

**OVERSIGHT OF THE DEPARTMENT OF ENERGY'S
RESEARCH AND DEVELOPMENT ENTERPRISE**

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE,
AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

JUNE 25, 2019

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June 25, 2019

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**OVERSIGHT OF THE DEPARTMENT
OF ENERGY'S RESEARCH
AND DEVELOPMENT ENTERPRISE**

TUESDAY, JUNE 25, 2019

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to notice, at 10:03 a.m., in room 2318 of the Rayburn House Office Building, Hon. Eddie Bernice Johnson [Chairwoman of the Committee] presiding.

**COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
HEARING CHARTER**

Oversight of the Department of Energy's Research and Development Enterprise

Tuesday, June 25, 2019

10:00AM EST

2318 Rayburn House Office Building, Washington, D.C. 20015

PURPOSE

The purpose of the hearing is to examine the Department of Energy's research, development, and demonstration (RD&D) and commercialization activities, including the impact of the President's fiscal year (FY) 2020 budget request.

WITNESS

- **The Honorable Rick Perry**, Secretary, U.S. Department of Energy

Background

The Department of Energy (DOE) supports a wide range of research, development, demonstration, and commercialization activities. This includes the management and support of 17 national laboratories, and programs that advance our scientific understanding and technologies in areas as varied as: nuclear power, materials science, renewable energy, particle physics, carbon capture and storage, fusion energy, computational modeling, energy efficiency, energy storage, modernization of the electric grid, climate research, engineering biology, next generation vehicle technologies, and more.

Budget

FY 2019 Enacted: \$11.69 billion

FY 2020 Budget Request: \$7.16 billion

Difference: - \$4.53 billion (-38.8%)

Office of Energy Efficiency and Renewable Energy

The mission of Office of Energy Efficiency and Renewable Energy (EERE) is to accelerate development and facilitate deployment of energy efficiency and renewable energy technologies.¹ EERE partners with industry and community leaders to bring clean energy technologies into the marketplace by providing research support and sharing developed technologies with industry and community leaders in the renewable electricity generation, buildings, manufacturing, and sustainable transportation sectors.²

The office houses such programs as DOE's Advanced Manufacturing, Buildings, Solar, Wind, Hydrogen and Fuel Cells, and Vehicles activities. The President's FY 2020 budget request proposes significant cuts to all EERE programs which range between 57% for water power to 82% for bioenergy technologies; and draw on \$353 million in previously appropriated but unspent EERE funds from FY 2018 and FY 2019 to meet the FY 2020 proposed funding level of \$696 million.

Budget

| | |
|-------------------------|---------------------------|
| FY 2019 Enacted: | \$2.40 billion |
| FY 2020 Budget Request: | \$343 million |
| Difference: | - \$2.36 billion (-85.6%) |

Office of Electricity Delivery and Energy Reliability

The mission of the Office of Electricity Delivery and Energy Reliability (OE) is to ensure that the nation's energy delivery system is secure, resilient, and reliable. OE works to develop new technologies to improve the infrastructure that brings electricity into our homes, offices, and factories, and the federal and state electricity policies and programs that shape electricity system planning and market operations. OE also works to bolster the resilience of the electric grid and assists with restoration when major energy supply interruptions occur.³

Budget

| | |
|-------------------------|-----------------|
| FY 2019 Enacted: | \$156 million |
| FY 2020 Budget Request: | \$182.5 million |

¹ U.S. Department of Energy, DOE Program Offices <https://www.energy.gov/technologytransitions/doe-program-offices>

² U.S. Department of Energy, EERE Partner Testimonials <https://www.energy.gov/eere/success-stories/partner-testimonials>

³ U.S. Department of Energy, DOE Program Offices <https://www.energy.gov/technologytransitions/doe-program-offices>

Difference: \$26.5 million (+17%)

Office of Cybersecurity, Energy Security, and Emergency Response

The Office of Cybersecurity, Energy Security, and Emergency Response (CESER) supports activities to improve energy infrastructure security, including preparedness and response to both natural and man-made threats.⁴

Budget

FY 2019 Enacted: \$120 million
FY 2010 Budget Request: \$156.5 million

Difference: \$36.5 million (+30.4%)

Office of Fossil Energy

The Office of Fossil Energy is responsible for Federal research, development, and demonstration efforts on carbon capture, utilization, and storage (CCUS) technologies, efficiency water management, and other areas to mitigate the environmental impacts of coal and natural gas production and use.⁵

Budget

FY 2019 Enacted: \$740 million
FY 2020 Budget Request: \$562 million

Difference: -\$178 million (-24.1%)

The President's FY 2020 budget request would, if enacted, reduce federal support for FE R&D activities by 24.1% from the FY19 enacted level. This would include a 65% cut for CCUS R&D and a 40% cut for research activities to reduce emissions resulting from the extraction and use of natural gas.

⁴U.S. Department of Energy, Cybersecurity, Energy Security, and Emergency Response, About Us <https://www.energy.gov/ceser/about-us>

⁵ About Fossil Energy, U.S. Department of Energy, Office of Fossil Energy <https://www.energy.gov/fe/about-fossil-energy>

Office of Nuclear Energy

The Office of Nuclear Energy's (NE) seeks to resolve technical, cost, safety, security, and regulatory issues through research, development, and demonstration of nuclear technologies.⁶

Budget

| | |
|-------------------------|-------------------------|
| FY 2019 Enacted: | \$1.32 billion |
| FY 2020 Budget Request: | \$824 million |
| Difference: | -\$502 million (-37.9%) |

The President's FY 2020 budget request would, if enacted, reduce federal support for NE by 37.9% from the FY19 enacted level. This includes the elimination of the integrated university program, a 65.9% cut to fuel cycle R&D, and a 33.5% cut to advanced reactor concepts RD&D.

Advanced Research Projects Agency-Energy

The Advanced Research Projects Agency-Energy (ARPA-E) advances high-risk, high-reward energy technologies that that neither the public nor the private sector had previously been willing or able to sufficiently support.

Since 2009, 71 projects supported by ARPA-E have led to the formation of new companies, 109 have partnered with non-DOE government agencies, and 136 have attracted over \$2.6 billion in private sector follow-on funding. ARPA-E projects have also produced 245 U.S. patents and 1,724 peer reviewed journal articles.⁷

Budget

| | |
|-------------------------|--------------------------|
| FY 2019 Enacted: | \$366 million |
| FY 2020 Budget Request: | -\$287 million |
| Difference: | -\$653 million (-178.4%) |

⁶ U.S. Department of Energy, DOE Program Offices <https://www.energy.gov/technologytransitions/doc-program-offices>

⁷ "ARPA-E Impact." Department of Energy. Accessed 21 Jun 2019 <https://arpa-e.energy.gov/?q=site-page/arpa-e-impact>

As it has in the President's FY 2018 and FY 2019 budget requests, the President's proposed FY 2020 budget has requested the elimination of ARPA-E and, if enacted, would rescind \$287 million of previously appropriated funding from FY 2018 and FY 2019.

Loan Programs Office

The Department of Energy's Loan Programs, administered by the Loan Programs Office (LPO), enable DOE to work with private companies and lenders to mitigate the financing risks associated with first-of-a-kind commercial clean energy projects, and thereby encourage their development on a larger scale. LPO stewards two major programs, the Loan Guarantee Program and the Advanced Technology Vehicles Manufacturing Loan Program, through which it originates, guarantees, and monitors loans.⁸

Thus far, the LPO portfolio has issued \$35.7 billion in loans and loan guarantees. This portfolio has generated \$2.58 billion in interest payments to the federal government and the actual and estimated loans losses are \$810 million. These losses are approximately 3% of the total disbursements.⁹

Budget

| | |
|-------------------------|------------------|
| FY 2019 Enacted: | \$19 million |
| FY 2010 Budget Request: | -\$169.2 million |
| Difference: | -\$188.2 million |

As it has in the President's FY 2018 and FY 2019 budget requests, the President's FY 2020 budget request proposes to eliminate LPO.

Office of Science

The U.S. Department of Energy Office of Science is the lead federal agency supporting scientific research for energy applications and the nation's largest supporter of research in the physical sciences, supporting over 22,000 investigators at over 300 U.S. academic institutions and the DOE laboratories. The Office of Science portfolio has two principal thrusts: direct support of

⁸ https://www.energy.gov/sites/prod/files/2019/04/f61/doe-fy2020-budget-volume-3-part-1_0.pdf

⁹ <https://www.energy.gov/lpo/portfolio>

scientific research and direct support of the development, construction, and operation of unique, open-access scientific user facilities.

Budget

FY 2019 Enacted: \$ 6.58 billion

FY 2010 Budget Request: \$ 5.54 billion

Difference: -\$ 1.04 billion (-15.8%)

The President's FY 2020 budget request would, if enacted, reduce federal support for the Office of Science by 15.8% from the FY19 enacted level.

Within the Office of Science, the Biological and Environmental Research program would be cut by 29.9%. Fusion Energy Sciences would receive a 28.6% cut, High Energy Physics would receive a 15.2% cut, Basic Energy Sciences would receive 14.2% cut, and Nuclear Physics would receive a 9.4% cut.

Attached

- Table of the President's FY 2020 budget request for Department of Energy Science and Energy programs

FY 2020 DOE Budget Request

| (in millions) | FY 2019 Enacted | FY 2020 Request | H - FY 2020 Report | FY20R - FY19E | | HFY20 - FY19E | |
|--|--------------------|--------------------|-----------------------|-----------------|---------------|-----------------|----------------|
| | | | | Amount | Percent | Amount | Percent |
| Department of Energy Science and Energy | 11,691.1 | 7,157.8 | 12,390.5 | -4,533.3 | -38.8% | 699.4 | 5.6% |
| Energy Efficiency and Renewable Energy | 2,379.0 | 343.0 | 2,651.7 | -2,036.0 | -85.6% | 272.7 | 11.5% |
| Electricity Delivery | 156.0 | 182.5 | 200.0 | 26.5 | 17.0% | 44.0 | 28.2% |
| Cybersecurity, Energy Security, and Emergency Response | 120.0 | 156.5 | 150.0 | 36.5 | 30.4% | 30.0 | 25.0% |
| Fossil Energy R&D | 740.0 | 562.0 | 740.0 | -178.0 | -24.1% | 0.0 | 0.0% |
| Nuclear Energy | 1,326.1 | 824.0 | 1,317.8 | -502.1 | -37.9% | -8.3 | -0.6% |
| ARPA-E | 366.0 | -287.0 | 425.0 | -653.0 | -178.4% | 59.0 | 16.1% |
| Loan Programs | 19.0 | -169.2 | 36.0 | -188.2 | -990.3% | 17.0 | 89.5% |
| Office of Science | 6,585.0 | 5,546.0 | 6,870.0 | -1,039.0 | -15.8% | 285.0 | 4.3% |
| Department of Energy Advanced Energy Programs | 5,106.1 | 1,611.8 | 5,520.5 | -3,494.2 | -68.4% | -9,014.8 | -163.3% |

| (in millions) | FY 2019 Enacted | FY 2020 Request | H-FY 2020 Report | FY20R - FY19E | | HFY20 - FY19E | |
|---|--------------------|--------------------|---------------------|-----------------|---------------|---------------|--------------|
| | | | | Amount | Percent | Amount | Percent |
| Department of Energy Science and Energy | 11,696.1 | 7,157.8 | 12,390.5 | -4,538.3 | -38.8% | 699.4 | 5.6% |
| Energy Efficiency and Renewable Energy | 2,379.0 | 343.0 | 2,651.7 | -2,036.0 | -85.6% | 272.7 | 10.3% |
| Sustainable Transportation | 690.0 | 157.4 | 770.0 | -532.6 | -77.2% | 80.0 | 11.6% |
| Vehicle Technologies | 344.0 | 73.4 | 370.0 | -270.6 | -78.7% | 26.0 | 7.6% |
| Bioenergy technologies | 226.0 | 40.0 | 256.0 | -186.0 | -82.3% | 30.0 | 13.3% |
| Hydrogen and Fuel Cell Technologies | 120.0 | 44.0 | 144.0 | -76.0 | -63.3% | 24.0 | 20.0% |
| Renewable Energy | 527.5 | 163.7 | 588.7 | -363.8 | -69.0% | 61.2 | 11.6% |
| Solar Energy | 246.5 | 67.0 | 270.0 | -179.5 | -72.8% | 23.5 | 9.5% |
| Wind Energy | 92.0 | 23.7 | 103.7 | -68.3 | -74.2% | 11.7 | 12.7% |
| Water Power | 105.0 | 45.0 | 125.0 | -60.0 | -57.1% | 20.0 | 19.0% |
| Geothermal Technologies | 84.0 | 28.0 | 90.0 | -56.0 | -66.7% | 6.0 | 7.1% |
| Energy Efficiency | 888.0 | 145.9 | 1,005.5 | -742.1 | -83.6% | 117.5 | 13.2% |
| Advanced Manufacturing | 320.0 | 80.5 | 360.0 | -239.5 | -74.8% | 40.0 | 12.5% |
| Building Technologies | 226.0 | 57.0 | 248.0 | -169.0 | -74.8% | 22.0 | 9.7% |
| Federal energy management program | 30.0 | 8.4 | 34.0 | -21.6 | -72.0% | 4.0 | 13.3% |
| Weatherization and Intergovernmental Program | 257.0 | 0.0 | 363.5 | -257.0 | -100.0% | 106.5 | 41.4% |
| Corporate support | 273.5 | 229.0 | 287.5 | -44.5 | -16.3% | 14.0 | 5.1% |
| Rescission | 0.0 | -353.0 | 0.0 | -353.0 | #DIV/0! | 0.0 | #DIV/0! |
| Electricity | 156.0 | 182.5 | 200.0 | 26.5 | 17.0% | 44.0 | 22.0% |
| Transmission Reliability and Resilience | 39.0 | 70.5 | 54.4 | 31.5 | 80.8% | 15.4 | 39.5% |
| Resilient Distribution Systems | 40.0 | 27.9 | 50.0 | -12.1 | -30.3% | 10.0 | 25.0% |
| Energy storage | 46.0 | 48.5 | 62.0 | 2.5 | 5.4% | 16.0 | 34.8% |
| Transformer resilience and advanced components | 7.0 | 9.0 | 7.0 | 2.0 | 28.6% | 0.0 | 0.0% |
| Transmission Permitting and Technical Assistance | 7.0 | 7.0 | 7.0 | 0.0 | 0.0% | 0.0 | 0.0% |
| Program direction (OE) | 17.0 | 19.6 | 19.6 | 2.6 | 15.3% | 2.6 | 15.3% |
| Cybersecurity, Energy Security, and Emergency Response | 120.0 | 156.5 | 150.0 | 36.5 | 30.4% | 30.0 | 20.0% |
| Infrastructure Security and Energy Restoration | 19.0 | 70.0 | 42.0 | 51.0 | 268.4% | 23.0 | 121.1% |
| Cyber security for energy delivery systems | 89.5 | 75.0 | 95.0 | -14.5 | -16.2% | 5.5 | 6.1% |
| Program direction | 11.5 | 11.5 | 13.0 | 0.0 | 0.0% | 1.5 | 13.0% |
| Fossil Energy R&D | 740.0 | 562.0 | 740.0 | -178.0 | -24.1% | 0.0 | 0.0% |
| Advanced Coal Energy Systems and CCUS | 486.2 | 387.4 | 504.3 | -98.8 | -20.3% | 18.0 | 3.7% |
| Carbon Capture, Utilization, and Storage | 198.8 | 68.8 | 227.0 | -130.0 | -65.4% | 28.2 | 14.2% |
| Transformational Coal Pilot | 25.0 | 0.0 | 20.0 | -25.0 | -100.0% | -5.0 | -20.0% |
| Advanced Energy Systems | 129.7 | 185.3 | 107.0 | 55.6 | 42.9% | -22.7 | -17.5% |
| Cross Cutting Research and Analysis | 56.4 | 72.8 | 88.3 | 16.5 | 29.2% | 31.9 | 56.6% |
| NETL Coal R&D | 54.0 | 60.5 | 38.0 | 6.5 | 12.0% | -16.0 | -29.6% |
| STEP | 22.4 | 0.0 | 24.0 | -22.4 | -100.0% | 1.6 | 7.0% |
| Natural Gas Technologies | 51.0 | 10.7 | 48.0 | -40.3 | -79.0% | -3.0 | -5.9% |
| Unconventional Fossil Energy Technologies | 46.0 | 19.0 | 30.0 | -27.0 | -58.7% | -16.0 | -34.8% |
| NETL Research and Operations | 50.0 | 40.0 | 50.0 | -10.0 | -20.0% | 0.0 | 0.0% |
| NETL Infrastructure | 45.0 | 43.1 | 46.0 | -1.9 | -4.2% | 1.0 | 2.2% |
| Program direction | 61.1 | 61.0 | 61.0 | 0.0 | 0.0% | 0.0 | 0.0% |
| Special recruitment programs | 0.7 | 0.7 | 0.7 | 0.0 | 0.0% | 0.0 | 0.0% |
| Nuclear Energy | 1,326.1 | 824.0 | 1,317.8 | -502.1 | -37.9% | -8.3 | -0.6% |
| Integrated university program | 5.0 | 0.0 | 5.0 | -5.0 | -100.0% | 0.0 | 0.0% |
| STEP R&D | 5.0 | 0.0 | 5.0 | -5.0 | -100.0% | 0.0 | 0.0% |
| Nuclear energy enabling technologies | 152.6 | 98.5 | 125.0 | -54.1 | -35.5% | -27.6 | -18.1% |
| Reactor concepts RD&D | 323.5 | 215.2 | 325.0 | -108.4 | -33.5% | 1.5 | 0.5% |
| Fuel cycle research and development | 263.9 | 90.0 | 318.5 | -173.9 | -65.9% | 54.6 | 20.7% |
| International nuclear energy cooperation | 3.0 | 0.0 | 2.5 | -3.0 | -100.0% | -0.5 | -16.7% |
| Radiological facilities management | 29.0 | 9.0 | 9.0 | -20.0 | -69.0% | -20.0 | -69.0% |
| INL facilities management | 318.0 | 209.2 | 310.0 | -108.8 | -34.2% | -8.0 | -2.5% |

| | | | | | | | |
|---|----------------|----------------|----------------|-----------------|----------------|--------------|--------------|
| INL Site-wide Safeguards and Security | 146.1 | 137.8 | 137.8 | -8.3 | -5.7% | -8.3 | -5.7% |
| Program Direction | 80.0 | 64.4 | 80.0 | -15.7 | -19.6% | 0.0 | 0.0% |
| Office of Science | 6,585.0 | 5,546.0 | 6,870.0 | -1,039.0 | -15.8% | 285.0 | 4.1% |
| Advanced scientific computing research | 935.5 | 920.9 | 956.5 | -14.6 | -1.6% | 21.0 | 2.2% |
| Research | 702.8 | 732.2 | 767.8 | 29.4 | 4.2% | 65.0 | 9.3% |
| Exascale Computing Project | 232.7 | 188.7 | 188.7 | -44.0 | -18.9% | -44.0 | -18.9% |
| Basic energy sciences | 2,166.0 | 1,858.3 | 2,143.0 | -307.7 | -14.2% | -23.0 | -1.1% |
| Research | 1,757.7 | 1,675.3 | 1,819.0 | -82.4 | -4.7% | 61.3 | 3.5% |
| Construction (LCLS-II, APS-U, ALS-U) | 408.3 | 183.0 | 324.0 | -225.3 | -55.2% | -84.3 | -20.6% |
| Biological and environmental research | 705.0 | 494.4 | 730.0 | -210.6 | -29.9% | 25.0 | 3.5% |
| Fusion energy sciences | 564.0 | 402.8 | 688.0 | -161.3 | -28.6% | 124.0 | 22.0% |
| Research | 432.0 | 294.8 | 438.0 | -137.3 | -31.8% | 6.0 | 1.4% |
| Construction (ITER) | 132.0 | 108.0 | 250.0 | -24.0 | -18.2% | 118.0 | 89.4% |
| High Energy Physics | 980.0 | 768.0 | 1,045.0 | -212.0 | -21.6% | 65.0 | 6.6% |
| Research | 800.0 | 648.0 | 814.0 | -152.0 | -19.0% | 14.0 | 1.8% |
| Construction | 180.0 | 120.0 | 231.0 | -60.0 | -33.3% | 51.0 | 28.3% |
| Nuclear Physics | 690.0 | 624.9 | 735.0 | -65.1 | -9.4% | 45.0 | 6.5% |
| Operations and maintenance | 615.0 | 579.9 | 669.0 | -35.1 | -5.7% | 54.0 | 8.8% |
| Construction | 75.0 | 45.0 | 66.0 | -30.0 | -40.0% | -9.0 | -12.0% |
| Workforce development for teachers and scientists | 22.5 | 19.5 | 25.0 | -3.0 | -13.3% | 2.5 | 11.1% |
| Science laboratories infrastructure | 232.9 | 163.6 | 250.8 | -69.3 | -29.8% | 17.9 | 7.7% |
| Infrastructure support | 79.7 | 45.2 | 65.2 | -34.5 | -43.3% | -14.5 | -18.2% |
| Payment in lieu of taxes | 1.7 | 4.5 | 5.6 | 2.8 | 165.0% | 3.9 | 227.5% |
| Oak Ridge landlord | 6.4 | 5.6 | 5.6 | -0.8 | -12.8% | -0.8 | -12.8% |
| Facilities and infrastructure | 45.5 | 25.1 | 45.0 | -20.5 | -45.0% | -0.5 | -1.2% |
| Oak Ridge nuclear operations | 26.0 | 10.0 | 10.0 | -16.0 | -61.5% | -16.0 | -61.5% |
| Construction | 153.2 | 118.4 | 185.7 | -34.8 | -22.7% | 32.5 | 21.2% |
| BNL - Critical Utilities Rehabilitation Project | 0.0 | 12.0 | 15.0 | 12.0 | #DIV/0! | 15.0 | 0.0% |
| LBNL - Seismic and Safety Modernization | 0.0 | 5.0 | 5.0 | 5.0 | #DIV/0! | 5.0 | 0.0% |
| TJNAF - CEBAF Renovation and Expansion | 0.0 | 2.0 | 2.0 | 2.0 | #DIV/0! | 2.0 | 0.0% |
| ORNL - Craft Resources Support Facility | 0.0 | 20.0 | 15.0 | 20.0 | #DIV/0! | 15.0 | 0.0% |
| SLAC - Large Scale Collaboration Center | 0.0 | 3.0 | 10.7 | 3.0 | #DIV/0! | 10.7 | 0.0% |
| BNL - Science User Support Center | 7.0 | 6.4 | 20.0 | -0.6 | -8.6% | 13.0 | 185.7% |
| ANL - Electrical Capacity and Distribution Capability | 30.0 | 30.0 | 30.0 | 0.0 | 0.0% | 0.0 | 0.0% |
| ORNL - Translational Research Capacity | 25.0 | 15.0 | 25.0 | -10.0 | -40.0% | 0.0 | 0.0% |
| LBNL - BioEPIC | 5.0 | 6.0 | 12.0 | 1.0 | 20.0% | 7.0 | 139.6% |
| PNNL - Energy Sciences Capability | 24.0 | 9.0 | 26.0 | -15.0 | -62.5% | 2.0 | 8.3% |
| FNAL - Integrated Engineering Research Center | 20.0 | 10.0 | 25.0 | -10.0 | -50.0% | 5.0 | 25.0% |
| BNL - Core Facility Revitalization | 42.2 | 0.0 | 0.0 | -42.2 | -100.0% | -42.2 | -100.0% |
| ANL - Materials Design Laboratory | 0.0 | 0.0 | 0.0 | 0.0 | #DIV/0! | 0.0 | #DIV/0! |
| LBNL - Integrative Genomics Building | 0.0 | 0.0 | 0.0 | 0.0 | #DIV/0! | 0.0 | #DIV/0! |
| Safeguards and security | 106.1 | 110.6 | 110.6 | 4.5 | 4.3% | 4.5 | 4.3% |
| Program Direction | 183.0 | 183.0 | 186.0 | 0.0 | 0.0% | 3.0 | 1.6% |
| ARPA-E | 366.0 | -287.0 | 425.0 | -653.0 | -178.4% | 59.0 | 16.1% |
| ARPA-E projects | 334.8 | 0.0 | 391.0 | -334.8 | -100.0% | 56.3 | 16.8% |
| Program direction | 31.3 | 0.0 | 34.0 | -31.3 | -100.0% | 2.8 | 8.8% |
| Rescission of prior year balances | 0.0 | -287.0 | 0.0 | -287.0 | #DIV/0! | 0.0 | #DIV/0! |
| Loan Guarantee Programs | 19.0 | -169.2 | 36.0 | -188.2 | -990.3% | 17.0 | 47.2% |
| TITLE 17 - Innovative Technology Loan Guarantee Program | 13.0 | 0.0 | 30.0 | -13.0 | -100.0% | 17.0 | 130.8% |
| Administrative expenses | 33.0 | 3.0 | 33.0 | -30.0 | -90.9% | 0.0 | 0.0% |
| Offsetting collection | -15.0 | -3.0 | -3.0 | 17.0 | 85.0% | 12.0 | -80.0% |
| Rescission of prior year balances | 0.0 | -160.7 | 0.0 | -160.7 | -160.7% | 0.0 | 0.0% |
| Advanced Technology Vehicles Manufacturing Loan Program | 5.0 | 0.0 | 5.0 | -5.0 | -100.0% | 0.0 | 0.0% |
| Administrative expenses | 5.0 | 0.0 | 5.0 | -5.0 | -100.0% | 0.0 | 0.0% |
| Tribal Energy Loan Guarantee Program | 1.0 | -8.5 | 1.0 | -9.5 | -950.0% | 0.0 | 0.0% |
| Administrative expenses | 1.0 | 0.0 | 1.0 | -1.0 | -100.0% | 0.0 | 0.0% |
| Rescission | 0.0 | -8.5 | 0.0 | -8.5 | #DIV/0! | 0.0 | 0.0% |

Chairwoman JOHNSON. The hearing will come to order. And without objection, the Chair is authorized to declare recess at any time.

Let me say good morning and welcome to today's hearing, the "Oversight of the Department of Energy's Research and Development Enterprise."

Welcome, Mr. Secretary. We are delighted that you are here today.

As you know, this Committee has jurisdiction over the Department of Energy's (DOE's) vitally important science and energy research and development (R&D) activities, the laboratories and facilities. So I hope we see you much more frequently from now on, and I look forward to working with you throughout this Congress.

With the budget season mostly behind us, I'd like to bring just a few items to your attention. I'll start with the good news, which is that, despite the Administration's best efforts to make draconian cuts across the board to DOE research and development programs, most actually fared well in the House of Representatives. I am particularly pleased to see the increases to the budget for ARPA-E (Advanced Research Projects Agency—Energy) and the Loan Programs Office, both of which have yielded truly transformative results for energy technologies of all types.

I'm also quite happy that the House supported a substantial increase in the ITER (International Thermonuclear Experimental Reactor) international fusion project, which I strongly advocated for as well. I went to visit that project a couple of years ago, and practically everybody over there was a Texan. It's crucial that we honor our commitment to this project and ensure that we are providing the support for that the Department of Energy itself identified would be necessary to maintain its construction schedule and minimize its total cost to U.S. taxpayers. The completion and operation of this project will have substantial contributions to what we know as fusion energy today. If successful, this project could be a huge gamechanger in the energy future of not only our nation, but for humanity as a whole.

Now for the bad news. Yet again, it is extremely disheartening that quite frankly disturbing to see the dramatic cuts laid out in the Administration's budget proposal. I know that you must think I sound like a broken record, Mr. Secretary, because we had this same conversation last year, but unfortunately, it is necessary until the Administration stops producing these short-sighted proposals and deploys a thorough, thoughtful process for developing its budget request. I'm thankful for your enthusiastic report of all these programs, Mr. Secretary, but enthusiasm alone is really not enough for the American people. We need to see constructive, forward-looking budget proposals being submitted to Congress.

Moving beyond the budget, we are here today to allow our Members to ask questions pertaining to all research and development programs within the entire Department, as the title of this hearing suggests. Constituents from Member districts on both sides of the aisle benefit greatly from these programs, and we believe it is our duty to ensure the responsible use of their tax dollars. Many of these programs haven't been authorized in many years, or ever, in some cases. We hope to create more thoughtful, bipartisan legisla-

tion this Congress to support the important science and energy research stewarded by the Department, and we want to work with you in that effort.

With that, I'd like to thank you again for being here, Mr. Secretary, and I look forward to a productive discussion this morning.

[The prepared statement of Chairwoman Johnson follows:]

Good morning, everyone, and thank you Mr. Secretary, for appearing before us today. It is good to see you again. As you know, this Committee has jurisdiction over all of the Department of Energy's vitally important science and energy research and development activities, laboratories, and facilities, so I hope we see you much more frequently from now on, and I look forward to working with you throughout this Congress.

With the budget season mostly behind us, I'd like to bring just a few items to your attention. I'll start with the good news, which is that despite the Administration's best efforts to make draconian cuts across the board to DOE research and development programs, most actually fared well in the House of Representatives. I am particularly pleased to see the increases to the budgets for ARPA-E and the Loan Programs Office, both of which have yielded truly transformative results for energy technologies of all types.

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Chairwoman JOHNSON. Our Ranking Member is not present, but we have a well-known Texan who is sitting in for him today, and so now I'd recognize Mr. Weber.

Mr. WEBER. Thank you, Chairwoman Johnson, for hosting this hearing, and welcome to our fellow Texas Statesman, Governor, Secretary Rick Perry. We appreciate him being here.

As we've heard from the Chairwoman, the Department of Energy and Secretary Perry have proposed a budget that requests cuts to programs that have traditionally received bipartisan support from this committee. I'd like to remind my colleagues on both sides of the aisle of two important facts. No. 1, the budget proposal is just that, a proposal. We, the Members of Congress, are the ones tasked with actually setting the funding levels after hearing from important witnesses like Secretary Perry today.

Second, I want to stress that we will have tough decisions to make on the DOE budget. We do not have unlimited funds, and we cannot fund every project, no matter how worthy. Critical programs must be prioritized, and we have to make smart, targeted investments that give the American taxpayer the best bang for their buck year after year.

And at the Department of Energy, there is an incredible range of programs for us to review. This committee's jurisdiction includes all of DOE's civilian research, including over \$10 billion in research, development, demonstration, and commercial application programs, as well as the Department's 17 national labs. This amount incredibly totals 1/3 of the Department of Energy's budget, 1/3 of the budget.

Mr. Secretary, I don't have to tell you that you lead an incredible Department—quite well, I might add—with a long history of major research achievements. Over the past 70 years, research conducted at DOE's national labs has led to monumental achievements in medicine, manufacturing, computing, as well as the development of innovative energy technology. Each national lab has made invaluable contributions to the United States' scientific progress, and they have repeatedly demonstrated that basic science research is the most effective way to encourage innovation.

Additionally, DOE's 26 user facilities provide our Nation's researchers with the most cutting-edge tools of modern science, like advanced light sources, particle accelerators, and the two fastest supercomputers in the world. Each year, approximately 22,000 researchers from academia and the private sector use DOE facilities to perform new scientific research and to develop new technologies.

Here at home, DOE heads most federally sponsored research in the physical sciences. Internationally, the United States, through the Department's work, is the world leader in basic science research and technological development. But other countries like China are making significant investments in basic research, threatening America's global standing as the leader in scientific knowledge. Without the Department's continued investment in basic and early stage research, the U.S. is in danger of losing its global technology edge.

By investing wisely in this research, the Department can achieve its goal of scientific discovery and technological breakthroughs for future generations. DOE must also invest in the research infrastructure that brings the best scientists in the world to the United States.

I look forward to hearing from Secretary Perry about DOE's implementation of several key pieces of bipartisan Science Committee legislation that was signed into law last Congress, including the *DOE Research and Innovation Act*; the *National Quantum Initiative Act*; and my bill, the *Nuclear Energy Innovation Capabilities Act*.

The Department of Energy must prioritize the kind of groundbreaking basic research authorized in these bills over grants for technology that is ready for commercial deployment. When the government tries to push developed technology into the market, it wastes limited resources in competition with private investors. But when basic research is the priority and target of Federal support,

everyone has the opportunity to access the fundamental knowledge that can lead to the development of future technologies.

I want to say thanks again to Secretary Perry for taking the time to be here today, and I yield the balance of my time, Madam Chair. [The prepared statement of Mr. Weber follows:]

Thank you, Chairwoman Johnson, for hosting this hearing and a big Texas welcome to our fellow statesman, Secretary Rick Perry.

As we've heard from the Chairwoman, the Department of Energy and Secretary Perry have proposed a budget that requests cuts to programs that have traditionally received bipartisan support from this committee.

I'd like to remind my colleagues on both sides of the aisle of two important facts. Number one, the budget proposal is just that; a proposal. We, the Members of Congress, are the ones tasked with actually setting the funding levels after hearing from important witnesses, like Secretary Perry today.

Second, I want to stress that we will have tough decisions to make on the DOE budget. We don't have unlimited funds, and we can't fund every project, no matter how worthy. Critical programs must be prioritized, and we have to make smart, targeted investments that give the American taxpayer the best bang for their buck year after year.

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But when basic research is the priority and target of federal support, everyone has the opportunity to access the fundamental knowledge that can lead to the development of future technologies.

Thank you again Secretary Perry for taking the time to be here today and I yield the balance of my time, Madam Chair.

Chairwoman JOHNSON. Thank you. Thank you very much. If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

[The prepared statement of Mr. Lucas follows:]

Today we welcome Secretary of Energy Rick Perry to discuss the Department's fiscal year 2020 budget request and the Department's priorities.

Before he joined the Administration in 2017, Secretary Perry served as the 47th Governor of Texas and under his direction, the State of Texas became a national leader in energy innovation and economic growth. The Secretary has brought this same approach and valuable experience to the Department of Energy—and today we can see the results.

DOE is the nation's largest federal sponsor of basic research in the physical sciences and is a world leader in technology development and innovation. The Department funds robust research programs across the scientific disciplines—from materials science and mathematical modeling to fusion energy science and the characterization of neutrinos.

Through decades of strategic investments in R&D, DOE is also responsible for groundbreaking discoveries in computing, manufacturing, and medicine.

The Committee on Science, Space, and Technology has jurisdiction over all of the Department's civilian research, development, demonstration, and commercial application programs, as well as the 17 DOE National Laboratories. This is equal to over \$10 billion in spending at DOE—approximately one third of its overall budget. Our discussion with the Secretary will focus on programs within this broad jurisdiction.

The President's request emphasizes increased reliance on the private sector to drive commercialization of energy technologies. This ensures the Department will focus limited research funds on the early-stage and basic research that the private sector cannot perform. While I support efforts to refocus on fundamental research, the FY 2020 budget request also cuts funding in the majority of these DOE programs from enacted levels.

This Committee has consistently supported robust funding for basic research performed by the Department, in particular the Office of Science. The President's request includes an overall \$1.04 billion decrease in funding for the Office of Science—including a \$307 million cut to Basic Energy Sciences, a \$211 million cut to High Energy Physics, and a \$161 million cut to Fusion Energy Sciences—all programs that have historically received strong bipartisan support from this Committee.

For example, Committee Members on both sides of the aisle have steadily supported full funding for U.S. contributions to the ITER project, a key fusion energy experiment funded through the Office of Science. With steep cuts to the Fusion program, the President's budget proposes just \$108 million in U.S. contributions for this project, which is only one third of what is required in FY 2020 to maintain our participation in this world-leading international research collaboration. Fusion could be the next great energy frontier—with the potential to produce near-limitless, zero emission power for centuries.

We can't afford to cut investments in this critical science.

However, by comparison, the FY 2020 budget request includes stable funding for Advanced Scientific Computing Research (ASCR), one of the Office of Science's top priority programs. ASCR supports the Exascale Computing Project and its mission goal of completing of the world's first exascale computing system.

Exascale systems can perform one billion, billion calculations per second and developing one is critical to enabling scientific discovery, strengthening national security, and promoting U.S. industrial competitiveness. Thanks to DOE's targeted investments in ASCR, the United States now hosts the top two fastest supercomputers in the world—Summit at Oak Ridge National Laboratory, and Sierra at Lawrence Livermore National Laboratory—and the Department is on track to reach exascale by 2021. As other countries like China race to develop exascale systems of their own, DOE's continued strong support of advanced computing is essential to maintain U.S. leadership in this field.

In order to support innovation in next-generation science, DOE must also invest in research infrastructure and in cross-cutting research initiatives with other Federal agencies. This includes initiatives in critical research areas like quantum information science, big data and artificial intelligence, and nuclear science, as well as key investments in our nation's light sources and neutron sources.

I want to thank Secretary Perry for his testimony today, and for outlining his plans to execute DOE's mission objectives in the upcoming fiscal year and beyond for this Committee. Maintaining U.S. leadership in science will require a shared commitment to prioritize DOE research and support the next generation of energy technology.

Chairwoman JOHNSON. At this time, I'd like to introduce our witness. The Honorable Rick Perry currently serves as the United States 14th Secretary of Energy. He oversees the Department of

Energy, which is tasked with advancing national, economic, and energy security of the United States, promoting scientific and technological innovation in support of that mission, and ensuring the environmental cleanup in the national nuclear weapons complex.

Prior to his current Cabinet post, Mr. Perry was elected Lieutenant Governor of Texas in 1998 and later served as Governor of Texas from 2000 to 2015. He was the longest-serving Governor in Texas history.

Not to tell my age, but I've known this gentleman since he was a young man serving in Texas. I'm going to ask our Secretary to make his opening statements, and then we'll proceed with questions. Mr. Perry.

**TESTIMONY OF THE HONORABLE RICK PERRY,
SECRETARY, DEPARTMENT OF ENERGY**

Secretary PERRY. Madam Chairwoman, thank you for your kind remarks. Our years in grade school together were great. And we're just out of college, for the record. So thank you.

And, Ranking Member Weber, it's my great pleasure to be in front of you in your current role, and thank you for your friendship and your wise counsel through the years, as I can say to a number of the Members that are up there.

Governor Crist, it's always a pleasure to be in front of a colleague, and as we were making remarks behind the door there that life after Governor is good, and so thank you for your friendship and assistance through the years.

It's a pleasure to be in front of each of you Members today and to share with you my observations about the President's 2020 budget and his budget request, as Ranking Member Weber so succinctly described it, appropriately, for the Department of Energy.

If I may, to further highlight some of the great work that we're doing, there's just a very short video here that I'd like to ask you to enjoy with me.

[Video shown.]

Secretary PERRY. And it actually has volume, too. It's kind of a new thing we're working on over at the agency to get some volume with our video.

Basically, what I'm saying here is that we do some pretty good—for those of you that aren't awake—

[Video shown.]

Secretary PERRY. Thank you for the privilege to be able to show that to you. As you can see, it is a really exciting time to be at the helm of DOE.

And I appeared before this Committee last year, and I committed to fulfill a number of goals, including protecting our critical energy infrastructure from cyber threats; investing in early stage, cutting-edge research and development; and advancing our leadership in exascale in quantum computing. And I'm proud to report to you that DOE has made progress in every one of those areas.

