Perspective on the Role of a Fusion Pilot Plant in the U.S.

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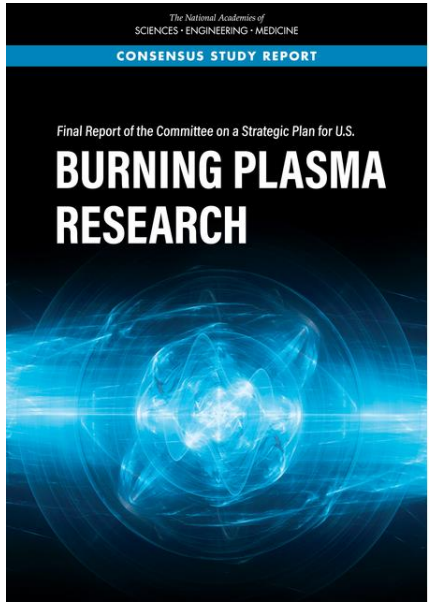
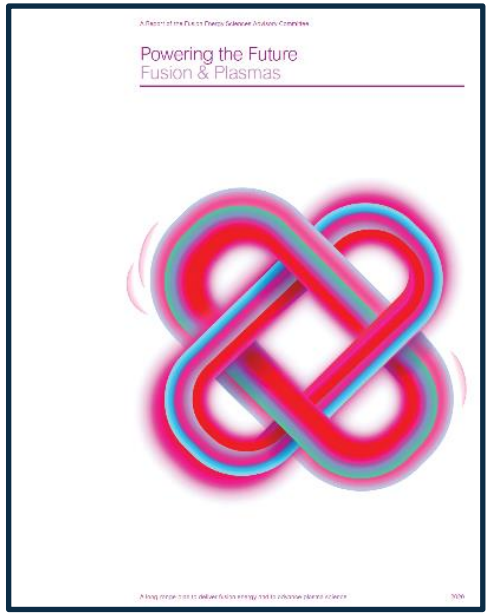
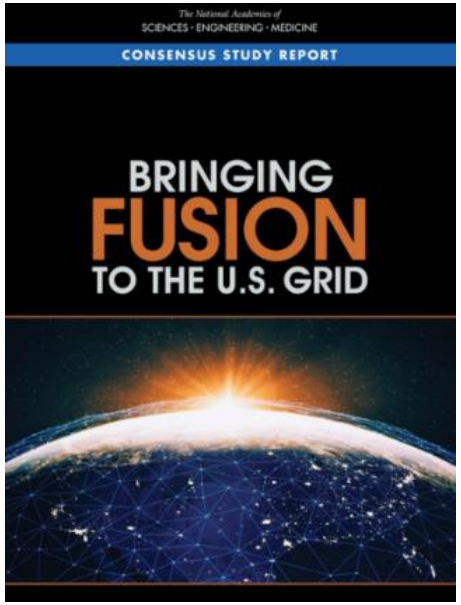
U.S. DEPARTMENT OF ENERGY | Office of Science

Series of Workshops and Reports and Technical Progress Together with Investor Interest Has Informed the U.S. Approach







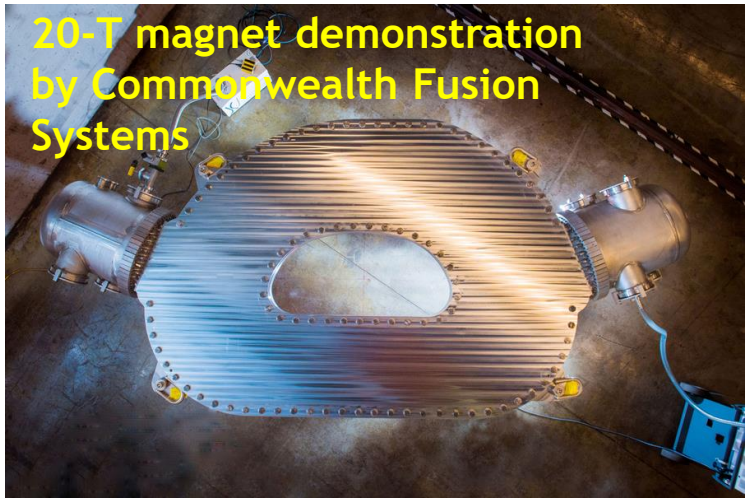
Recommendation: … "the Department of Energy and the private sector should produce net electricity in a fusion pilot plant in the United States in the 2035—2040 timeframe."

