UNIVERSITY OF CAMBRIDGE

HARVARD Kennedy Sch
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Towards a workable and effective climate policy: a focus on innovation policies

EPRG Winter Seminar, University of Cambridge
The Moller Centre, Churchill College
Cambridge, UK

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Getting to Net Zero will require major change across all sectors..

Power | Transport | Buildings | Industry | AFOLU

1. Accelerated deployment of net-zero or less-carbon intensive technologies we have today (considering co-benefits, possible trade-offs…)

2. Individual action to shift to lower-carbon or net-zero alternatives and reduc waste

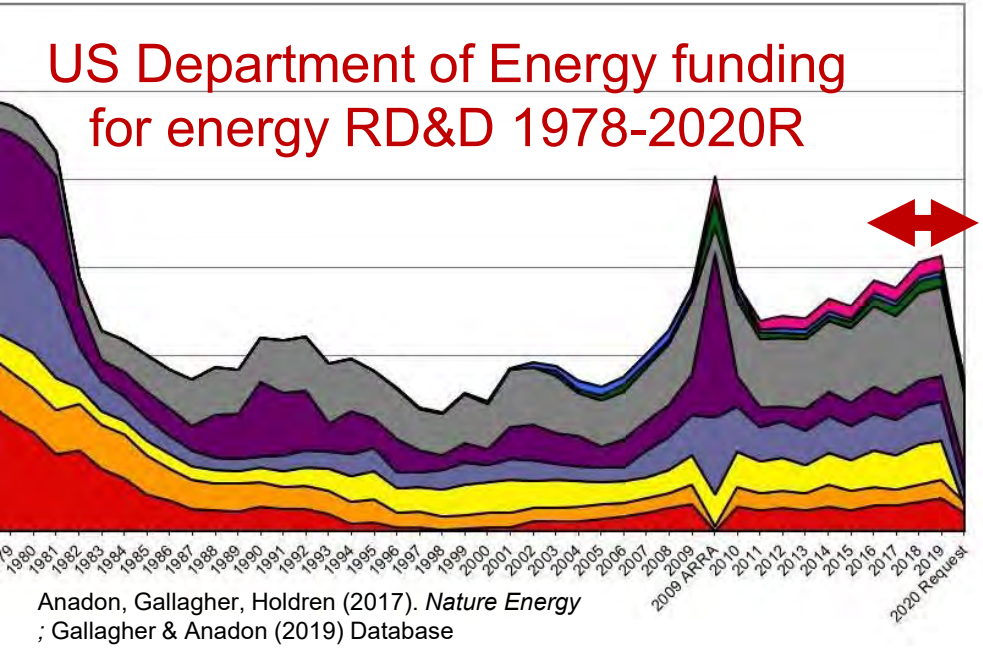
3. **Development and deployment of technologies that are not yet available**

1. The role of governments in innovation in the energy sector

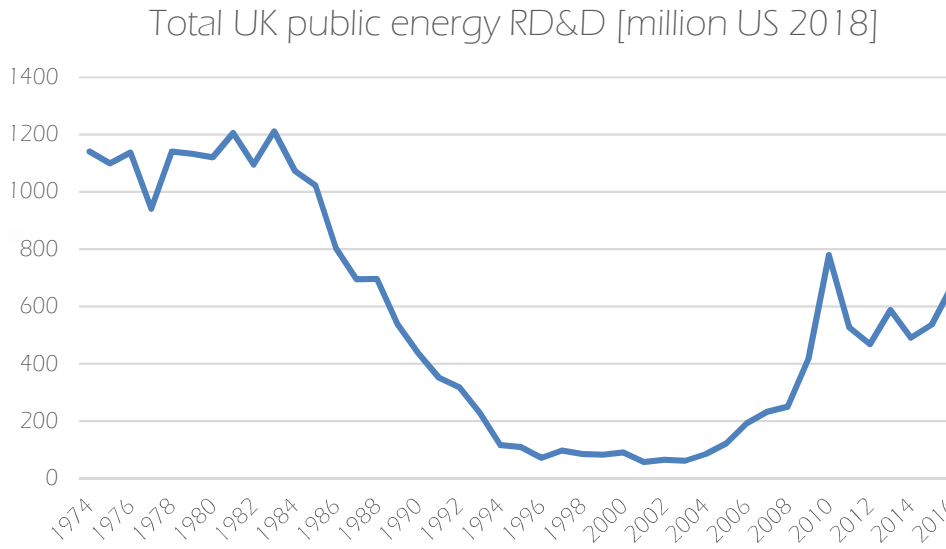
Government policy has played an important role in innovation in energy technologies for many reasons

Government policies (tech push and market pull) have played historically a key role in energy

There is relative consensus on the value of energy RD&D



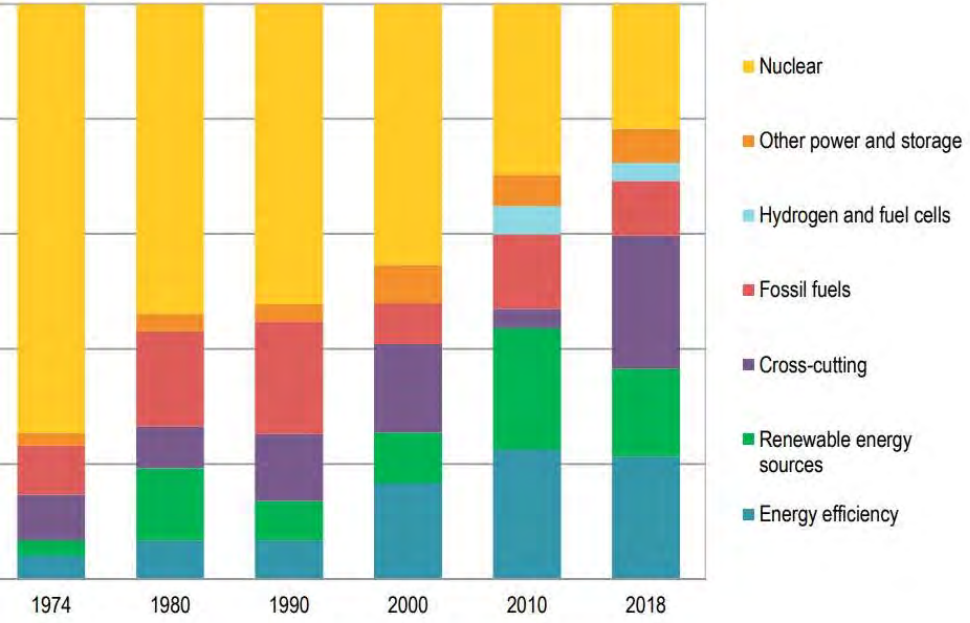
Anadon, Gallagher, Holdren (2017). *Nature Energy* ; Gallagher & Anadon (2019) Database



