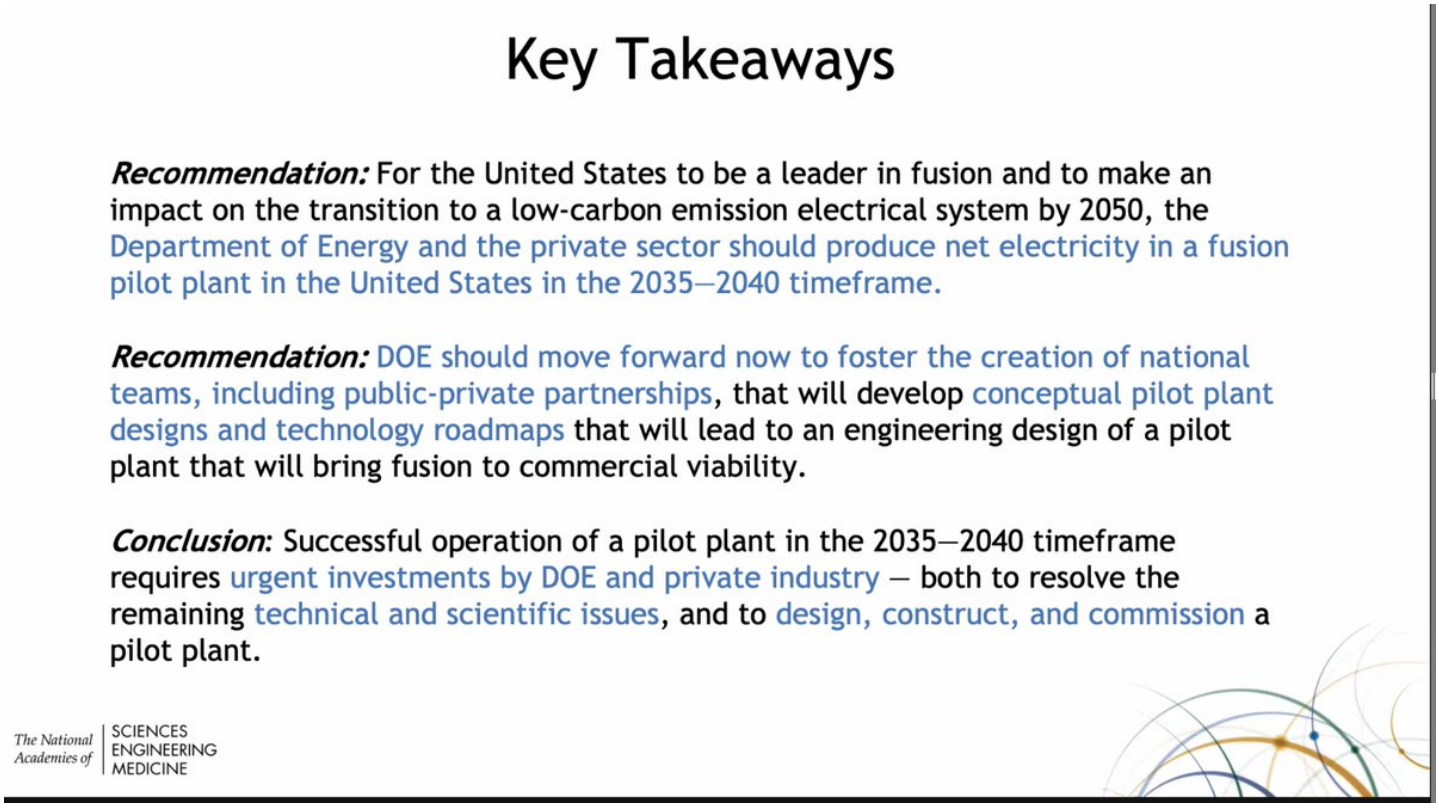
Twitter Thread by Guerin Green

Guerin Green
@GuerinGreen

Bringing Fusion to the Grid 'tweetstorm'



Nat'l Academy of Science on bringing #fusion to the grid

Key Takeaways

Recommendation: For the United States to be a leader in fusion and to make an impact on the transition to a low-carbon emission electrical system by 2050, 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.