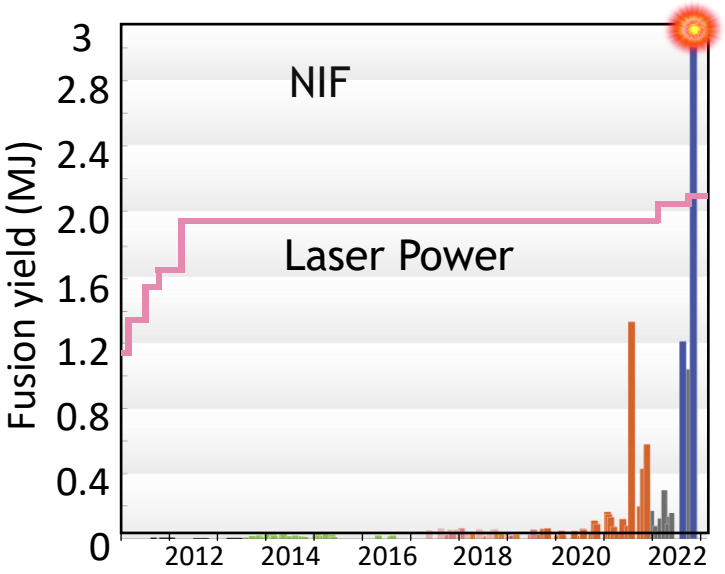
White House Summit declared ambition to accelerate this to the early 2030s
- Bold Decadal Vision

Recommendations, findings and conclusions from the "Bringing Fusion to the U.S. Grid" report are in quotes

Recent Scientific and Technical Developments Created New Opportunities and Support a New Fusion RD&D Strategy

