Laser Inertial Fusion Energy (LIFE) - a path to US energy independence

Presented to: 2012 annual meeting of the Southern States Energy Board

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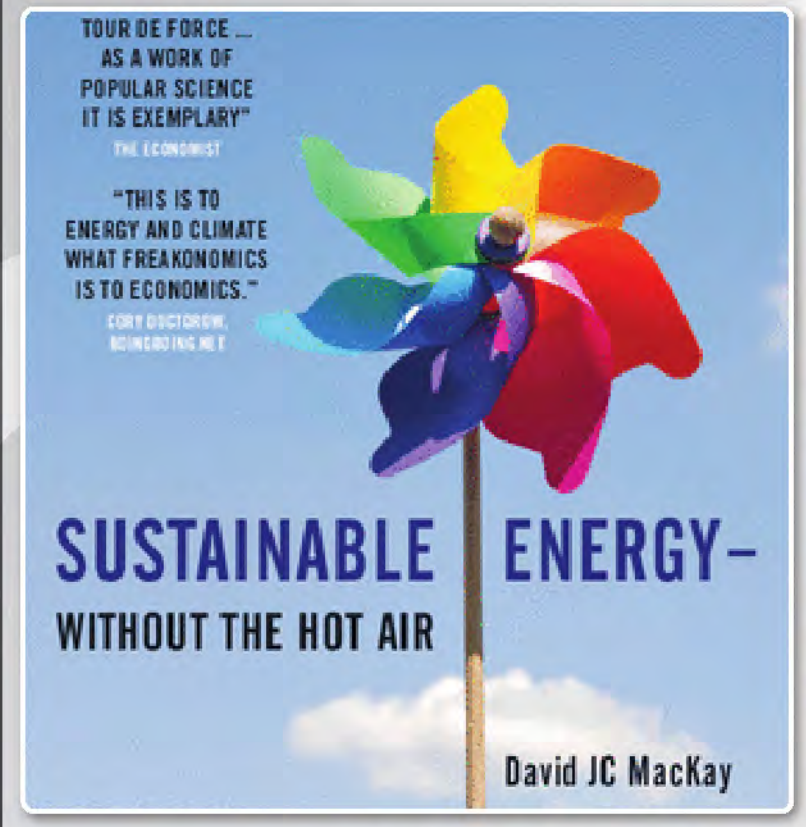
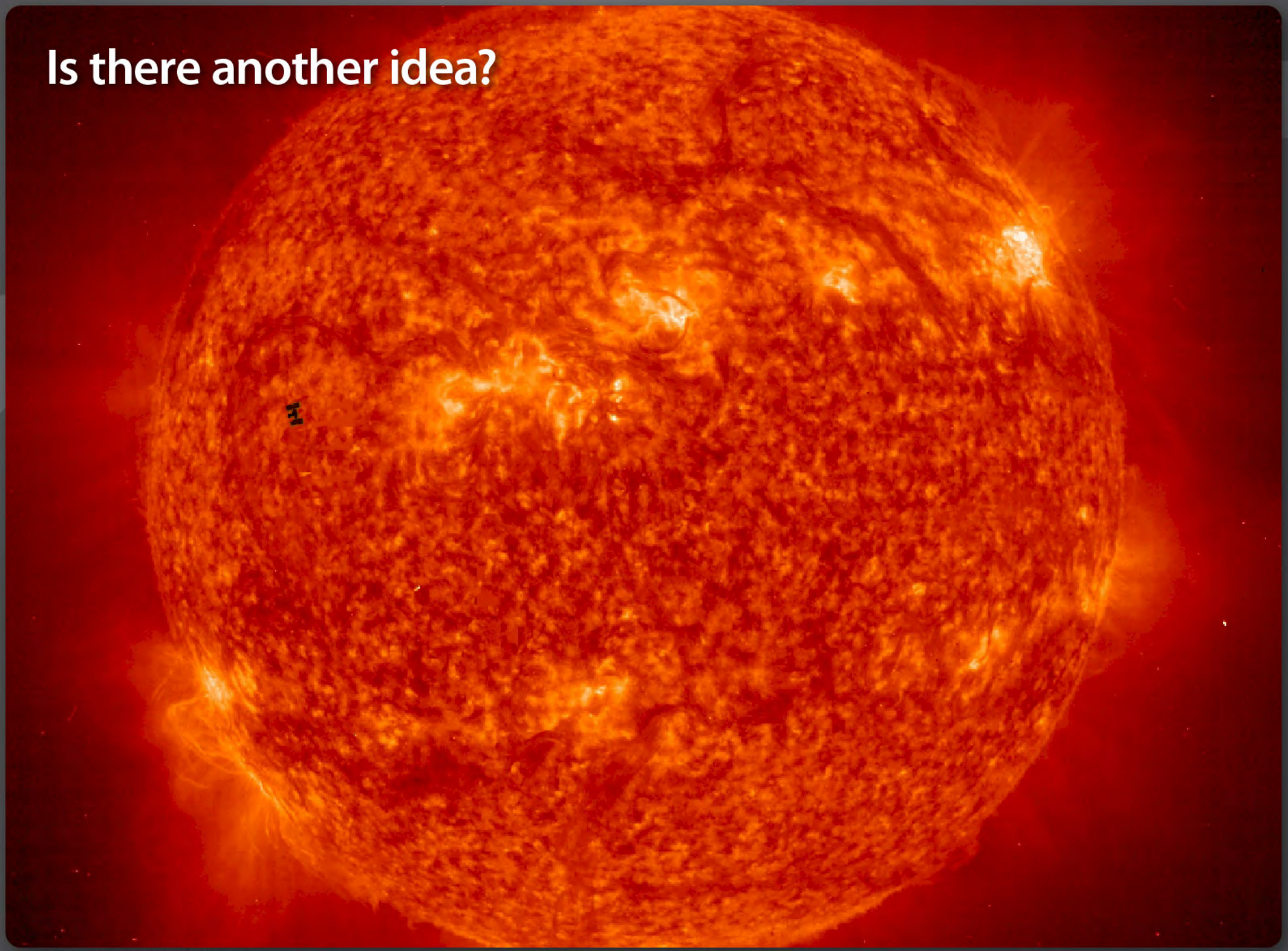
This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

Careful analysis shows there is no simple solution



Is there another idea?



