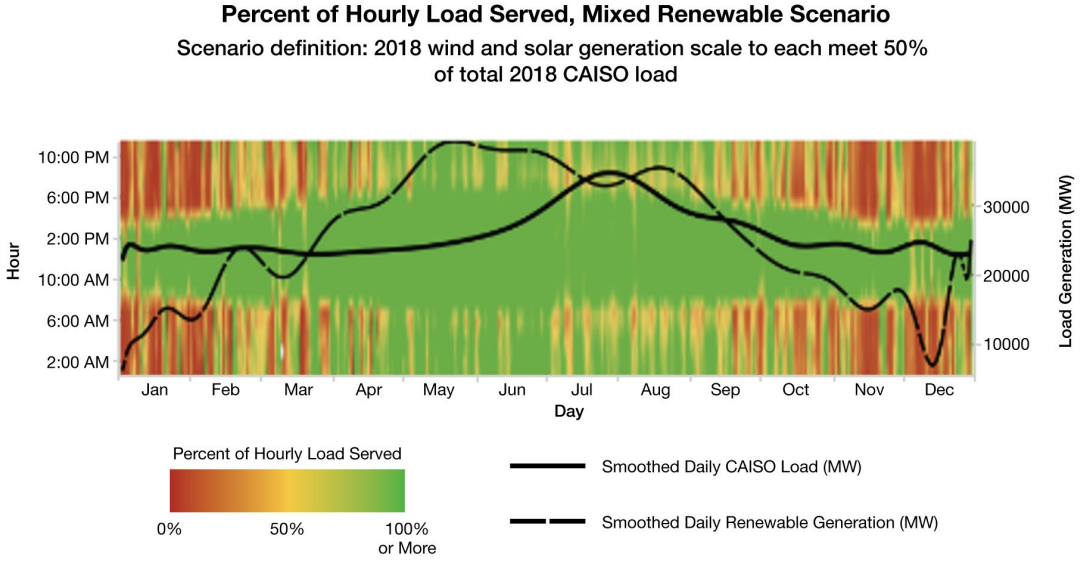
Why the Carbon-Free Technology Initiative?

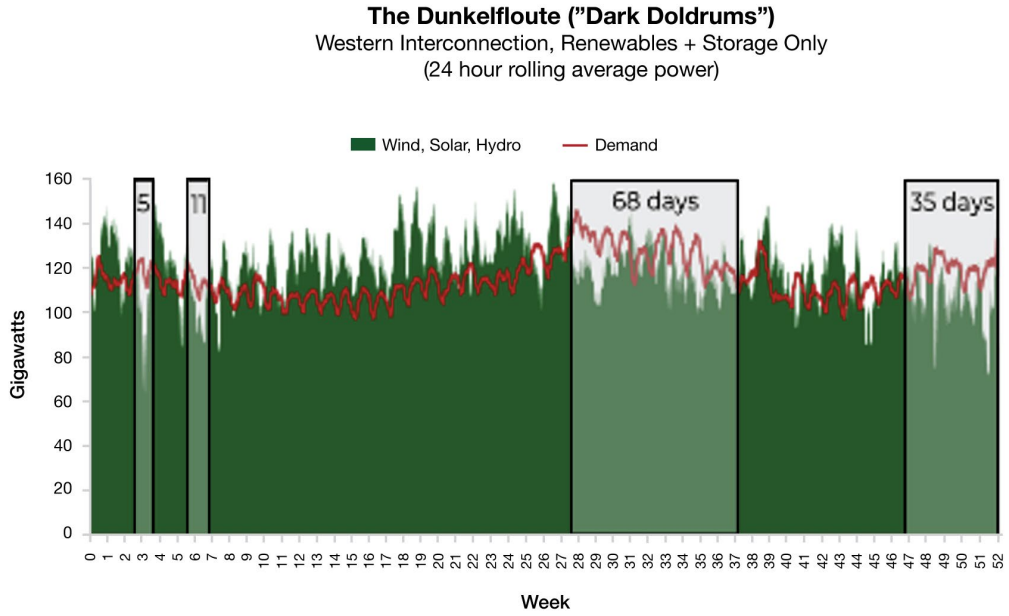
- To date, **47 EEI members** have announced long-term carbon reduction goals.
- **Thirty-two of EEI's member companies have pledged to achieve zero- or net-zero carbon emissions** by mid-century or earlier.
- To meet these pledges, firm, dispatchable, zero-carbon resources are needed by the early 2030s.
- The Carbon-Free Technology Initiative (CFTI) **promotes federal policies** that can help ensure the commercial availability of affordable, carbon-free, 24/7 power technologies by the **early 2030s.**
- If the CFTI is successful, the electric power industry could be positioned to achieve a mid -century net-zero target and support decarbonization of other sectors, such as transportation and industry.

Overview of Recommendations

- **The CFTI focuses on policy recommendations to advance six key technology areas:**
  - **Advanced renewables**, seeking increased output and efficiency from variable sources, including advanced power electronics to improve grid management of variable generation
  - Deployment of **new dispatchable resources** (e.g., superhot rock deep geothermal)
  - Medium-duration and long-duration **storage and advanced demand efficiency**
  - **Zero-carbon fuels**, such as hydrogen, produced from carbon-free pathways
  - **Advanced nuclear energy** (both fission and fusion)
  - And **carbon capture, utilization, and sequestration**, especially for natural gas power generation facilities

The necessity for zero-carbon firm power





While solar and wind costs have fallen dramatically, building an electric system that can theoretically provide 100% of average annual electric demand, as in the above California example, would leave the system short of power for many hours of the year, shown in yellow, orange and red.

