

The Opportunity of Global Nuclear Innovation

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Japan Atomic Industrial Forum

Tokyo, Japan

“...in 2012 around 7 million people died
- one in eight of total global deaths -
as a result of air pollution exposure.”
- World Health Organization



<https://storify.com/ucirvine/made-in-china-air-pollution-as-well-as-exports>

1.2 billion people lack access to electricity;
2.7 billion people lack clean cooking facilities
- International Energy Agency

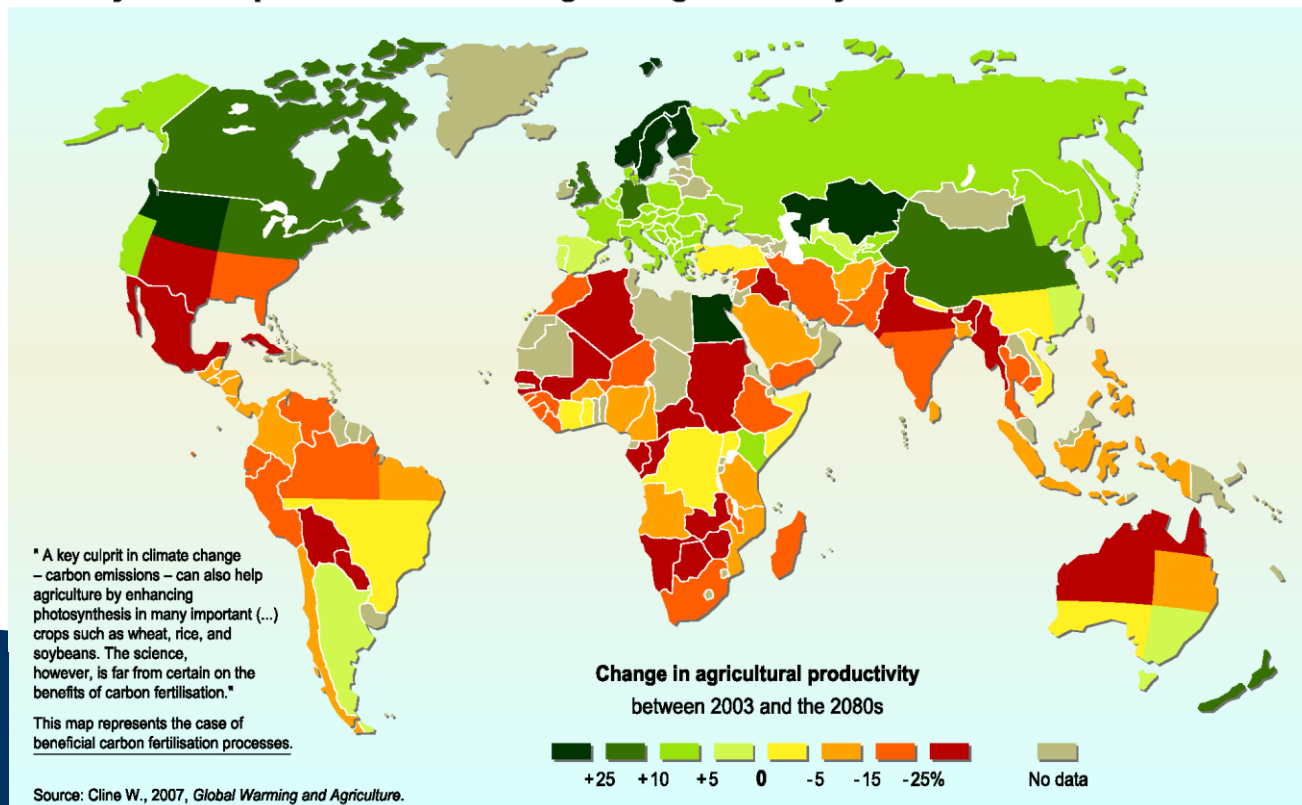


http://www.thestar.com/news/world/2013/07/22/how_electricity_has_the_power_to_transform_the_lives_of_girls_around_the_world.html

“...climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries...”

- COP21 Agreement

Projected impact of climate change on agricultural yields



Environment, Health, Prosperity

How do we help the world
develop sustainably?