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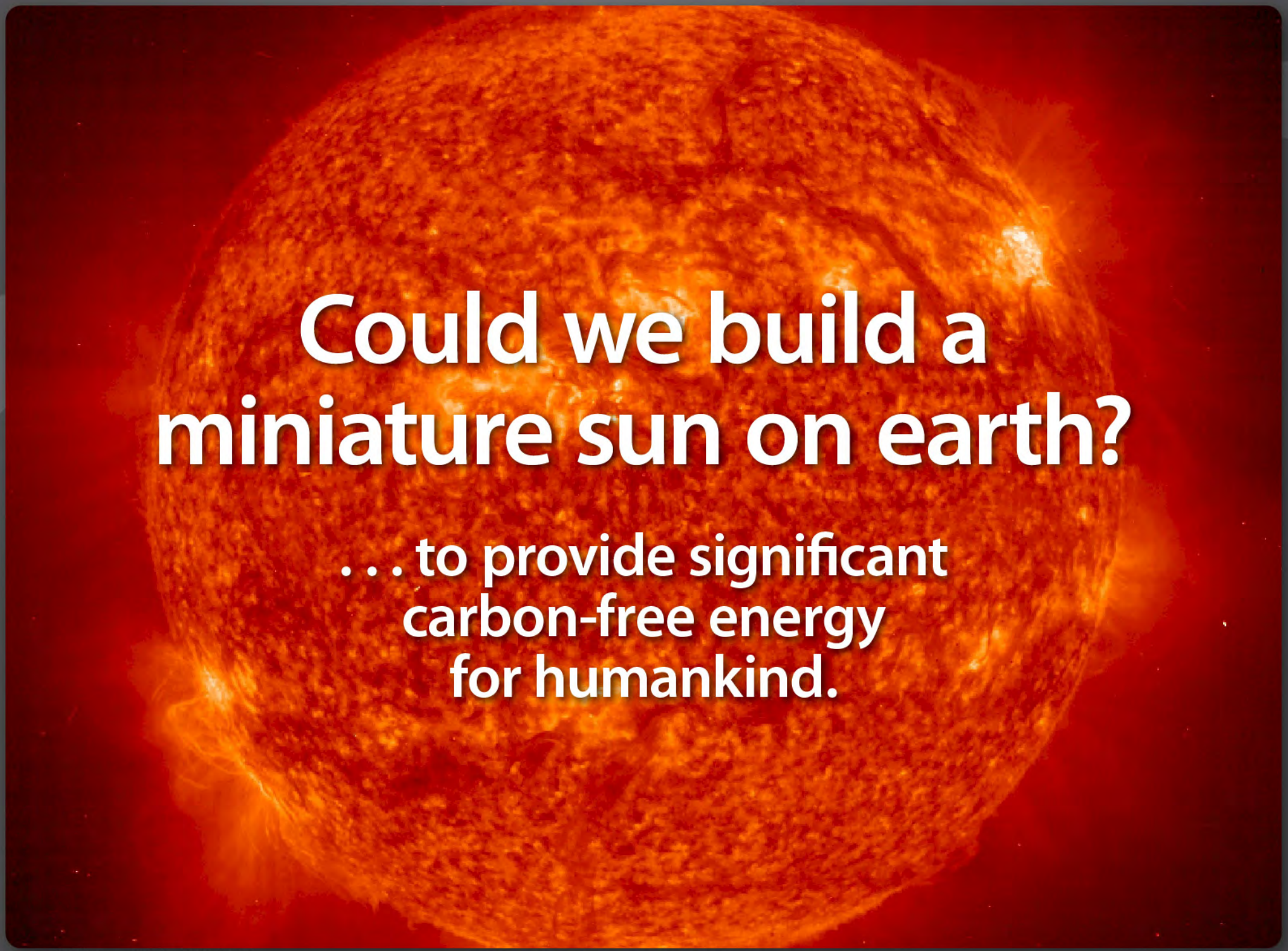
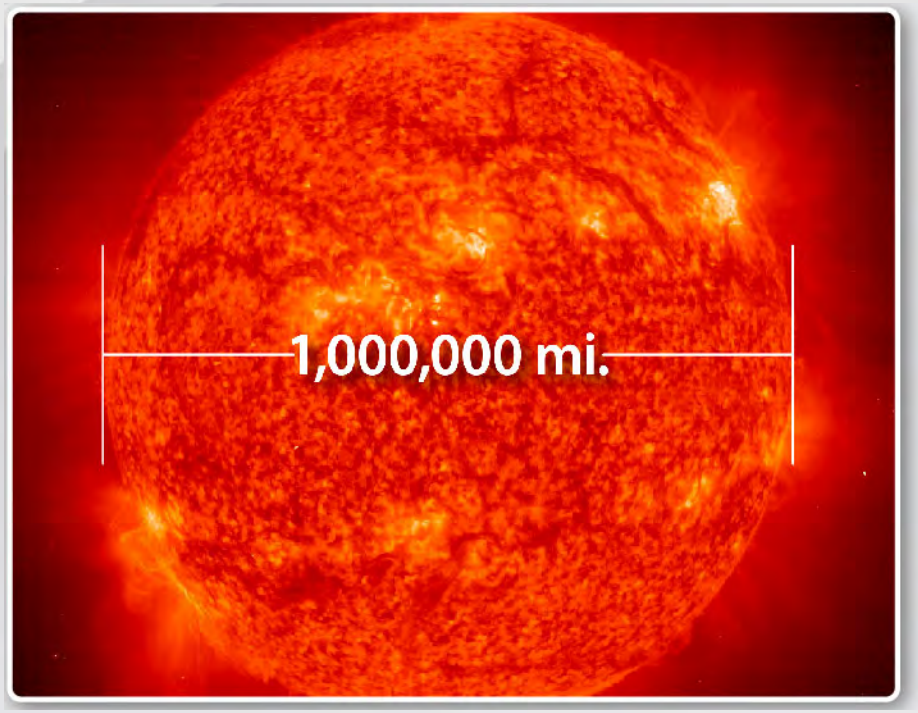
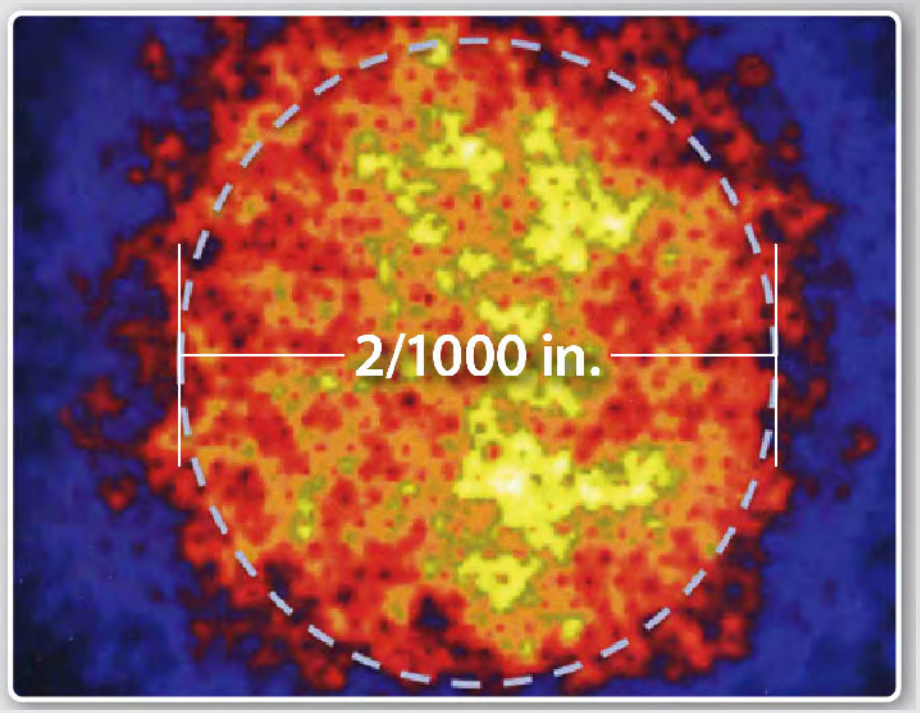
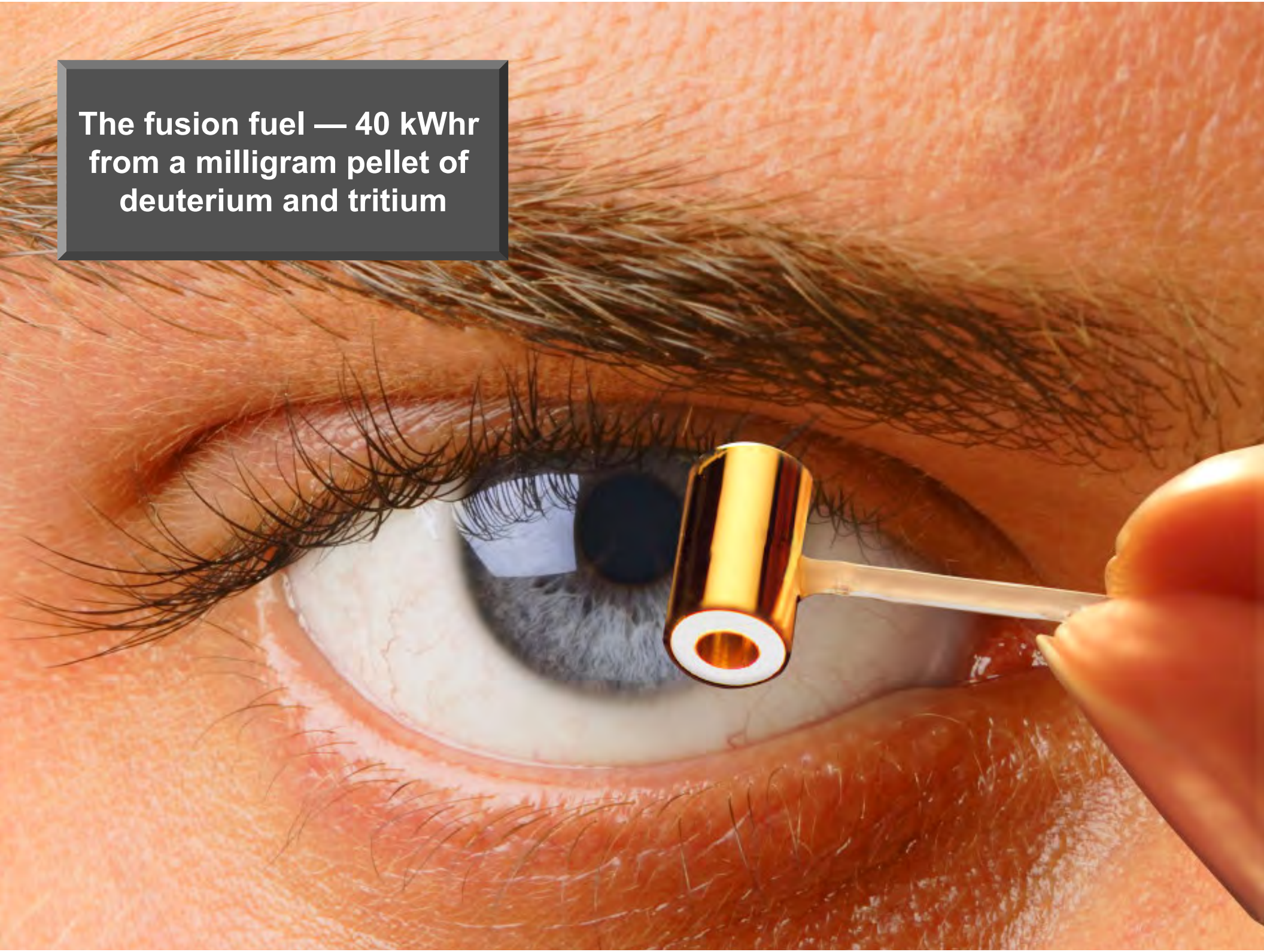

Could we build a miniature sun on earth?
. . . to provide significant carbon-free energy for humankind.