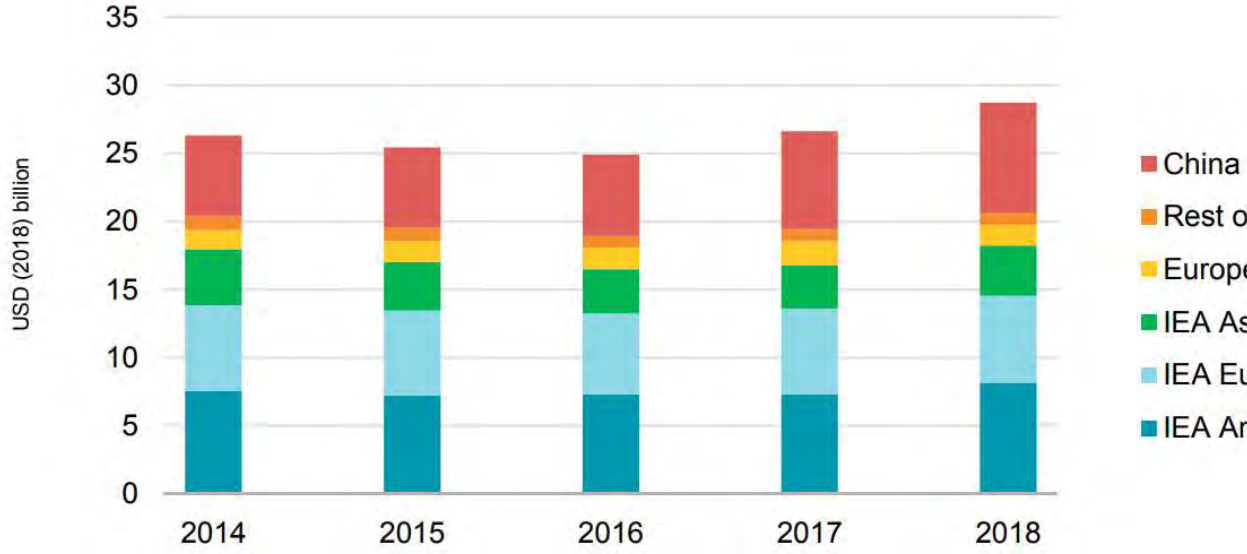
IEA (2019)

he focus of public energy RD&D investments has changed

lic energy R&D by technology of
Member Countries (1974-2018)



Global public energy RD&D budget
by region/country (2014-2018)



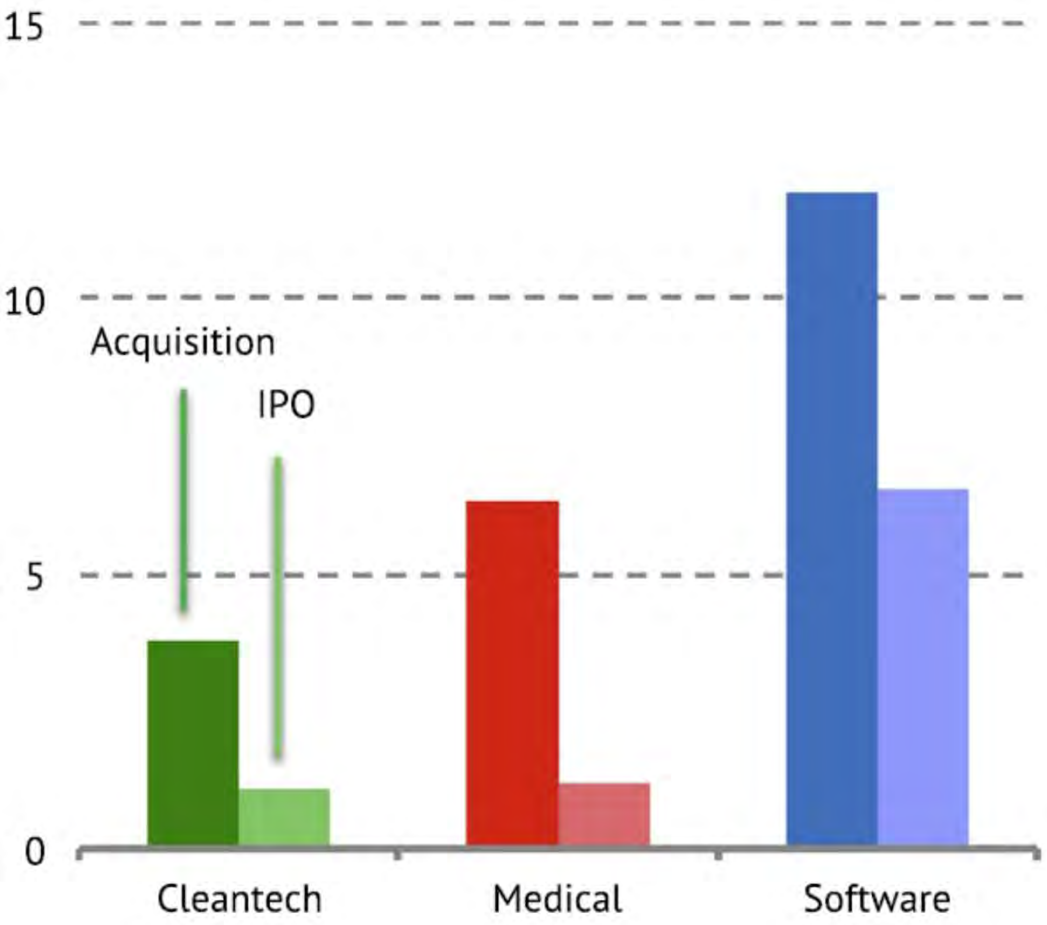
- Increase in public energy RD&D since Mission Innovation, especially from China

IEA (2019)

LDA1 Laura Diaz Anadon, 09/12/2019

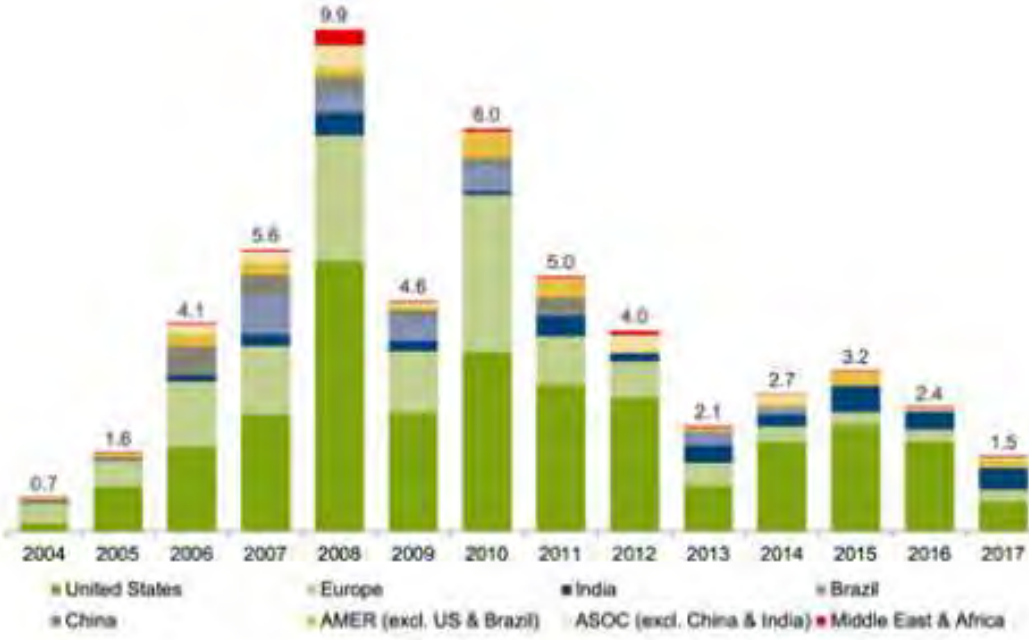
Exit outcomes of US cleantech VC investments vs other sectors (2004-2014)