<http://www.insidesources.com/wp-content/uploads/2015/11/bigstock-Energy-4298515-300x300.jpg>

Global Nuclear Innovation

- The world is concerned with a lot of big things
- Nuclear energy can be an important part of a suite of solutions
- Our current model doesn't work as well as we'd like
- There are ways that our model could work better
- There are new opportunities for action
- We can build structures to capitalize on and expand those opportunities
- To be a better world

We Need Cleaner Energy

- Nuclear's lifecycle emits very little CO₂ or air pollution

g CO ₂ eq /KWh	Solar (PV / CSP)	Wind	Nuclear	Coal	Natural Gas
Min	5 / 7	2	1	675	290
Max	271 / 89	220	220	1689	930

- Nuclear energy is an important component, it
 - Exists and is large scale
 - Is reliable / always on
 - Uses little land
 - Can be an economic boon

What's Not Working?

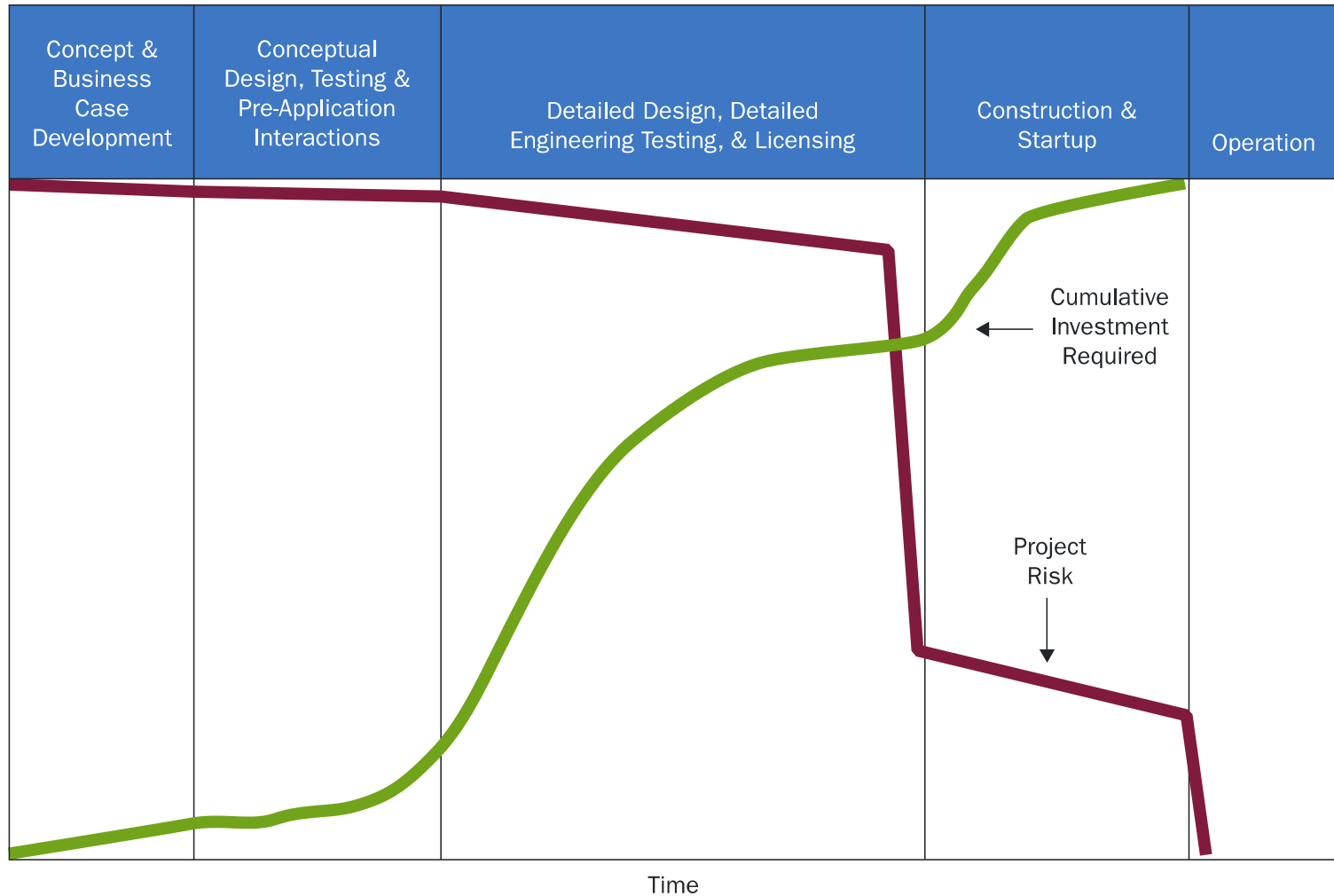
...But it's not perfect

- Rate of change
- Poor public communication
- Small range of products
- Innovative mindset?
- Economic viability
- Capital intensity
- Used fuel and waste / long-term fuel supply
- Safety and security

We must *shift* how we think about nuclear energy and nuclear innovation

Why Isn't it Working?

