

# Introduction

## 22.011

February 5<sup>th</sup>, 2020

# Nuclear Science and Engineering at MIT

- Core discipline, research and teaching areas in NSE, will play an increasingly important role in the world
- Demand for electricity globally will not decrease, need carbon-free sources of energy
- Global electricity consumption is projected to grow 45% by 2040
- **NSE vision is to build new partnerships at MIT and beyond to expand research in support of fission and fusion for addressing climate change**

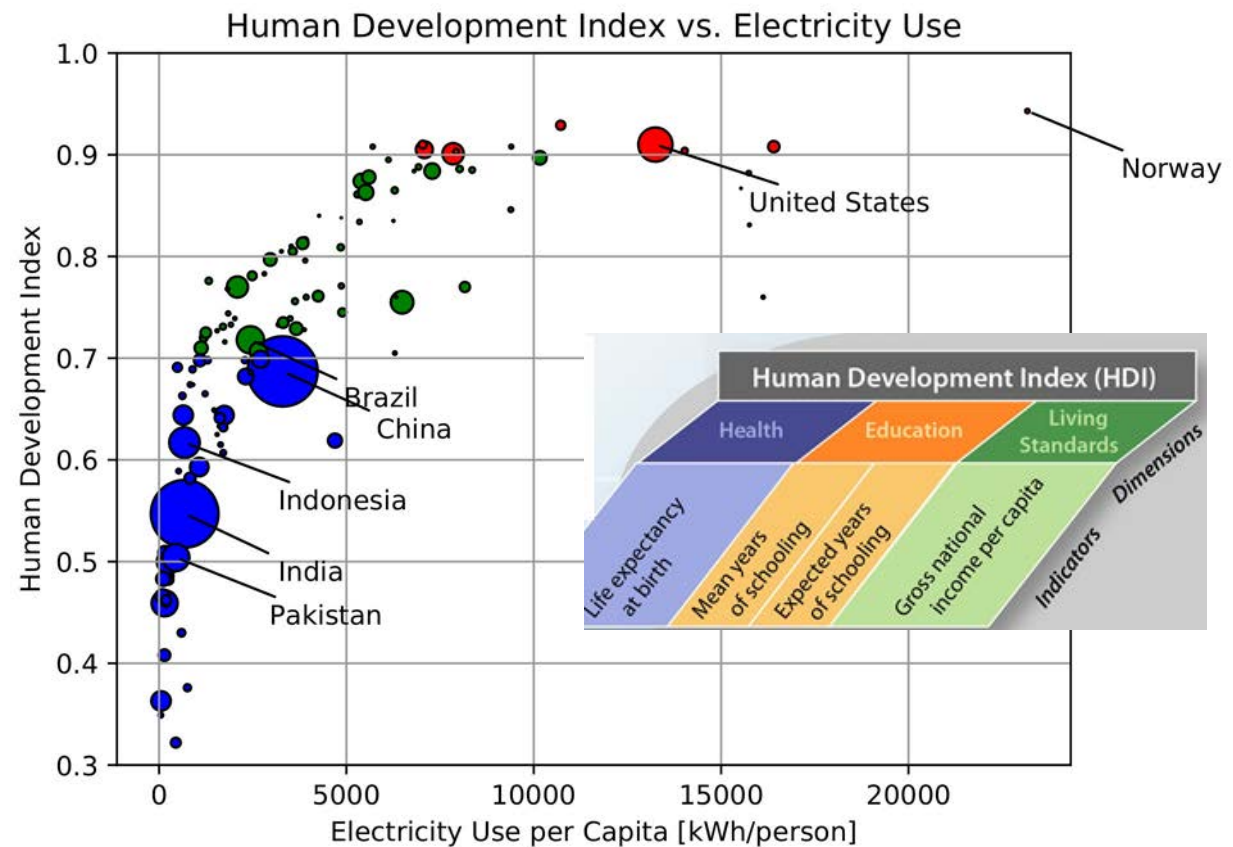


Figure courtesy of Jacopo Buongiorno. Used with permission.