First ITER central-solenoid magnet module constructed by General Atomics

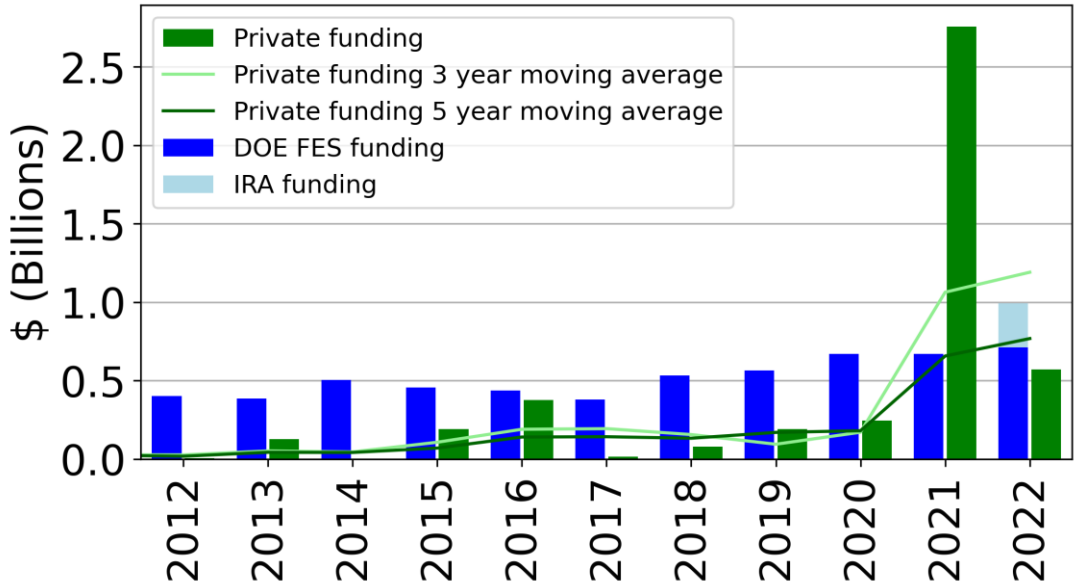




Achieved ignition and target gain =1.5

Fusion Companies Have Raised >$4.8B in Private Capital

Fusion Industry Association
37 member companies



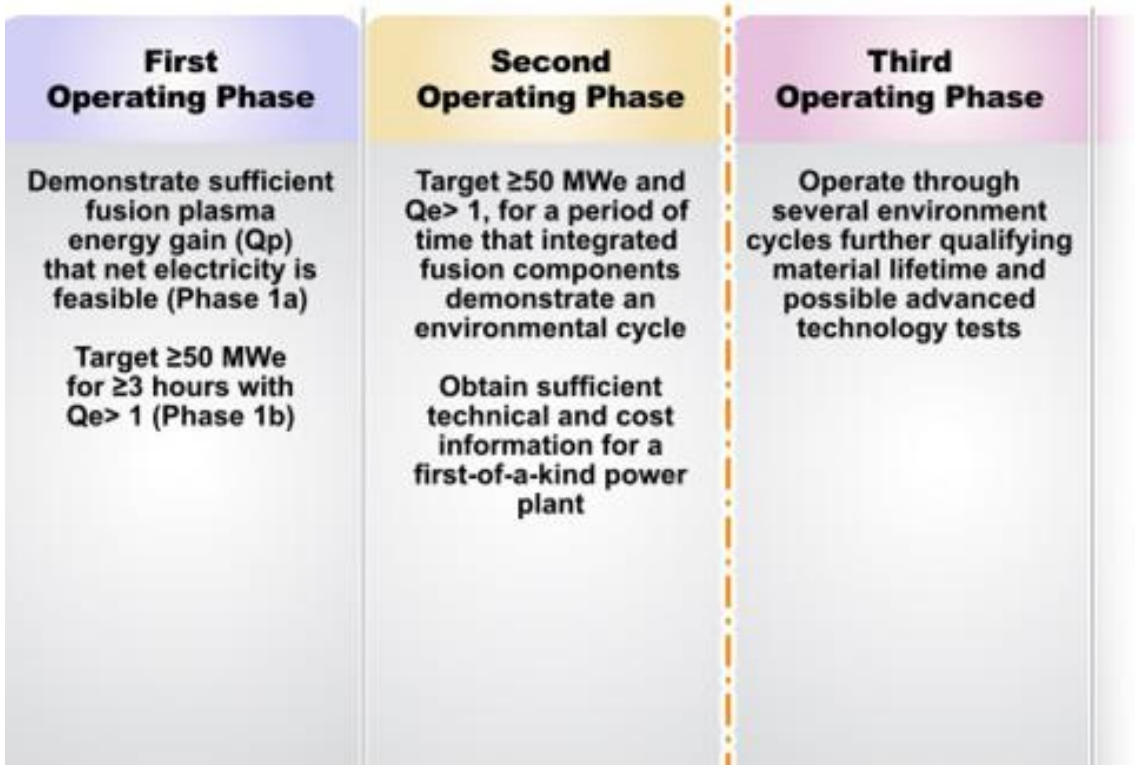
- Pursuing diverse number of fusion approaches and fuel cycles
- Now building the largest new fusion experiments in the U.S.

Goals for a Fusion Pilot Plant:

"Pilot plants in the U.S. A pilot plant must provide the technical and economic information needed for utilities to operate future plants. It must be a test to ensure public confidence in the technology and the success of the commercial plants that will follow."

- Minimize the investment cost of a pilot plant
- Reduce the cost of a power plant

"A pilot must produce an amount of fusion power and energy that is sufficiently representative of the market needs in order to meet the pilot's goal of demonstrated integrated performance and cost, while also demonstrating net electricity gain Qe > 1 and produce peak net electrical power ≥ 50 MWe."



Innovation and Research Investments are Targeted to Meet Technical and Economic Goals

- We need to:
  - Improve the economics of a First-of-a-Kind power plant
  - "The pilot plant design will need to be based on a vetted, well-established confinement physics basis for achieving net plasma gain well in excess of unity."
  - Address regulatory issues to reduce uncertainty
- ***Recommendation:*** … "innovations in fusion confinement concepts and technology to extract fusion power and close the fusion fuel cycle should be developed in parallel. This will enable the engineering design of a pilot plant and the construction decisions to be accelerated by a combination of government and private funding."

DOE Launched a Milestone-Based Fusion Development Program

- Modeled, in part, after the NASA COTS (commercial space flight) program and Nuclear Energy advanced reactor program
- Private industry takes the lead with strong participation from universities and national laboratories
- Milestone payment occurs upon successful execution
  - Greater intellectual property protection for industry
  - Reduced procurement and cost-accounting burdens
  - Reduced risk to the government
- Criteria:
  - Scientific and technical viability
  - Commercialization viability
  - Business and financial viability
  - Community Benefits Plan

Selected Proposals Span a Wide Range of Plasma Concepts

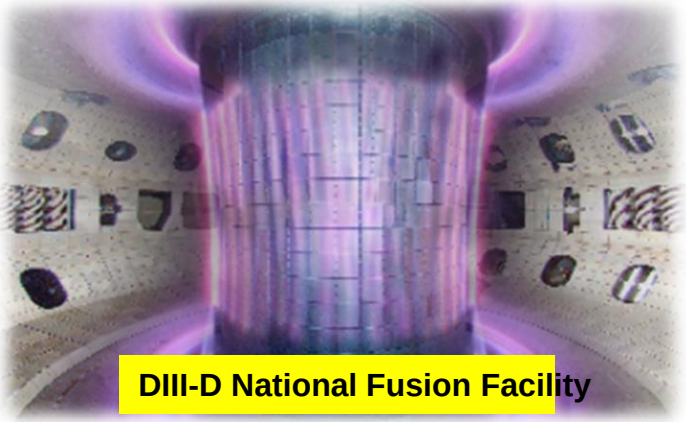
Tokamaks: Commonwealth Fusion Systems Tokamak Energy Inc.	**Laser Inertial Fusion:** Excimer Energy Inc. Focused Energy Inc.
Stellarators: Type One Energy Group Princeton Stellarators Inc.	**Linear Configurations:** Zap Energy Inc. Realta Fusion Inc.