Bringing star power to Earth

Use very high power lasers to create fusion – releasing city-scale energy output, safely and sustainably






The fusion fuel — 40 kWhr
from a milligram pellet of
deuterium and tritium

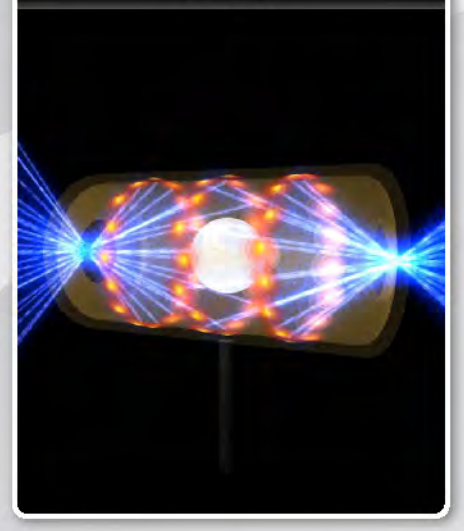
One liter of heavy water has the energy of more than 2 million gallons of gasoline

Gasoline

Heavy water

Fusion energy is attractive, but needs to be timely

Safe



Sustainable

Energy security

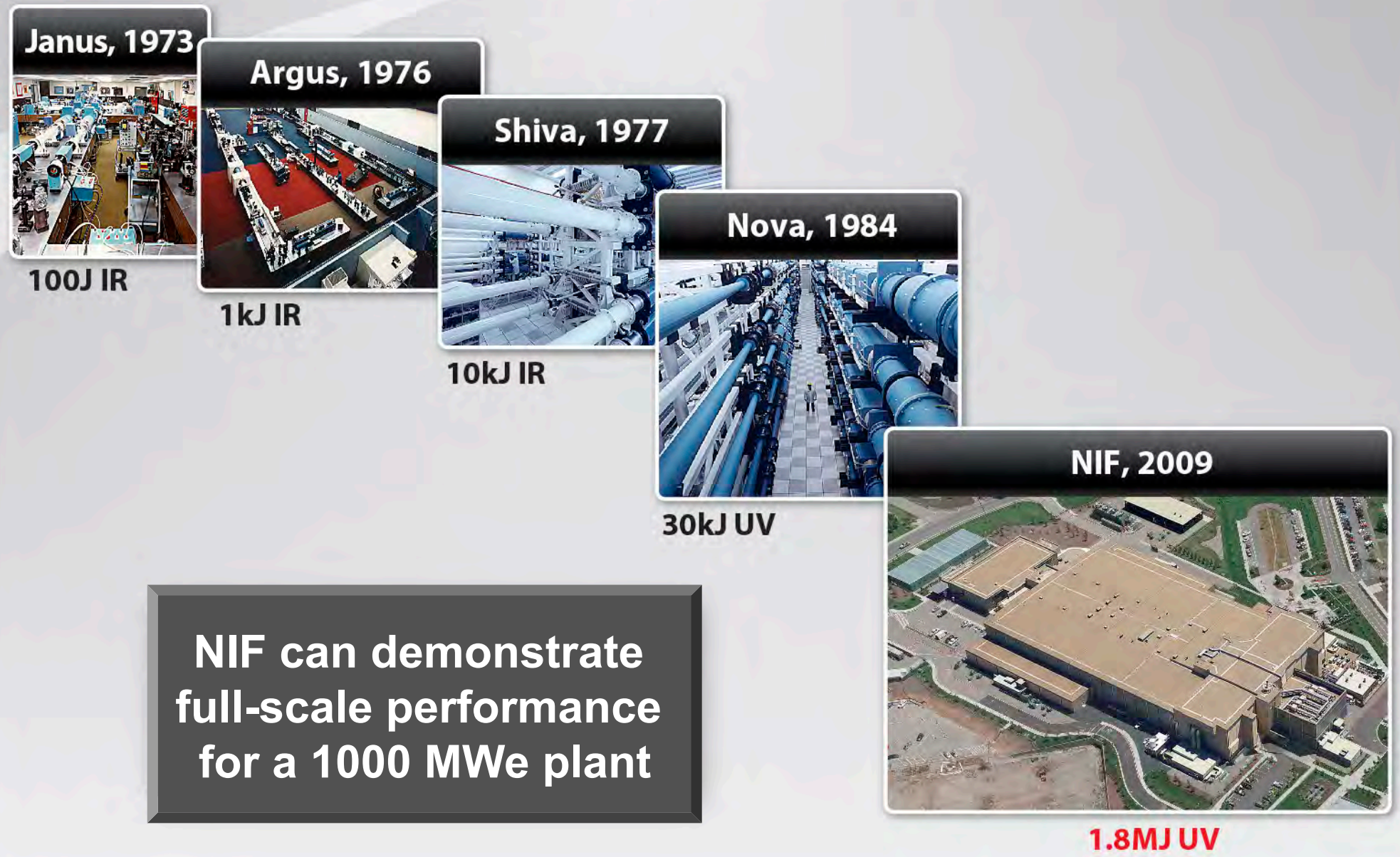
Baseload

Carbon-free

Industrially attractive

No geologic storage

The NIF facility is the culmination of many decades of US leadership and investment in this field