Even adding inexpensive batteries and building wind and solar well in excess of peak demand and including hydro electric power, as in this example for all the Western states, would leave the system short on power over multiple weeks.

Source: Jenkins, Jesse. Unpublished modeling of zero-carbon electricity systems in California and the Western Interconnection. Princeton University. May 28, 2019.

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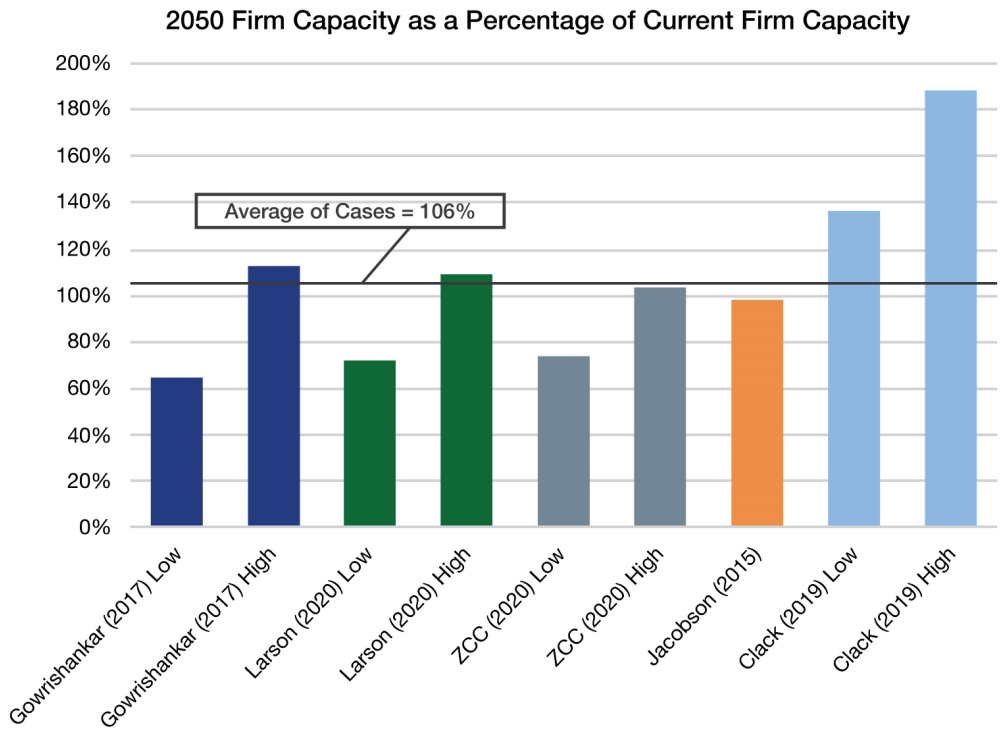
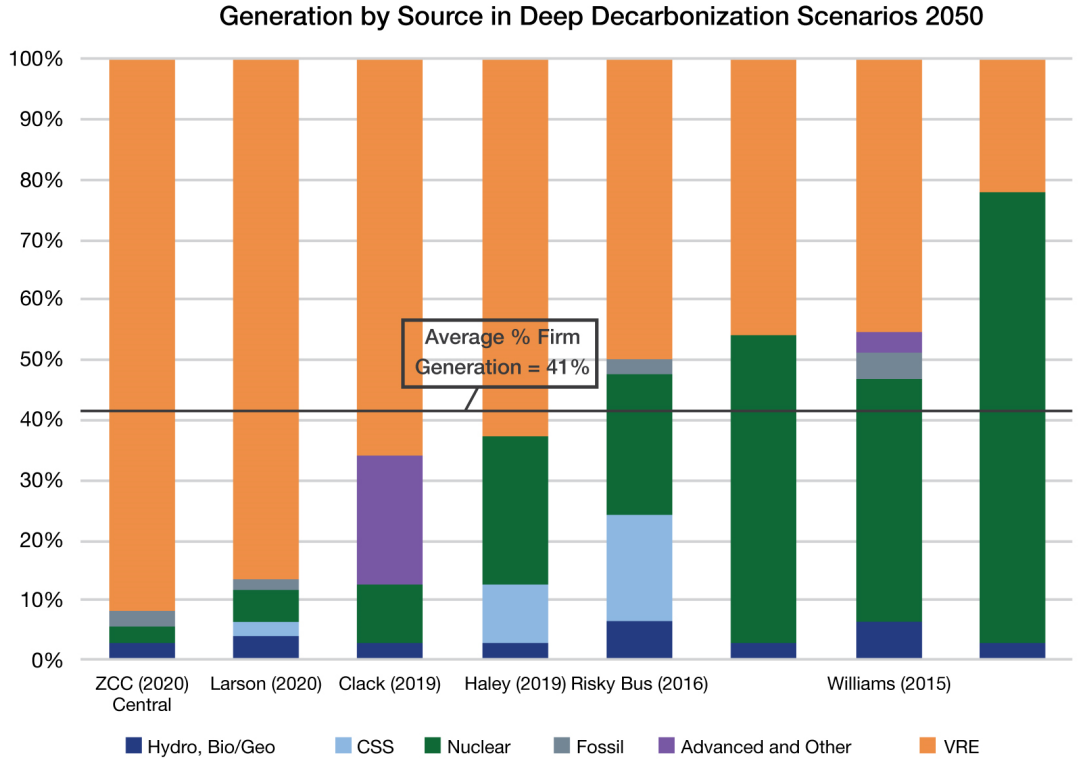
Almost all studies demonstrate the need for a substantial amount of firm capacity in 2050, ranging from 8-78%





Source: Phillips, B., N. Fisher, A. Liu. Review and Assessment of Literature on Deep Decarbonization in the United States: Importance of System Scale and Technological Diversity The Northbridge Group. April 20, 2021.