Financial Risk



Why Isn't it Working?

Communication and Understanding

Lack of trust; little public understanding of risk;
insufficient discussion about risk
Impacts cost, policy, career choice, viability...
Also impacts public health in underappreciated way

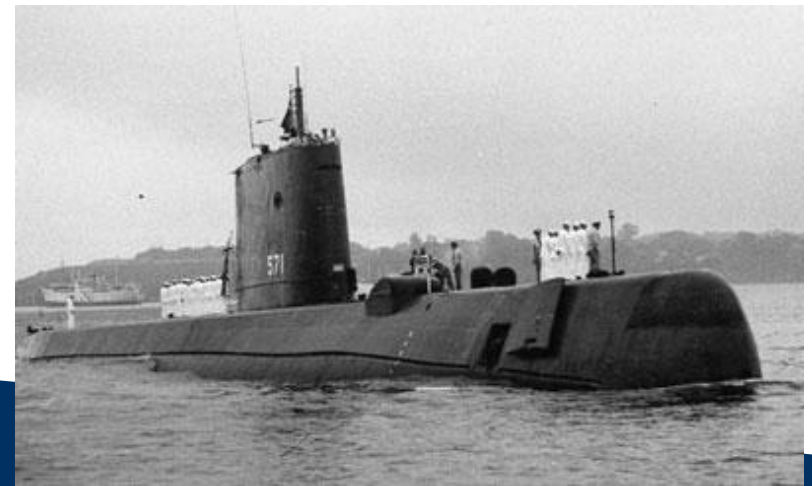
Residual bad
will from
original program
secrecy

- Three Mile Island
 - Some increase in stress-related health effects [1]
- Chernobyl
 - Significant increase in stress-related health effects [2]
- Fukushima
 - ~1 600 deaths from stress of evacuation [3]

Why Isn't it Working?

Drivers and Regulatory Models

- In other fields, profit motivates innovation
- In nuclear, profit is anti-aligned with big changes
- We were innovative when motivated
- Innovation drivers have lessened
- Lost place to have failures; lost mindsets



New Motivations Could Change the Game

Environment
Health
Prosperity



What Could Nuclear Innovation Look Like?

What If?

- National and international scientific resources are leveraged



<https://www.olcf.ornl.gov/titan/>



https://www.jaea.go.jp/english/04/ntokai/kasokuki/kasokuki_02.html

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- An inspired, innovative workforce is available
- Regulation is fast and responsible