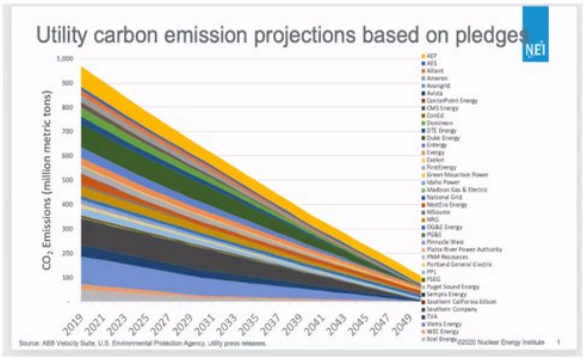
Recommendation: DOE should move forward now to foster the creation of national teams, including public-private partnerships, that will develop conceptual pilot plant designs and technology roadmaps that will lead to an engineering design of a pilot plant that will bring fusion to commercial viability.

Conclusion: Successful operation of a pilot plant in the 2035—2040 timeframe requires urgent investments by DOE and private industry — both to resolve the remaining technical and scientific issues, and to design, construct, and commission a pilot plant.

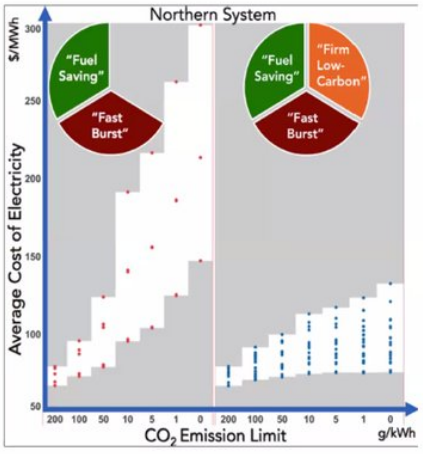
The National Academies of SCIENCES ENGINEERING MEDICINE

#fusion would be key to future electrical generation mix

Role of the Pilot Plant:
Future Electricity Generation Market



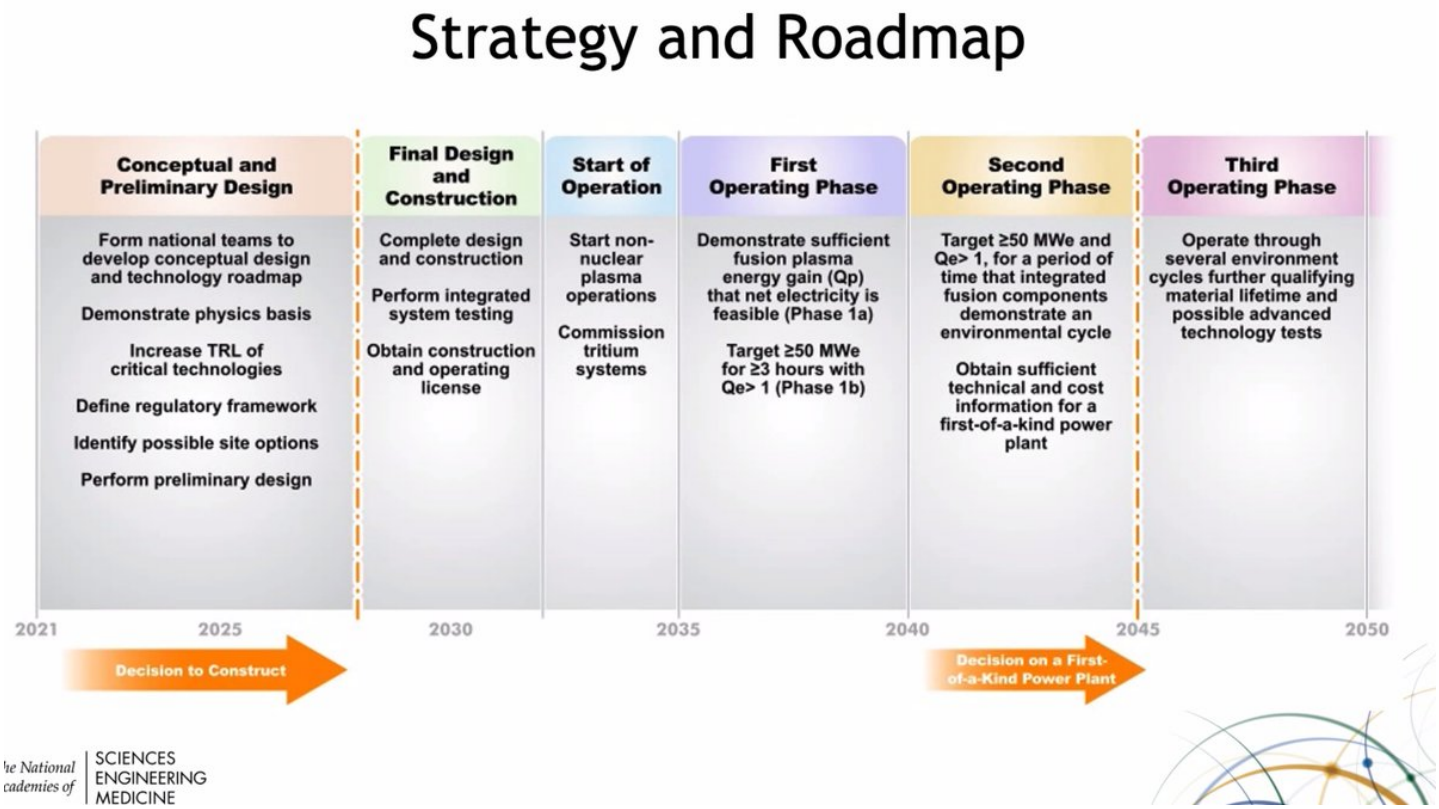
Utilities foresee a transition to low-carbon electrical generation by 2050.