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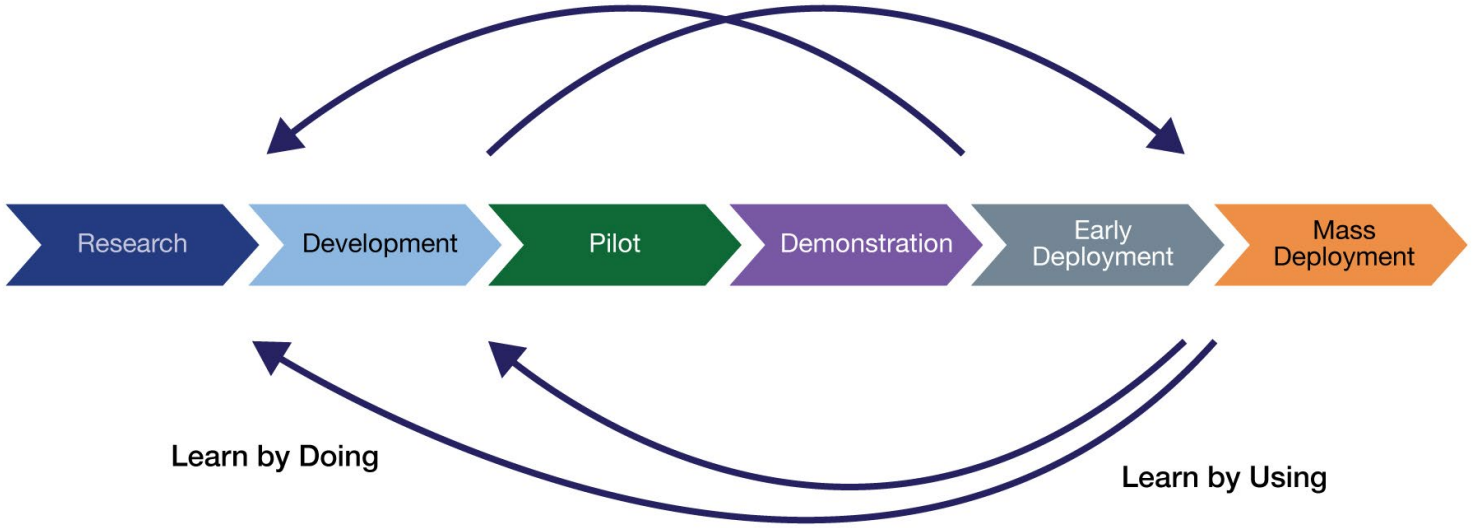
Scope of recommendations: covering the full innovation lifecycle

- A successful technology innovation strategy should focus on early-stage research through later-stage deployment. Without consideration of the full lifecycle, large technology and financing risks deter marketplace adoption. Moreover, **each segment of the innovation lifecycle is not isolated – the successes and failures from each step inform others**. The figure below illustrates the common feed-back and pass-forward lessons learned from different stages of the innovation lifecycle.



Adapted from: Wong, J. and D. Hart. Mind the Gap: A Design for a New Energy Technology Commercialization Foundation. ITIF. May 11, 2020.

Federal government support needed at various stages

Research – where discovery and invention happen. Federal support for research (both basic and applied) at national labs and universities is necessary to address the market failure to adequately price the benefits of future technology deployment.

Development – where scientific discoveries are turned into new technologies and applications. Federal programs like the Department of Energy's Advanced Research Project Agency – Energy (ARPA-E) and technology offices help address development risks.

Pilot – where small-scale (i.e., not the commercial product) fully integrated systems are created as a technological proof of concept, resulting in important technology de-risking. ARPA-E has expanded support to this stage through its new SCALEUP program.

Demonstration – where fully integrated "first-of-a-kind" projects are done on a commercial scale. Private sector involvement is crucial, and these projects must be led by the private sector. But high costs of capital, with remaining technology and project risks, can be alleviated by federal support through direct grants, loan guarantees, technological assistance, and procurement incentives.

Early Deployment – where early "Nth-of-a-kind" projects are done, with an emphasis on improving financing options and driving down costs through multiple iterations of same/similar design. The federal government can help by off-setting technology risk and creating markets, either through direct procurement or tax incentives, to build momentum for more projects being built in the future.

Mass Deployment – where technological and financial mechanisms have been fine-tuned and projects are developed profitably in response to market demand. The federal government can create predictable markets that incentivize mass deployment, if there is clear public benefit. Financing and procurement support can help accelerate the deployment of new technologies thus driving costs down more quickly.