This past fall, I fulfilled a commitment to visit all 17 of our national labs, and I got to witness firsthand, as you saw in that video, the brilliant work that those incredible facilities are engaged in. You'll have the opportunity to see examples at National Lab Day

July the 24th. It's going to be right up here in your backyard on the Hill, and I hope you will consider coming by.

Our national labs are homes to, as Randy shared with you, the two fastest supercomputers in the world, 5 of the 10 fastest supercomputers in the world, and we've got next-generation if you will exascale computers that are coming online in the very near future to accelerate America's capacity and capabilities in the artificial intelligence (AI) world. This is really important. It's important in a host of different reasons, which we'll expound on here during the course of this committee meeting.

But I am completely and absolutely convinced the impact that this is going to have on the world that we live in, not just in the area of energy as we commonly think about it, but a broad array of science-oriented, science-centric areas.

Unfortunately, the success of our national labs has also made them a target, a target for people and nations seeking to steal America's ingenuity. And in response, we're requiring DOE employees to fully disclose their involvement in foreign government talent recruitment programs that are sponsored by countries of risk. And you know all who all those are, Iran and China and Russia, North Korea.

And we've banned our researchers from joining Chinese talent recruitment programs. I happen to think these are commonsense approaches. These are things that we should be doing. And they will better protect our national security and advance research and technology.

So in the coming weeks and months I look forward to working with all of you at the Department as we work on these programs that we talked about, our shared programs, Dr. Babin, and we—I thank you, Madam Chair, for your kindness, your hospitality, and for your longtime friendship. Thank you.

[The prepared statement of Secretary Perry follows:]

**Testimony of Secretary Rick Perry
U.S. Department of Energy
Before the
U.S. House Committee on Science, Space and Technology
June 25, 2019**

Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, it is an honor to appear before you today to discuss the President's FY 2020 Budget Request ("Budget Request" or "Budget") for the Department of Energy ("the Department" or "DOE").

It continues to be a great privilege and an honor to serve as the 14th Secretary of Energy.

This Budget is a request to the American people through their representatives in Congress to secure America's future through energy independence, scientific innovation, and national security.

As such, it represents a commitment from all of us at DOE that we will honor the trust of our citizens with increased stewardship, accountability, and commitment to excellence. For too long, government success has been measured by how much we spend on it. This Budget Request makes clear that success will be measured by how effectively and efficiently government is able to manage the precious resources entrusted to them by the American taxpayer to achieve its mission.

When I appeared before this Committee last year, I committed to protect our critical electric grid and energy infrastructure from cyber threats; improve resilience and reliability of the Nation's electricity system; make progress on the Federal Government's responsibility to dispose of the Nation's nuclear waste; focus resources on early-stage, cutting edge Research and Development (R&D); advance exascale and quantum computing; address responsibilities for the cleanup and disposition of facilities; and, rebuild and restore our Nation's security.

This FY 2020 \$31.7 billion Budget Request for the Department of Energy focuses on advancing these commitments – from opening a New American Energy Era to sustaining our recent historic economic growth by investing in reliable, affordable energy, transformative scientific innovation, and national security.

The Department's world-leading science and technology enterprise generates the innovations needed to fulfill our missions. Through support of cutting-edge research at our 17 National Laboratories and at over 300 universities across the Nation, we are expanding the frontiers of scientific knowledge and laying the groundwork for new technologies to address our greatest challenges.

When I became Secretary of Energy, I made a promise to visit all 17 of the Department's National Laboratories. I am pleased to report that I have fulfilled that promise and have witnessed first-hand the innovative and brilliant work performed by the dedicated individuals at each of these sites across the Nation. The National Laboratories are doing outstanding work in many areas. Each has a unique, rich history of innovation across a broad scope of scientific expertise, and the record of collaboration across the National Laboratory system – which makes its impact greater than the sum of its parts – has bettered the lives of millions across the globe.

For example, in 2018, the National Laboratories won 32 of the prestigious R&D 100 Awards, including technologies regarding new materials, protecting the environment, incorporating renewable energy reliably to the electric grid, and sophisticated cybersecurity tools. These are just a few examples of the work the National Laboratories have done just last year to push the boundaries of research, development, commercialization, and national security.

I am especially proud of the work the National Laboratories are doing in collaboration with other federal agencies, universities, doctors, and researchers to harness the power of our world-class supercomputers to maintain America's leadership in High Performance Computing (HPC), advance Exascale computing, and push for breakthroughs in Artificial Intelligence (AI).

To do so, this Budget proposes nearly \$11 billion in early-stage R&D that will focus the intellectual prowess of scientists and engineers on the development of technologies that the ingenuity and capital of America's entrepreneurs and businesses can convert into commercial applications and products to improve the lives and security of all Americans. The Budget also invests in laboratory infrastructure and test beds for future breakthroughs in energy. It prioritizes funding to maintain the world-class nature of national laboratory facilities and better facilitate private sector demonstration and deployment of energy technologies.

Securing Against Cyber Threats

In addition to nuclear security, our national security also depends on a resilient electric grid and successfully countering the ever-evolving, increasing threat of

cyber and other attacks on networks, data, facilities, and infrastructure. Among the most critical missions at the Department is to develop science and technology that advances these aims.

At stake is continued U.S. economic competitiveness and leadership, as well as the overall safety and security of the nation. We need to understand the increasing and evolving natural and man-made threats and develop the tools to respond to those threats across our energy infrastructure.

To that end, the Budget provides \$157 million for the Office of Cybersecurity, Energy Security, and Emergency Response (CESER) to develop tools needed to protect the U.S. energy sector against threats and hazards, mitigate the risks and the extent of damage from cyberattacks and other disruptive events, and improve resilience through the development of techniques for more rapid restoration of capabilities.

Securing against cyber threats means we must also protect against threats to the Department's own infrastructure in science, technology, and nuclear security. This Budget takes major steps to safeguard DOE's enterprise-wide assets against cyber threats. It provides \$71 million for the Chief Information Officer directed funding to secure our own networks, modernize infrastructure, and improve cybersecurity across the DOE IT enterprise. Funding for cybersecurity in the National Nuclear Security Administration (NNSA) is increased to \$208 million to enhance security for our nuclear security enterprise. In the Environmental Management program, we provide \$37 million for cybersecurity at seven cleanup sites.

This Budget provides the resources we require to secure DOE systems and energy infrastructure.

Improving Grid Resilience

As we protect our energy infrastructure from cyber threats, we also must improve the resilience and reliability of the nation's electricity system. The Budget provides \$183 million for the Office of Electricity to support transmission system resource adequacy and generation diversity. The Budget will explore new architecture approaches for electric transmission and distribution systems, including the development of the North American Energy Resilience Model that will provide unique and ground-breaking national-scale energy planning and real-time situational awareness capabilities to enhance security and resilience. The Budget continues to advance energy storage through the Advanced Energy Storage Initiative (AESI), including

development of a new Grid Storage Launchpad aimed at accelerating materials development, testing, and independent evaluation of battery materials and systems for grid applications. In addition, the Budget supports R&D at DOE's National Laboratories to develop technologies that strengthen, transform, and improve energy infrastructure so that consumers have access to reliable and secure sources of energy.

Addressing the Imperative of Nuclear Waste Management

The Budget includes \$116 million, of which \$26 million is in defense funds, to move ahead in fulfilling the Federal Government's responsibility to dispose of the Nation's nuclear waste. This request is dedicated to resuming regulatory activities concerning the Yucca Mountain site and initiating a robust interim storage program.

The Budget Request supports functions necessary to support regulatory activities, including legal support to represent the Department as well as responding to litigation and other legal matters. The Budget also provides for technical and scientific work necessary to support and respond to any challenges in the regulatory process. Resuming regulatory activities at Yucca Mountain and committing to a robust interim storage capability for near-term acceptance of spent nuclear fuel, our Budget demonstrates the Administration's commitment to nuclear waste management and will help accelerate fulfillment of the Federal Government's obligations to address nuclear waste, enhance national security, and reduce future burdens on taxpayers. This also will increase public confidence in the safety and security of nuclear energy, thus helping nuclear energy remain a significant contributor to the country's energy needs for generations to come.

Energy Independence and Innovation

The Budget requests \$2.3 billion in funding for energy independence and innovation. Within the applied energy program offices, the FY 2020 Budget focuses resources on early-stage, cutting-edge R&D conducted by the scientists and engineers at our 17 National Laboratories who are striving to develop the next great innovations that will strengthen American competitiveness and transform society as these breakthroughs reach the private marketplace.

The Harsh Environment Materials Initiative (HEMI) is a new coordinated effort within the Offices of Fossil Energy R&D (FE), Nuclear Energy (NE), and Energy Efficiency and Renewable Energy (EERE) to use common investments. This effort will coordinate interrelated R&D in materials, sensors, and component manufacturing R&D for advanced thermoelectric power plants between FE and NE.

For example, NE's budget includes \$23 million for the Nuclear Energy Enabling Technologies (NEET) Transformational Challenge Reactor (TCR) program, which enhances the development of breakthrough technologies that provide the ability to manufacture small/micro advanced reactor components using additive manufacturing techniques. Investments will also be aligned with EERE's Advanced Manufacturing Office R&D in materials and manufacturing process research, as well as flexible combined heat and power systems.

The AESI is a coordinated effort across DOE that will accelerate the development of energy storage R&D as key to increasing energy security, reliability, resilience, and system flexibility technologies. The AESI will focus DOE's efforts to take a broad, more holistic view of energy storage as a set of capabilities with temporal flexibility in the conversion of energy resources to useful energy services. The initiative will develop a coordinated strategy for aligning DOE R&D for cost competitive energy storage services.

The Budget supports, and makes for more efficient, programs focused on bringing technologies to the market in the Office of Technology Transitions, requesting a 7% increase from the FY 2019 enacted level. Through coordination with our Labs, these efforts will reduce costs to the taxpayer while at the same time providing an enhanced technology transfer program to transfer breakthroughs from the National Laboratories to the private sector.

Nuclear Energy

The Budget for Nuclear Energy focuses funding on early-stage R&D, such as the NEET program, which includes \$23 million for the (TCR), at Oak Ridge National Laboratory, to continue to develop an advanced manufacturing technique to demonstrate a new approach to nuclear design, qualification, and manufacturing of advanced reactor technologies.

The FY 2020 Budget includes \$215 million for the Reactor Concepts Research, Development and Demonstration program. Within this total, the Budget provides \$100 million to put DOE on a path to construct the Versatile Test Reactor, a facility that would enable development and testing of advanced fuels and materials for the next generation of commercial nuclear reactors. This is one of the highest priorities for the Department. The Budget also provides \$85 million for early-stage R&D on advanced reactor technologies, including \$10 million for the Advanced Small Modular Reactor R&D subprogram.

Within the Fuel Cycle R&D program, the Budget requests \$40 million in the Civil Nuclear Enrichment subprogram for the high-assay low-enriched uranium (HALEU) demonstration project. This three-year cost-shared subprogram is designed to demonstrate U.S.-origin enrichment technology that could produce HALEU. We understand that multiple reactor designs under development by U.S. advanced reactor developers will require fuel containing HALEU. In addition, the Budget requests \$36 million for the Fuel Cycle R&D program's early-stage R&D work in support of industry's development of light water reactor accident tolerant fuels.

Finally, the Budget for Nuclear Energy also supports a safeguards and security program with funding at \$138 million for protection of our nuclear energy infrastructure and investments at Idaho National Laboratory facilities.

Fossil Energy Research and Development

The Fossil Energy Research and Development (FER&D) program advances transformative science and innovative technologies needed for the reliable, efficient, affordable, and environmentally sound use of fossil fuels. Fossil energy sources currently constitute over 81 percent of the country's total energy use and are critical for the nation's security, economic prosperity, and growth. The FY 2020 Budget focuses 89 percent, or \$501 million, on cutting-edge fossil energy R&D to secure energy dominance, further energy security, advance strong domestic energy production, and support America's coal industry through innovative clean coal technologies.

FER&D will support early-stage research in advanced technologies, such as materials, sensors, and processes, to expand the knowledge base upon which industry can improve the efficiency, flexibility, and resilience of the existing fleet of coal fired power plants. The request also focuses funding on early-stage component research that will enable the next generation of high efficiency and low emission coal fired power plants that can increase the resiliency and reliability of the electric grid by providing low-cost reliable power 24/7.

Funding is also provided to support competitive awards with industry, National Laboratories and academia geared toward innovative early-stage R&D to improve the reliability, availability, efficiency, and environmental performance of advanced fossil-based power systems. For example, the Advanced Energy Systems subprogram will focus on the following six activities: 1) Advanced Combustion/Gasification Systems, 2) Advanced Turbines, 3) Solid Oxide Fuel Cells, 4) Advanced Sensors and Controls, 5) Power Generation Efficiency, and 6)

Advanced Energy Materials. While the primary focus is on coal-based power systems, improvements to these technologies will result in spillover benefits that can reduce the cost of converting other carbon-based fuels, such as natural gas, biomass, or petroleum coke into power and other useful products in an environmentally-sound manner.

Energy Efficiency and Renewable Energy

The Energy Efficiency and Renewable Energy budget requests \$696 million, including the use of \$353 million in prior year balances, towards maintaining America's leadership in transformative science and emerging energy technologies in sustainable transportation, renewable power, and energy efficiency.

The Budget emphasizes early stage R&D and other activities, which private industry does not have the technical capability to undertake. Knowledge generated by early-stage R&D to facilitate U.S. industries, businesses, and entrepreneurs to develop and deploy innovative energy technologies, and to gain the competitive edge needed to excel in the rapidly changing global energy economy.

The request funds \$105 million for the AESI, which takes a holistic approach to energy storage and develops electric grid technologies to create flexible generation and load, thereby increasing the reliability and resilience of the U.S. electric grid.

The request supports DOE's Grid Modernization Initiative, which includes reliably integrating an increasing amount of variable generation into the electric grid through R&D infrastructure investments at the National Renewable Energy Laboratory (NREL) to accelerate the conversion of the National Wind Technology Center (NWTC) campus into an experimental microgrid capable of testing grid integration at the megawatt scale.

Strategic Petroleum Reserve

The Department of Energy is responsible for the Nation's energy security, and the Strategic Petroleum Reserve (SPR), one component of that effort, protects the U.S. economy from disruptions in critical petroleum supplies and meets the U.S. obligations under the International Energy Program. The Budget includes \$174 million to support the Reserve's operational readiness and drawdown capabilities. The Department is requesting authorization to deposit into the SPR Petroleum

Account up to \$27 million in proceeds from the sale of one-million barrels of refined petroleum product (gasoline blendstock) from the Strategic Petroleum Reserve to fund the cost of drawdowns.

The Budget also proposes to disestablish the Northeast Home Heating Oil Reserve (NEHHOR). In its two decades of existence, the NEHHOR has not been used for its intended purpose, and the Administration believes the continued taxpayer-funded expense of maintaining the reserve is unwarranted, particularly as the existing commercial storage contracts are up for renewal in March 2020. The Budget also proposes to disestablish the Northeast Gasoline Supply Reserve (NGSR). The NGSR has not been used since its establishment, and is not considered to be cost efficient or operationally effective. Proceeds of the combined sales of the NEHHOR and NGSR (estimated at \$130 million in receipts, net of the \$27 million retained for mandatory sale drawdown costs) will be contributed to deficit reduction.

Power Marketing Administrations

The Budget includes \$78 million for the Power Marketing Administrations (PMAs). The Budget proposes the sale of the transmission assets of the Western Area Power Administration (WAPA), the Bonneville Power Administration (BPA), and the Southwestern Power Administration (SWPA) and to reform the laws governing how the PMAs establish power rates to require the consideration of market based incentives, including whether rates are just and reasonable. The Budget also proposes to repeal the \$3.25 billion borrowing authority for WAPA authorized by the American Recovery and Reinvestment Act of 2009.

Leading World-Class Scientific Research

The Department of Energy is the Nation's largest Federal supporter of basic research in the physical sciences, and the President's FY 2020 Budget provides \$5.5 billion for the Office of Science (Science) to continue and strengthen American leadership in scientific inquiry. By focusing funding on early-stage research, this Budget will ensure that the Department's National Laboratories continue to be the backbone of American science leadership by supporting cutting-edge basic research, and by building and operating the world's most advanced scientific user facilities, which will be used by over 22,000 researchers in FY 2020.

Support for Core Research and Facilities

We provide \$921 million for Advanced Scientific Computing Research (ASCR), a decrease of \$15 million below the FY 2019 enacted level. This funding will continue supporting the Nation's world-class high-performance computers that make possible cutting-edge basic research, while devoting \$500 million in the Office of Science to reflect the Department's plan to deploy an exascale computing system in calendar year 2021. The FY 2020 Request also supports quantum computing R&D and core research in applied mathematics and computer science, and high-performance computer simulation and modeling.

The Budget also provides \$1.9 billion for Basic Energy Sciences (BES), supporting core research activities in ultrafast chemistry and materials science and the Energy Frontier Research Centers. We will continue construction of the Advanced Photon Source Upgrade at the Argonne National Laboratory, and initiate the Advanced Light Source Upgrade project at the Lawrence Berkeley National Laboratory, and the Linac Coherence Light Source-II High Energy project at SLAC National Accelerator Laboratory. The operations of the light sources across the DOE science complex and supporting research across the Nation maintain U.S. world leadership in light sources and the science they make possible. The Budget also supports continued construction for Spallation Neutron Source Proton Power Upgrade and Second Target Station at Oak Ridge National Laboratory.

The Budget requests \$768 million for High Energy Physics (HEP), including \$100 million for construction of the Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment at Fermilab, \$30 million below the enacted FY 2019 level. We will continue to fund ongoing major items of equipment projects, including three new projects at the Large Hadron Collider: the High Luminosity Large Hadron Collider Accelerator Project; the High Luminosity ATLAS; and the High Luminosity CMS detector upgrade projects. By supporting the highest priority activities and projects identified by the U.S. high energy physics community, this program will pursue cutting-edge research to understand how the universe works at its most fundamental level.

The Budget for the Office of Science provides \$403 million for Fusion Energy Sciences (FES), including \$296 million for domestic research and fusion facilities and \$107 million for the ITER project to continue to support delivery of the highest priority in-kind hardware systems contributions. For Nuclear Physics (NP), the budget provides \$625 million to discover, explore, and understand nuclear matter, including \$40 million for continued construction of the Facility for Rare Isotope Beams and operations of facilities. For Biological

and Environmental Research (BER), the Budget includes \$494 million to support foundational genomic sciences, including the Bioenergy Research Centers, and to focus on increasing the sensitivity and reducing the uncertainty of earth and environmental systems predictions.

Advancing Exascale Computing

As I discussed last year, the Department's leadership in developing and building the world's fastest computers faced increasingly fierce global competition over the last decade. Maintaining the Nation's international primacy in high-performance computing is more critical than ever for national security, economic prosperity, and a continued leadership role in science and innovation.

I am proud to say that, as of the present day, the Department is actively sustaining America's leadership in this vital area. As of June 2019, the world's two fastest supercomputers were located at DOE National Laboratories – Summit at Oak Ridge and Sierra at Lawrence Livermore. In fact, the Summit system achieved the global number one ranking as the world's fastest system in June 2016, was delivered nine months ahead of schedule and \$13.5 million below budget, and is another example of the DOE lab continued project management excellence. In all, the United States currently owns five out of the world's top ten supercomputers, with four of those located at DOE national laboratories. In addition, teams from DOE's Oak Ridge and Lawrence Livermore National Laboratories captured the 2018 Gordon Bell Prize, the most prestigious award for achievement in high performance computing software and applications. These coupled achievements in both hardware and software are significant, since it is by sustaining integrated capabilities in hardware, software, algorithms, and applications – along with basic research in applied mathematics – that America will maintain leadership in this critical field.

To cement America's leadership position, the Budget includes \$809 million to accelerate development of an exascale computing system, including \$500 million in the Office of Science (Science) and \$309 million in NNSA. This reflects the Department's plan to deploy an exascale machine for the Office of Science in calendar year 2021 at Argonne National Laboratory, a second machine with a different architecture in the 2021-2022 timeframe at Oak Ridge National Laboratory, and provides support for the procurement of and site preparation for a third exascale system, architecturally similar to the second machine at Oak Ridge, delivered to NNSA at Lawrence Livermore National Laboratory in FY 2023.

To achieve these goals, the Science/NNSA partnership will focus on hardware and software technologies needed to produce an exascale system, and the critical DOE

applications needed to use such a platform. This world-leading exascale program will bolster our national security by supporting the nuclear stockpile, while also supporting the next generation of scientific breakthroughs not possible with today's computing systems.

Quantum Information Science

Even as we prepare to deploy exascale systems, we are pursuing research in Quantum Information Science (QIS), an emerging multidisciplinary area that has the potential to define the next frontier in information processing and a range of other fields. Our QIS effort is genuinely interdisciplinary, a \$168 million investment involving all six major DOE Office of Science program offices: ASCR, BES, BER, FES, HEP, and NP.

The potential of QIS to contribute to a wide range of disciplines is striking. Quantum computing promises the capability to attack large problems that elude classical computing and to provide new insights into materials and chemistry through accurate modeling and simulation of quantum systems. In addition, QIS holds the potential of developing exquisitely sensitive quantum sensors, for applications ranging from biology to the effort to detect Dark Matter. Finally, QIS may hold the key to ultra-secure networking, at a time when cybersecurity is a mounting concern.

The Budget provides \$40 million to ASCR, BES and HEP to establish a new QIS center, which would integrate universities with National Laboratories, through investments across all six Science program offices. We are seeking to sustain U.S. leadership in this important and highly competitive area.

Artificial Intelligence/Machine Learning

Artificial Intelligence (AI), including Machine Learning (ML) defines another critical cross-disciplinary activity, with the potential to contribute to advances across multiple fields. This is another rapidly developing area in which it is vital for America to maintain a leadership role.

In a world awash with data, AI holds the promise of harnessing and deriving new insights from massive data sets. The massive quantities of data generated by DOE Office of Science user facilities such as X-ray light sources are believed to provide a major opportunity for the development of new AI applications for data analysis. It is also believed that AI may provide a pathway to improving the performance of particle accelerators and other key facilities. The FY 2020 Budget provides \$71

million for AI/ML spread across all six Science program offices for both the application of AI/ML to research and the development of new AI/ML approaches and algorithms as well as \$48 million requested in the FY 2020 Budget for NNSA for AI.

Microelectronics

By virtue of its leadership in supporting high-performance computing, as well as its longstanding sponsorship of research in materials science, the DOE Office of Science has been a major contributor over the decades to the development of microelectronics. Science has helped lay the fundamental scientific foundation for advances in these technologies, while partnering with industry in the development of new systems requiring new chips. This role is becoming increasingly important as we approach the end of Moore's Law and stand at the threshold of what is likely to be a new era in microelectronics. In an important new initiative, the FY 2020 Budget provides \$25 million for redoubled research efforts on microelectronics. The research will benefit from groundwork laid at an October 2018 DOE workshop on "Basic Research Needs in Microelectronics," bringing together top experts and co-sponsored by ASCR, BES, and HEP.

Biosecurity

As mentioned, back in 1986, the Department provided the original impetus and idea for the Human Genome Project, and later partnered with the National Institutes of Health, to successfully complete the sequencing of a human genome in 2000. Since then the Department's Office of Science has remained on the cutting-edge of genomics-based system biology, making major contributions to the continued advancement of the relevant technologies. These dual use technologies have now advanced to a point where they pose new and unprecedented security challenges. To address this growing challenge, the FY 2020 Budget includes \$20 million for BER for research related to biosecurity.

Isotopes

One of the Department's important contributions to medicine and industry is the Isotope Development & Production for Research and Applications Program, known more simply as the DOE Isotope Program. The program, managed by Science's Office of Nuclear Physics, supports the production and development of production techniques, as well as radioactive and stable isotopes that are in short supply for research and applications. In doing so, it provides a vital contribution to research, medicine, and industry. The Budget provides \$5 million to initiate a construction

project for a U.S. Stable Isotope Production and Research Center at ORNL.

Fulfilling Legacy Cleanup Responsibilities

The mission of the Department's Environmental Management (EM) program is to complete cleanup of legacy nuclear weapons development and research sites. It is the largest program of its kind in the world and represents one of the top financial liabilities to the American taxpayer. EM is working collaboratively with regulators, federal, state, and local governments, and others toward a future that drives cleanup toward completion safer, sooner and at a responsible cost. As EM is put on a sustainable path forward, the FY 2020 Budget Request provides the resources necessary to build upon recent successes and bring a renewed sense of urgency to the program for meaningful and measurable progress at projects and sites throughout the cleanup complex.

The Budget Request includes \$6.5 billion for EM to address its responsibilities for the cleanup and disposition of excess facilities, radioactive waste, spent nuclear fuel, and other materials resulting from five decades of nuclear weapons development and production and Government-sponsored nuclear energy research. To-date, EM has completed cleanup activities at 91 sites in 30 states and Puerto Rico, and is responsible for cleaning up the remaining 16 sites in 11 states –some of the most challenging sites in the cleanup portfolio.

The Budget Request includes \$1.4 billion for the Office of River Protection at the Hanford Site for continued work at the Hanford Tank Farms and to make progress on the Waste Treatment and Immobilization Plant. This budget will continue progress toward important cleanup required by the Consent Decree and Tri-Party Agreement to include a milestone to complete hot commissioning of the Low Activity Waste Facility by December 31, 2023. The Budget also includes \$718 million to continue cleanup activities at Richland. The Budget continues River Corridor decontamination and decommissioning activities including remediation of the highly contaminated 300-296 waste site under the 324 Building. For Savannah River, the Budget provides \$1.6 billion, \$91 million above enacted FY 2019, to support activities at the site. This will include the Liquid Tank Waste Management Program, completing cold commissioning beginning operation of the Salt Waste Processing Facility, continued construction activities for Saltstone Disposal Unit #7 and #8/9 design and construction activities for Saltstone Disposal Unit #10-#12, and funding to support design and construction of the Advanced Manufacturing Collaborative facility.

The Waste Isolation Pilot Plant (WIPP) is essential for the disposition of transuranic

defense-generated waste across the DOE complex, and the Budget provides \$398 million to safely continue waste emplacement at WIPP. The Budget Request will continue WIPP operations, including waste emplacements, shipments, and maintaining enhancements and improvements, and progress on critical infrastructure repair/replacement projects, including \$58 million for the Safety Significant Confinement Ventilation System and \$35 million for the Utility Shaft (formerly Exhaust Shaft). These steps will increase airflow in the WIPP underground for simultaneous mining and waste emplacement operations.

The Budget Request includes \$348 million to continue cleanup projects at the Idaho site, such as the Integrated Waste Treatment Unit, and to process, characterize, and package transuranic waste for disposal at offsite facilities. It provides \$429 million for Oak Ridge to continue deactivation and demolition of remaining facilities at the East Tennessee Technology Park, continue preparation of Building 2026 to support processing of the remaining U-233 material at the Oak Ridge National Laboratory, and support construction activities for the Outfall 200 Mercury Treatment Facility at the Y-12 National Security Complex and design for a new On-Site Waste Disposal Facility to support cleanup.

For Portsmouth, the Budget Request includes \$426 million to continue progress on the deactivation and decommissioning project at the Portsmouth Gaseous Diffusion Plant, safe operation of the Depleted Uranium Hexafluoride Conversion Facility, and construction activities at the On-Site Waste Disposal facility. At Paducah, the Budget Request includes \$277 million to continue ongoing environmental cleanup and depleted uranium hexafluoride (DUF6) conversion facility operations at the Paducah site. In addition, the FY 2020 Budget Request supports activities to continue the environmental remediation and further stabilize the gaseous diffusion plant.

The Budget continues funding of \$128 million to address specific high-risk contaminated excess facilities at Lawrence Livermore National Laboratory.

Together, these investments for EM will make significant progress in fulfilling our cleanup responsibilities while also beginning to address our high-risk excess facilities at NNSA sites.

National Security through Nuclear Security: Sustaining and Modernizing the Nuclear Stockpile and Infrastructure

Our national security rests upon the foundation of the Nation's nuclear security enterprise and the deterrent it provides. The Budget funds the overdue modernization of the nuclear stockpile and the aging infrastructure that supports it; strengthens key science, technology, and engineering capabilities that support stockpile modernization; reduces global nuclear threats through nonproliferation and counterterrorism initiatives; and designs and maintains safe and effective nuclear propulsion systems for the U.S. Navy for years to come.

The Budget fulfills the President's vision of rebuilding and restoring our Nation's security through investments in the Department's nuclear security mission. The Budget provides \$16.5 billion for the National Nuclear Security Administration (NNSA). Of this amount, the Budget Request includes \$12.4 billion for Weapons Activities. This \$1.3 billion increase supports maintaining the safety, security, and effectiveness of the nuclear stockpile; continuing the nuclear modernization program; and modernizing NNSA's nuclear security infrastructure portfolio in alignment with the Nuclear Posture Review.

The Budget includes \$2.1 billion for our ongoing Life Extension Programs (LEP), Major Alteration, and Modifications, a \$197 million increase. I am pleased to report that the W76-1 LEP completed its last production unit in December 2018. Final deliveries to the Navy will be completed by the end of this fiscal year. The W76-2 Modification, the low-yield variant of the W76, is on schedule, on budget, and will be completed consistent with Nuclear Weapons Council (NWC) direction.. We also continue to make progress on the B61-12 LEP and the W88 Alteration 370. That said, we are currently working through recently identified challenges that will impact delivery schedules and we are assessing options with the Department of Defense to mitigate delays. The Budget also supports the Air Force's Long-Range Stand-Off program through an increase of \$244 million from the FY 2019 enacted level for the W80-4 LEP to deliver the first production unit in FY 2025 of the cruise missile warhead. The request includes \$112 million for the W87-1 Modification Program, which will replace the W78, one of the oldest warheads in the stockpile, by 2030.

The Weapons Activities Budget request also includes \$309 million for NNSA collaboration with the Office of Science on the development of exascale computer systems; \$778 million for the protection of personnel, facilities, nuclear weapons, and materials across the Department's nuclear security enterprise; and \$309 million for information technology and cybersecurity protection.

The infrastructure portion in Weapons Activities increases investments to modernize our nuclear infrastructure, improve working conditions of NNSA's aging facilities and equipment, and address safety and programmatic risks through facility and equipment recapitalization and the stabilization of deferred maintenance. In this Budget is \$745 million for construction of the Uranium Processing Facility, which is needed to replace deteriorating facilities at the Y-12 National Security Complex, as well as \$123 million for the High Explosives Science and Engineering Facility at Pantex, \$27 million for a Tritium Finishing Facility at the Savannah River Site (SRS), and \$32 million for a Lithium Processing Facility at Y-12. The Budget also includes \$168 million to support the Department's commitment to finishing the Chemistry and Metallurgy Research Replacement Facility Project, which is necessary to support the pit production mission and other actinide activities at Los Alamos National Laboratory (LANL).

The highest NNSA infrastructure priority is re-establishing a plutonium pit production capability to meet military requirements, supported by numerous studies and analyses, of no fewer than 80 war reserve pits per year by 2030. Last May, the NWC endorsed NNSA's recommended alternative calling for plutonium pit production at LANL and SRS. This two-site approach bolsters the nuclear security enterprise's responsiveness and resiliency.

The Budget also includes \$2.0 billion for the Defense Nuclear Nonproliferation program to reduce global threats from nuclear weapons. This critical national security program prevents the spread of nuclear and radiological materials, and technologies, advances technologies that detect nuclear and radiological proliferation worldwide, and eliminates or secures inventories of surplus materials and infrastructure usable for nuclear weapons.

The Budget invests \$774 million at SRS in FY 2020, a 76 percent increase over FY 2019. NNSA will continue termination activities for the orderly and safe closure of the Mixed Oxide Fuel Fabrication Facility Project. The Budget will also continue to pursue a dilute and dispose strategy to fulfill the U.S. commitment to dispose of 34 metric tons (MT) of plutonium and modernize SRS infrastructure to support the tritium supply chain.

The Budget provides \$372 million for Nuclear Counterterrorism and Incident Response, \$53 million above the FY 2019 enacted level, to work domestically and around the world to improve our ability to respond to radiological or nuclear incidents, in conjunction with other agencies in a broader U.S. Government effort.

In the NNSA's Office of Naval Reactors, the Department has the ongoing

responsibility to provide militarily effective nuclear propulsion plants for the Navy and to ensure their safe, reliable and long-lived operation. The Budget provides \$1.6 billion to support the operation of the Navy's nuclear-powered fleet, the continuation of the *Columbia*-class reactor plant design, refueling of the land-based prototype reactor, and the construction of the Naval Spent Fuel Handling Facility.

Today, nearly 45% of the Navy's major combatants are nuclear powered. The Department's role in propulsion plant design, spent fuel handling, and recapitalization is critical to the Navy's ability to conduct its missions around the globe.

Finally, the Budget includes \$435 million for Federal Salaries and Expenses at the NNSA. This \$25 million increase is essential to ensuring our world-class workforce of dedicated men and women can effectively oversee NNSA's critical national security missions.

Focusing Priorities on Core Missions

The Budget continues to focus the Department's energy and science programs on early-stage research and development at our National Laboratories to advance American primacy in scientific and energy research in an efficient and cost-effective manner.

Also, in line with Administration priorities, the Budget terminates the Advanced Research Projects Agency-Energy, known as ARPA-E, and the Department's Loan Programs, while maintaining necessary federal staff to oversee existing awards and loans. Termination of these programs will save over \$850 million in FY 2020 alone while significantly reducing financial risk to the taxpayer moving forward.

Conclusion

In conclusion, I reaffirm my pledge that the Department of Energy, along with our National Laboratories, will continue to support the world's best enterprise of scientists and engineers who create innovations to drive American security, prosperity, and competitiveness. The President's FY 2020 Budget Request for the Department of Energy reflects the priorities to enhance our energy, economic, and national security today, while making strategic investments to accelerate the breakthroughs that will fuel America's tomorrow.

In the coming weeks and months, I look forward to working with you and your

colleagues in Congress on the specific programs mentioned in this testimony and throughout the Department. Congress has an important role in the path forward on spending decisions for the taxpayer, and I will, in turn, ensure DOE is run efficiently, effectively, and that we accomplish our mission-driven goals. Thank you, and I look forward to answering your questions.

Secretary of Energy Rick Perry

Secretary of Energy Rick Perry currently serves as the 14th Secretary of Energy, and leads an agency tasked with overseeing the United States' energy supply, nuclear defense capacity, and the 17 National Laboratories, home to many of the country's best scientists.

Prior to joining the Administration as Secretary of Energy, Perry served as the 47th governor of Texas. As Governor of the Lone Star State, Perry championed conservative principles that helped Texas become America's economic engine. Under Gov. Perry's leadership, Texas became a national leader for job creation, innovation and population growth.

Perry's leadership of Texas proved that economic growth and protection of the environment can be achieved simultaneously. While adding population and over 2.2 million jobs during his tenure, Texas also experienced major reductions in carbon dioxide, sulfur dioxide and nitrous oxide emissions. Despite having a rapidly growing population and one of the largest petro-chemical refining industries in the world, Texas saw its climate and air quality improve.

Governor Rick Perry is a veteran of the United States Air Force, a former farmer and rancher, and the longest serving governor in Texas history, having led the world's 12th largest economy from 2000 to 2015. He has devoted his adult life to creating prosperity and opportunity for families.

Perry grew up the son of tenant farmers in the tiny West Texas community of Paint Creek. The younger of Ray and Amelia Perry's two children, he was active in scouting and earned distinction as an Eagle Scout. He was one of the first in his family to go to college, earning a degree in Animal Science from Texas A&M University, where he was also a member of the Corps of Cadets and a Yell Leader.

Between 1972 and 1977, Perry served in the U.S. Air Force flying C-130 tactical airlift aircraft in Europe and the Middle East. He is a lifetime member of both the NRA and American Legion Post #75. Prior to being elected Lieutenant Governor in 1998, he served two terms as Texas Commissioner of Agriculture and three terms in the Texas House of Representatives.

Perry married his childhood sweetheart, Anita, in 1982. They have two children and two beautiful granddaughters.

Chairwoman JOHNSON. Thank you very much.

At this point, we'll begin our first round of questions, and the Chair recognizes herself for the first round.

Mr. Secretary, do you stand by the proposal of the elimination of ARPA-E? I've heard you make some very positive statements, but we are concerned about the future of ARPA-E. It's been such a positive program, and our Appropriations Committee just recommended a fair amount of funding.

Secretary PERRY. That's right.

Chairwoman JOHNSON. Give us a little bit of how you stand on ARPA-E.

Secretary PERRY. Madam Chair, I'm going to give you a backwards look, and then I'm going to give you a forward look if I may. My backwards look is to my previous position of being the Governor of the State of Texas and the work that we did there while Randy was a member of the Texas legislature. We worked together on some really exciting, successful public-private partnerships, Texas Enterprise Fund, Texas Technology Fund, and those basically were mini-ARPA-E's if you will. If—a little different in some senses, but when you think about the cutting-edge technology that comes out of our national labs, for instance, the dollars that we expend in that arena, our desire to bring technology and then commercialize it, that's what ARPA-E from my perspective historically has been about.

And I respect OMB's work in what they do, but I'll be real honest with you. I respect this Congress more. And I understand how the process works, and I think Ranking Member Weber was spot on when he reminded us that this is a starting point, and we recognize that.

So going forward, just like I said in other Committee hearings previously, I respect this process, and I understand how this process works fairly well. And we're going to expend the dollars—and hopefully very wisely and thoughtfully and efficiently—that Congress appropriates.

So as you all have historically said, we like ARPA-E, we want it to be run efficiently and effectively, be wise about it, but we hear the message here. Previous Congress sent a clear message about what they think ARPA-E needs to be. I hope you see a reflection of your desire for this program to go forward and to expend these dollars thoughtfully with the result of programs that are making for a better future for this country.

Chairwoman JOHNSON. Well, thank you. Have you had a dialog with some stakeholders as to whether or not they would continue to invest in these programs without support, or has there been the opportunity for that dialog?

Secretary PERRY. Yes. Yes, Madam Chair, there has been that dialog with stakeholders. And, as a matter of fact, the timeliness of your question is succinct here today. DOE is going to be announcing our 2019 Technology Commercialization Fund Project selections. And there are 77 different projects, and they're going to be matched with funds from the private sector.

As a matter fact, I think there's about seven of you on this Committee. Congressman Baird, your district is one of those that's going to be receiving some of that, and I think, Congressman Lamb

and Perlmutter, Wexton, Tonko, McAdams, and Governor Crist, your district as well are all going to have funding for projects.

And so to lengthen the answer just a little bit more, Madam Chair, those conversations are almost continual because of the work that's gone on at our national labs. The focus of the Department when it comes to—I'm a big believer both in a personal and professional way that public-private partnerships are very, very good for commercializing technology that is developed in our national labs.

Chairwoman JOHNSON. Well, thank you very much. My time is expired. I'll now recognize Mr. Weber.

Mr. WEBER. Thank you, Madam Chair.

And I'm glad to hear, Mr. Secretary, that you all are going to have National Lab Day on July 24th in honor of Charlie Crist's birthday, so happy birthday in advance, Governor.

Secretary PERRY. That's exactly why I picked that day, Governor.

Mr. WEBER. So I just didn't realize he had that kind of pull, you know?