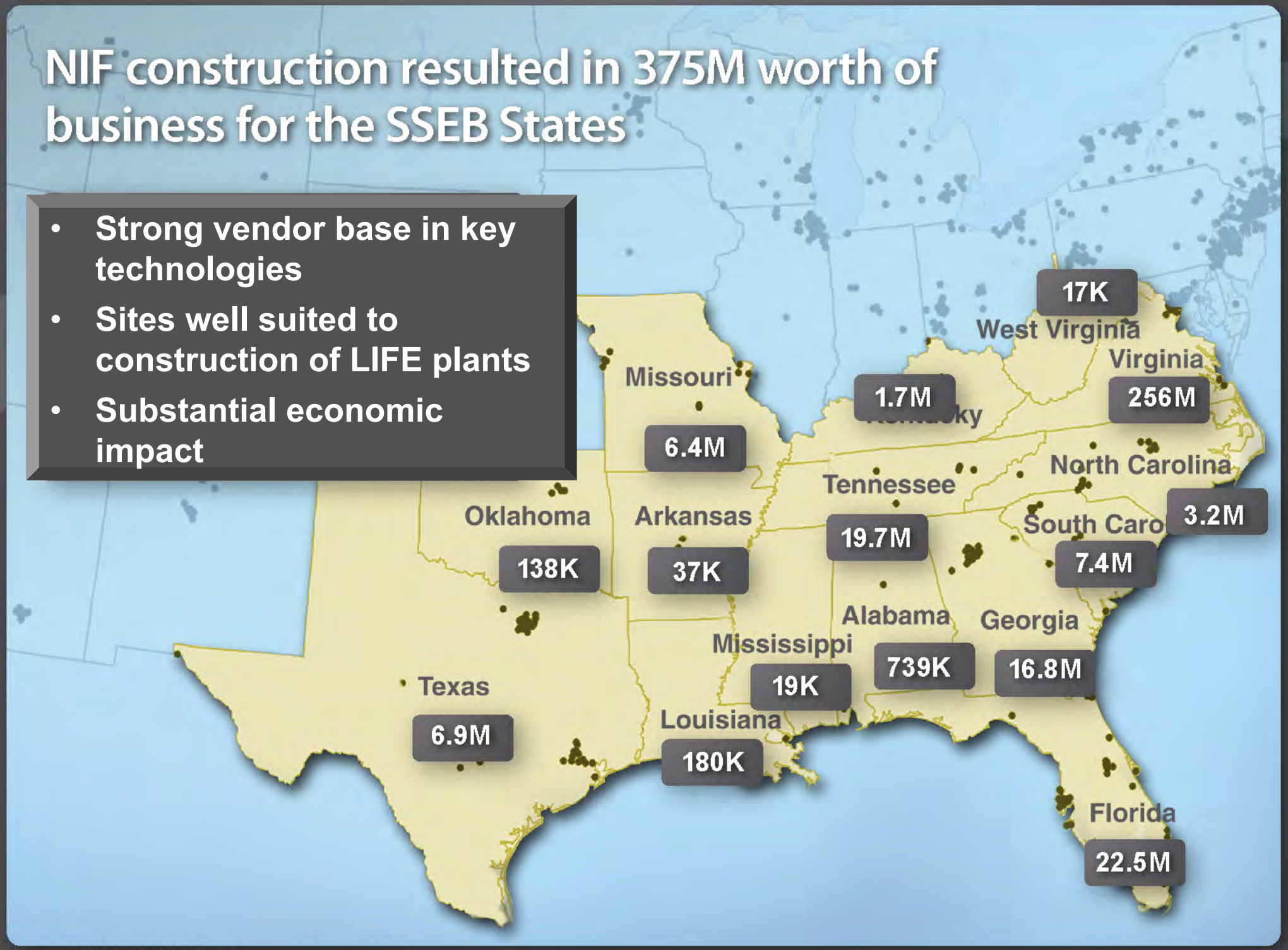


NIF can demonstrate full-scale performance for a 1000 MWe plant

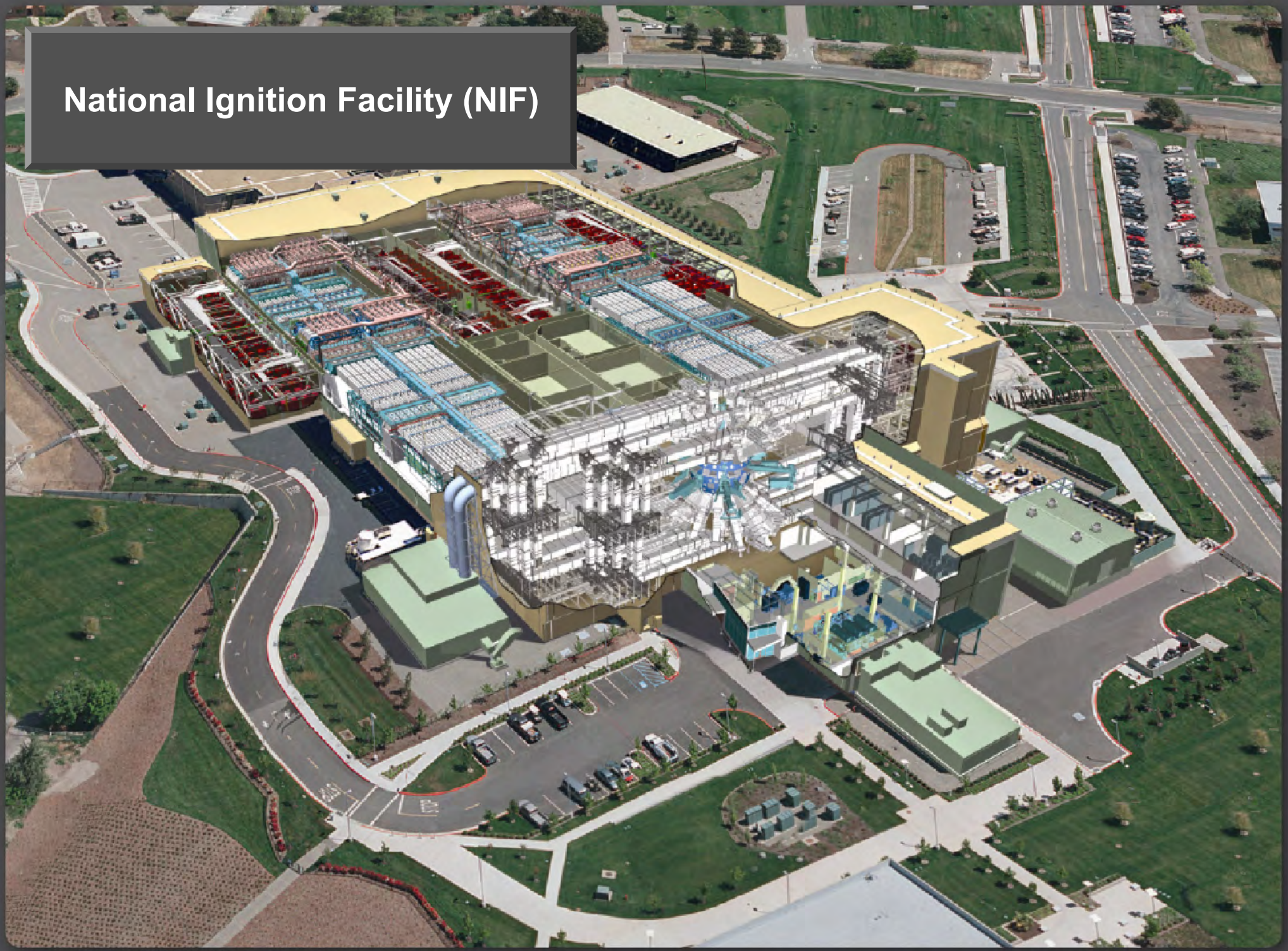
U.S Partners in NIF Enterprise

NIF construction resulted in 375M worth of business for the SSEB States

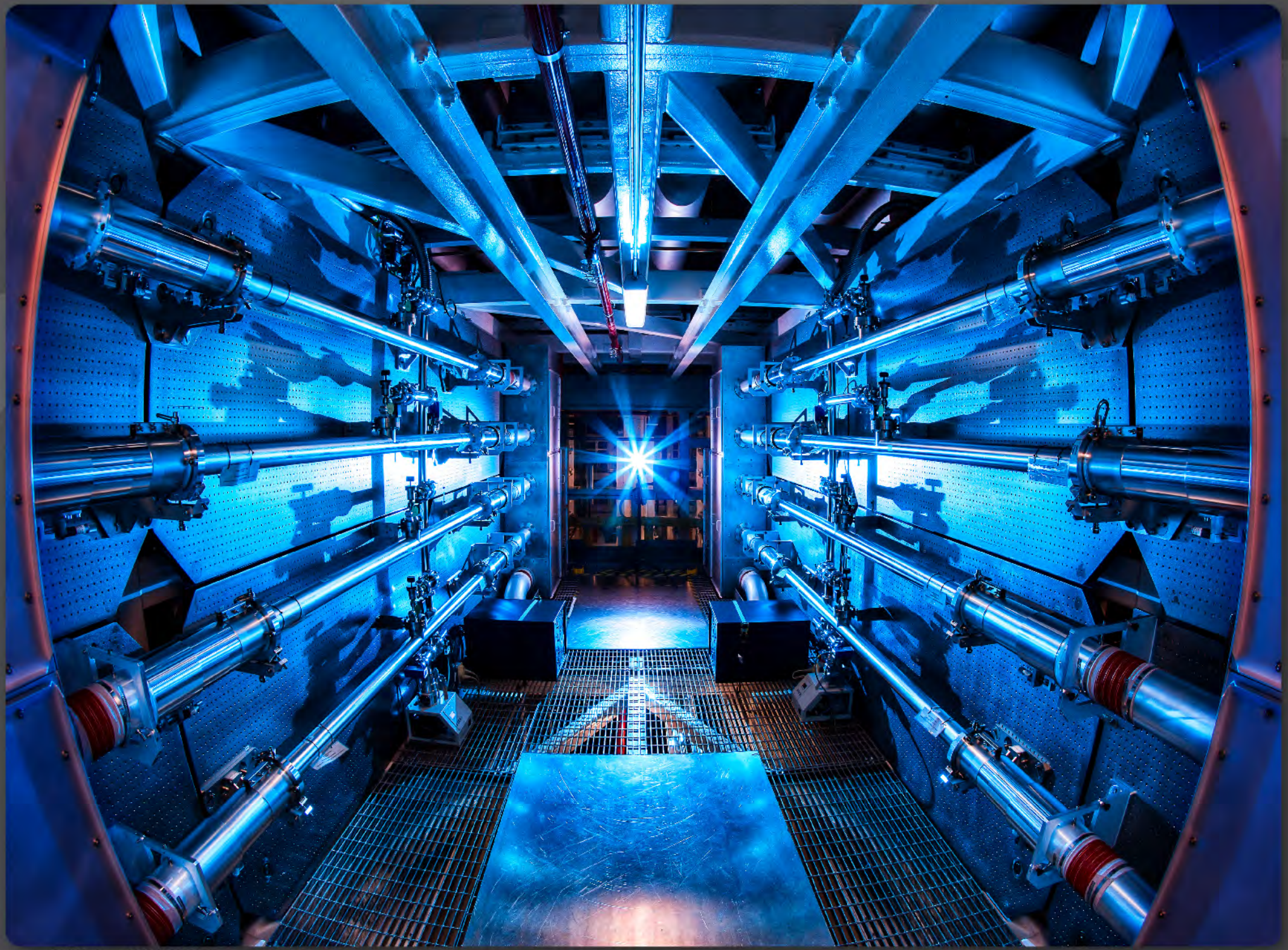
- Strong vendor base in key technologies
- Sites well suited to construction of LIFE plants
- Substantial economic impact



National Ignition Facility (NIF)




