A new pathway for science innovation

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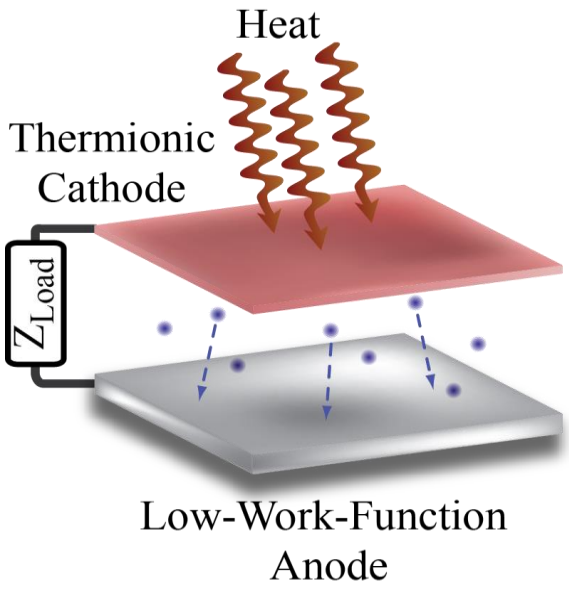
National Academies GUIRR Webinar
February 15, 2017

Part I: The Problem

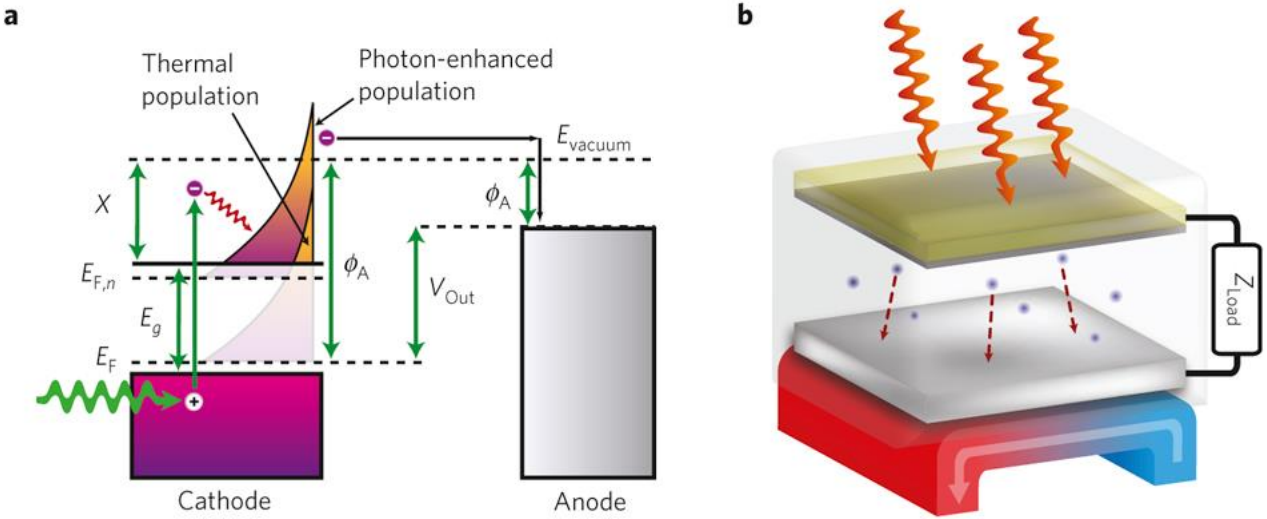

Heat
Thermionic
Cathode
Z_{Load}
Low-Work-Function
Anode

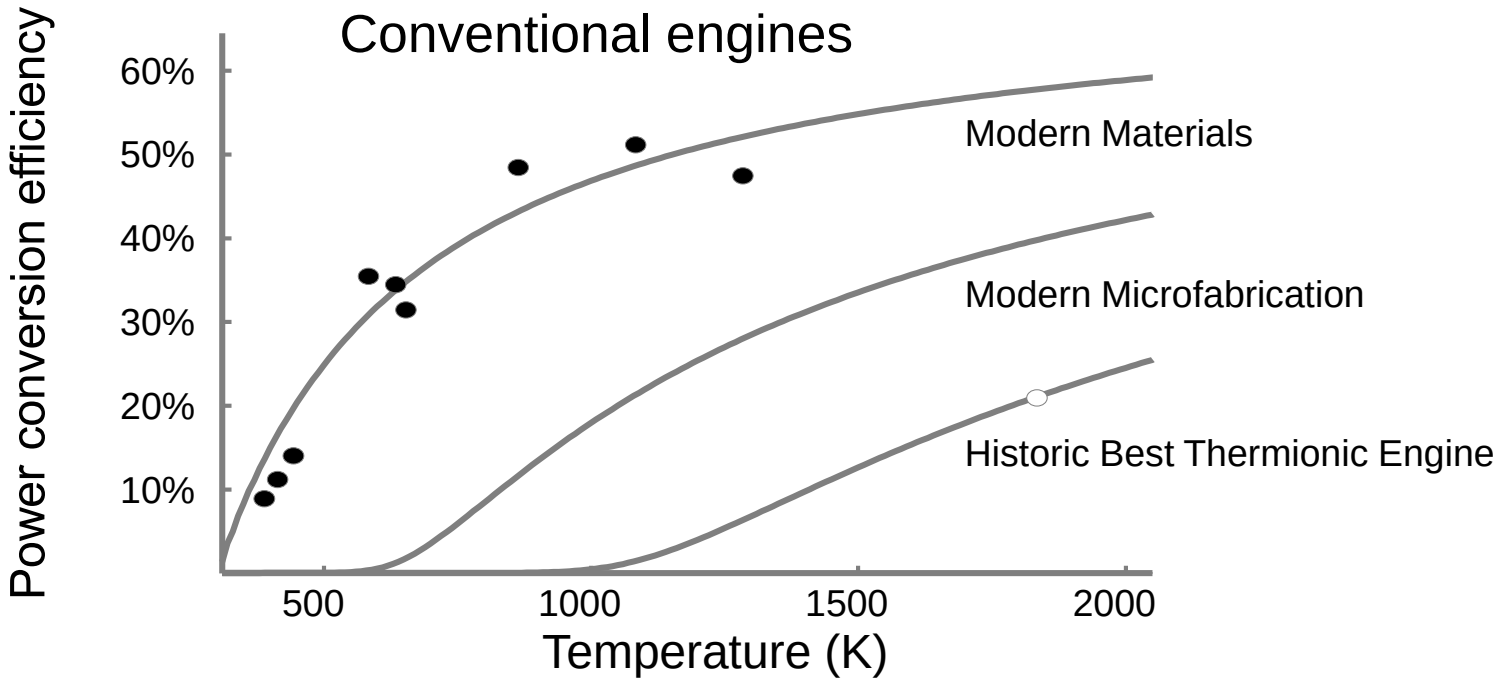
GE Research, 1960

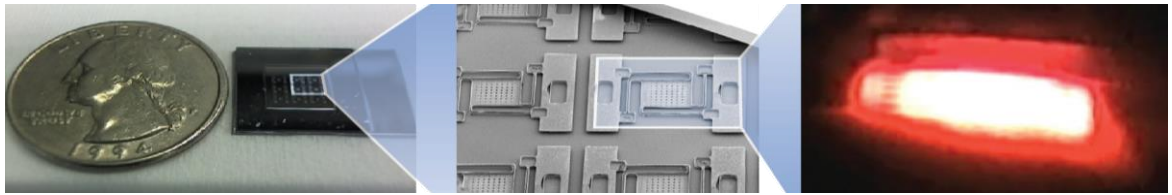
Stanford University, 2010

nature materials

Photon-enhanced thermionic emission for solar concentrator systems




Conventional engines
Power conversion efficiency
60%
50%
40%
30%
20%
10%
500
1000
1500
2000
Temperature (K)
Modern Materials
Modern Microfabrication
Historic Best Thermionic Engine



Space race technology, reinvented for the silicon age

1st-gen target efficiency: ***25%***

Efficiency potential: ***>50%***

Where can I go to develop new technology?

Academia

Industry

Startup

“Today, our highly optimized, venture-capital-driven innovation system is simply not structured to support complex, slower-growing concepts that could end up being hugely significant--

the kind that might lead to disruptive solutions to existential challenges in sustainable energy, water and food security, and health
.”

