

# MYTHS OF INNOVATION: What can we learn from history?

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- How innovation happens?
- What is the mother of inventors?
- Innovation is not technology
- Technological transitions take time
- Technology is shaped socially

WHY STUDY HISTORY?

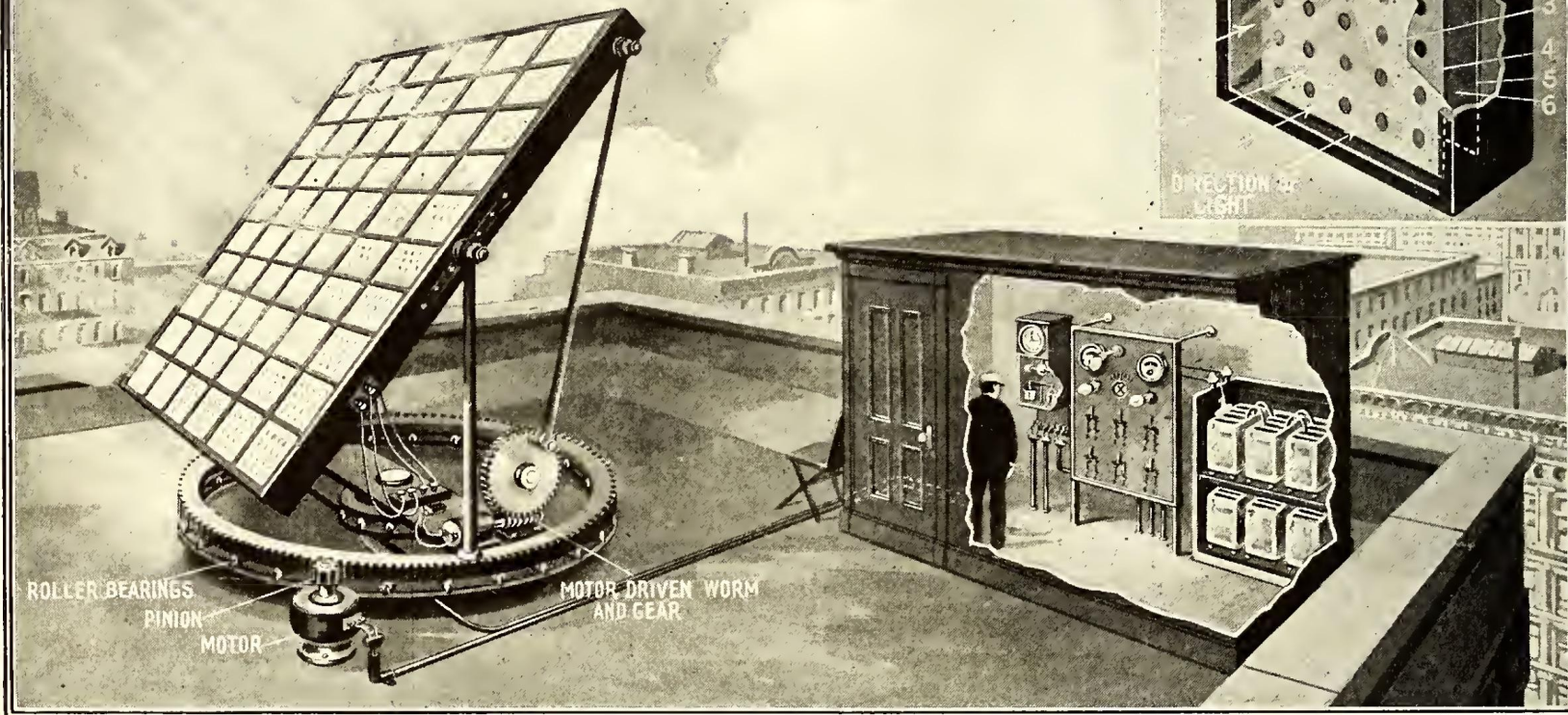


Guess the year!

*“Recent research suggests that a largely or wholly solar economy can be constructed in the United States with straightforward [renewable] technologies that are now demonstrated and now economic or nearly economic.”*

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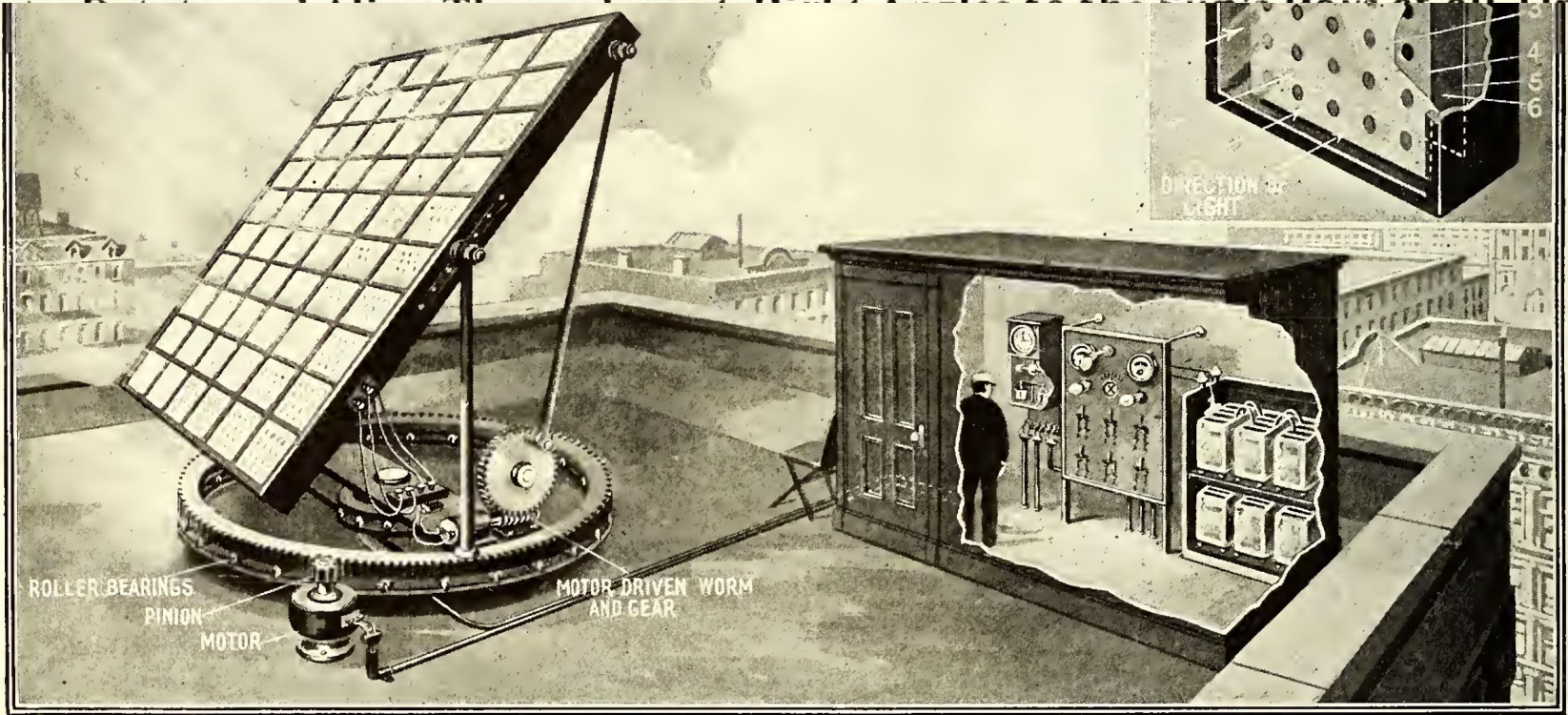
Lovins, A. (1976). Energy strategy: the road not taken. *Foreign Affairs*, (55), 65–96.



A Solar-Electric Generating Plant May Be Available in the Not-Far-Distant Future, Which, When Installed on the Roof, Will Cause Light-Active Cells to Rotate and Align Themselves at Right Angles to the Sun's Rays at all Times. The Electric Energy May Be Stored in Storage Batteries So As to Be Available at Night. Insert Detail of Single Cell Shows Two Copper Plates, 4 and 5, Immersed In a Salt Water Solution 6; 3 Is Glass, While Gas Vents Appear at 7. Electric Terminals at 1 and 2.



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## ELECTRICITY FROM WIND.

### ECONOMICAL WAY OF OBTAINING POWER AND LIGHT.

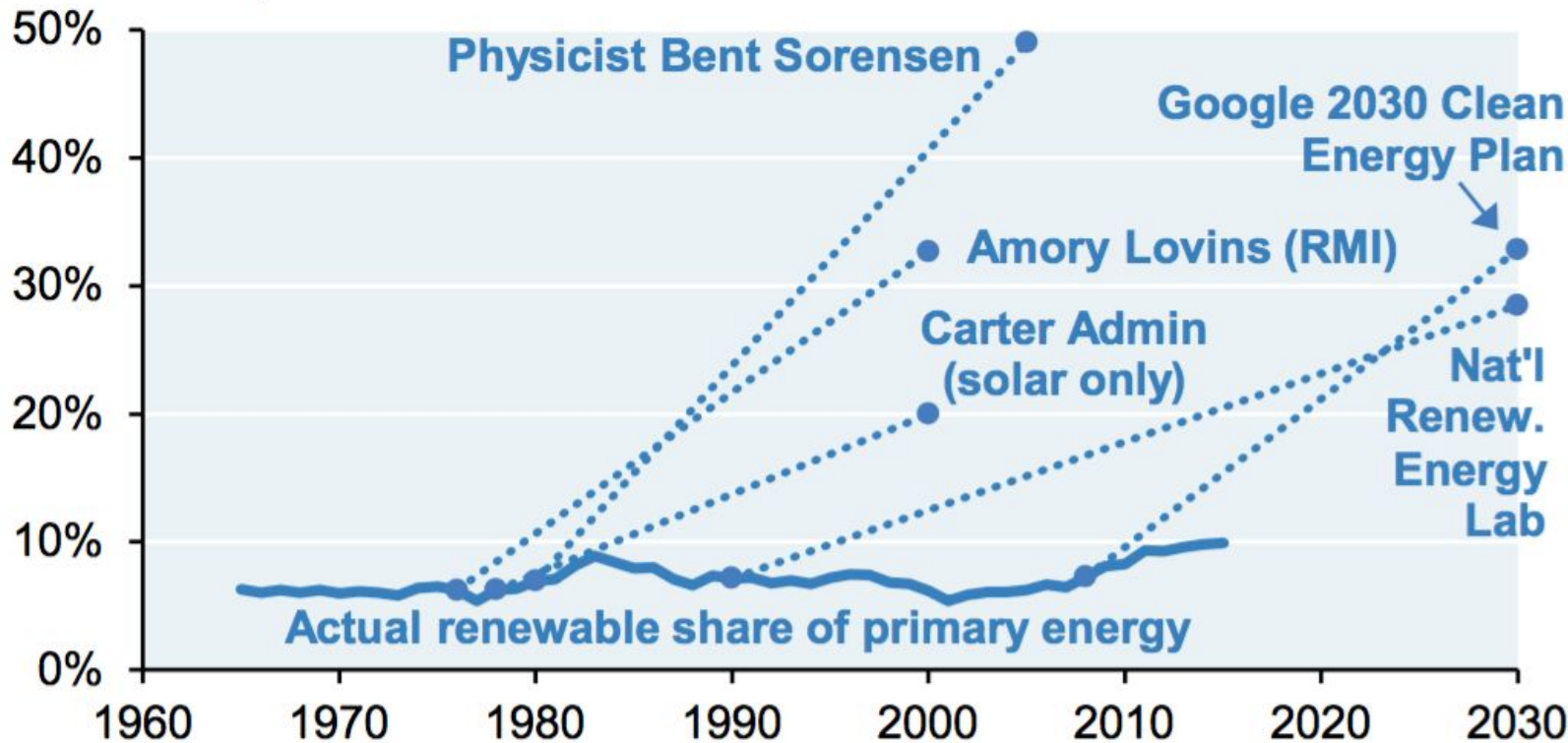
Successful efforts are now being made to convert wind into electricity. Quite a large farm near Hamburg is being supplied with electrical energy generated by wind power, threshing machines, pumps, and various farm appliances being electrically driven, while some hundreds of incandescent lamps are lighted in various sheds and houses on the farm.

A large wind turbine is placed at the top of a tower, and as this is revolved by the wind it actuates a dynamo, which charges accumulators; consequently the electricity generated by a wind during the night can be stored up for the following day. An auxiliary oil engine has been installed for times when the wind fails.

This is not the only wind plant for generating electricity. A firm of electrical engineers at Willesden Green have for some time had one running successfully. An ingenious arrangement is used by them to check the vagaries of the wind. When a strong wind is blowing the turbine naturally revolves quicker than in the case of a light breeze, hence the dynamo is driven quicker. The voltage or pressure of a dynamo rises in direct proportion to its speed, and a considerable rise might easily ruin the accumulators it was charging. The arrangement referred to automatically checks any change in voltage, so that a sudden change in the wind is instantly counterbalanced.

Several country houses are being fitted with wind plants, as where fuel is difficult to obtain or abnormally dear the wind proves a useful substitute.

# The share of US primary energy coming from renewable sources, and some notable forecasts



Source: EIA, listed authors, Vaclav Smil, JPMAM. 2015. Renewables include wind, solar, hydropower, geothermal, biomass, wood and waste.



FRIENDS, HERE ARE JUST A FEW OF THE USES TO WHICH WE HOPE TO PUT ATOMIC POWER FOR THE BENEFIT OF CIVILIZATION ! ON OUR NEXT BROADCAST WE WILL REPORT TO YOU OUR PROGRESS !

