A painting of an industrial landscape, likely a steel mill or coal mine, featuring tall smokestacks emitting smoke, a large arched bridge in the background, and a factory building with multiple windows and a chimney. The scene is depicted in a dark, moody style with heavy shadows.

Analysis of IR

PS 1599 | Week 4: Innovations

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Administration

- Office hours, emails...
- COVID policy
- Readings on website
- Research report

What did we talk about last time?

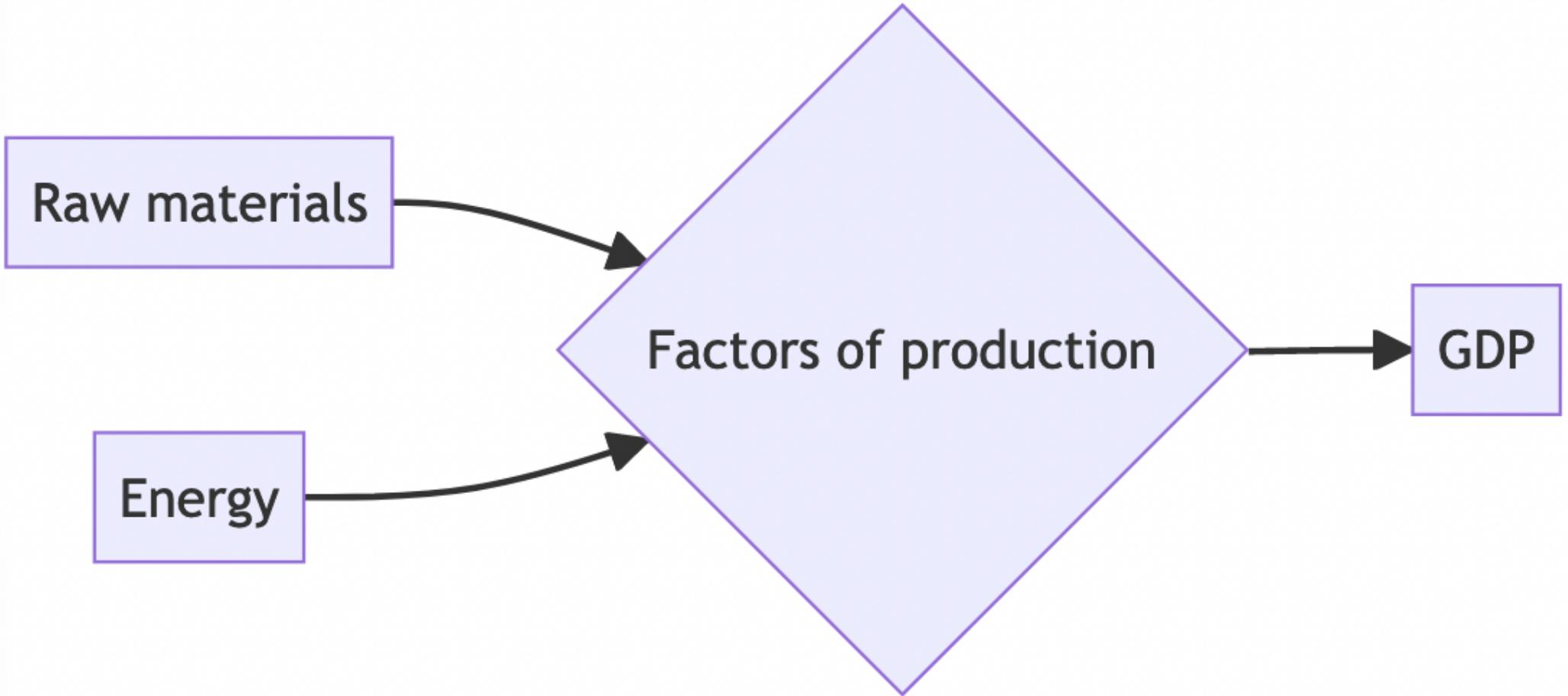
Starting point

- We now know what we aim for: economic development
- We know why we want it: material welfare
- It also often reduces inequality (across+within countries)
- Development comes from (tech) innovations
- But need to address tech's negative externalities
- Big question: how?