# Fission – Challenges

- **Cost! Megaprojects...**
- Can fission go smaller? Less expensive to construct fission reactors?
- **Public perception**
- Despite an outstanding safety and environmental record, civilian nuclear power faces significant acceptance challenges.
- This class will explore how scholars communicate about very technically complex topics through traditional Op-Ed pieces in newspapers.

OPINION

Opinion: California's San Onofre nuclear plant is a Chernobyl waiting to happen



The San Onofre nuclear plant was permanently shut down in 2013 after a radioactive leak was discovered in a new steam generator. Humans will need to manage the plant's nuclear waste for thousands of years. (Los Angeles Times)

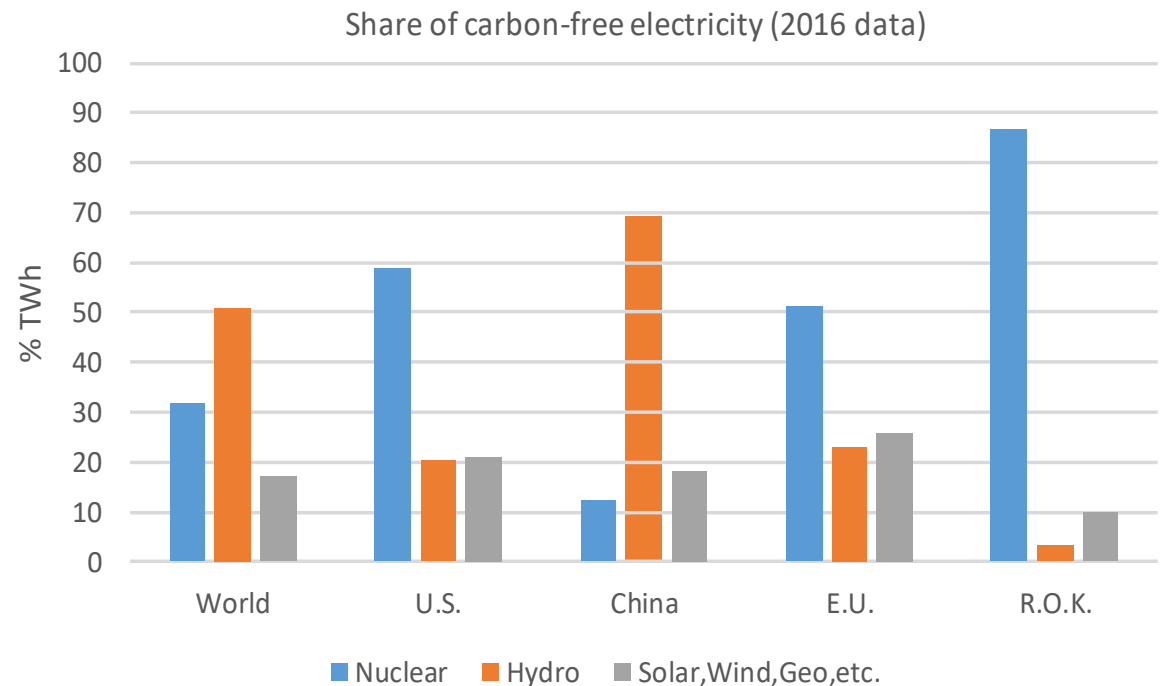
OPINION

Letters to the Editor: No, San Onofre isn't another Chernobyl waiting to happen



# Fission – Carbon Free Energy

- Fission has reliably and economically contributed ~20% of electrical generation in USA over the past two decades
- Fission power & Hydro together provide majority of carbon-free electric power generation worldwide



Courtesy of Jacopo Buongiorno. Used with permission.