### PEACETIME ATOMIC INVENTIONS

ATOMIC TRUCK



ATOMIC PLANE



ATOMIC SHIP



ATOMIC MACHINES



ATOMIC ROBOT

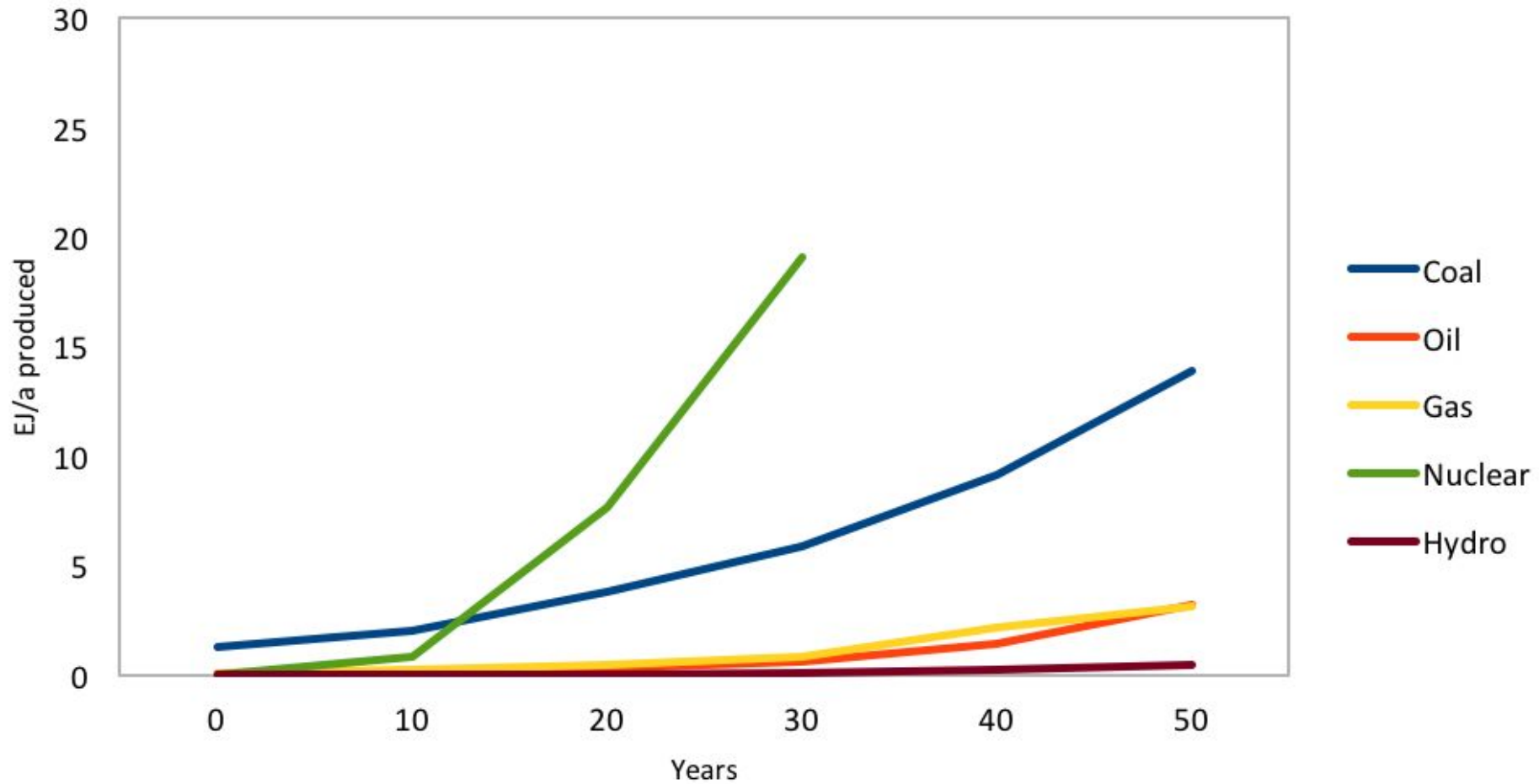


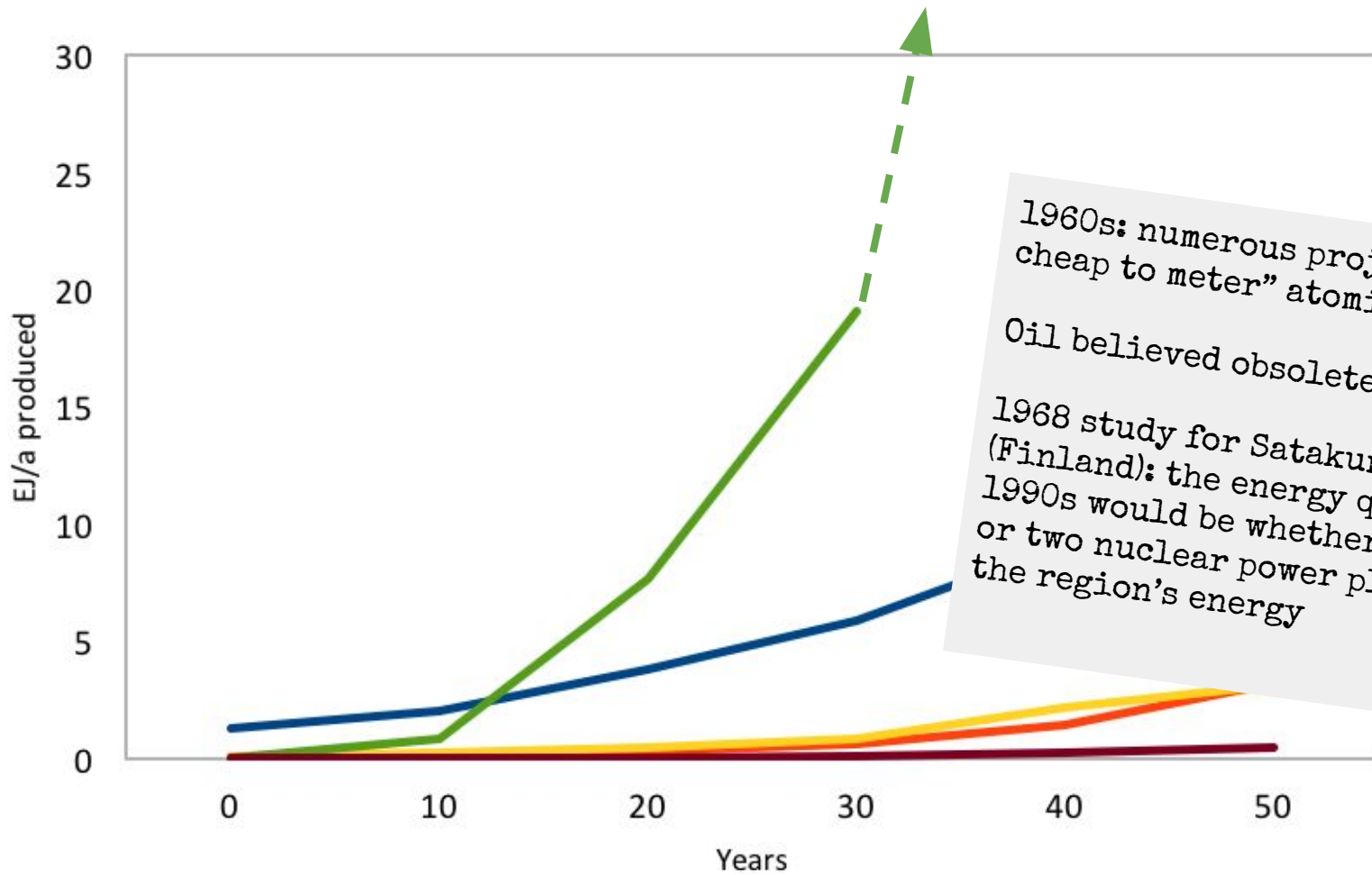
ATOMIC MAIL  
ROCKET



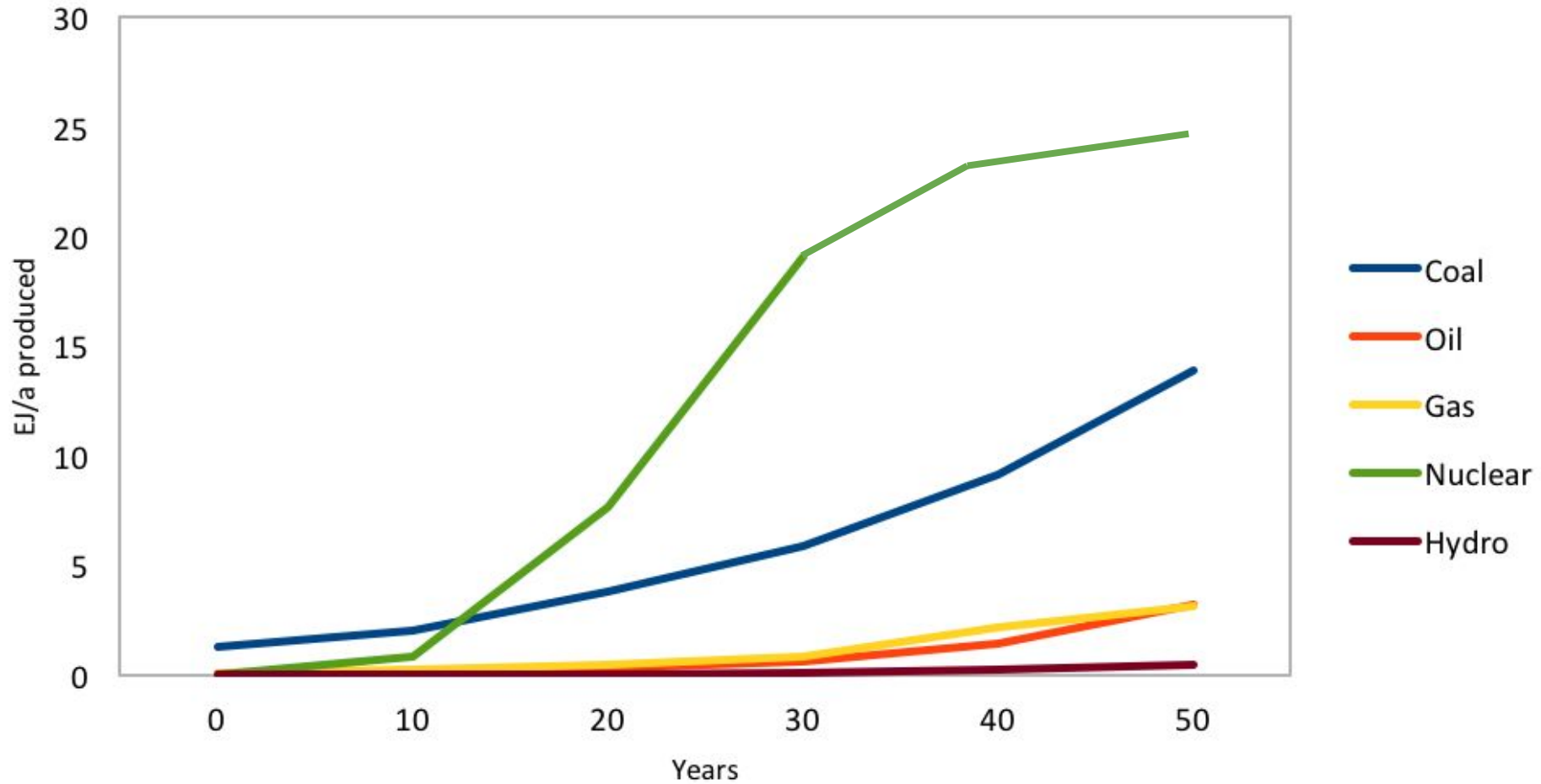
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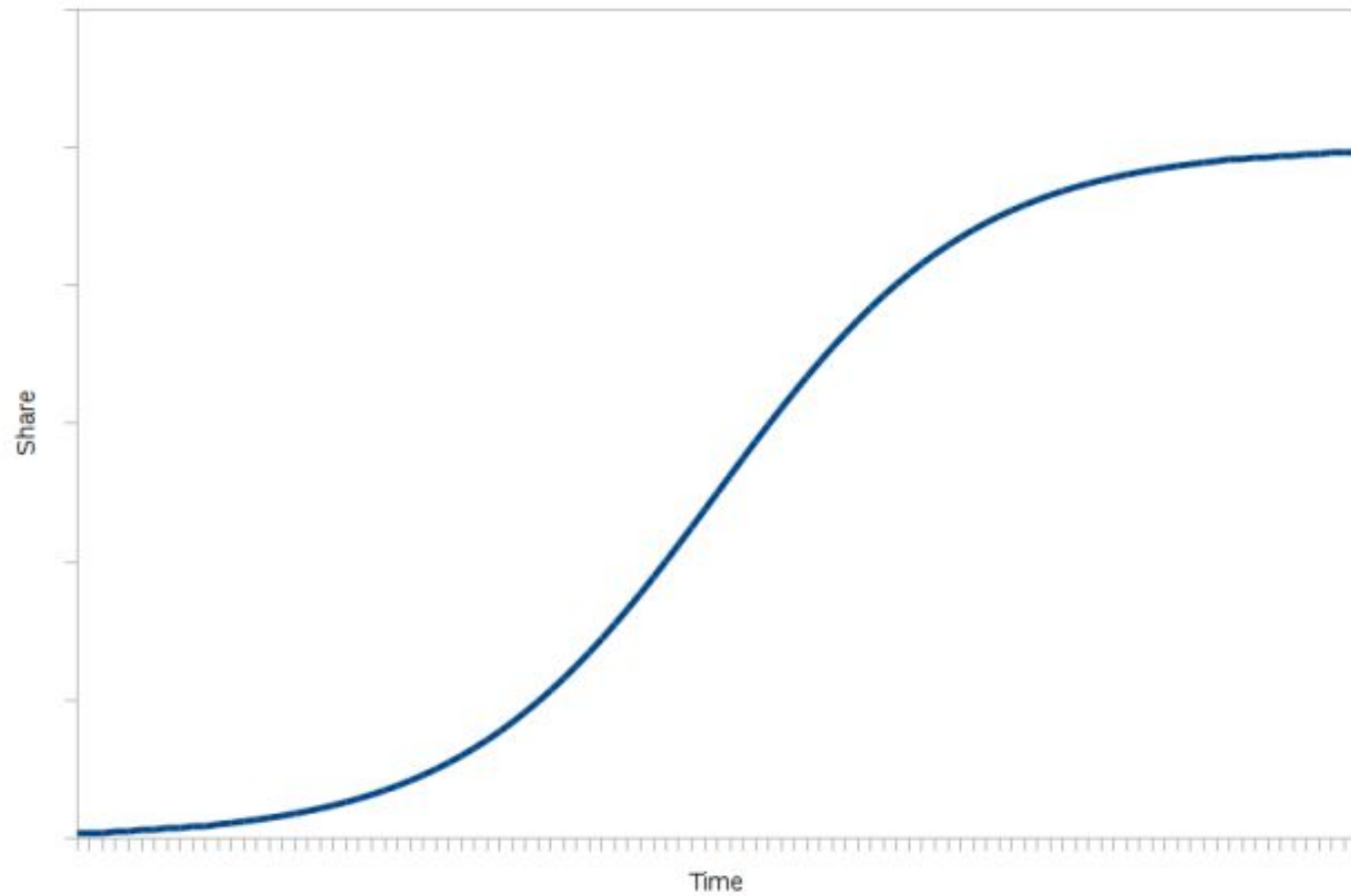