Supply-side failures I: Innovations

Basic model

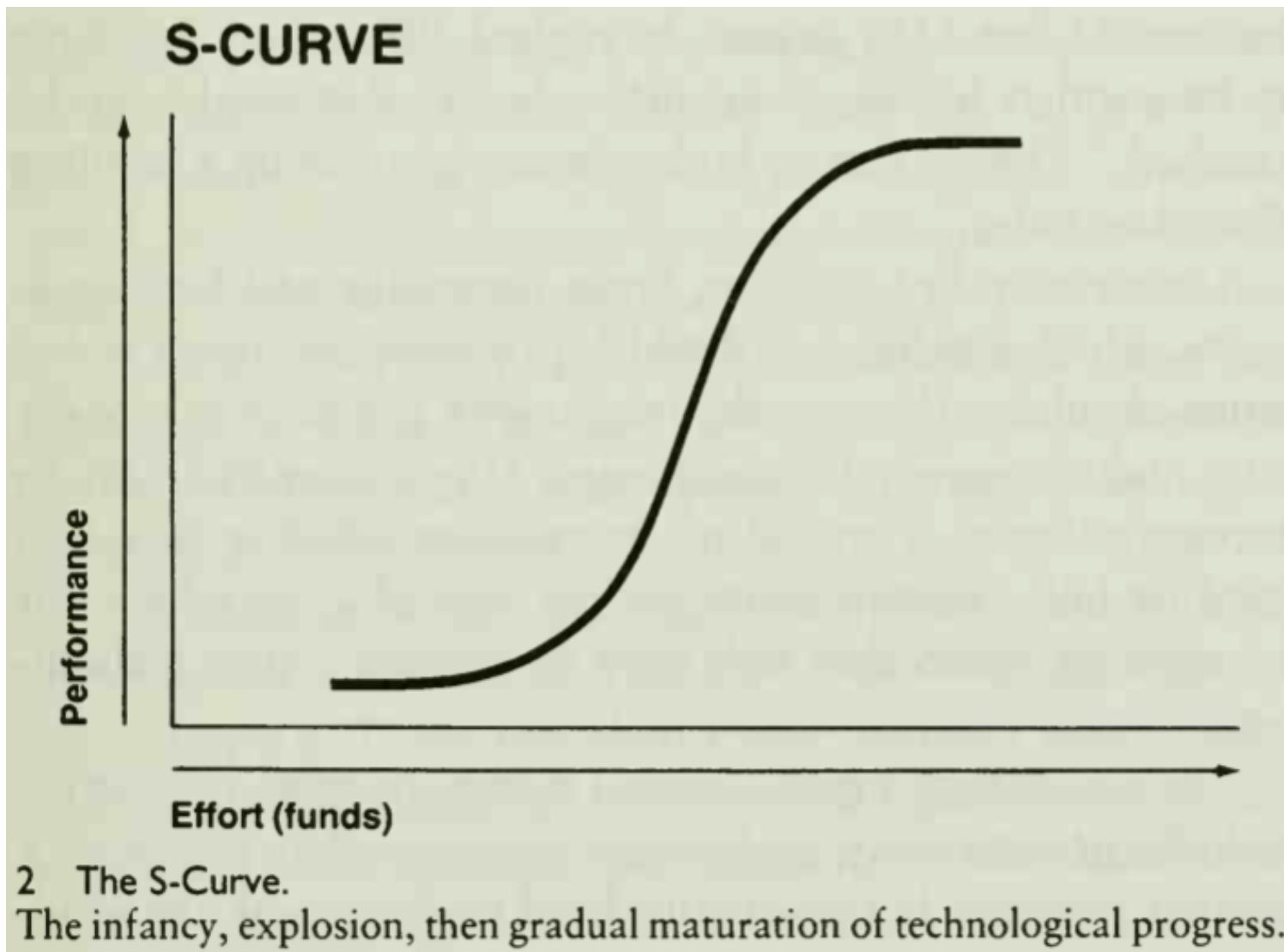
- We are interested in economic **output** (aka GDP)
- Output is generated by **factors of production**...
 - Labor, capital, land
- ... and **inputs**
 - raw materials, energy, ...



- Output = inputs transformed by factors of prod
- Technology = how “well” FoP transform inputs

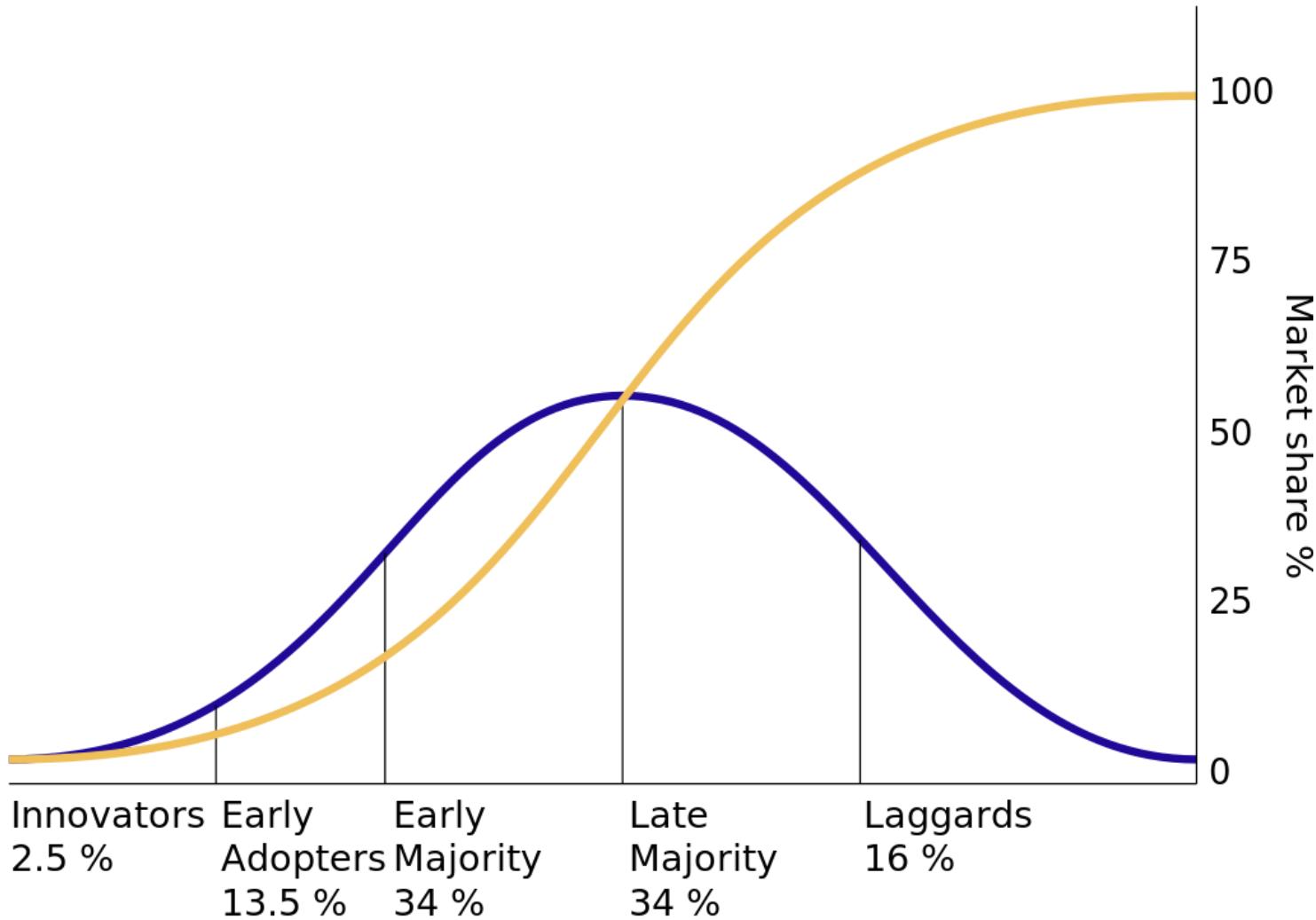
- Core question: where do new goods/services come from?
- Need to think about markets and dev of new products
- Typical lifespan of a new product
 - Stage 1: early development
 - Stage 2: diffusion
 - Stage 3: maturity
- Two parallel S-curves