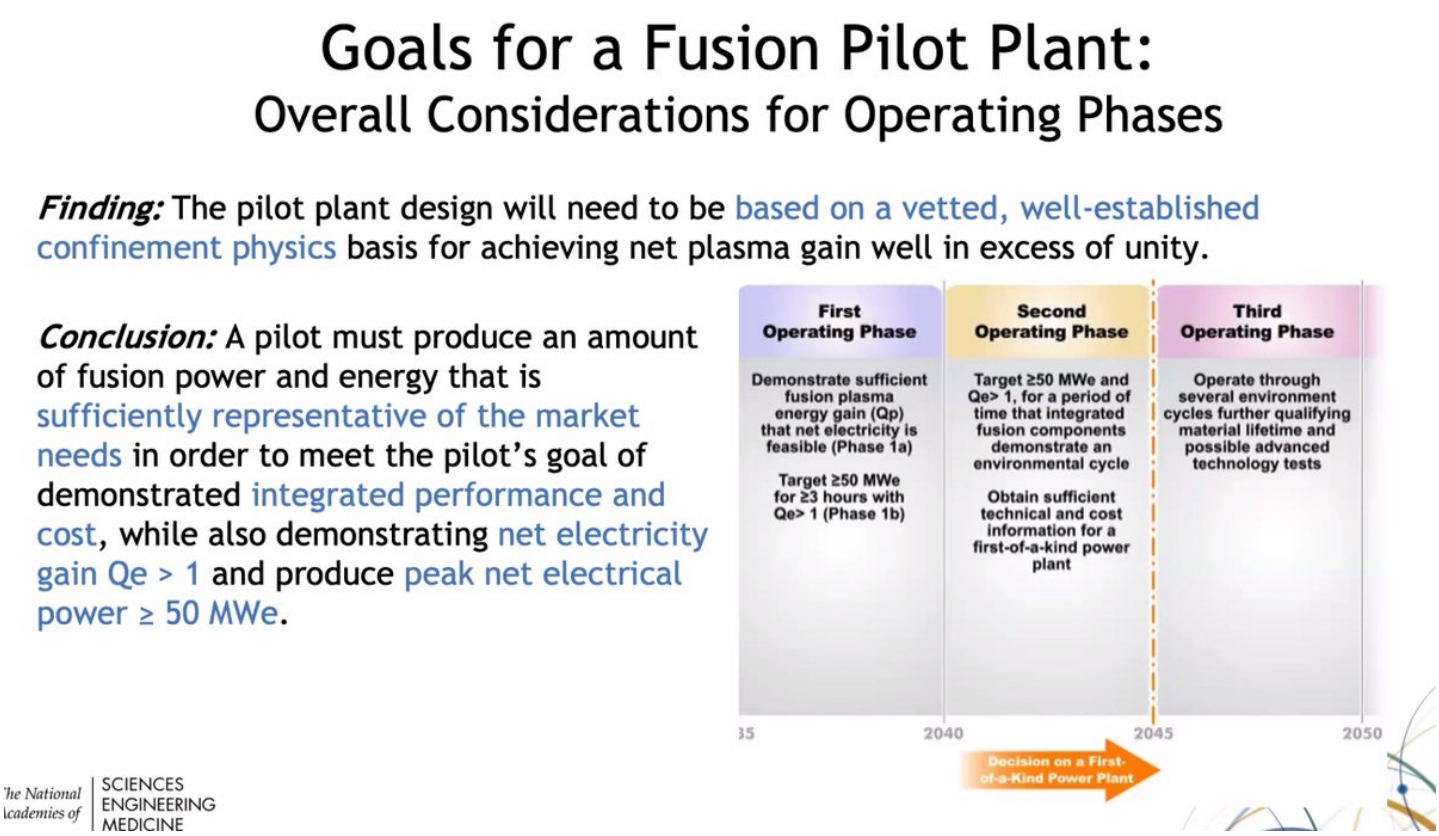
Firm low-carbon/non-carbon electrical energy generation will be needed to decrease the cost.