Secretary Perry, as you know, the President signed my bill the nuclear iteration—*Nuclear Energy Innovation Capabilities Act* into law last fall. And while I've been pleased to see the Department take some important steps in implementing this legislation such as announcing the mission need for the versatile fast test reactor, which is authorized in the bill, we really heard kind of little from the Department about the rest of the bill.

So talking about the budget specifically, I was kind of disappointed to see the fiscal year 2020 budget request did not include funding for the National Reactor Innovation Center, which was included in the budget request. And just by way of notes, this innovation center is critical to the development of advanced reactors and will allow those private companies you were talking about to prove their reactor designs without having to endure the lengthy NRC (Nuclear Regulatory Commission) licensing process. And it's also my understanding that the Department of Defense, DOD, is interested in this funding and a reactor prototype at one of the national labs through this program. So I guess my question to you is how do we not get that in the budget? What's your thoughts on that process?

Secretary PERRY. One of the things I'm going to do if I may, Madam Chair, is I'm going to ask for Under Secretary Dabbar to share just a little bit of his observation here because I think this is really important. He's head of our science shop. All the—all of the—our national labs are underneath him and what have you.

But, Randy, before—or, excuse me, Congressman Weber, before we do that, I just want to say that we think some of the most exciting research that's being done at the Department is dealing with small modular reactors (SMRs), the advanced reactors that are out there. We've got two private-sector companies that we're working incredibly close with. We've got a piece of line land on Idaho National Lab property where we're going to be, you know, building this out and seeing some real progress made on this. And we think that not only from a commercialization aspect of being able to deliver emissions-free power, it's also going to be a very, very important tool to nonproliferation with these small modular reactors.

So, if I may, could I get Paul Dabbar to share——

Mr. WEBER. Sure. If you'd be very quick because I do have a question for——

Secretary PERRY. Yes, sir. All right.

Mr. DABBAR. So the versatile test reactor, which is part of the legislation we'd like to thank this Committee for passing, we're moving down the process to identify where to actually place it, at which of the national labs. As you can probably guess, we have more than one interest from a national lab Director about where to place it. But we're in the middle of that process. And obviously, we're looking forward to placing it in one of the labs. It has a long history which we have several of, of nuclear power. Yes, good. Thank you.

Mr. WEBER. OK. Well, I'll take that to mean that you really don't know what the cost is going to be, so how much to put in the budget, but we do need to focus on that. Let me go to question two.

Fiscal year 2020 budget request includes \$161 million cut to the Fusion Energy Sciences program, and, as a result, proposes \$108 million in the U.S. contributions to the ITER project, which is the world-leading international research collaboration in fusion energy that has in the past received strong and continued bipartisan support from this very committee.

This funding level is just over 1/3 of what is required in fiscal year 2020 to maintain the U.S. commitment to participate in ITER. So my question is is the Department recommending that we withdraw from ITER because—it's hard to square this fusion budget which would make the U.S. responsible for delaying the project and increasing the overall cost with maintaining our international commitment. Are we thinking of withdrawing from the ITER project? I mean, how can we expect other countries to make investments in the U.S.-hosted international projects like, for example, the Long-Baseline Neutrino Facility if we don't keep this—our commitments overseas?

Secretary PERRY. Yes, sir, Congressman, you know the history of this, and it really got sideways back when I showed up here in the spring of 2017. ITER was in pretty dire straits frankly. It had poor management. There was not the type of results that I think any of us were comfortable with.

Subsequently, they have a new Executive Director in there that's doing some really good work. We have regained our confidence. I went and was on the ground there to see, to talk, to interact with the folks there in the south of France where this facility is. We have become convinced that they are making the right kind of progress. We're doing more in-kind contribution on the solenoid that's coming out of General Atomics in California rather than direct appropriations. But with that said, the \$107 million request for 2020 is sufficient to maintain the progress on some of the highest-priority U.S. hardware contributions that we're making.

So to answer your question specifically, we are recommending that we continue to be engaged with this, cautiously optimistic that when we roll back in here for the next budget cycle that we'll be able to even have better evidence of progress that they're making.

Mr. WEBER. Well, I appreciate that, Mr. Secretary. It's no surprise to me that you focused on it and were already on top of it,

so I appreciate it, but I just—again, I think it's important, and so I think we want to continue that commitment as much as we possibly can.

I'm over my time, Madam Chair. Thank you. I yield back. Thank you, Mr. Secretary, for being here.

Chairwoman JOHNSON. Thank you very much. Ms. Lofgren.

Ms. LOFGREN. Thank you. And thank you, Mr. Secretary, for being here.

Following up on Congressman Weber's focus on fusion energy, I wanted to mention the National Ignition Facility at the Lawrence Livermore National Lab, which is the world's largest laser run by the National Nuclear Security Administration (NNSA). It's the premier facility within the United States for high energy density and inertial confinement fusion research.

I was concerned that the budget from the Administration was low. However, the House Administration Committee has provided level funding. I just would throw this caution out. When we lowball in the budget, it does have an impact on morale among the scientists even though—this is not the first time this has happened. It happened under the prior Administration as well where the request is low. Congress, you know, gets level funding, but it has an impact that's not positive on the morale of the workforce, so just for the future.

I'd just like to ask about the *Energy Research and Innovation Act*, which the President signed last fall. There's a provision in there which directs you to establish and support an R&D program in inertial fusion for energy applications. There was a clear recommendation in the National Academies' report which highlighted several promising research areas to explore with the enormous clean energy potential of inertial fusion energy concepts. These are areas that the weapons Stockpile Stewardship Program would never pursue because it's really not their bailiwick, but the research needs are quite different.

What is the status of the Department's implementation of this now statutory direction to establish and support an inertial fusion energy research and development program?

Secretary PERRY. Madam Chair, if I could, I'd like to have, again, Paul Dabbar kind of share with you a little more detail on that specific—

Ms. LOFGREN. Thank you. Thank you.

Secretary PERRY. Paul?

Mr. DABBAR. So, Congresswoman, we are very much focused on seeing commercial fusion move forward. We've been very enthusiastic about the private sector also working with us, increasingly so, including Congressman Bera's—where he went to university at Irvine, which is Tri Alpha Energy. In inertial confinement there's a company that came out of technology from Livermore and from Los Alamos called General Fusion, which is actually approaching this from an inertial-confinement point of view. We've accelerated our work with the private sector, including with inertial confinement, that inertial confinement company, and we look forward to advancing that technology, as well as others.

Ms. LOFGREN. So the Department's R&D program is basically just private sector?

Mr. DABBAR. No. No, Congresswoman. Most of it is the science area, but what we've seen is that there has been a growth in the private sector also, so——

Ms. LOFGREN. Which is good.

Mr. DABBAR. Yes. And so—and they've brought—there's over \$1 billion worth of private-sector money which has been raised, and one of them is in inertial confinement. And we are engaged with them in a number of programs to engage with them, amongst others.

Ms. LOFGREN. I wonder if I could ask this. Could you follow up this hearing with a more detailed, in writing, report on kind of the status of implementing this statute and where we are, next steps, and the like? This is enormously important to the Committee on both sides of the aisle and really to our country and the world. I would very much appreciate that if you could do that.

Secretary PERRY. Ms. Lofgren, I—let me just add to that that I certainly—I don't think I am out of line here inviting you to go take a look at one or both of the private-sector efforts that are going on. TAE, which is down in the—is that the Inland Empire?

Mr. BERA. It's——

Secretary PERRY. Is that right, Dr. Bera? Is that——

Mr. BERA. It's in Orange County.

Secretary PERRY. In Orange County. Yes, it's in Irvine. And——

Ms. LOFGREN. It's not inertial, though.

Secretary PERRY. Yes.

Ms. LOFGREN. I mean, it's interesting, but——

Secretary PERRY. It—yes. So there's just some fascinating work. I visited there down at General Atomics and what they're doing in that side of it.

And then at Idaho National Lab, some of the work that's going on there, and I think you're next door to Lawrence Livermore——

Ms. LOFGREN. Correct.

Secretary PERRY [continuing]. And with the—with that light source there. It's—there are some—it's down the road, we understand that, but investments that we're making today we may look back on 20 years ago—20 years from now and say well done.

Ms. LOFGREN. I'll just note, thank you for your enthusiasm for the national labs. It's really important.

Secretary PERRY. Yes.

Ms. LOFGREN. And I think if we put the kind of focus on this area of research that we should, we'll get there a lot sooner. We've never adequately funded the science on it. And I thank you, Mr. Secretary. And my time is expired.

Chairwoman JOHNSON. Thank you very much. Mr. Posey.

Mr. POSEY. Thank you, Madam Chair, for holding this hearing, and thank you for appearing, Mr. Secretary. Over here.

About half the people in this room are old enough to remember the fuel crisis, the energy crisis in 1973 where everybody in the world that—everybody in this country that wanted to get gas had to go get in line on an odd number of tag days in Florida and wait for hours to get a half a tank of gas, just brought everything to a screeching stop. And in response to which Congress passed and President Carter signed the act in 1977 which created the Depart-

ment of Energy to make sure we would never, ever again be victims of such an energy crisis.

And I commend you for reaching the current point that we're at now, an unprecedented level of energy independence, so thank you for a job well done, you and the Administration.

I was very happy to see your references to space in your video presentation. Ultimately, the exploration of space is about the survival of the human species and exploring the unknown to expand our knowledge.

Last year, the House Science, Space, and Technology Committee worked together to pass H.R. 589, a bipartisan Department of Energy reauthorization bill, which is now law. And, as you know, part of the legislation directs the Department to carry out a program on low-dose radiation research within the Office of Science, which is going to be necessary to better understand for the future of human spaceflight.

And so I just wondered if you could give us a little bit of an update on the status of the plan to implement the program and, if not, you can mail it to me.

Secretary PERRY. Thank you, Congressman Posey. That focus on the partnering between DOE and other agencies of government, in this case NASA, is—it's one of the more fascinating things that we do, particularly developing the ways to propel us to deep space. There's going to be work that's done, and small modular reactors may be part of the tie-in here to the propulsion on some of these.

But the other side of it is there's a program that's—I think it's called KRUSTY (Kilowatt Reactor Using Stirling Technology), and I actually—I got to see the work that they are doing on it at the Nevada test site a few months back. And KRUSTY is an acronym for Kilowatt Reactor Using Stirling Technology. And Los Alamos is the—is actually where the work's being done. They were just—there were showing it to us out at the test site in Nevada. And it's—the—they're partnering—it's just like you see public-private partnerships and you see NASA (National Aeronautics and Space Administration), DOE, DOD particularly through DARPA (Defense Advanced Research Projects Agency) working together on some of these projects. The national labs partner up often, so Los Alamos and the Y-12 National Security Complex, and then the national security—I always call it the Nevada test site. That's not the proper name, but the Nevada national security site are where they're building and testing these full-scale flight prototypes for nuclear reactor.

And by the—we're going to get back into space. We're going to go very far into space, and it's going to be driven by funding that you all are making available through these national labs, so thank you.

Mr. POSEY. Thank you, Madam Chair. I yield back.

Chairwoman JOHNSON. Thank you very much. Mr. Bera.

Mr. BERA. Thank you, Madam Chairwoman.

Secretary Perry, thank you for being here. I just wanted to follow up on a conversation we had a year ago regarding the budget hearing and the 123 nuclear agreement with Saudi Arabia. You know, at that time there were negotiations taking place, and I think in your comments there was some hesitation of moving forward with-

out that 123 Agreement. And, you know, just for the record, the *Atomic Energy Act of 1954* requires a peaceful nuclear cooperation agreement, which is the 123 Agreement for export of nuclear commodities.

I know this past March, earlier this year, you approved the Part 810 authorizations for transfer of certain nuclear energy technologies to Saudi Arabia. And while that Part 810 authorization doesn't require the 123 Agreement to be in place, part of the approval process requires us to consider whether the transfer of these technologies are in the best interest of the United States, which is what the 123 Agreement typically symbolizes.

And let me put it in context. My other committee is the House Foreign Affairs Committee and obviously we are very concerned about the tensions in the region. You know, we've obviously pulled out of the Iran nuclear deal. In recent days, the Iranian regime has talked about increasing their nuclear production and potentially restarting their nuclear program.

Last year, the Saudi Crown Prince on "60 Minutes" suggested that if Iran were to pursue nuclear weapons, they would certainly be within their right to pursue nuclear weapons as well. And I think all of the Members of this Committee, certainly when we're thinking about the United States' interest, would be very concerned about seeing a nuclear arms race take off in the Middle East in one of the most unstable parts of the world.

So both in my role as Chairman of the Subcommittee on Oversight for Foreign Affairs, as well as my role as Vice Chair on this Committee, could you give us an update on where we are with Saudi nuclear sales?

Secretary PERRY. Dr. Bera, thank you. I think you very succinctly, for all of us, described why it's so important for the United States to continue to be engaged in that process. If you really care about nonproliferation, if you care about peace in the Middle East if you will, and there's—in the broadest context, the United States being involved, being engaged, continuing to have a discussion and a negotiation going on not just with Saudi Arabia but with all the folks that we can bring to the table on this, wherever they may be.

I think it's important from a—just in edification process, the—there's been some misinformation out there from my perspective on the Part 810 and what—just what does that mean. And this isn't some blessing that we're, you know, basically saying, you know, here's the keys to the kingdom so to speak and, you know, take this information, do as you will with it and what have you. And 810—signing off on a Part 810 simply says it's OK to go have a conversation. It's OK to—you know, to start this conversation with a U.S. technology company dealing with civil nuclear and your—and you don't necessarily have to have a 123 agreement in place to do that. Thailand is a great example of a country that we have signed Part 810s with.

And then there was some other misinformation out there about this information somehow or another is secret, and it's not. We have—now, some of it is proprietary. And previous Administrations have made that proprietary information, you know, off the books so to speak, appropriately. But we tried to be—you know, we've got a reading room where the folks can come and take a look at it, and

we're working with Members of Congress that are really interested in this and want to see what's going on as well.

Mr. BERA. Great. Thank you.

Secretary PERRY. Yes.

Mr. BERA. And I would just emphasize, you know, again, given the tensions in the region, this is a complicated issue, I would still push for that 123 Agreement——

Secretary PERRY. Absolutely.

Mr. BERA [continuing]. And I understand there's the competing interests of the Russians and the Chinese and the Saudis could pivot and go in that direction, but if they're really serious about this and they want to be a serious player in the world, we've got the best technology, the safest technology——

Secretary PERRY. Yes.

Mr. BERA [continuing]. And the best companies. They shouldn't go in that direction, so——

Secretary PERRY. And I made the statement to the leadership of the kingdom that if you want to send a message to the world that you're really serious and want to be adult members of the world community, you need to sign a very strong 123 agreement with the United States.

Mr. BERA. Great, thank you. I yield back.

Chairwoman JOHNSON. Thank you very much. Mr. Biggs.

Mr. BIGGS. Thank you, Chairwoman Johnson and Ranking Member Lucas. I appreciate conducting the hearing today even though it's Randy Weber sitting in, so that's good.

Mr. WEBER. Will the gentleman yield?

Mr. BIGGS. No, I will not yield to you, sir.

I thank you, Secretary Perry, for joining us today. And I congratulate you, Secretary Perry, on the excellent job that you are doing at the Department of Energy. And I think it's amazing to see what a deregulatory agenda, coupled with pro-growth policies, can do to benefit our economy and national security at the same time.

I'm also encouraged by the Administration's commitment to a long-term strategy for viable and competitive nuclear energy and to developing the necessary infrastructure to meet our Nation's energy needs. Nuclear energy is particularly important to my home State of Arizona where nearly 30 percent of the State's electricity comes from nuclear energy. The Arizona Public Service, the largest electricity company in the State, serves 2.7 million people and operates the Palo Verde generating station, which produces more than 70 percent of the State's clean energy. The Palo Verde nuclear power plant is America's largest source of clean air energy, providing over 2,500 jobs and generates an economic impact of more than \$2 billion, all while emitting no greenhouse gases.

Secretary Perry, you visited Arizona in February where you stated that President Trump is focused on having a diverse energy portfolio that includes nuclear energy, and we're glad that you came out. I'm personally glad that you came to Arizona to see what we're doing there.

You also stated that America needs to continue to be engaged in the development of the next generation of nuclear power. And so, Mr. Secretary, I'm wondering if you would please elaborate on the

Department's efforts related to the development of the next generation of nuclear power.

Secretary PERRY. Mr. Biggs, thank you. The advanced reactor technology program is what you're making reference to, and we're doing the R&D on that as we speak to address the long-term technical barriers that we have. And SMRs is part of this, and I think from my perspective increased funding for microreactors—and microreactors, this is particularly of interest to the DOD as they—as we live in this world—and I know we're going to talk about resiliency at some point in time today of the grid and what's going on, but, Mr. Waltz, from a military standpoint, having these microreactors, even smaller than our SMRs, to develop the power in some of our military operations is going to be tantamount to our ability to perform the national security mission that we have.

We're continuing—and I want to talk with some specificity here. We, the DOE, is continuing to support the development of NuScale Power. That's their efforts to complete the licensing process and begin to commercialize the design and build associated with the supply chain that they're going to need, the commercial deployment of those reactors. And that's happening at the Idaho National Lab outside Idaho Falls, and 2026 is the projected timeframe on that.

So we know—look, the key for us is we're going to have to have lower capital costs to build these nuclear plants. I mean, that's the—we all recognize that, what—the challenges that the civil nuclear program has got, reducing the schedule times, the costs that go into building those. We need to be focused on the supply chain, keeping it in the United States and the components that are fabricated by U.S. companies for this and, again, getting back to—when we're able to do that, Madam Chair, we're going to be able to send the message that, No. 1, our energy supply is going to be harder to disrupt, so whether it's a cyber attack, whether it's a natural disaster, all of that is going to be directly affected by these advanced reactors and the development of those—

Mr. BIGGS. So, Mr. Secretary, with regard to that, you know, we've talked about private enterprise and their role in this. How do you incentivize private—the private sector to participate in this and accelerate the science with this?

Secretary PERRY. Yes, well, I think the fastest way you incentivize the private sector is for government to get out of the way from a regulatory standpoint, from, you know, a cost standpoint, so both—and I don't want to—I don't want anybody to walk away thinking that I have left somehow my understanding of how States function. States have to be very engaged in this process as well and State governments not be an impediment to the development of these technologies as well, for that matter, States not be impediments to the development of an all-of-the-above energy portfolio for this country.

So I would suggest to you one of the best ways that we can send a message that we want you to invest in this is to make sure that—either by permitting or regulatory fiat we create more of a hurdle for these companies to be able to bring their product to the market.

Mr. BIGGS. Thank you, Mr. Secretary. Thank you, Madam Chair. Chairwoman JOHNSON. Thank you very much. Ms. Bonamici.

Ms. BONAMICI. Thank you to the Chairwoman, Ranking Member. And thank you, Secretary Perry, for being here today.

Last year, I asked you about exascale and quantum computing, and today, I'd like to start my questions on the existential threat of climate change and the Department's efforts to accelerate our transition to clean energy. Secretary Perry, the Fourth National Climate Assessment makes clear that greenhouse gas emissions from human activities are the most substantial factor in global warming over the past six decades. The Department of Energy is one of the 13 Federal agencies in the U.S. Global Change Research Program that contributed to the assessment.

So, Secretary Perry, did the Department of Energy sign off on the findings of the Fourth National Climate Assessment? I'm going to make it easy. This is a yes or no question because I want to—

Secretary PERRY. Yes.

Ms. BONAMICI [continuing]. Get to several questions. Did it? OK. And do you agree that the National Climate Assessment is the result of collaborative peer-reviewed effort across Federal agencies compiled by the nation's top scientists? Again, that's yes or no. Do you agree that it's—

Secretary PERRY. Yes.

Ms. BONAMICI. OK. And according to the assessment, fossil fuel combustion accounts for 77 percent of our nation's total greenhouse gas emissions. Do you agree with this finding in the assessment?

Secretary PERRY. I—Senator, that one I've gone to the point of—I know you're reading—I mean, you're reading a technical report, and if that's what the technical report says, I'm—here's what I will share with you, that the climate's changing, man's having an impact, and, as I've stated before, you know, I welcome a thoughtful conversation with anyone on how we can cleanup the environment, you know, no matter which side of the aisle you may be on here.

What we're focused on at the Department is coming up with new innovation, new technology that will help us address this issue of the climate—

Ms. BONAMICI. I appreciate that. Mr. Secretary, I have some more questions, and I'm going to ask you about that. So the assessment also identified that without a rapid decarbonization of the world's energy systems over the next few decades, it is unlikely that we'll be able to reach the 2 degrees Celsius warming target that was set in the Paris Climate Accord. Do you agree with that finding in the assessment as well?

Secretary PERRY. Here's what I'd like to do. I know you got a lot of questions you want to ask me that are yes or no. But I'd really like to get Paul Dabbar to share with you what Fatih Birol, who's the head of the International Energy Agency said within the last 30 days about the decarbonization of the planet.

Ms. BONAMICI. Well, I'd like you to submit that for the record because—

Secretary PERRY. OK. Great.

Ms. BONAMICI [continuing]. This is your time here today. So also, Mr. Secretary, last year, the Natural Resources Defense Council sent a letter to this Committee outlining the failure of the Department as Office of Energy Efficiency and Renewable Energy, or

EERE, to spend the funds that were appropriated by Congress in fiscal year 2018.

So the President's fiscal year 2020 budget request outlines the Administration's plans to reprogram \$353 million in prior-year balances from EERE to help pay for fiscal year 2020 programs. The *Impoundment Control Act* requires the Administration to obligate funds when Congress appropriates money to the executive branch.

And last year, this Committee learned through a GAO (Government Accountability Office) request from Chairwoman Johnson that the Administration violated the *Impoundment Control Act* in 2017 by withholding 1/3 of the budget for ARPA-E. So you can understand why we're concerned about the same issue occurring at EERE. So the *Impoundment Control Act* does allow agencies to withhold obligation of funds when a deferral or rescission is requested by the President and approved by Congress.

So, Secretary Perry, are you aware of any deferrals or rescissions that Congress has approved for fiscal year 2018 or 2019 funding for DOE programs?

Secretary PERRY. I am not.

Ms. BONAMICI. And how did the total number of funding opportunity announcements (FOAs) for EERE in '19 compare to the number of announcements issued in fiscal year 2018 to date?

Secretary PERRY. Do want to take—

Ms. BONAMICI. And, Mr. Secretary, you're the witness here today; I'd like you to answer the question.

Secretary PERRY. Yes, well, I'm going to refer to my expert then if you don't mind, ma'am.

Mr. DABBAR. Where—we issued all the FOAs for EERE, and they're in there in the middle of submittals and reviews right now for 2019.

Ms. BONAMICI. Mr. Secretary, will you recommit here today to distributing DOE's appropriated funds for 2019 and 2020 in accordance with congressional intent?

Secretary PERRY. Yes.

Ms. BONAMICI. I appreciate that. Thank you very much, Madam Chairwoman, and I yield back.

Chairwoman JOHNSON. Thank you very much. Mr. Cloud.

Mr. CLOUD. Thank you, Secretary, for being here. It's good to see you.

Secretary PERRY. Yes.

Mr. CLOUD. It's great to have a Texan heading up the Department of Energy.

Secretary PERRY. Thank you.

Mr. CLOUD. I want to thank you, first of all, for your thoughtful written report. I found it personally refreshing actually that we had a comprehensive report that sought to recognize the security challenges facing us but—and recognize the breakthroughs that we need to make for advancement but also kept in mind that we are supposed to be, as the Chair said, responsible use of the taxpayer's dollar. And while we do want to make sure DOE employees' morale is high, I think we should also make sure that the taxpayers' morale is high, and with \$22 trillion hanging around their neck, I think most of us realize that their morale is not as high as it should be.

I represent of course the 27th District of Texas, so, first of all, I want to thank you for the work in helping with the port of Corpus Christi. Seeing the first crude shipment come out of the United States in a while out of that port was really great for the United States as we're making this transition to an energy-dominant nation, which you've been so key in.

I'm also home to the South Texas Project Electric Generating Station, and I know we're committed to America's leadership in nuclear energy to help deliver clean, reliable power to the people of Texas and across the country.

Much of America's existing fleet of reactors is aging with many of the nuclear plants nearing the end of their 40-year license. The Department of Energy is researching ways to promote the longevity and safety of nuclear plants through its Light Water Reactor Sustainability (LWRS) Program. The program works with universities and companies like STP, South Texas Project, on research. Could you provide an update on the work being conducted through the LWRS program?

Secretary PERRY. Do you want—do you know which one that is? No?

Mr. Cloud, if I could, let's take that one for the record—

Mr. CLOUD. OK. Yes.

Secretary PERRY [continuing]. And get you the proper information and give it to you and the rest of the Committee Members in writing.

Mr. CLOUD. I appreciate that.

Secretary PERRY. Yes, sir.

Mr. CLOUD. Your written report touched on rare-earth minerals and, you know, there's a lot of talk about alternative forms of energy, having an all-of-the-above approach. Could you discuss what DOE might be doing in terms of rare-earth minerals? I mean, we know China controls 70 percent of them, so as we look to alternative forms of energy, as we're becoming a dominant—energy-dominant nation that's finally independent in energy, we don't want to trade that for dependence on rare-earth minerals.

Also, of course, rare-earth minerals have, as your report mentions, extreme national security, military applications, and those sorts of things.

Secretary PERRY. And I think that's very succinct that we—I want to stop and draw a line right there and say that that's looking backwards, and some of the innovation and technology that's going on at the Department at this particular point in time may shed some light on that—dealing with rare-earth minerals that are controlled by maybe some countries that don't necessarily have our best interest in mind may not be as big a challenge as what we thought it was 12 months ago. And part of that reason is because of the research that's going on at our national labs.

And I'm going to again ask Paul to kind of share with you just—because he's fresh out of seeing some of this, and it has to do with battery storage. And the progress, Mrs. Fletcher, that's being made on battery storage is really fascinating. And I've always said that battery storage is the Holy Grail. If we're able to get to that point where we can use our renewables, solar and wind in particular, to power these batteries that have longtime storage—and what we're

finding now is that the elements that are being used to create some of these batteries are not rare-earth minerals and—they're elements that we have right here in the United States, so we're going to be in control of our future substantially more on the battery storage.

Paul, if you just kind of give them a little glimpse of what's going on here, and I think that's pretty exciting stuff.

Mr. DABBAR. So a couple of examples, obviously the complexes to a large degree are a very large R&D business, and so in this particular area, for example, in batteries that are not lithium-ion, beyond lithium-ion batteries that not only have tremendous improvements in performance at 3 to 5 times but are made out of elements, as the Secretary said, that we don't have to source it from places that we have had more of a challenge.

The second thing, as an example, that we did with the support of this Committee is the recycling battery announcement that we made it Argonne National Lab where we announced the first research for recycling batteries, so the materials that you are talking about that have to be potentially sourced from other places in the world, we're looking at with all these batteries being used in the economy now, how we could reuse those rather than needing to source that from other locations.

Mr. CLOUD. You mentioned on the electric grid, and I think in 2017 you produced—or the DOE I should say produced a report on listing recommendations that we should do to prepare for an EMP (electromagnetic pulse) attack. Do you know of any progress that's been made?

Secretary PERRY. Yes, sir, a substantial amount of it. In April of this year we—DOE issued a \$35 million Cybersecurity for Energy Delivery Systems research sale—excuse me, research call to the federally funded research and development centers. And they're working exactly on what you're talking about there, the resiliency, the reliability of the Nation's energy infrastructure, and they're looking at a host of different ways to—you know, we actually stood up an office that we refer to as CESER (Cybersecurity, Energy Security, and Emergency Response) cybersecurity and the emergency response that's headed up, and so, again, thank you for the funding of that. I think it's very timely.

And the previous that I talked about, this \$35 million is going to be used for testing that can be used to verify and validate operational technology equipment and software. And there was also a funding opportunity announcement that was released in the month prior, in March, of—to establish a Cyber Manufacturing Institute, and that one's co-managed by our CESER office and EERE to mitigate cybersecurity threats.

And so there is a—there's a lot of movement in that space. The DOE, our national labs, and our private sector partners are all engaged I think in a very constructive way to send the message to our citizens, to those that operate our electric and power systems that we're doing everything possible to protect them against both cyber threats, physical threats, and national—or natural disasters as well.

And in Florida, you know, your—I think your Governor is about to do a—an announcement on infrastructure resiliency and what

have you. You know, our two States, you know, we—from time to time we get more natural disasters than we'd really like to have. But how we build that infrastructure and how we develop that resiliency of the grid is very, very important not just because of the cyber side of this that, you know, 10 years ago that wasn't a problem. It is today.

Chairwoman JOHNSON. Thank you very much. Mr. McNerney.

Mr. MCNERNEY. Well, I thank the Chair and thank the Secretary for coming today. And I do want to say I worked at Sandia National Laboratories in Albuquerque. I worked at the National Renewable Energy Laboratory (NREL) and I have—Livermore Lab is right outside of my district. I'm well aware of the quality and quantity of labs, and I encourage you to support those labs as much as you possibly can.

Secretary Perry, do you believe that research on climate science is needed, or do you think that the climate science is settled?

Secretary PERRY. I—well, I think we're continuing to add to the body of science that's out there, Mr. McNerney.

Mr. MCNERNEY. Do you think we need to continue to work on that? What makes the DOE labs uniquely qualified among the national science agencies to conduct research on climate?

Secretary PERRY. Well, partly because we've historically been engaged in it, so when you go back and look at the history of climate science, DOE and their scientists have been involved with it. There is a FOIA out right now, Congressman, that is going to—it's a selection that DOE issued yesterday on climate modeling. And I think this is just another example of how DOE's role in the predictive modeling of what's going on in the environment, these severe storms that we're seeing now—

Mr. MCNERNEY. Secretary, I know you're not intentionally filibustering, but I—

Secretary PERRY. Yes. No, I'm just excited about the—

Mr. MCNERNEY. I am, too, but—

Secretary PERRY [continuing]. What's going on at DOE.

Mr. MCNERNEY [continuing]. And so I strongly urge you to continue to double down on climate research—

Secretary PERRY. Yes.

Mr. MCNERNEY [continuing]. Including climate intervention research because we're going to have to have those tools available.

Secretary Perry, one way to make energy from renewable sources that are remote available to load centers across the country is to better connect them with the—what we call Interconnection Seams. The National Renewable Energy Laboratory has completed a study on this. However, the Committee staff has informed me that the release of the report that contains findings from this study has been delayed without explanation, and the authors have been told not to discuss it publicly. Are you aware that the limits have been placed on the authors in discussing results of this study publicly and whether these limits remain in place today?

Secretary PERRY. I'm not.

Mr. MCNERNEY. OK. So will you make a commitment to make this report publicly available?

Secretary PERRY. Yes, sir. We'll circle back and find out where that originated from and make it right.

Mr. MCNERNEY. Thank you, Secretary. I appreciate that.

In April of 2018 the DOE canceled a \$46 million funding opportunity announcement on solar R&D just days before the winners were to be announced. Can you or anyone on your staff explain why that was pulled at the last minute?

Secretary PERRY. We'll go research it, sir, and get back to you.

Mr. MCNERNEY. I appreciate that. And I appreciate also your comments on artificial intelligence. Mr. Olson and I are Co-Chairs of the Artificial Intelligence Caucus, and we're going to continue to pursue that subject with vigor. And I know the national labs have a lot to offer on that, so again I urge you to keep those labs well-funded and keep the morale high at those labs——

Secretary PERRY. Yes, sir.

Mr. MCNERNEY [continuing]. By not threatening their funding year after year.

Secretary PERRY. Yes, sir.

Mr. MCNERNEY. And with that, I'm going to yield back.

Secretary PERRY. Thank you.

Mr. MCNERNEY. I'm going to yield back the three minutes that the prior speaker took.

Chairwoman JOHNSON. Thank you very much. Mr. Olson.

Mr. OLSON. I thank the Chair. And howdy, Secretary Perry.

Secretary PERRY. Don't go over your time, Pete.

Mr. OLSON. Never my intention. I want to start off, sir, with something that's very important to Fort Bend County, a town called Needville, Texas. I want to give you a personal invitation from a young Texas lady we both know and admire. Her name is Katie Vacek.

Secretary PERRY. Yes.

Mr. OLSON. You remember you met her at President's—Trump's first speech before Congress.

Secretary PERRY. Yes.

Mr. OLSON. She fell out of a live oak tree, broke her spine, has not walked for 3 years. As you can see, now, she's a fellow Aggie——

Secretary PERRY. Yes.

Mr. OLSON [continuing]. Proud Aggie, and she wants to thank you personally for meeting with her and inspiring her to get moving forward and going to College Station. So on her behalf, maybe find some time to come down to Needville, Texas. The Jay Cafe had the best chicken-fried steak and pecan pie in all of Texas, and maybe pop over to the Petra Nova power plant right across the way from Needville. So if you have some time, come down. We'd love to have you come down.

Secretary PERRY. You don't even have to use the extra bait of chicken-fried steak to get me there.

Mr. OLSON. Thank you. Now, I have a question that's very important to my hometown of Sugarland, Texas. It involves the NNSA. As you know, the NNSA picks up some nuclear waste that's been used by industry and then disposes of it. They send it out to a site called the Waste Isolation Pilot Plant, the WIPP. Radioactive americium-241 is needed for safe drilling. This is one of the nuclear waste. It is a known carcinogen. Usually what happens, NNSA picks it up, they send it off for safe storage somewhere in America,

but there's a very small amount of that mineral that is picked up by NNSA but can't be kept here because it came from foreign sources originally. It's an identical fuel, identical. We can't dispose of it because it came from another country. And so we have these sites all across our country now, right now sprinkled with this radioactive waste. One site, Secretary Perry is half a mile from my son's high school Fort Bend Christian.

In 2015, they had a small release of americium and cesium-137. Workers took that home on their clothes. I know you'd like to change the law to make sure we dispose of this carcinogen without regard to where it came from. So are you aware of this, and how can we help you to make this commonsense dispose, dispose, dispose and not delay?

Secretary PERRY. Yes, sir. Congressman Olson, we are familiar with this, and what I—I apologize for turning my back to you and asking a question but—because I wanted to make sure that I was correct in the assumption that I was making that this is going to require a statutory change in which you just mentioned, and we will assist you in any way we can from the standpoint of using science at the labs or what have you to back up because, I agree with you that these types of materials do need to be put in appropriate disposal places.

And so the idea that just because it was produced in a foreign country versus the exact same element that is produced at a national lab's reactor for these isotopes—and there's a host of these isotopes that we use in medical and obviously for the oil and gas industry. But we agree that the statute needs to be changed because it clearly—I think it's the old land-use act—

Mr. OLSON. Yes.

Secretary PERRY [continuing]. That prohibits any foreign-produced elements of—being placed in—like the WIPP.

Mr. OLSON. Yes.

Secretary PERRY. So we would support your effort there. Anything we can do from a scientific standpoint to back that up, consider it available.

Mr. OLSON. It sounds like I have to call the ball, three down and cleared to land.

Secretary PERRY. Yes, sir.

Mr. OLSON. This is our job, not your job.

Secretary PERRY. Yes, sir.

Mr. OLSON. We're on that, sir. Thank you so much.

A final question very briefly is about AI. As Mr. McNerney mentioned, we are co-chairs of the House AI Caucus. And your video was awesome. It shows the potential future about AI. Can you discuss briefly AI's potential for protecting our grid, protecting our pipelines, protecting our national labs? I mean, this is the future.

Secretary PERRY. Yes.

Mr. OLSON. And how are you guys doing that at DOE to make sure we utilize—

Secretary PERRY. Yes. I can't do it briefly because it's just such a broad—and—but I think at some time in the future—let me just leave it at this: I don't think there is a field that government is participating in that has any more potential to have a bigger impact on our citizens than artificial intelligence. The supercomputers

that the Department operates, two of the fastest, five of the 10 fastest that we operate. And we are—our next-level computers are going to be operating—the exascale computer that's coming online at Argonne over in Mr. Foster's district in 2021 will do a billion billion transactions per second.

Mr. OLSON. Wow.

Secretary PERRY. That's the speed of which we are—that's anywhere between—I think it's up to 50 times faster than the computers we have today. I mean, it's fascinating work. So the AI, machine learning that's coming with that, we're going to find answers to challenges that we had no idea we were going to be able to address in the very near future.

Mr. OLSON. Thank you. Final request, beat Alabama. I yield back.

Chairwoman JOHNSON. Thank you very much. Ms. Horn.

Ms. HORN. Thank you, Madam Chairwoman.

And, Mr. Secretary, thank you for being here.

And I want to start off by framing this, that issues of workforce development, STEM, (science, technology, engineering, and mathematics) building our workforce of tomorrow, as well as the cutting-edge technology development are all very important both to me and to my district, and clearly energy is a big issue in Oklahoma, as it is across the country.

So I want to start with ARPA-E and the funding because I think we have to have a conversation about the role of technology development. In its 10-year history, ARPA-E has funded high-risk, high-reward energy innovation projects that create cleaner energy and economic growth. And the important thing about that, of the 145 projects that have been supported by ARPA-E, they have attracted \$2.9 billion in follow-on funding, follow-on private-sector funding, and 76 of these projects have gone on to form new companies.

I say that to ask, in the proposed budget, it basically zeros out ARPA-E, and in the balance of public-private partnerships, we're looking at the cutting-edge development of government investment leading to follow-on actual companies and economic growth and development.

So my question is what are you doing as the Secretary of Energy to communicate the clear successes that this program has had to the President and his budget team?

Secretary PERRY. Mostly sitting in front of Committees like this defending what ARPA-E has historically done, so—and I will continue to do that. I recognize that from time to time we're not always on the same page of the hymnbook, and this is one of those.

Ms. HORN. I hope you've raised that, because it's such an important way to encourage that economic growth and development by investing in cutting-edge.

Now, turning for a moment to cybersecurity and manufacturing, which are also topics that are critical and I think that we need to talk about. The Manufacturing USA program, of course you probably know it's a network of advanced manufacturing technology areas that have the goal of establishing American leadership in manufacturing.

And with respect to cybersecurity, which is absolutely critical in high-tech manufacturing, the Manufacturing times Digital or MxD,

which is a program that's funded by the Department of Defense, is focused on improving cybersecurity and digital manufacturing, and that is their focus. And on March 26 of this year, your Department announced a \$70 million award for cybersecurity for a new Manufacturing USA Institute.

So, Secretary, my question is why the duplication of efforts in those projects, which are basically the same? And have you encouraged your staff and the DOE to work with the DOD because this is very important, but in terms of streamlining our programs and not duplicating effort, why the duplication here?

Secretary PERRY. Yes. Congresswoman Horn, may I ask Paul Dabbar to weigh in here just a second? I think he may be able to enlighten us all a little better than me telling you from a high level.

Mr. DABBAR. So we work with Under Secretary Griffin, who is in charge of research at DOD quite a bit, as well as our other peers at NASA and NSF (National Science Foundation) and the others. We each focus on different areas. To be direct, DOD focuses on lethality applications. The Department of Energy is more about energy and about science, and so there's different applications for different aspects. DOD, for example, does not focus on cybersecurity for the grid. They focus on cybersecurity for what they do.