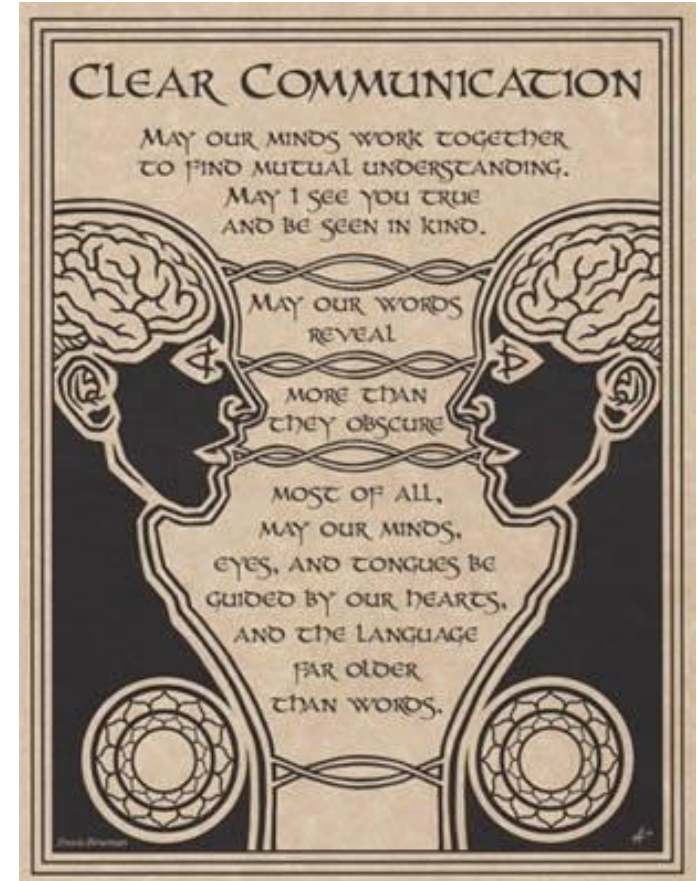
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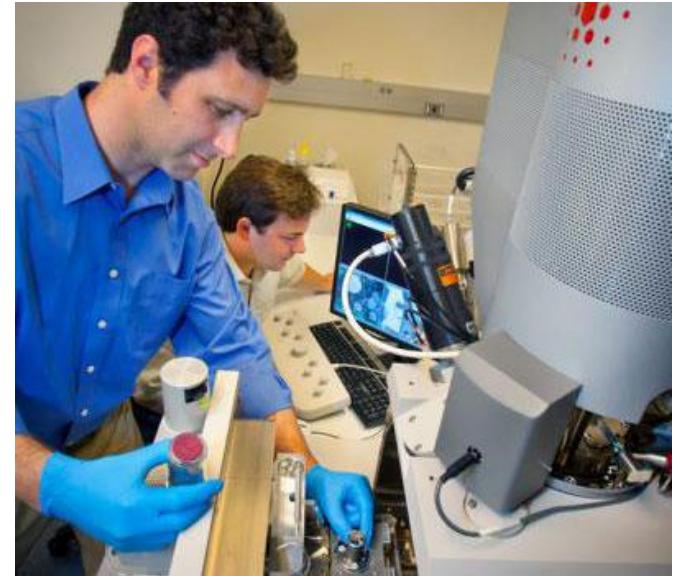
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- An inspired, innovative workforce is available
- Regulation is fast and responsible
- Policy supports global cooperation and market health
- Communication is clear



<http://adviceyouneed.net/2014/08/12/the-lost-art-of-communication/>

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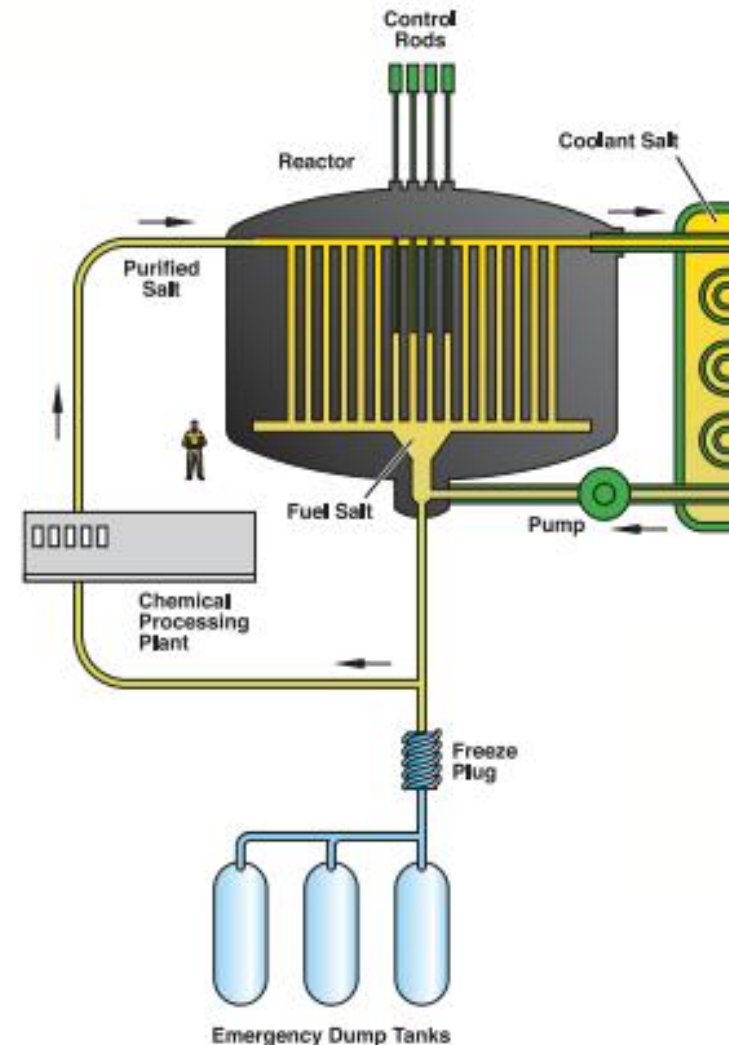
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- Technology needs are met



<http://physicsworld.com/cws/article/news/2011/jul/01/testing-nuclear-materials-on-the-nanoscale>

What If?