# Present Data and Future Projections to the year 2040: Electricity generation by fuel (billion kilowatthours)

MIT  
NSE

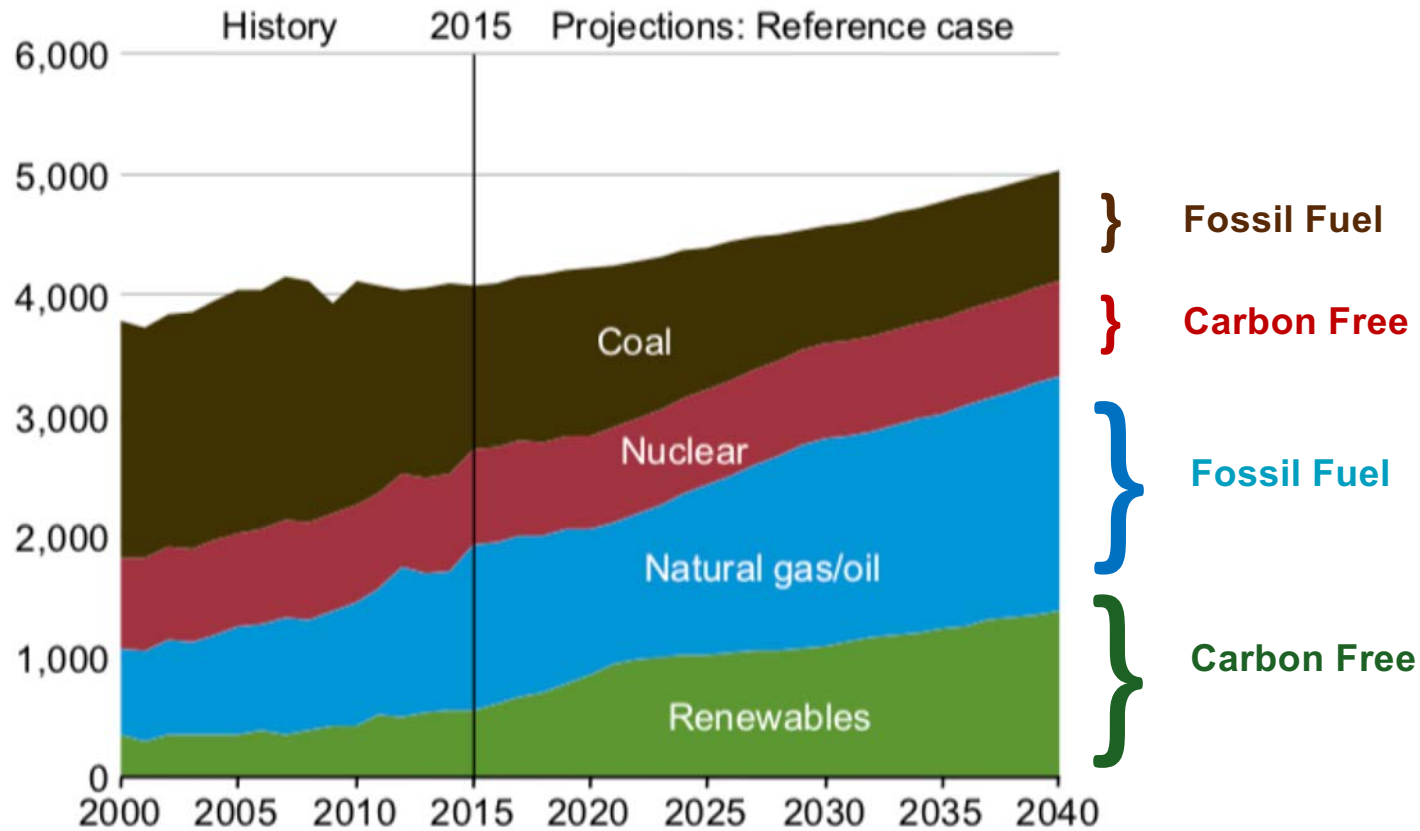


Image courtesy of U.S. Energy Information Administration.