FLIGHT
DIRECTOR



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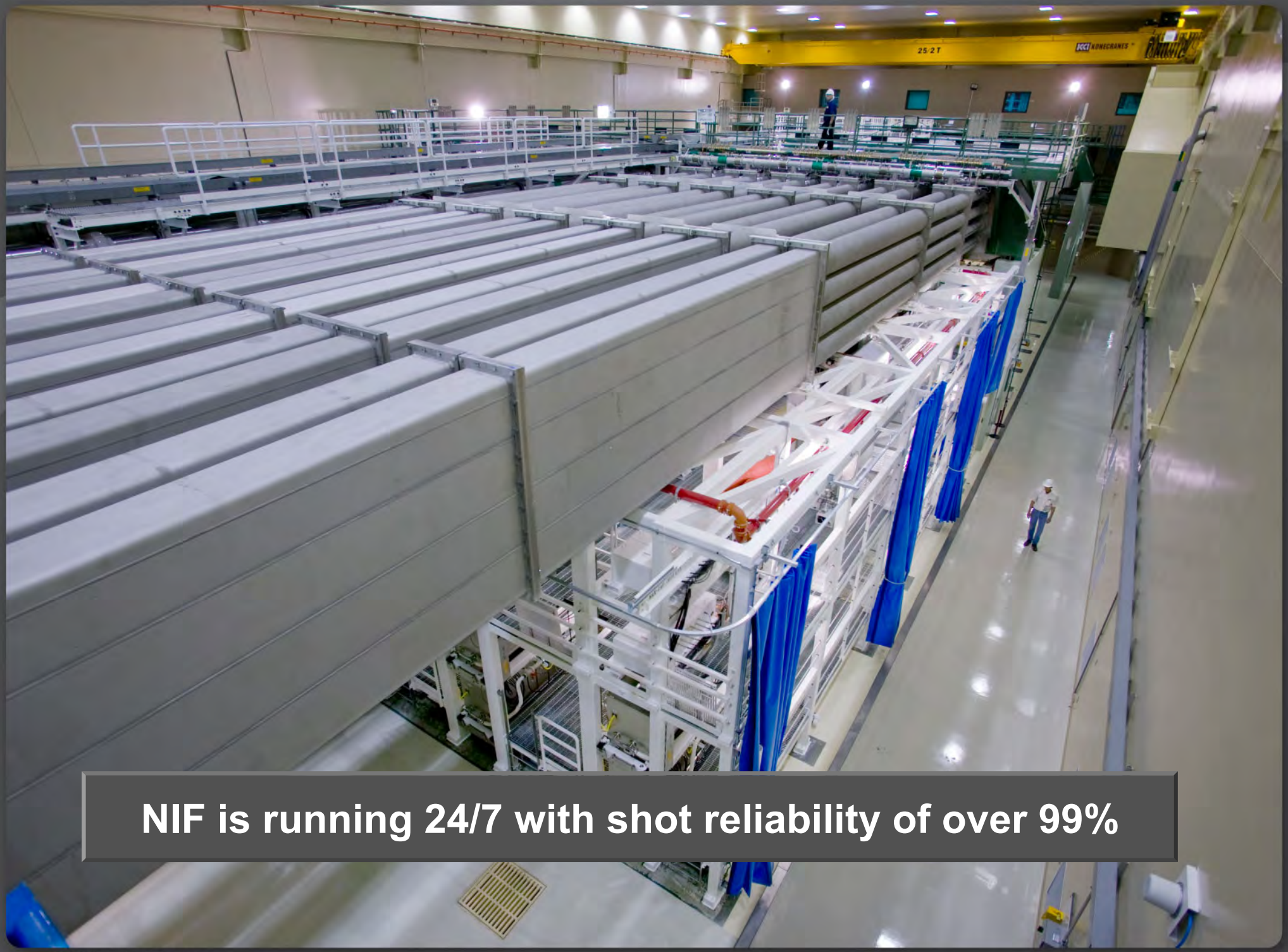
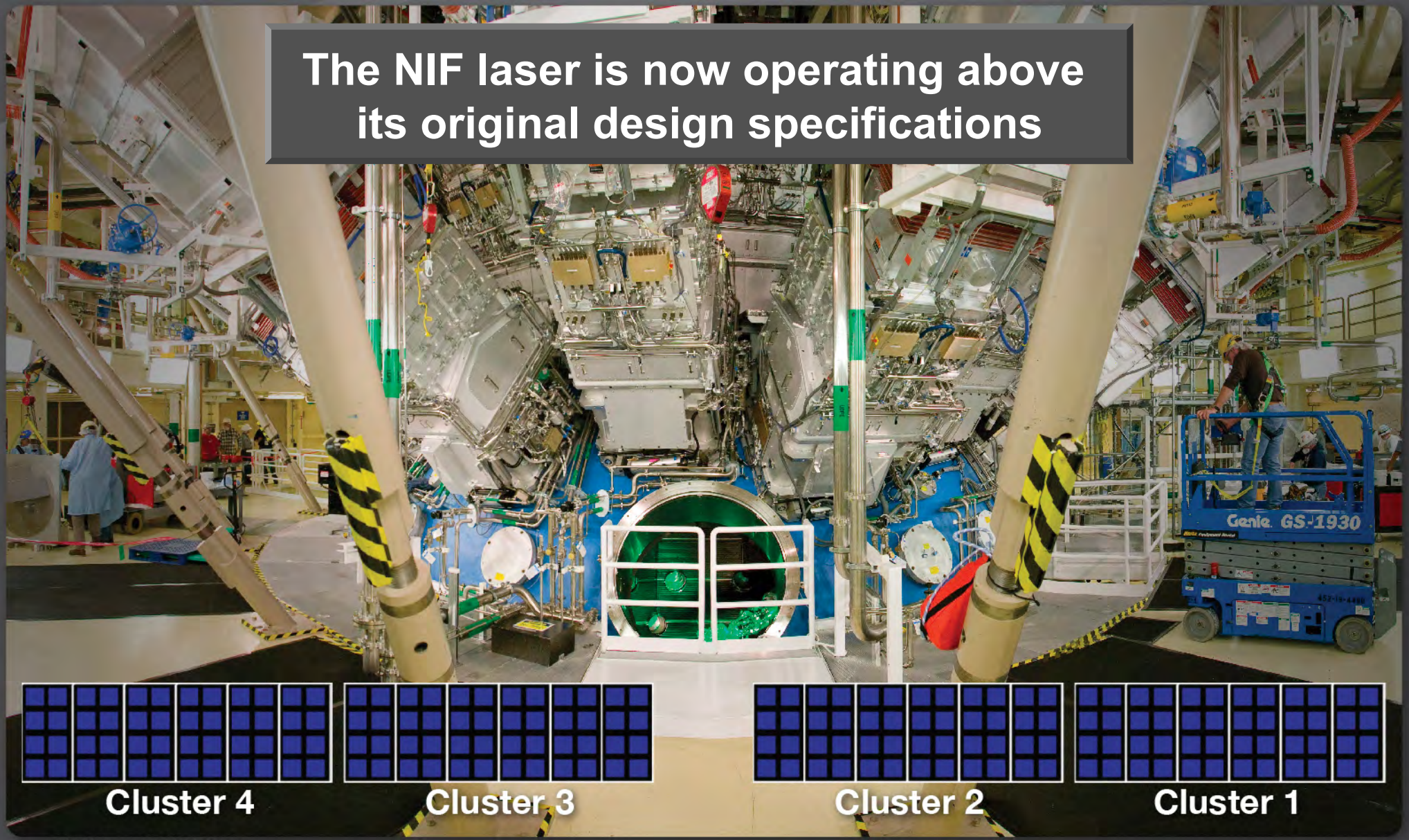


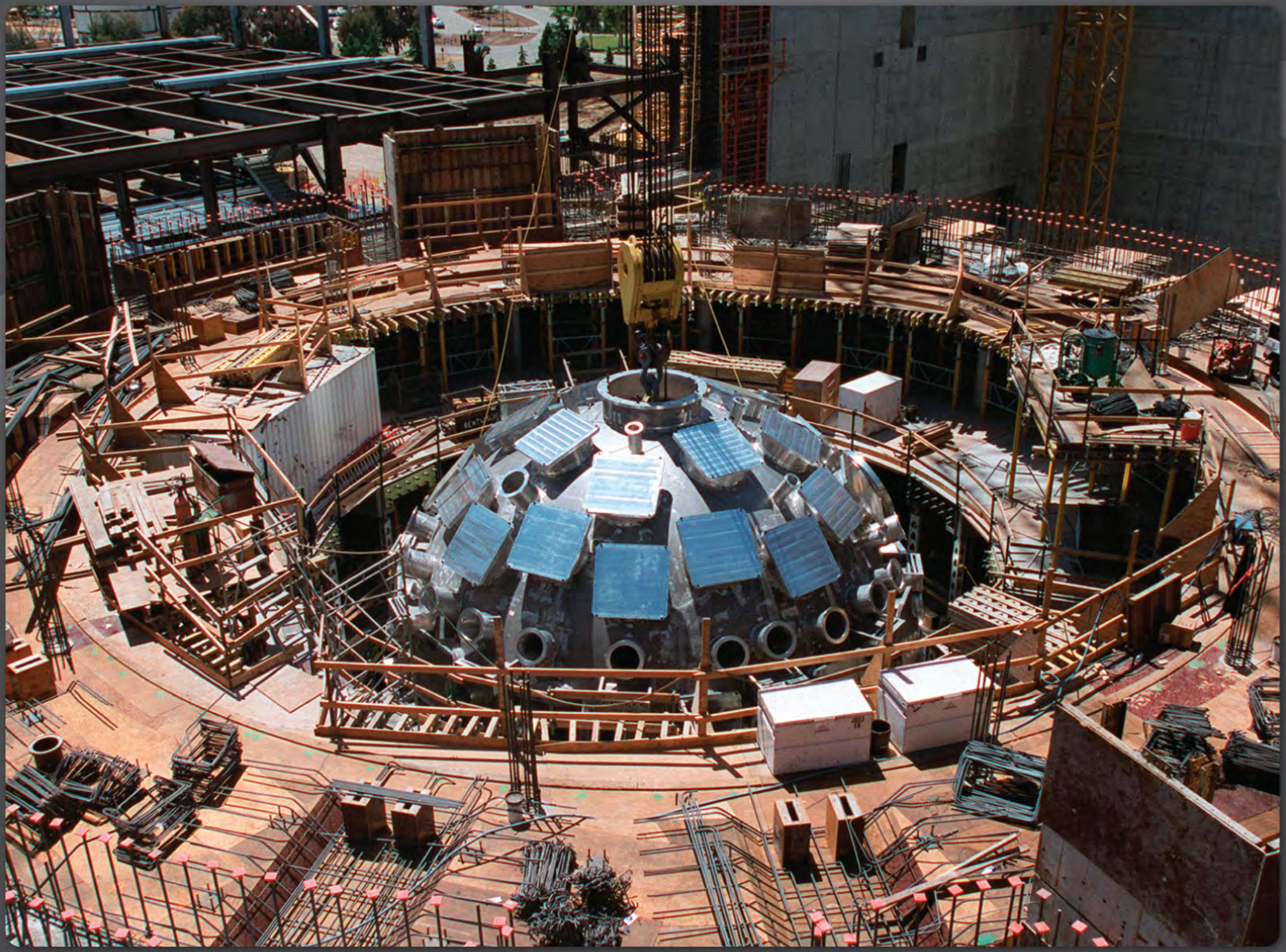
NIF is running 24/7 with shot reliability of over 99%