The National Academies of SCIENCES ENGINEERING MEDICINE

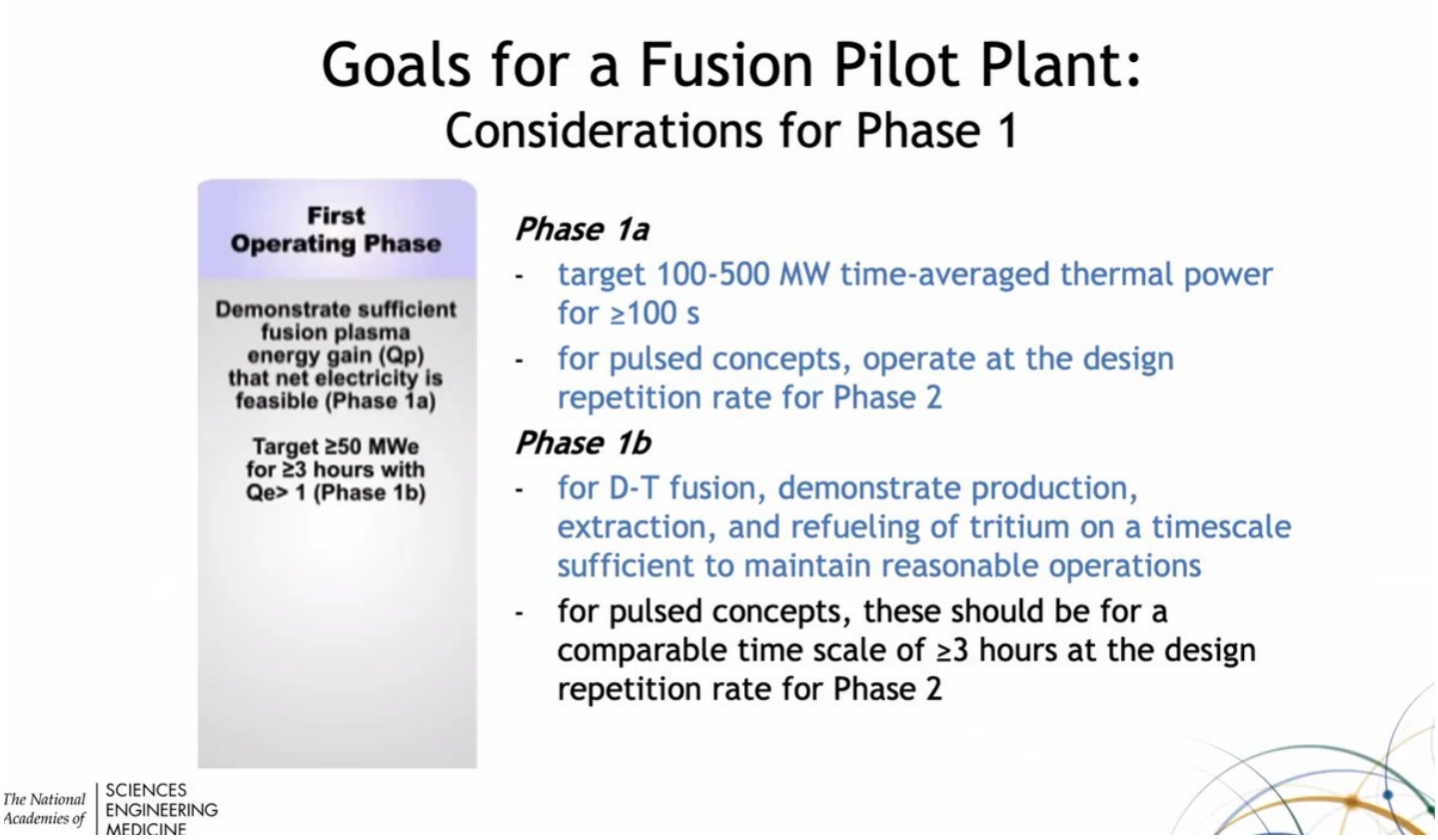
Report suggests the beginning of #fusion operating plant as soon as end of the decade