% of companies receiving A-round that exited through an IPO or acquisition



t al. 2017 Energy Policy

VC/PE investment in renewable energy by region (2004-2018) $BN



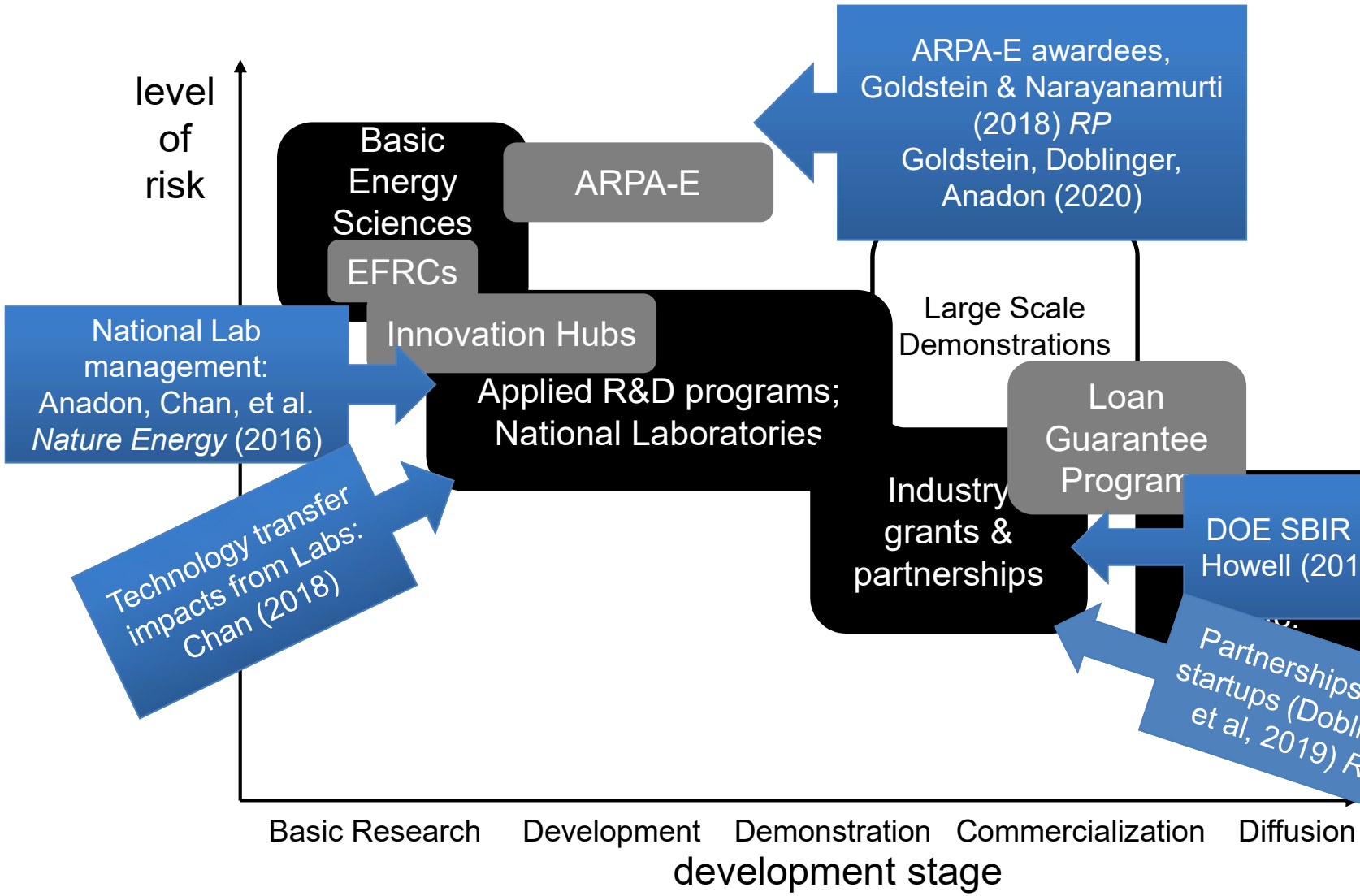
Source: UN Environment, Frankfurt School-UNEP Centre, BloombergNEF

2. Public energy R&D in the US

Evidence on the impact of different US public energy innovation institutions

Data has starting to become available to learn about short- to médium term **outputs** *(dependent variables), i.e. firm-level publications, patents, follow on funding, survival*