Supply-side



Source: Foster (1986).

Demand-side



Source: wikipedia

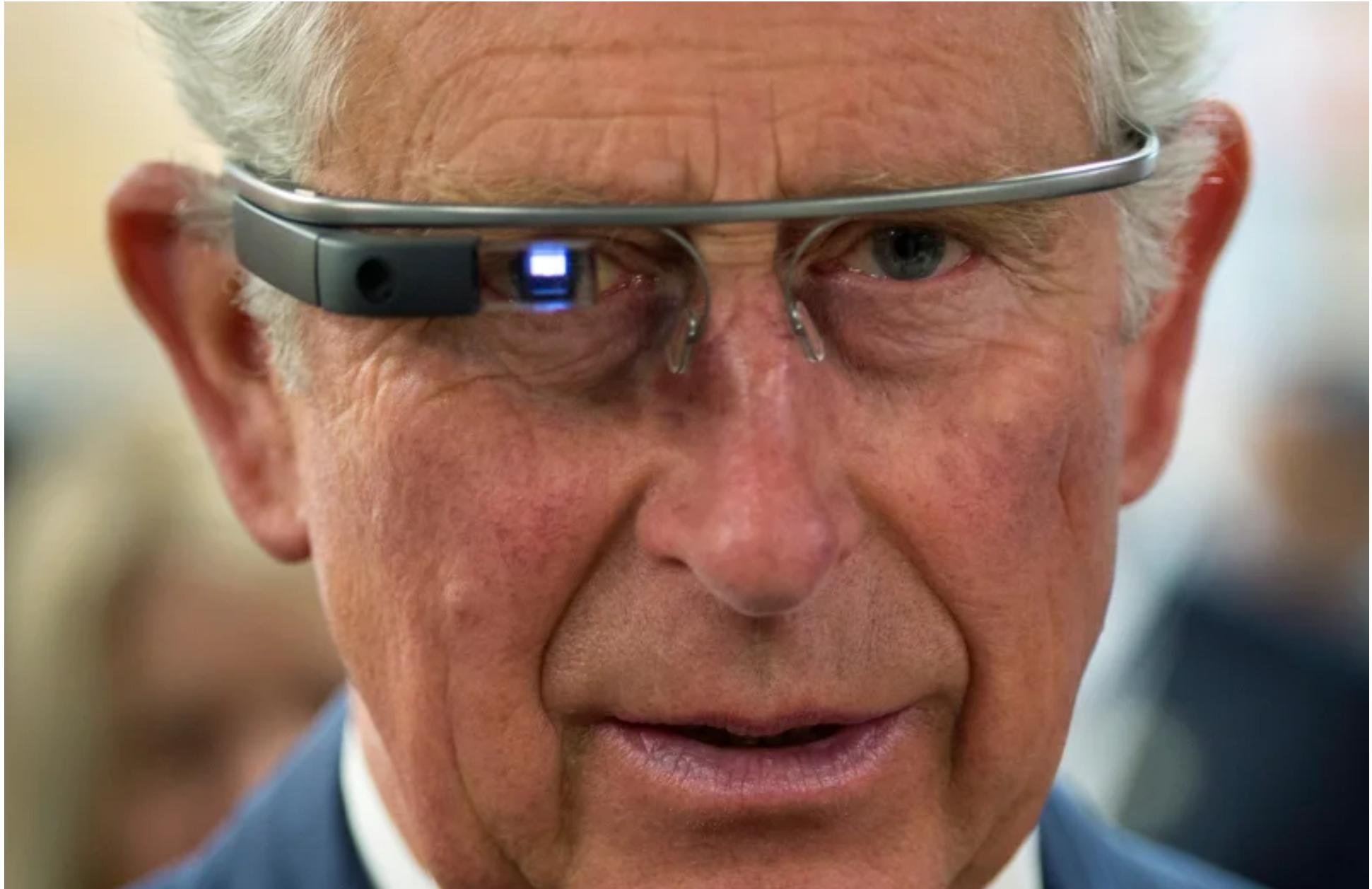
Find examples of tech/goods that

never succeeded...

