MYTHS OF INNOVATION: What can we learn from history?

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AGENDA

- Why study history?
- What is technology?
- Technological transitions take time
- How innovation happens?
- What is the mother of inventors?
- 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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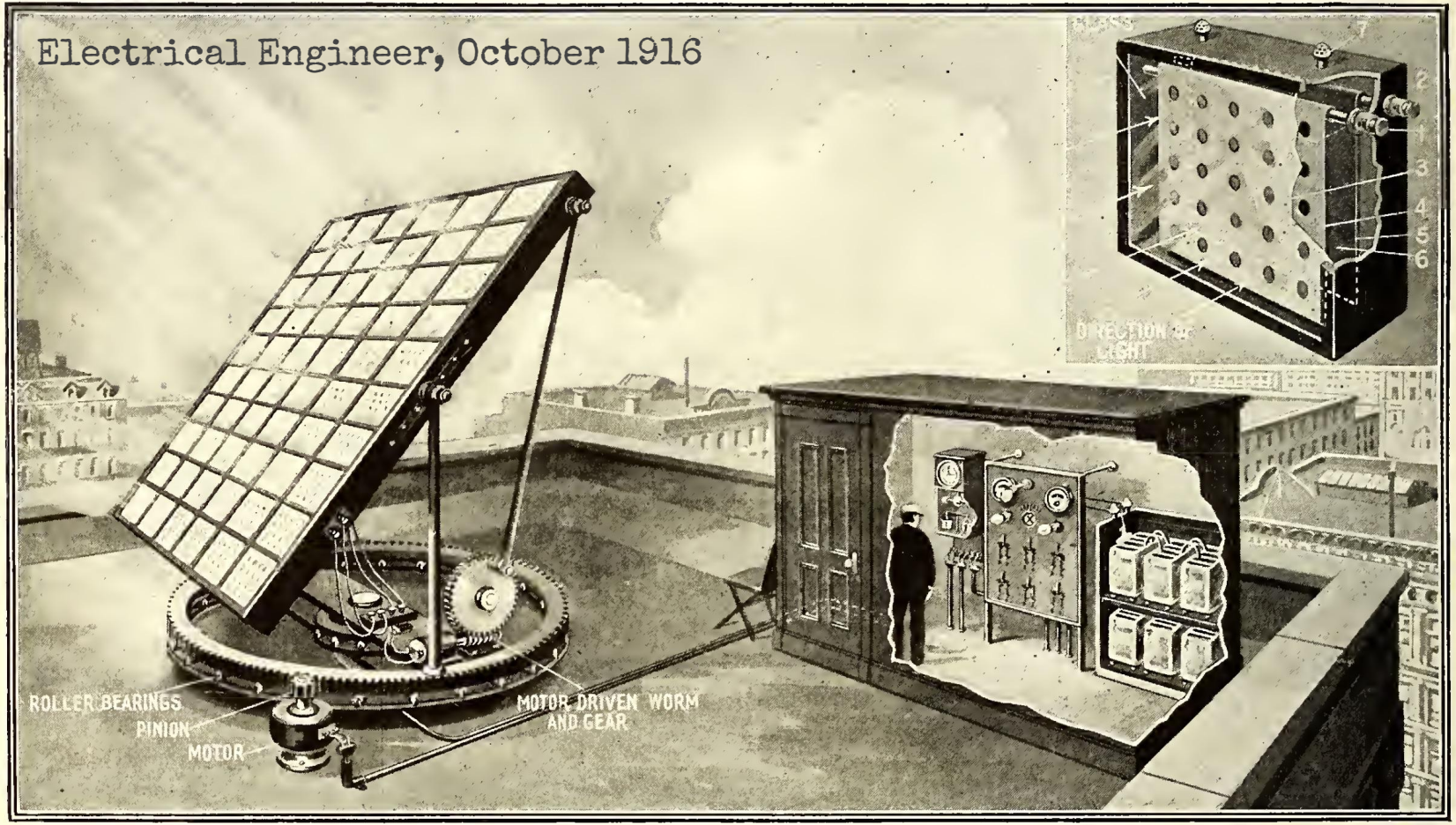
Lovins, A. (1976). Energy strategy: the road not taken. *Foreign Affairs*, (55), 65-96.