we have some sense of at works, at least in the ort- to medium-term

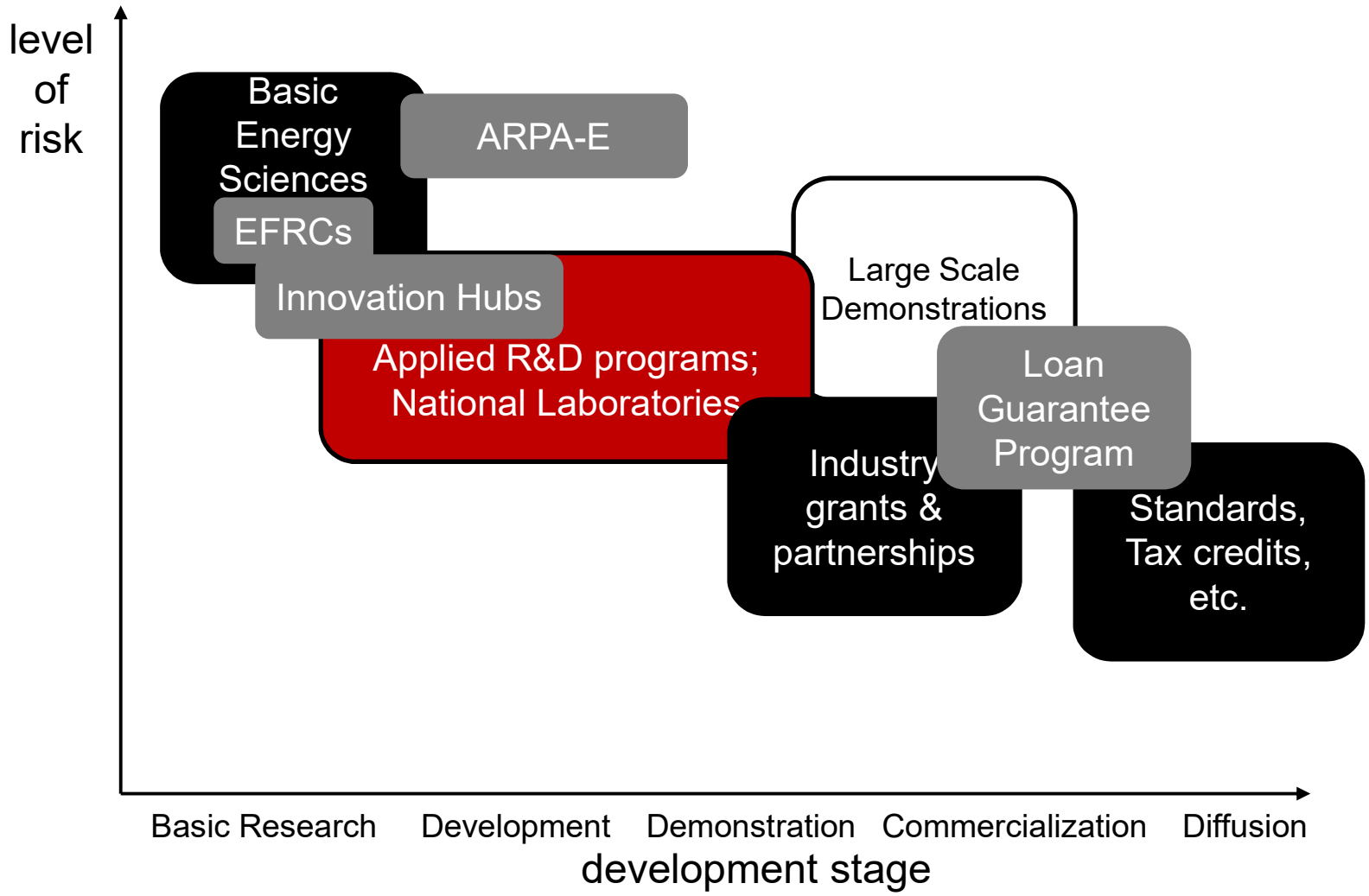


Anadon, Bunn, Narayanamurti (2014). *Cambridge University Press.*

US National Labs

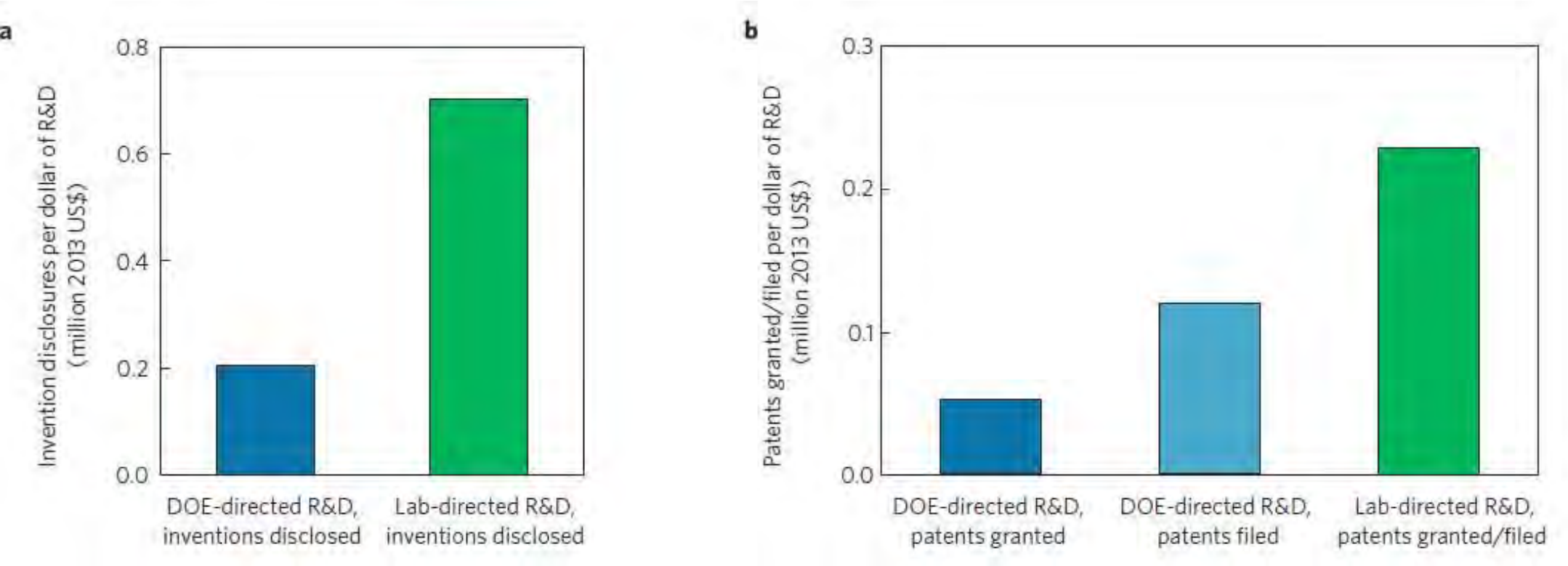
- **In over 68 countries, national labs conduct at least 30% of all R&D in the country**

- Research combining public expenditure data for different funding types and technology transfer outputs (patents, disclosures, licenses) on about $2 billion of public funding for Labs



Anadon, Bunn, Narayanamurti (2014). *Cambridge University Press.*

Lab-controlled funds are more productive than centrally controlled funds (at the margin) in terms of tech transfer



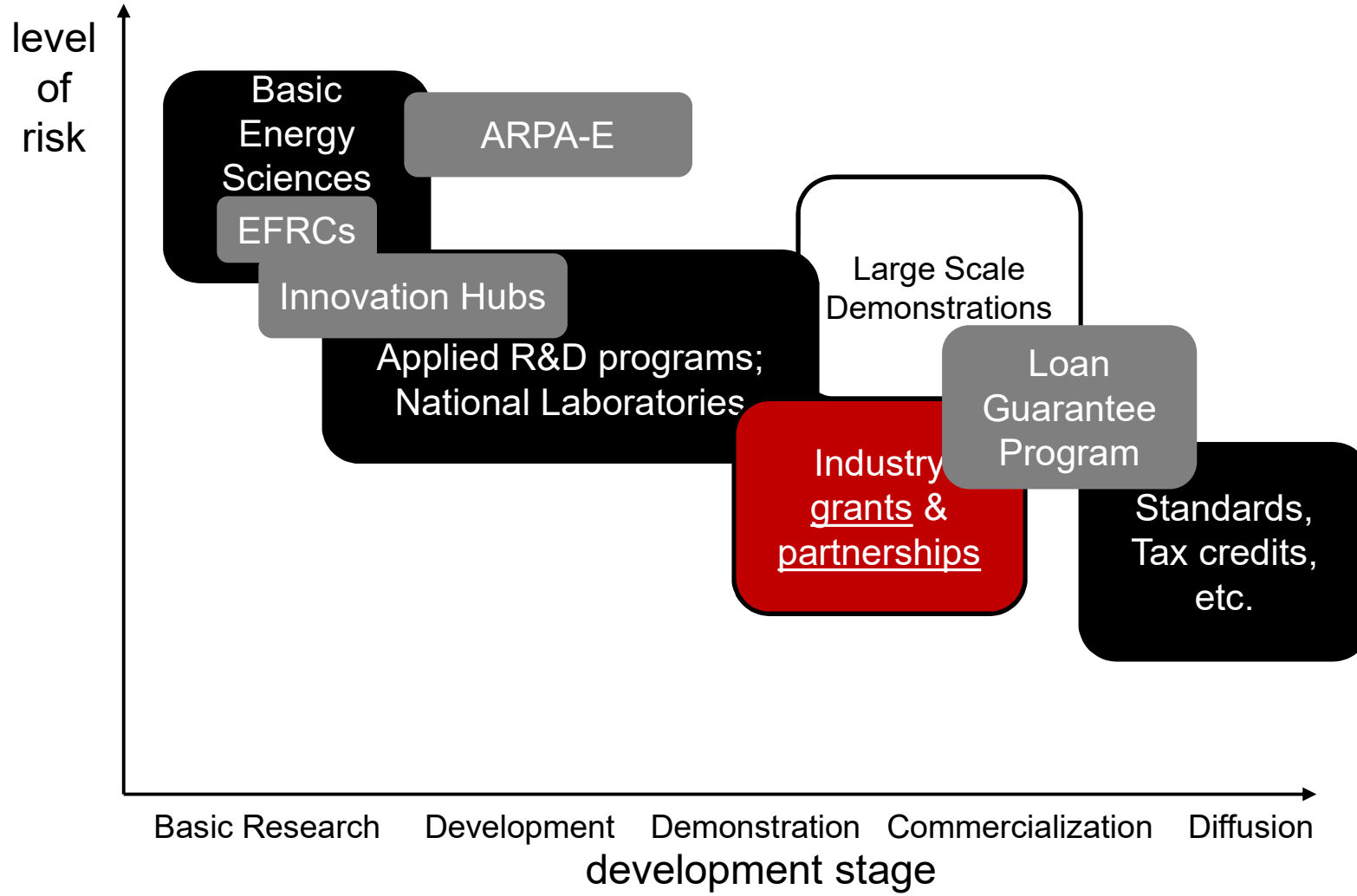
- Lab directed funds **(green)** have decreased twice recently but are the most productive than those centrally controlled **(blue)**