1960s: numerous projections of "too cheap to meter" atomic energy  
Oil believed obsolete by 2000  
1968 study for Satakunta region (Finland): the energy question for 1990s would be whether to build one or two nuclear power plants for all the region's energy



Logistic (S-) curve



## KEY LESSONS:

- *We don't learn from history*
- *Things could have gone differently*

# POWERING THE DREAM



THE HISTORY AND PROMISE OF  
GREEN TECHNOLOGY

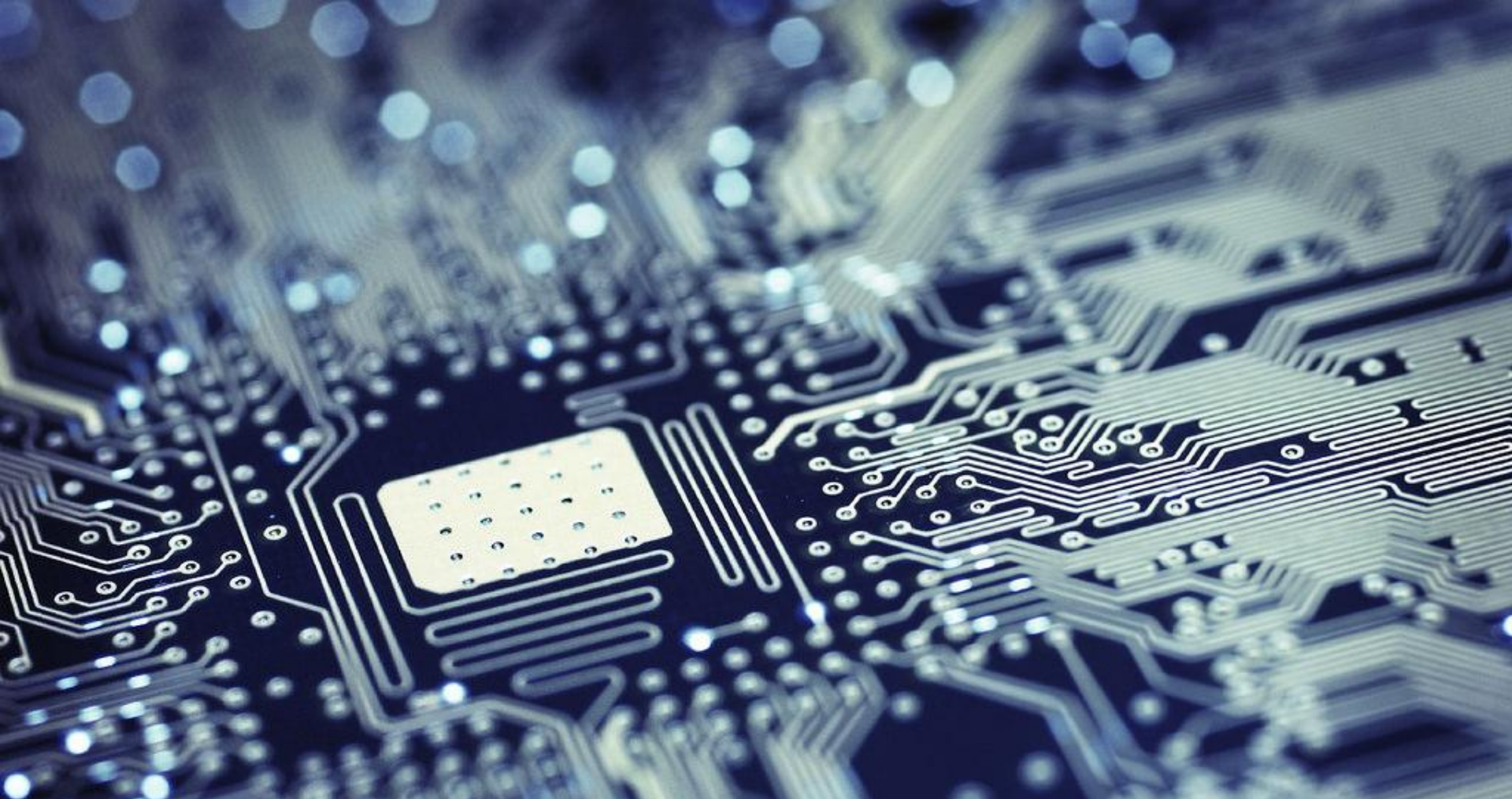
ALEXIS MADRIGAL

What is technology?



John O'Neill, (User:Jjron)(wikimedia)







John T. Daniels, Library of Congress. Photo in public domain





Bill Bertram (Wikimedia)



NOT JUST ARTEFACTS!





# TECHNOLOGY IS...

**Knowledge?**

**Processes?**

**Tools?**

**Efficient means?**

**Artifacts?**

# TECHNOLOGY IS...

1. **a means to fulfill a human purpose:** either explicit, or hazy, multiple , and changing. As a means, a technology may be a method or process or device; simple or complex; material or nonmaterial.



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(Arthur 2009:28)

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# TECHNOLOGY IS...

“The ensemble of artifacts intended to function as relatively efficient means.”

Willoughby (2005)

HOW INNOVATION HAPPENS?

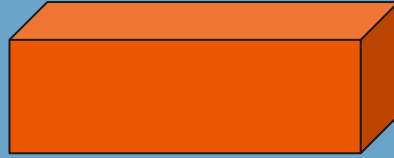












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“a giant leap”

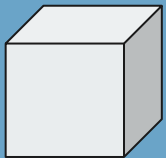


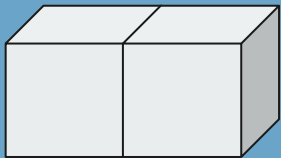
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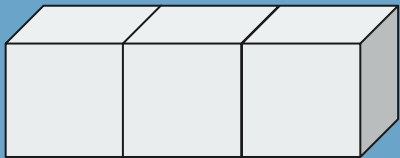
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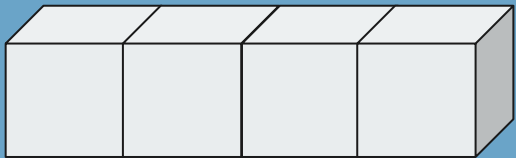