So there's a lot of similarities, there's a lot of overlap in their lab research and our lab research, but there's some very practical points of research that are different that's hard to fully get into here today.

Ms. HORN. So just a quick follow-up on that, did you coordinate with the DOD to build the scope of this program to not overlap or their overlapping of the manufacturing? Because it's a whole new institute. That's my question. It's a whole new institute. Are there not other ways that this could be coordinated?

Mr. DABBAR. For this particular institute I'm not certain if there was a discussion specifically with Under Secretary Griffin's scope, but we do it all the time with him across, you know, quantum, around AI, around hypersonics. So this particular one, I can't answer, and we can follow up with you on that.

Ms. HORN. I would appreciate that, and I yield back the balance. Thank you, Madam Chair.

Chairwoman JOHNSON. Thank you very much. Mr. Gonzalez.

Mr. GONZALEZ. Thank you, Madam Chair and Secretary Perry, for being here today.

One of the challenges that I think we always face in this committee is connecting our basic research, which I think is absolutely critical to the future of our Nation to everyday constituent issues and things that folks on the ground are feeling on a day-to-day basis. And kind of with that in mind, especially when we're talking about things like quantum computing and AI and big data—and these are, you know, important buzzwords but, again, how do we connect it to the day-to-day?

And one of the big issues across our country and in my district is the issue of veteran suicides. The number that's been most widely circulated is 20 veteran suicides a day. I know that the DOE and the VA (Veterans Affairs) have engaged in a partnership to solve just that with the use of some of our technology. I know my col-

league Mr. Norman has introduced legislation to reauthorize that partnership. And I guess I'd like to just turn it over to you just to hear from your perspective how is the partnership working? What are you working on specifically with respect to the VA, and how can we do even better?

Secretary PERRY. Thank you. And, Mr. Gonzalez, thank you for your serious passion about this issue. Probably every one of us in here—because this isn't just about veterans.

Mr. GONZALEZ. Right.

Secretary PERRY. This is about our kids, it's about our colleagues, it's about the citizens of this country. And, Mr. Tonko, you and I talked about this. Congressman McNerney and I have talked about it, the importance of what we potentially have in front of us now because of the breakthroughs that we're seeing in the partnerships that are being created between historically disparate agencies of government. Nobody ever thought DOE was supposed to be involved in the—in traumatic brain injury or, you know, posttraumatic stress or CTE (chronic traumatic encephalopathy).

And what we are showing people is that we have a real role to play in this. As a matter of fact, we may have one of the most important roles to play because of that computing capacity that we have and the ability for us to partner with the VA in the sense of working with the VA. The data that they have—and they know they can trust us. No offense to maybe some of the private-sector folks who have big computers and what have you, but I'm pretty sure that the VA and those veterans know that they can trust the Department of Energy not to allow this information to be used for some other purpose.

So we are going to continue to look for ways to—you all have funded a line item at the DOE now if I'm correct in that to—this program is funding a—and it's a partnership of—and, if I may, the University of California San Francisco, Dr. Geoffrey Manley out there, finding some just really big breakthroughs dealing with brain science. So this is important work.

Mr. GONZALEZ. Fantastic. And, as you may also be aware, I recently joined my colleagues on this Committee to introduce the bipartisan *Securing American Science and Technology Act*, which is designed to improve our ability to protect federally funded research from foreign espionage, cyber attacks, and theft. I think it's a huge issue. We're going to invest in our technology. We want to make darn sure that nobody's here stealing it.

Secretary PERRY. Yes.

Mr. GONZALEZ. And so I applaud your efforts on the talent program and, again, I was hoping you could maybe provide an update on what the policy is and how you see it evolving going forward.

Secretary PERRY. Can I ask—

Mr. GONZALEZ. Absolutely.

Mr. DABBAR. So the first thing that we just implemented, as the Secretary mentioned in his opening, was to ban people working at the national lab complex to work for foreign talent programs from China, Russia, North Korea, or Iran. And so we'll be giving people who are currently employed in the lab complex working for the Chinese State as a—you know, being co-hired, that that's no longer

going to be allowed, and they have to make a decision of either working for them or working for us.

By the way, this is very consistent with the cutting-edge universities where a lot of universities around this country are beginning to realize that this is a conflict of interest for them, so we're very consistent with what the university systems are looking at.

The second thing that we're looking at is whether we should be developing a list of technologies that we're developing in the national labs and whether that list should be included—that before we do any work with anyone from those foreign countries, that we have an extra review—

Mr. GONZALEZ. Yes.

Mr. DABBAR [continuing]. So this would not be a ban but this would be an extra review for key technologies such as quantum, such as new generation of batteries, and so on.

Mr. GONZALEZ. Fantastic. And I guess what—my final comment, I would encourage to—when I think of the innovation space, there's a funding component, there's a talent component and some other components, but not only should we be about making sure that folks aren't playing for both sides but how do we attract even more great talent here to the U.S.?

And with that, I yield back.

Mr. TONKO [presiding]. The gentleman yields back. The Chair now recognizes himself for five minutes.

And thank you again, Mr. Secretary, for joining us this morning. Obviously, the agency has many daunting challenges before it and very timely, so great to have you here.

Every year, the EPA (Environmental Protection Agency) publishes data on economywide greenhouse gas emissions. In 2017, the transportation sector was the highest-emitting sector, but not too far behind it at 22 percent of U.S. emissions was industry. Emissions from the sector are expected to grow in the near term, and many industrial processes are considered to be difficult to decarbonize without readily available or cost-effective alternatives.

Despite over 1/2 of our economy's climate emissions coming from transportation and manufacturing, the majority of our Federal R&D spending at DOE focuses on reducing emissions from the electricity sector. While these are critical and indeed worthy investments, I also believe DOE must support innovation in cleaner energy, not just cleaner electricity. Will you agree that DOE can help to develop cost-competitive technologies that reduce the greenhouse gas emissions out there while ensuring that domestic energy-intensive manufacturers continue to be leaders in innovation and remain globally competitive?

Secretary PERRY. Yes, sir. And I think our labs are engaged in some of those efforts as well. You know, the nonpoint source pollution issue, while I was the Governor of Texas, I had the opportunity to work with and put into place some programs that did exactly that, big fleet engines, for instance, the TERP (Texas Emissions Reduction Plan) program. Congresswoman Weber, if you'll remember, that was a reduction in emissions from old, inefficient fleet-type engines, and we gave a tax credit—and again, this wasn't on the innovation and the technology side, which is what DOD—E does, but it would—it's a—maybe it's an idea that those of you

in Congress could take a look at from the standpoint and give some incentives to States to implement programs like this.

But we will continue to look for ways to—and I'm really proud of what the United States has done from the standpoint of reducing emissions. I mean, we're leading the world in the total reduction of emissions. And a lot of that's—

Mr. TONKO. Well, but then we were swinging back up, so—

Secretary PERRY. But I think that's—you know, most of my folks at the Department tell me that is a temporary bump back up. And again, as we transition, I think it's important for us to go—where I can go sell American LNG (liquefied natural gas) into the European theater, remove old, inefficient coal-burning plants for cleaner-burning American LNG, I think that's just good all the way around. If I can get the Indians and the Chinese to recognize that, then we'll be making some progress in the world.

Mr. TONKO. Well, we do that at the common table—

Secretary PERRY. Yes, sir.

Mr. TONKO [continuing]. We need to stay with.

There are many technology options we can explore to decarbonize manufacturing. This includes cogeneration, combined heat and power and waste heat to power, which can greatly improve energy efficiency at our industrial facilities. Mr. Secretary, is supporting greater adoption of cogeneration a priority for the Department?

Secretary PERRY. I don't know whether I'd put it as a priority. It's one of the areas that we care about, just like over in Congressman Weber's district there's a—I think it's in your district where the Petra Nova facility is. It's in Mr. Olson's.

But the point is innovation and technology is the key to—you know, again, I don't want to backtrack here, but 15 years ago they told us we'd found all the energy resources that we had in this country, and they were wrong because innovators in technology—and I will suggest that the innovation and technology is going to be found through the artificial intelligence and the machine learning that we have the power to control at the Department of Energy because of the funding by this Committee.

Mr. TONKO. While cogeneration is critical, it will not solve challenges with process emissions, so other advancements such as carbon capture may be necessary. And I understand that the Office of Fossil Energy has done substantive work in developing this technology. And while CCS (carbon capture and storage) is not yet cost-effective in power generation, I believe it will ultimately be necessary for certain industrial applications. And what will you do to encourage collaborations amongst relevant offices at DOE to leverage existing resources and programs to ensure the CCS for industrial purposes are being given proper consideration and funding?

Secretary PERRY. I have made that one a priority, sir, and up to and including in the Clean Energy Ministerial we got CCUS (carbon capture, utilization and sequestration) put in as a priority at a global level at the Clean Energy Ministerial that was initially held in China and this last year in Vancouver. So we're making not just progress here in the United States, we're seeing some global saluting of that flag if you will by our partners around the globe.

Mr. TONKO. But, again, I would suggest it needs to be applied to industrial emissions.

With that, I have exhausted my time and will now recognize Representative Baird for five minutes.

Mr. BAIRD. Thank you, Mr. Chair, and thank you, Mr. Secretary, for being here.

We do appreciate the research funding that you mentioned in your initial comments. But your Department has an Office of Science, which funds the Bioenergy Research Centers (BRC), and they conduct coordinated and geographically diverse research in support of developing a viable and sustainable domestic biofuel and bioproducts industry from dedicated bioenergy crops. So each BRC is led by a DOE national laboratory or leading a U.S. research university and is staffed by multidisciplinary stakeholders in science, engineering, and industry.

So as a scientist and a farmer, I support the biofuels and the bioproducts industry, and I'm particularly interested in the research and development that can diversify these industries, and that helps them to produce more product while lowering their cost of reducing their environmental impact.

So my question is what do you see in fiscal year 2020 and beyond to support Bioenergy Research Centers and to expand their important research?

Secretary PERRY. Mr. Baird, we are very supportive of these Bioenergy Research Centers, and each of them are led by a DOE lab or a top university and sometimes—and even in partnership, and they're basically designed to lay out the scientific groundwork for new bio-based economy.

And the—well, I give you an example. Maybe some in your districts the following centers were selected based on an open competition. The Great Lakes Bio Research Center, that's up in Madison, and they're partnering with Michigan State. There's another at the Oak Ridge National Lab. There's another at Lawrence Berkeley National Lab (LBL). There's a center for bioenergy and byproducts—bioproducts innovation, and that's at the University of Illinois at Urbana at Champaign.

So I think there's been—over 2,500 peer-reviewed publications came out of that. There's been 1,000-plus invention disclosures that came out of it, so from the standpoint of what your return on the investment I think it's pretty—it's been pretty good, sir.

Mr. BAIRD. Thank you. I have one other question, and that deals with looking in another area. Now, my colleague Mr. Gonzalez made reference to the Veterans Administration, but—and I recently cosponsored some legislation along with my colleague Representative Wexton to prioritize opioid research at the National Science Foundation. And I know you've indicated the use of the DOE's supercomputing capacity to tackle the big data challenges often in the healthcare space. So would you mind elaborating again on what kind of role you think the DOE might play in helping the Federal healthcare agencies, including the Veterans Administration—

Secretary PERRY. Yes, sir.

Mr. BAIRD [continuing]. Better understand—to better understand the opioid crisis?

Secretary PERRY. Yes, sir. The good news is we're making some good progress. Mr. Waltz, back probably in mid-2000s, '06, '07

when the war on terror was really at one of its apexes, being the Governor of Texas, I had the opportunity to go to Brooks Army Medical Center on a fairly regular—more regular than I'd like to be in going to young men and women who were burned.

And then at that particular point in time we saw our Federal Government being rather liberal in the dispensing of opioids and, you know, half-a-dozen years later we figure out that we've basically created a whole generation of young people who are dependent upon these things. And we started pulling back from them. And this was probably 3 or 4 years ago. BAMC (Brooke Army Medical Center) had decreased by 90 percent the amount of opioids that they were giving to the young people that were coming in and dealing—they were coming up with some different ways to deal with it.

With that said, we've still got a real opioid crisis in this country. We think it may be genetically driven to some degree, so again, the supercomputers and our ability to do genetic testing of some of these populations out there and, again, doing it in a way that the people know that this information is going to be safe and secure, the Department of Energy is going to play a very vital role in being a partner working with NIH (National Institutes of Health), working with the VA, working with some of our private sector partners and our university systems to—I think we will find a solution to the opioid epidemic that we have in this country. And we'll—this will happen—my projection is this will happen sooner rather than later.

Mr. BAIRD. Thank you, and I yield back.

Chairwoman JOHNSON. Thank you very much. Dr. Foster.

Mr. FOSTER. Thank you, Madam Chair, and thank you, Secretary Perry.

You know, I just want to tell you how much I enjoyed having the privilege of escorting you around the two crown jewels of the national laboratory system, Argonne National Laboratory and actually I think there was a slide that was going to be put up here in a moment, if we could put it on the screen, please.

[Slide.]

Mr. FOSTER. Yes, so this is one of the many hats I wear is as the Co-Chair of the National Labs Caucus where we are also planning to be visiting all 17 of the national laboratories. And I'll be leading as large a congressional delegation as I can corral. The first of these, shortly after National Lab Day, we're going to be heading to the New Mexico national labs, Los Alamos, Sandia, also White Sands where they do missile, antimissile, directed energy work, and the Alamogordo Trinity test site where the first nuclear weapon was detonated about 75 years ago now.

The next one is going to be in the bay area where Representatives Jerry McNerney and Zoe Lofgren on this Committee will be the hosts of a visit to the bay area labs, Livermore, Sandia, LBL, and SLAC.

Following that, we are visiting the crown jewels. I'll be hosting a visit to the Illinois labs at Argonne National Lab that I represent and, which, by the way one of the things that they have done at their synchrotron light source is to use them to directly image the molecules that are involved in opioid receptors in the brain, these

G-coupled protein receptors. This is Nobel Prize-winning research that allows us to directly image the molecules involved in opiate addiction and one of the very wonderful things that are often not talked about, and of course Fermi National Lab where I worked for 23 years before getting into this insane business.

Also, later on, Congressman Ed Perlmutter will enthusiastically host a visit to the Denver area and western labs and at times to be scheduled where also the two Republican Co-Chairs of the National Lab Caucus will be hosting visits to Oak Ridge and Savannah by Chuck Fleischmann. Lee Zeldin will be hosting a visit to the Brookhaven National Lab. And we've actually already had our first visit, where Chairman Lamb has invited us to go see NETL (National Energy Technology Laboratory).

And so, I understand why you enjoyed so much visiting these 17 labs, and it's really essential that the entire Congress recognizes the importance of these. And so—any of you—any opportunity for Paul Dabbar, you or any of your staff to join these, you're obviously more than welcome.

Now, in my remaining time I would like to discuss the issue of low-enriched versus high-enriched uranium. You know, this is something that comes up in many guises. You mentioned the KRUSTY work. You also recently signed a letter where the Navy was trying to discourage Congress from pursuing something that it's pursued for quite a while now, which is to encourage the Navy to look at the possibility of using low-enriched uranium in its propulsion reactors.

Now, I'd just like to emphasize the reason that 30 Nobel Prize winners have signed a letter advocating the minimization of low-enriched uranium. There's a reason that we don't test nuclear weapons. If we did test nuclear weapons, our nuclear arsenal would be safer, cheaper, more secure, more reliable. But we do not test nuclear weapons because if the rest of the world followed us in that example, it would be a national security disaster.

The situation is identical for low-enriched and high-enriched uranium. If we start using high-enriched uranium, weapons-grade uranium in applications where it is not strictly needed and the rest of the world follows us, things like propulsion reactors for icebreakers or, you name it, the things that they have the right to do under the nonproliferation treaty, it will be a disaster for nonproliferation and national security because any country that has a reactor's worth of high-enriched uranium has everything they need in terms of fissile material to make multiple nuclear weapons.

And so we've worked as a country for 40 years minimizing worldwide use of this, and we will continue to engage with you to make sure that every time that we have the option of using low-enriched or high-enriched uranium that we choose the safe one and not use weapons-grade.

Secretary PERRY. Yes.

Mr. FOSTER. So we've already communicated on this—

Secretary PERRY. Yes, sir.

Mr. FOSTER [continuing]. And we'll be continuing.

Secretary PERRY. Yes, sir.

Mr. FOSTER. And I have a grand total 23 seconds left, so I guess I just wanted to see how you view after having now completed your

visit of the 17 labs. You know, what are the things you'd really like to get done organizationally that will really improve their effectiveness?

Secretary PERRY. Yes, sir. Let me just add, as I don't know if I would make any changes organizationally to the structure that we have. I think these labs—I got some pretty good advice from former Secretary—former Governor of New Mexico Bill Richardson. He said, “Perry, don't mess with the national labs.” And that's frankly some pretty good advice.

For the record, I would like to invite all of you to come out to your neck of the woods in October of this year for an XLab event that we're having, which is where we bring in the private sector that are partnering with the national labs in a host of different areas. I mean, it's some fascinating stuff. And again, we don't have time for me to put on my cheerleader hat and talk about these national labs, but whether you've got one in your district or not, if you have the opportunity to go to a national lab, please do it. It's some of the most brilliant, capable men and women who are making, I think, more difference in America than any single group of people in this country.

Mr. FOSTER. Thank you. And you've been a wonderful Ambassador to science to an Administration that makes that not always an easy job, so thank you so much—

Secretary PERRY. Yes, sir.

Mr. FOSTER [continuing]. And yield back.

Secretary PERRY. And, Mr. Foster, let me just say, in the timeliness of this XLab event in Argonne in October is on artificial intelligence.

Chairwoman JOHNSON. Thank you very much. Mr. Balderson.

Mr. BALDERSON. Thank you, Madam Chair. Thank you, Mr. Secretary, for being here this morning.

Mr. Secretary, approximately 25 percent of my district in Ohio is rural.

Secretary PERRY. Yes, sir. There you are.

Mr. BALDERSON. For my constituents to access a quality education, science, technology, engineering, and mathematics—STEM—is critical. Many of the job openings that cannot be filled in rural Ohio are STEM-focused. As Secretary of Energy, what are you doing this year and what will be done in fiscal year 2020 to ensure that the Department's STEM outreach and engagement activities reach the rural communities like mine?

Secretary PERRY. Yes, sir. One of the areas that we're focused is on the DOE's Office of Economic Impact and Diversity, and that program is created to expand the participation of individuals who historically may not have had the same opportunities.

I can speak a little bit of—historically to this. I grew up in a place—my high school—well, my school, grades 1 through 12, had 115 kids. I probably wouldn't be sitting here in front of you if I'd gone to a bigger school because I could've learned how to use a slide rule and probably done a little better in organic chemistry and I would've ended up being a veterinarian. Organic chemistry changed my life and made a pilot out of me. So anyway, enough of my personal travails.

The point is that a lot of these rural communities don't—haven't historically had access to some of the science, technology, engineering, and math programs that children really need to be successful, and this program is exactly focused on that.

And Secretary—or I should say Under Secretary of Science Paul Dabbar and our Chief Commercialization Officer are currently working with our national labs, again, and the University of Chicago to do a roundtable this summer to explore some pathways of continuing to harness these kids with this technology, and we're—you know, I'm pretty excited. We've got a—we've got a program called Making Nuclear Cool Again at the Department where we're reaching out and helping to—you know, again, when I was going to college, being a nuclear engineer was a pretty cool thing, and it's lost a lot of its shine if you will.

So, again, whether it's small modular reactors, whether it's the microreactors we're talking about, bringing the nuclear energy interest back into that area and preparing young people to be the scientists and technicians that we're going to need are going to require these STEM programs. And rural America absolutely does not need to be overlooked any longer.

Mr. BALDERSON. All right. Thank you very much for that answer. My final question is I'm honored to be the lead Republican cosponsor of Congresswoman Stevens' bill, the *American Manufacturing Leader Leadership Act*. The bill passed out of this Committee last month and underscores my support for making strategic investments in advanced manufacturing R&D.

Mr. Secretary, if this bipartisan legislation was enacted and the Department had the ability to open an additional Center of Manufacturing Innovation, what manufacturing challenges would you look to research?

Secretary PERRY. Well, there's a host of areas that advanced manufacturing is making some housing—and you think about Secretary Carson actually had on the Mall I think within the last 30 days some manufactured housing. And, you know, when we talked about—Mr. Baird, where I'm from, manufactured housing generally was on wheels, and that's not the case anymore. Because of our additive manufacturing processes that we have today, we're able to build some housing that is highly efficient, that is cheaper substantially than—so advanced manufacturing in places that you don't historically think about, automotives, the—we're literally building a nuclear reactor and the parts for the nuclear reactor out of additive manufacturing. I mean, it's just—it's stunning the progress is being made in that arena, so Advanced Manufacturing Office is, you know, obviously got our attention, and it is another of those priorities that we have.

Mr. BALDERSON. Thank you very much. Thank you, Madam Chair.

Chairwoman JOHNSON. Thank you very much. Mr. Beyer.

Mr. BEYER. Thank you, Madam Chair, very much. Mr. Secretary, thank you for being here.

You know, DOE has robust programs have helped demonstrate carbon capture technology, on an ethanol plant, on a hydrogen production facility, on a coal-fired power plant, but we're enjoying this explosion of natural gas, the shale gas revolution. What is DOE

doing for carbon capture on natural gas plants and on other things like cement manufacturing?

Secretary PERRY. Yes, sir. As I said—and I'm not going to rehash this again, but we—we've really focused—I think one of the first projects I went to as Secretary was the Petra Nova plant outside of Houston. I think it's in Fort Bend County. And the—where 90-plus percent of the emissions are captured. They're then sent over to be used in an enhanced oil recovery process in an oilfield I think 80 miles away in—outside of Victoria, Texas. So—

Mr. BEYER. And what kind of plant is Petra Nova?

Secretary PERRY. Petra Nova is a coal-powered plant.

Mr. BEYER. OK. So those are—you know, those—we're not building any new ones; we're closing the old ones down. What are we doing with the natural gas plants?

Secretary PERRY. Paul, you want to take a—

Mr. BEYER. Mr.—

Mr. DABBAR. So this is actually one of the most exciting things that we're doing—

Mr. BEYER. Paul, if I could focus on the Secretary—

Mr. DABBAR. Yes.

Mr. BEYER. Great, thanks. But if you don't know, Mr. Secretary, I'll move on. The National Academies—

Secretary PERRY. Well, here's what I'm interested in. I'm interested in trying to pass on information the best I can to you, and if I don't have—

Mr. BEYER. OK. OK. I understand.

Secretary PERRY [continuing]. Those timely, I'd like to use Paul because he gets out into that area more than I do.

Mr. BEYER. But we have greater access to Paul.

Secretary PERRY. Yes.

Mr. BEYER. We can—

Secretary PERRY. Yes. Great.

Mr. BEYER [continuing]. Do that for the record.

Secretary PERRY. Perfect.

Mr. BEYER. We only get you once a year or something.

Secretary PERRY. I hope you've got good access to me. All you got to do is call.

Mr. BEYER. Well, I do.

Secretary PERRY. OK. Great.

Mr. BEYER. The National Academies have pointed out that we need negative emissions technologies, pulling carbon out of the air, out of the ocean. How has the National Academies' assessment been received by the Department of Energy and what are you doing about the negative emissions technology?

Secretary PERRY. Yes, let me just give you a little statement that I think—I found really interesting. Fatih Birol is the head of the International Energy Agency in Paris. I don't think there's anybody that I've been dealing with that's got a better handle on—that's as nonpolitical. He just looks at the facts and what have you. And he said if we eliminate 100 percent of the passenger cars that are running on gasoline today, transition every one of them to electric, we would still need 81 percent of the oil and gas production that is occurring in the world to be able to continue on developing, manufacturing, running our fleet engines and what have you.

So we know we've got—we've got some real challenges here from the standpoint of how are we going to deal with—you know, there are folks that are talking about completely switching over their fleets to renewables, and that—you know, I'm not going to argue—

Mr. BEYER. Mr. Secretary, can I interrupt? I asked specifically about pulling carbon out of the atmosphere and out of the oceans. Secretary PERRY. Yes.

Mr. BEYER. Is DOE working on this? This is one of the National Academies' recommendations.

Secretary PERRY. Yes, I think there are some Oregon State projects that are going on on the ocean side of it, correct, is my understanding.

Mr. BEYER. OK. Well, maybe we'll follow up with Paul later.

Secretary PERRY. Yes.

Mr. BEYER. One more question. You mentioned a number of times about artificial intelligence and your excitement about machine learning. What questions is the Department of Energy attempting to answer with machine learning?

Secretary PERRY. You don't have enough time to get the answer to that from me or anybody else sitting here because it's across the board. It's things as interesting as concussions. And we've historically been taught that there are three levels of concussion, mild—or, excuse me, there's mild, moderate, and severe. And because of the work that's been done at the University of California San Francisco, the program that we're involved with, their Department of Neuroscience, Dr. Geoffrey Manley will tell you there's 28, and that's because of artificial intelligence and machine learning and these supercomputers that we're running at the Department. So, I mean, that's just in a very slender area of brain science. When you—

Mr. BEYER. So you're using artificial intelligence to solve problems across the board not specifically Department of Energy questions?

Secretary PERRY. Right, and I hope—

Mr. BEYER. Department of Energy as a resource rather than energy questions that are arising.

Secretary PERRY. Right, but they're energy questions that are arising that we're being able to find solutions to because of this massive amount of data that we're able to crunch if you will and give us answers to questions that, before, we just didn't have the time and the computing capacity to get to.

Mr. BEYER. OK. My time is up, but I'd appreciate, perhaps through the Under Secretary, answers to the questions about carbon capture—

Secretary PERRY. Right.

Mr. BEYER [continuing]. And the shale gas. So thank you very much. I yield back.

Chairwoman JOHNSON. Thank you very much. Mr. Waltz.

Mr. WALTZ. Thank you, Madam Chairwoman, and thank you, Mr. Secretary, for your leadership.

Look, I think that what's going on in the energy revolution in the United States of America is one of the great news stories and maybe the news story of the 21st century from the exports reaching

10 million barrels a day to export of LNG and shifting that entire industry, and then, as a combat veteran, which my colleagues have heard me say on this committee, I can't tell you how many veterans, how many wounded warriors we have in Walter Reed, how many we've lost hauling diesel fuel across exposed supply lines getting IED'ed when many of those outposts and in fact many portions of our military can and should be existing on renewables.

So one of the things that I'm most excited about is solar and where Florida is going with solar. One of my first visits was to a solar site with—that's built by Florida Power and Light, and its drive to have 30 million panels by 2030 with 10 gigawatts of electricity. I am proud to say Florida has eclipsed California now in Q-1 of 2019 with the most solar power installations for No. 1 in the country for new panels and in the next five years is—should be No. 1 across the board. So I think the Sunshine State is living up to its name.

My question, Mr. Secretary, is how do you see the Department really sustaining the private-sector growth? And, as a conservative, I love it that it's the private-sector leading the charge on this, but obviously it's a state issue, and Governor DeSantis has been a real leader. How do you see the Department continuing to really embolden and empower the private sector and—particularly in solar but renewables writ large?

Secretary PERRY. Well, I look at our role as—from the standpoint of continuing to fund the opportunities to have public-private partnerships, the commercialization of innovation and technology that's coming out of our national labs, for instance. I think a Governor and a legislature in a particular state would be wise to look at ways for that—and give incentives to companies to risk their capital, working with their universities, for instance, which is where, by and large, your State's innovation and technology will come from, looking for ways to partner up with the DOE where you have the trifecta if you will of the State, the Federal, and the local working together on some of these projects.

So—and a great example of this, Florida Power just announced a 491 megawatt utility battery. I mean, that's massive. I mean, we're talking—and so with what you're doing—

Mr. WALTZ. It's exciting.

Secretary PERRY [continuing]. On solar—and by the way, just for the record, solar just bypassed hydro—or was it—isn't that right? Solar just bypassed hydro as a total deliverer of power in this country. I mean, it's just some—you know, the wind, the solar side of things are really making some good progress. And battery storage is I think the—as we talked about—

Mr. WALTZ. Yes.

Secretary PERRY [continuing]. Earlier, the Holy Grail of this—

Mr. WALTZ. Mr. Secretary, just in the interest of time, I'm glad that you mentioned resiliency. Again, my predecessor in this seat, now Governor DeSantis, has announced a Chief Science Officer and is going to announce a Chief Resiliency Officer. If there's anything I hear about from constituents, it's traffic and flooding. I've joined the National Flood Coalition. Where do you see—I know you mentioned a bit earlier. Where do you see the Department's help in resiliency issues?

And then just in the interest of time if I could ask you to submit for the record—I know you mentioned the 17 labs. We’ve talked a lot about it. DOD also has 63 labs, and I’d be interested for the record how you coordinate. I mean, that’s a lot of activity, and we need to spend those dollars efficiently and just how you coordinate, and then also expanding the scope of ARPA-E and—I think if we get into some other areas like nuclear waste disposal and other things that it may be more palatable across the board—

Secretary PERRY. Yes.

Mr. WALTZ [continuing]. In terms of funding that organization.

Secretary PERRY. Yes. And so let me back up here and just hit a few of the highlights of what you talked about. I think coordinating between agencies is really important, and one of the ways to do that is actually to show up and to know what other agencies are doing rather than just kind of staying siloed in your own—I’m going to DARPA tomorrow to talk to them about some of the things that they’re doing, some of the ways that we can partner with them and, quite frankly, to make sure that, you know, they’re not duplicating some things.

I think Paul did a pretty good job earlier talking about—you know, we kind of got different—we’ve got different missions—

Mr. WALTZ. Right.

Secretary PERRY.[continuing]. DOD and DOE, but to make sure that we’re not—and the resiliency side of what, you know, we talked about, CESER is really important in that. We are the agency that has the responsibility for the reliability in the electrical sector. That’s—to make sure that the lights come on and it’s protected, that is the DOE’s responsibility. Other agencies have some areas of—that kind of come in on the fringes, but DOE, that’s their baby, making sure that we have that reliability, that resiliency in the electrical grid. So we’re doing everything that we can, using those computers to model.

And let me finish up by saying that the modeling side of what DOE is doing on the environment is going to pay, I think, some great dividends to your State, those States with those low-lying areas that are seeing flooding occurring, seeing the effect of this changing climate that we live in, and so, you know, I think these are some important goals and roles of which DOE is a—

Mr. WALTZ. Thank you, Mr. Secretary. I’m on Armed Services as well, so I certainly appreciate that coordination. And, Madam Chair, I yield my time.

Chairwoman JOHNSON. Thank you very much. Mr. Crist.

Mr. CRIST. Thank you, Madam Chair. And thank you, Secretary, Governor Perry, for being with us today. It’s always good to see you.

It’s no secret I’m really excited about solar energy, as is my colleague, Representative Waltz, to help our nation and frankly the world transition to a clean energy economy. Unfortunately, the Administration proposed cuts to the Solar Office of more than 70 percent and justified those cuts by saying that the office is conducting activities that can and should be carried out by the private sector.

Last year, however, the Administration established tariffs on solar cells, which supply the majority of U.S. solar companies. These tariffs have arguably raised prices, slowed the industry to a

degree, and made it harder for solar companies to invest in their own research and development activities. And, notably, two companies the tariffs were intended to help—Suniva and SolarWorld—are now out of business as of just this month.

Did the Administration consult with solar developers to your knowledge about their ability to invest in research, development, and demonstration under the financial constraints of the tariffs?

Secretary PERRY. Congressman Crist, I have no information that—either acknowledging that or—I have no knowledge about any correspondence between those companies and the Administration.

Mr. CRIST. OK. Thank you. Did you ever consult with others in the Administration such as maybe the trade representative about how tariffs could negatively impact the ability of solar companies to invest in research and development?

Secretary PERRY. Not necessarily just solar companies but there have been a number of companies that I've had conversations with that I did share with Ambassador Lighthizer the challenges that the tariffs, as proposed, were going to have on these U.S.-based companies and, frankly, have had some, you know, success in being able to—you know, one of the things I do—one of my jobs as Governor, as you know, is get people together and to open up some doors. I think it's wise for us to be able to say, hey, look, here's a constituent that I've got that's having some challenges with what you're proposing and would you talk to him? And I've had some success in being able to put them together.

I don't know—because those—you know, we don't have a deal yet with the Chinese with specificity—

Mr. CRIST. Right.

Secretary PERRY [continuing]. But I think it's important for us to—you know, they need to hear from people who are on the ground who see the challenges that decisions that we make in government have on them.

Mr. CRIST. Wonderful. Do you think tariffs are a more effective way to protect these companies than sustained Federal investment in research and development?

Secretary PERRY. You're starting to get a little bit out of my area of expertise, Governor.

Mr. CRIST. All right. Very well. Well, I will yield the balance of my time, and thank you for being here again.

Secretary PERRY. Yes, sir, thank you.

Chairwoman JOHNSON. Thank you very much. Mr. Marshall.

Mr. MARSHALL. Yes, thank you so much, Chairwoman. And, Mr. Secretary, again, welcome.

And I just want to start by saying what a great country we live in. I'm so proud that our carbon emissions today, a nice, steady downward trend since 2003, and I think that's mainly due to conservation and innovation.

And if I could take our time to look in on agriculture and rural America for a second, as I look at the big picture, transportation creates about 29 percent of this country's carbon emissions, industry about 1/4, and agriculture about 9 percent. So we feed this entire country and only produce about nine percent of carbon emis-

sions, and we're still able to transport another 1/4 of our products out of the country with that in mind.

In my adult lifetime we're doubling the agriculture production, we're using less water, but still over the last decade agriculture has had a smaller carbon footprint. So I'm really proud of that.

What is the DOE doing to help promote conservation, promote innovation? So even though we're improving, agriculture wants to keep improving. How can we keep working together? What can we do to put wind beneath your sail?

Secretary PERRY. Yes, Mr. Marshall, I think there's a couple of areas that I would mention just that I've seen, again, in my travels through the national labs. And keep in mind one of my prior jobs in the State of Texas would be the Agriculture Commissioner for 8 years, so—and I grew up on a farm and my mom still lives on that farm. So there's this real personal connection back to rural lifestyle, rural values, and certainly the great contribution that agriculture and those rural communities make to America.

With that said, in—the additive manufacturing side is one of the areas where I think we have some great potential to continue to be developing more efficient equipment both from a weight and a strength standpoint that these national labs, the work that's being done at Oak Ridge National lab, their additive manufacturing facility there is pretty fascinating. I made mention of Secretary Carson having some manufactured housing, additive manufacturing housing shown on the Mall here within the last 30 days. He also had a vehicle. It was a Cobra, a Shelby Cobra that was built by the national labs.

And so the agricultural community can be served, I think, well in the additive manufacturing side with some of the work that we're doing.

Also at the Sandia National Lab at—and this is Sandia National Lab over in California at Lawrence Livermore, the work that they're doing on efficiency, on diesel engine combustions and the emission side of it, again, there is—you don't think about the Department of Energy and agriculture—that's not the first thing that comes to mind.

Idaho National Lab—and I'll finish with this—the work that they're doing on biofuels and some of the real progress that they're making there. So there's three examples of a place where the Department of Energy is I think making some positive impact on the agriculture/rural communities.

Mr. MARSHALL. Great. Let's talk about rural America for a second and the challenges, the improvements of battery storage. Like Texas, Kansas has a large wind energy production. About 35 percent of our electricity is generated from wind, was recently in Johnson City, Kansas, our largest solar farm. We are breaking ground on it recently. And what I learned is that, despite originally intending to buy those solar panels from China, that already, as President Trump predicted, they've removed that supply chain of solar panels to other countries, and therefore able to pull this project off, so it's exciting.

But one of the challenges is when we have battery storage for one or two people in a mile stretch of dead-end road is a little bit different than battery storage for big cities. Can you speak a little

bit what the DOE is doing for battery storage and how that technology is being—improving. What do you see the future looks like?

Secretary PERRY. Yes. I mentioned a little earlier what was happening in Florida with what Governor DeSantis was laying out, along with Florida Power, on their storage. A lot of that technology came from work that's been done at a national lab, PNNL (Pacific Northwest National Laboratory) and some of the work that they're doing on battery storage, so we're—you know, there's new grid storage launchpad that's occurring at DOE. That's going to accelerate material development, testing, having some independent evaluation of battery materials, battery systems.

I think I asked Paul to talk a little bit about some of the elements in these batteries that are not rare-earth minerals that are going to be very effective for us and that we don't have quite—well, we don't have the concern about where those materials are going to be coming from. They're developed in the United States. So validating this material capability, accelerating new technologies, and obviously collaborating—the collaboration both with the DOE and the labs out there in the private sector.

And the States have a role to play in this as well.

Mr. MARSHALL. Of course.

Secretary PERRY. I mean, one of the things I always remind people is that when they think about Texas, they always think about, you know, yes, you are a big oil-and gas-producing state, which we are, but we also became the number-one wind-energy-producing State while I was the Governor of the State because we wanted to have a diverse portfolio. And so the wind energy side of what occurred in Texas—I remind my friends in Europe on a regular basis, Mrs. Fletcher, when I go over there, that Texas produces more of its energy percentage-wise than what the European Union does. That's a good thing.

Mr. MARSHALL. Thank you, and I yield back.

Chairwoman JOHNSON. Thank you very much. Ms. Wexton.

Ms. WEXTON. Thank you, Madam Chairwoman, and thank you, Secretary Perry, for joining us here today.

Mr. Secretary, earlier this month, your Department moved a political appointee into the position of Deputy Assistant Secretary for Energy Efficiency within DOE. Do you know who—the name of this individual? I can just tell you, Mr. Secretary. It's Alex Fitzsimmons.

Secretary PERRY. Yes.

Ms. WEXTON. Does that sound familiar?

Secretary PERRY. Yes, I—yes.

Ms. WEXTON. OK. Can you tell me anything about his qualifications for this job?

Secretary PERRY. I—as a regular practice, I don't talk about personnel issues in the public.

Ms. WEXTON. Very good. Well, I'll just share with you some of what I've learned in the public domain about Mr. Fitzsimmons. He graduated from George Washington University in 2012 with a degree in political science, and he spent the next 4 years in a variety of junior roles at fossil fuel energy advocacy groups, including the American Energy Alliance.

Now, I was surprised to learn, but you may not be, that in 2015, while Mr. Fitzsimmons was there, the American Energy Alliance called for Congress to eliminate the Office of Energy Efficiency, the very office he now leads. Were you aware of that?

Secretary PERRY. No, ma'am, but here is what I am aware of.

Ms. WEXTON. No, that was my question. Now, you know about the Office of Energy Efficiency—

Secretary PERRY. This is going to be good. You should let me go, but I'm not going to do it now.

Ms. WEXTON. Fair enough. Now, you do know about the Office of Energy Efficiency. It has hundreds of full-time staff. It supports thousands of national lab employees. It's the lead Federal agency for energy efficiency policy programs and research, which include advanced manufacturing, building Federal energy management, and low-income weatherization, right? I mean, that's what it does.

Now, by way of contrast with regard to qualifications, the previous Deputy Assistant Secretary for Energy Efficiency Kathleen Hogan served in that role for a decade. Prior to that, she served at EPA as a Division Director. She received a Presidential Rank Award, was inducted into the Energy Efficiency Hall of Fame for the U.S. Energy Association, and was a contributor to the Nobel Peace Prize awarded to the Intergovernmental Panel on Climate Change. She has a Ph.D. from the Department of Geography and Environmental Engineering at Johns Hopkins University.