Anadon, Chan, Bin-Nun, Narayanamurti (2016), *Nature Energy; See also* Chan et al. (2017) *Nature* "Six guiding principles for energy innovation"

Alliances (joint development, licensing, procurement) between public institutions (e.g., labs) and cleantch startups

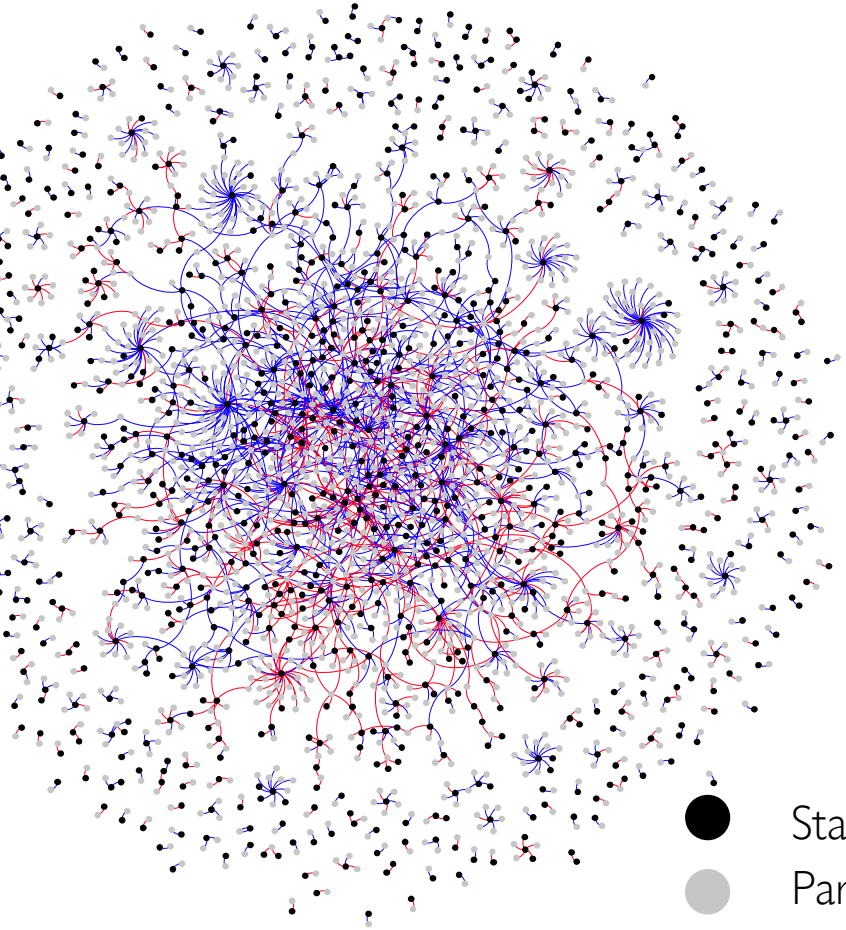
ecommendation from the ainly qualitative) literature to te was (approximately): llaborate as much with as any diverse partners as ssible or "Don't Go At It one" Baum et al., (2000, p. 267)

t startups cannot collaborate h everyone: Who holds tical technological resources cleantech innovation?