March 15, 2012
1.875 MJ
411 TW

July 5, 2012
1.855 MJ
523 TW



Target Chamber Dedication June 1999



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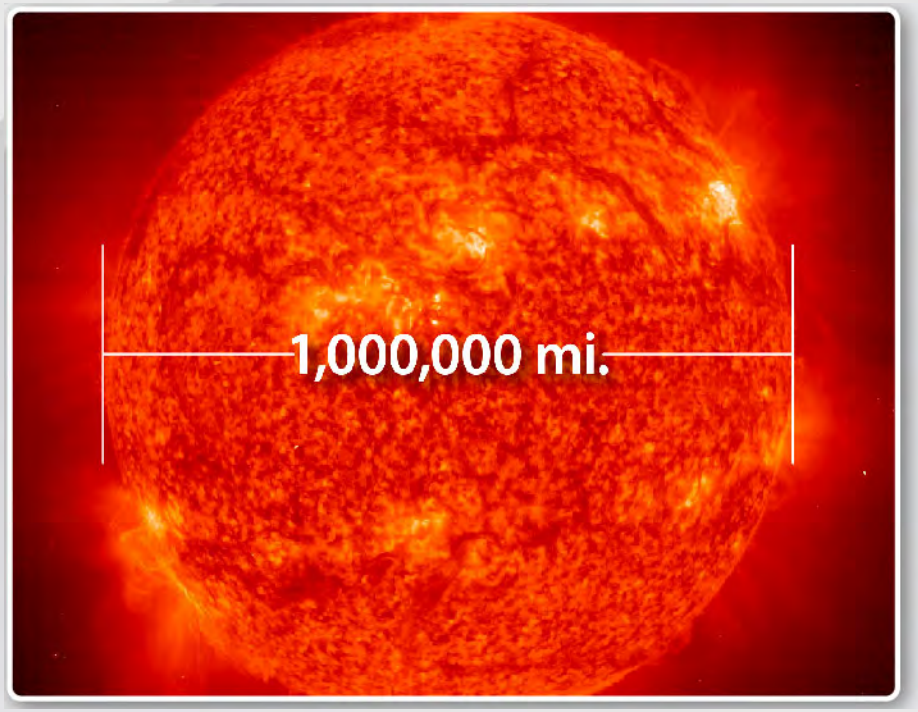
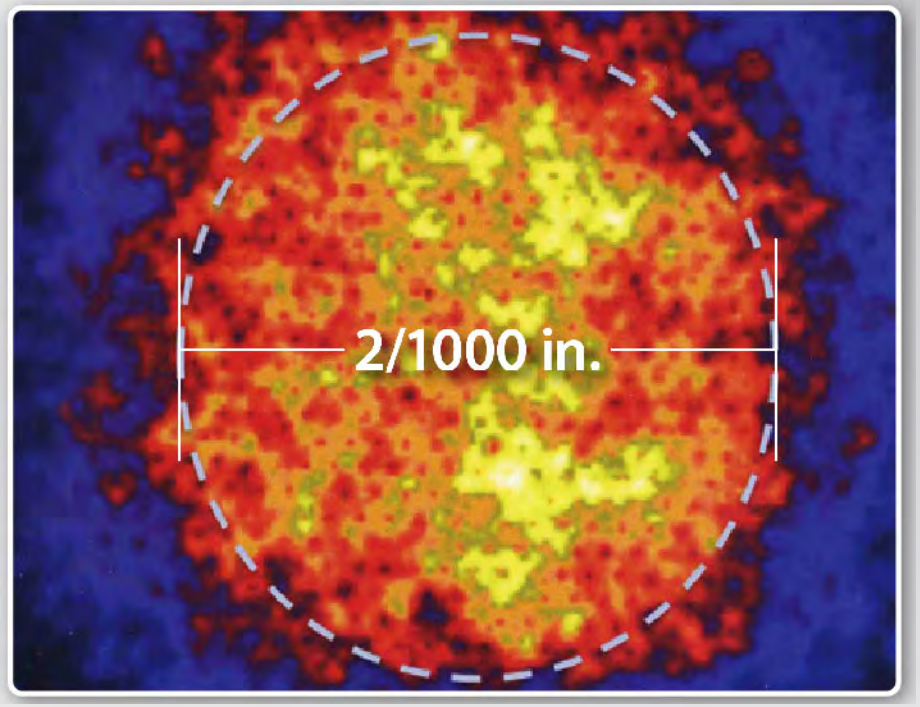
In the Target Chamber

Bringing star power to Earth

The program is focused on achieving "ignition" – the culmination of over 50 years work





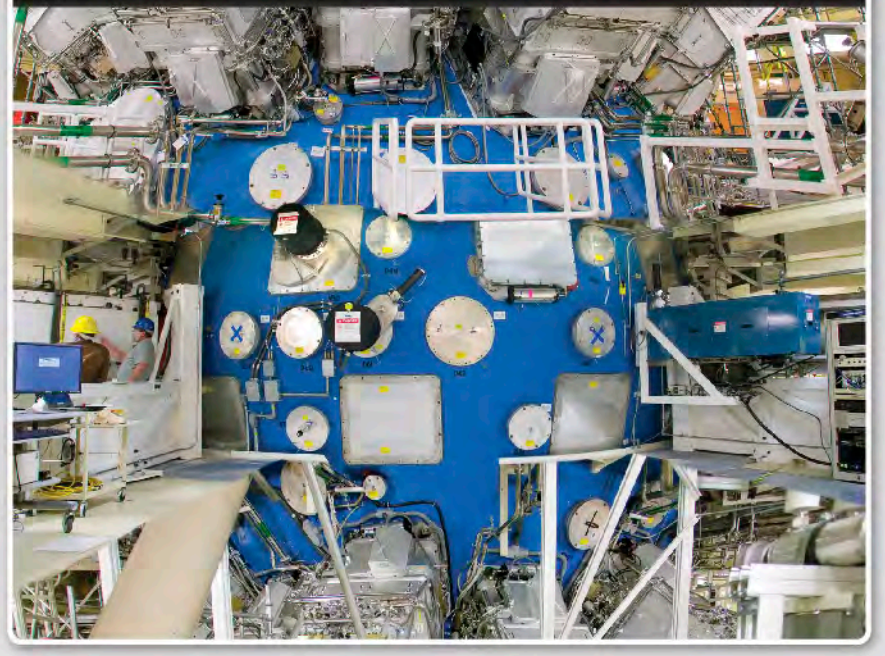
Progress over the past 18 months:
Factor 60 improvement in fuel pressure. Factor 2-3 to go.

NIF can demonstrate full-scale performance for a power plant based on Laser Inertial Fusion Energy (LIFE)