- Technical diversity driven, in part, by industry's assessment of commercial viability
- And by reducing the risk of one approach encountering technical or scientific obstacles

The Milestone Program is Supported by Scientific and Technical Research in the Public Sector

- From user facilities to computation and modeling
  - Participation in ITER
  - IFE studies
- Budget Request for FY'24 includes:
  - Formation of R&D centers (fueling and blankets, materials, simulations, and enabling technologies)
  - R&D to explore a less expensive fusion neutron source for materials studies
  - Increased funding for milestone program
- Recent workshops have been held to ensure alignment between these research efforts and the goals of the milestone program

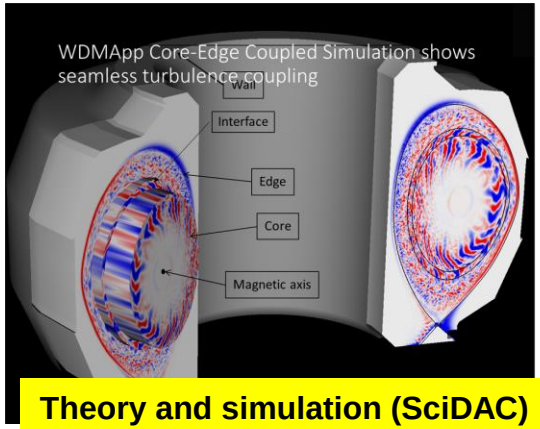
Office of Science – Fusion Energy Sciences (FES)



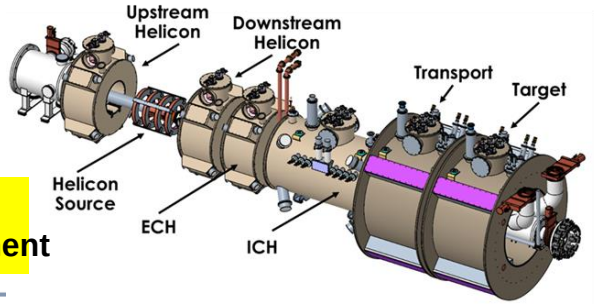
DIII-D National Fusion Facility

National Spherical Torus Experiment-Upgrad

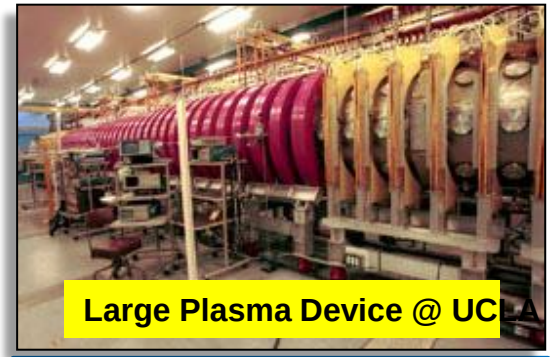
US ITER



Theory and simulation (SciDAC)

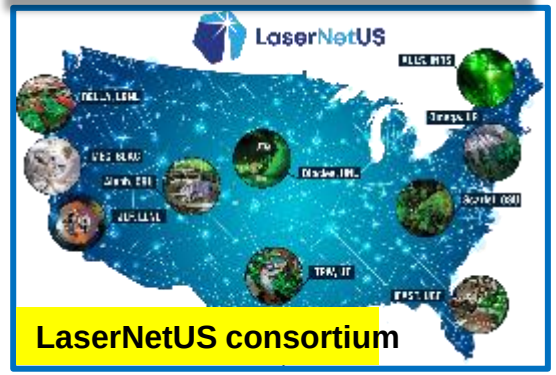


Material Plasma Exposure Experiment



Large Plasma Device @ UCLA

INFUSE public-private partnership program



LaserNetUS consortium

- *Advanced computing (SciDAC)*
- *Artificial intelligence*
- *Quantum information science*
- *Advanced manufacturing*
- *High-temperature superconductor magnets*
- *Public-private partnerships*

Also leverages investments by NNSA and ARPA-E

Development of Fusion Energy is Important for Mankind

- There are many approaches to achieve fusion energy both technical and financial

- U.S. DOE is partnering with private industry to accelerate the development of fusion and develop a fusion pilot plant

- Milestone program together with public R&D is focused on bridging the gaps from scientific and technical research to commercialization
  - Laboratories and universities have an important role in addressing the scientific and technical challenges
  - Private industry is focused on the challenges of commercialization