- National and international scientific resources are leveraged
- An inspired, innovative workforce is available
- Regulation is fast and responsible
- Policy supports global cooperation and market health
- Communication is clear
- Technology needs are met
- Big improvements become viable



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Companies are rewarded for making the world better

The World Thrives

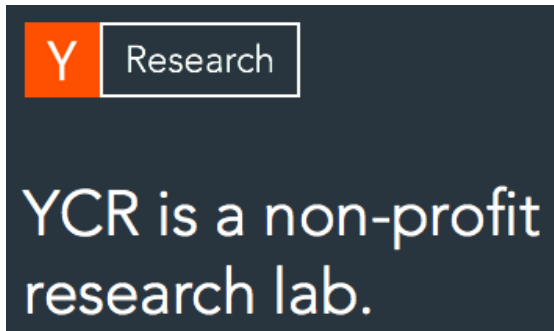


But how do we
get there?

Examples of Broader Motivation



<http://www.gatesfoundation.org/What-We-Do/Global-Health/Malaria>



<http://www.mission-innovation.net/>



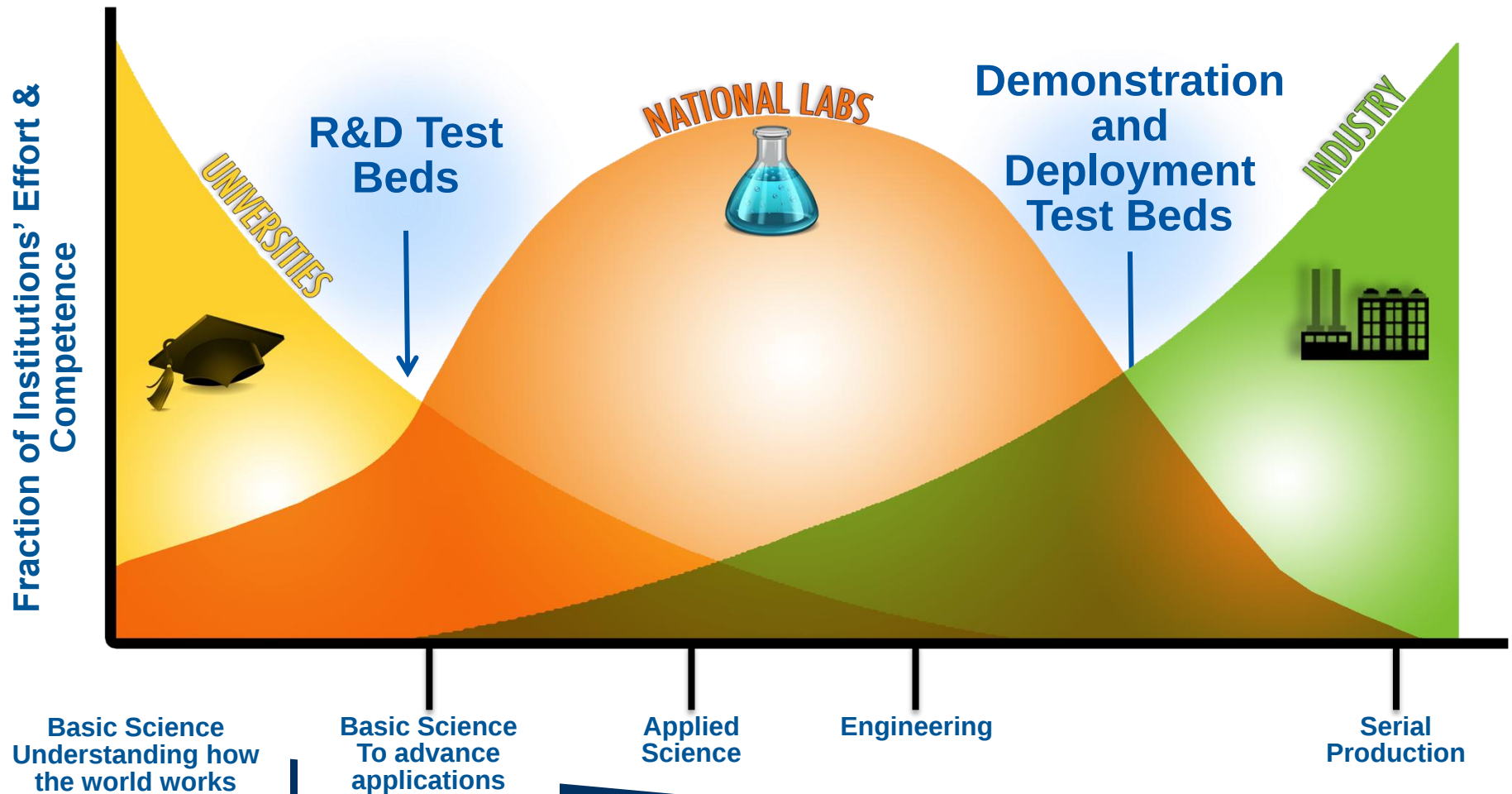
Introducing the Advanced Nuclear Industry