And her predecessor served at DOE as a technology leader for nearly 20 years before rising to the rank of Deputy Assistant Secretary.

Now, as I understand it, Mr. Fitzsimmons is the first-ever political appointee to serve in that role, and he is by far the youngest. Can you tell me why you chose to fill the position with a political appointee instead of a career technologist?

Secretary PERRY. I'm going to pass on talking about personnel issues.

Ms. WEXTON. OK. Well, I understand that Mr. Fitzsimmons is serving in an acting role. Can you tell us when you expect to fill that position on a permanent basis?

Secretary PERRY. I can't.

Ms. WEXTON. Well, when you do, I hope that you find somebody with the experience and gravitas to lead hundreds of the nation's best scientists and engineers.

Now, I want to talk a little bit about some of the budget proposals from the Administration. This year, the Administration's budget request proposes massive cuts to renewable energy across the board with cuts higher than 70 percent for both wind and solar offices. If these cuts were to take place, can you tell me approximately how many lab employees would lose their job?

Secretary PERRY. I would have to go back and—I think trying to play the hypothesis game of if you do this, then what's this budget look like is—

Ms. WEXTON. But would you see that cutting the budget—

Secretary PERRY [continuing]. Kind of a waste of my time and your time frankly.

Ms. WEXTON. Would you agree that cutting the budget by 70 percent will cause some of the lab employees to lose their jobs?

Secretary PERRY. What I'll tell you is that I think, you know, cutting the—you could make the statement that cutting the budget by 100 percent would cause some people to lose their job, but that's not the reality that's going to happen in this Committee, and how you look back historically at what this Committee has done.

And here's what's more important is that I understand how to manage an agency. I had the opportunity to manage a fairly big entity for 14 years as the Governor of the State of Texas. And I also respect the appropriations process. And the appropriators are going to decide the dollars—

Ms. WEXTON. Madam Chair, reclaiming my time—

Secretary PERRY [continuing]. That are spent.

Ms. WEXTON [continuing]. If I may. Reclaiming my time. I understand Mr. Secretary, what you're saying about the budget and appropriations process, but what I would ask that you keep in mind is that even when these proposed cuts are rejected by Congress, which they surely will be, that you understand that these proposed cuts have severe impacts on lab employees and the morale within those labs that you have spoken so highly of.

Thank you, and I yield back my time.

Chairwoman JOHNSON. Thank you very much. Mrs. Fletcher.

Mrs. FLETCHER. Thank you, Chairwoman Johnson, for holding this hearing. Thank you, Secretary Perry, for testifying before our Committee today.

As a native Houstonian and a Texan and now the Representative for Texas' 7th Congressional District in Houston where I represent the energy corridor, I appreciate the all-of-the-above energy approach that you talked about this morning and that you embraced as the Governor of our State. And these innovative policies have led Texas to being really the leader in renewable energy.

People are indeed surprised when I tell them that Texas produces the most wind energy of any State in the union, more than three times the next-leading State. And I give credit to your policies for that every time I talk about it because I really think that it is important what we're doing in terms of diversifying our portfolio in talking about research.

And so for that there are a couple of budget priorities that I do want to talk about and get your perspective on this morning. The Department of Energy has worked on carbon dioxide removal technologies, and the intergovernmental panel that we've talked about this morning as well recommend carbon capture as being a critical piece in our path forward in combating climate change. So where DOE has worked on technologies like direct air capture and development through fossil energy, the Office of Energy Efficiency and Renewable Energy, ARPA-E, and the Office of Science, we've seen some of the major successes from that in the Petra Nova plant that you referenced earlier in your testimony.

In addition, in response to Congressman Beyer's question, there's the NET Power plant just outside of Houston, which is working on natural gas technologies, as well as coal. So there's a lot of that happening.

But from the budget priorities, it's not clear whether the Department of Energy will continue to support this promising technology. Can you talk a little bit about what the Department of Energy

plans to do going forward when it comes to carbon capture technology?

Secretary PERRY. I can give it to you—the short version is we’re going to continue to support it. It’s going to continue to be a priority. There’s a National Carbon Capture Center in Alabama, and that’s going to be validating new technologies that are out there and some transformational technologies, taking it from the bench to lab scale.

Our—a key priority to all of this is going to be continuing to reduce the cost of the technology so that you can get this broad deployment of these technologies.

One of the things we try to do and the reason, Congresswoman Fletcher, we put in—and I asked and was successful in getting into the Clean Energy Ministerial carbon capture utilization sequestration technologies in a global way because, you know, one of our roles I think is American technology is how the world in a lot of cases gets transformed. And if we can take this type of technology, if we can continue to improve it where it’s at commercial scale and get our friends in India and in China to take this technology and to implement it, then we really start having commercial-scale impact on the environment.

So one of the reasons this is—you know, we continue to really push this is because of its applications globally, and so I’m—I can assure you that it’s going to continue to stay a priority at the agency.

Mrs. FLETCHER. Well, in a follow-up to that question because it was concerning to me that the fiscal year 2020 budget proposal, which I understand is just a proposal, but it had a 65 percent reduction in CCUS. And my understanding was that some of the rationale at least presented was that this would be a place where industry could better commercialize the technology. My understanding at this point is that while certainly we use it for enhanced oil recovery, generally, CCUS is not commercially viable. And so I guess the question I have for you in front of this Committee is what do you suggest that we do here to chart the path forward for CCUS and give you the tools that you need to continue that research at DOE?

Secretary PERRY. Yes, I tend to agree with your observation that it’s going to still continue to require our—DOE’s engagement from the standpoint of expending some funds on innovation and technology, and this National Carbon Capture Center in Alabama is a great example of that.

There’s still work to be done, so—and if I could correct the record just on one thing that I said earlier, and I made mention that solar was producing more energy than hydro, it’s actually wind energy. I should have known better in—being from Texas—

Mrs. FLETCHER. Thank you.

Secretary PERRY [continuing]. But I just—for the record.

Mrs. FLETCHER. Thank you, Secretary Perry. And with that I see I’ve exceeded my time, so I will yield back, Mr. Chairman.

Mr. CASTEN [presiding]. The Chair now recognizes Mr. Sherman for five minutes.

Mr. SHERMAN. Mr. Secretary, half a million people live within just 10 miles of the Santa Susana Field Nuclear Laboratory. Your

Department signed the consent order for corrective action in 2007 and the administrative orders on consent (AOC) in 2010 with the California Department of Toxic Substance Control. The latter required full cleanup of the site by 2017, so in 2010 your Department agreed to full cleanup by 2017. But to date no meaningful cleanup has occurred at all, so you're supposed to be completed by 2017; you haven't started by 2019. Will you come to the San Fernando Valley and explain to people when this site will be fully cleaned up?

Secretary PERRY. Mr. Sherman, I would be more than happy to accompany you and try to explain—well, I'll do my best to explain that what happened the 7 years before I got here and why there wasn't any progress made on that, but I don't know if I'll be successful in convincing anybody but—

Mr. SHERMAN. I look forward to joining you in the San Fernando Valley, and I thank you your—

Secretary PERRY. Yes, sir.

Mr. SHERMAN [continuing]. In making that comment for the record.

Countries that are friends live by the nonproliferation treaty if they signed it. Iran and North Korea have gone toward a nuclear program without the additional protocol with the IAEA (International Atomic Energy Agency). And we have Saudi Arabia, which claims to be our friend, but at least when it comes to nuclear matters, seems to be acting like a rogue state. The South Korean firm, Korea Electric Power Corporation, is talking to the—to Saudi Arabia about a large nuclear power construction project. That project, South Korean nuclear project, is based on American technology. Can you state for the record the Administration's position on whether this South Korean firm would need to see a 123 Agreement between the United States and Saudi Arabia to sell large nuclear reactors to Saudi Arabia?

Secretary PERRY. Mr. Sherman, what I think we—would be helpful here is if people understand that Part 810 and—

Mr. SHERMAN. I'm going to get to a Part 810 question—

Secretary PERRY. Yes.

Mr. SHERMAN [continuing]. But the first question is is South Korea free to build large nuclear plants in Saudi Arabia using American technology—

Secretary PERRY. Here would be my answer is it would be no because they would require a Part 810 before they could go into a—because that is U.S. technology.

Mr. SHERMAN. I think they'd also need a 123 agreement, but I agree with you, it is U.S. technology.

Secretary PERRY. Yes, sir.

Mr. SHERMAN. Can you commit to me that the Administration won't enter into a nuclear cooperation agreement with Saudi Arabia unless Saudi Arabia signs the additional protocol? This has been our bargaining position on these since the—

Secretary PERRY. Yes, sir, that's—that has been our position in all of our conversations that we have had with the Kingdom of Saudi Arabia.

Mr. SHERMAN. Good answer. The *Atomic Energy Act* section 303 requires that you keep Congress fully and currently informed on

subject matters relating to atomic energy. You have issued at least seven Part 810 authorizations to allow U.S. companies to discuss and submit documents to Saudi Arabia seeking their business. It took my office about six months to get a copy of these Part 810s. Can you promise to provide the 810 authorizations in the future if they relate to Saudi Arabia to both this Committee and the Foreign Affairs Committee promptly?

Secretary PERRY. Yes, sir. And let me just—the caveat on that, Mr. Sherman, would be unless the company deems them to be of proprietary information. At that particular point in time—I don't know all the specific details, but every bit of information that is publicly disclosable you can bet will—

Mr. SHERMAN. Well, I would hope that you keep in mind Members of Congress are trusted—

Secretary PERRY. Yes, sir.

Mr. SHERMAN [continuing]. With the most secret information of our intelligence and defense agencies. If I'm not going to reveal what I know from the CIA (Central Intelligence Agency), I think Westinghouse can trust me.

Secretary PERRY. Yes.

Mr. SHERMAN. With that, I thank you for your answers, good answers. Thank you.

Secretary PERRY. Thank you.

Mr. CASTEN. The Chair recognizes Mr. Perlmutter for five minutes.

Mr. PERLMUTTER. Gentlemen, thank you for your testimony. Thanks for your stamina. We're getting to the end of the line here.

So, first thing, Mr. Secretary, 2033, OK? I hold this bumper sticker up at a lot of hearings. The Under Secretary is familiar with this. This is when the orbits of Mars and Earth are the closest for decades, and we've been talking about getting our astronauts to Mars by 2033. And with your interest and your work with NASA on potentially nuclear propulsion as part of the ability to get our astronauts there is I just want to enroll you in getting our astronauts to Mars by 2033 and I want you to work with Mr. Bridenstine on that. You don't have to answer it. I just want to enroll all of you in this measure.

Secretary PERRY. Yes, I want to answer it, though.

Mr. PERLMUTTER. All right.

Secretary PERRY. Buzz Aldrin will wear me out if we don't get ourselves to Mars as soon as we can.

Mr. PERLMUTTER. All right. Thank you. I'm glad to hear that. No. 2, Dr. Foster, who was up here talking about Argonne and Fermi in Illinois and all that stuff, he is one of the most biased Co-Chairs in favor of his state than any of us could ever have. And I appreciate the visits that you all have made out to the National Renewable Energy Lab, which is in my district and obviously very proud of that.

And I think some of the words you've used I think we've got to really take heart. And I'm going to lay into you guys a little bit because you used words like brilliant, capable, outstanding staff, your scientists, your technicians, your engineers, second to none in the world, OK? And you as the chief executive, you as the lieutenant, the CFO (chief financial officer) here, you've got a staff that's fan-

tastic. And if you were back as Governor of Texas and you say to that staff, you know what, I'm going to cut your budget by 85 percent, that's what you guys mean to me, I mean, when you say that, it hurts.

And so Ms. Lofgren and you had an interesting conversation. You said I'm going to look to Congress to help me on this. But I'm going to say to you, Mr. Secretary, we look to you. We depend on you to defend your Department.

So I'm going to just ask you, what are the dynamics that lead to something like an 85 percent cut to the Energy Efficiency and Renewable Energy portfolio?

Secretary PERRY. Yes. I'll give it back to you like I did—or I think I did——

Mr. PERLMUTTER. Remember, last year, you and the Under Secretary and I talked about these budget cuts, which last year were pretty draconian. I said, look, I—you know, Administration to Administration you can, you know, kind of push a priority but you don't gut the rest of it. And you said, no, we don't want to do that, but again, it happened.

Secretary PERRY. But I don't think—that's not what—that's not the budget, and we have a budget that's already been approved, and that's not what the budget is. I know what the OMB said, but, I mean, again, I go back——

Mr. PERLMUTTER. So I guess my dynamics are between you and OMB (Office of Management and Budget), how does it really work? Because they come in with these budgets. They say this is what it's going to be and you have to say OK but we're going to work with Congress?

Secretary PERRY. Pretty much.

Mr. PERLMUTTER. OK.

Secretary PERRY. I mean, I ain't going to lie to you.

Mr. PERLMUTTER. All right.

Secretary PERRY. Listen, I——

Mr. PERLMUTTER. No, I—no, that's why I'm asking you.

Secretary PERRY. I don't write that budget. And when I was the Governor of the State of Texas, I had a budget, and it would go over to the legislature, and I knew what it would turn out to be. And that was a doorstop.

Mr. PERLMUTTER. All right. Well, so——

Secretary PERRY. And that's how OMB's budget——

Mr. PERLMUTTER. Let me ask you this. So let's——

Secretary PERRY [continuing]. I think this Congress looked at it.

Mr. PERLMUTTER. No, I appreciate this conversation. So as the head of the Department, when OMB comes back with these numbers that really aren't realistic that are going to change dramatically in Congress, what do you say to the staff? It doesn't matter? We're going to go to Congress and we'll see what they do?

Secretary PERRY. Pretty much.

Mr. PERLMUTTER. All right. All right. OK. So that's enough of that.

Secretary PERRY. Listen, it's their——

Mr. PERLMUTTER. I'm just—look——

Secretary PERRY. It's their—this is their prerogative. I understand how the process works. I don't get spun up—and——

Mr. PERLMUTTER. But I don't want your staff to get spun up. That's the point. And that's where——

Secretary PERRY. I don't think they do.

Mr. PERLMUTTER. All right. If——

Secretary PERRY. I don't think the national lab folks—they know where I stand on this. They have heard me not only in word but in deed——

Mr. PERLMUTTER. And we've seen that.

Secretary PERRY [continuing]. Supporting them.

Mr. PERLMUTTER. We've seen that, and I appreciate that because you have defended and stood up for the National Renewable Energy Lab and these other labs, and I——

Secretary PERRY. And will continue to.

Mr. PERLMUTTER [continuing]. Appreciate that. All right.

Last thing, that laboratory, NREL, has something similar to—somebody else mentioned what we call the Collaboratory, which is the lab, Colorado University, Colorado State, the School of Mines——

Secretary PERRY. Yes.

Mr. PERLMUTTER. [continuing]. Conoco used to be part of that group; I think they still may be—you know, as a way to provide the best minds toward, you know, advancing science and advancing the commercial use of some of these new technologies. So I just wanted to put that out there, that we've been doing that for a while.

Secretary PERRY. And that's interesting. It's some of these types of innovative solutions, options is how I look at managing DOE, you know, the—listen, OMB has their job. They do their job. I get that. But it's coming up with some of these solutions using the private sector, using some university resources and what have you to find the—you know, find a way to manage these, to get us to the point where we can have solutions that are——

Mr. PERLMUTTER. All right. Thank you, gentlemen, and I yield back my time.

Mr. CASTEN. Thank you. The Chair will now recognize himself for five minutes.

Thank you so much for coming, Secretary Perry. I really appreciate it.

Earlier this week, we had received reports that the Department of Agriculture was actively working to bury peer-reviewed scientific reports on the impacts of climate change in the agricultural sector, and there's a significant problem. This Administration has some discomfort around objective truth, but as it comes to climate change, this is a real concern because if we are essentially going to reject the scientific method in our process, we're going to put not just the American people but our entire species at risk.

So my question to you, Mr. Secretary, which is a real simple one—I don't think you'll need your notes for this—are you personally aware of any steps that your Department is taking to suppress reports that discuss climate change or its effect?

Secretary PERRY. No. As a matter of fact, we just announced today a——

Mr. CASTEN. I've got a number of questions, so that's——

Secretary PERRY. OK.

Mr. CASTEN. I'm delighted to hear that. That's terrific. Can I have your commitment that if you become aware of any of those efforts, you will exert your leadership role to make sure it doesn't happen?

Secretary PERRY. Sure.

Mr. CASTEN. Terrific. I am delighted to hear that. I'm delighted to hear in your opening testimony that you accept that manmade climate change is real and something we have to deal with. I like to point out to people that in the hundred thousand years or so that our species has existed, 50 percent of all the CO₂ we have ever emitted was since 1980. That was the year that Nolan Ryan signed with the Houston Astros. That's within our collective memory, and the scale of that change is meaningful.

As we warm the climate, the average temperature goes up by a few degrees, but the number of extreme events increases dramatically. You mentioned that in a number of your testimony as well. I know you're personally aware of this in Houston. I think these are easy. Presumably you would agree that there's been a significant increase in the number of extreme weather events?

Secretary PERRY. Yes.

Mr. CASTEN. And would you agree that those are caused by global warming?

Secretary PERRY. I'm not sure I can—

Mr. CASTEN. Would you agree that weather is a bell curve, and as you move the average on the bell curve, you increase the tails by a much greater percent than the middle?

Secretary PERRY. I'm not going to—you know, I have—those are your words, not mine. And I—listen, I think—

Mr. CASTEN. Well—

Secretary PERRY [continuing]. Sitting here trying to—

Mr. CASTEN. Well, I'm asking you to opine on basic statistics. If you're not comfortable—

Secretary PERRY. Yes.

Mr. CASTEN [continuing]. With basic statistics, I'll move on, but—

Secretary PERRY. Yes.

Mr. CASTEN [continuing]. I will—

Secretary PERRY. Here's what I'm not comfortable with—

Mr. CASTEN. I will stipulate that—

Secretary PERRY. I'm comfortable with the Department of Energy is doing some really fascinating work on predictive modeling, and I hope you would be supportive of that—

Mr. CASTEN. Well—

Secretary PERRY [continuing]. Rather than sitting here trying to go back and forth about do you believe this, do you believe that is look at what we're doing.

Mr. CASTEN. Well, Secretary, I'm—

Secretary PERRY. And what we're doing is making some real progress on giving predictive real science-based evidence to this Committee and to the citizens of this country—

Mr. CASTEN. Secretary Perry, if I may—

Secretary PERRY [continuing]. And that's what's important.

Mr. CASTEN [continuing]. I agree. I think the Department of Energy is awesome. And I'm going to echo Mr. Perlmutter. You run

a \$12 billion agency that does fantastic work. The weatherization budget is zeroed out. What I need as a citizen and I think what we need as a Congress is for you to exercise leadership to defend those budgets and priorities even when the Administration doesn't because it is clear that OMB and the President are not supporting that.

I want to shift to something that I think we may have a whole a lot of agreement on. I am delighted to hear you describe energy storage as the Holy Grail of energy. We've got this fantastic improvement in your state and elsewhere of resources that need storage to balance that load. It's why one of the first major bills I introduced when I got here was the bipartisan *Promoting Grid Storage Act*, which would create crosscutting R&D programs at DOE and technical assistance and demonstration programs to help the public and private sector de-risk and deploy those new storage technologies.

Your budget, to its credit, increases the energy storage R&D supported by the Office of Electricity by 5 percent. That's about \$2.5 million. It reduces spending in the Renewable Energy Vehicle Technologies program by 79 percent or \$270 million. So that is a net drop of—it's rounded off—\$270 million in funding for energy storage that I think from your testimony and sort of where I come from we agree.

Can you help me understand and this Committee understand why, if energy storage is indeed the Holy Grail of technology, we have a budget that drastically defunds our commitment to deploy the energy storage that we need to keep our grid resilient and the mix of changing resources we have?

Secretary PERRY. In a broad sense what I would tell you is that the crosscutting technologies—I mean, just because we don't fund at the same level as we have historically or that you've seen in previous line items doesn't mean that there's not ongoing technology moving something forward. For instance, I would suggest to you that in some of the electric vehicle side of things we're—we've spent the dollars to get us to the point where we need to be with those, and we don't need to be, you know, spending more dollars going forward in that that we've already, you know, moved to a place where we're comfortable——

Mr. CASTEN. But I'm talking about in aggregate total spending. Your budget would suggest that you think that the technologies are all mature and we don't need R&D anymore——

Secretary PERRY. Not——

Mr. CASTEN [continuing]. Given a 79 percent cut.

Secretary PERRY. Not necessarily. What I'm saying is that I think that we have the ability to manage those dollars in a way where the priorities are. Are the priorities on the electric vehicle the place they were 4 years ago? No, because we've matured.

Mr. CASTEN. OK. Well, given the comments just made to Mr. Perlmutter that it sounded like you were—you felt like the OMB budget was just something but we're going to fix that. We agree that energy storage is the Holy Grail. I think we agree that the budget doesn't meet that goal. What would you like to see Congress do——

Secretary PERRY. I——

Mr. CASTEN [continuing]. To develop a budget that's actually going to deploy energy storage at the scale we need?

Secretary PERRY. I think the budget that we've got is appropriate to get us to the place that we need to be——

Mr. CASTEN. Across the board?

Secretary PERRY. Yes, across the board, the budget that's already been approved.

Mr. CASTEN. The OMB budget——

Secretary PERRY. No, the budget that——

Mr. CASTEN [continuing]. The proposed budget?

Secretary PERRY. The '19.

Mr. CASTEN. OK. OK. I yield back my time.

Ms. Hill is recognized for five minutes.

Ms. HILL. Thank you, Mr. Chairman.

Secretary Perry, my colleague Mr. Sherman a few minutes ago engaged with you about the Santa Susana Field Lab. We are neighbors, and so I want to second what he stated given that many of my constituents are impacted by this site as well, which is just outside of my district. And although operations at the site ceased in 2006, it remains extremely toxic with both chemical and radioactive contamination. I'm deeply disappointed, along with my constituents, with that lack of action and transparency the DOE has shown with respect to clean up activities at the site over the last decade.

As Mr. Sherman discussed, the DOE and NASA signed an administrative order of consent ordering that DOE and NASA take responsibility for their pollutants and contaminants at the Santa Susana Field Lab and do a full cleanup, which was supposed to be completed in 2017 and clearly has not been, and in fact nearly nothing of progress has happened.

So can you speak more specifically about your plans of action for the complete cleanup of this site and how long it will take?

Secretary PERRY. I can—let me give you the—for the record here the Department, as you said, signed an administrative order of consent with California to clean up—the background cleanup at the site. And the preferred alternative in the FEIS (Federal environmental impact statement) is not in the AOC cleanup for the following reasons. There are various factors that are included in making a recommendation for preferred alternative. These include considering the final land use of the site as open space and the ecological and cultural impacts of any cleanup option.

Additionally, studies performed after signing the AOC identified less contamination than previously projected. When considering the factors with potential effects at the—at that—at the site, the preferred alternative would be the best option for the site to be clean in a way that ensures it will be protective of human health and the environment while avoiding unnecessary damage to the cultural and ecological resources present at the site. The final decision will be fully protective of human health and the environment.

Ms. HILL. I understand that. So what's the progress in terms of the preferred alternative? Is there a negotiation that needs to happen? What are we looking at in terms of something being able to—I mean, no cleanup really has started, right? So even a preferred

alternative I would like to see some action toward, and I'm wondering if you can speak to that.

Secretary PERRY. May I get Under Secretary Dabbar to—

Ms. HILL. Yes, thank you.

Secretary PERRY [continuing]. Share with you—

Mr. DABBAR. The environmental impact statement was completed by us, and sorry we can't comment what happened in a previous leadership team, but we completed that. We submitted that to the State, and we're working with the State on the actual specifics of what would make sense, given that environmental impact statement. We look forward to working with the State of California on that.

Ms. HILL. Thank you. So I know that you mentioned to Mr. Sherman or my colleague that you might visit our region and—

Secretary PERRY. Yes.

Ms. HILL [continuing]. Speak about this with our constituents, and I look forward to discussing those plans further.

Secretary PERRY. Happy to.

Ms. HILL. I know that the other piece that has been somewhat confusing to our region is the level of resources that have been allocated to clean up. And I do recognize that this happened before your Administration, but can you explain how the Department decides to distribute the funds between nuclear cleanup sites?

Secretary PERRY. Well, I think we go through a process of—I mean, when you look at the history of this country, when you look at Hanford, for instance, when you look at the Manhattan Project and all of the cleanup—that we have a massive amount of work to be done in the future. So, you know, we prioritize it as best we can, and I think do a relatively passable job of—my bet is you think they probably need to spend a little bit more money, and the San Fernando Valley would be my—

Ms. HILL. I'm guessing everybody wants more money to be spent—

Secretary PERRY. And I'm pretty sure—

Ms. HILL [continuing]. On their cleanup.

Secretary PERRY [continuing]. That the Senators from Washington State have a—the same observation, that there's not enough money spent in the Hanford site to suit them.

Ms. HILL. I do think that it would be worth us taking a better look at just how these decisions are made, maybe some—

Secretary PERRY. I don't disagree with you.

Ms. HILL [continuing]. Metrics and how we can just better understand that and explain it back to our constituents as well. But I do commend the Department for restarting the low-dose radiation program, and if we want fewer resources to be spent on cleanup, we should change our radiation limits in regulation.

Really quick, I know I don't have a lot of time left, but I want to turn to freedom gas and renewables. And, Secretary Perry, last month you released an announcement that the Department of Energy would be expanding Freeport LNG facility in Texas to spread freedom gas to other countries. And while I applaud the desire to increase the economic competitiveness of the United States throughout—through the export of energy technologies to other

countries, I'm concerned that the majority of the time is spent advocating for coal and natural gas as opposed to renewable sources.

So I'm wondering if you can just talk about how—how those other sources of energy, whether it's solar, wind, hydropower and geothermal—

Secretary PERRY. Yes.

Ms. HILL [continuing]. Are going to be included in these plans in terms of export.

Secretary PERRY. Again, I remind people of my history with wind. There was not an elected official in the country, not a Governor, not a President, no one who has a record that is any more productive when it comes to a renewable, in this case wind, than I had as the Governor of the State of Texas. So—and we continue to promote them and talk about them. We do an all-of-the-above impact.

But let me get with specificity to LNG and why you may—or it may appear to a lot of folks that you spend an inordinate amount of time promoting liquefied natural gas. And I don't shy away from that. I do. I think it's a—I think it is a clean-burning fuel that every molecule of LNG that we can get into the market displacing older, inefficient coal-burning plants in Europe, for instance, is a win for the climate.

And I'm going to continue doing that because I think the idea that, you know, the—not only is it in our best interest from a geopolitical standpoint, it's also in the climate's best interest, and I think it's in the world's best interest.

So we promote an all-of-the-above approach. I—we, by and large, don't try to pick winners from losers. We try to explain to people why the technology may be better for them to go one way or the other. But, by and large, we stick with the all-of-the-above approach. And if it can come from the United States and be United States-friendly technology-wise or resource-wise, then I think that's good for us.

Ms. HILL. Well, I know I'm out of time and I want to thank you—

Secretary PERRY. Yes.

Ms. HILL [continuing]. And I yield back.

Mrs. FLETCHER [presiding]. Thank you. I'll now recognize Mr. Lipinski for five minutes.

Mr. LIPINSKI. Thank you. Thank you, Mr. Secretary, for being here, for your testimony. You talked about high-performance computing, the importance of it. You were at Argonne National Lab a couple months ago for an announcement on the Aurora computer, so thank you for coming out there. Just last week in the House Energy and Water appropriations bill I introduced an amendment, we passed the amendment to provide additional funding for the Argonne leadership computing facility support personnel and help us to hopefully speed through the process of this exascale computer.

So can you elaborate on the potential of exascale computing and the ramifications if we fall behind as we are racing China on this?

Secretary PERRY. Yes. Mr. Lipinski, I think the most—the simplest way that I tell people about what's going on with exascale and then quantum computing is this: Who gets to quantum first wins. And I know that's—that may be so simplistic and—but it's

really true. And the work that we're doing getting us to exascale, obviously that Aurora computer at Argonne is one of the first steps. I think the next one is out at Lawrence Berkeley in getting us to exascale. And that's doing, as I said earlier, a billion billion transactions per second.

Then, the next step is quantum, and at that particular point in time—and for the United States to get to that first, it's going to impact everything across the board because the artificial intelligence, the machine learning that goes along with them and being able to manage that much data is kind of the name of the game. So—

Mr. LIPINSKI. Thank you. Well, I appreciate your support and we need to continue to support it and provide the funding that's necessary to move this forward.

I want to move on to artificial intelligence efforts. The DOE has many efforts going on, as well as other Federal agencies. I know that the Administration is taking steps to improve coordination of AI, but I think the coordination efforts could be improved, so, earlier this year, I introduced the *Growing Artificial Intelligence Through Research Act*, which in part ensures that they're an essential coordinating entity.

So I just wanted to ask, can you describe how AI efforts are coordinated across DOE, as well as coordinated with other Federal agencies, and how might your AI efforts benefit from additional coordination?

Secretary PERRY. Yes. Mr. Lipinski, your question is pretty timely. I mentioned this a little earlier. But tomorrow, I'm doing a little tour of DARPA of which we're talking about the coordination between DOE and in this case DOD and the Defense Advanced Research Projects Agency over there. And so they're very focused on AI.

Now, in a lot of cases, as Under Secretary Dabbar said, they have a different mission than DOE does, but we complement each other. And what we want to do is make sure that we're not duplicating, that we are in fact complementing, that there's some synergy that comes out of the dollars that we're spending dealing with artificial intelligence and how we combine those.

Nuclear security is part of this. The electric grid security is part of this. All of these areas are going to—cybersecurity, you know, modeling for the—Mrs. Fletcher, the thing that I mentioned with Mr. Carson earlier about the predictive modeling that DOE has gone into so we can better predict what's going to happen with these severe storms, these computers, this artificial intelligence that's going to be managed with these computers, with this predictive modeling, this—these are examples of where we can stand up in front of our constituents and say, listen, here's where your tax dollars are being spent, and here's some good return on that investment that you're having. Self-driving cars, I mean, this list goes on and on.

Mr. LIPINSKI. Thank you. I just want to get in one more question.

Secretary PERRY. Yes.

Mr. DABBAR. Mr. Lipinski, I think actually Argonne is really at the cutting edge of your exact topic. Let me just quickly comment to it. Historically, AI has been looked—has—primarily people have been focused on it as image capture and data—pattern recognition.

That's what most people talk about when they talk about AI. Argonne is much farther down the road on this, and this deals with your exact point, which deals with coordination. Using AI to learn first principles at physics, at chemistry, at biology, and of materials. For AI to actually do research based on first principle science is actually where AI is going. And so I think your bill is very important.

And about coordination, what they're doing at Argonne I think is very much at the cutting edge because this isn't just about the advanced computing. And Rick Stevens at Argonne, they just showed up here and just laid out—the head of materials and chemistry from Argonne, the head of the light source for imaging, and the head of computing. And they're developing a holistic cycle of research based on first principles of using AI to drive first principles of physics and of materials and then using the imaging machine at Argonne as all one organized entity for—to do research. This is actually where research is going.

Mr. LIPINSKI. And I just for the record, I'm going to ask you, because my time is up, if you can get more information about the funding opportunity announcement for fiscal year 2020 about the two or more multidisciplinary quantum research centers. I wanted to find out more about that. It's something I'm very interested in. It's something also that Argonne is very interested in. So——

Secretary PERRY. Yes, sir. We'll get it, and we'll get it on the record.

And let me just finish by saying October, this coming October, there will be an XLab event at Argonne, and it is focused on artificial intelligence. I hope you'll be there.

Mr. LIPINSKI. Thank you.

Secretary PERRY. Yes, sir.

Mr. LIPINSKI. I yield back.

Mrs. FLETCHER. Thanks. Before we bring the hearing to a close, I want to thank Secretary Perry for coming to testify before the Committee today.

The record will remain open for two weeks for additional statements from Members and for any additional questions the Committee may ask of the witness.

The witness is excused, and the hearing is now adjourned.

Secretary PERRY. Thank you, Madam Chair.

[Whereupon, at 12:56 p.m., the Committee was adjourned.]

Appendix I

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

Responses by the Honorable Rick Perry

U.S. House Committee on Science, Space and Technology

June 25, 2019 Hearing: Oversight of the Department of Energy's Research and Development Enterprise

Questions for the Record Submitted to the Honorable Rick Perry

QUESTIONS SUBMITTED BY REPRESENTATIVE EDDIE BERNICE JOHNSON,
CHAIRWOMAN
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

- Q1. Secretary Perry, advanced nuclear reactors look like a promising tool to use in our fight against climate change. These reactors create the need for High Assay Low Enriched Uranium, or HALEU, for both civilian and military use. Currently, we do not have a domestic supply of HALEU in the U.S. In January 2019, DOE awarded a no-bid contract to the private company Centrus to demonstrate HALEU enrichment capabilities. In its Justification for Other than Full and Open Competition (JOFOC), DOE defended the sole-source award as follows:

"Demonstrating the capability of U.S.-origin enrichment technology for the production of HALEU is the objective because only U.S. origin technology would be capable of producing HALEU for use in any type of advanced reactor application, civilian or defense-related."

Appearing as witness before the Senate Energy and Natural Resources Committee hearing on the DOE budget, you indicated that DOE's decision to sole-source the contract for HALEU enrichment demonstration *"has to do with the Department of Defense requirement to restore that market."*

- Q1a. Can you please clarify whether the purpose of the HALEU demonstration in Piketon is for civilian purposes, or for both civilian and defense purposes?
- A1a. The purpose of the HALEU demonstration in Piketon, Ohio is to demonstrate U.S. – Origin/domestic enrichment technology. Such technology could ultimately be used to make enriched uranium for civilian/commercial purposes, as well as purposes that require enriched uranium free from peaceful use restrictions. Through this demonstration, DOE's efforts are aimed at supporting advanced reactors. The Department does not intend to become a commercial HALEU provider.
- Q1b. Can you please confirm DOE's intended programmatic source and out-year spending plan for the HALEU demonstration award?
- A1b. The planned programmatic source for the HALEU demonstration award is the Civil Nuclear Enrichment Subprogram in the Fuel Cycle Research and Development Program within DOE's Office of Nuclear Energy (NE). The proposed spend plan is \$35M in FY

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2019 and \$40M/year in FY's 2020 and 2021. HALEU is a three year, \$115M demonstration program.

- Q1c. Does DOE plan to charge any of the expenses of the HALEU demonstration project to the National Nuclear Security Administration (NNSA) budget?
- A1c. None of the proposed \$115M in the proposed HALEU demonstration project spend plan will be funded by NNSA. NE's HALEU development is independent of the NNSA efforts. NNSA maintains its ongoing and separate efforts to identify long-term options to supply enriched uranium free from peaceful-use restrictions for national security purposes.
- Q1d. The JOFOC also notes that "due to the sensitive nature regarding access to and operation of U.S.-origin enrichment technology, the Department requires the contractor to be a U.S.-owned and U.S. controlled entity." What Departmental policy does this requirement refer to?
- A1d. Access to and operation of U.S.-origin enrichment technology requires the contractor to have a favorable Foreign Ownership, Control, or Influence (FOCI) determination and facility clearance. An entity that was not U.S.-owned and U.S.-controlled would not be able to qualify for access in a timeframe needed to meet DOE's schedule at the time of the anticipated award.
- Q2. Principal Deputy Assistant Secretary for the Office of Nuclear Energy Ed McGinnis testified in May 2018 before the House Energy and Commerce Committee stating that the Office of Nuclear Energy was collaborating with NNSA on HALEU enrichment issues.
- Q2a. To what extent is the Office of Nuclear Energy working with the NNSA or DoD on the HALEU enrichment demonstration that DOE awarded in January 2019?
- A2a. The Office of Nuclear Energy (NE) is in charge of contract execution for the HALEU enrichment demonstration, which utilized some technologies developed through previous NNSA activities. NE is working closely with NNSA and DoD on issues related to peaceful use restrictions that may be associated with enriched uranium produced as a

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result of this demonstration. The Department remains engaged with other government agencies (e.g., DoD and NRC) and external stakeholders, including vendors, fuel cycle entities, and industry groups.

- Q3. The Department's FY19 budget request for the Office of Nuclear Energy did not include funds for demonstration of HALEU enrichment technologies. However, since 2009, the Department has allocated up to 20% of appropriated funds for Nuclear Energy Research and Development (R&D) programs towards the Nuclear Energy University Program. The Nuclear Engineering Department Heads Organization (NEDHO) wrote to you in February 2019 to express concerns that DOE's sole-source award to demonstrate HALEU enrichment was made at the expense of NEUP.
- Q3a. Can you confirm that what portion (in dollars) of the \$36 million in competitive grant funding that DOE extended for NEUP awards under the September 2018 Funding Opportunity Announcement for Consolidated Innovative Nuclear Research (DE-FOA-0001913) was re-dedicated to fund the HALEU enrichment demonstration that DOE awarded in January 2019?
- A3a. None of the \$36M in competitive grant money was re-dedicated to the HALEU enrichment demonstration.
- Q3b. What portion (in dollars) of the overall funding resource that was originally offered under DE-FOA-0001913 was ultimately awarded to applicants?
- A3b. \$30M was ultimately awarded to universities through the Nuclear Energy University Program (NEUP). The Office of Nuclear Energy plans to award an additional \$5.5M to universities under DE-FOA-0001913 for a total of \$35.5M.
- Q3c. How many applicants submitted letters of intent or other pre-application materials to DOE under DE-FOA-0001913?
- A3c. DE-FOA-0001913 received 721 pre-applications.
- Q4. By all accounts, since his appointment as Director General of the ITER international fusion project about 4 years ago, Dr. Bigot and his team have made remarkable progress in improving the management of what may well be the most complex scientific project in the world. The U.S. played a leading role in pushing for the major personnel and management changes that have gotten this project back on track. Yet the last three budget requests for ITER have been a fraction of the DOE-approved estimates for what it will

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take to minimize the project's total cost to U.S. taxpayers and to maintain its current schedule.

- A4. The Department considers the ITER Project to be an important step in the development of practical fusion power. The Department has assessed the ITER project and balanced it with the funding needs of other priorities within a constrained Office of Science budget request. I am happy to discuss ITER funding levels and relative priorities for Office of Science funding with you.
- Q4a. Do you agree that ITER's current leadership has done an excellent job in addressing the project's past management challenges, and are you confident in their ability to maintain this progress?
- A4a. The ITER Director-General has moved aggressively to correct past management failures at ITER. Progress is evident both in the construction occurring on site and in the alignment of ITER management and staff to efficiently address project issues. My staff informs me that meetings of the ITER Council, which is the ITER governing board, have taken on the appropriate role of project oversight, and that ITER Members are pleased with the progress that the project has made during the past four years. The Director-General is currently undertaking a reorganization that will facilitate the transition from construction to assembly and installation of the ITER facility. I believe that this change in management structure will help ensure continued progress at the ITER site.
- Q4b. Could you provide us with a brief summary of the unique insights that the ITER international fusion project will provide for the development of a viable fusion reactor?
- A4b. The ITER facility is an experimental research reactor that is optimized to demonstrate the scientific and technical feasibility of fusion power. It will be the first-ever fusion device to gain access to the unexplored frontier of the burning plasma regime, and therefore can deliver scientific and technical discoveries needed on the path toward a demonstration fusion reactor. Construction and operation of the ITER facility, if successful, would provide important research understanding in fusion nuclear science and engineering science topics such as fusion fuel processing, blanket design, and tritium breeding; fusion safety, remote handling, and waste management; plasma heating and current drive

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systems; and the technologies for a self-sustained burning plasma. These insights would be paired with ongoing progress in materials, advanced reactor components, innovative diagnostics, high performance computing, and fusion plasma control systems, among other areas, to facilitate necessary research progress towards a commercially viable fusion reactor.