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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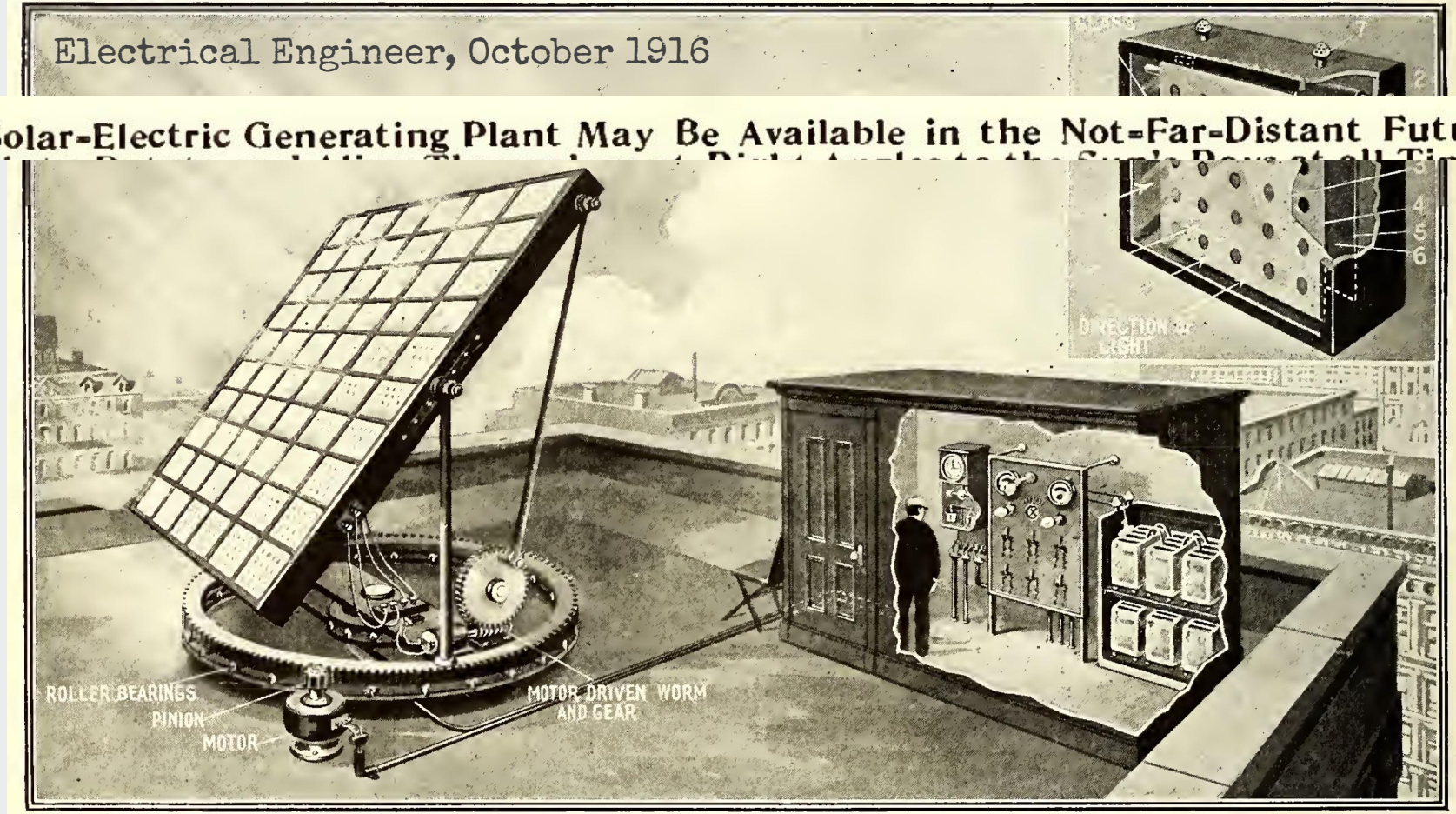

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ELECTRICITY FROM WIND.