International activity in this area

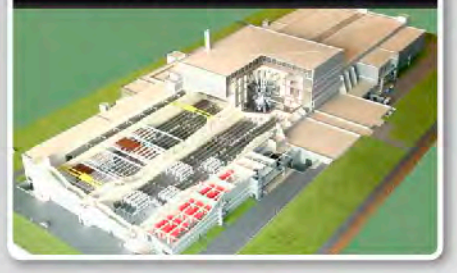
China - SG-III

USA - NIF Laser

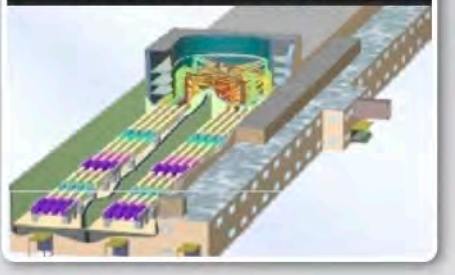


UK - ORION

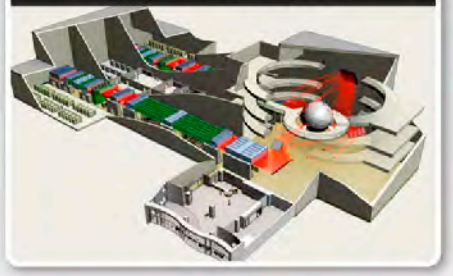
France - LMJ



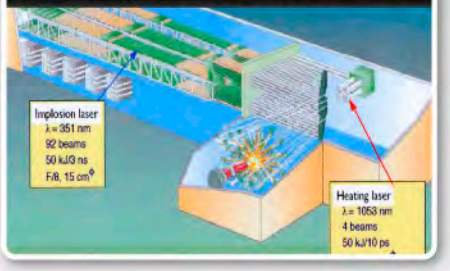
Russia - ISKRA



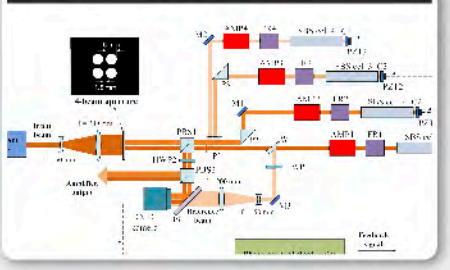
EU - HiPER



Japan - FIREX



Korea




LIFE: A sustainable, carbon-free source of safe baseload electricity
• Security of supply (reducing our reliance on foreign oil imports)
• No enrichment, no reprocessing, and no high-level radioactive waste
• Global commercial competitiveness from a U.S.-led solution
• Compatibility with existing grid infrastructure
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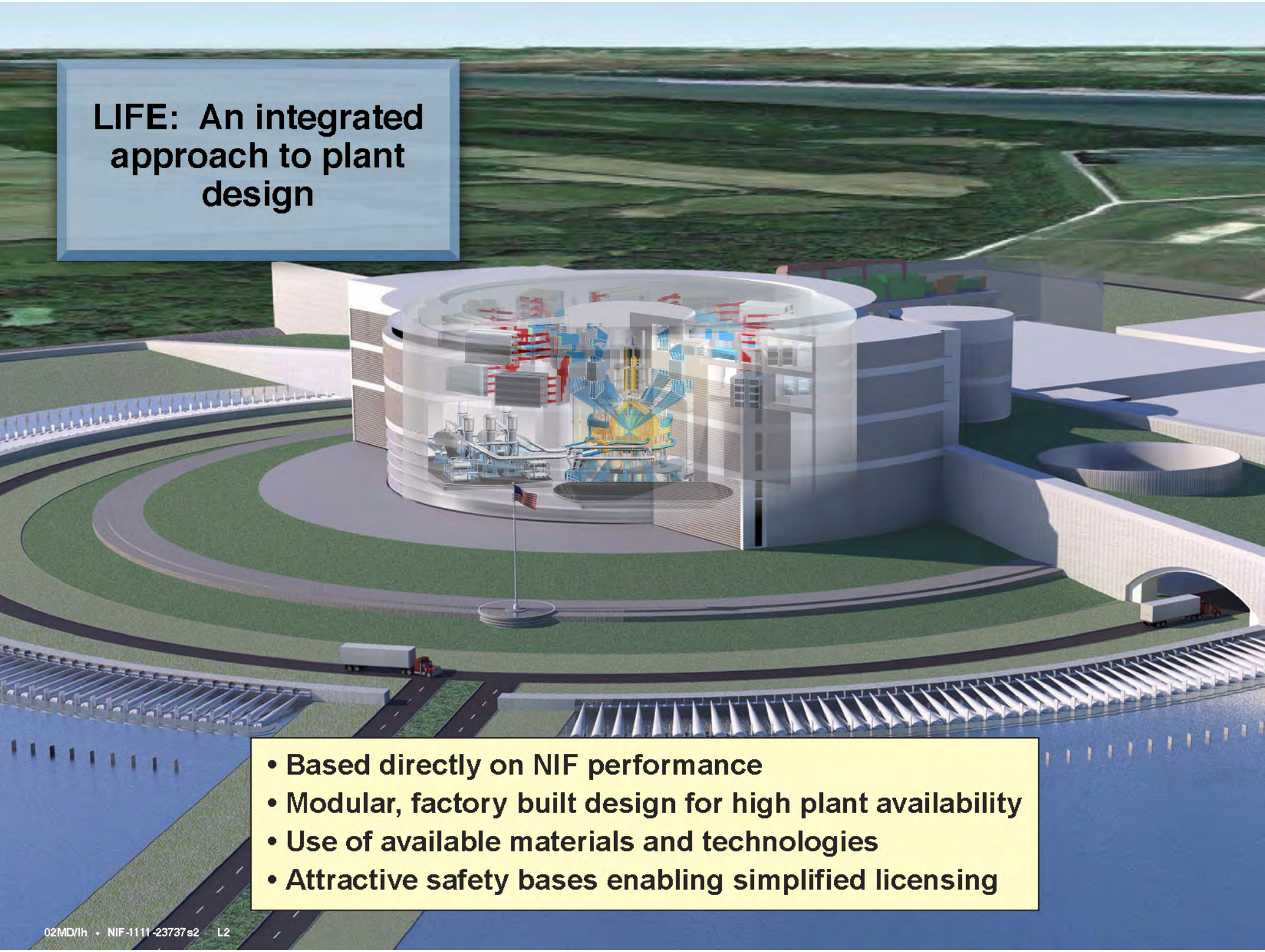
LIFE: An integrated approach to plant design



- Based directly on NIF performance
- Modular, factory built design for high plant availability
- Use of available materials and technologies
- Attractive safety bases enabling simplified licensing

The LIFE project is being guided by a board of senior utility executives

Donald Brandt — President and CEO, Pinnacle West Capital Corporation

Joseph Callan — Former Executive Director, U.S. NRC

David Christian — CEO, Dominion Generation; President, Virginia Power

Peter Darbee — CEO and President, Pacific Gas & Electric Company (Retired)

Brian Debs (Member in residence) — former SVP, Ontario Power Gen Corp.

William Fehrman — President and CEO, MidAmerica Energy Company

John Herron — President and CEO, Entergy Operations

Richard Kuester — CFO, Wisconsin Energy Corporation

Kenneth Nemeth — Executive Secretary, SSEB

Charles "Chip" Pardee — SVP and COO, Exelon Generation

Michael Sellman — CEO, Nuclear Management Company (Retired)

Michael Wallace — COO, Constellation Energy Group (Retired)

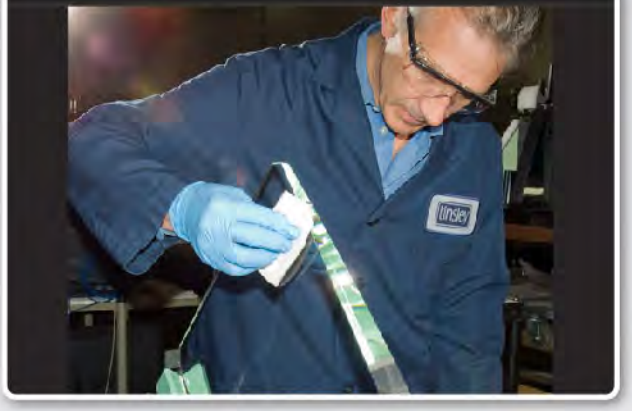
Industrial partners are being consulted

Construction / Engineering

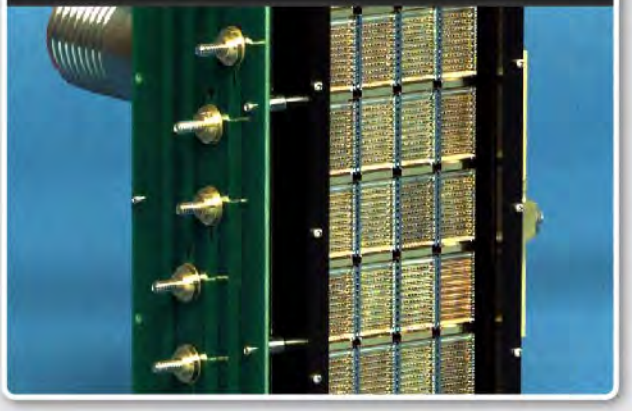
Optics

Controls

Manufacturing



Semiconductor

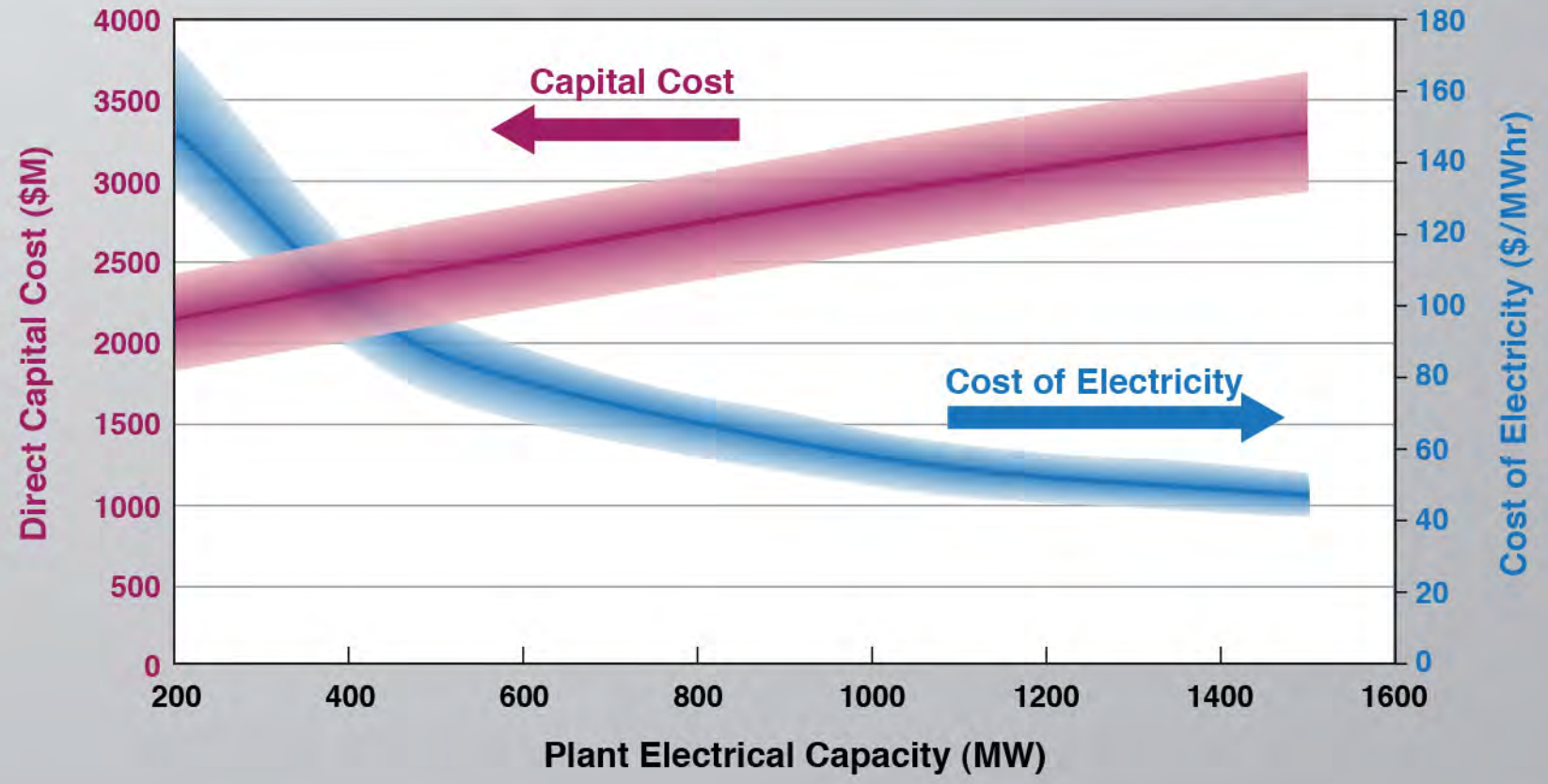


Laser

30+ major vendors engaged to determine component availability, performance and cost