- Q4c. Is there a reasonable path to a commercial fusion power plant that does not include building and operating a burning plasma experiment?
- A4c. The National Academies report "A Strategic Plan for U.S. Burning Plasma Research" (2019) stated that any strategy to develop magnetic fusion energy requires study of a burning plasma. The report also indicated that the only existing project for creating a burning plasma at the scale of a power plant is ITER, and that ITER provides the most near-term confidence for a path to fusion power. The Department will take this National Academies report under advisement in formulating our fusion strategy.
- Q5. A report released by the National Academies in December highlighted the myriad benefits to the U.S. fusion research community's scientific expertise and our industrial capacity, and it warns of dire consequences to the ability of the U.S. to ever establish a domestically-based commercial fusion industry if we pulled out of the project at this point.
- Q5a. After 2 ½ years in office, is the Administration still considering withdrawing from ITER, and if so, why would that make sense now given everything the U.S. has successfully achieved in improving the management of and sustaining a high quality management team for this project?
- A5a. The past missteps and performance of ITER prior to 2015 raised concerns among the ITER Members. We have taken note of the excellent leadership of Director-General Bigot since then and the more recent performance of the project. We are now assessing how best to provide contributions to support the ITER project.
- Q5b. Do you agree that DOE's most recent budget requests for ITER have been a fraction of what it will take to minimize the project's total cost to U.S. taxpayers and to maintain its current schedule? If so, then how will you address this problem going forward?

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- A5b. ITER is an important project that could lead to the development of practical fusion power. The Department is balancing the funding needs of the ITER project with those of other important initiatives in the Office of Science. In future budget requests, we will continue to balance the funding needs of the ITER projects and other Office of Science initiatives.
- Q6. My understanding is that the international agreement which established ITER in 2006 allows for any partner to withdraw, but that partner would still be responsible for its entire share of the construction costs. So if we withdrew, we would just be sending our 9 percent share of the costs to our former partners instead of spending most of it building components here, and have no guaranteed access to the facility or the intellectual property generated.
- Q6a. Have I characterized this correctly?
- A6a. The ITER Joint Implementation Agreement contains provisions on withdrawal conditions, along with the opportunity for consultation and engagement among the ITER Members.
- Q6b. Would you be able to comment on the possible implications of our withdrawal beyond financial obligations, such as how the U.S. would be viewed as a potential partner in future international scientific projects like the Long Baseline Neutrino Facility that will be built in Illinois and South Dakota?
- A6b. I am confident that the U.S. approach to ITER participation will not significantly affect our on-going or future collaborations with our international colleagues. The United States builds some of the most sought-after scientific research facilities in the world and has world-class scientists who also contribute significantly to international research facilities. Maintaining our strong international relationships in science is important for the Department and particularly for the Office of Science. The Department engages regularly with our international partners in order to foster and grow these relationships for our common purposes and benefit.

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- Q7. Over the past few years, several promising alternative approaches to achieving a viable fusion reactor have emerged from small and mid-sized start-ups, as well as academia and our national labs. As you likely know, in 2016 ARPA-E established a 3-year program to further explore the potential for some of these concepts, particularly an approach called "magnetized target fusion". But, like all ARPA-E initiatives, this program is temporary, and it does not cover the full range of emerging alternatives that currently receive no federal support.
- Q7a. What is the Department doing to ensure that the full range of viable options to achieve commercial fusion energy is sufficiently vetted and, where appropriate, actively pursued?
- A7a. The Department is pleased that there has been a surge in interest in fusion energy. While we cannot make long-term financial commitments to all fusion approaches, we can make assessments and do what we can to nurture interest and investment in the field. One way that the Department is encouraging such development is through the new "Innovation Network for Fusion Energy" (INFUSE), a pilot program for private-public partnerships that will provide access to technical capabilities at the DOE national laboratories. We will also work to ensure that research findings from facilities such as ITER are made available generally, which will be useful to U.S. private entities pursuing commercial development of fusion energy.
- Q7b. Does the Office of Science's current fusion research program have the flexibility to shift resources to promising new approaches if they don't align with the conventional tokamak research pathway? If not, what can we do to provide the Office with that flexibility?
- A7b. The Department's fusion research activities are geared toward research understanding and the path to a burning plasma. We continue to believe that a burning plasma facility is necessary to provide the insights and advancements required to underpin other advancements in fusion research and development. We will continually assess the portfolio of potential approaches to fusion energy to see if there is a better way to achieve our goals.

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QUESTIONS SUBMITTED BY REP. FRANK
LUCAS, RANKING MEMBER, COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY

- Q1. Today, we have a limited understanding of how exposure to low doses of radiation effects the human body. This impairs our ability to address potential radiological events and medically-based radiation exposures, and may limit our ability to best care for American astronauts in space and adequately prepare for the future of American space travel. I feel strongly that more research is necessary for experts to make better informed decisions regarding the health risks associated with low doses of ionizing radiation.
- Q1a. Last Congress, the House Science Committee worked together to pass a H.R. 589 – a bipartisan DOE reauthorization bill which is now law. As you know, a part of this legislation specifically directs the Department to carry out a program on low dose radiation research within the Office of Science. Could you please provide an update on the status of DOE's plan to implement this program direction?
- A1a. While the Department agrees that understanding the health effects exposure to low doses of radiation is important to many fields of science, industry, and human endeavor, the FY 2019 appropriation did not include funding for the Office of Science to carry out a program in low dose radiation research, precluding implementation of a plan in response to H.R. 589 during the current fiscal year.
- Q1b. Also last Congress, the Committee passed H.R. 4675, the Low Dose Radiation Research Act through the House. This bipartisan bill provided specific requirements for DOE's low dose program, including that DOE must ensure the Office of Science consults with relevant federal agencies like NASA while carrying out the program. Do you support interagency collaboration on this research? If so, what will you do to guarantee that it is maintained in the low dose program?
- A1b. Yes. DOE is a member of a multi-agency working group under the Physical Sciences Subcommittee (PSSC) of the NSTC charged with developing mechanisms to coordinate and communicate results of low dose radiation research activities among the agencies with interests in this area. This includes DOE, NIH, EPA, NRC, DoD, NIST, DHS and NASA.

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- Q2. Last Congress, the Science Committee worked together to pass H.R. 6227, the National Quantum Initiative Act. This bill was written to coordinate quantum research and development activities across the federal government, including those carried out by the Department of Energy's Office of Science and national labs. What steps have you taken to ensure this act is fully implemented at the Department?
- A2. In support of H. R. 6227, the *National Quantum Initiative Act*, the Department has undertaken several activities to coordinate Quantum Information Science (QIS) research and development across the Department and with the other Federal agencies. Within the Department, the Office of Science (SC) is focused on early stage QIS research that builds on its expertise and capabilities in frontier computing, quantum materials, quantum information and field theory, control systems, isotopes, cryogenics, and other relevant topics spanning the national laboratory system and multiple program offices. All six of the SC Associate Directors and their staff maintain awareness of other QIS activities across the Department. The Associate Director of the Office of Science for Advanced Scientific Computing Research, and her staff, meet regularly with counterparts in the National Nuclear Security Administration program to discuss and coordinate evolving QIS research and future hardware investments.

The Department also recognizes the urgency articulated in the National Cyber Strategy¹ for innovation in quantum information science that maintains the United States' strategic advantage in cyberspace. In particular, the Strategy prioritizes risk-reduction for seven key areas including national security, and energy and power.

As such, the Department's Office of Cybersecurity, Energy Security, and Emergency Response (CESER) and SC have further strengthened their well-established coordination of research activities, to advance quantum technology for cybersecurity of our Nation's critical energy delivery infrastructure.

The FY 2020 President's Budget Request contained funding in the Advanced Scientific Computing Research, Basic Energy Sciences, and High Energy Physics programs to

¹ <https://www.energy.gov/sites/prod/files/2018/10/f57/National-Cyber-Strategy.pdf>

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jointly fund at least one National Quantum Information Research Center. The three programs are working closely to identify possible center topics and plan to release a joint funding opportunity announcement when appropriated funds are available.

In addition, the Department closely coordinates its QIS activities with the other Federal Agencies. For instance, in coordination with the QIS Subcommittee of the National Science and Technology Council, DOE and DOD/NSA held a three-day workshop from November 27-30, 2018 to identify potential areas of collaboration in both the open and classified areas. The Office of Science (SC) held a Quantum Information Science Principal Investigator kick-off meeting on January 31-February 1, 2019 that brought together funded researchers from all of the SC program offices and observers from across the federal government. Invitations to the kick-off meeting were specifically extended to the members of the QIS Subcommittee to further collaboration between industry, academia, and Federal agencies. SC continues to be actively involved in the QIS Subcommittee, serving as one of the three co-chairs.

- Q2a. DOE recently announced plans to establish the first Quantum Information Science Centers, which were authorized in this bill in order to drive multidisciplinary, collaborative research between government, academia and industry. How do you plan to engage both universities and industry as you establish these centers?
- A2a. Recognizing that broad community involvement is critical to defining the Quantum Information Science (QIS) research centers, SC invited attendees of SC's first QIS Principal Investigators meeting in late January to present their ideas for Centers. Using that information as input, ASCR, BES, and HEP released a Notice of Intent (NOI) to release a Funding Opportunity Announcement (FOA) for QIS Research Centers, subject to availability of funds, coupled with a Request for Information (RFI) in the Federal Register on May 20, 2019. The NOI/RFI invited interested parties, including universities and industry, to provide input on possible topic areas, organization, requirements, review criteria, and assessment process to be described in a forthcoming FOA. The RFI was open for comments until July 5, 2019 and SC is now analyzing the submissions. Several universities and industry stakeholders responded to the RFI. We will use their input,

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along with the other responses, to further refine our thoughts on the types of centers and outreach needed to ensure that DOE gets a broad participation in the FOA, which is expected to be released in FY 2020.

- Q3. I am invested in maintaining America's leadership in nuclear energy that can deliver clean and reliable power to the American people. But the truth is, today much of America's existing fleet of reactors is aging, with many nuclear plants nearing the end of their 40 year licenses. And while NRC license renewals are vital to ensure nuclear safety, the license re-application process requires robust analysis, planning, and science and technology based solutions to modernize nuclear plants— a challenging process for plants that are already struggling to maintain competitive.

Fortunately, the Department of Energy is carrying out this critical R&D through its Light Water Reactor Sustainability (L-W-R-S) program. This program funds research in materials, modeling, and system analytics to support extending the operating life of the existing fleet. Mr. Secretary, could you please provide us with an update on the work conducted through LWRS program?

- A3. While the Light Water Reactor Sustainability (LWRS) program will continue to fund materials research and development (R&D) in metals, concrete, cables, and mitigation techniques needed to reduce the costs of potential future repairs, the biggest risk that the existing fleet of nuclear reactors face is the current economic uncertainty. Because of this, the LWRS program is focusing on R&D projects that will work to reduce operating costs and increase revenue in the areas of Plant Modernization, Flexible Plant Operation and Generation, Risk-Informed Systems Analysis, and Physical Security.

Working directly with industry and other research organizations, prior year investments through the LWRS program have shown that there are no major material issues limiting the life extension of the existing fleet from 60 to 80 years. This conclusion has been demonstrated with the first three plants submitting a Subsequent License Renewal application and other utilities.

- Q3a. How do you plan to support this critical research in FY 2020 and beyond, while balancing investments in next generation nuclear power, like advanced

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reactor development?

- A3a. The Office of Nuclear Energy will balance the portfolio of R&D between maintaining the existing fleet and developing the advanced reactor pipeline by leveraging cost-shared, private-public partnerships through the Industry Funding Opportunity Announcement and other competitive solicitations awarded by the Office of Nuclear Energy.
- Q4. H.R. 617, the Department of Energy Veterans' Health Initiative Act, authorizes DOE to continue conducting collaborative research with the VA, leveraging DOE's supercomputing capacity and expertise with the VA's massive health data sets to provide better care for America's veterans. This bill passed through the House in the 115th Congress, and was reintroduced in both the House and Senate this year. What is the status of this partnership now?
- A4. The partnership is supported by a Memorandum of Agreement signed in 2018 between the Secretary of Energy and the Secretary of Veterans Affairs and has two primary connected objectives: secure a state-of-the-art data-compute enclave, and sponsor DOE-VA SME research teams to advance Artificial Intelligence (AI) and data analytics technologies and improve veterans' health.
- DOE hosts a Secure Compute-Data enclave for Veterans Affairs health data, which includes a copy of the VA's electronic healthcare records as well as the VA's Million Veteran Program (MVP) at the Oak Ridge National Laboratory. This infrastructure ensures secure data access while providing state of the art computer resources and enabling best-in-class data analytics tools to be developed and implemented for veterans' health.
 - Collaborative research progress is paced by two factors: approval processes to fund the teams through FY19 appropriations, and the VA Institutional Review Board (IRB) approval process for data use.
 - In July 2019, DOE and Veterans Affairs held a strategic planning summit to identify specific outcomes for the program. Primary joint efforts focus on developing AI and

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genomics technologies supporting research in: suicide prevention, cardiovascular disease, and prostate Cancer.

- DOE scientists and VA clinical researchers are motivated and remain engaged due to the recognized importance and significant potential of the partnership. Presently, there are seven DOE national laboratories actively involved and progress is being made. For example:
 - DOE computer scientists accelerated a processing algorithm for Minimal Viable Product (MVP) data, saving multiple weeks of processing time; this improvement awards VA clinical researchers' new opportunities to use the analysis on additional data sets attending to different segments among veteran populations.
 - In addition, DOE scientists developed an AI-enabled genome analysis algorithm that utilizes the full computing power of Summit- DOE's supercomputer at Oak Ridge National Laboratory- to reveal new insights into the interconnectedness of the human genome. The code is currently the fastest in the world, and a DOE-VA team is starting to use the results of the analysis to reduce veteran opioid addiction and polypharmacy complications.
- Q4a. H.R. 617 also allows DOE to enter into other partnerships similar to the one with the VA- using DOE supercomputers at the National Labs to help other federal agencies solve their big data challenges. What kind of partnerships could this authority help enable?
- A4a. Partnerships with other Federal agencies on big data challenges will feature two key elements (1) the partner agency has large-scale data management and analytical needs that outstrip their infrastructure capabilities and expertise, yet could be instrumental in advancing the critical federal missions and national need; and (2) DOE can build on the strengths of the national labs in high performance computing and big data by using the challenge space to develop new AI and data technology solutions to improve national laboratory capabilities and maintain national leadership. We are in discussions with multiple federal agencies about their data challenges and AI needs.

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Specifically, partnerships supporting the DOE-VA effort will include federal agencies with large-scale data, often of inherent complexity, related to clinical records, human health, human genomics, and data in areas targeting DOE-VA joint efforts and priorities, including: suicide prevention, cardiovascular disease, and prostate cancer. In support of this effort, we are currently in discussions with the National Cancer Institute and the Department of Defense.

- Q5. FY 2020 budget request includes a \$161 million cut to the Fusion Energy Sciences program, and as a result proposes \$108 million in U.S. contributions to the ITER project, the world-leading international research collaboration in fusion energy that has received strong and continued bipartisan support from this Committee. This funding level is just over one third of what is required in FY 2020 to maintain the U.S. commitment to participate in ITER. Is the Department recommending that we withdraw from ITER? Because, it's hard to square this fusion budget – which would make the U.S. responsible for delaying the project and increasing the overall cost – with maintaining our international commitment.
- A5. ITER is an important project that could lead to development of practical fusion power. The Department is balancing the funding needs of the ITER project with those for other important initiatives in the Office of Science.
- Q5a. How can we expect other countries to make investments in U.S.-hosted international projects – like the Long Baseline Neutrino Facility – if we don't keep our commitments overseas?
- A5a. Maintaining our strong international relationships in science is important for the Department and particularly for the Office of Science. The Department engages regularly with our international partners in order to foster and grow these relationships for our common purposes and benefit.
- Q6. S. 97, the Nuclear Energy Innovation Capabilities Act, was signed into law last fall. While the Department has taken some important steps in implementing this legislation – such as announcing the mission need for the versatile fast test reactor authorized in the bill – we've heard very little from the Department about the rest of the bill.

Specifically, the fiscal year 2020 budget request did not include funding for the National Reactor Innovation Center clearly authorized in S. 97. This innovation center

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is critical to the development of advanced reactors – and will allow private companies to prove their reactor designs without having to endure the lengthy NRC licensing process. Why hasn't the Department requested funding for this program that is authorized under current law?

- A6. The Department is taking a number of steps to implement the provisions of *the Nuclear Energy Innovation Capabilities Act* (NEICA), which amends the Energy Policy Act of 2005 to enable civilian research and development of advanced nuclear energy technologies by private and public institutions.

NEICA § 2(h) authorizes the establishment of a National Reactor Innovation Center (NRIC) as a program to enable the testing and demonstration of reactor concepts to be proposed and funded, in whole or in part, by the private sector.

In addition, in response to NEICA § 2(h), the Department has prepared and is in the process of finalizing a Report to Congress on the Department's capabilities to authorize, host, and oversee privately funded experimental advanced nuclear reactors.

Also, in response to NEICA § 2(h), the Department and NRC have jointly drafted and are in the process of signing a Memorandum of Understanding to share technical expertise to support research, development, demonstration, and commercial application by the civilian nuclear industry for safe and innovative advanced nuclear reactor technology.

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QUESTIONS SUBMITTED BY REPRESENTATIVE BRIAN BABIN (TX-36),
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

Q1. Secretary Perry, Last Congress, the Science Committee worked together to pass H.R. 6227, the National Quantum Initiative Act. This bill was written to coordinate quantum research and development activities across the federal government, including those carried out by the Department of Energy's Office of Science and national labs.

Q1a. What steps have you taken to ensure this act is fully implemented at the Department?

A1a. In support of H. R. 6227, the *National Quantum Initiative Act*, the Department has undertaken several activities to coordinate Quantum Information Science (QIS) research and development across the Department and with the other Federal agencies. Within the Department, the Office of Science (SC) is focused on early stage QIS research that builds on its expertise and capabilities in frontier computing, quantum materials, quantum information and field theory, control systems, isotopes, cryogenics, and other relevant topics spanning the national laboratory system and multiple program offices. All six of the SC Associate Directors and their staff maintain awareness of other QIS activities across the Department. The Associate Director for Advanced Scientific Computing Research and staff meet regularly with counterparts in the National Nuclear Security Administration program to discuss and coordinate evolving QIS research and future hardware investments.

The Department also recognizes the urgency articulated in the National Cyber Strategy² for innovation in quantum information science that maintains the United States' strategic advantage in cyberspace. In particular, the Strategy prioritizes risk-reduction for seven key areas including national security, and energy and power.

As such, the Department's Office of Cybersecurity, Energy Security, and Emergency Response (CESER) and SC have further strengthened their well-established coordination

² <https://www.energy.gov/sites/prod/files/2018/10/f57/National-Cyber-Strategy.pdf>

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of research activities to advance quantum technology for cybersecurity of our Nation's critical energy delivery infrastructure.

The FY 2020 President's Budget Request contained funding in the Advanced Scientific Computing Research, Basic Energy Sciences, and High Energy Physics programs to jointly fund at least one National Quantum Information Research Center. The three programs are working closely to identify possible center topics and plan to release a joint funding opportunity announcement when appropriated funds are available.

In addition, the Department closely coordinates its QIS activities with the other Federal Agencies. For instance, in coordination with the QIS Subcommittee of the National Science and Technology Council, DOE and DOD/NSA held a three-day workshop from November 27-30, 2018 to identify potential areas of collaboration in both the open and classified areas. SC held a Quantum Information Science Principal Investigator kick-off meeting on January 31-February 1, 2019 that brought together funded researchers from all of the SC program offices. Invitations to the kick-off meeting were extended to the members of the QIS Subcommittee to further collaboration between industry, academia, and Federal agencies. SC continues to be actively involved in the QIS Subcommittee, representing DOE as one of the three co-chairs.

- Q1b. DOE recently announced plans to establish the first Quantum Information Science Centers, which were authorized in this bill in order to drive multidisciplinary, collaborative research between government, academia and industry. How do you plan to engage both universities and industry as you establish these centers?
- A1b. Recognizing that broad community involvement is critical to defining the QIS research centers, SC invited attendees of SC's first QIS Principal Investigators meeting in late January to present their ideas for Centers. Using that information as input, ASCR, BES, and HEP released a Notice of Intent (NOI) to release a Funding Opportunity Announcement (FOA) for QIS Research Centers, subject to availability of funds, coupled with a Request for Information (RFI) in the Federal Register on May 20, 2019. The NOI/RFI invited interested parties, including universities and industry, to provide input

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on possible topic areas, organization, requirements, review criteria, and assessment process to be described in a forthcoming FOA. The RFI was open for comments until July 5, 2019 and SC is now analyzing the submissions. Several universities and industry stakeholders responded to the RFI. We will use their input along with the other responses to further refine our thoughts on the types of centers and outreach needed to ensure that DOE gets a broad participation in the FOA which is expected to be released in FY 2020.

- Q2. Secretary Perry, DOE has an excellent track record of success when it funds basic and early-stage research – like quantum science as I mentioned in my first question – and then allows the private sector to step in to finance and deploy new technologies. But when DOE starts taking on commercial scale projects, or providing loans or loan guarantees, DOE's track record is a lot less successful. The FY 2020 budget request again proposes to close the DOE Loan Guarantee Program, which has wasted over \$800 million in taxpayer dollars on bad loans to failed technology companies.
- Q2a. Do you believe the Department should get out of the finance business, and focus on the research and development it does best?
- A2a. Thank you for acknowledging the Department of Energy's excellent track record of success in funding basic and early-stage research. That track record does extend to commercial-scale projects. Since Congress authorized the Title 17 Innovative Energy Loan Guarantee Program in the Energy Policy Act of 2005 and the Advanced Technology Vehicles Manufacturing Loan Program in the Energy Independence and Security Act of 2007, the Department's Loan Programs Office (LPO) has closed on \$35.69 billion of loans and loan guarantees to commercial-scale projects; of that amount, five projects closed on \$1.85 billion in total loans but withdrew before receiving disbursements. As of March 2019, LPO has disbursed \$27.45 billion and borrowers have repaid \$9.52 billion in principal and paid \$2.58 billion in interest. Five projects have exited LPO's portfolio due to their inability to meet their debt obligations, which has resulted in losses of \$810 million, or only 2.93 percent of LPO's total disbursements. While a few technologies and companies did not ultimately succeed, others have been able to emerge from their early financial difficulties to continue operating today. LPO currently manages a portfolio of 20 active

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projects that are under construction or commercially operating and servicing their debt obligations. Additionally, four projects have exited the portfolio because they repaid in full ahead of their loan maturity date.

However, the Federal role in supporting advanced technologies is strongest in the early stages of research and development. The Government should not be in the business of picking which technologies “win” the commercialization race and displacing private sector investment opportunities.

- Q3. Secretary Perry, Last time that you sat before this committee, I brought up the issue that the renewable energy industry receives substantially higher subsidies than any other energy form. Information regarding these subsidies *used to be* published in the Energy Information Administration's (EIA) reports, but as of late are no longer published. When I spoke about this concern last Congress, you agreed that it was important to continue publishing this information in order to be transparent to the hardworking taxpayer, the American public. Additionally, I have spoken with Administrator Capuano of the EIA since you were last here who was supportive of pursuing this issue so that we can increase transparency.
- Q3a. Do you believe it is important that we continue to pursue this matter and move forward to provide data in as transparent of a way as possible to the American people?
- A3a. I am happy to hear that you and EIA Administrator Capuano had a good discussion about what additional data would help move this forward. As you know, EIA is committed to provide data in a transparent way to the American people; and publishes the Federal energy expenditures data in its *Direct Federal Financial Interventions and Subsidies in Energy* reports. However, while EIA makes the data available to all, the current Administrator, as did her two predecessors, believes that combining the data into a single table does not meet their information communication quality standards because the data have varying time scales.

I understand that EIA produced an instructive version of that table for you that demonstrated their concerns. I also understand that Administrator Capuano and her staff have continued to work with your staff to discuss ways to improve the data and achieve the level of quality we expect from EIA.

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QUESTIONS SUBMITTED BY REPRESENTATIVE DONALD S. BEYER JR. (VA-08),
 COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

- Q1. The Department of Energy has a robust program that has helped demonstrate carbon capture technologies on an ethanol plant, a hydrogen production facility, and a coal-fired power plant. However, with the U.S.'s significant natural gas reserves does the Department have any plans to demonstrate carbon capture technologies on other sources, such as natural gas power plants, or cement manufacturing?
- A1. Natural gas power plants have been eligible to apply for prior CCUS demonstration funds; although, there were no successful bidders. However, the learnings from much of the Department CCUS program applies to natural gas. The Department is currently intending to fund \$30 million for front-end engineering design (FEED) studies where natural gas-fired power plants are eligible to apply.

In the past 10 years, DOE has invested approximately \$4 billion in CCUS technologies and demonstration projects. Currently, DOE continues to conduct R&D to reduce the cost of capture which is crucial to making this commercially viable. While these technologies are primarily focused on coal, they also have applicability to natural gas and other industrial processes, including cement. For example, they share many common goals such as reducing capital and operating costs, and decreasing the energy penalty. For natural gas systems, some adjustments may be necessary to optimize for different flue gas conditions such as higher oxygen content, lower carbon dioxide concentration (CO₂), and temperature differences compared to coal-derived flue gas. The DOE program allows technology developers to test their capture materials and systems on natural gas as long as the results are also applicable to coal. In addition, the National Carbon Capture Center is installing a natural gas-fired boiler that will allow technology developers the option to test on both coal and natural gas flue gases. Finally, all of the work conducted in the utilization and storage programs can be leveraged for any source of CO₂ such as coal and natural gas power plants, industrial sources like cement manufacturing, and CO₂ captured from the atmosphere.

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Finally, former Secretary Perry commissioned the National Petroleum Council (NPC) to author a report on CCUS which includes power and industrial sources of CO₂ and looks at a variety of issues pertaining to CCUS including the business case. This study was issued in December 2019.

- Q2. The National Academies released a detailed research and development roadmap last fall around negative emissions technologies—technologies that remove carbon dioxide that is already in the atmosphere or in the ocean, rather than just reducing or preventing emissions.
- Q2a. How has the National Academies report been received in the Department of Energy?
- A2a. The Department's Office of Fossil Energy (FE) co-funded the National Academies of Science (NAS) report on negative emissions technologies. At the conclusion of the study, the NAS provided copies of the report and briefed the Department on the findings and recommendation for research and development (R&D) on negative emissions technologies.
- Q2b. Are there efforts to implement any of the Academies' recommendations?
- A2b. The Department is integrating the NAS Report findings into our existing research efforts on carbon capture utilization and storage (CCUS), including direct air capture (DAC), which FE leads in the government. Since the publication of the report, the Department has released a call for proposals to develop novel carbon capture materials, is developing a set of economic guidelines and lifecycle assessment tools, and is working on a resource assessment for DAC, all recommended by the NAS. The department is supporting several projects focused on DAC, and many of the other capture technologies in its R&D portfolio can be evaluated for their potential to remove carbon dioxide (CO₂) from the atmosphere. Additionally, FE is seeking to build upon its existing R&D efforts and the recommendations from the report by developing a program plan to integrate DAC R&D into the Department's R&D efforts, and recently hosted a workshop with approximately 70 experts from the national laboratories, academia, industry, technology developers, and other applied energy offices and the Office of Science.

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QUESTIONS SUBMITTED BY REPRESENTATIVE ANTHONY GONZALEZ (OH-16),
 COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

Energy Storage Research

- Q1. As you know, the Office of Electricity (OE) focuses on energy storage research in an effort to deliver reliable, secure, and resilient electricity. The FY 2020 budget request includes several priorities to improve grid development and research within OE. I am supportive of the Department's efforts in this area and was pleased to see the Administration's budget proposes the creation of a Grid Storage Launchpad (GSL) project, designed to accelerate materials development, testing, and independent evaluation of battery materials and battery systems for grid applications. I have also introduced the Better Energy Storage Technology Act - also known as the BEST Act - with several other members of this Committee in an effort to set ambitious goals for DOE's role in the development of the next generation of energy storage technology. An ambitious goal will drive resources into the most promising technologies, and I am hopeful the Committee will consider the BEST Act expeditiously.
- Q1a. Can you explain what DOE hopes to achieve with the GSL project? How will this project support the goals of the Advanced Energy Storage Initiative (AESI), which is designed to coordinating energy storage research across the Department?
- A1a. The proposed GSL will extend U.S. research and development (R&D) leadership in energy storage through validation, collaboration, and acceleration. By validating new technologies at earlier maturity stages, the GSL will lower the time and expense of storage chemistry innovations. Through collaboration with universities and the commercial sector, the GSL will augment the industry with enhanced testing protocols and materials validation capabilities. Finally, the GSL will accelerate and de-risk new technologies by propagating rigorous grid performance requirements to all stages of storage development, from benchtop to systems. These advances in electrochemical technologies will help achieve market-aware, cost-competitive, and technology-neutral energy storage cost targets, which will be developed as part of the AESI.
- Q1b. As I mentioned, I recently joined several members of the Committee in introducing the BEST Act. This bill focuses on R&D goals to address long-duration and seasonal storage technologies. If enacted, how would this bill influence energy storage research efforts at DOE?

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- A1b. This bill requires the Secretary to establish a “research, development, and demonstration program of grid-scale energy storage systems” within OE.

The new R&D activities would be focused on cost-effective energy storage systems with specific performance characteristics that would be applicable to daily, weekly, or seasonal cycling.

The bill also directs the Secretary to establish technology-neutral cost targets, taking into account electricity market prices and the goal of being cost-competitive in specific markets for electric grid products and services.

Finally, the bill directs the Secretary to “accelerate the standardized testing and validation of grid-scale energy storage systems” in collaboration with our national laboratories. Increasing the capacity for energy storage technology testing and validation is the primary objective of the proposed GSL.

DOE supports recognizing that energy storage is a cross-cutting activity. Many of these activities, such as establishing market-aware, cost-competitive, and technology-neutral cost targets, are currently underway as part of the AESI, which includes activities in OE and across multiple programs in the Office of Energy Efficiency and Renewable Energy. The Office of Science also supports extensive battery R&D efforts, including through the Joint Center for Energy Storage Research. Providing resources and a formal structure for these activities will help the Department accelerate storage technology development and commercialization.

LaserNetUS

- Q2. According to a December 2017 National Academy of Sciences report, “Opportunities in Intense Ultrafast Lasers,” the U.S. is losing ground to China in a second laser revolution of highly intense, ultrafast lasers that have broad applications in manufacturing, medicine, and national security.
- Q2a. Can you outline how the administration is dealing with this challenge?

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- A2a. The National Academies report "Opportunities in Intense Ultrafast Lasers: Reaching for the Brightest Light" offered several recommendations. In response to the recommendation about creating a broad national network, the Department in FY 2018 established LaserNetUS, a collaborative network of six university and three national laboratory laser facilities, with enhanced access for scientists from all institutions to perform experiments requiring high-power lasers. This network has proven to be popular.

Also, in response to the recommendation about planning for a large-scale open-access high-intensity laser facility that leverages other major science infrastructure, the Department has approved the mission need for a petawatt laser facility and is now moving toward alternative selection in the Department's critical decision process. The DOE's Office of High Energy Physics (HEP) organized a focused Workshop on Laser Technologies for Accelerators, in 2013, which identified laser parameters and R&D needs for part of the Office of Science's needs. HEP has since been funding a modest basic R&D program aimed at developing laser technology for higher repetition rate ultraintense lasers, working in coordination on program objectives and funding with other program offices in the Office of Science and other Federal agencies such as the Department of Defense, the National Science Foundation, Department of Homeland Security, and the National Aeronautics and Space Administration.

Regarding the recommendation about increasing federal coordination and defining facilities and laser parameters, I note that the federal agencies that sponsored the National Academies report on intense ultra-fast lasers are also involved in the currently ongoing National Academies decadal assessment of plasma science. Furthermore, scientific stakeholders in this area hold workshops as part of the DOE Fusion Energy Sciences program's current long-range strategic planning activity.

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QUESTIONS SUBMITTED BY REPRESENTATIVE KENDRA HORN (OK-05),
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

- Q1. I understand that the Department of Energy is proceeding with plans to establish a new \$70 million Manufacturing USA institute on Cybersecurity in Energy Efficient Manufacturing, through a Funding Opportunity Announcement released on March 26, 2019. One of the main focus areas of an existing Manufacturing USA institute, Manufacturing times Digital (MxD), is Cybersecurity in Manufacturing. MxD, funded by the Department of Defense, has been operational since February 2014 and has already been focused on the topic of Cybersecurity since then.
- Q1a. Secretary Perry, were you involved in the decision to select Cybersecurity in Energy Efficient Manufacturing as the new topic of this Manufacturing USA institute?
- A1a. In developing this funding announcement, the Office of Energy Efficiency and Renewable Energy (EERE) followed the internal protocols for briefing departmental leadership. The identification of the topic area for DOE's sixth manufacturing institute was coordinated at the EERE and Under Secretary (of Energy) levels.
- Q1b. Which DOE personnel were involved in the selection of the focus area of this new Manufacturing USA institute?
- A1b. The identification of the topic area for DOE's sixth manufacturing institute was developed by EERE leadership in alignment with Secretarial initiatives around key technology focus areas critical to DOE's mission.
- Q1c. Did DOE coordinate with the DOD prior to issuing this funding award? If so, what was the nature of that coordination?
- A1c. DOE attempted to involve DoD in the review of the draft Institute FOA, but DoD declined to provide feedback. However, DOE is committed to ongoing coordination with DoD during the award selection and performance period. For instance, DoD personnel reviewed the initial concept papers received from applicants after the FOA was released and will also serve on the proposal review teams to ensure that DOE and DoD efforts are integrated.

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DOE will also coordinate with DoD during award negotiations, to ensure that the technical scope does not duplicate the cybersecurity efforts of MxD (the DoD Institute). During the award performance period, DoD federal partners will be included in the governance board of the selected institute. DOE will also use program management milestones to ensure management coordination between the DOE and DoD efforts. DOE has previously used this approach to effectively coordinate complementary efforts within the Department (e.g., the Advanced Research Projects Agency – Energy (ARPA-E) and EERE have utilized milestones requiring recipients to coordinate).

- Q2. Our Committee staff has had conversations with staff at MxD and at the ManTech program at the DOD, which oversees its Manufacturing USA institutes. They were told that the DOD staff and MxD staff repeatedly raised concerns with DOE staff about this funding award and urged them not to pursue funding an institute on a topic that the DOD is already focused on.
- Q2a. Has DOE talked with DOD about any expressed concerns on this proposed DOE institute on Cybersecurity in Energy Efficient Manufacturing? If so, what were the nature of those conversations?
- A2a. Cybersecurity in manufacturing is a broad and far-reaching space with significant R&D needs beyond the ability of any single institute. DOE is committed to ensuring that the Cybersecurity in Energy Efficient Manufacturing Institute is coordinated with efforts across the federal government, including but not limited to DoD, the Department of Homeland Security, and the Department of Commerce. Within DOE, the Institute is being funded and managed by EERE in partnership with the Office of Cybersecurity, Energy Security, and Emergency Response (CESER). One of CESER's key priorities is to work closely with local, state, and federal agency partners, as well as energy industry partners.

To make sure that the efforts of the institute would not duplicate or overlap the technical scope, DOE proactively provided the draft Funding Opportunity Announcement (FOA) to our DoD federal partners for input prior to release of the FOA. DoD declined to

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provide input on the draft FOA topics beyond stating DoD's preference to provide non-competitive funding to MxD.

DoD recommended a non-competitive award of DOE funding to the DoD Institute. However, the DOE Institute will focus on R&D to enable energy efficient manufacturing, which is an inherently different mission than MxD. It is also important to run an open and competitive solicitation to ensure that the best applicant is selected.

Members of existing DOE, DOD, and Department of Commerce Manufacturing USA Institutes, including MxD, may be eligible to apply as primes or sub-recipients to the FOA that was released on March 26, 2019, and includes specific eligibility requirements.

- Q3. I understand that the staff at DOE intends to involve DOD in the review of applications for this FOA.
- Q3a. What specific ways does DOE plan to coordinate with the DOD to ensure, should this proposed institute proceed, that the work done by this proposed DOE institute does not overlap with the existing DOD institute?
- A3a. DOE is committed to involving DoD in the review and selection of applications for the DOE Institute. DOE has engaged DoD federal staff in the review of concept papers, and will engage DoD Federal staff in review of full applications. DOE will also coordinate with DoD during award negotiations to ensure that the technical scope does not duplicate the cybersecurity efforts of MxD (the DoD Institute). During the award performance period, DoD will be included in the governance board of the selected institute. DOE will also use program management milestones to ensure management coordination between the DOE and DoD efforts. DOE has previously used this approach to effectively coordinate complementary efforts within the Department (e.g., ARPA-E and EERE have utilized milestones requiring recipients to coordinate).

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QUESTIONS SUBMITTED BY REPRESENTATIVE DANIEL W. LIPINSKI (IL-03),
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

- Q1. The National Quantum Initiative legislation included a provision for multi-disciplinary quantum research centers. I am aware that DOE recently announced plans to issue a Funding Opportunity Announcement in FY20 for two or more multi-disciplinary quantum research centers. Can you please elaborate on plans for these centers, and the importance of continued U.S. leadership in quantum science?
- A1. The purpose of the multi-disciplinary Centers is to push the current state-of-the-art science and technology toward realizing the full potential of quantum-based applications, from computing, to communication, to sensing. The interdisciplinary nature of the field, the reliance on complex, sophisticated, and precise physical arrangements in order to observe and utilize quantum behavior, and the potential for substantial economic consequences are the major drivers of the National Quantum Initiative. The Department expects that the planned Office of Science (SC) Quantum Information Science (QIS) Centers, coupled with a robust core research portfolio stewarded by the individual SC programs, will create the ecosystem needed to foster and facilitate advancement of QIS with public benefits in national security, economic competitiveness, and leadership in scientific discovery.

The Centers will require highly collaborative research teams, spanning multiple scientific and engineering disciplines. The Department anticipates that all types of domestic entities will be eligible to apply as prime applicants, with the exception of other Federal agencies, non-DOE/NNSA FFRDC contractors, and certain nonprofit organizations engaged in lobbying. By bringing together top talent from across the full spectrum of research and development (R&D) performers—including universities, private industry, non-profits, and National Laboratories—the Centers will serve as world-leading R&D centers in Quantum Information Science.