Why did they fail?



minidisks. Source: Sony



Google Glass. Source: Time Magazine



3D TV. Source: The Verge

- We will talk about **demand** side problems later
- For now: **supply** side. Two key moments:
 - At “birth”: problem of generating new ideas (**innovation**)
 - At “puberty”: prob of diffusing products (**non-market competition**)
- So: **where** does innovation come from?

Definitions

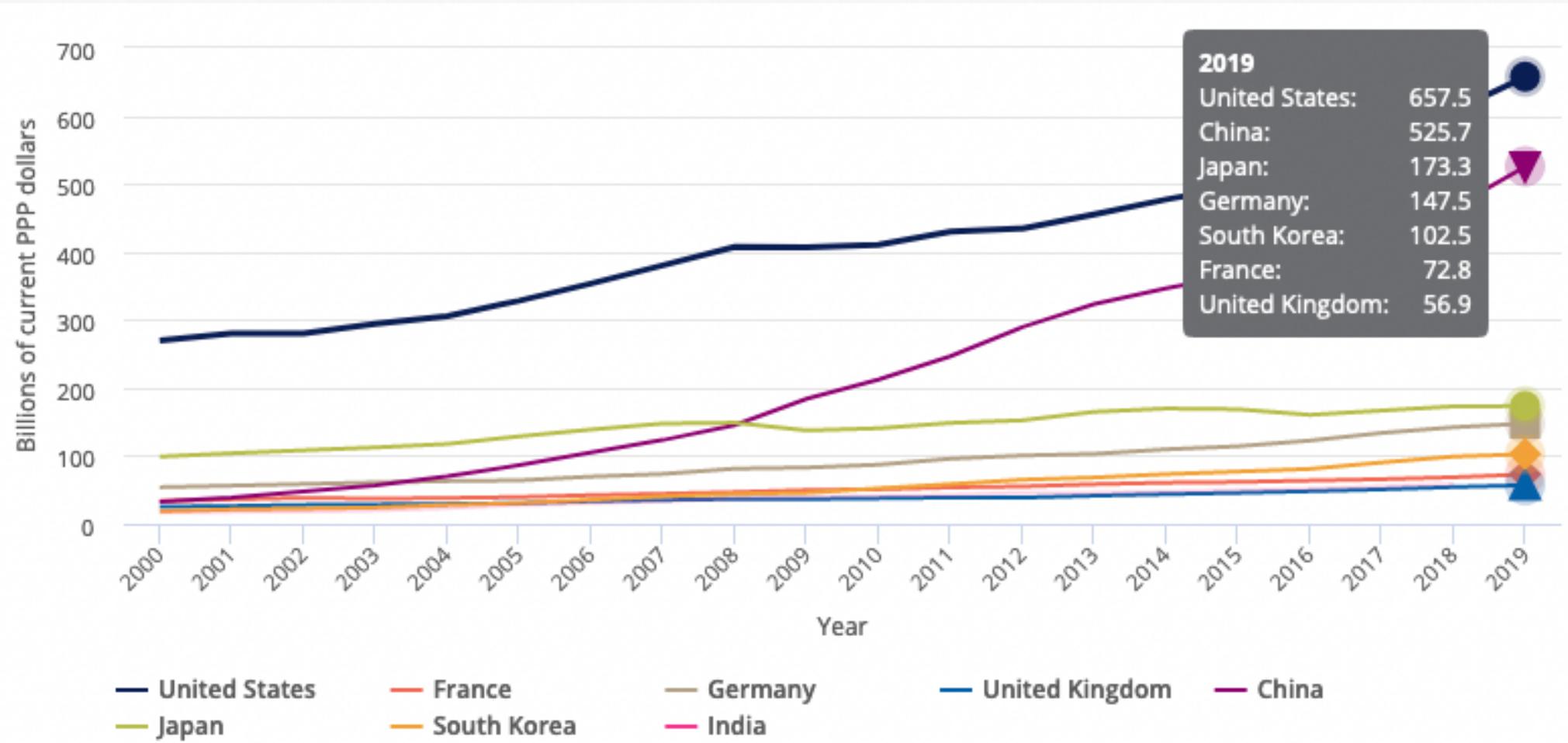
- **Technology**: “manner of accomplishing a task” (Webster)
- **Invention**: a new idea or new process
- **Innovation**: “*market* introduction of a technical or organisational novelty” ([Schumpeter 1934](#)) (emph added)
- Note:
 - tech=level vs. invention+innovation=change
 - invention=individual vs. innovation+tech=social

- Typically: innovation is the result of **research & development**
- First issue: design a **cost-effective** product (**supply**)
- R&D: invention → innovation
 - Identify demand to solve a problem (surveys, etc)
 - Identify a solution (invention)
 - Deploy a solution in the market (innovation)
- R&D can be public, private (ATT, Google), in-between (Pitt, RAND)
- 2019: US (\$658n, 27%), China (\$526b, 22%)