L. Rafael Reif, President, MIT

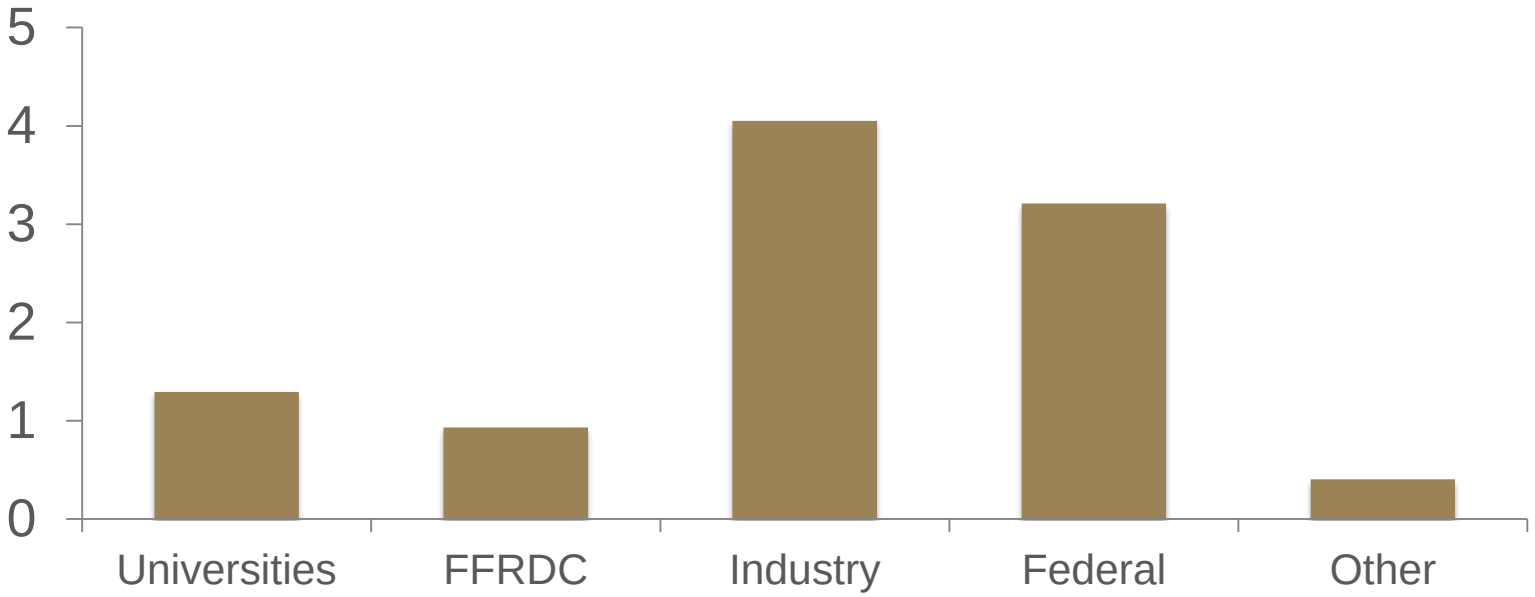
How did we get here?

“First, we must have plenty of men and women trained in science, for upon them depends both the creation of new knowledge and its application to practical purposes. Second, we must strengthen the centers of basic research which are principally the colleges, universities, and research institutes.”

- Vannevar Bush, July 1945

1957

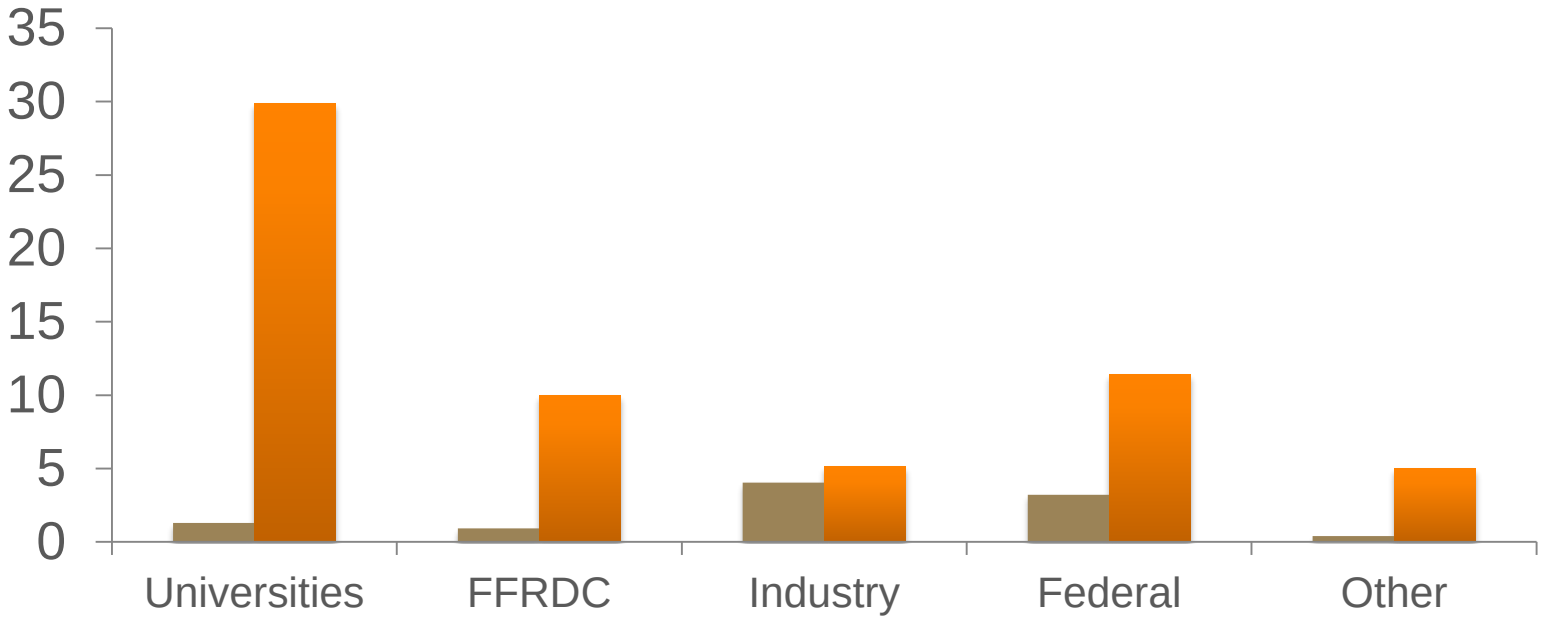
U.S. Federal Research Funding (billion $)