US cleantech startup alliance network overview

All partners and partnerships



Startups

Partners

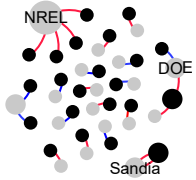
Technology-based relationship

Market-based relationship

Closer look at govmn‘t partne

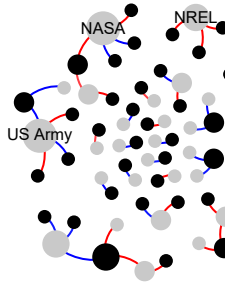
Startup – Government

2009



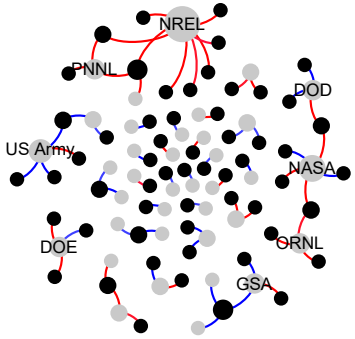
Startup – Governm

2010



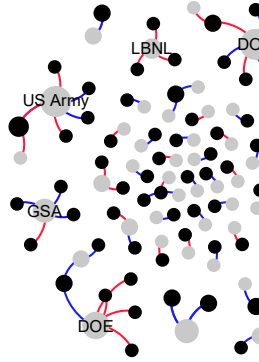
Startup – Government

2011



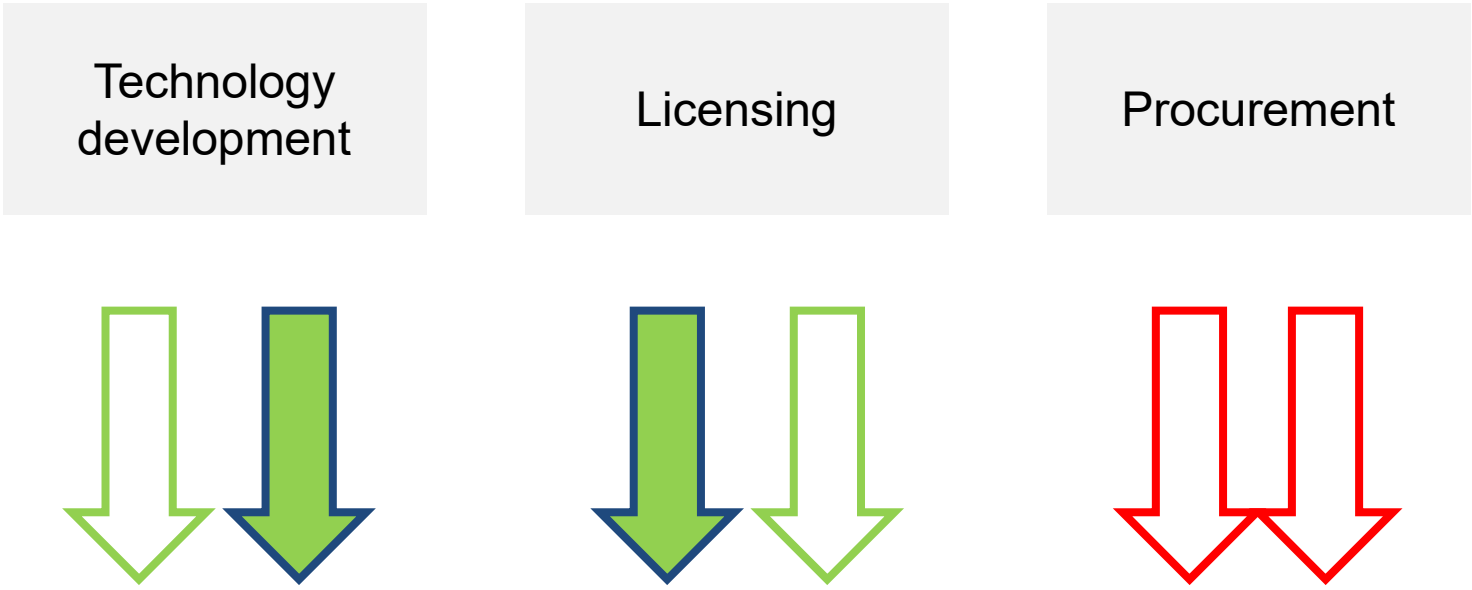
Startup – Governm

2012



Doblinger, Surana and Anadon (2019) *Research Policy*

Direction and significance of relationship between cleantech startup-government collaborations and outcomes



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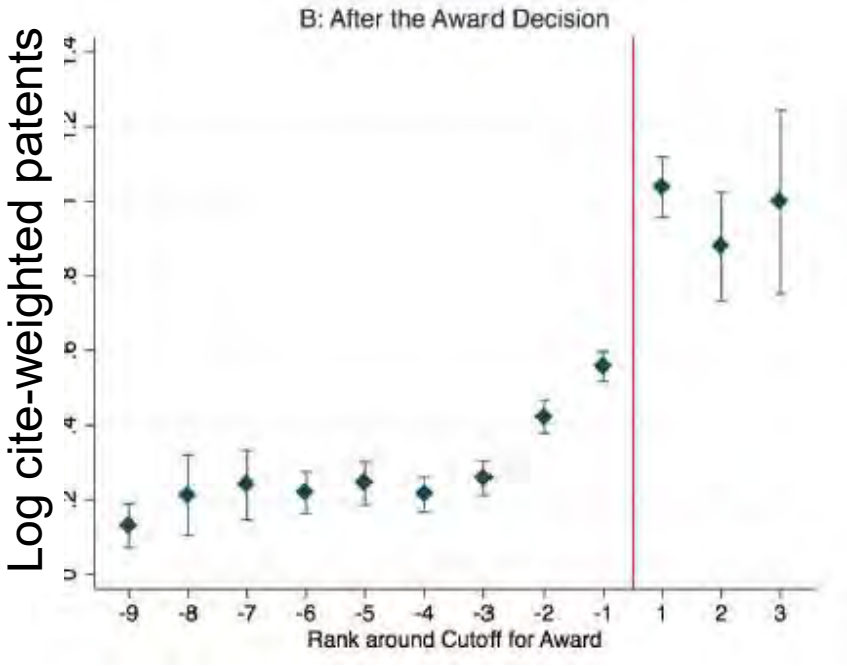
Regressions, ir
Instrumental Va
Approach

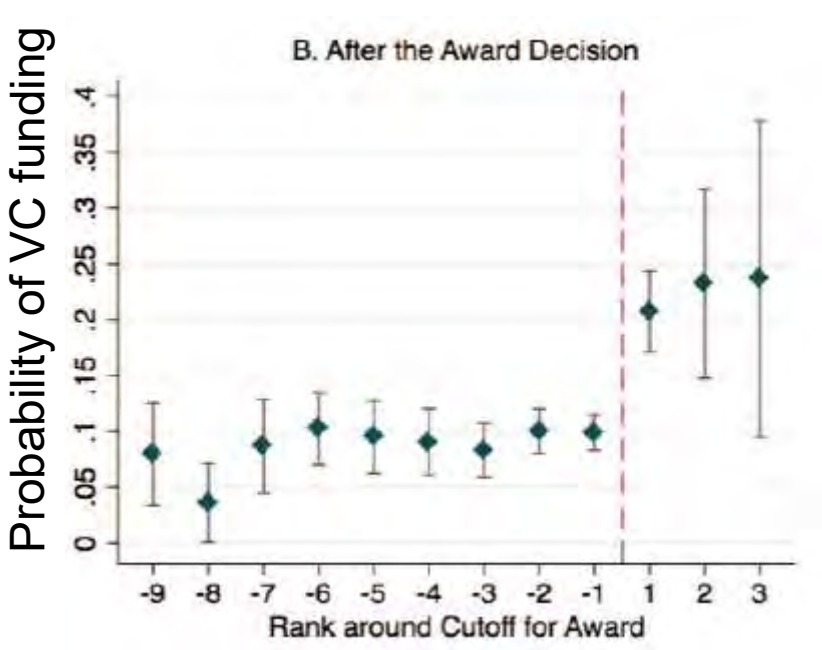
Doblinger, Surana and Anadon (2019) *Research Policy*

Consistent with results from research on the U.S. Department of Energy R&D grants to small businesses

Analysis of U.S. DOE Small Business Innovation Research (SBIR) grant recipients over 2 years

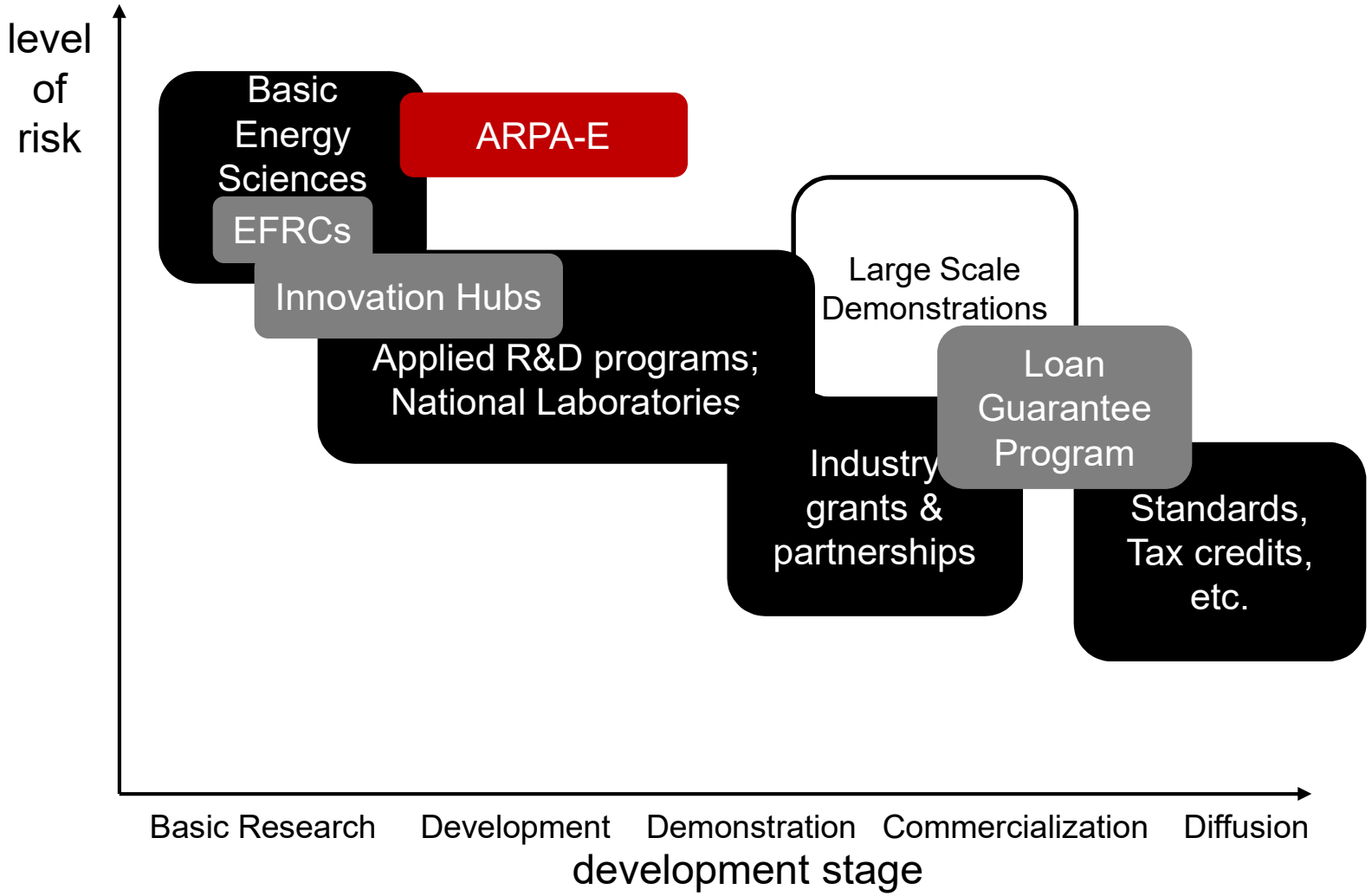
- Award doubles probability that a firm receives subsequent VC and has large, positive impacts o patenting and commercialization