Overview of Recommendations:

- Research and development
- Commercial demonstration
- Scale-up and diffusion
- Deployment and infrastructure

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Research and development

- Most federal support for clean energy R&D occurs through the Department of Energy (DOE). Regarding R&D for carbon-free technologies, proposed policy recommendations would:
  - **Significantly increase funding for energy innovation R&D programs at DOE over the next five years**, including through ARPA-E and national laboratories. Such funding should continue to increase after the initial five-year period.
  - Create dedicated programs and initiatives at DOE for each of the technology areas to **accelerate their development and establish new mechanisms for public and private-sector** collaboration, including with state and local entities.
  - Revise the focus of the DOE Office of Fossil Energy to highlight carbon capture for natural gas generation.
  - Launch a Nuclear Affordability Initiative that would direct DOE to **emphasize reducing the cost and schedule to construct new nuclear plants** and reduce the operation and maintenance costs for those new plants.

Commercial demonstration

- **Enabling projects to quickly move from R&D and pilot demonstration toward commercial-scale demonstration is essential**. Demonstration projects face several hurdles, including limited appetite by private investors and federal efforts suffering from limited funding and limited risk appetite. To overcome these hurdles, proposed policy recommendations would:
  - Establish a dedicated program to guide and support the demonstration of the priority technologies noted above.
  - Establish consortia with collaboration and knowledge-sharing across federal agencies, the national labs, and non-governmental and other entities with relevant expertise.
  - Adopt measures to reduce barriers to using loan guarantees offered by the DOE Loan Program Office.
  - Establish alternative cost-share formulas for demonstration projects not necessarily tied to a 50/50 split (e.g., for early-stage project development, an 80/20 cost-share grant program would be appropriate).
  - Increase appropriations to support commercial-scale demonstration projects involving first-of-a-kind and Nth-of-a-kind technologies.

Scale up and widespread diffusion (1)

- **A range of mechanisms are needed to support carbon-free technologies** to move from the demonstration stage to achieving technical maturation at a commercial scale and relative competitiveness in the marketplace. Policy recommendations with respect to the deployment of carbon-free technologies would:
  - Provide financial incentives for investing in deployment of these technologies, including production or investment tax credits (with monetization), loan guarantees, and grants.
  - Extend and expand existing tax credits, such as 45Q for carbon sequestration.
  - Develop a technology-neutral tax credit to incentivize deployment of new carbon-free technologies.
  - Authorize the federal government to offer a contract for difference mechanism that buffers the technology against downside market risk while sharing upside profits with taxpayers.

Scale up and widespread diffusion (2)

- Proposed policy recommendations with respect to the deployment of carbon-free technologies would also:
  - Utilize federal government virtual power purchase agreements of 10-30 years for some carbon-free energy technologies.
  - Establish enterprise zones for power plant sites that are closing to encourage deployment of new carbon-free energy technologies in those zones.
  - Establish a federal clean energy fund that would invest in, as well as spur private investment into, carbon-free energy technologies.

Deployment and infrastructure

- **Achieving net-zero carbon emissions from the electric power sector will require substantial infrastructure investments**. This will require both the ability to permit and site (1) generating facilities and (2) the supporting infrastructure, such as transmission, natural gas pipelines and storage that enables their operation. Proposed policy recommendations to address these "ecosystem" issues would:
  - Address siting barriers to construction of clean energy generation, transmission, and CO_2 pipelines.
  - Reform siting and permitting on federal lands.
  - Provide federal support mechanisms for licensing carbon-free energy technologies, such as advanced nuclear facilities by the Nuclear Regulatory Commission.
  - Establish industry consortia for broader deployment and use of carbon-free energy technologies across industries.

Budget and Appropriations:

- What is it going to take?
- Duration of this effort
- FY22 budget recommendations
- Appropriations requests