# Fusion – Carbon Free Energy

- Fusion relies on confining a 100,000,000 degree plasma for seconds to generate energy from reactions of hydrogen isotopes
- Bringing a star to earth!
  - Zero carbon, no polluting emissions**
  - Freely available and inexhaustible fuel supply**
  - Flexible generation anywhere**
  - No risk meltdown or long-lived waste**

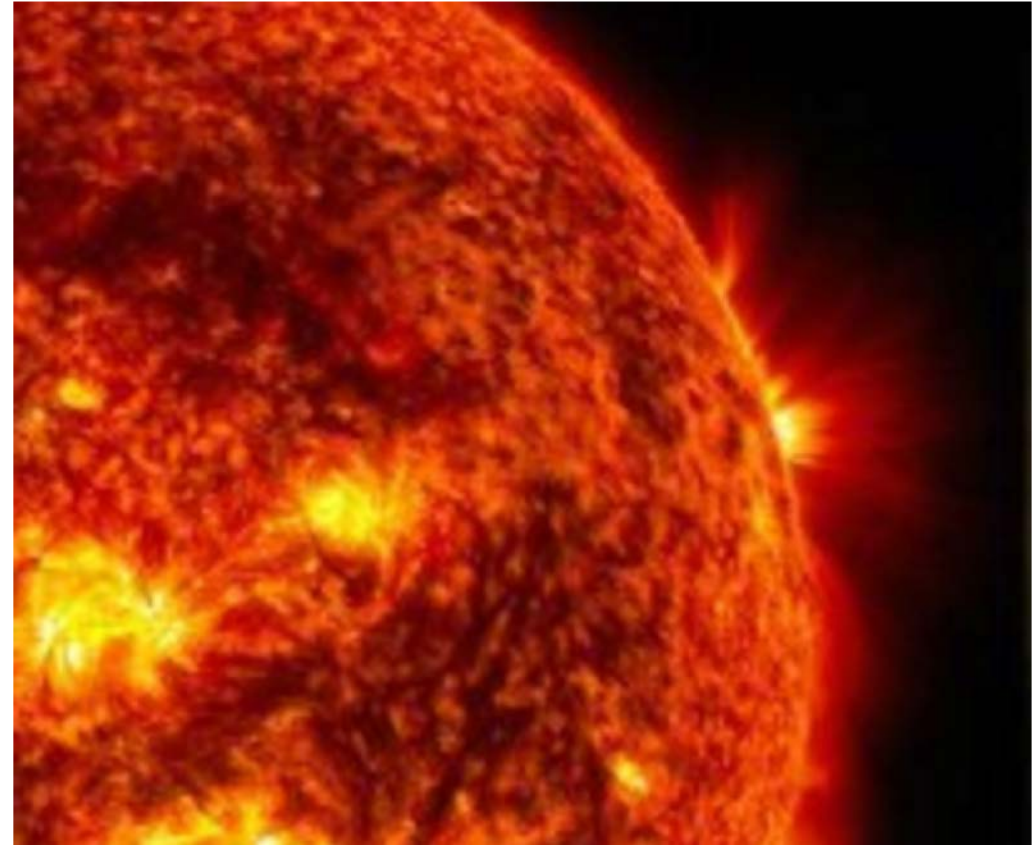
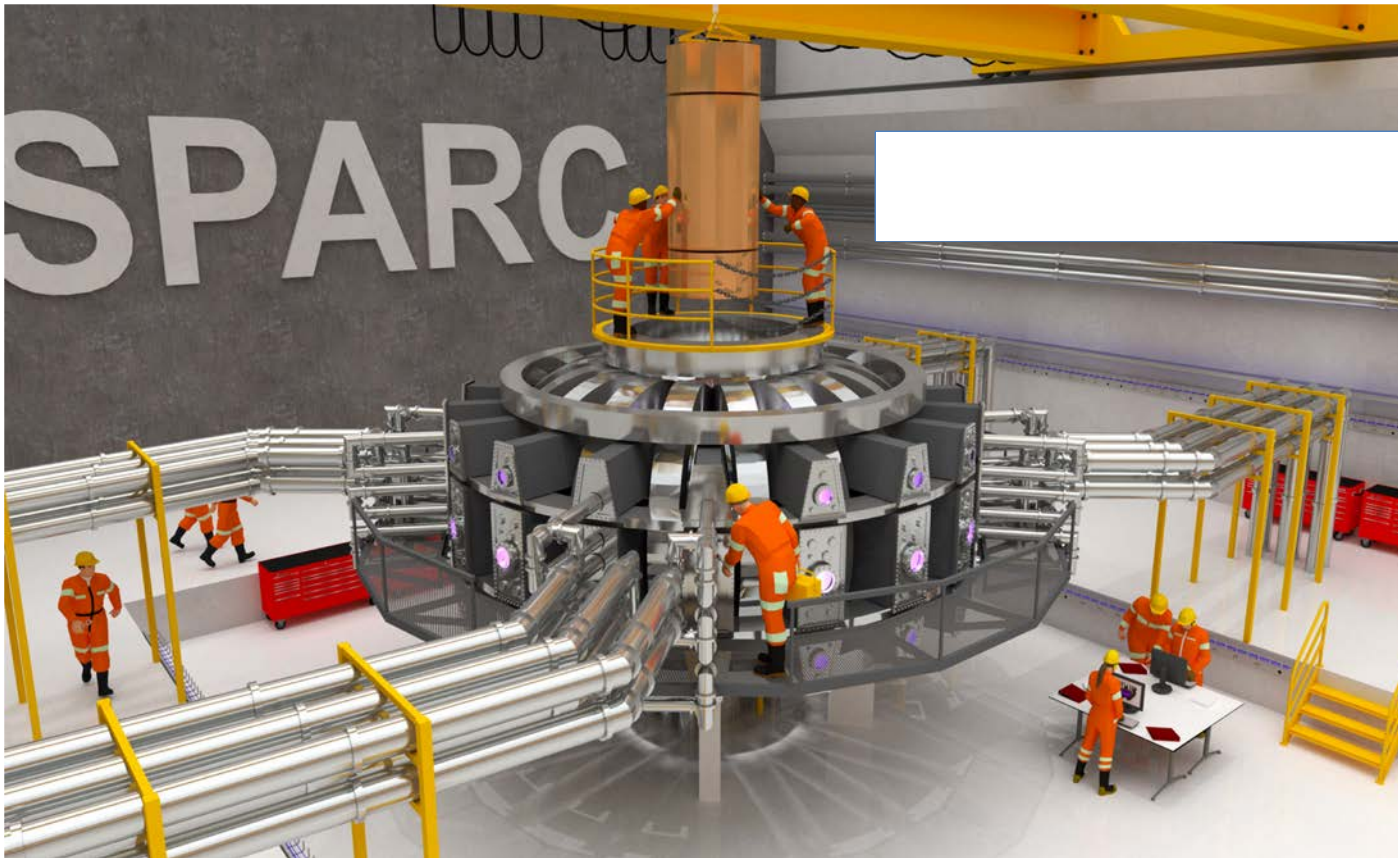