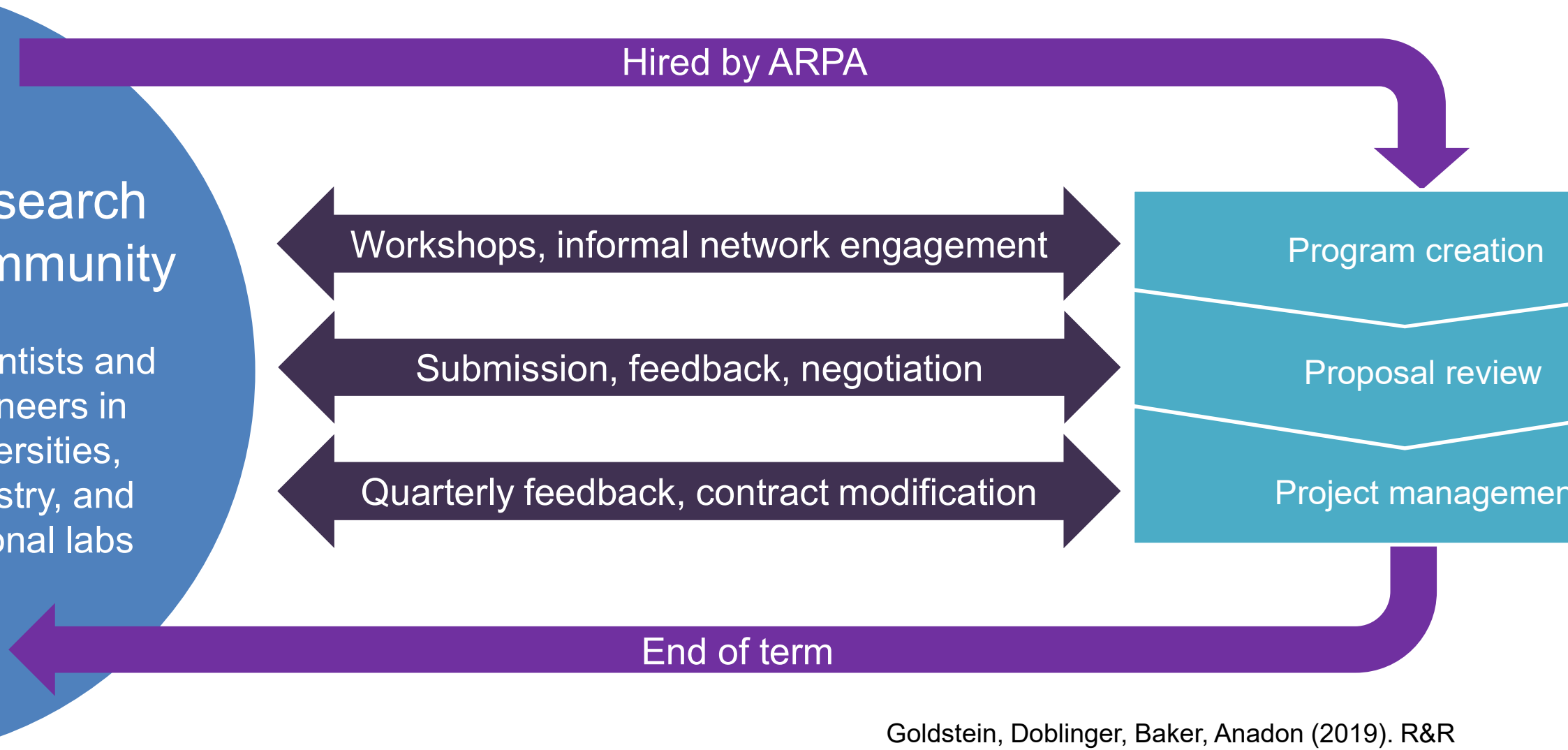


Howell (2017) *American Economic Review*

Actively managed R&D funding organizations: ARPA-E



ARPA-E program management



Goldstein, Doblinger, Baker, Anadon (2019). R&R

ARPA-E research question

~~Does ARPA-style funding *improve* outcomes for startups?~~

Does ARPA-style funding advance technology more than other types of funding?

- Allows for the possibility of selection and/or treatment
- Aligns with the goal of the agency, which is to overcome long-term technological barriers