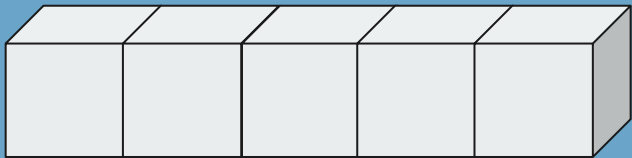


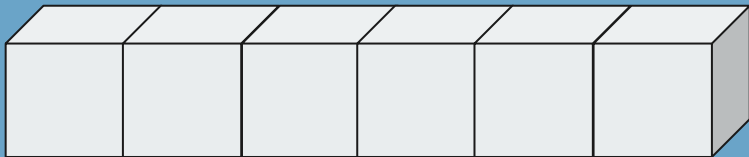


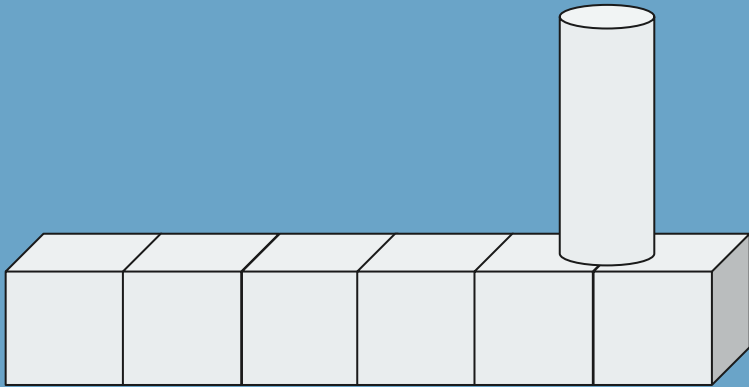


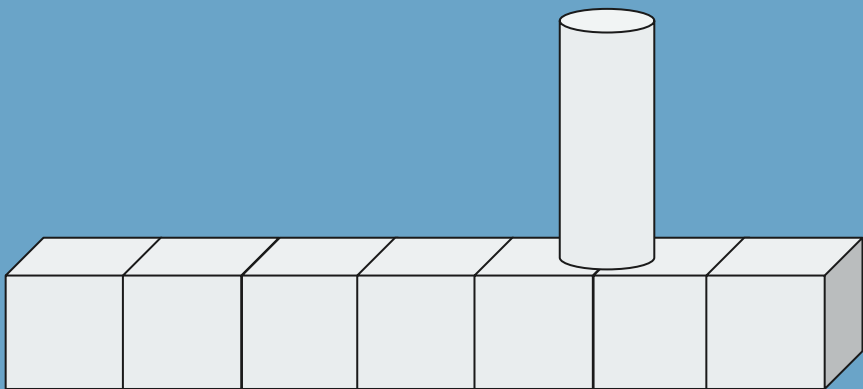


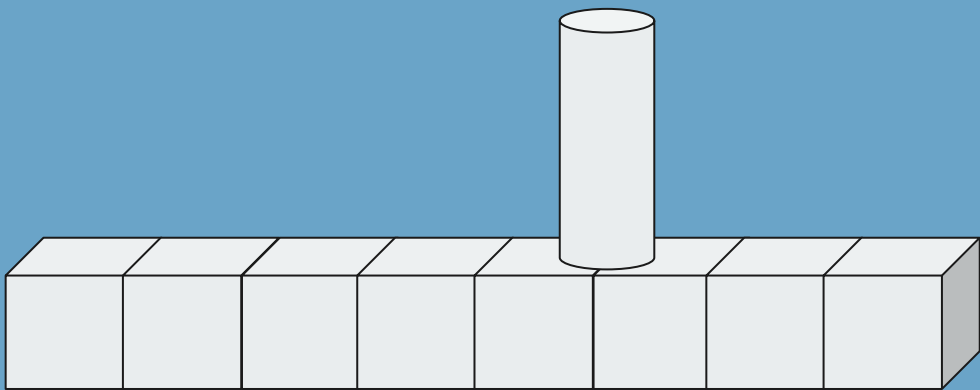


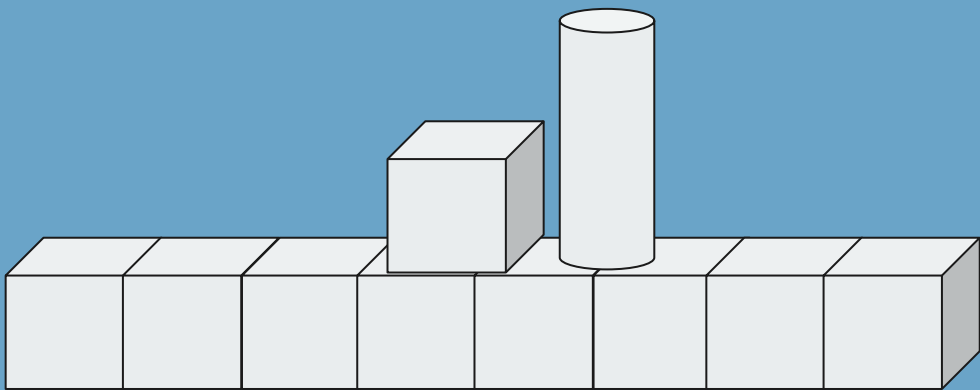


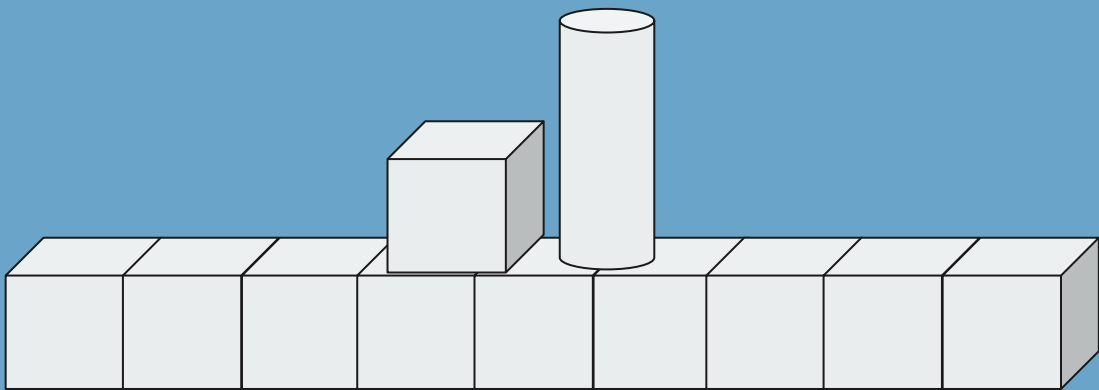




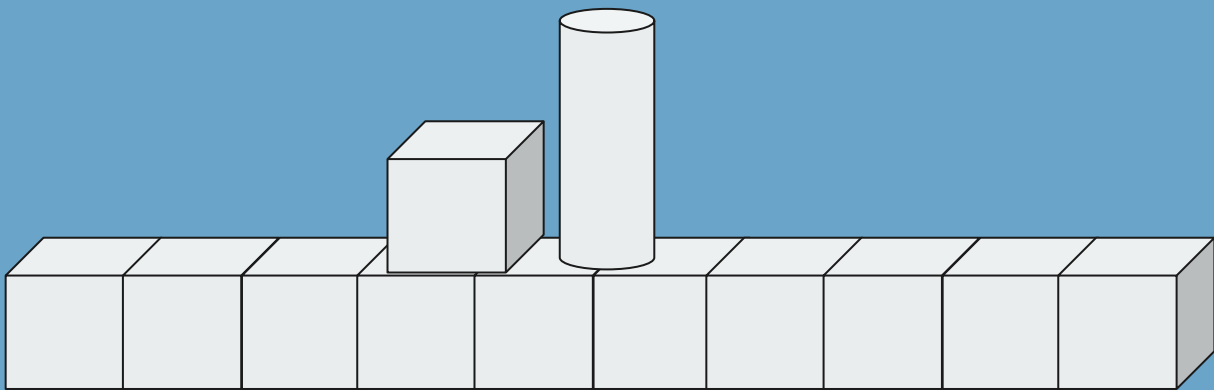


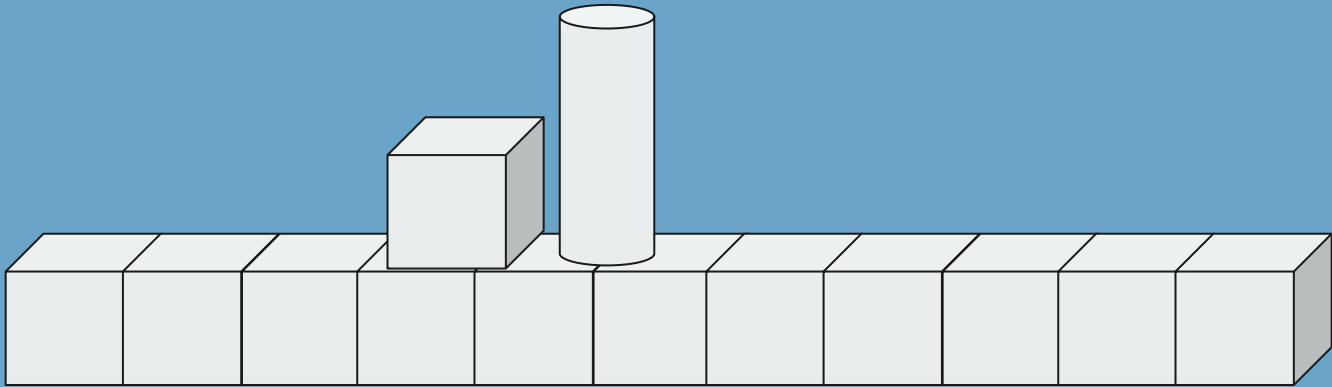


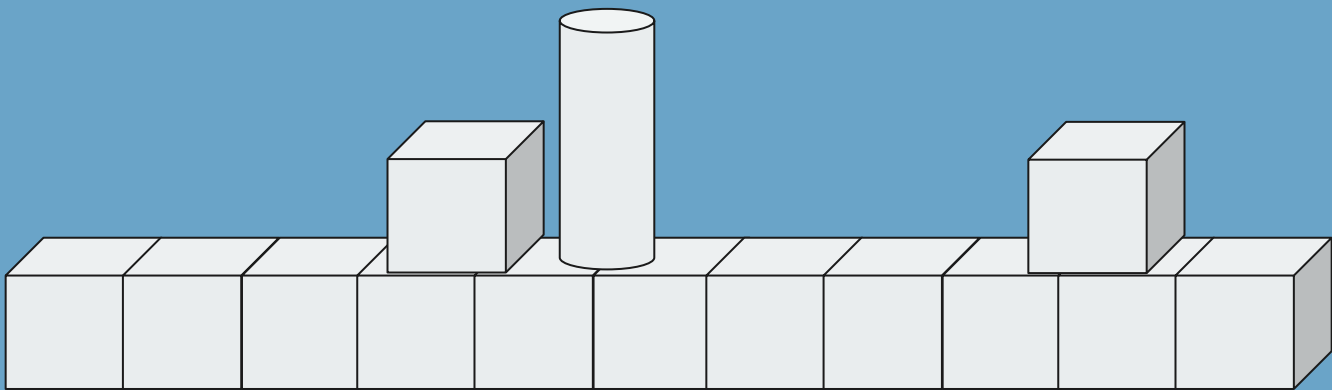


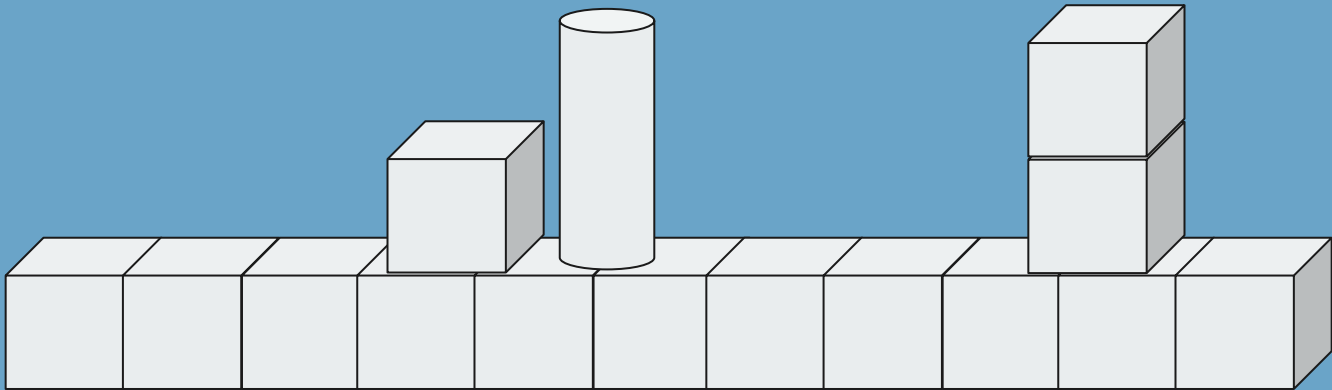


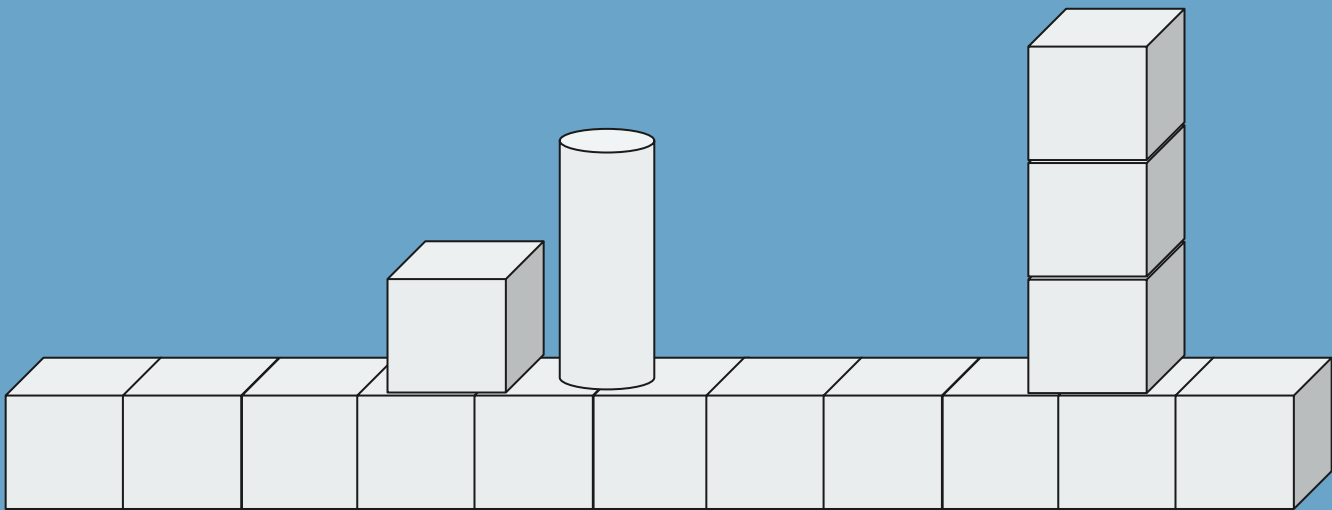


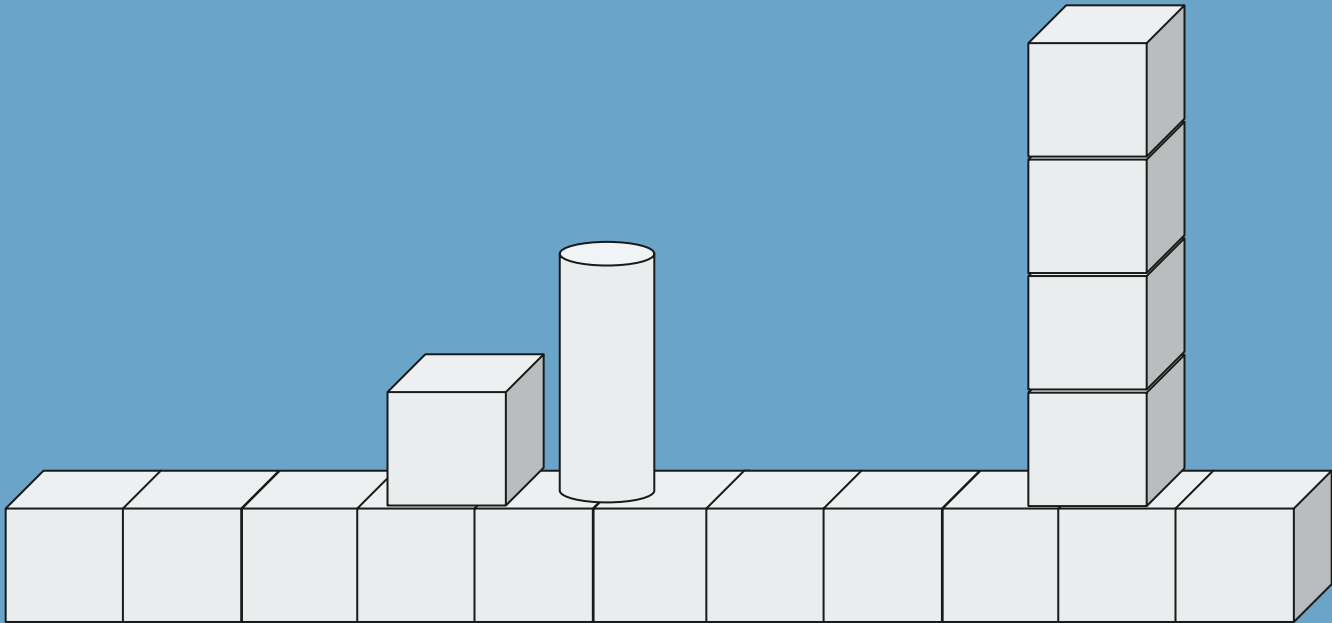




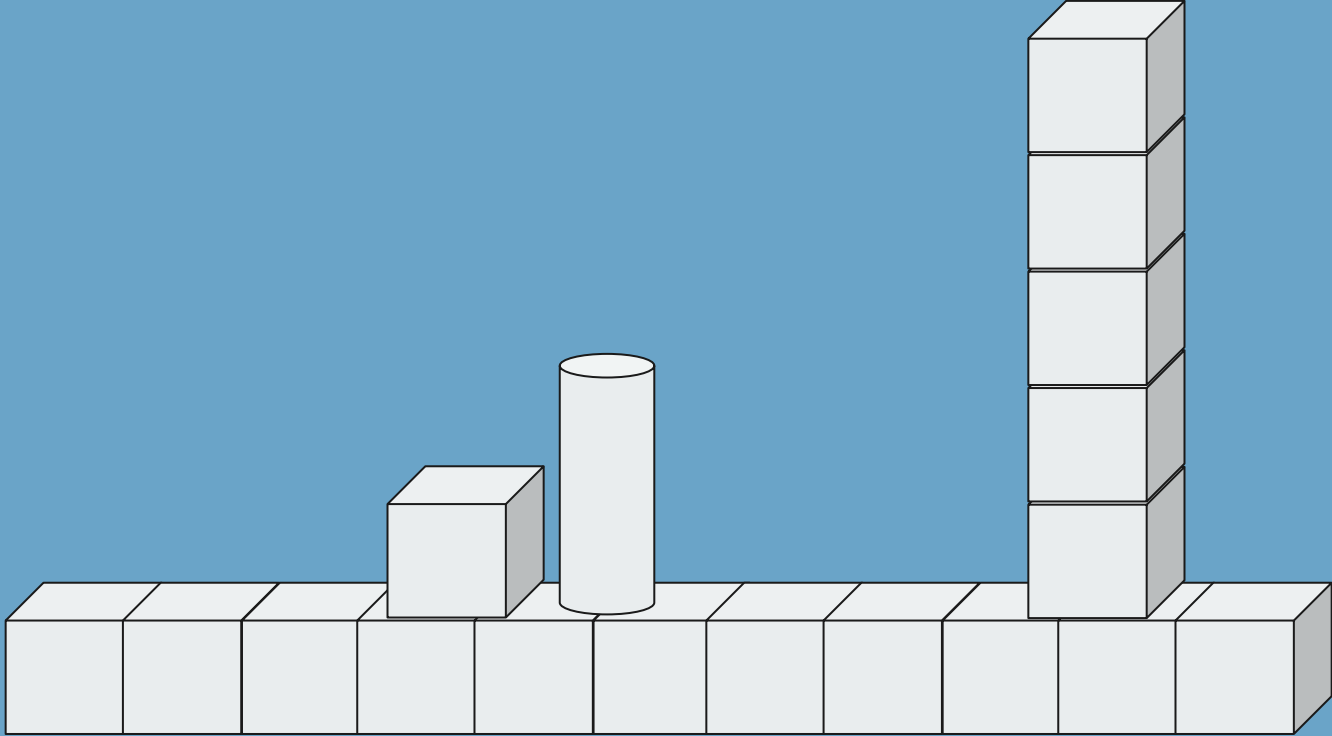


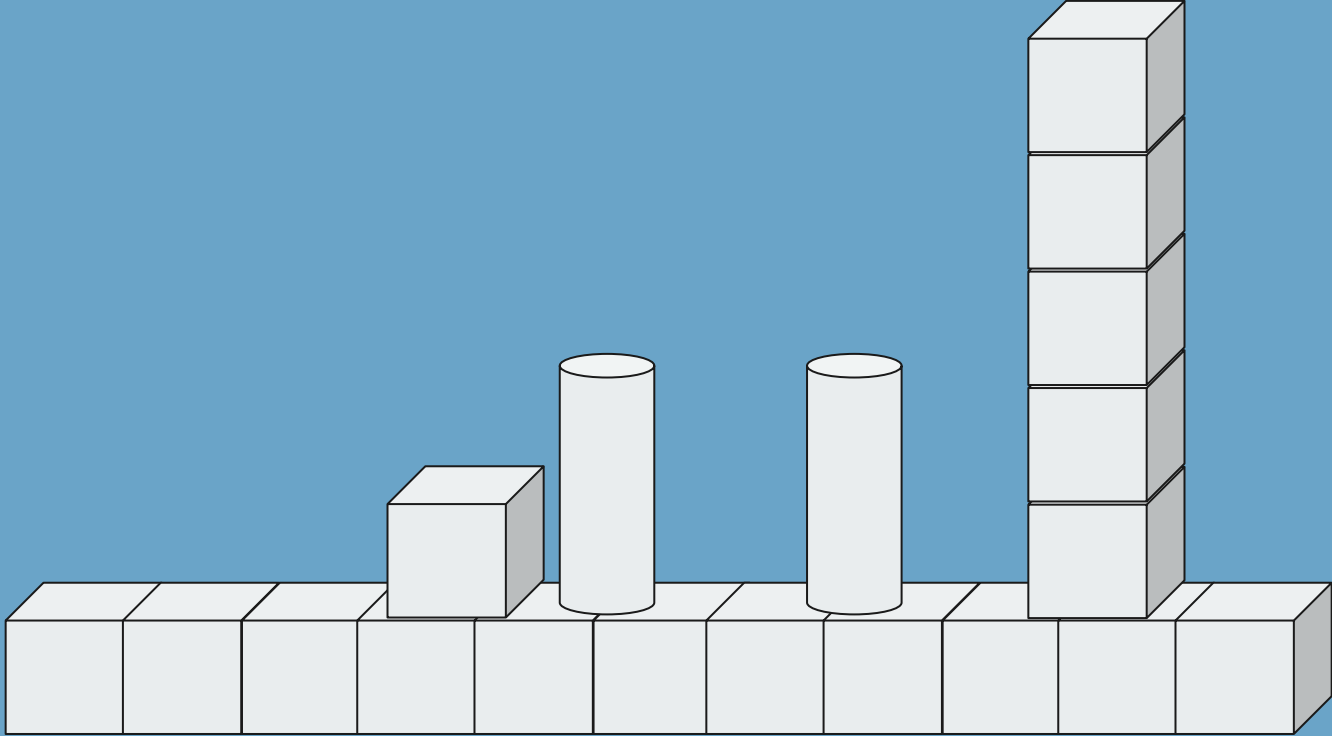


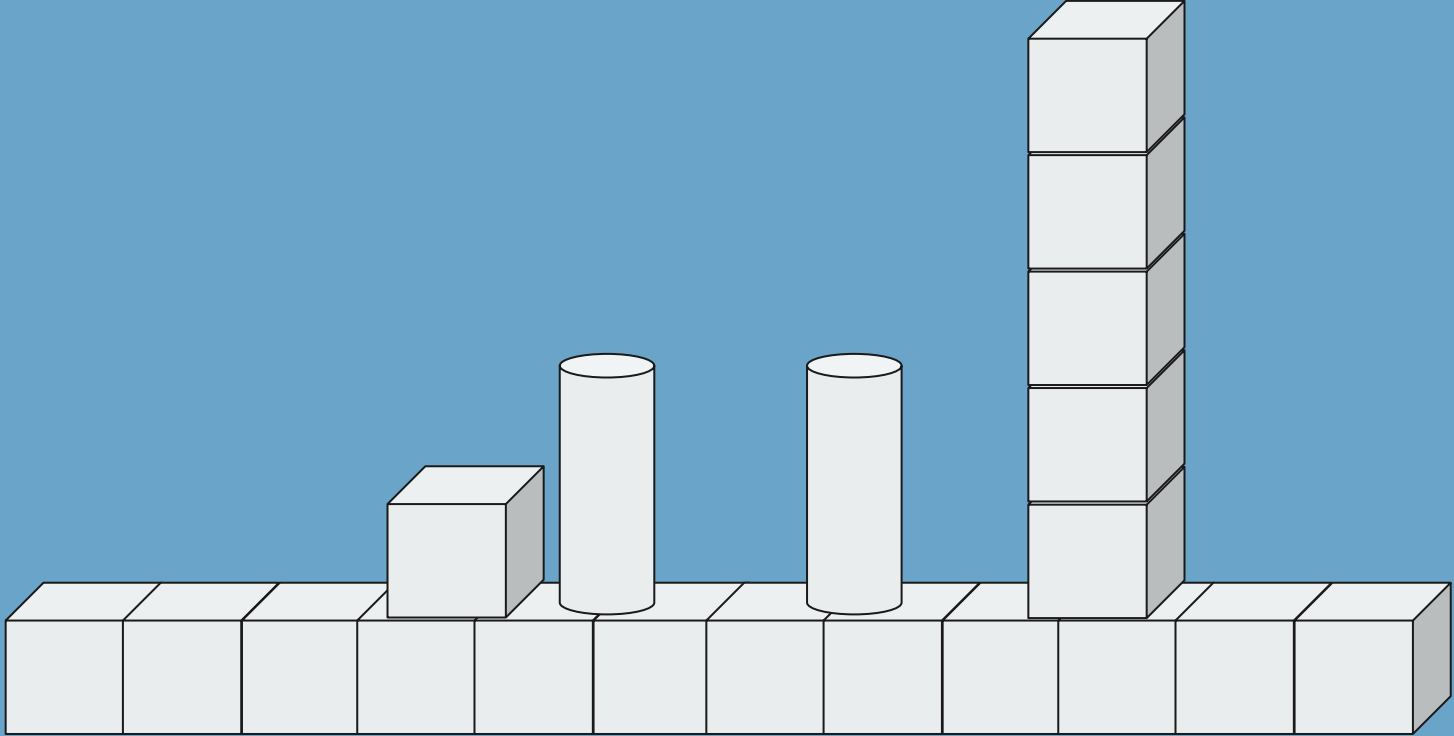


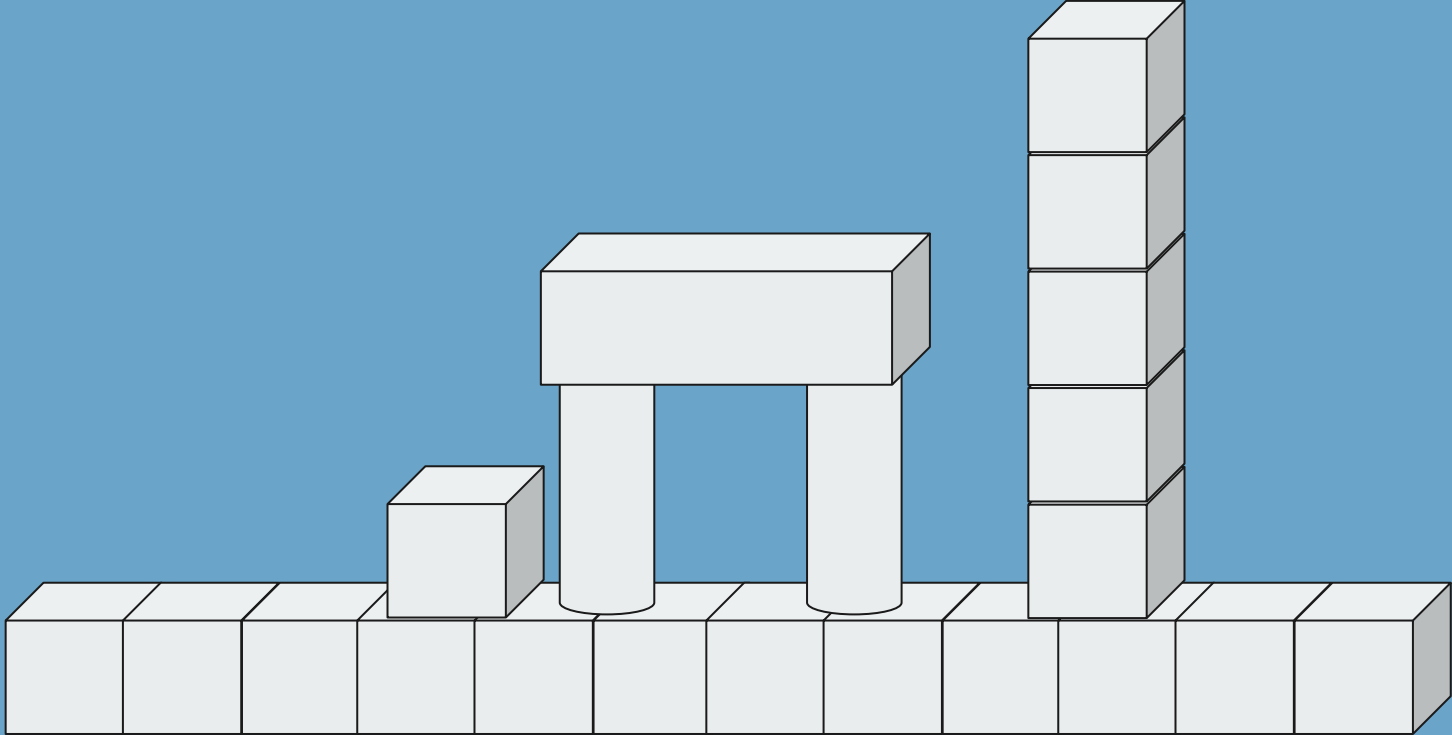


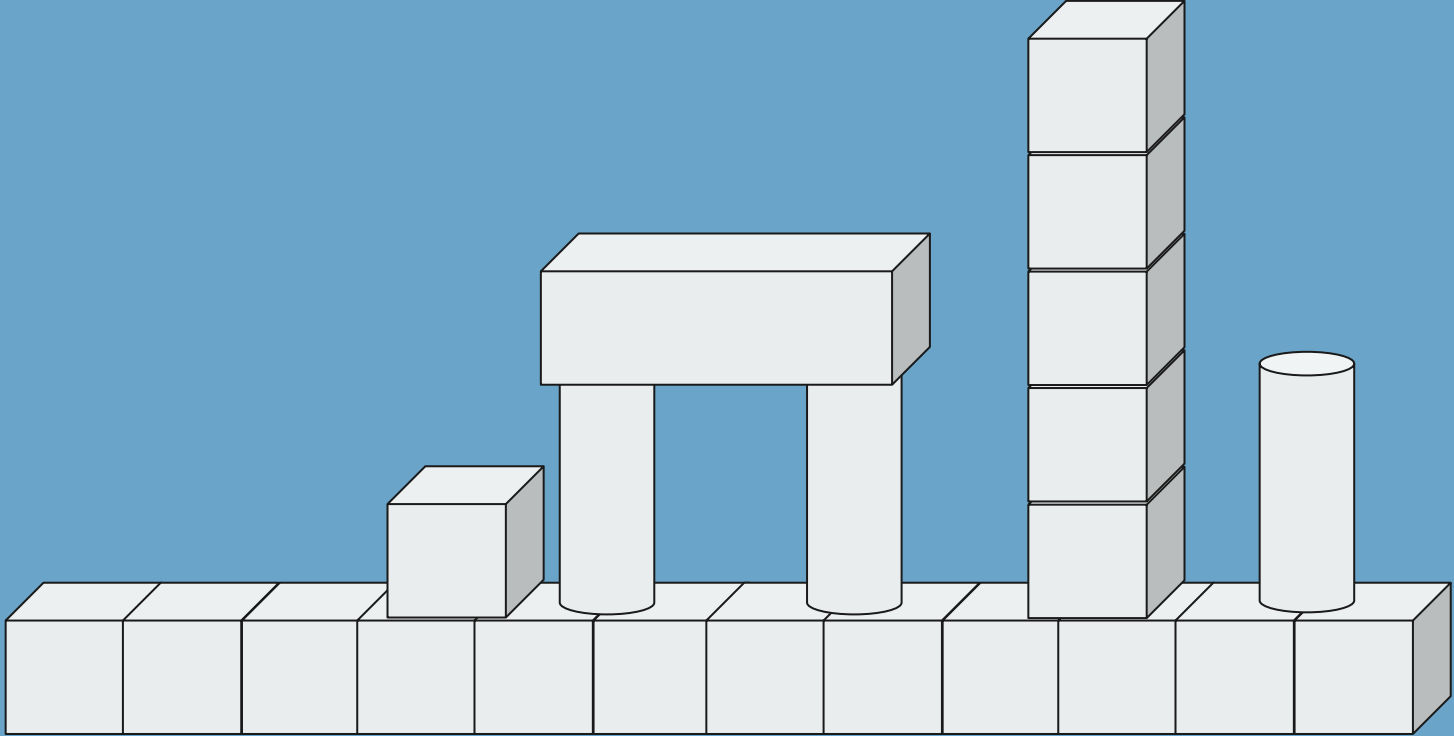


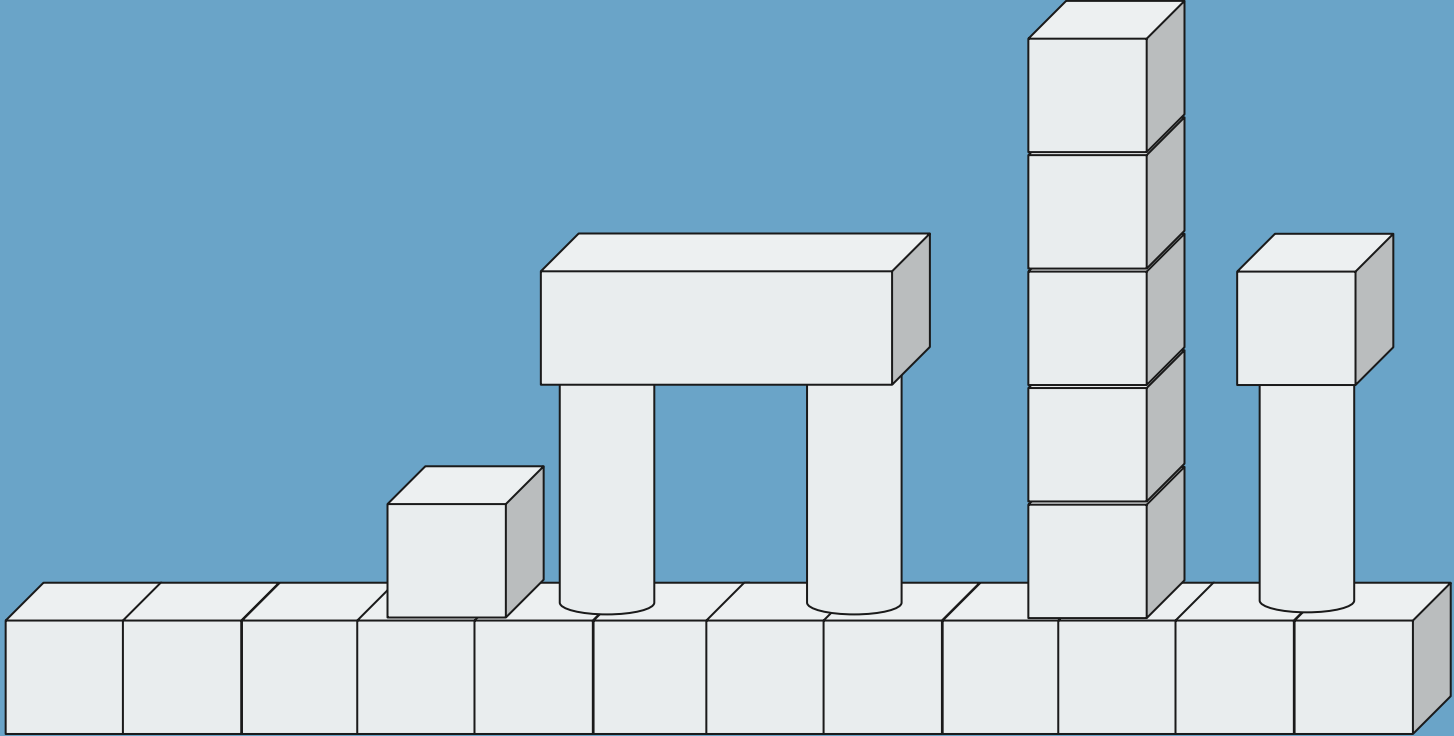


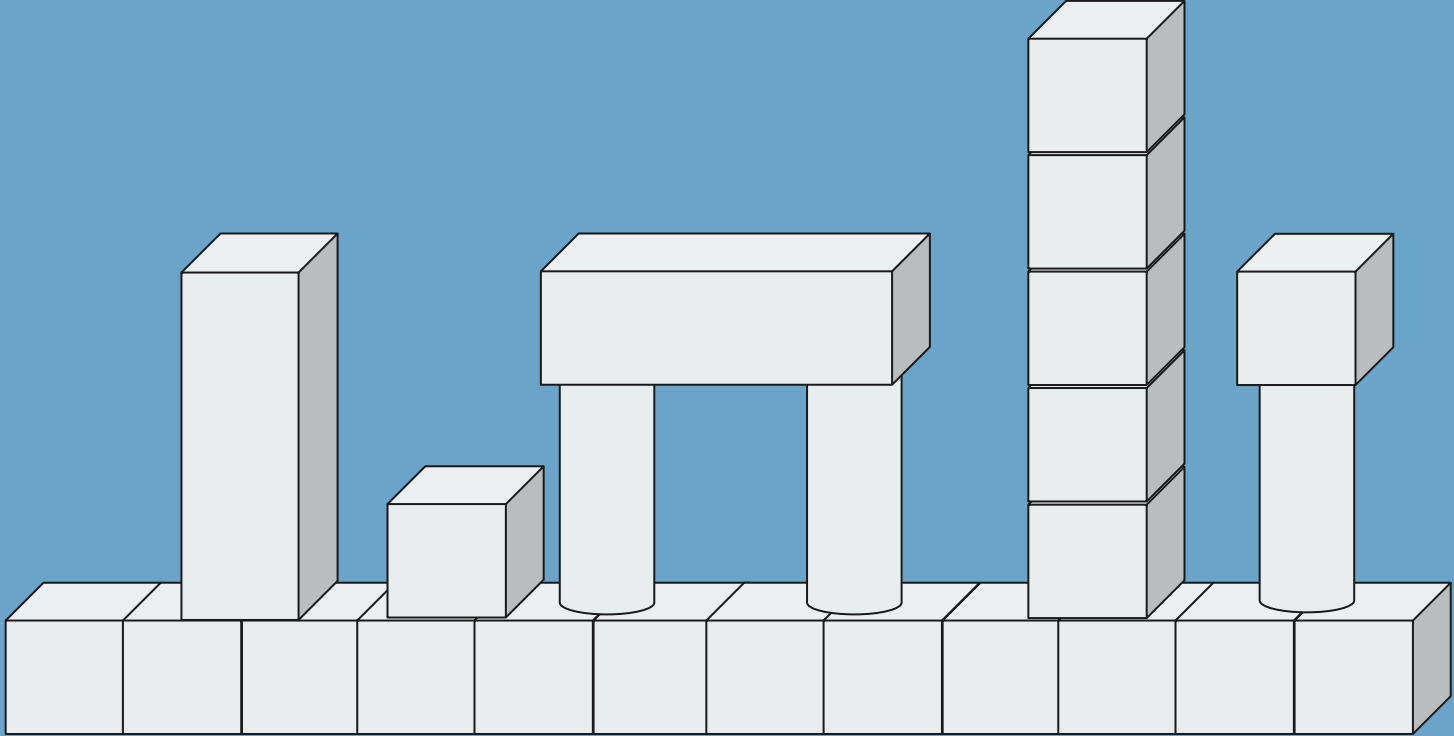