SOURCE: NSF, National Patterns of R&D Resources

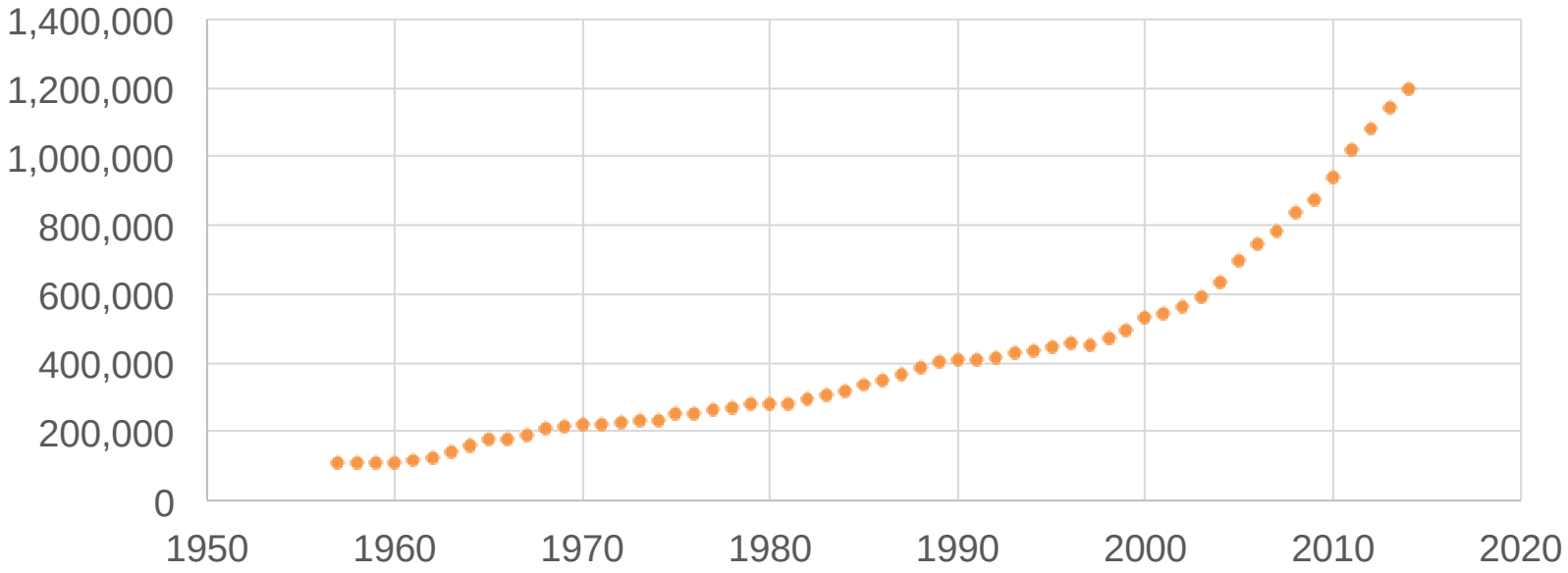
2012

U.S. Federal Research Funding (billion $)