Figure 12

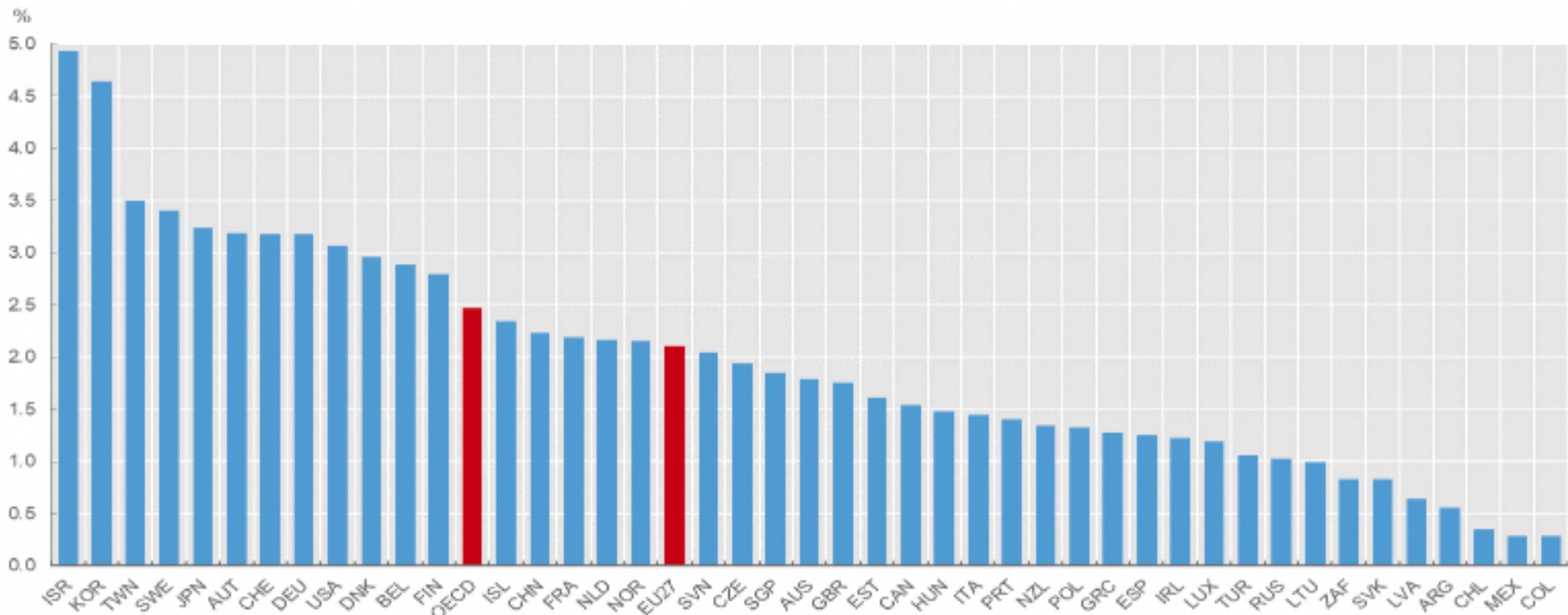


Gross domestic expenditures on R&D, by selected country: 2000–19



Source: NSF.

R&D intensity in OECD countries and selected economies, 2019



Source: OECD Main Science and Technology Indicators Database, March 2021. <http://oe.cd/msti>

Note: For Chile and Singapore, data refer to 2018. For Argentina, Australia, New Zealand, South Africa and Switzerland, data refer to 2017.

Source: OECD (2021)