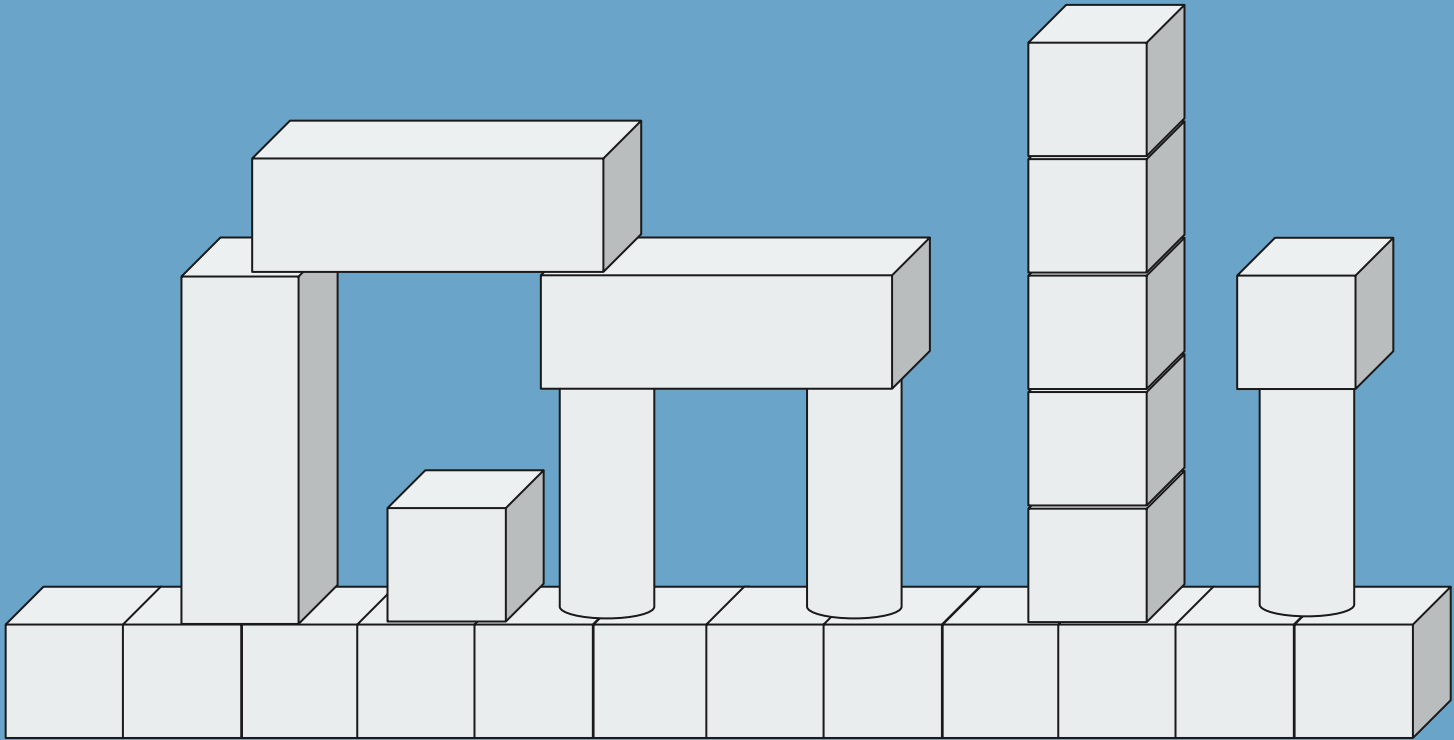




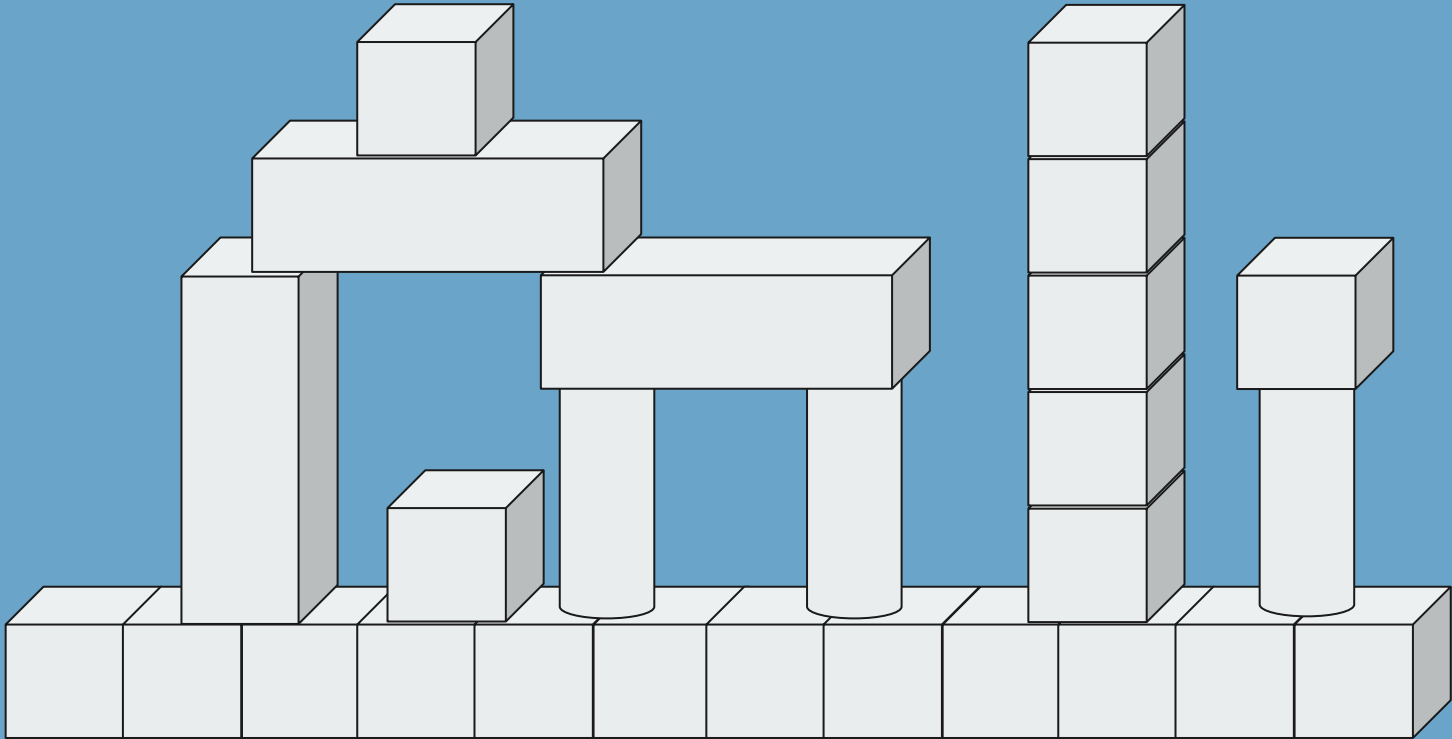


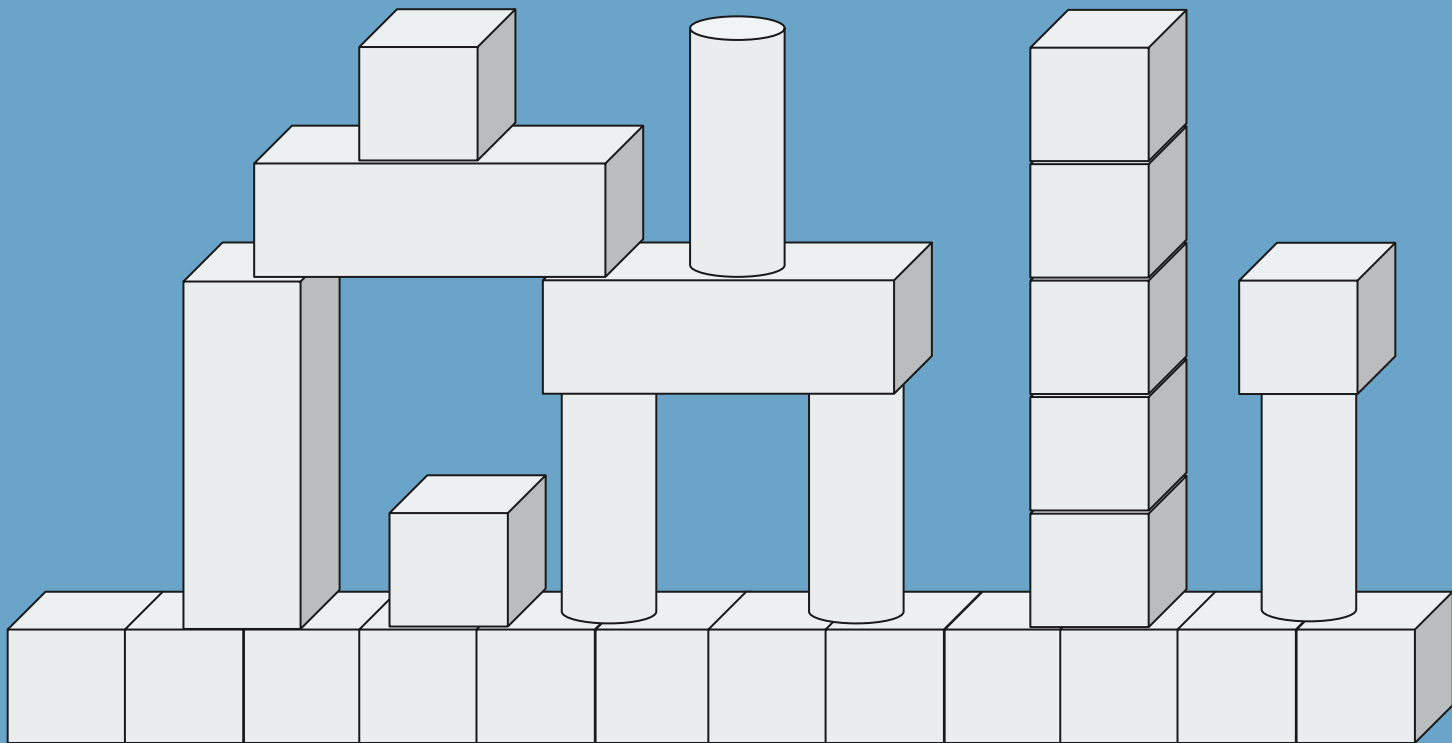


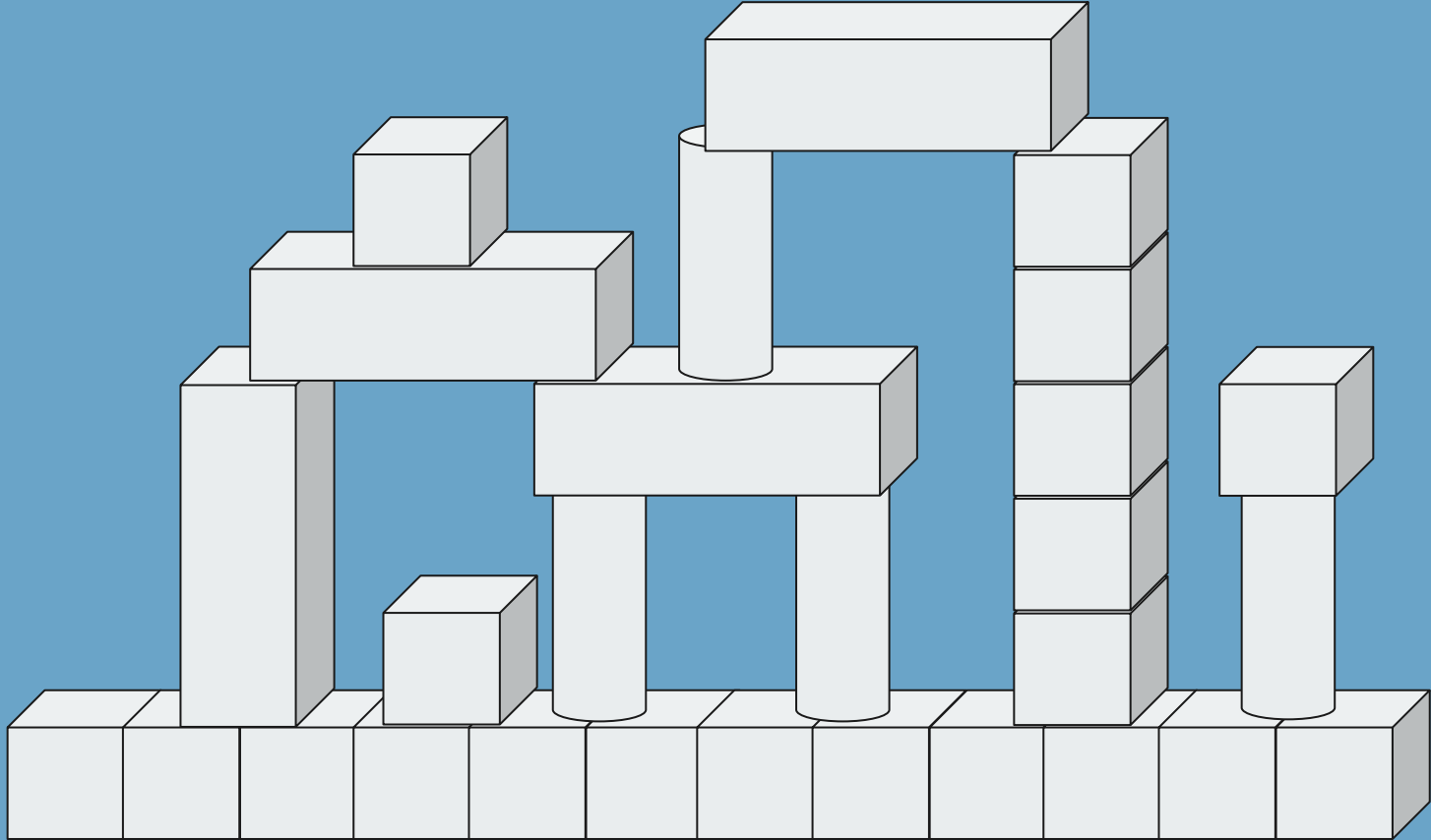


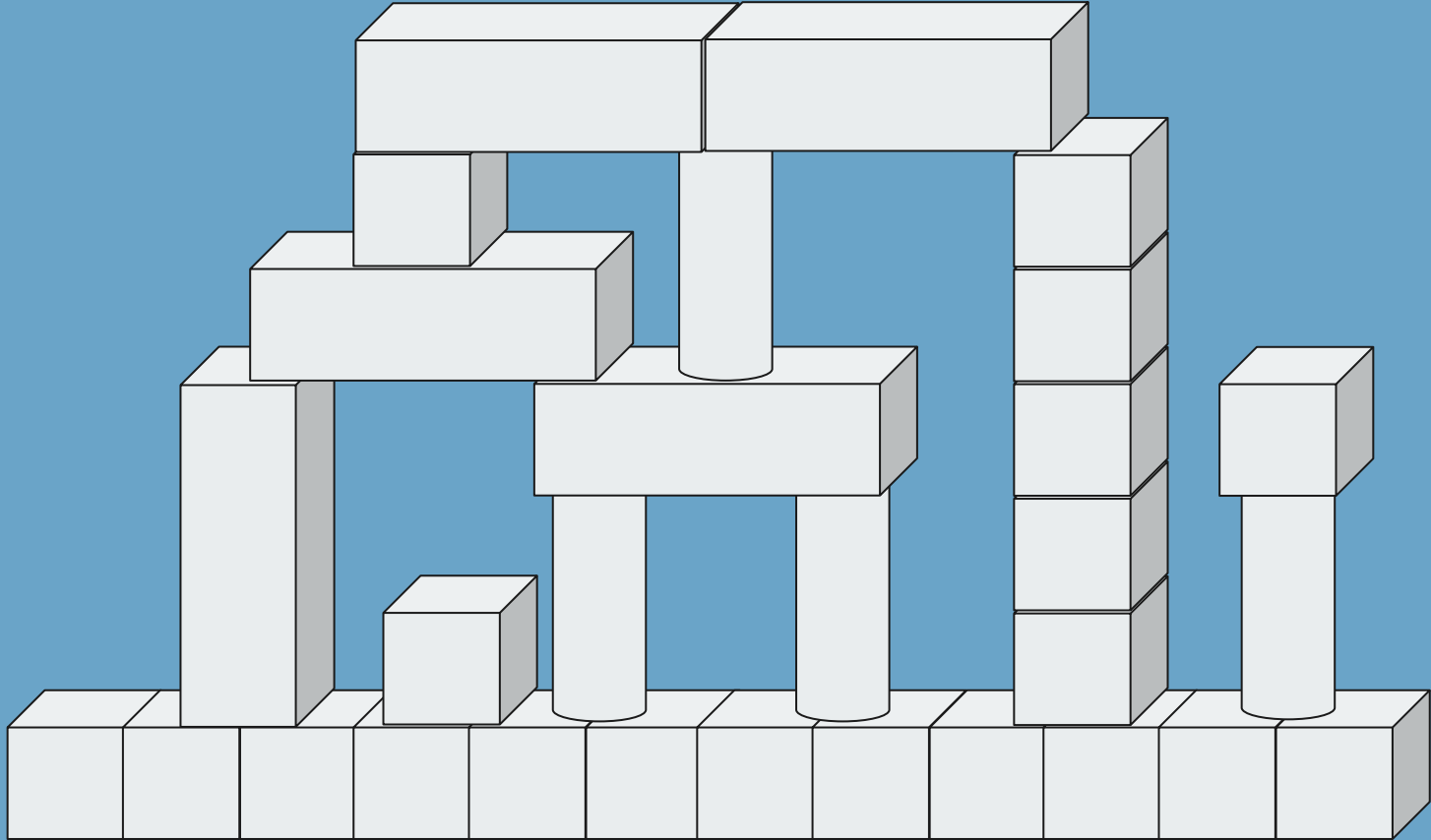


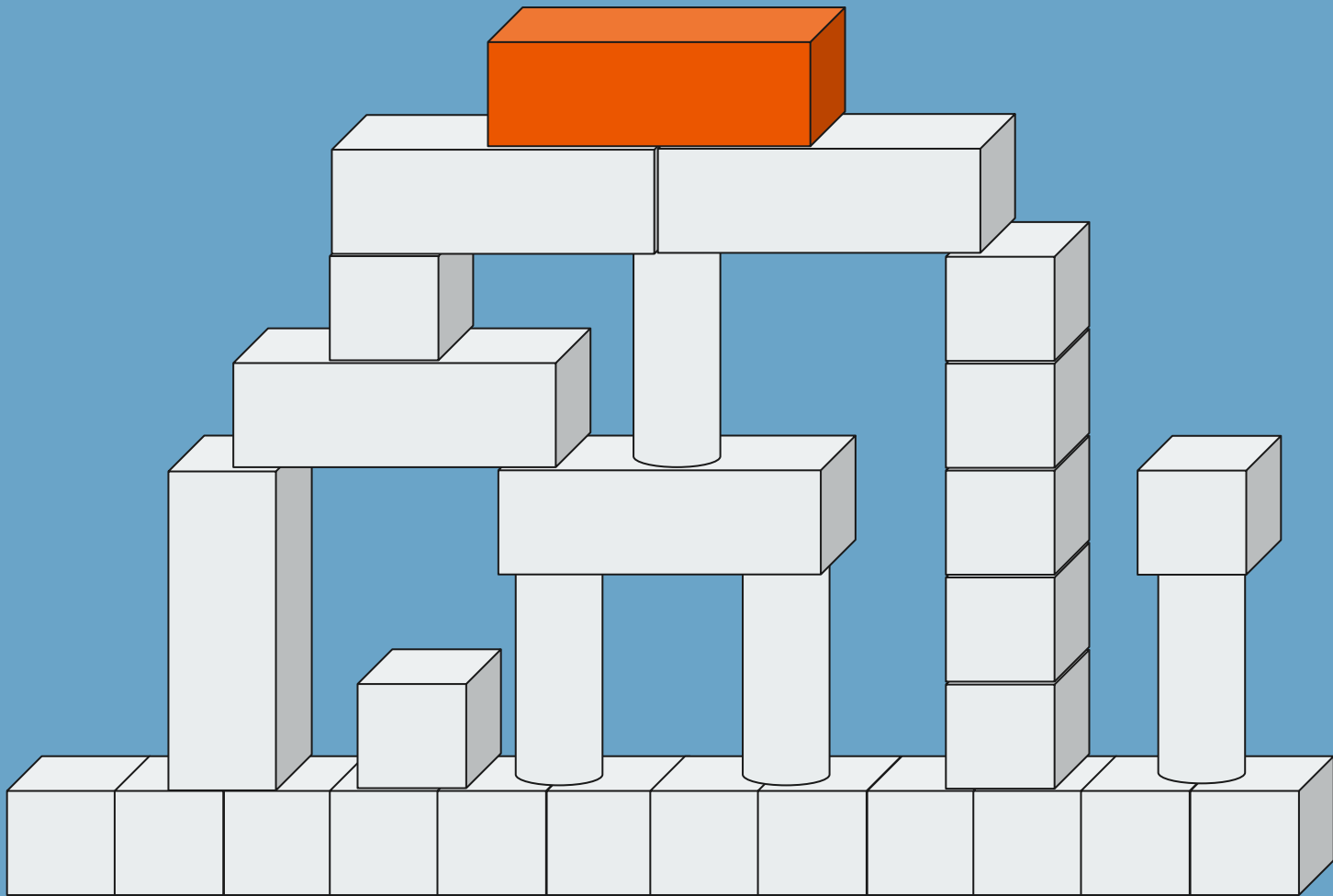


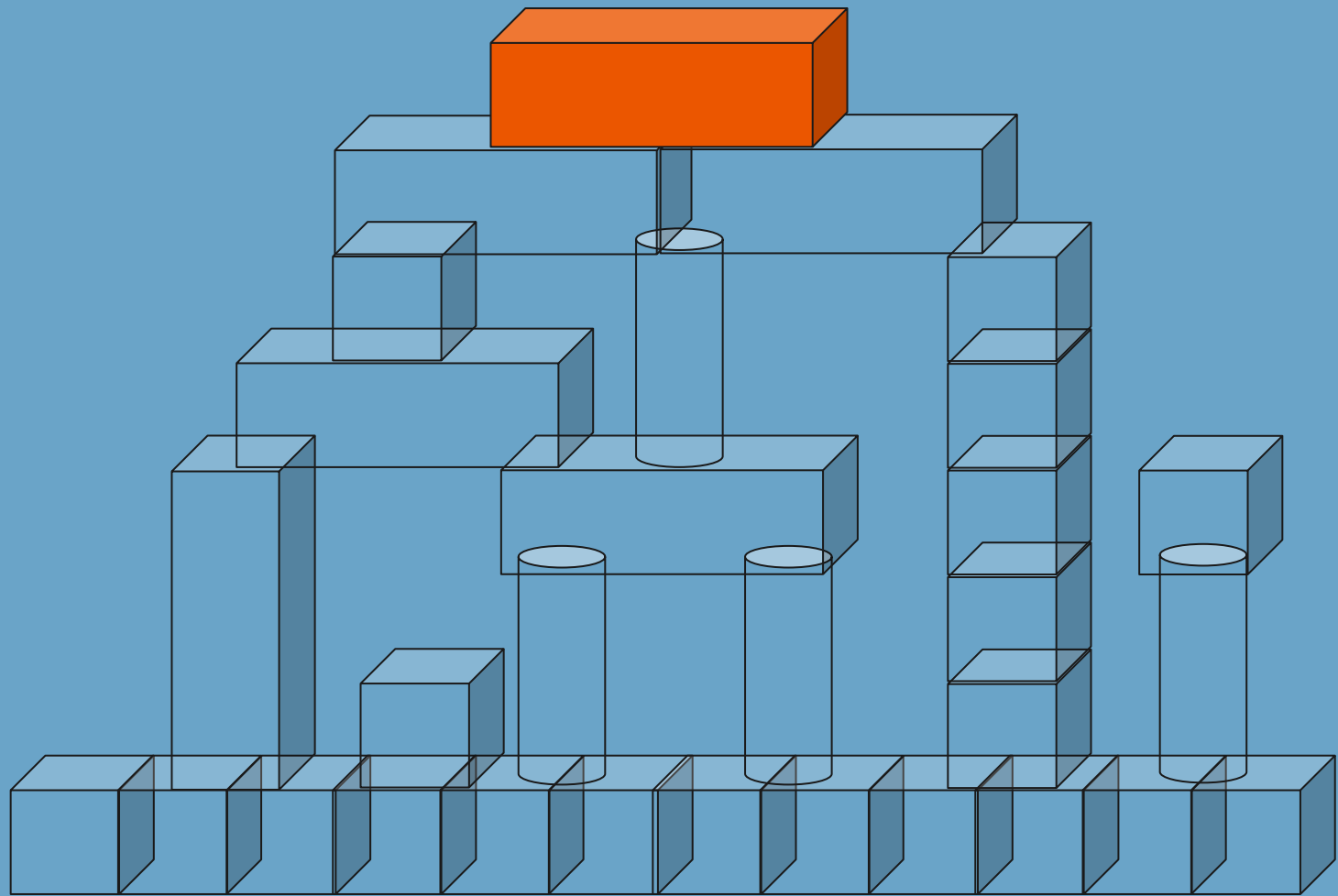














Was this a radical innovation?



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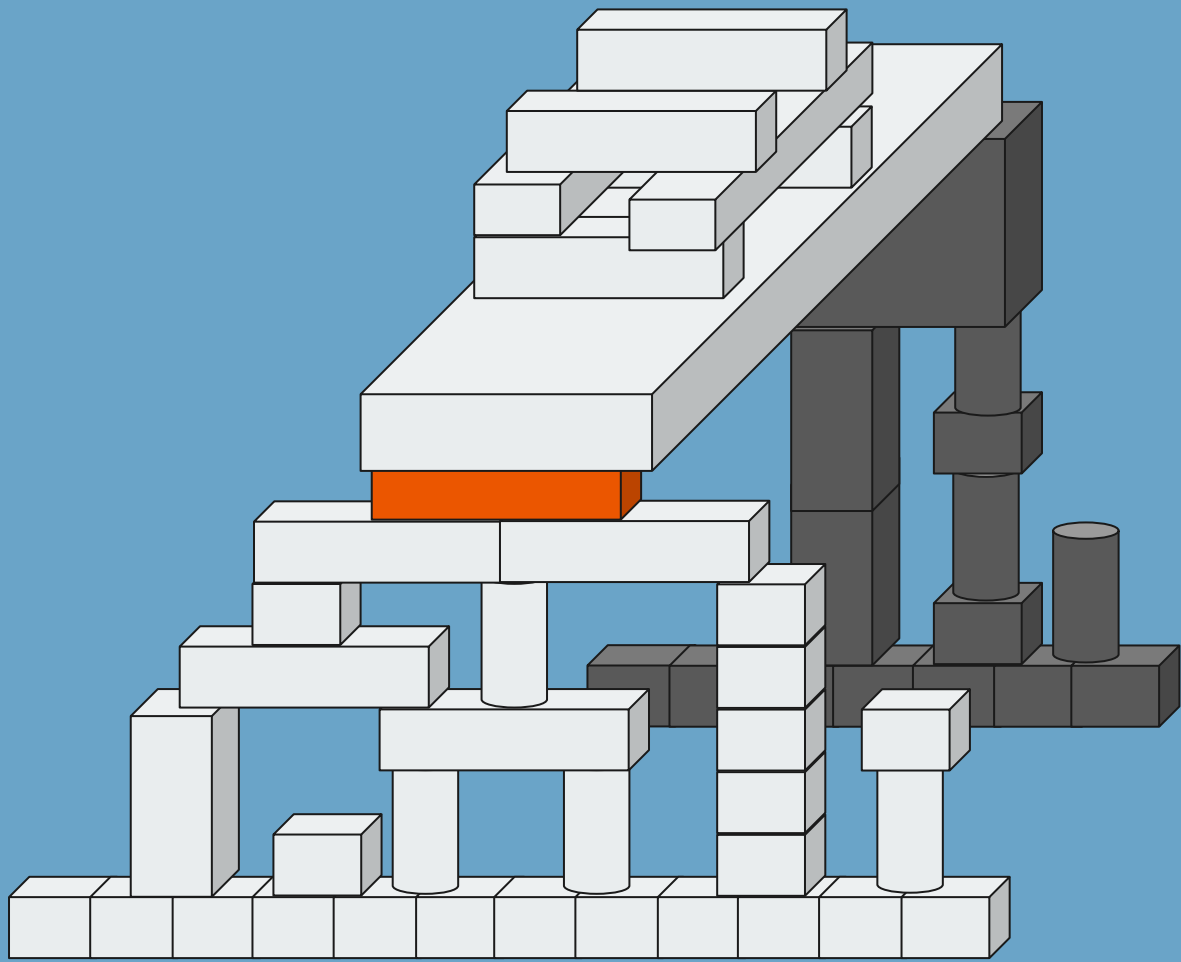
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- If components are not available, technology cannot be realised
- There are both physical and mental components: parts and knowledge
- New technologies become new building blocks for further advances

See Arthur (2009)



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- Furthermore, the problems new innovations try to solve are usually universal (if a problem is not widespread, there probably wouldn't be demand for innovation)