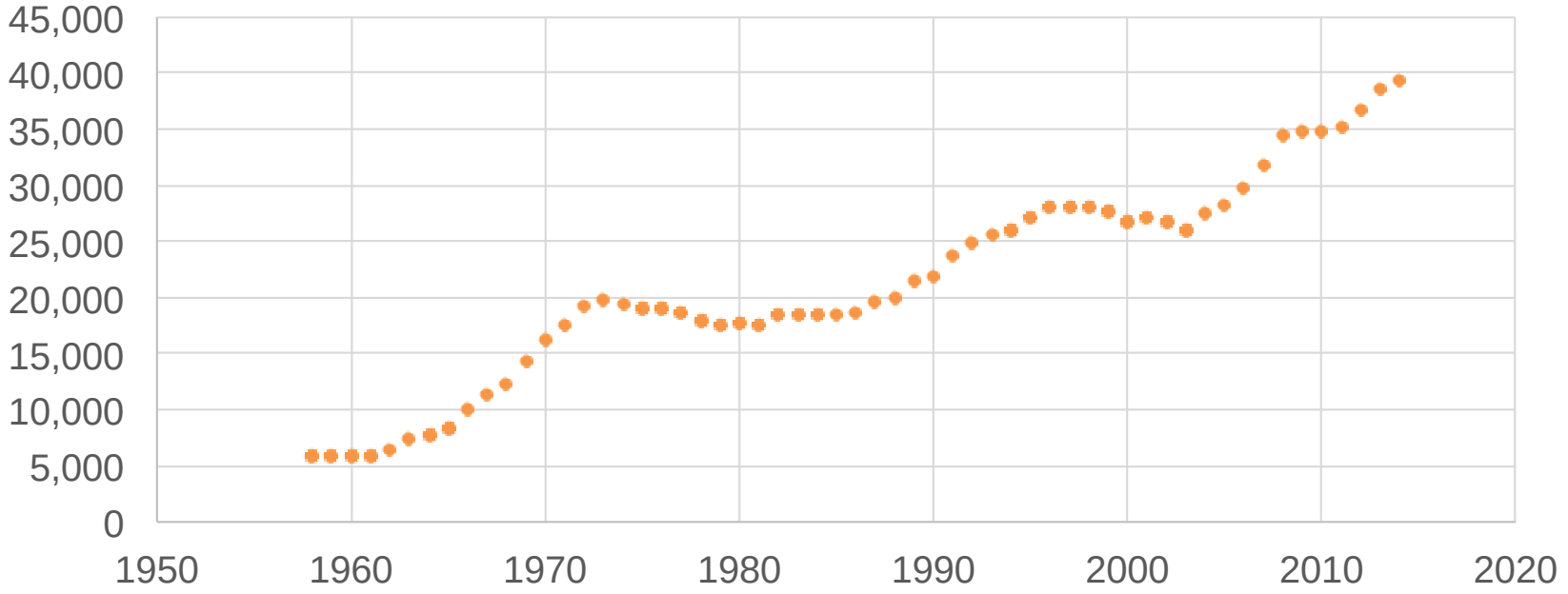
SOURCE: NSF, National Patterns of R&D Resources

Articles Indexed in PubMed (annual)
1957–2012



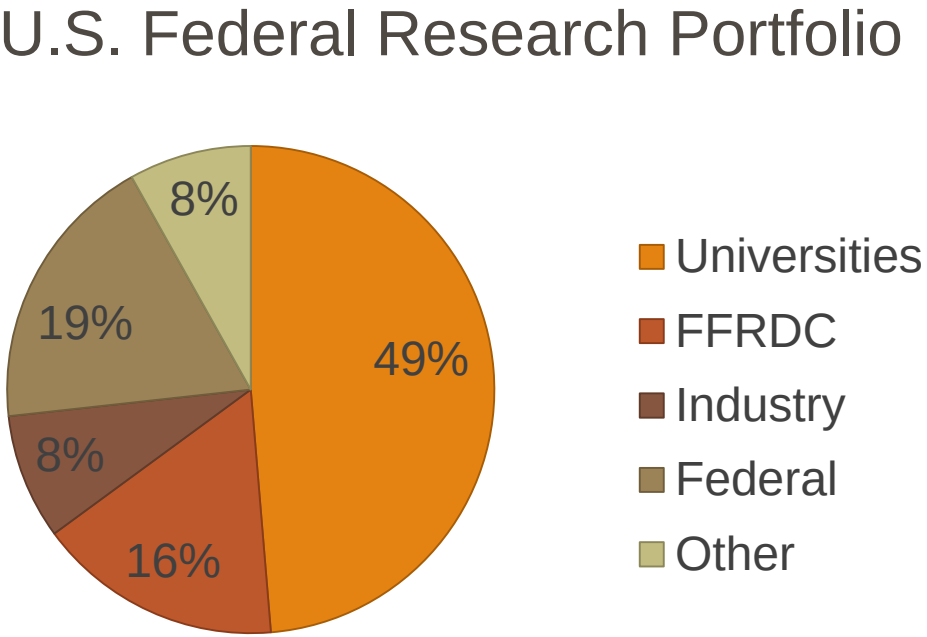
SOURCE: PubMED

U.S. STEM doctorate recipients
1957–2012



SOURCE: NSF Survey of Earned Doctorates.

2012



SOURCE: NSF, National Patterns of R&D Resources

“the United States needs a more systematic way to help its bottled-up new-science innovators deliver their ideas to the world.”