Image courtesy of NASA.

# MIT is partnering with startup company and industry to build world's first net-energy fusion experiment

MIT  
NSE



# Engineering the Tools of the Future

MIT  
NSE

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- Quantum Engineering in NSE
- Quantum computing, but also quantum sensing and simulation
- Do you want to model a black hole using a crystal purchased from eBay?

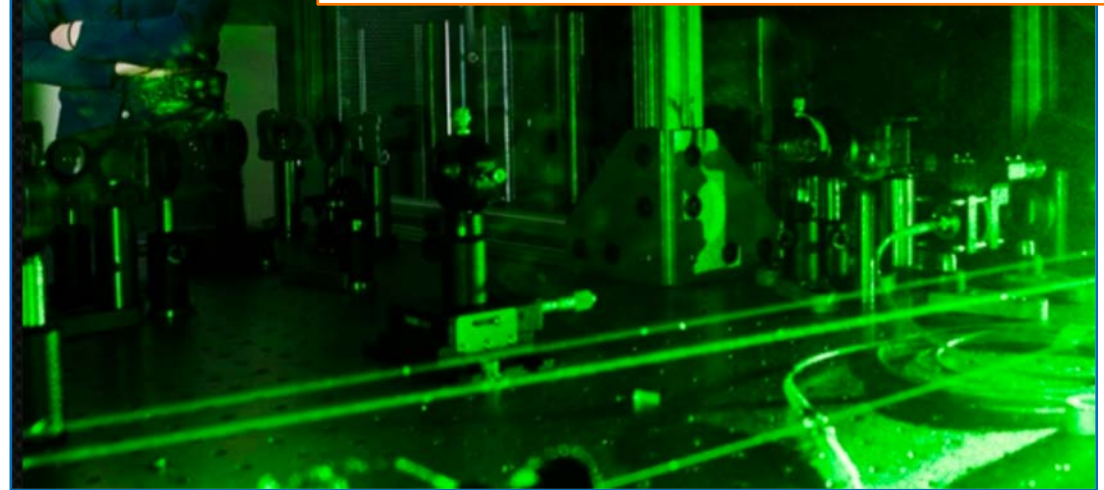
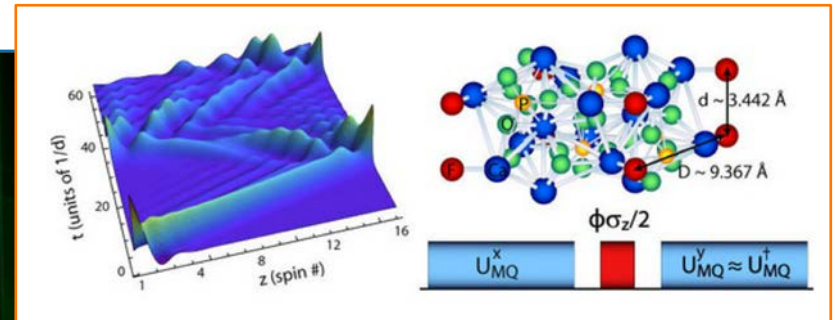
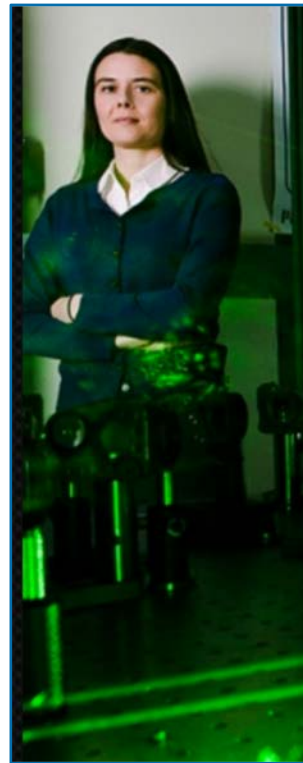


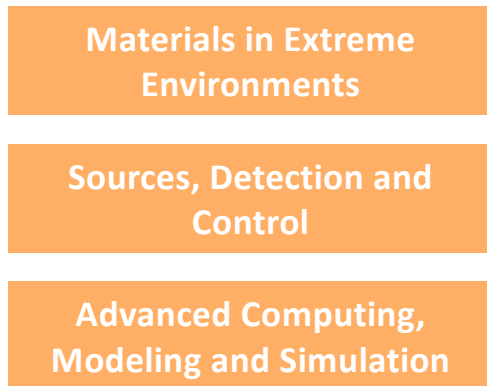
Image courtesy of MIT News.