The emerging fields of Quantum Information Science (QIS) – the ability to exploit intricate quantum mechanical phenomena to create fundamentally new ways of obtaining and processing information – are opening new vistas of science discovery and technology

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innovation. It provides a basic foundation for countless application areas including computing/simulations, sensing and metrology, and communication. QIS is currently at the threshold of a revolution, creating opportunities and challenges for the Nation, as growing international interest and investments are starting a global quantum race. China, the European Union (EU), the United Kingdom (UK), Canada, Australia, and the Netherlands are the main players in this field. Both China and the EU have announced plans to invest billions of dollars and the UK already has a National Quantum Technologies Programme in place that focuses more on technology development rather than basic research. How great the opportunities QIS can yield for the U.S. Science and Technology sectors and how rapidly the field will proceed, will hinge on a strategic and U.S. National Quantum Initiative, in which DOE is taking a leadership role.

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QUESTIONS SUBMITTED BY CONGRESSWOMAN ZOE LOFGREN (CA-19),
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

- Q1. Last September, the President signed into law H.R. 589, the Department of Energy Research and Innovation Act, which included a provision that directs the Secretary to establish and support an R&D program in inertial fusion for energy applications. After several years of advocating that the Department take its own proactive steps in this critical area, this statute follows up on the clear recommendations provided in a report that the National Academies produced in 2013, which highlighted several promising research areas to explore the enormous clean energy potential of inertial fusion energy concepts. These are areas that the weapons stockpile stewardship program alone will not pursue, as many of those research needs are quite different.
- Q1a. What is the status of the Department's implementation of this now-statutory direction to establish and support an inertial fusion research and development program for energy applications?
- A1a. The Department through the Office of Science supports a vigorous research program on high-energy-density plasma science, which provides the scientific basis for inertial fusion energy as well as an assessment of its requirements. This is consistent with the mission space of the Office of Science. In addition, several SBIR/STTR projects related to inertial fusion energy are being supported, and inertial fusion energy has been included as a responsive topic in several recent solicitations (SC/NNSA Joint Program in High Energy Density Science, SC Early Career Research, and the SC annual open solicitation).

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QUESTIONS SUBMITTED BY REPRESENTATIVE JERRY MCNERNEY (CA-09),
 COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

Study on Interconnections Seams

Q1. As we transition to a clean energy economy in the U.S., we will need to make important changes to how we deliver power to the American people by making upgrades to our nation's electricity system. Secretary Perry, with you being the former Governor of the state of Texas I know you can appreciate the role that wind energy and other forms of renewable energy play in delivering low-cost power to the American people. However, not all states were blessed with the wind energy resources that Texas has, but there are ways for states located far away from renewable energy resources to receive power generated from these sources. And one way to do that is to better connect the different components of our nation's electricity grid, with what we call interconnection seams.

Secretary Perry, the National Renewable Energy Laboratory has completed a study on this very topic, namely interconnection seams on the electric grid. NREL scientists presented the preliminary results of this study, known as the "Interconnections Seam Study," at the TransGrid-X 2030 Symposium at Iowa State University in July 2018. Although the slides for this presentation are available online, it has now been a year since this presentation was released and the results of the study have still not been posted publicly.

Q1a. Why has there been a delay in making the results of this study public?

A1a. The Department of Energy (DOE) has a specific interest in large-scale (e.g., inter-regional and even continental-scale) transmission planning. The Interconnection Seams Study was funded through DOE's Grid Modernization Initiative and conducted by NREL to use current tools to assess the benefits of increasing connectivity between the Eastern and Western Interconnections. DOE officials reviewed preliminary results from the study and decided to expand the project to model and analyze additional scenarios. This includes refining methods and data parameterization for improved modeling of transmission congestion within capacity planning tools and grid operations models. The improved characterization of congestion will model how this transmission expansion can contribute to reliability and resilience in the future grid.

Q1b. What is the status of this and any other DOE studies on interconnection seams?

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- A1b. The expanded scope of work for the study is nearly complete. We expect to have some initial results in FY 2020, with the overall project expected to be complete in the summer of 2022.
- Q1c. What plans do you have for additional analyses on the benefits of new transmission investments along interconnection seams, which are critical to ensuring resiliency of the nation's electricity grid?
- A1c. In addition to the expanded scope described earlier in Question b), DOE routinely uses analysis tools (e.g., Capacity Expansion Models) to understand the value of building new transmission lines. Depending on their scope and results, these analyses may demonstrate value through expansion of the interconnection seams.

Solar FOAs

- Q2. Secretary Perry, in April of 2018, the Solar Energy Technologies Office at the DOE cancelled a \$46 million funding opportunity announcement (FOA) on integration of solar energy onto the electric grid, just days before the winners were to be announced, under the leadership of then-acting political appointee Cathy Tripodi. The cancellation was issued without any explanation and the FOA wasn't reissued until October 2018, after a six-month delay. According to Bloomberg, the time and money spent reviewing applications initially to meet the April 2018 deadline is estimated to have cost nearly half a million dollars, money that is now completely wasted.
- Q2a. Why was this funding opportunity pulled at the last second?
- A2a. In April 2018, the Solar Energy Technologies Office announced a four-part, \$105.5 million Funding Opportunity Announcement (FOA). Three of the four parts moved forward as announced. With respect to the fourth part, \$46 million to research Advanced Solar Systems Integration Technologies (known as "Topic 1"), it was determined that revisions were appropriate.

The Advanced Solar Systems Integration Technologies topic area was reissued in October 2018 as the Advanced Systems Integration for Solar Technologies (ASSIST) FOA. The ASSIST FOA, as revised, emphasizes the role of solar energy's contribution to

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grid resilience and the security of the nation's critical infrastructure; including schools, hospitals, and military installations.

As a result, the potential funding amounts per award were higher—from a top boundary of \$4.5 million to \$10 million—and the office increased its attention to the transmission grid and critical infrastructure sites that can help ensure reliable energy delivery in the face of manmade or natural threats.

The revised ASSIST FOA received more applications than the original FY18 FOA Topic

1. On March 25, 2019, DOE selected 10 projects.

- Q2b. What is the typical process used to select awardees for FOAs like this one? What was different about the selection process for awardees for the original April 2018 deadline as compared to the October 2018 deadline?
- A2b. The selection process for both FOAs was the same. The selection process includes a review of eligibility and a thorough technical review by independent experts in the subject matter of the funding opportunity. The selection official considers the reviewers' recommendations, program policy factors as described in the published FOA, and the amount of funds available when selecting applications for negotiation of an award.

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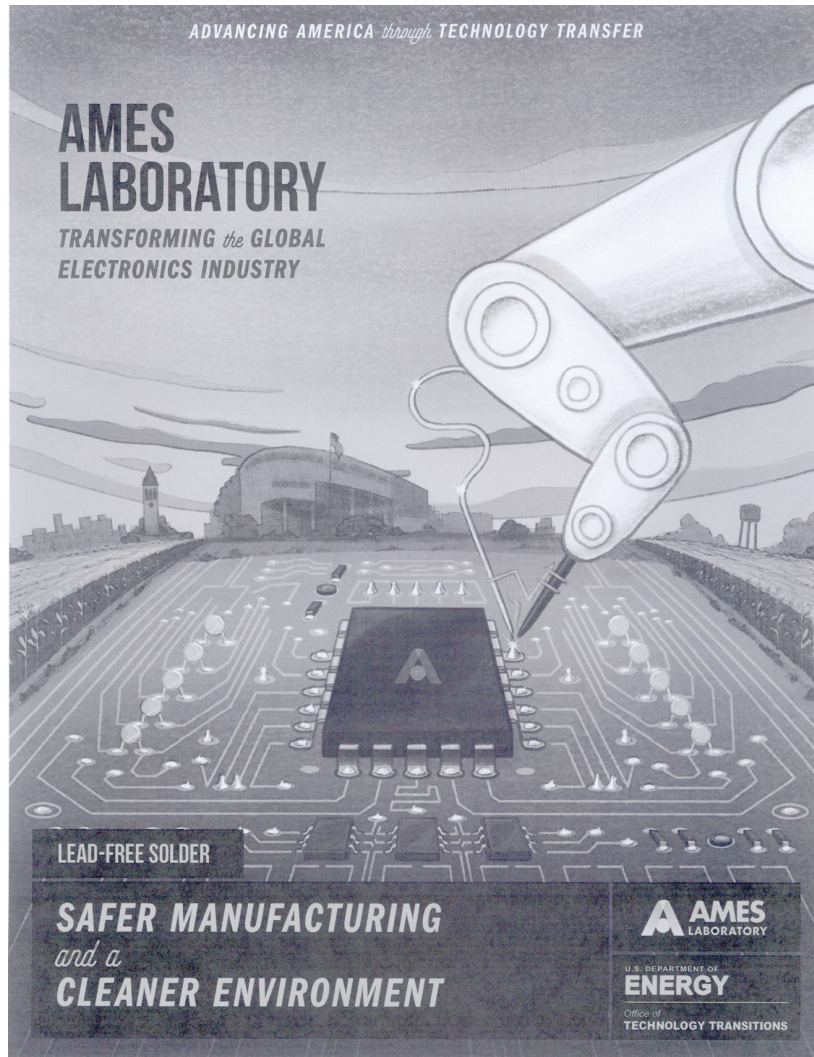
QUESTIONS SUBMITTED BY REPRESENTATIVE RALPH NORMAN (SC-05),
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

- Q1. What is the current status of the DOE project to establish the Advanced Manufacturing Collaborative at the University of South Carolina Aiken in conjunction with the Savannah River Site?
- A1. The President's Budget Request for Fiscal Year 2020 included a \$50M line item construction project, representing full funding for establishing the Advanced Manufacturing Collaborative (AMC) on the campus of the University of South Carolina Aiken. Detailed plans for design, construction, commissioning and operation of the AMC will be established consistent with the process set forth in Department of Energy (DOE) Order 413.3b, "Program and Project Management for the Acquisition of Capital Assets," including equivalencies/exemptions. Critical Decision-0, "Mission Need," was approved by the Department in March 2015. Assuming full funding is appropriated for Fiscal Year 2020, the Department anticipates completion of Critical Decision-1, "Approve Alternative Selection and Cost Range," during the Fiscal Year. If full funding is not provided, then the path forward and the timing of the project and its completion will be reexamined.

Appendix II

ADDITIONAL MATERIAL FOR THE RECORD

REPORT SUBMITTED BY THE HONORABLE RICK PERRY





How can we save the environment and advance industry?

Scientists at Ames National Laboratory discovered a cost-effective and non-toxic alloy replacement to the millennia-old highly toxic lead solder. Lead soldering was the norm of the electronics industry up until the early 1990s when concerns arose regarding electronics disposal and the potential for lead leeching from landfills into the environment.

The Ames discovery of a safe, effective alternative to lead solder drove sweeping international adoption and licensing by the multibillion-dollar electronics industry and protects the environment, human health, and economy on a global scale.

Ames Lab at a Glance

Ames Laboratory's central location on the campus of Iowa State University fosters a decades-old collaborative relationship that inspires minds to create materials, solve problems, and address global challenges. A leader in the discovery, synthesis, analysis, and use of new materials, novel chemistries, and transformational analytical tools, Ames Laboratory seeks solutions to energy-related problems of national concern through the exploration of physics, chemistry, engineering, applied mathematics, and materials sciences.

U.S. Department of Energy National Laboratories

The 17 U.S. Department of Energy (DOE) National Laboratories comprise a preeminent federal research system that executes long-term government scientific and technological missions, often with complex security, safety, project management, or other operational challenges. The National Laboratory system produces the scientific research needed to develop national energy policy and solutions allowing DOE to be one of the largest supporters of technology transfer in the federal government.

Ames Laboratory's most successful commercial technology transfer

Technology

A tin-silver-copper replacement for traditional lead solder.

Industry

Widely adopted as an alternative to lead solder and preferred by the worldwide electronics assembly industry.

Economy

Generated close to \$60 million in licensing revenue.

Contact Us

The scientific discovery highlighted on this poster is just one of DOE's many successes advancing America.

Learn more about available resources and partnering opportunities with the National Labs by visiting:

www.energy.gov/technologytransitions

Technology Transitions

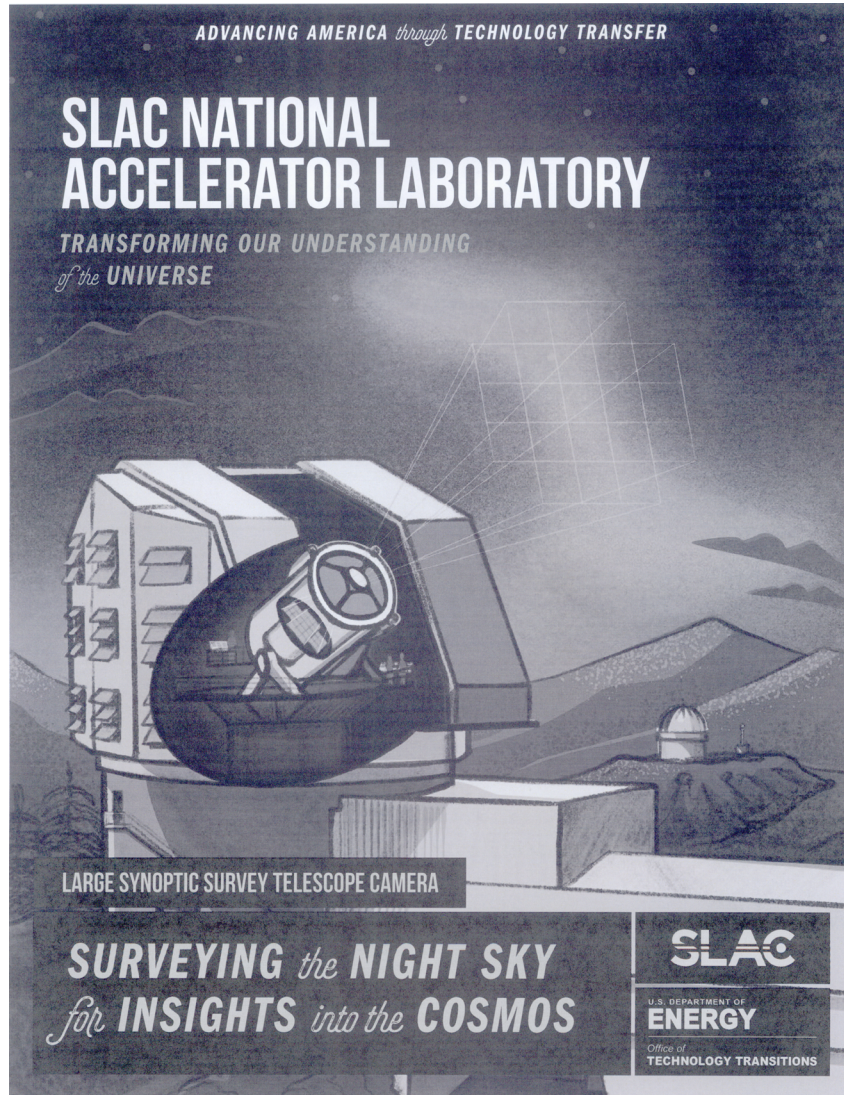
The mission of the Office of Technology Transitions (OTT) is to expand the commercial impact of the DOE's research and development portfolio to advance the economic, energy, and national security interests of the Nation. The office develops the Department's policy and vision for expanding the commercial impact of its research investments, and streamlines information and access to DOE's National Labs and sites to foster partnerships that will move innovations from the labs into the marketplace.

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DOE-OR-10-001



ADVANCING AMERICA *through* TECHNOLOGY TRANSFER

SLAC NATIONAL ACCELERATOR LABORATORY

TRANSFORMING OUR UNDERSTANDING
of the UNIVERSE

LARGE SYNOPTIC SURVEY TELESCOPE CAMERA

SURVEYING the NIGHT SKY
for INSIGHTS into the COSMOS

SLAC
U.S. DEPARTMENT OF
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To boldly go where no camera has gone before?

The largest digital camera ever constructed for optical astronomy will survey the night sky for 10 years, catalog 17 billion stars and 20 billion galaxies, generate millions of gigabytes of data and the largest non-proprietary dataset in the world, and bring together a collaborative international community.

SLAC National Accelerator Laboratory is playing key roles in the tremendous public-private partnership that is building the Large Synoptic Survey Telescope (LSST), including leading the construction of the massive LSST camera. The LSST's unprecedented dataset promises to yield discoveries into the nature of dark energy, dark matter, galaxy formation, and many other fundamental science questions, as well as enthruse a new generation to discover solutions to beyond-the-horizon challenges in data science.



SLAC at a Glance

SLAC National Accelerator Laboratory's origins trace to the rolling hills west of Palo Alto where in 1962 an extraordinary feat of imagination, brainpower, and collaboration resulted in the world's longest particle accelerator and the inception of a unique scientific partnership with Stanford University. Credited with discovering fundamental building blocks of matter and creating the first website in North America, SLAC continues to open new windows to the natural world and build a brighter future through scientific discovery.

U.S. Department of Energy National Laboratories

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LSST's astronomical catalog will surpass existing catalogs thousands of times over

Technology

The LSST camera will weigh 6,000 lb and covers near UV to IR wavelengths with over 3 billion pixels per image.

Data

Generating millions of gigabytes of data over a decade presents challenges that will spark discoveries and solutions.

Collaboration

A large team of scientists and engineers at a number of institutions across the U.S. and abroad are collaborating to build LSST, with funding from the National Science Foundation and DOE.

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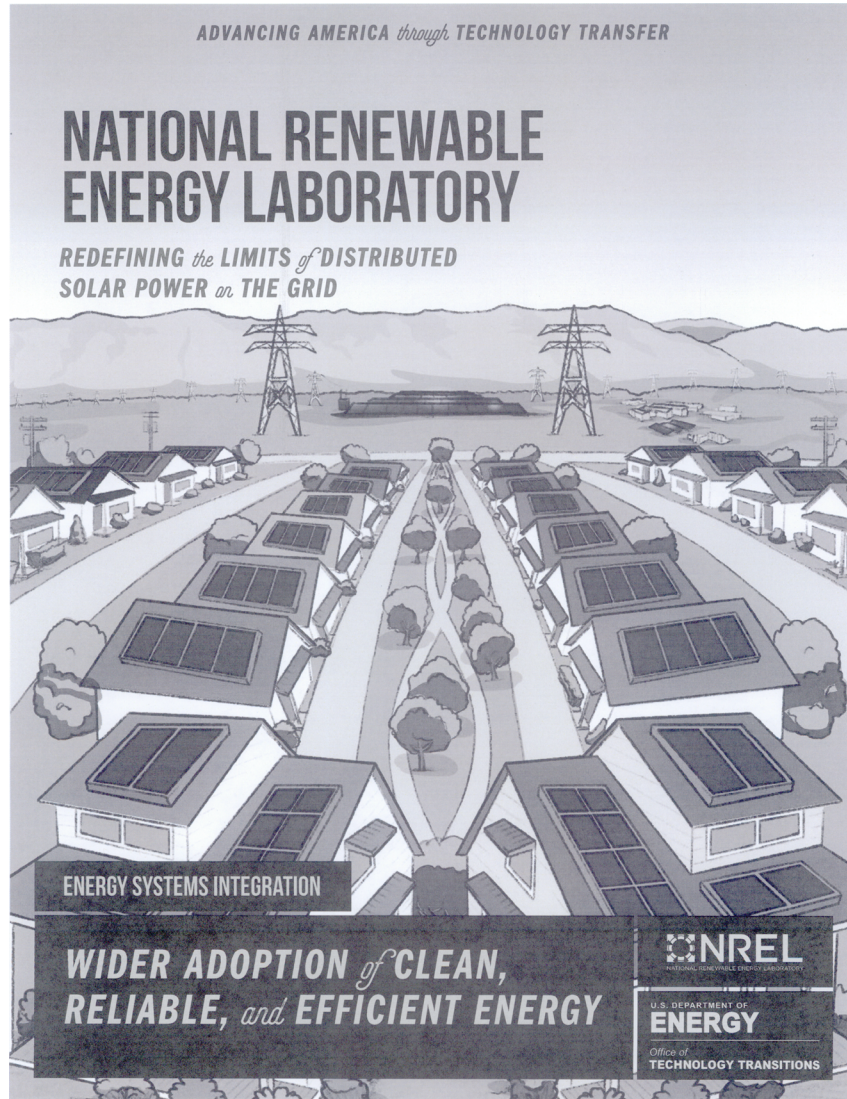
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How do we maximize opportunities for distributed renewable energy?

National Renewable Energy Laboratory (NREL) scientists, in collaboration with industry, used sophisticated test facilities to prove distributed rooftop photovoltaics (PV) could safely connect to the Hawaiian power grid.

The scalable, realistic test environment at NREL's Energy Systems Integration Facility (ESIF) enabled scientists to replicate the larger Hawaiian electrical distribution system, safely push the emulated grid to its limits, and demonstrate the power grid's solar power tolerance. As a result, the allowable Hawaiian solar power ceiling more than doubled, permitting wider adoption of customer-owned PV technology and validating a replicable global model to manage distributed renewable energy.

NREL at a Glance

NREL's origins trace to the 1973 global oil embargo that crippled America and underscored a critical shortfall in the nation's energy security. At the entrance of the majestic Rocky Mountains, NREL's predecessor – the Solar Energy Research Institute (SERI) – was established in response to the oil crisis with a mission to advance American energy independence through technological development. Today, NREL's world-class researchers and collaborative facilities are advancing the science and engineering of efficient, sustainable, and renewable energy technologies, providing the knowledge to integrate and optimize energy systems, and discovering solutions that transform how the world uses energy.

U.S. Department of Energy Laboratories

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NREL is helping lead Hawaii's transition to highly renewable electric grids

Customers

ESIF test results ended a moratorium on PV connections to the grid and cleared a queue of 2,500 waiting customers.

Standards

ESIF test methods drove the development of new national interconnection and interoperability standards.

Collaboration

Several industry partners, standards organizations, and research teams worked together to make this leading-edge research possible.

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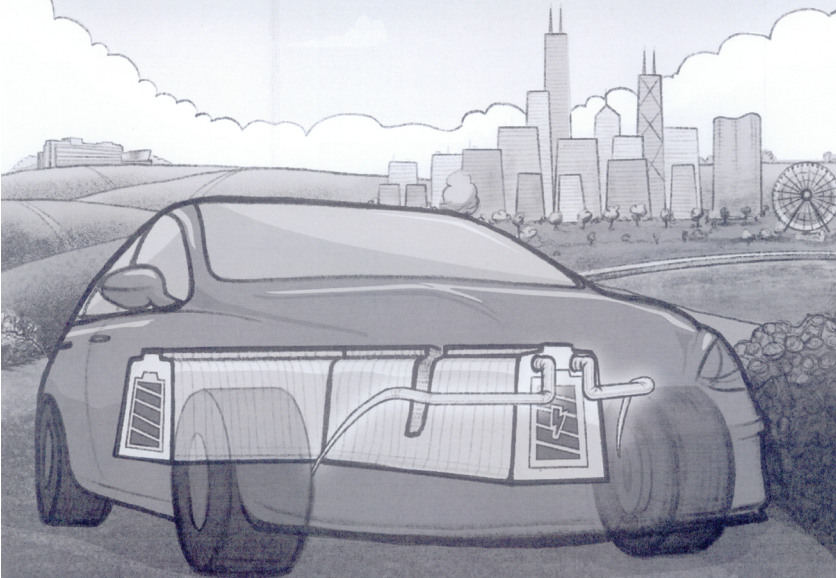
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DOE OTT LBNL 10-0012001-4

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ARGONNE NATIONAL LABORATORY

ENERGIZING *the* ELECTRIC CAR INDUSTRY



NICKEL MANGANESE COBALT BATTERY TECHNOLOGY

**CLEANER POWER,
REDUCED EMISSIONS, *and*
NEW MANUFACTURING JOBS**

Argonne 
NATIONAL LABORATORY

U.S. DEPARTMENT OF
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How do we transform the energy storage industry and create jobs?

Scientists at Argonne National Laboratory (ANL) invented a lithium-ion battery cathode chemistry delivering revolutionary improvements over earlier cathode technologies. The Nickel Manganese Cobalt (NMC) blended cathode structure provides the greatest energy storage capacity available along with improved safety and increased battery lifespan all in the smallest and lightest package on the market.

Nearly two decades and various commercial licensing agreements later, NMC is found in applications ranging from electric cars to power tools, has created hundreds of American jobs, and is helping pave the way to the next generation of large-scale energy grid storage.

ANL at a Glance

Argonne's origins trace to the University of Chicago, where in 1942, Enrico Fermi led a team of 49 scientists in creating the world's first self-sustaining nuclear chain reaction. Argonne has built on Fermi's pioneering legacy by delivering pivotal discoveries and disruptive technologies that meet national needs for sustainable energy, economic competitiveness, and security. Boasting world-class talent and a powerful suite of unique facilities and tools, Argonne's multidisciplinary scientists, engineers, and collaborators are advancing our understanding of the world around us, discovering new materials and applications, and driving next-generation super-computing.

U.S. Department of Energy Laboratories

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NMC is the safest, best performing, and most cost-effective technology among its peers

Technology

NMC offers a 50% to 100% increase in energy storage capacity over earlier cathode technologies.

Industry

NMC technology was licensed to four international corporations, creating hundreds of American jobs.

Awards

Argonne was a recipient of the 2010 "Deals of Distinction" Award from the Licensing Executives Society, noting the potential of NMC to improve the environment and spur economic growth.

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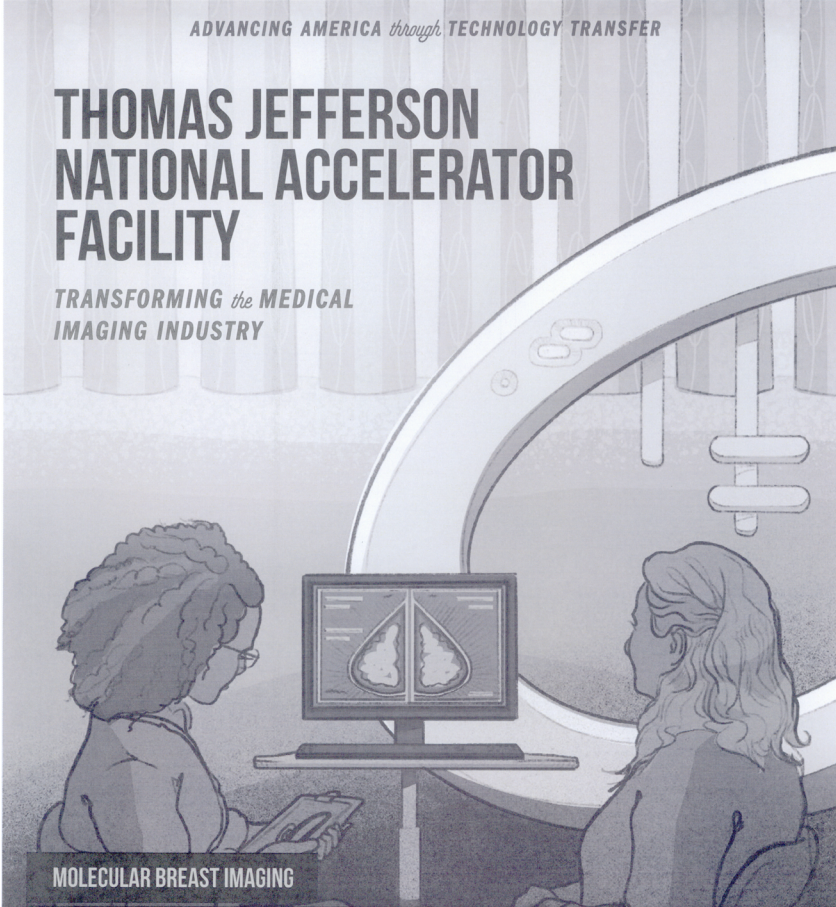
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THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

TRANSFORMING *the* MEDICAL
IMAGING INDUSTRY



MOLECULAR BREAST IMAGING

**IMPROVING QUALITY *of* LIFE
WITH EARLY DETECTION *and*
DIAGNOSIS *of* BREAST CANCER**

Jefferson Lab
U.S. DEPARTMENT OF
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How do we apply nuclear research to life-saving nuclear medicine?

Scientists at Thomas Jefferson National Accelerator Facility (Jefferson Lab), in collaboration with industry, advanced conventional breast cancer screening tools with the development of Breast Specific Gamma Imaging, also known as Molecular Breast Imaging (MBI) technology.

Using radiopharmaceutical beacons, MBI's optimized camera form factor improves imaging sensitivity and resolution across all breast cancer risk groups, enabling radiologists to find tumors earlier with greater accuracy. The resulting benefits include reducing unnecessary follow-on diagnostics, allaying patient anxiety, treating cancer less invasively, and improving survival rates and quality of life for patients and their families.

Jefferson Lab at a Glance

Cradled between the James and York Rivers in coastal Newport News and birthplace of the Continuous Electron Beam Accelerator Facility, Jefferson Lab began its first experiments in 1994 as the youngest of the DOE's 17 labs and serves as a forefront nuclear physics research facility to an international scientific user community. With a mission to responsibly enable discoveries and address societal challenges, Jefferson Lab's scientists explore the building blocks of atoms, apply advanced accelerator technologies, and share knowledge through education and public outreach.

U.S. Department of Energy Laboratories

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MBI improves odds of survival by detecting cancers earlier and more accurately

🔍 Detection

MBI reduces benign biopsies by 50% over Magnetic Resonance Imaging (MRI).



MBI with mammography results in a nearly threefold increase in invasive cancer detection in at-risk women with dense breast tissue.

👤 Outcomes

MBI enables earlier breast cancer detection when treatment is less invasive, survival rates are higher, and health outcomes are better.

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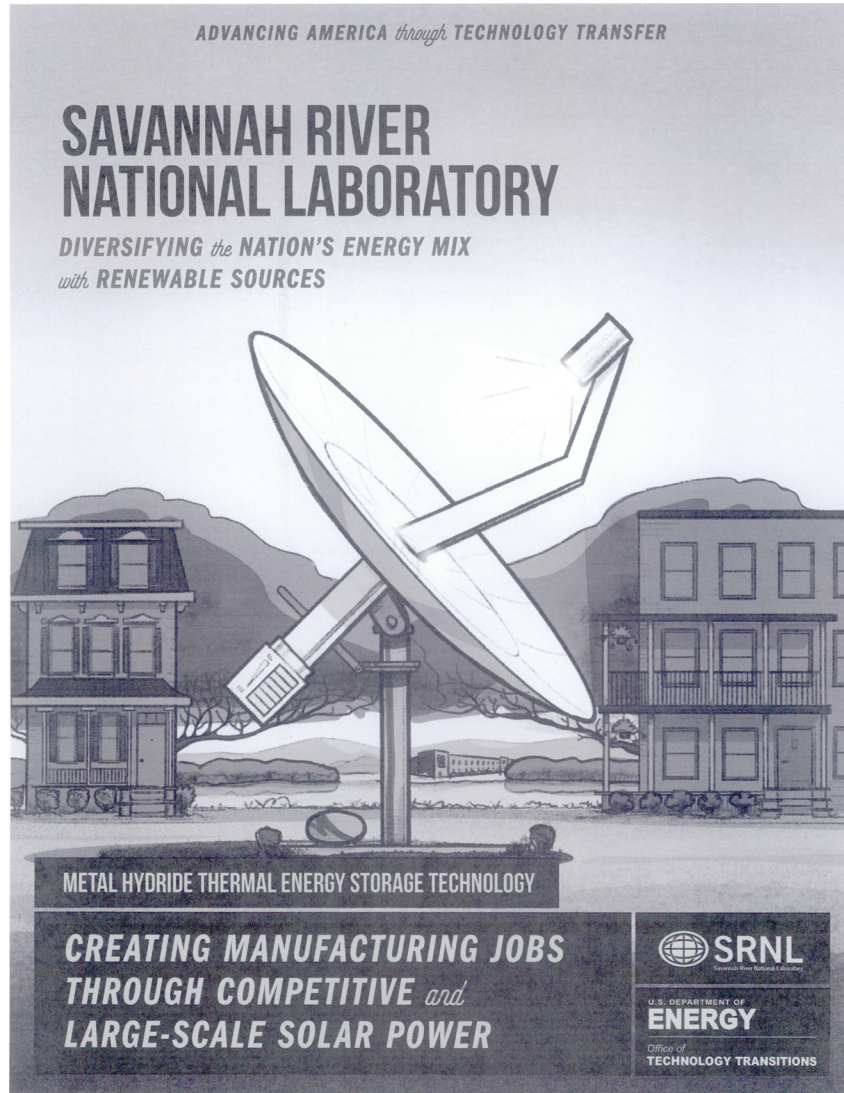
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ADVANCING AMERICA *through* TECHNOLOGY TRANSFER**How do we save sunshine for a rainy day?**

Researchers at Savannah River National Laboratory (SRNL) discovered Metal Hydride materials and developed an associated Thermal Energy Storage (TES) technology that offer a superior and enduring alternative to conventional materials and TES technologies used in Concentrated Solar Power (CSP) systems. Prior to SRNL's development of Metal Hydride TES technology, CSP systems used materials and technology that could not compete with the cost, performance, and short and long-term reliability offered by fossil fuels.

Metal Hydride TES technology addresses each shortfall and through industry licensing enables new CSP systems to provide large-scale reliable solar energy production and distribution, creates thousands of American manufacturing jobs, and makes renewable energy competitive with fossil fuels for the first time in history.

SRNL at a Glance

Born in Aiken, SC in 1950 and situated in the Central Savannah River Area, SRNL was a deliberate response to Russian nuclearization and was America's sprinter in the Cold War's nuclear arms race. Today, SRNL is a multidisciplinary research and development center that protects the Nation by applying science to the energy economy, global security, and the environment. SRNL's scientists and engineers have advanced energy storage technology, materials science, and nuclear non-proliferation, and offer trusted expertise for environmental cleanup and nuclear materials management.

U.S. Department of Energy Laboratories

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Metal Hydride Thermal Energy Storage Technology is revolutionizing the energy landscape

Technology

Metal Hydride materials more efficiently store heat in chemical bonds yielding TES gains ten times greater than traditional materials and TES technologies.

Industry

Licensing of Metal Hydride TES technology promises large-scale solar electricity produced and distributed at prices 95% less than current photovoltaic systems.

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LAWRENCE BERKELEY NATIONAL LABORATORY

TRANSFORMING *the* ELECTRONIC DISPLAY INDUSTRY

QUANTUM DOTS

**CAPTIVATING USER EXPERIENCES
WITH MORE VIVID *and*
EFFICIENT DISPLAYS**

 **BERKELEY LAB**

**U.S. DEPARTMENT OF
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BERKELEY LAB

How do we improve display performance, power consumption, and cost?

Scientists at Lawrence Berkeley National Laboratory (LBNL) discovered how to manipulate a type of nanocrystal, called a quantum dot, to emit pure colors at nearly perfect photo conversion efficiency. Startup licensing of these color-tunable nanocrystals and an industry partnership yielded a nanoscience breakthrough for electronic display technology with the development of engineered sheets of quantum dots. Commercialization of engineered quantum dot sheets has resulted in brighter, more color-accurate, and less power-consumptive displays when compared to larger particle Liquid Crystal Display (LCD) peers within the same price point.

LBNL at a Glance

Located in the hills above University of California (UC) Berkeley and overlooking the San Francisco Bay, Berkeley Lab was founded in 1931 on the belief that the biggest scientific challenges are best addressed by multidisciplinary teams. Berkeley Lab continues this legacy by connecting diverse teams of researchers to develop sustainable energy and environmental solutions, create useful new materials, advance the frontiers of computing, and probe the mysteries of life, matter, and the Universe. In addition, scientists from around the world rely on the Lab's facilities for their own discovery science.

U.S. Department of Energy Laboratories

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Quantum dots provide cost competitive and energy efficient displays with uncompromised color accuracy and brightness

Discovery

LBNL's quantum dots are only 50 atoms wide and made from a cadmium-selenide core within a cadmium-sulfide shell.

Technology

Engineered quantum dot sheets provide 50% wider color spectrum and 20% lower power consumption over LCD.

Industry

Licensed quantum dots technology is used in HDTVs, tablets, laptops, and smartphones.

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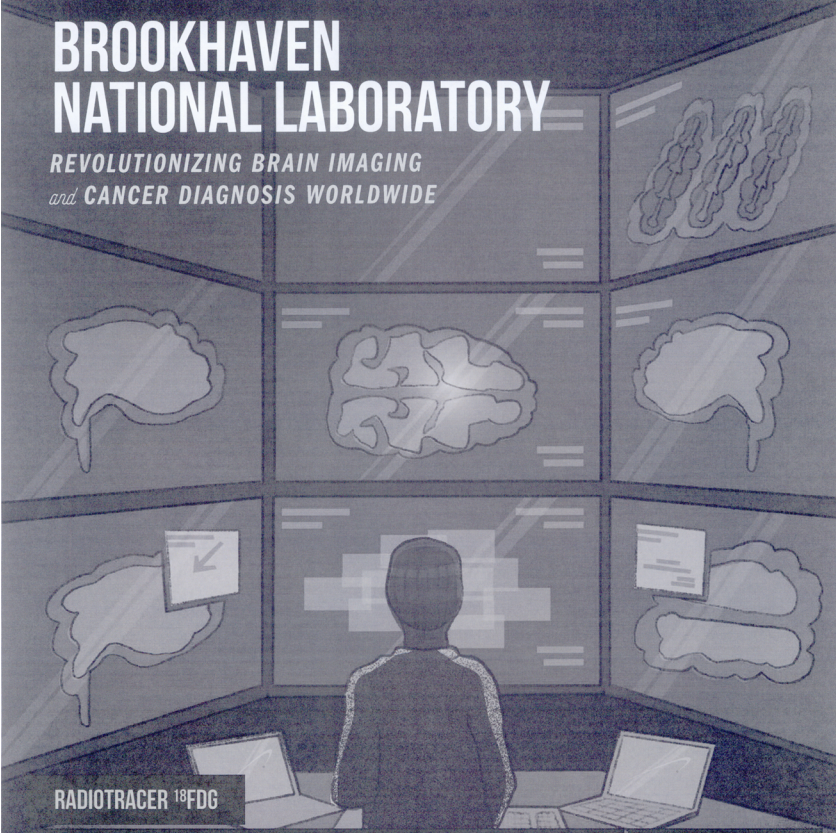
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BROOKHAVEN NATIONAL LABORATORY

REVOLUTIONIZING BRAIN IMAGING
and CANCER DIAGNOSIS WORLDWIDE



RADIOTRACER ¹⁸F_{FDG}

**IMPROVING LIVES *with* EARLY
DETECTION *and* DIAGNOSIS
of DISEASES**

BROOKHAVEN
NATIONAL LABORATORY

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BROOKHAVEN NATIONAL LABORATORY

How can a radiotracer save your life?