L. Rafael Reif, President, MIT

The experiment

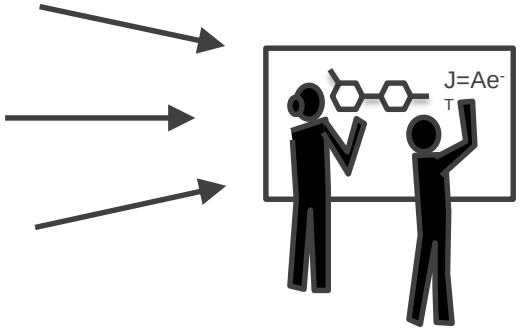
Academic R&D

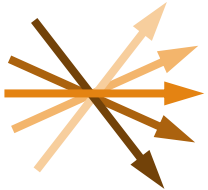
Industry R&D

Startups

???

Cyclotron Road





Venture capital

Corporate acquisition

License or open source

① **Recruit** the best energy science innovators

② **Support** with facilities, experts, networks, and experience

③ **Position** people and technology for market

We provide

Runway

- Up to 2 years of living stipend, health insurance, and travel allowance

Labs

- Cross-cutting access and $100k of research funding at Berkeley Lab

Mentorship

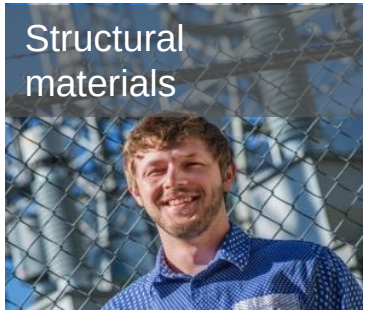
- Science innovation mentorship, training, and connections

The First Cohort

150 Applicants for 6 Slots

Dan Riley and Jared Schwede

Steven Kaye



Raymond Weitekamp

Marcus Lehmann

Kendra Kuhl, Etosha Cave

Deepak Dugar

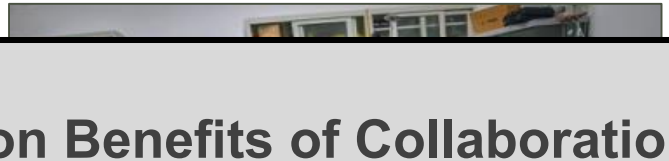
After one year

4 w

$ m

40

20



Berkeley Lab Scientists on Benefits of Collaboration

Lets me diversify knowledge, network, and research portfolio

Excited to work with “all-in” innovators & drive real-world impact

They are enhancing my equipment and capabilities

They may bring funding into my research group

I’m learning about industry needs and from different perspectives

I may have an opportunity to be part of a startup

SC)

Computational Research & Theory Facility

Results of pilot

Demand

- Highly selective 5% acceptance rate
- Candidates from top research institutions
- Many would not have a home otherwise

5%

Caltech

Stanford University

PRINCETON UNIVERSITY

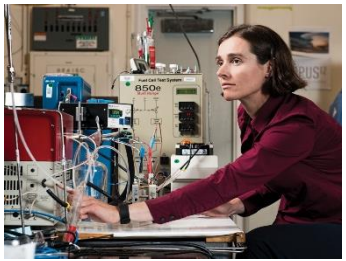
Massachusetts Institute of Technology

Berkeley UNIVERSITY OF CALIFORNIA

Results of pilot

Impact

- 100% will achieve prototype & business hypothesis
- $10M in follow-on grants; $5M in private funding
- All teams funded for next stage after graduation



100%

mosaic

polySpectra

VISOLIS
CARBON NEGATIVE MATERIALS

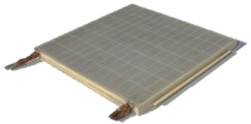
OPUS12

SPARK THERMIONICS

CalWave

Specific Power (W/kg)

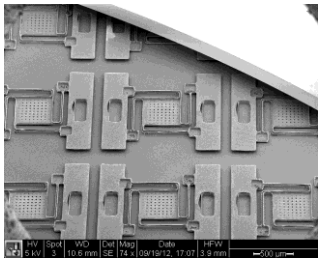
5,000	SPARK First generation
1,000	hydrogen fuel cell Honda FCX Clarity
700	solid-oxide fuel cell NASA Glenn high-power-density cell
165	thermoelectric HZ-20