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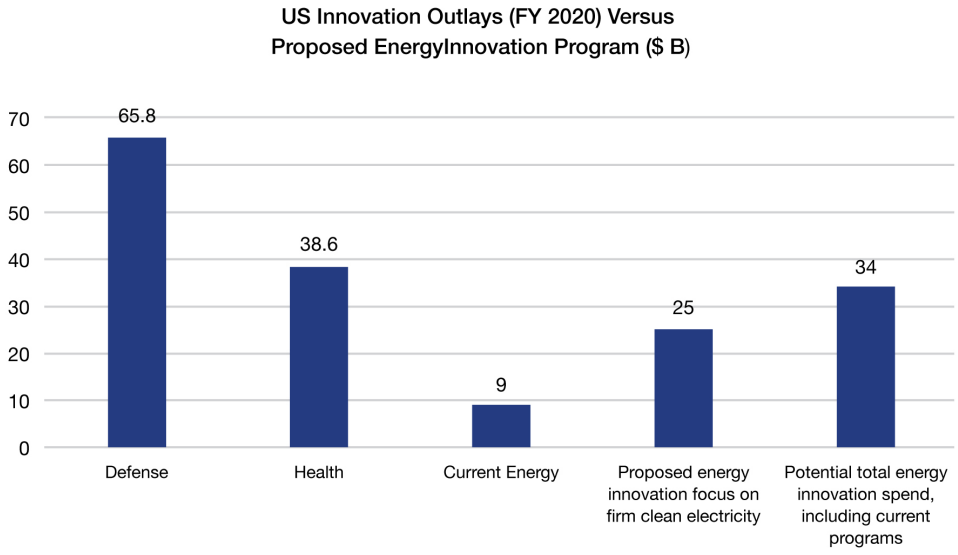
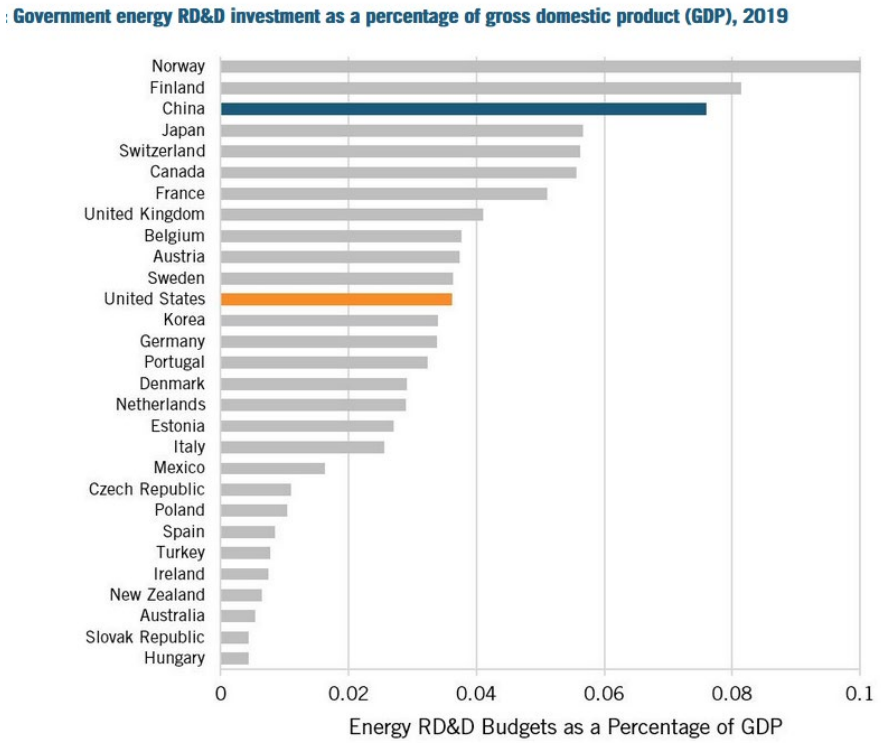
What is it going to take?

- We recommend a sustained innovation effort over a decade, reaching approximately **$25B in early years**
- Adding to current expenditures of $9 Billion for all energy innovation in FY2020, this would put clean energy innovation on par with public health and **put the US more in league with its competitors in the OECD and China**.





Sources:

American Association for the Advancement of Science (AAAS). "Historical Trends in Federal R&D." See Excel sheet "Trends in Federal R&D by Function FY1953-2020" for Defense and Health figures.

Cunliff, C. and L. Nguyen. "Energy Innovation: Raising the Ambition for Federal Energy RD&D in FY22." ITIF. May 17, 2021.

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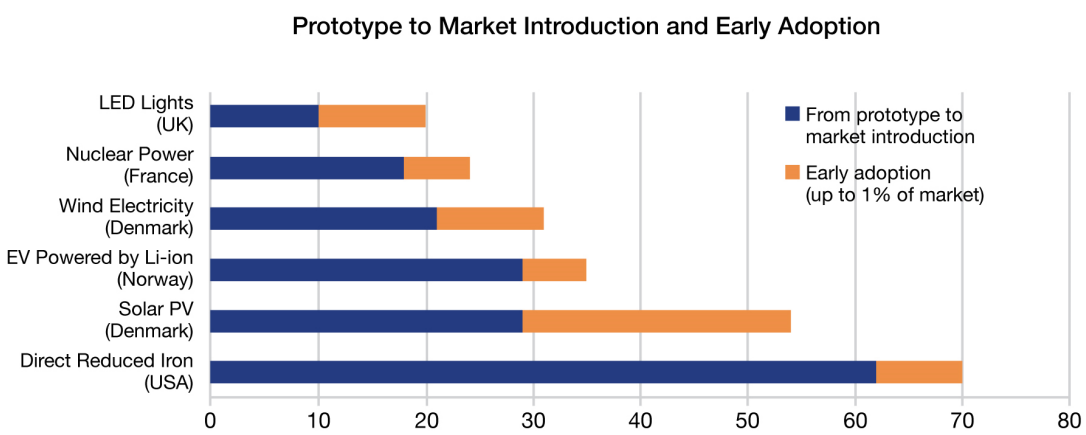
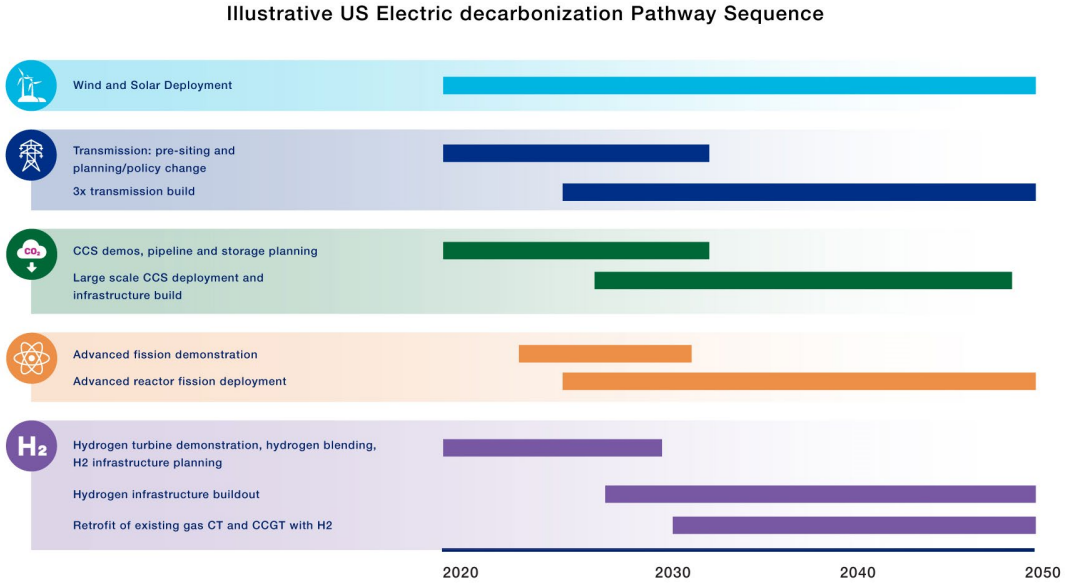
Duration of this effort