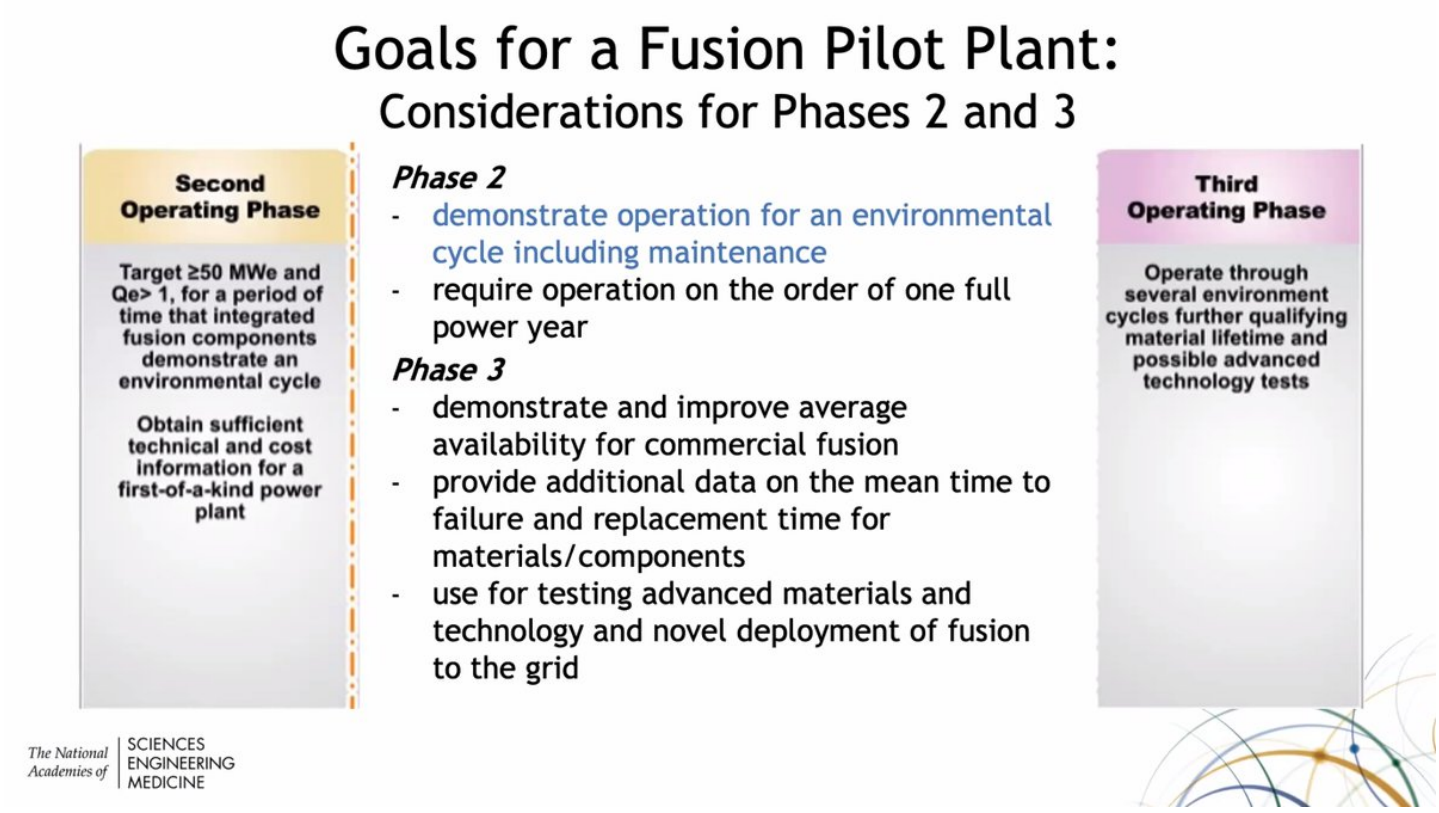
https://t.co/UMapDuWjTa



Keyed to a particular fusion #fuelcycle



https://t.co/yd9hjFgLQS



Key guidepost - pilot plant cost of $5-6 billion

Goals for a Fusion Pilot Plant:
Economic Considerations

Finding: On the basis of today's energy market and costs, the fusion First-of-a-Kind power plant will need to have a total overnight construction cost less than $5 billion to $6 billion in order to be viable in the present U.S. electrical marketplace with a projected operation life of at least 40 years for the plant.

Conclusion: A fusion pilot plant should have a generating power >50 MWe and total overnight construction cost <5-6 B$.

The National Academies of | SCIENCES ENGINEERING MEDICINE

https://t.co/onJm1NOrLM

Goals for a Fusion Pilot Plant:
Additional Topics Addressed

- Integrated fusion and electric power performance
- Materials and manufactured components
- Fuel and Ash
  - D-T fuel cycle – need for tritium breeding
  - Alternative fuel cycles to D-T
- Reliability and availability
- Environmental and safety consideration
- Regulatory process

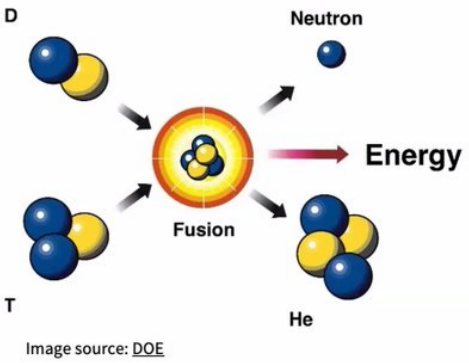


Image source: DOE