arpa·e

CHANGING WHAT'S POSSIBLE

Modern fabrication



1st Generation
>20-25% efficiency

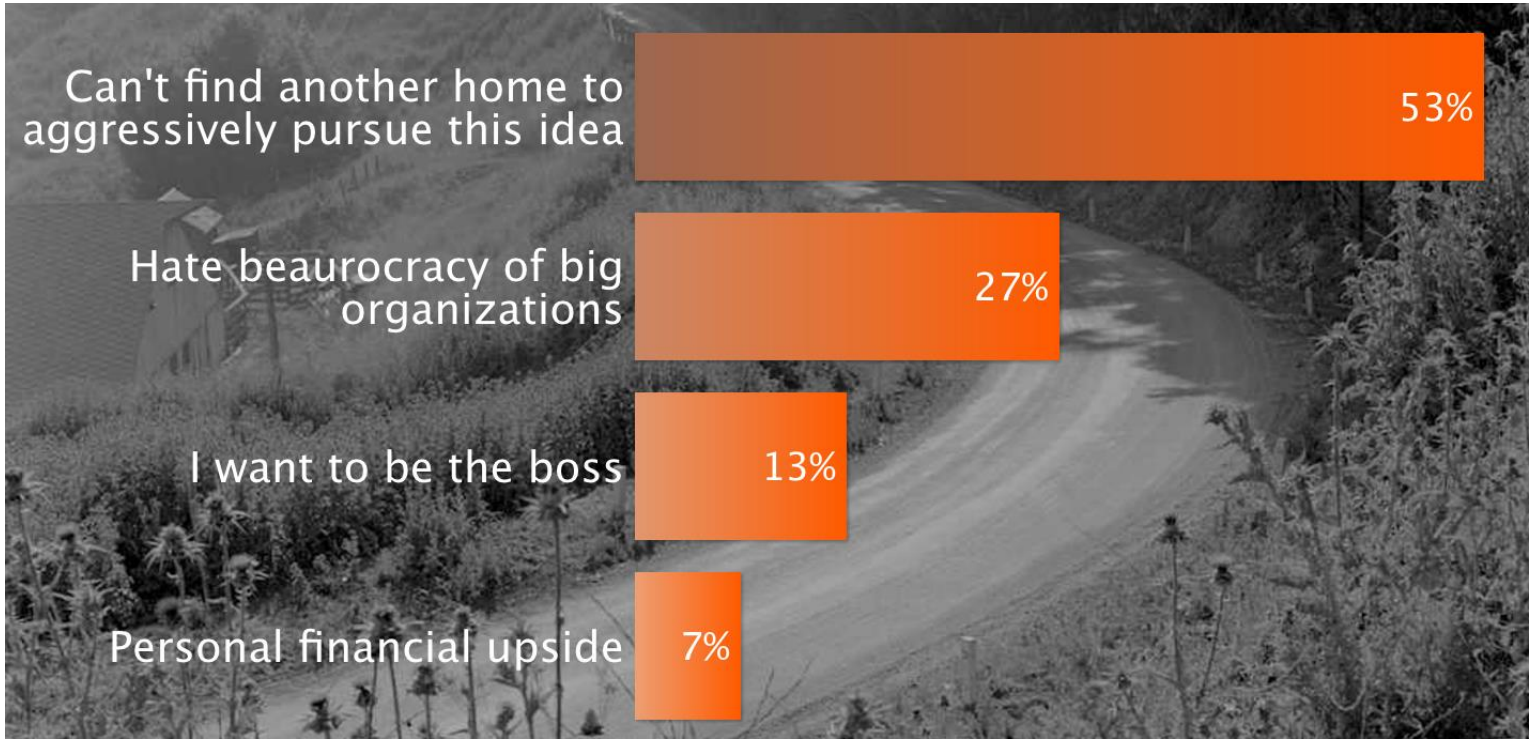
DARPA

2nd Generation
>35% efficiency

Future potential efficiency ~50-60%

What’s next?

Biggest reason to join Cyclotron Road?