- Greater funding for energy innovation must begin immediately and be sustained over a long period for benefits to fully materialize for deep decarbonization of the power sector for a couple reasons:
  - The innovation process takes a long time. According to the International Energy Agency (IEA), bringing new energy technologies to market can take 20-70 years from first prototype.
  - It can take years for greater funding to translate into greater numbers of researchers and scientists in a particular field.
- Putting it all together, if we begin immediately in demonstrating and scaling key technologies, the U.S. electric power industry could be well positioned to achieve a net-zero target by mid-century.





Sources:

IEA. Clean Energy Innovation, Innovation Needs in the Sustainable Development Scenario. IEA. Paris. July 2020.

Clean Air Task Force.

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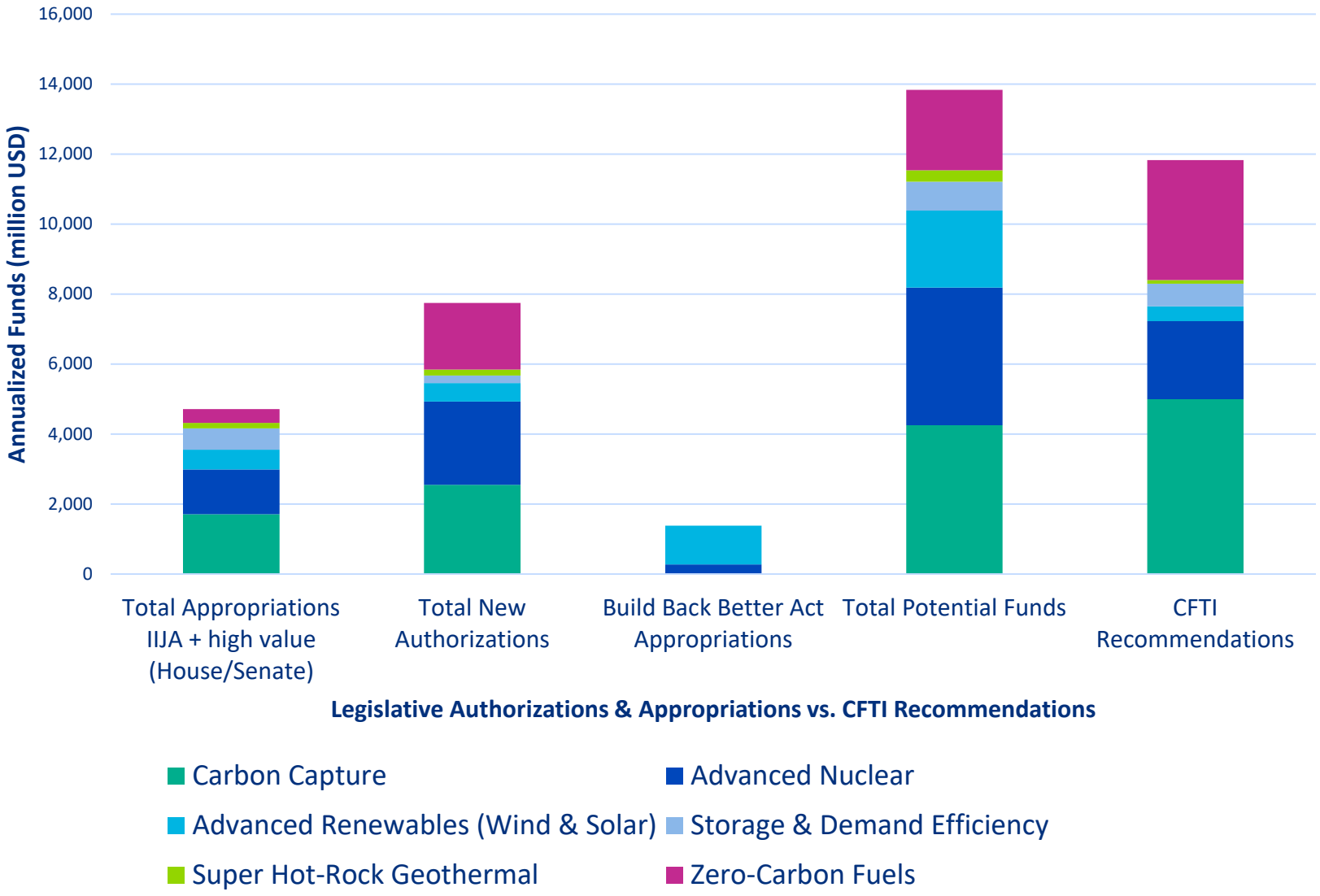
Potential Total FY22 Investments in CFTI-Recommended Energy Technologies

Advanced Nuclear
Double existing research and development budgets for nuclear fission technologies to approximately $1 billion in fiscal year 2022.