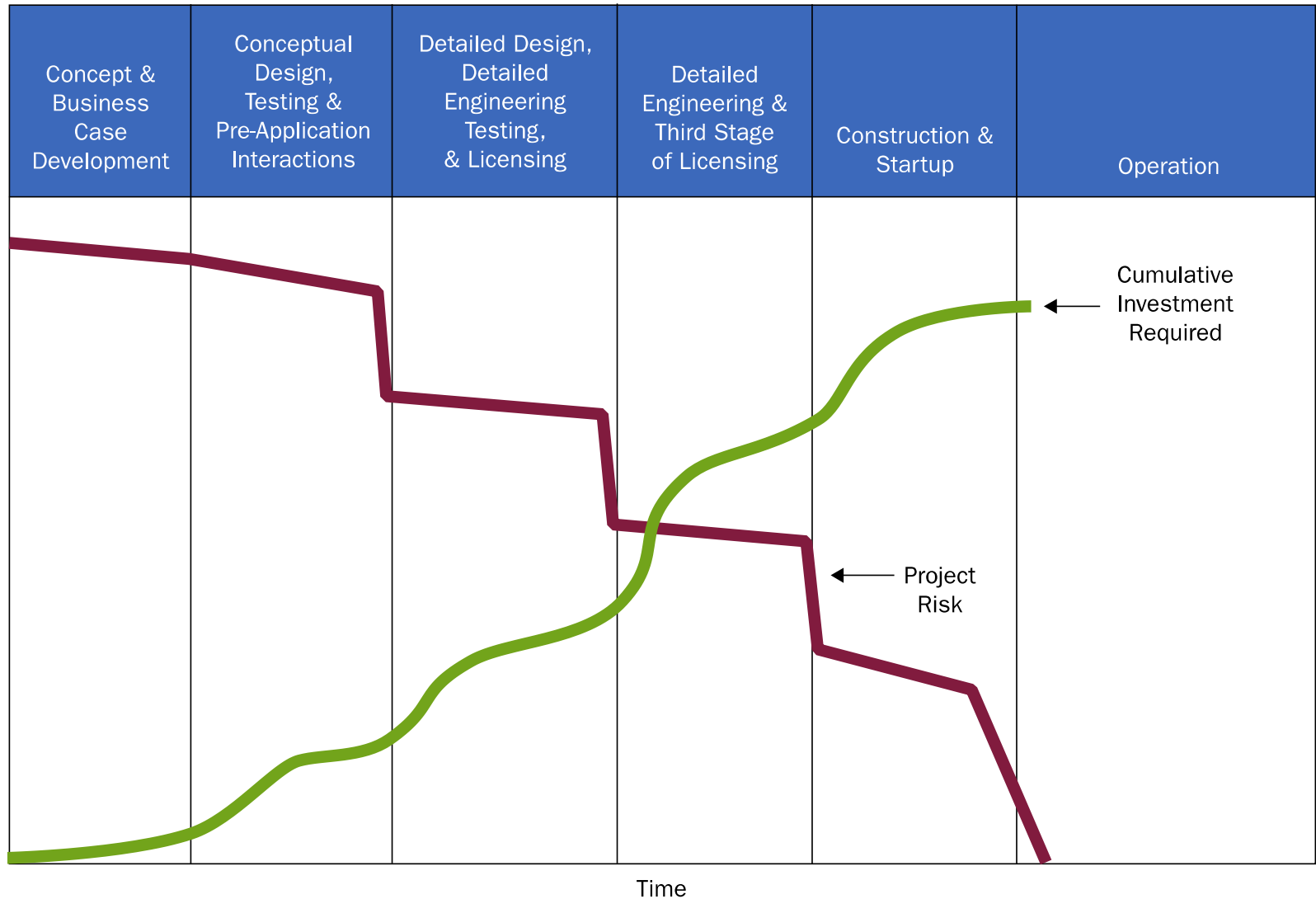
~50 companies

~\$1.3B of private capital

Bridge the “Valleys of Death”