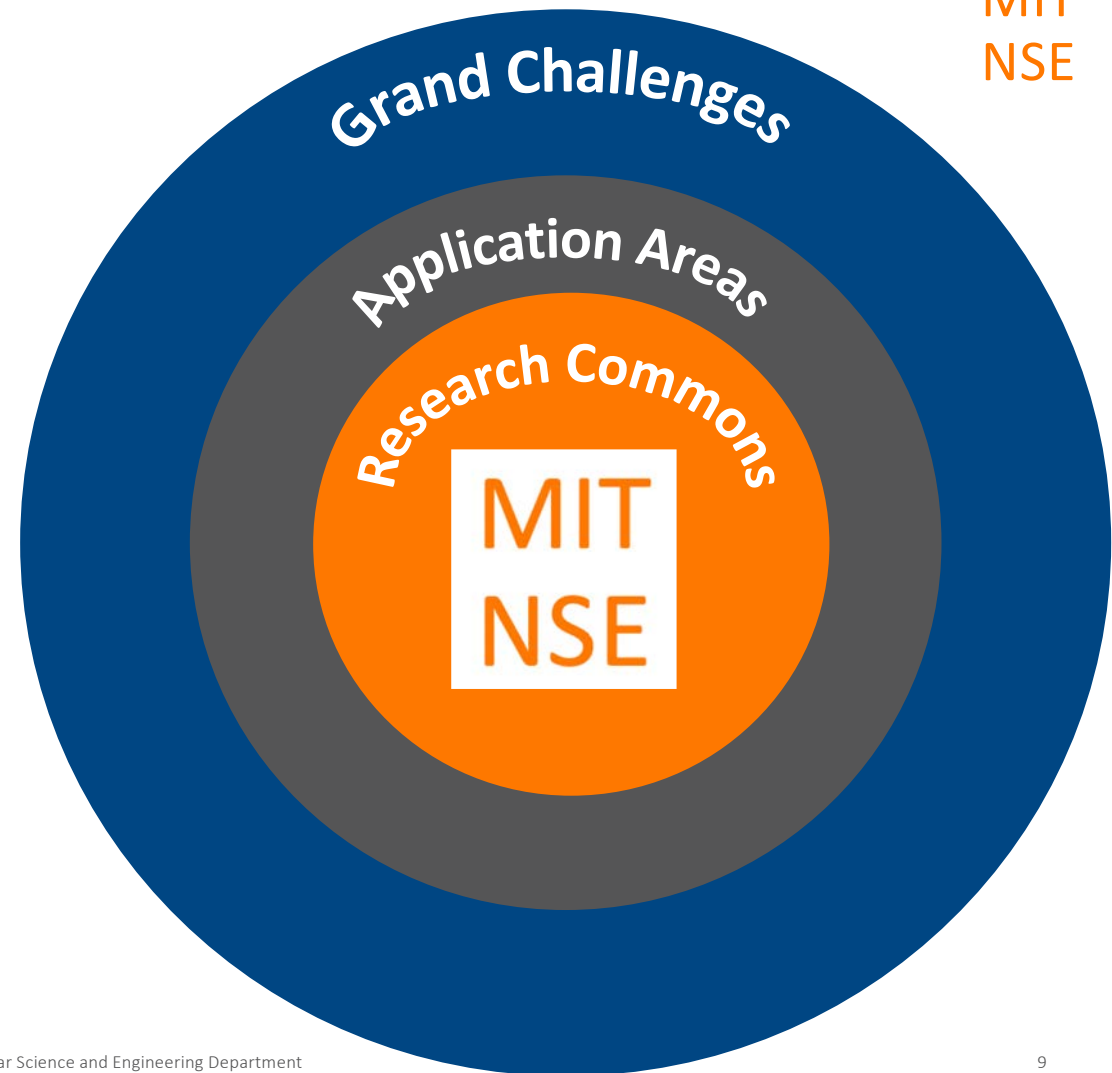
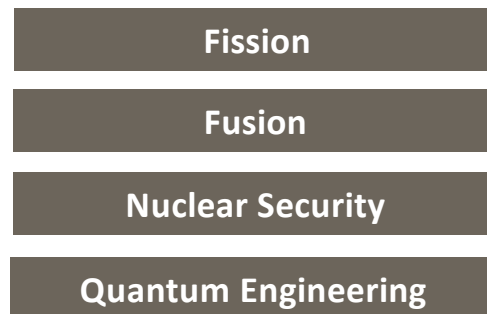
# Science : Systems : Society

MIT  
NSE

## Research Commons



## Application Areas



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