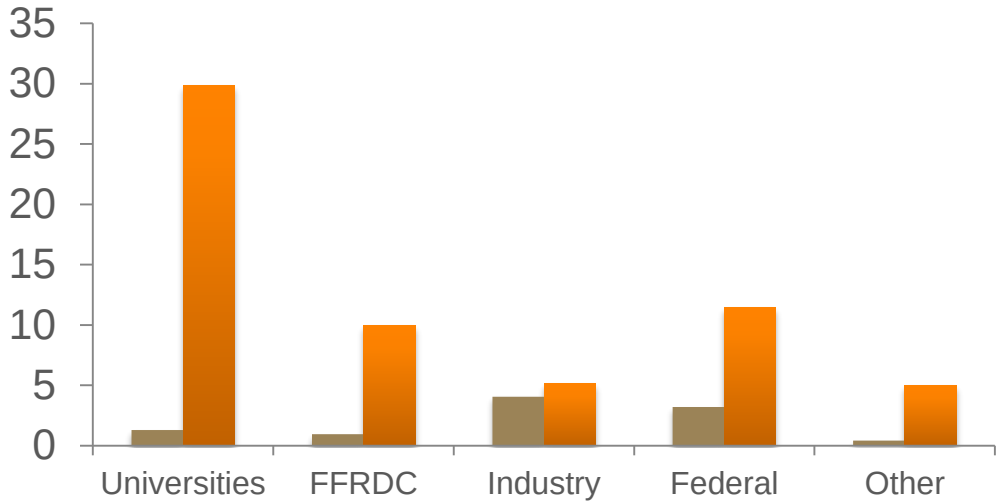


Step one: recognize the problem

Top scientists need a home to transform concepts to products

Step two: identify the root cause

We have abandoned application driven research institutions



Step three: take action

We must rebuild critical infrastructure for science innovation

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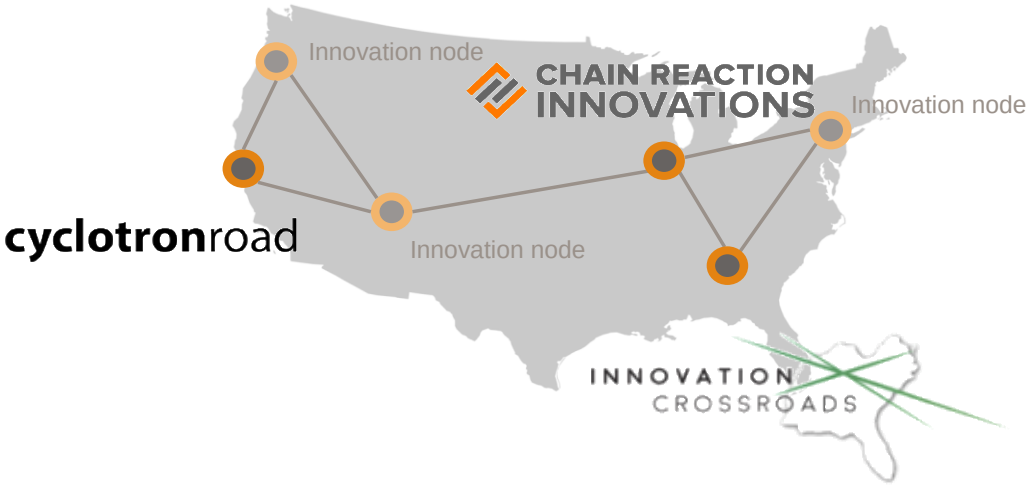

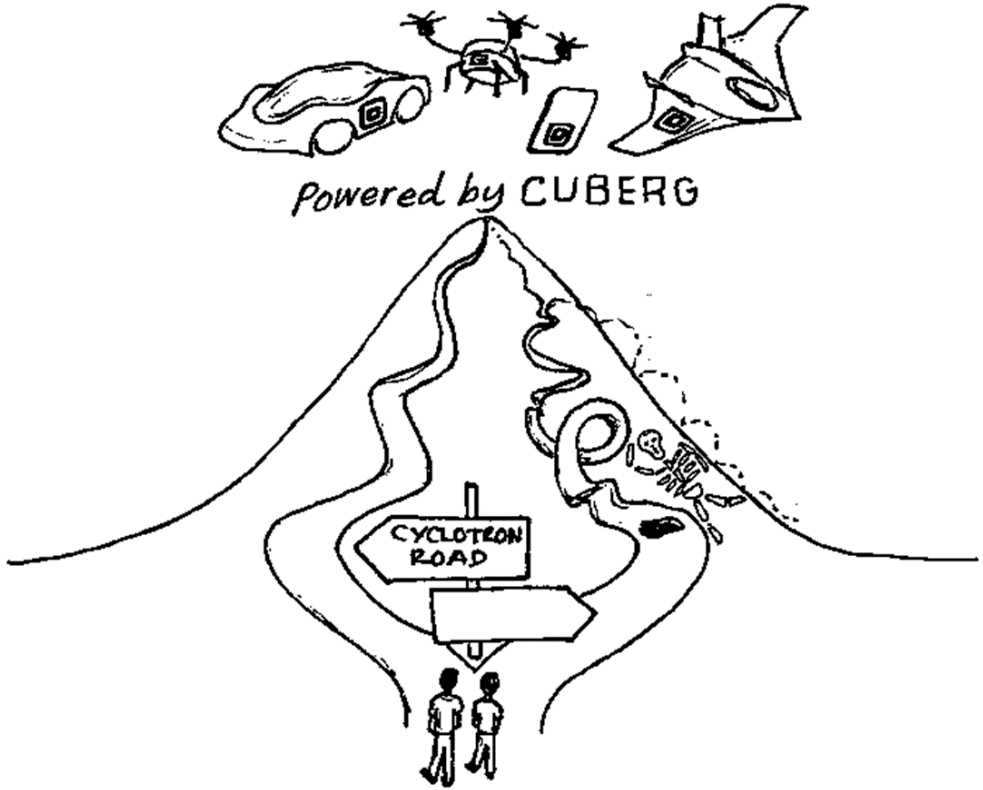
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