The National Academies of | SCIENCES ENGINEERING MEDICINE

https://t.co/5P1eSNehy7

Innovation and Research Needs:
Overall Innovation Strategy

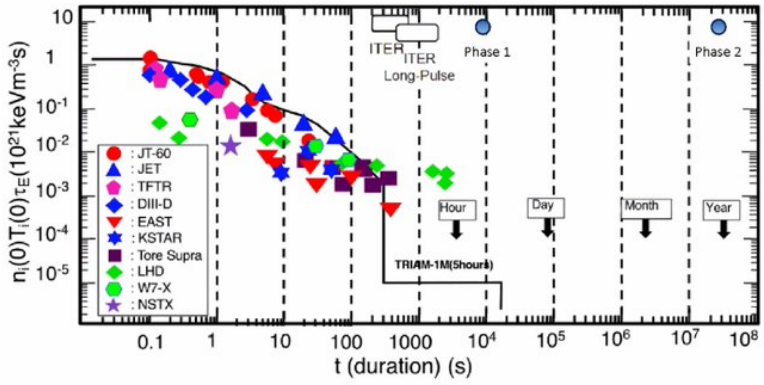
Recommendation: To meet the challenge of having a viable design by 2028 and initial pilot plant operation in the 2035-2040, innovations in fusion confinement concepts and technology to extract fusion power and close the fusion fuel cycle should be developed in parallel. This will enable the engineering design of a pilot plant and the construction decisions to be accelerated by a combination of government and private funding.

The National Academies of | SCIENCES ENGINEERING MEDICINE

https://t.co/00dksiNrZH

Innovation and Research Needs:
Fusion Plasma Confinement and Pulse Duration

Fusion triple product vs. plasma duration



Conclusion: Before proceeding to the fina pilot plant design phase, a DT fusion conc should simultaneously demonstrate temperatures of at least 100 million °C, a a triple product >2 (in units of 10^{21} keV s corresponding to an DT equivalent plasma energy gain >1.

Conclusion: For alternate fuels, equivale parameters needed for net plasma energy gain must be demonstrated.