R&D expenditure trends in OECD countries, 2007-19

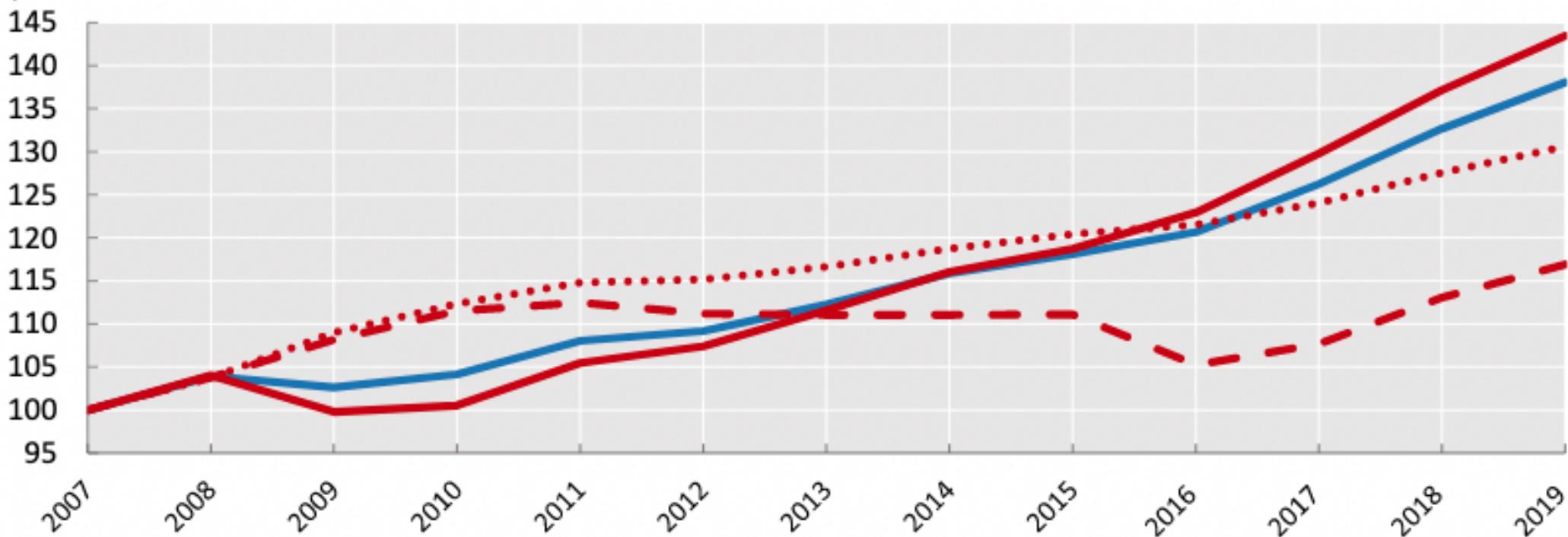
Index
2007=100,
constant
prices

Total OECD R&D expenditure

Higher Education

Business Enterprise

Government

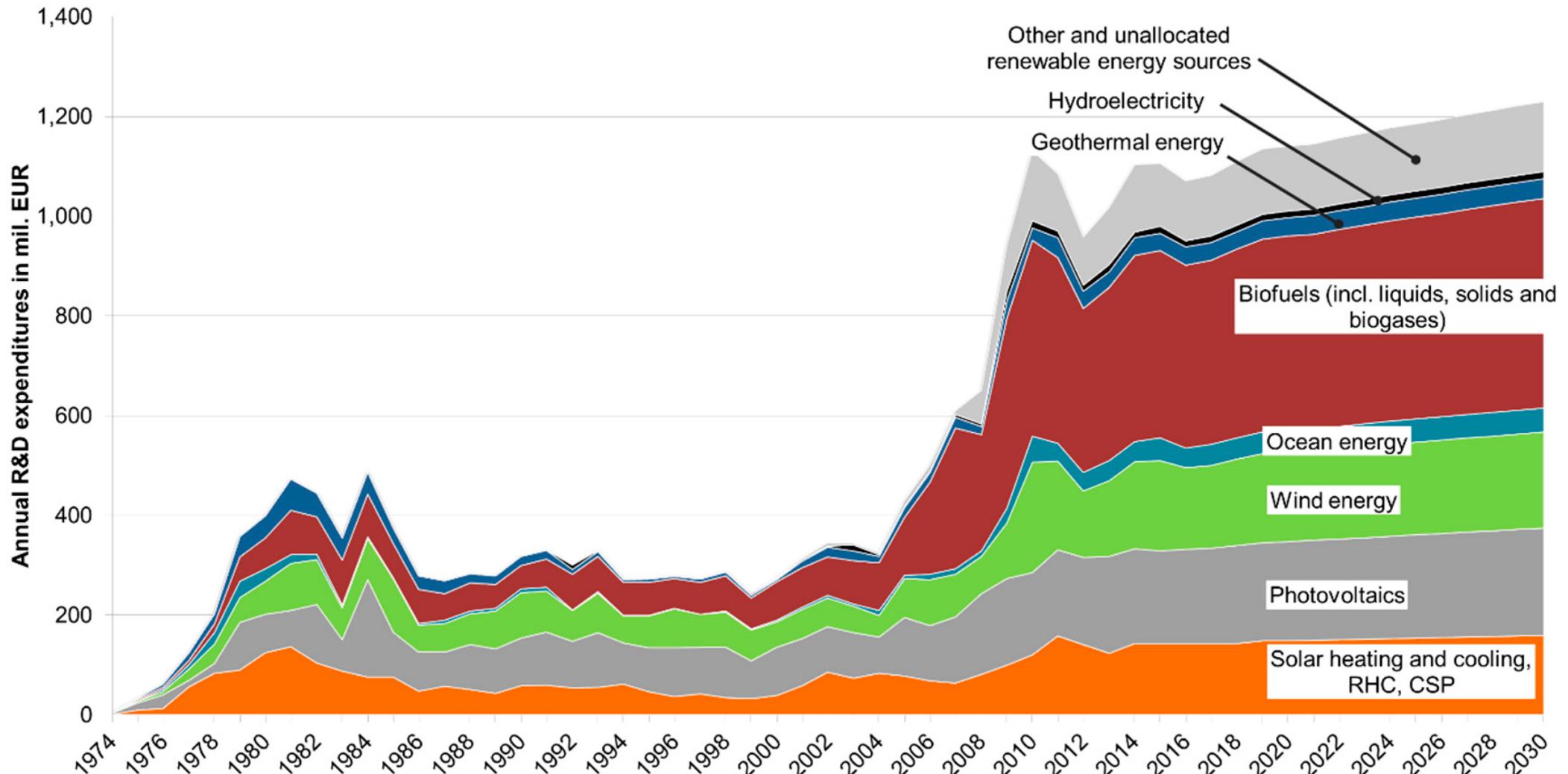


Source: OECD Main Science and Technology Indicators (MSTI) Database, March 2021. <http://oe.cd/msti>

Source: OECD (2021)

Case study: renewable energy

- 1970s: oil shocks + env concerns
 - → demand for innovation in energy
- Problem: no alternative to oil+coal
- Solutions: new energy technologies!
 - France: investments in nuclear
 - US, DE, DK: investments in renewable energy