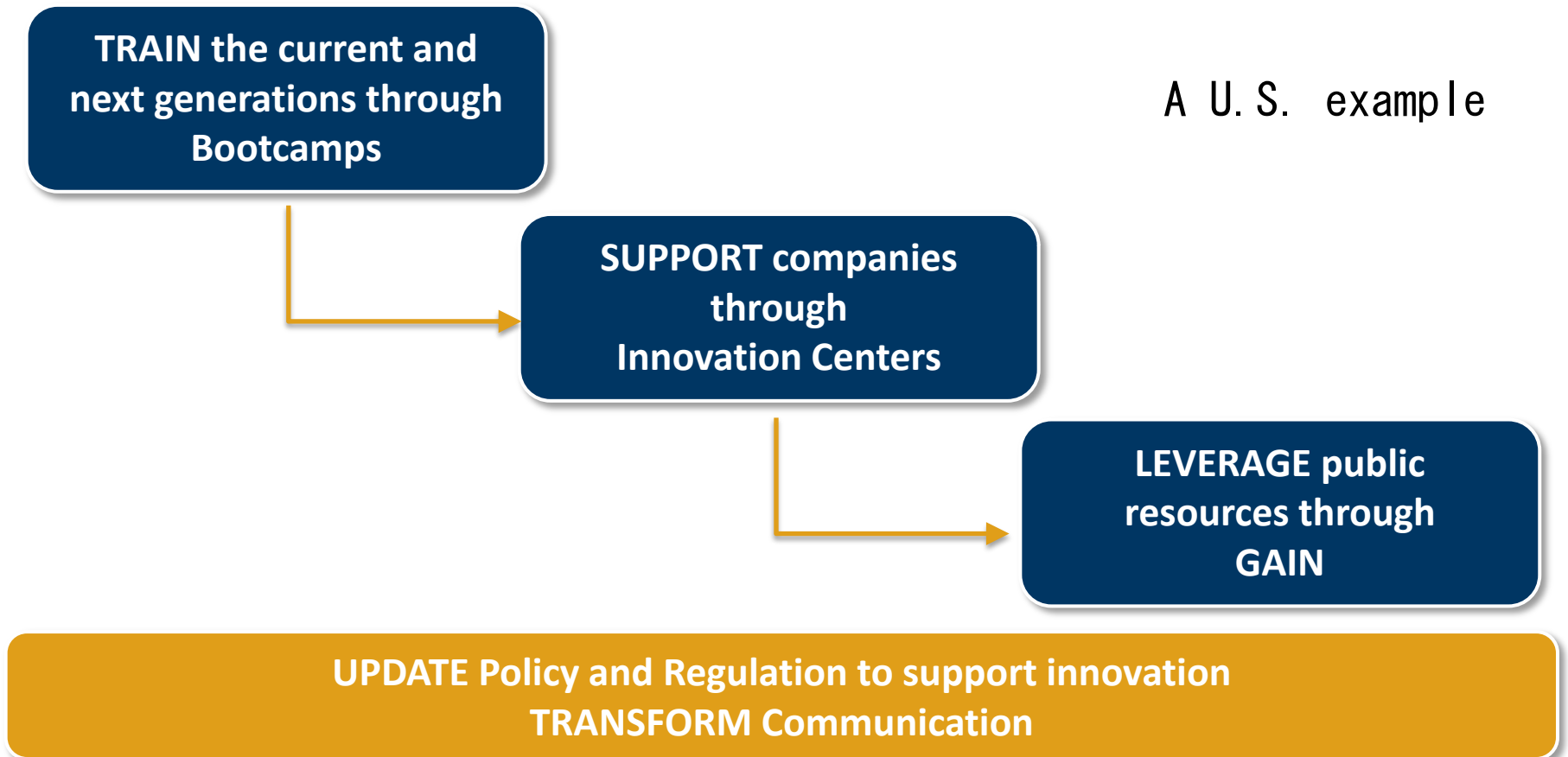


Shift the Curve



Build A Pipeline

A U. S. example



Nuclear Innovation Alliance

- The NIA's mission is to lead advanced nuclear energy innovation by addressing:
 - Regulatory Pathways
 - Testing and Development
 - International Cooperation
 - Financial Support
- Assemble companies, investors, experts, stakeholders, students
- Find ways to bring new ideas to market more efficiently