LIFE is economically viable over a range of plant sizes

Economic Performance as a Function of Plant Size



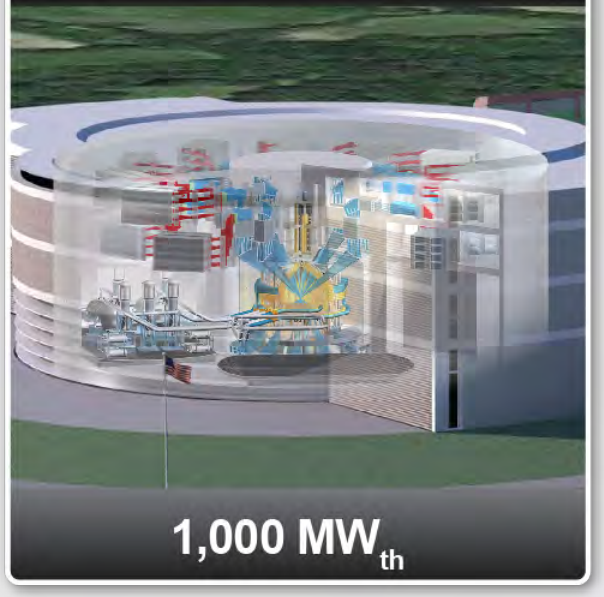
A detailed LIFE delivery plan has been developed, with 1000 MW power production in less than 10 years

National Ignition Facility

2009 - Facility complete
2012 - Ignition

Performance

Market Entry Plants



1,000 MW_{th}

2020's

Integration

Mature LIFE Technology

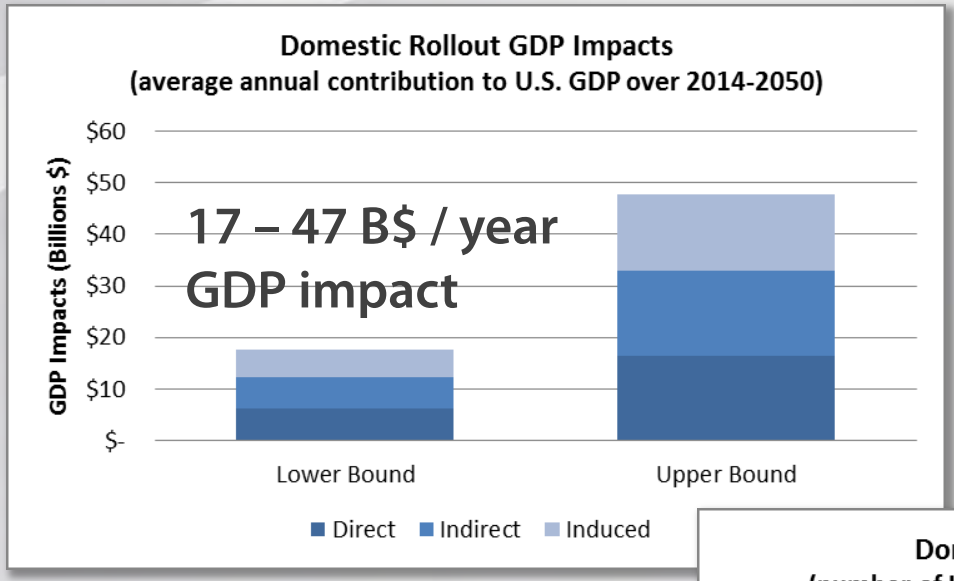
400 MW to 1,600 MW_e

2030's

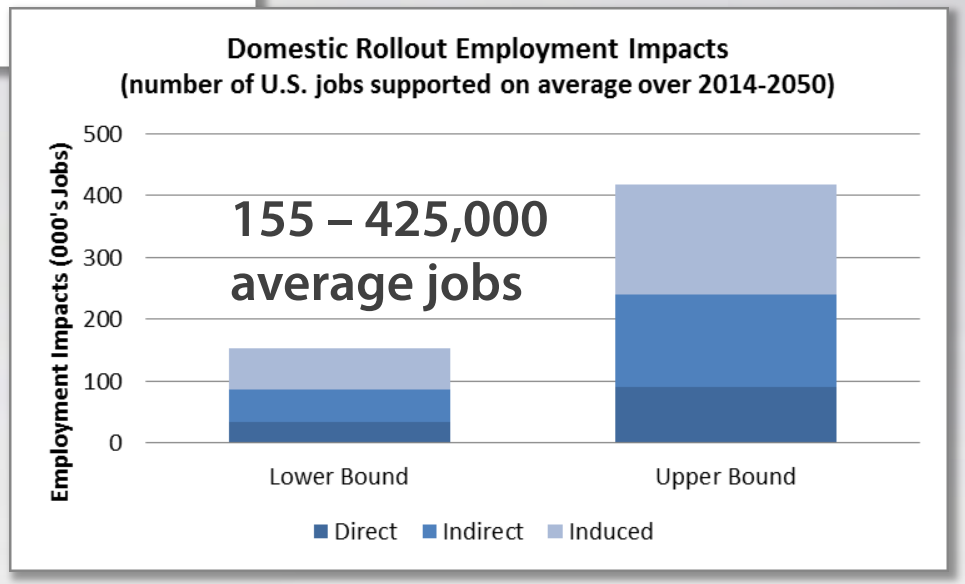
The macro-economic impact of LIFE is being independently assessed

Later this month: Report on the impact in the Southern States

Oxford Economics have calculated the impact of domestic LIFE rollout on GDP and new jobs



- 4 to 12 B$ annual federal and state tax revenue
- Substantial jobs impact in the high-tech sector



Low / High scenarios
are for 10 year or 5 year doubling times

High-skilled, Well-paying Jobs

- Some of the jobs that will be generated through the supply chain impacts will be high-tech/high-skilled and well-paying jobs.
    - These jobs will be mainly clustered in the laser optic, semiconductor, and laser diode industries.
- This is reflected in the higher annual labor productivity and income compared to the manufacturing sector and US economy as a whole.
- In addition to the high-skilled manufacturing jobs, many of the on-site craft labor jobs will also require a high-skill level.

	Labor Productivity	Labor Income
LIFE Associated Jobs	**$ 147,350**	**$ 86,890**
Manufacturing Sector	$ 139,350	$ 76,000
U.S. Economy	$ 83,700	$ 51,990

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Southern States Impacts

- The construction of the Market Entry Plant (MEP) will generate **$3.0 billion of total GDP** and an average **of 6,600 total jobs** annually of the 6-year construction period in the Southern States.
- The construction of an individual Nth of a kind 1.6GWe (NOAK 1.6GWe) plant will generate **$3.3 billion in total GDP** impacts and an average of **6,850 total jobs** annually in the Southern States over the 6-year construction period.
- The construction an individual NOAK 1.6GWe LIFE plant outside of the Southern States will generate **$925 million in total GDP** and **9,500 total job-years** due to spending at manufacturers located in the Southern States.
- The Southern States might be able to use their competitive advantage to develop large market shares in some of the key LIFE technologies.

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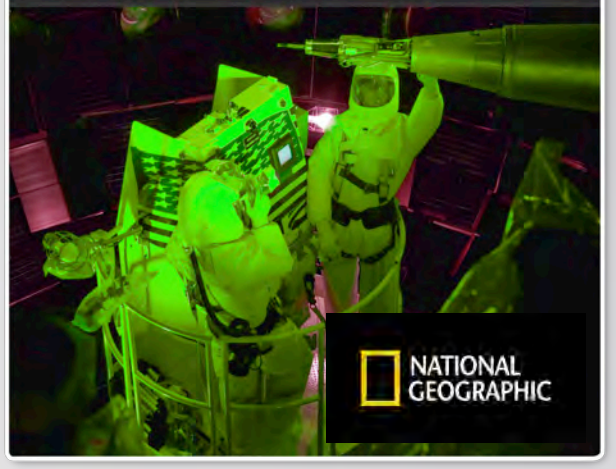
Recent TV / documentary coverage of NIF and LIFE

BBC with Steven Hawking

National Geographic



Horizon with Brian Cox

Discovery Channel's NOVA

Achieving ignition on NIF can be a defining moment for the world's energy future