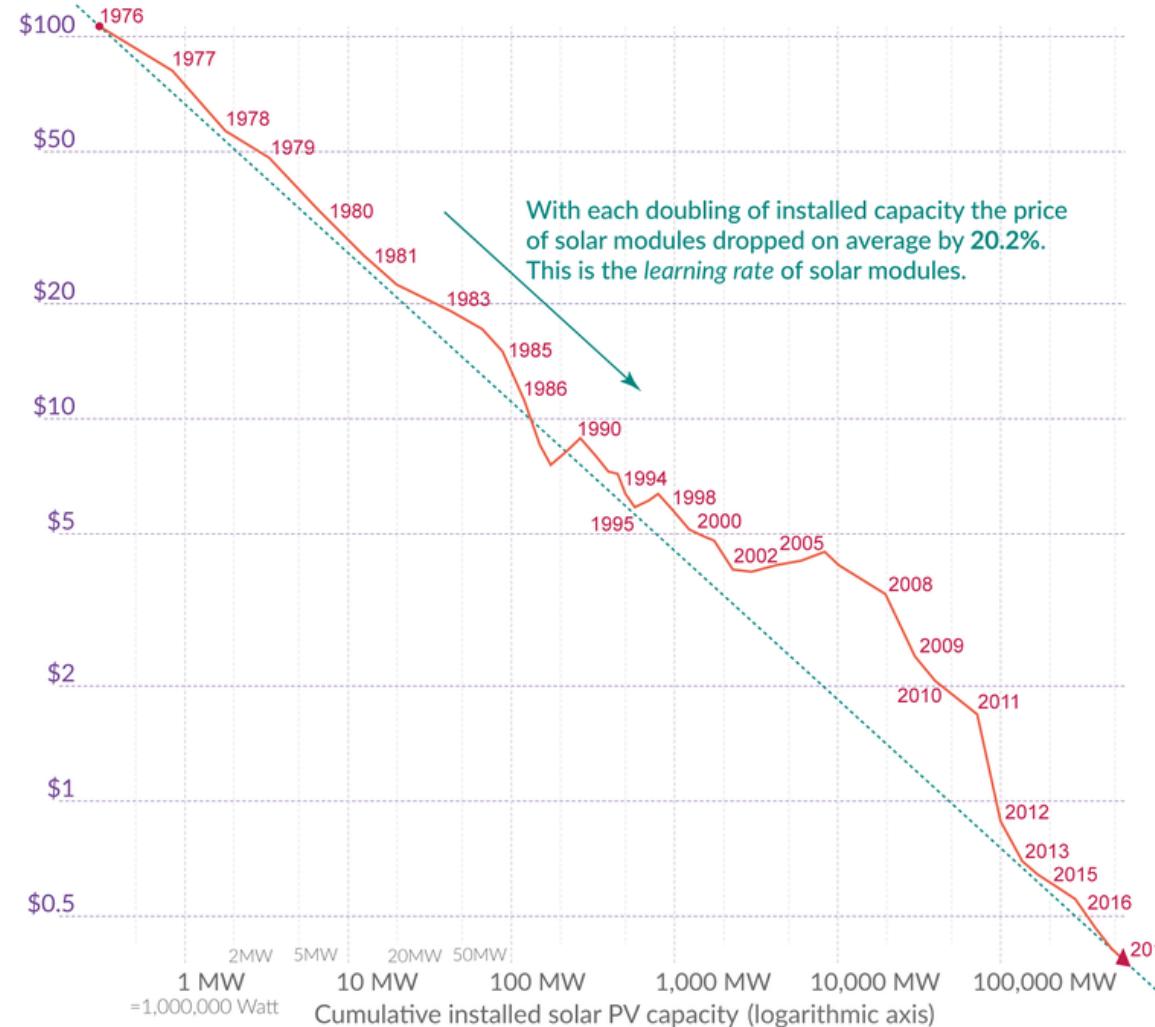


Source: Bointner et al. (2016)

The price of solar modules declined by 99.6% since 1976

Our World
in Data

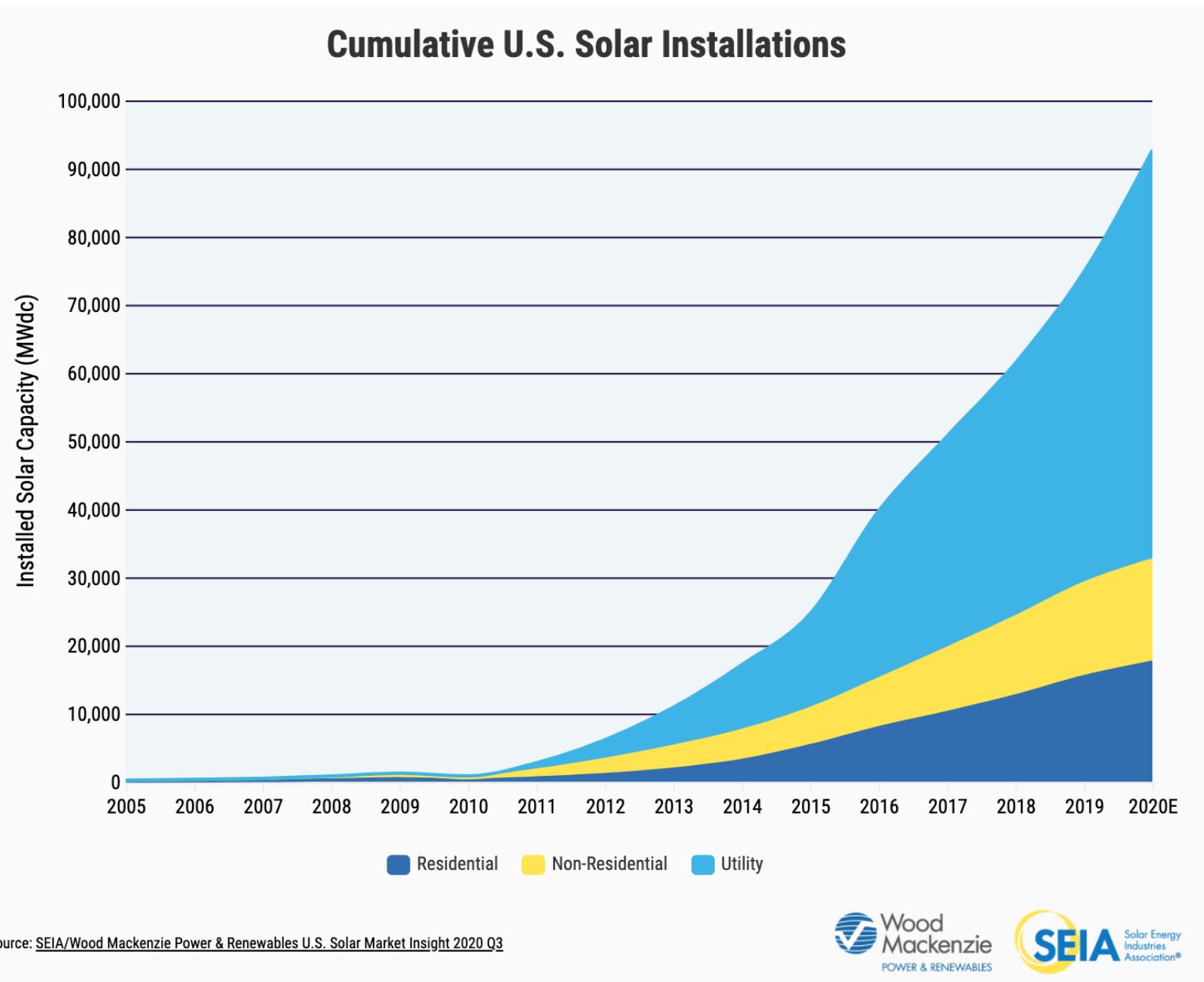
Price per Watt of solar photovoltaics (PV) modules (logarithmic axis)
The prices are adjusted for inflation and presented in 2019 US-\$.