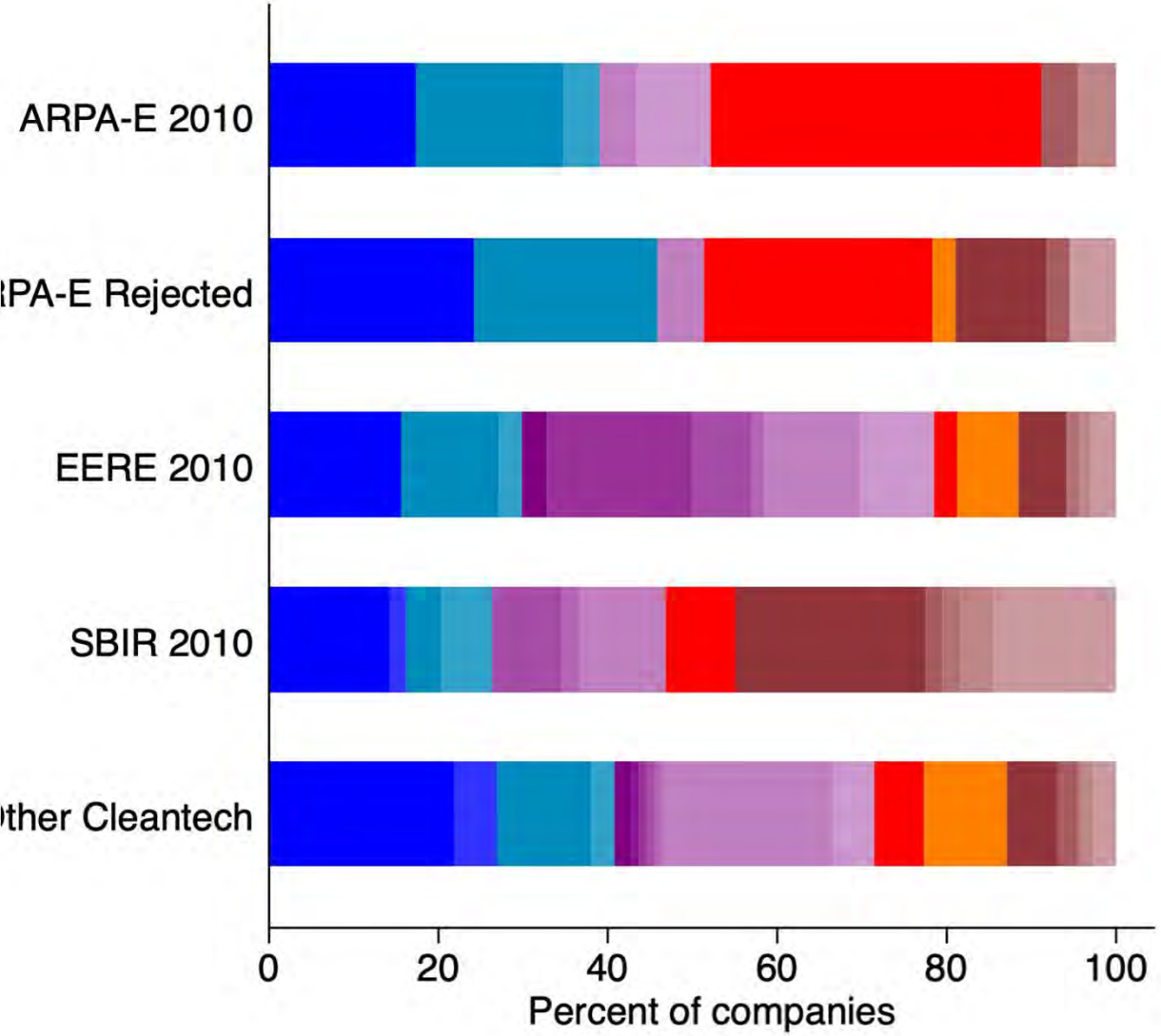
Goldstein, Doblinger, Baker, Anadon (2019). R&R

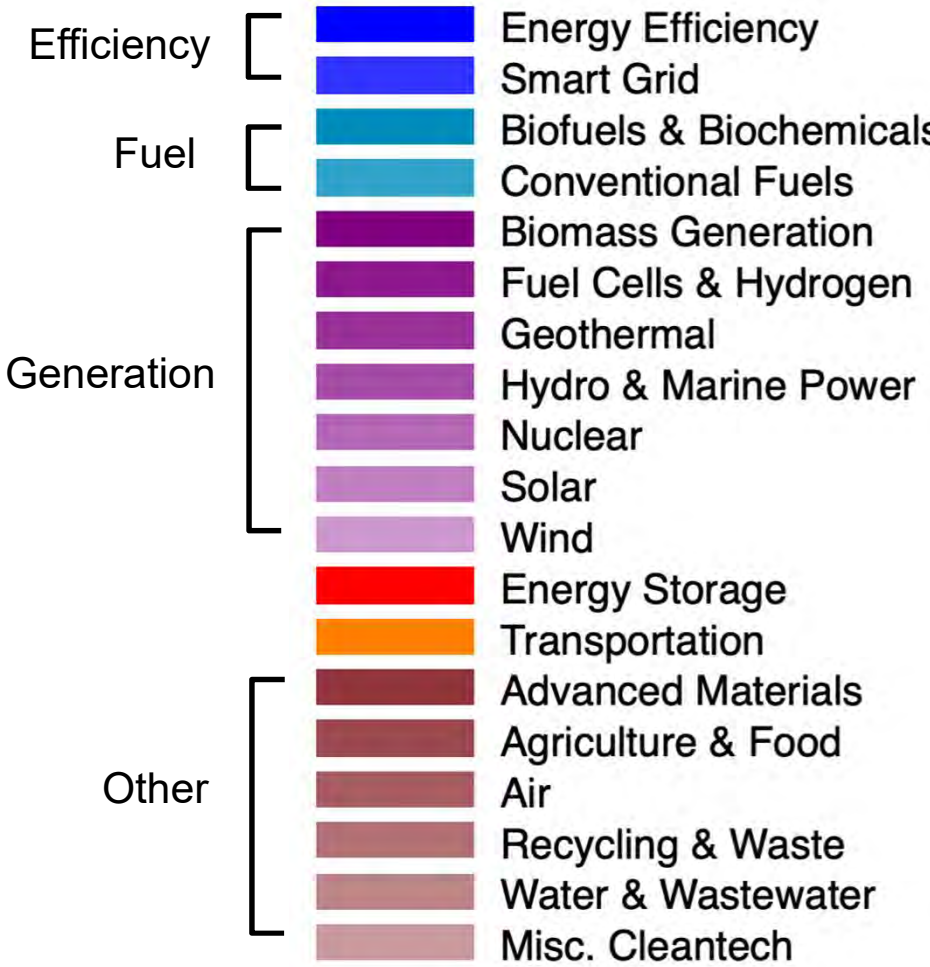
Enhanced patenting for US cleantech startups post-ARPA-E: result robust to all specifications

ARPA-E awardees receive more post VC funding, although the effect not significant when conducting the statistical analysis

Goldstein, Doblinger, Baker, Anadon (2019). R&R

ARPA-E allocated funding to a different range of technologies compared to other programs and the universe of startups





Goldstein, Doblinger, Baker, Anadon (2019). R&R

3. Public energy innovation institutions in the UK

UK institutional innovation on public energy R&D

$: provision of funds
circles: direct private
sector involvement in
decision-making;
house: creation of new
entity during the
unding;
person: provision of
expertise in the form of
usiness or technical
dvice.

dated and adapted from
adon (2012) in *Research*
licy & Chan et al. (2017) in
ture

Country	Selection of new institutions funding and enabling energy innovation	Use-inspired basic research	Applied R&D	Demons-tration	Market formation and deployment
United Kingdom	UK Carbon Trust (2001-)				
	UK Energy Research Center (2004-)	Non-technology, social science research			
	Energy Technologies Institute (2007-)				
	Env. Transf. Fund/International Climate Fund (2008/2011-)				
	Technology Strategy Board/Innovate UK (2008/2014)[1]				
	Catapults[2] (2011-)				
United States	Energy Frontier Research Centers (2008-)				
	ARPA-E (2009-)				
	Energy Innovation Hubs[3] (2009-)				
	Cyclotron Road (2015-)				

2017: Faraday Institute

rom the US experience and the UK context

1. The UK has not increased public funding for R&D in general commensurate with other nations
2. Institutional approaches have not been sticky (volatility)
3. Very limited national lab infrastructure
4. Limited (although now significant) VC funding
5. Less R&D funding focus on small firms
6. Now that the Carbon Trust has been redefined, no managed funding

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hank you for your attention!

nd thanks also to my **co-authors**!

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