In 1976, a multidisciplinary team of scientists at Brookhaven National Laboratory (BNL), working with partners from the University of Pennsylvania and the National Institutes of Health, revolutionized cancer diagnosis and management as well as brain research with the synthesis of Radiotracer ^{18}F FDG. Used in Positron Emission Tomography (PET) scanning, ^{18}F FDG is a diagnostic beacon that spotlights metabolic activity in the body. The discovery opened an unprecedented exploratory window on a wide range of diseases, conditions, and treatments. Most notably, ^{18}F FDG's ability to spot cancer cells' notoriously high glucose demand long before anatomical changes are detected has positioned the radiotracer as the global benchmark for early cancer diagnosis and in monitoring how patients respond to treatment. Use of the ^{18}F FDG radiotracer results in less invasive treatments, better health outcomes, and improved quality of life for patients and their families.

BNL at a Glance

Brookhaven National Lab opened its doors in 1947 on the former site of the U.S. military's Camp Upton with an initial mission centered on the peaceful exploration of the atom. Today, Brookhaven is a global powerhouse of scientific discovery and boasts multidisciplinary scientists and facilities that advance fundamental research in nuclear and particle physics to gain a deeper understanding of matter, energy, space, and time; apply photon sciences and nanomaterials research to energy challenges of critical importance to the Nation; and perform cross-disciplinary research on computation, sustainable energy, national security, and Earth's ecosystems.

U.S. Department of Energy Laboratories

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^{18}F FDG is the world's most widely used radiotracer for neuroimaging, and cancer diagnosis and treatment tracking

Industry

More than 1.5 million ^{18}F FDG PET scans are performed annually.

Application

^{18}F FDG supports the research, diagnosis, and evaluation of treatments associated with cancer, mental health disorders, epilepsy, coronary artery disease, and neurodegenerative diseases such as Alzheimer's.

Collaboration

BNL, National Institutes of Health, and University of Pennsylvania comprise the team that first synthesized and used ^{18}F FDG.

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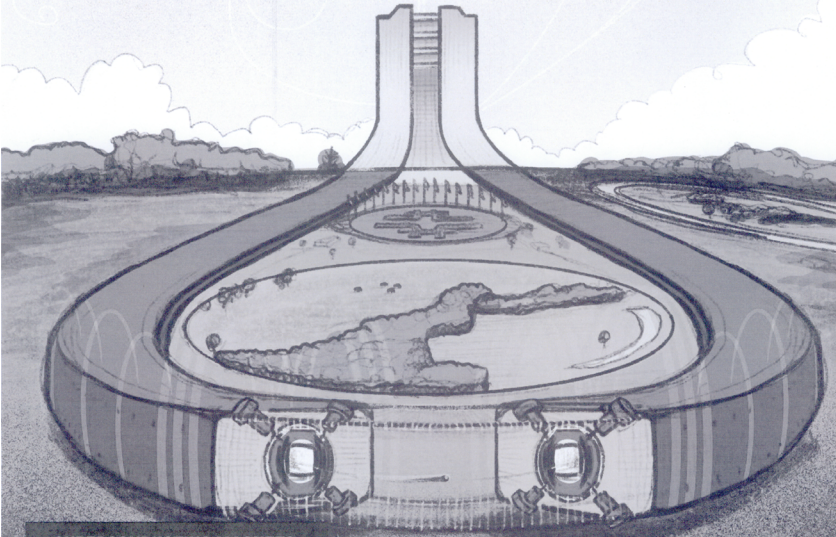
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ADVANCING AMERICA *through* TECHNOLOGY TRANSFER


FERMI NATIONAL ACCELERATOR LABORATORY

ACCELERATING *the* SUPERCONDUCTING WIRE INDUSTRY



SUPERCONDUCTING MAGNETS

**EXPANDED UNDERSTANDING *of the*
UNIVERSE *and a* HEALTHIER WORLD**

 **Fermilab**

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What do a particle accelerator and medical imaging have in common?

Both use superconducting magnets. In the 1970s, when scientists at Fermi National Accelerator Laboratory (Fermilab) envisioned an unparalleled particle accelerator – the Tevatron – that would advance discoveries into the structure and origins of the Universe, they didn't expect to create an industry and improve lives, too.

Realizing Fermilab's vision required superconducting magnets that demanded an unprecedented supply of unavailable niobium-titanium wire. The Tevatron's prodigious construction effort drove the wire's commercial production and as a result, literally and figuratively laid the groundwork for the nascent superconducting industry and transformed medical diagnostics with Magnetic Resonance Imaging (MRI) technology. Decades later, Fermilab remains the global leader in research and development of superconducting magnet and accelerator technologies with advances that benefit industry and mankind.

Fermilab at a Glance

Born in 1967 in the wide, open Illinois prairie 35 miles west of Chicago and later named in honor of one of the greatest scientists of the 20th century, Fermilab is America's premier particle physics and accelerator laboratory where the global physics community collaboratively coalesces to solve the mysteries of matter, energy, space, and time. The Lab's mission is to build, operate, and lead the world in particle accelerator and detector facilities; perform pioneering research on a global scale; and develop new technologies for science that support American industry. Fermilab's discoveries benefit everyday Americans with applications that span medical diagnostics and treatment, homeland security, energy, transportation, and advanced computing.

U.S. Department of Energy Laboratories

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Fermilab's pioneering role in commercializing superconducting wire made applications such as MRI commercially viable

Technology

The accelerator's 1,000 superconducting magnets operated at -450°F to achieve desired particle energies.

Economy

The annual global MRI market is projected to exceed \$6 billion by 2025.

Awards

Fermilab was awarded the prestigious IEEE Milestone Award for the development of the Tevatron's superconducting magnets.

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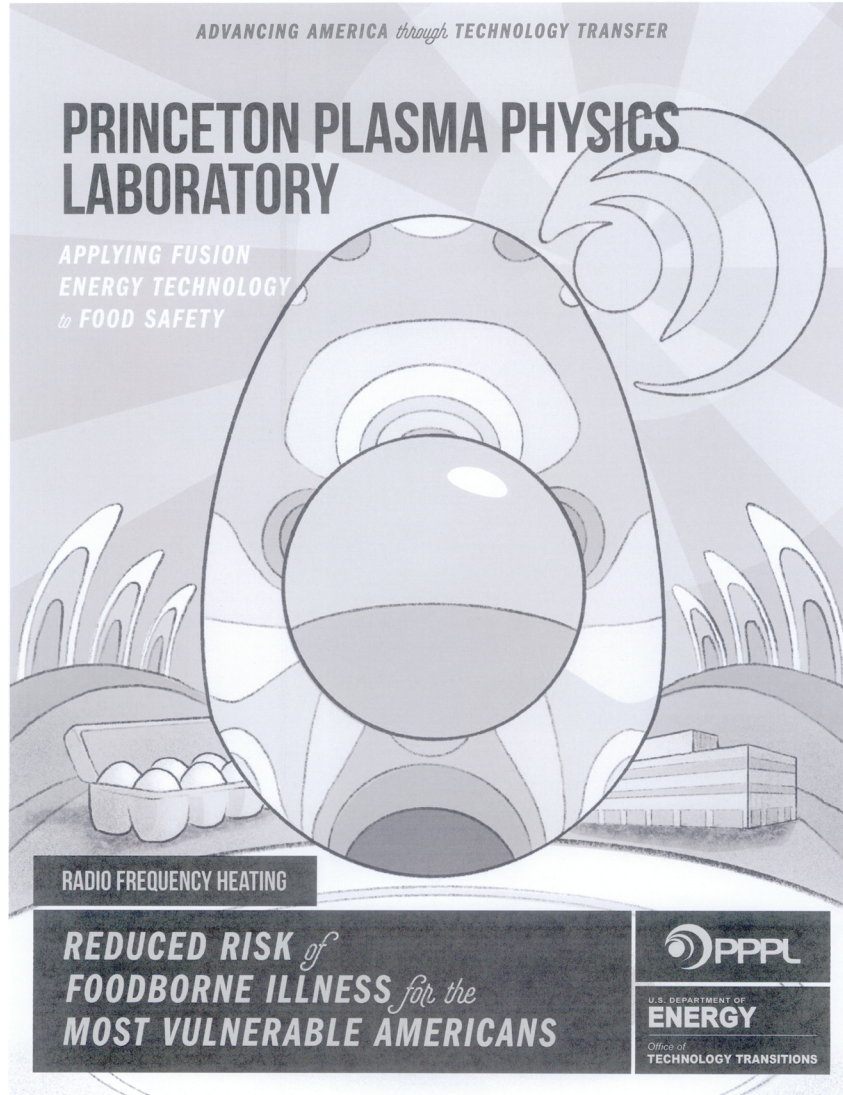
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DOE-OTTT-16-01-001-0001





What do fusion energy research and raw eggs have in common?

Scientists at Princeton Plasma Physics Laboratory (PPPL) working in partnership with the U.S. Department of Agriculture invented a device to more rapidly pasteurize shell eggs without damaging the delicate egg whites by adapting a technique that uses radio waves to heat plasma in fusion energy experiments. Shell egg pasteurization leaves little room for error since egg white pasteurizes at a lower temperature and is especially sensitive to overheating and unintentional cooking when compared to egg yolk. Radio Frequency (RF) Heating pasteurizes raw eggs without affecting composition by simultaneously exposing a rotating shell egg to RF waves and cool water to effectively distribute RF heat. Commercialization of PPPL's patented apparatus is expected to sharply reduce illness stemming from egg-borne salmonella bacteria, a widespread public health concern.

PPPL at a Glance

PPPL's origins trace to Princeton University's Forrestal Campus in Plainsboro, New Jersey, where in 1951 Princeton's preeminent interstellar plasma expert, Lyman Spitzer, conceived of a world with stable fusion power and masterminded the first controlled fusion experiment famously known as Project Matterhorn.

Boasting a world-class workforce, large-scale user facilities, and unique advanced instrumentation, PPPL's scientists and engineers continue Spitzer's pioneering legacy today by providing the highest quality science education to future generations and leading plasma science and technology discoveries to achieve a world powered by safe, clean, and plentiful fusion energy.

U.S. Department of Energy Laboratories

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Pasteurization of shell eggs using RF heating can reduce egg-borne salmonella illness in the United States by up to 85%, or more than 110,000 cases annually

Application

The RF Heating device can pasteurize shell eggs in one-third the time of current methods and without any discernable difference when compared to a raw shell egg.

Collaboration

PPPL and USDA engineers collaborated on the research and development, and share a patent for the RF Heating pasteurization technique and device.

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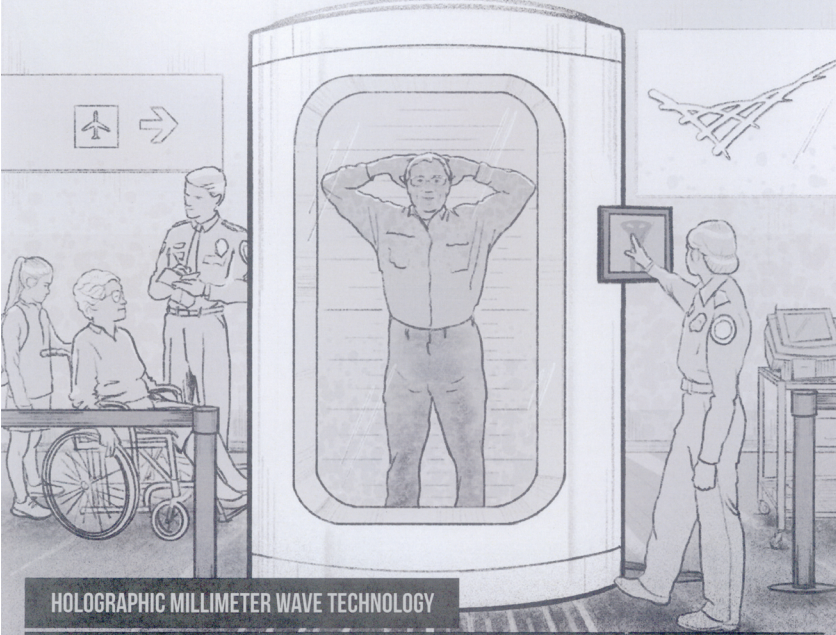
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PACIFIC NORTHWEST NATIONAL LABORATORY

TRANSFORMING *the* PERSONAL SECURITY INDUSTRY



HOLOGRAPHIC MILLIMETER WAVE TECHNOLOGY

**SECURE AIRPORTS, BORDERS,
and PUBLIC PLACES USING
SAFE DETECTION TECHNOLOGY**

Pacific Northwest
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Super vision without the X-rays?

Scientists at Pacific Northwest National Laboratory (PNNL) invented a safer and superior security screening alternative to traditional threat detection technologies. An outgrowth of PNNL's 1960s optical and acoustic holography research and first applied to airport security in 2003, the award-winning Holographic Millimeter Wave technology cost-effectively outperforms conventional X-ray and metal-only threat detection by using safer non-ionizing illumination. The invention more rapidly scans individuals and objects within a smaller technology footprint and produces higher resolution 3D images across a wider range of materials.

The discovery was licensed and incorporated into airport passenger security portal scanners and to date, more than 2,300 installations of the systems are used worldwide with more than 100 million individuals scanned. The public and military benefit from enhanced safety through more effective threat detection in high-traffic security situations, such as airport, border, and military checkpoints and public events.

PNNL at a Glance

Situated in Washington State's Tri Cities at the intersection of the Columbia, Snake, and Yakima Rivers, PNNL was conceived in the 1940s out of the Manhattan Project's Hanford Site and founded in 1965. PNNL advances scientific discovery and creates solutions to the nation's toughest challenges in energy resiliency and national security by drawing on signature capabilities in chemistry, earth sciences, and data analytics.

U.S. Department of Energy National Laboratories

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Rapidly identifies hidden weapons, explosives, and other contraband through clothing

Technology

Scans people for security applications in seconds and detects threats, such as plastic and liquid explosives.

Industry

Applications span the security, medical, health and fitness, entertainment, manufacturing, construction, and apparel industries.

Awards

- R&D 100 Award
- R&D Magazine's Editor's Choice Award
- Federal Laboratory Consortium Award

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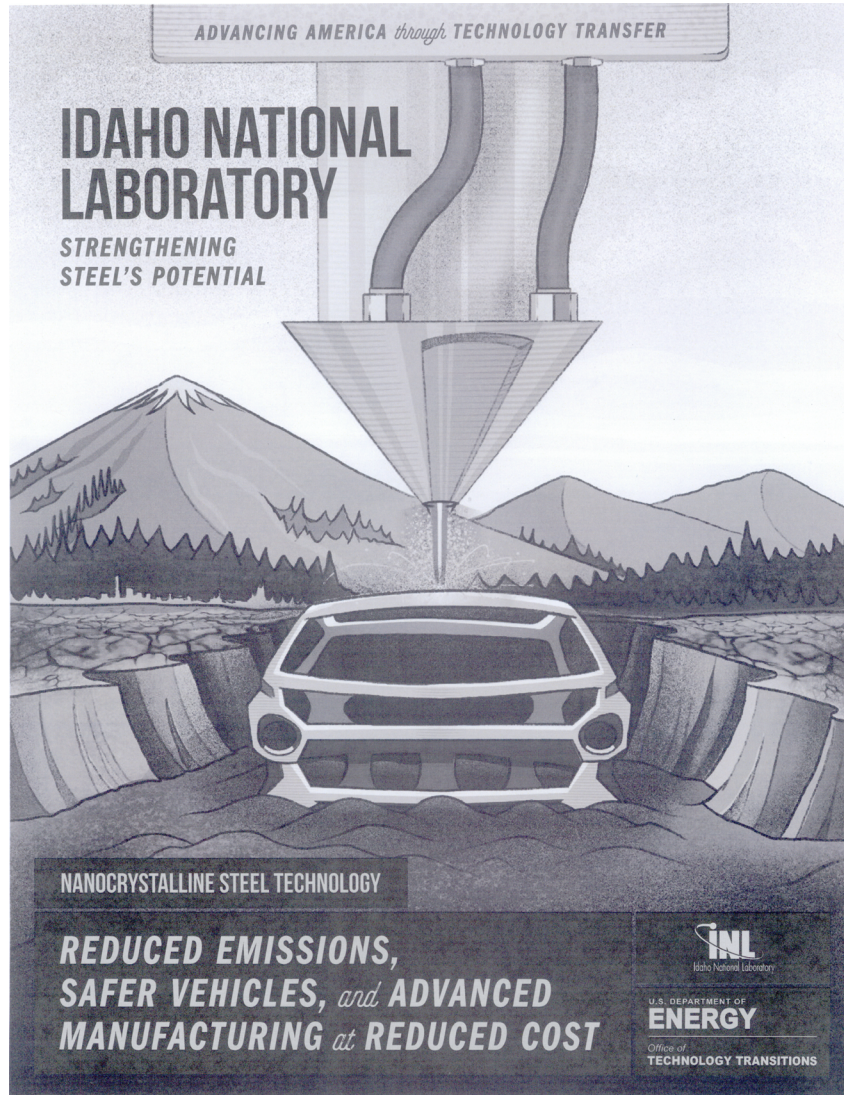
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DOE OTT LAB 11-2013-0012





Steel that is – harder, better, lighter, stronger?

Scientists at Idaho National Laboratory (INL) transformed the manufacturing, mining, and automotive industries when they discovered a new class of nanostructured steel lighter and more ductile than conventional material.

Nanocrystalline steel harnesses the collective capability of miniscule grains of metal to deliver superior performance and durability, driving the sustainable expansion of steel's functionality and application in fields such as additive manufacturing. The material mimics steel in production processes, empowering manufacturers to embrace conversion by using existing equipment and skills while reducing emissions and cost. INL's invention disrupts accepted paradigms, minimizing automotive and aerospace vehicle weight and improving material flexibility without sacrificing strength or safety.

INL at a Glance

Nearly every nuclear reactor in the world owes its existence to research and development conducted at INL. Nestled against the stunning Rocky Mountains and commanding 890 square miles of desert territory, the largest National Laboratory by geographic area began as the Nation's chief nuclear energy research facility. Home to the world's largest concentration of nuclear reactors, INL's research portfolio highlights state-of-the-art capabilities in advanced manufacturing and transport, predictive modeling, and sustainable energy development. Today, INL continues to power the Nation forward, conducting cutting-edge research across all of the DOE's strategic goal areas.

U.S. Department of Energy National Laboratories

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Using nanocrystalline steel increases vehicle fuel economy by 9.5%

Industry

Nanocrystalline steel is among the most widely used materials in the automotive industry.



Nanocrystalline steel increases the lifespan of mining equipment by 400%.



Awards

Nanocrystalline steel products have won five R&D 100 Awards since 2001.

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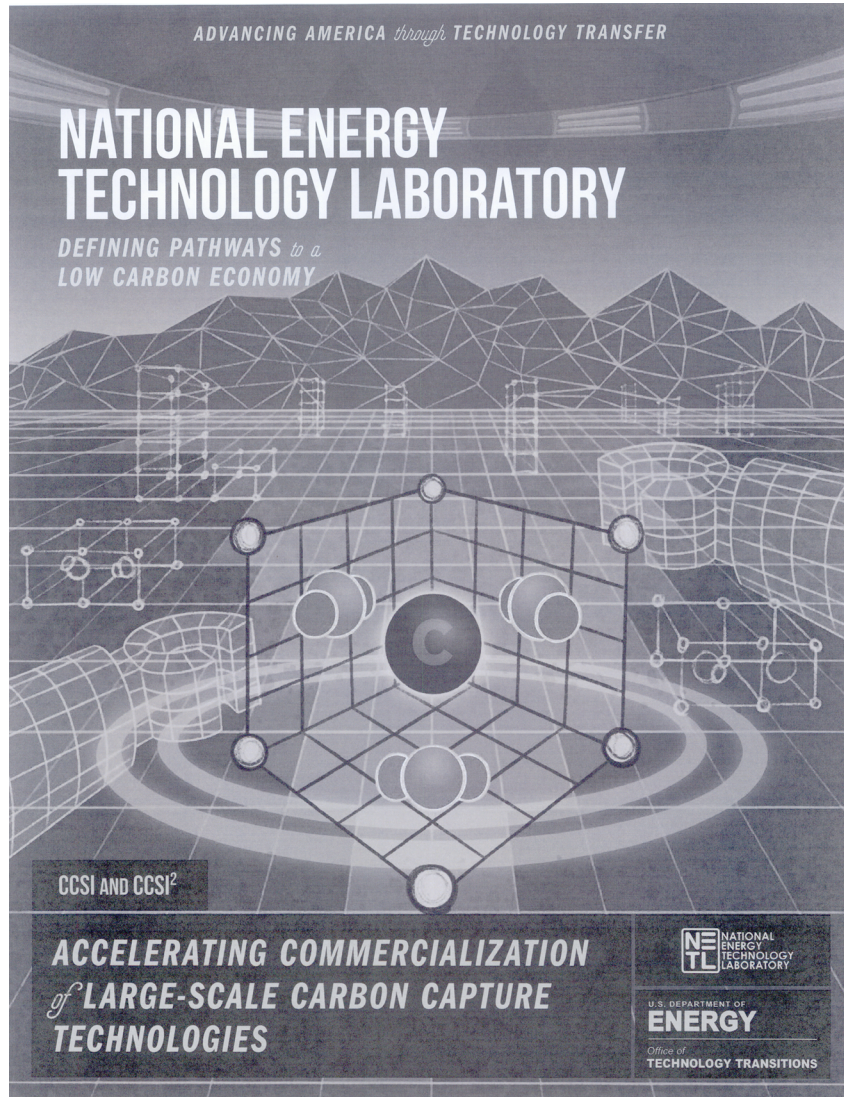
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DOE-OTTT-12-0022004





How do we navigate a long-term path to reduced emissions?

Carbon capture technologies are among the most promising means to manage carbon dioxide emissions and the most challenging to commercialize given the extreme complexity, scale, expense, and duration of pilots and demonstrations required to deploy real-world solutions. In response, the National Energy Technology Laboratory (NETL) launched the Carbon Capture Simulation Initiative (CCSI) – a collaboration to develop a suite of computational tools that reduces technical risk, reveals optimal pathways to market earlier, and accelerates the scalable implementation of carbon capture technologies.

Carbon Capture Simulation for Industry Impact (CCSI²) works to ensure the success of costly large-scale demonstrations by pairing CCSI's capabilities with smaller experimental pilots to better understand and eliminate technical risk. Together, CCSI and CCSI² reduce costs and accelerate commercialization of carbon capture technology that benefits all mankind.

NETL at a Glance

With facilities from sea to shining sea, NETL has a 100-year history of serving America's energy needs as the only National Laboratory that is both government-owned and operated. In fulfilling a two-part mission to enhance the Nation's energy foundation and protect the environment for future generations, NETL continues to advance energy technology solutions for short-term deployment and long-term development. Boasting state-of-the-art facilities and a world-class workforce, NETL powers the future of U.S. energy by leading coal, oil, natural gas, and energy technology research.

U.S. Department of Energy National Laboratories

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CCSI optimizes 7 cutting-edge carbon capture technologies

Industry

CCSI is deployed in 10 federally-funded projects worth more than \$60 million.

Collaboration

CCSI and CCSI² bring together 5 National Labs, 5 universities, and several industry partners.

Awards

The CCSI Toolset won a 2016 R&D 100 Award.

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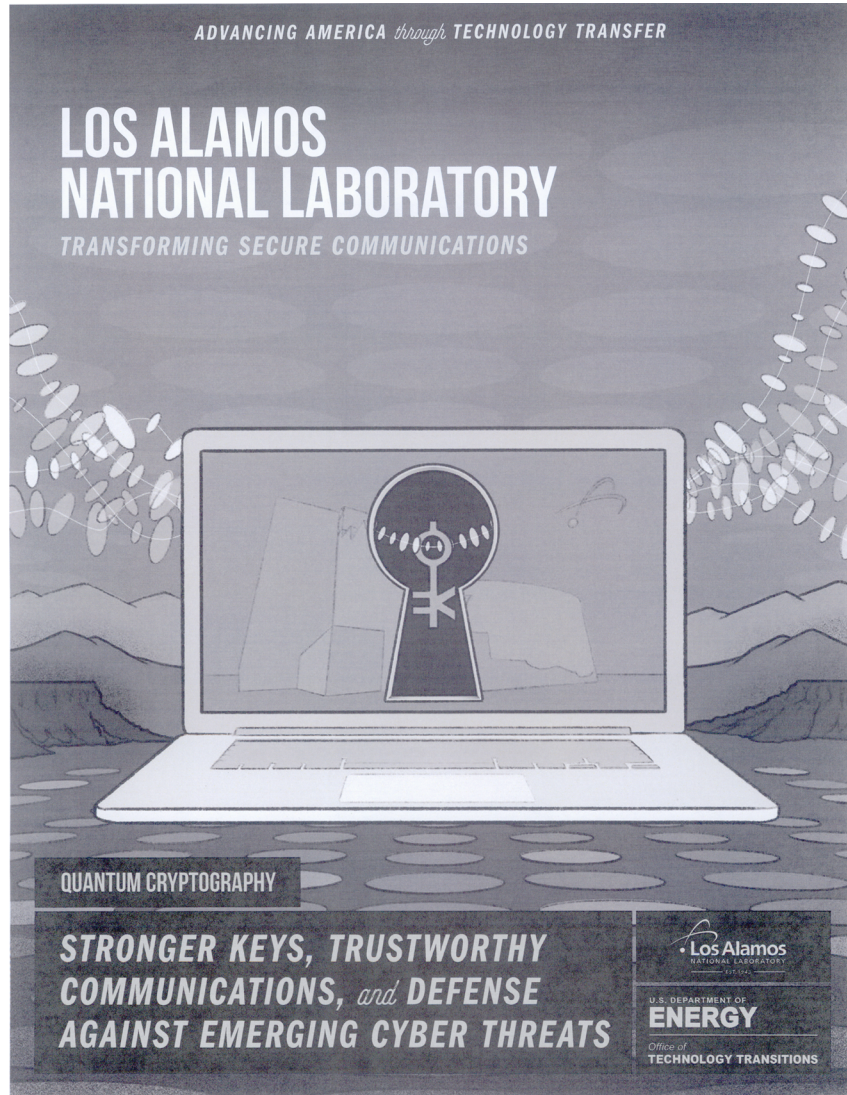
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DOE OTT LAB 12-0012001





How can quantum mechanics strengthen the foundation of computer security?

When scientists at Los Alamos National Laboratory (LANL) couldn't find a random number generator fast enough to handle the increasing demands of modern encrypted communications, they invented the Quantrandor.

A quantum random number generator, the Quantrandor relies on the unpredictable nature of quantum mechanics to generate an inexhaustible stream of truly random numbers and surpasses conventional software-based approaches by orders of magnitude. Using standard and low-cost photodetectors turned LANL's quantum "science project" into a larger quantum cryptography portfolio of technologies that commercializes entropy as a service and provides unprecedented defense against cybersecurity threats. Offering speed and security to industries spanning ecommerce to national security, LANL is fortifying the Nation's private communications for a quantum future.

LANL at a Glance

Nestled between the mountains, canyons, and mesas of the American Southwest, Los Alamos traces its origins to 1943 as Site Y of the Manhattan Project, responsible for design and coordination of the entire program. LANL researchers, including J. Robert Oppenheimer and Richard Feynman, took just 27 months to successfully design, build, and test the world's first atomic bomb, protecting the Nation and promoting global stability. Today, LANL's world-class scientists and engineers secure the Nation by developing solutions that support nuclear deterrence and stockpile stewardship, defend against nuclear threats, detect emerging cybersecurity threats, and enhance energy security and sustainability.

U.S. Department of Energy National Laboratories

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Quantrandor offers truly unpredictable random numbers at unprecedented rates

Technology

The Quantrandor generates 200 megabits of random numbers per second.

Industry

The Quantrandor utilizes readily available, low cost, plug-and-play components.

Demonstration

Using LANL's power control center as a test-bed of the quantum cryptography portfolio's capability, scientists demonstrated command links controlling Los Alamos's electrical power distribution were impervious to interception and spoofing.

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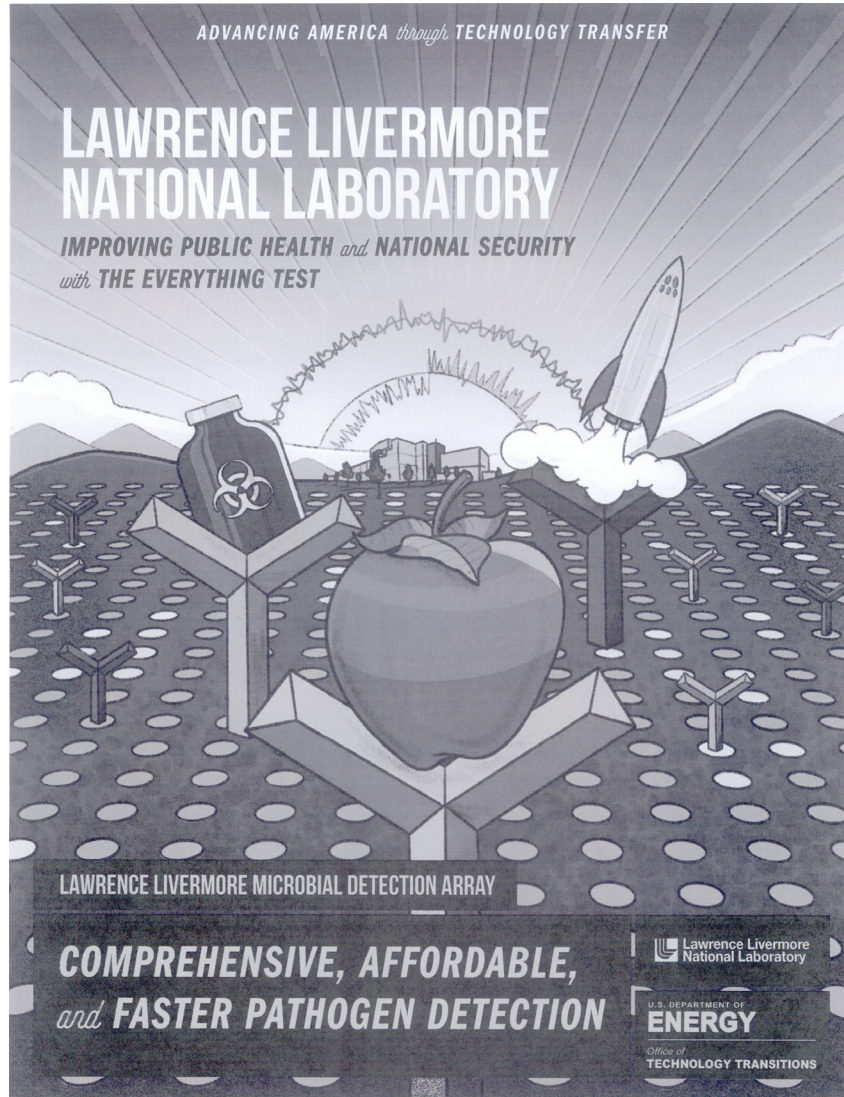
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How do we keep babies, astronauts, and combat veterans healthier with a single test?

The Lawrence Livermore Microbial Detection Array (LLMDA), also known as the Everything Test, is the most comprehensive and widely applicable technology of its kind, improving upon conventional pathogen testing in speed, capability, sensitivity, and cost. The Everything Test contains 388,000 probes within three square inches, accurately tests for more than 10,000 microbes in a single assay, and detects more than 3,000 viruses and 1,900 bacteria within 24 hours.

LLMDA enables the scientific community to better evaluate vaccine safety, prevent and contain epidemics, respond to biological terror attacks, promptly treat combat wound infections, and manage astronaut health while in outer space. The results are improved public health and a safer and more secure Nation.

LLNL at a Glance

Lawrence Livermore National Laboratory traces its origins 50 miles west of San Francisco, where in 1952 a 'new ideas' laboratory was born in direct response to the Cold War's nuclear arms race with a mission to meet urgent national security needs by advancing nuclear weapons science and technology. More than half a century later, LLNL continues to strengthen the security of the Nation by developing and applying world-class research, technology, and engineering across diverse mission areas spanning biosecurity, counterterrorism, defense, energy, intelligence, nonproliferation, various sciences, and weapons.

U.S. Department of Energy National Laboratories

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LLMDA is the most comprehensive diagnostic platform ever developed

Performance

The LLMDA is cheaper and faster than DNA sequencing, significantly more comprehensive than Polymerase Chain Reaction, and five times better in detection capability than conventional assays.

Examples in Excellence

LLMDA detected contaminated infant vaccines prior to entry in the supply chain.

 LLMDA accelerates treatment and recovery of injured military members by rapidly and precisely detecting combat wound pathogens.

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SANDIA NATIONAL LABORATORIES

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SOLID-STATE LIGHTING

**GLOBAL ENERGY SAVINGS,
SMART PRODUCTIVITY, *and*
ENHANCED NATIONAL SECURITY**

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What's an idea brighter than a light bulb?

Since the turn of the century, scientists at Sandia National Laboratories have championed the innovative use of solid-state lighting (SSL) for a host of applications, revolutionizing the lighting industry and establishing the scientific basis for a radically new U.S. energy economy.

As global thought leaders in the adoption of smart SSL to replace traditional lighting, Sandia's team saw the vast potential of ultra-efficient light-emitting diodes (LEDs). Altering the compounds of elements used to create LED microchips enabled Sandia's scientists to produce various colors of light with greater efficiency, luminosity precision, and directional specificity than conventional incandescent or fluorescent lights. SSL technology is projected to be employed globally by 2030, saving the world a projected \$120 billion each year.

Sandia at a Glance

Spread across the diverse terrains of New Mexico, Nevada, California, and Hawaii, Sandia's offices and test sites have served the Nation's evolving national security challenges since 1945. As the engineering arm of the Nation's nuclear weapons enterprise, Sandia develops the innovative research and technology necessary to enable a peaceful world. Today, Sandia's scientists keep the U.S. homeland secure and its armed forces safe by developing advanced technologies that effectively and reliably manage the U.S. nuclear stockpile; deter nuclear proliferation; protect critical assets and infrastructure; ensure long-term energy resilience; and reduce global threats posed by nuclear, chemical, biological, and radiological materials.

U.S. Department of Energy Laboratories

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Current SSL technology is ten times more efficient than incandescent bulbs

Sustainability

Adoption of SSL can reduce U.S. lighting energy consumption by 25%.

Innovation

Sandia holds more than 20 patents related to SSL and its applications.

Efficiency

Conversion from conventional lighting to SSL increases employee productivity by enhancing controls and optimizing lighting conditions in homes and offices.

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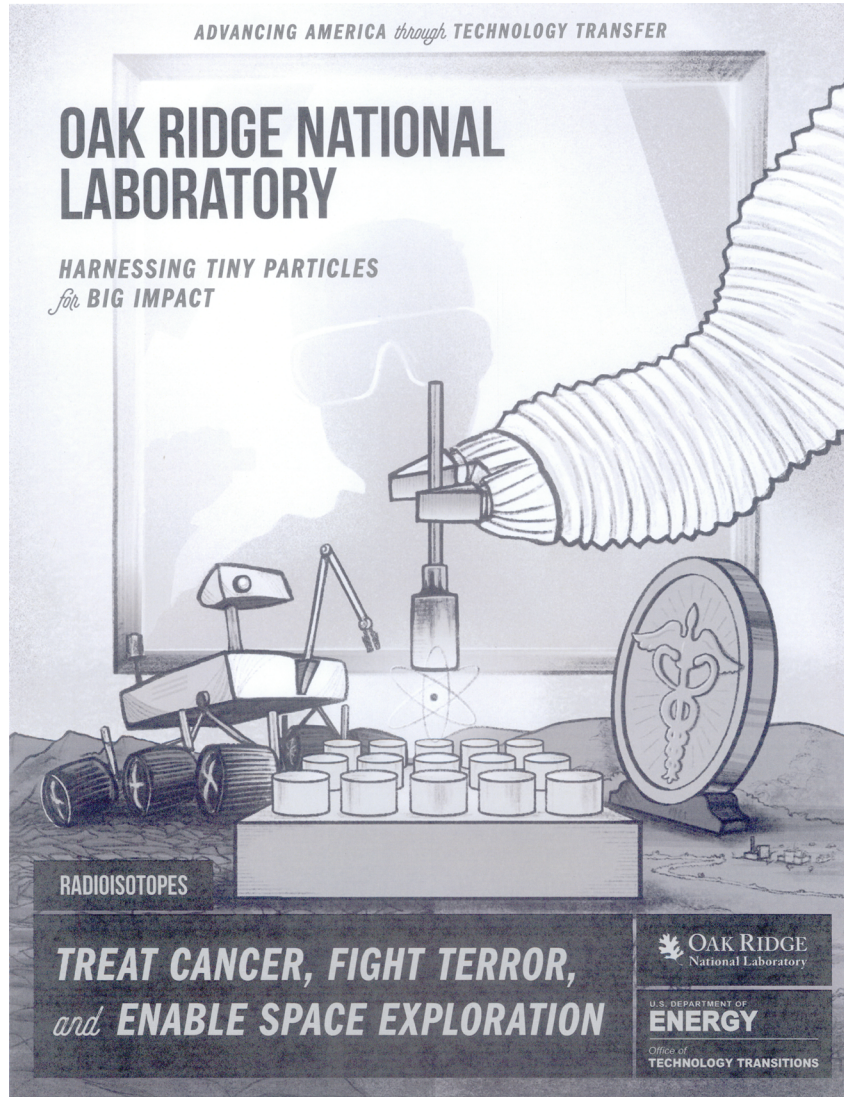
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DOE-OTT-14-0010001





How can a half-life give you a long life?

Oak Ridge National Laboratory (ORNL) made history in 1943 when Manhattan Project scientists created the first continuously operating nuclear reactor and soon recognized the unprecedented potential to produce and study radioisotopes spanning the periodic table. Nearly 80 years later, radioisotopes boast a long resume of commercial applications that improve American lives and expand the boundaries of scientific research.

ORNL's High Flux Isotope Reactor is one of only two facilities worldwide capable of producing high-impact particles that power satellites and Mars rovers, reduce cancer-induced bone pain, and make possible countless scientific experiments. Today, ORNL propels innovation in both radioisotopes' production and their applications across healthcare, counter-terrorism, and space exploration.

ORNL at a Glance

Rooted in the hills of East Tennessee, Oak Ridge has served the nation for more than 75 years, pioneering the study of radioisotopes, radiation's effects on materials, and neutron diffraction. Scientists of the Manhattan Project built the first continuously operating nuclear reactor at Oak Ridge in 1943, fueling the development of modern technologies to treat cancer and heart disease, prevent terrorism, and power deep space exploration. Thirteen different research centers and reactors, including the Spallation Neutron Source, keep ORNL at the forefront of advances in biology, chemistry, and physics, producing cutting-edge technologies in materials, medicine, nuclear energy, and computing benefiting millions of Americans.

U.S. Department of Energy National Laboratories

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Radioisotopes are used in more than 100 million therapies and tests each year to diagnose and treat cancer and heart disease

Improve Lives

ORNL completes more than 100,000 annual shipments of life-saving therapeutic isotopes exclusively manufactured in its state-of-the-art facilities.

Counter Terrorism

ORNL's nickel-63 isotope is used in airport screening and detection.

Power Exploration

NASA's Voyager 1, Voyager 2, Galileo, and Cassini spacecraft, and the Mars Curiosity Rover are powered by radioisotope iridium alloy-clad fuel spheres.

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