GAIN: Public-Private Leverage



**New DOE-NE Initiative
within the Clean Energy
Initiative**



Integrated institute managing a
distributed test-bed and demonstration
platform, dedication to innovation in
Nuclear Energy

Public-private partnership including
Industry, Entrepreneurs, National
Laboratories, and Academia

Headquartered at the
Idaho National Laboratory

- Tens of \$B in DOE and partner assets (experimental and computational)
- More than \$1M in yearly investments for R&D and infrastructure
- \$12.5B in loan guarantees
- \$10M in SB vouchers
- Expertise and intellectual

Innovation Centers



Regulator

Test Bed

Investment
Community

Developers



Key Physical Capability

Core Innovation
(Reactor Concept, Fuel,
Communications, Regulation)

Key Intellectual Capability

- Seeded with Federal Funds
- Fungibility of Staff to Core Institutions
- Aggressive Innovation

- ***Can have Centers at early innovation and at demo***



Nuclear Innovation Bootcamp

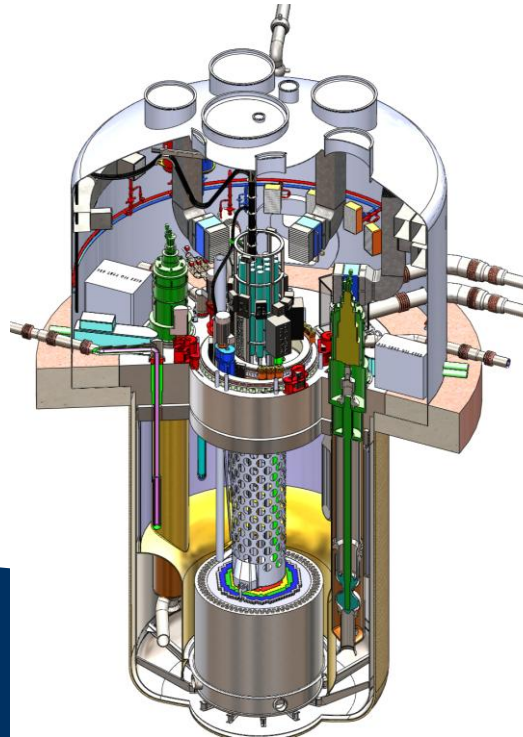
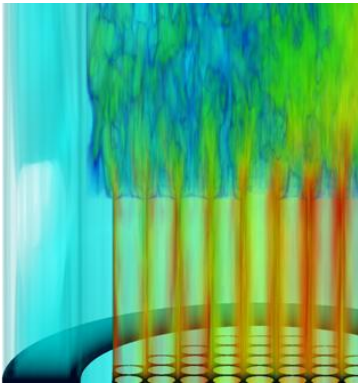


[http://www.nuclear
innovationalliance.org/
bootcamp](http://www.nuclearinnovationalliance.org/bootcamp)

- Teach students *how* to innovate:
 - Entrepreneurship
 - Nuclear aspects
 - Non-traditional material
- Two week pilot program August 1–12
- Team design projects
 - Teams have non-technical member
- Large company involvement
- Experts teach and mentor
- Judged completion

Nuclear Innovation Bootcamp

- Full program Summer 2017
- Deeper content
- Expand to include professionals



Nuclear Innovation Pipeline

- Goal: reduce the non-technical barriers while enabling technical breakthroughs



- Global participation; expand model
- Beyond GAIN: need a coordinated interagency (U.S.) and international strategy for global deployment

Global Nuclear Innovation

Now is the time

Motivated by Global Health, Prosperity, and Environment,
we have the opportunity to **reinvent** the way we do things

What do we want the world to look like?



Thank You



Acknowledgements

- Nuclear Innovation Alliance
- Third Way
- UC Berkeley
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- MIT
- University of Wisconsin
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- Google
- Southern Company
- Transatomic
- TerraPower
- Venrock
- Lightbridge
- Advanced Reactor Concepts
- General Fusion
- Exelon
- INPO