Data: Lafond et al. (2017) and IRENA Database; the reported learning rate is an average over several studies reported by de La Tour et al (2013) in Energy. The rate has remained very similar since then.
OurWorldInData.org – Research and data to make progress against the world's largest problems.

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by the author Max Roser

“Swanson’s law” (from “Moore’s law”)



Source: [SEIA/Wood Mackenzie Power & Renewables U.S. Solar Market Insight 2020 Q3](#)



- What's the problem with R&D? Can't the market solve that?
- Fundamental problem: **collective action failures**
 - = indivs behave in a way that's not optimal for society
 - Note: optimal ≠ rational. Optimal = normative
 - Politics = study of CA problems
- Main types of CA probs: **public goods, coordination failures, commitment problems**
- Today: public goods

	Excludable	Non excludable
Rival	Private	Open-access
Non-rival	Club	Public

- Definitions
 - **Excludable**: users can be excluded from accessing good
 - **Rival**: stock of good decreases with consumption

- **Private goods:** your pen
- **Open access good:** public parc
- **Club good:** Netflix
- **Public goods:** ideas!
- **Market failure:**
 - Situations where markets don't work optimally
 - Common outside of private goods

- Problem: public goods are generally under-produced
- Why? Free-riding
- Often captured by the prisoner's dilemma
- Example: you are asked to contribute to a group project
- PD is useful, but doesn't capture uncertainty of result

- N: people who would benefit from project
- n: people who contribute (aside from you)
- B: your benefit if project succeeds; everybody gets it (public good)
- $\frac{n}{N}$: probability of success of project
- c: your cost of participating
- Cost-benefit:
 - If you don't participate: $B \cdot \frac{n}{N}$
 - If you participate: $B \cdot \frac{(n+1)}{N} - c$
 - Participation is worth it if $\frac{B}{N} > c$

- R&D is a **public good!**
- Thus: here, research is done if $\frac{B}{N} > c$ (if model is true!)
- Suppose N is the US (300m), $B = \$1m$
- You won't contribute if costs > 0.3 cents!
- R&D will be underprovided...
- General insight by Olson (1965): with public goods...
 - Large N: bad
 - **Diffuse interests:** bad

- Problem: you don't capture benefits from your investments
- Ideas are domestic+global public goods!
- Need solution to free-riding
- How can we solve this problem?

Side note: problem-solving

- Many models (Define-Measure-Analyze-Improve-Control)
- First: define the **problem**
 - What *should* the goal be? Ethics!
- Second: establish **mechanisms** leading to prob
 - What is the **cause** of prob? Theory and evidence
- Third: design+test **interventions** (policies)
 - What is the **solution**? Experiment

Problem: research is a **global public good!**

How do you solve it?

- Define goals
- Mechanisms of prob
- Solutions to (root of) prob

Goals and mechanisms

- Goal(s)
 - Possibly: *High levels of R&D, \$700b/year, \$500b in clean energy, \$200 in electric cars, 1000 startups by 2050, etc.*
 - Consequentialism ethical view
- Mechanisms
 - Free-riding: investors don't get rewarded
 - Domestic + international

Solutions

- Need to solve **domestic** free-riding:
 - **Incentivize** private sector: patents, prizes, subsidies
 - **Socialize** research: public unis, research centers
- Need to solve **global** free-riding:
 - World Intellectual Property Organization (WIPO)
 - International treaties (Patent Cooperation Treaty, 1970)
 - Punishment?

Conclusion

- We (often) want new goods/services
- Innovations are generally needed to obtain them
- Innovation is often under-produced (public good and free-riding)
- Solutions: domestic+international rules to solve free-riding

Questions?

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Source for title page painting: Joan Renner, *J and L Steel with the Hot Metal Bridge late 1970s-early 1980s*

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