The National Academies of | SCIENCES ENGINEERING MEDICINE

significant hurdles include basic science and materials needs

Innovation and Research Needs:
Additional Topics Addressed

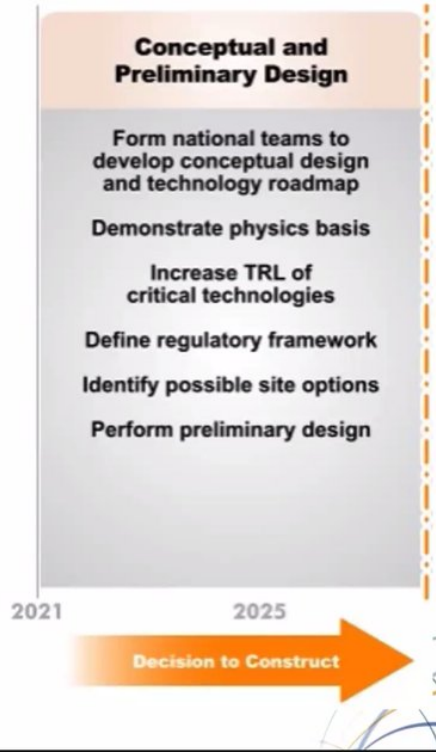
- Scientific and technical innovations and research advances
  - Fusion performance and plasma confinement
  - High heat flux challenge: plasma facing components
  - High temperature superconducting magnets
  - Structural and function materials: neutron degradation assessment
  - Closing the fuel cycle: tritium processing, developing a breeding blanket
- Many technological elements are at a low level of technical readiness
- Participants in developing a pilot plant
  - Workforce issues including Diversity, Equity and Inclusion
- Models for Public-Private Partnerships
- ITER contributions to a pilot plant

The National Academies of | SCIENCES ENGINEERING MEDICINE

https://t.co/O5WP346Z5m

Strategy and Roadmap

Recommendation: The Department of Energy should move forward now to foster the creation of national teams, including public-private partnerships, that will develop conceptual pilot plant designs and technology roadmaps and lead to an engineering design of a pilot plant that will bring fusion to commercial viability.



The National Academies of | SCIENCES ENGINEERING MEDICINE

https://t.co/lexcg30Uku

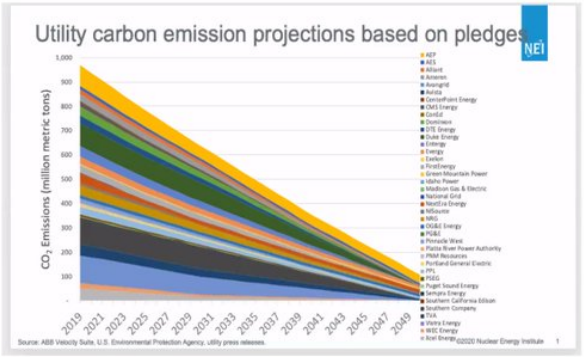
Strategic Risks and Opportunities

Risks	Opportunities	Mitigation
• Level of scientific and technological readiness resulting in schedule risk • Schedule will not support the electricity transition • U.K. or China will be first to put fusion on the grid • Obtaining public and private funding	• Engagement of the private sector • Impact the transition to low-carbon emission electricity • Be a leader in the development of fusion energy	• Perform R&D in parallel with design • Decision points to evaluate progress

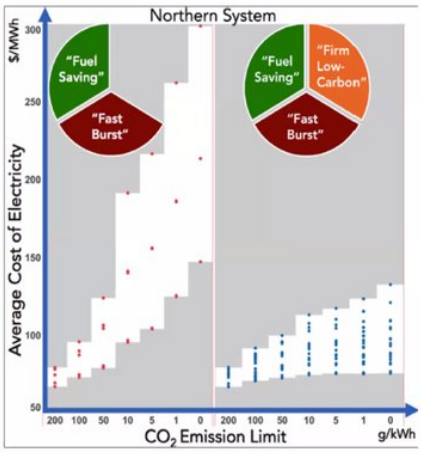
The National Academies of | SCIENCES ENGINEERING MEDICINE

https://t.co/0pd9a8xCBY

Role of the Pilot Plant:
Future Electricity Generation Market



Utilities foresee a transition to low-carbon electrical generation by 2050.



Firm low-carbon/non-carbon electrical energy generation will be needed to decrease the cost.

The National Academies of | SCIENCES ENGINEERING MEDICINE

Availability of #tritium - very limited worldwide supply - key hurdle and need for urgency

@threadreaderapp unroll #fusion #NAS #fusiontweetstorm