- I.e. changes in demand and supply affect multiple persons simultaneously



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3. Do we overemphasize the role of radical innovation, and underemphasize incremental?
4. What is the value of idea compared to value of execution?

VERY IMPORTANT OBSERVATION:

*ALL TECHNOLOGIES EVOLVE*

*CONTINUOUSLY, EVEN IF YOU*

*DON'T HEAR ABOUT IT*

WHAT IS THE MOTHER OF INVENTORS?

WHAT MAKES PEOPLE TO INVENT?



DEMAND PULL

TECHNOLOGY PUSH



Both explanations unsatisfactory  
(Nemet 2009)

More realistic explanation:

*People just like to invent new things?*

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- Demand incentives can help but demand alone does not bring about innovations: otherwise we would have cheap batteries and anti-gravity by now
  - We don't have the components for either
- “Fortune favors the prepared mind” (Louis Pasteur)



INVENTION IS A SOCIAL  
PHENOMENON

INNOVATION IS NOT TECHNOLOGY

# German army, World War II



Bundesarchiv, Bild 101I-218-0504-36 / Dieck / CC-BY-SA 3.0  
Wikimedia



Hans Karner, Wikimedia

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- But our societies are defined by technologies **we use**
- Technology ≠ technological change ≠ invention ≠ innovation



TECHNOLOGICAL TRANSITIONS TAKE  
TIME

# CHANGE IS WHEN THINGS HAPPEN

- Greatest impact of new technologies comes when they are actually taken into use
- This is usually long after they've been invented (10-20 years is typical)
- RED QUEEN RACE: "you must run very fast to stay where you are"
- Remember that technologies develop even if you aren't looking!
  - The competition evolves as well, but incremental innovations are rarely newsworthy!

In 1968, Finnish energy supply was still dependent on horses...

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TECHNOLOGY IS SOCIALLY SHAPED











# SUMMARY

# WHAT DID WE LEARN?

- History shows multiple futures are possible, and predictions can fail
- Technology is not limited to physical artifacts
  - Technology: *means to a human purpose*
- All technologies are combinations of components
- All innovation is incremental
- There are no simple explanations for what drives innovation
- Technology ≠ technological change ≠ invention ≠ innovation
- Technological change takes time!
- ...and is shaped by the society.

# REFERENCES & FURTHER READING

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