Carbon Capture, Utilization and Storage
Double funding for existing demonstrations and authorize new programs that will fund carbon capture infrastructure.

Super Hot Rock Geothermal
Provide support for at least two demonstrations from super hot rock geothermal technologies and establish a dedicated program and laboratory for super hot rock research and development.

Zero-Carbon Fuels
Double research and development dollars for zero-carbon fuels and authorize new programs for demonstration and deployment.



Source: Analysis by Waxman Strategies for Clean Air Task Force

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CFTI Technology Spending Comparisons ($M): House & Senate Proposed FY22 Appropriations* vs. CFTI

	FY21 (status)	FY22 House proposed approps	FY22 Senate proposed approps	IIJA proposed approps	IIJA + Highwater mark House/Senate	CFTI recommendations
Carbon Capture	$228	$336	$382	$1,324	$1,706	$4,995
Advanced Nuclear	$1,040	$767	$722	$511	$1,278	$2,230
Advanced Renewables (Wind&Solar)	$390	$520	$505	$45	$565	$425
Storage & Demand Efficiency	$648	$484	$460	$126.25	$610	$648
ZCFs	$210	$394	$285	$0	$394	$3,430
Super Hot-Rock Geothermal	$106	$137	$130	$21	$158	$100

*Values include “likely” appropriations; Build Back Better Act budget reconciliation values are not included.

Source: Analysis by Waxman Strategies for Clean Air Task Force

CFTI Technology Spending Comparisons ($M): House & Senate New & Proposed FY22 Authorizations vs. CFTI

	Energy Act — New Authorizations	IIJA — New Authorizations	Total New Authorizations	CFTI recommendations
Carbon Capture	$1,349	$1,200	$2,549	$4,995
Advanced Nuclear	$1,181	$1,200	$2,381	$2,230
Advanced Renewables (Wind&Solar)	$425	$100	$525	$425
Storage & Demand Efficiency	$216	$2	$218	$648
ZCFs	$0	$1,900	$1,900	$3,430
Super Hot-Rock Geothermal	$170	$0	$170	$100

Source: Analysis by Waxman Strategies for Clean Air Task Force

CFTI Technology Spending Comparisons ($M): Potential total FY22 appropriations and authorizations vs. CFTI

	IIJA + Highwater mark House/Senate	New Authorizations	Reconciliation (Potential)**	Total Potential	CFTI Recommendations	Delta (CFTI Recs – Total Potential)
Carbon Capture	$1,706	$2,549	$0	$4,255	$4,995	**– $740**
Advanced Nuclear	$1,278	$2,381	$273*	$3932	$2,230	**+ $1,702**
Advanced Renewables (Wind&Solar)	$565	$525	$1108	$2,198	$425	**+ $1,773**
Storage & Demand Efficiency	$610	$218	$0	$828	$648	**+ $180**
ZCFs	$394	$1,900	$0	$2,294	$3,430	**– $1,136**
Super Hot-Rock Geothermal	$158	$170	$0	$328	$100	**+ $228**

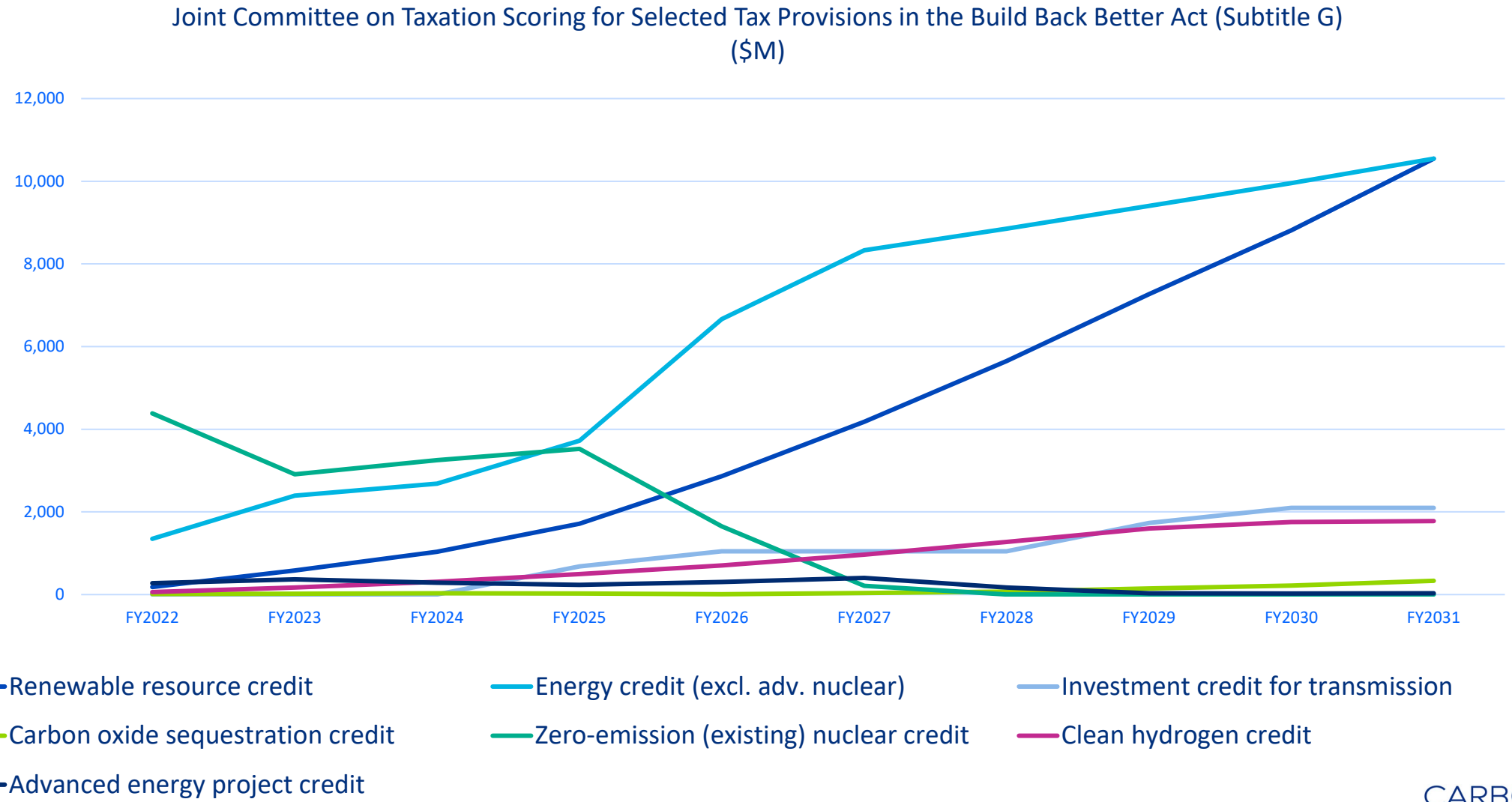
*SST proposed reconciliation text also includes $1325M for the ITER, $180M for Low-dose Radiation Research, and $1240M for various Fusion R&D programs

**E&C proposed reconciliation text also includes the CEPP, $30B in additional Loan Programs Office authority, $8.8B for new and upgraded transmission lines, $100M for offshore wind transmission planning, and $2.5B for low-income solar installations; while the House W&M proposed text includes over $267B worth on clean energy tax incentives - none of which are quantified in the above numbers.

Joint Committee on Taxation has low expectations for extended Carbon Oxide Sequestration Credit

Carbon oxide PTC forecasted at $12-331M for FY2022-2031.

Clean hydrogen credit forecasted at $60-1,779M for FY2022-2031.



Source: Data are from the Joint Committee on Taxation, Sept. 13, 2021

Cross Cutting, Multi-Technology Recommendations

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Research and Development

- Increase current Department of Energy (DOE) R&D and ARPA-E budgets by two to four times current levels for carbon-free technologies over the next five years and continue to increase such funding after the initial five-year period.
- Establish a “bypass budget,” similar to a model used by certain initiatives of the National Institutes of Health (NIH), to allow the electric power industry and electric customers outside of the federal government to identify innovation needs and desired levels of federal support and submit a budget directly to Congress for approval, bypassing the traditional budget process.
- Direct DOE to establish targets that accelerate the development of specific technologies by a given year and identify more specific cost and performance targets.
- Expand on and establish new mechanisms for collaboration between the public and private sectors and with state and local entities.

Demonstration

- Establish a dedicated program to guide and support the demonstration of the portfolio of dispatchable carbon-free technologies needed by the electric industry to achieve deep carbon reductions (e.g., a DOE Office of Major Demonstration).
- Establish consortia to ensure robust feedback and communication on demonstration projects, including identifying strengths and areas needing improvement. Consortia should promote collaboration and knowledge-sharing across federal agencies, the national labs, and non-governmental and other entities with relevant expertise.
- Adopt a range of measures to reduce barriers to using loan guarantees offered by the DOE Loan Program Office (LPO) and enhance program effectiveness.

Deployment

- Establish technology-neutral incentives for the deployment of innovative zero-carbon technologies. These incentives should:
  - be available as production and/or investment tax credits,
  - have a commence construction window from now through at least 2035,
  - authorize some form of monetization, and
  - authorize a minimum of 10-15 years of claiming.
- Establish incentives that could cover aspects of the supply chain in bringing zero-carbon technologies to scale (e.g., transportation, construction, and installation equipment and capabilities).
- Encourage equipment and processes that can be easily replicable at scale (e.g., fast modular on-site fabrication; minimization or substitution of expensive materials; simplified designs; offshore installation vessels).

Marketplace/“Ecosystem” Barriers

- Develop a federal vision for future carbon-free technology infrastructure deployment, including carbon-free fuel transportation, carbon transportation, and/or other investments and enhancements for the purposes of achieving deep carbon reductions in the electric power industry.
- Establish federal-level efforts to review permitting processes for carbon-free technology infrastructure, identify best practices and provide technical guidance to states and the public.
- Clarify procedures for the siting and permitting of carbon-free technology infrastructure on federal land.

Thank you

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We believe we can meet the challenge of addressing climate change and develop the carbon-free technologies that will help the world meet this challenge.