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.

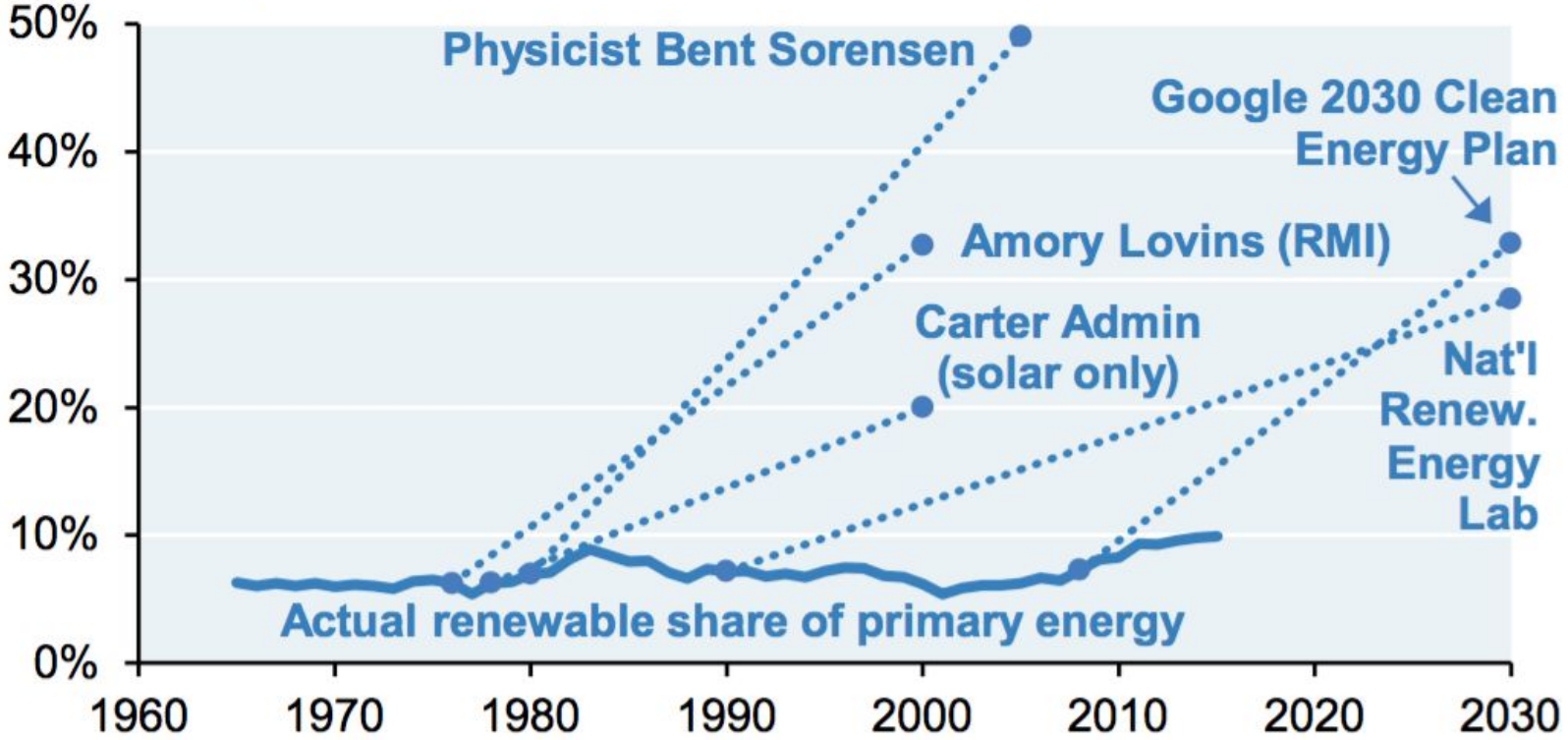
This is not the only wind plant for generating electricity. A firm of electrical engineers at Willesden Green have for some time had one running successfully. An ingenious arrangement is used by them to check the vagaries of the wind. When a strong wind is blowing the turbine naturally revolves quicker 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.

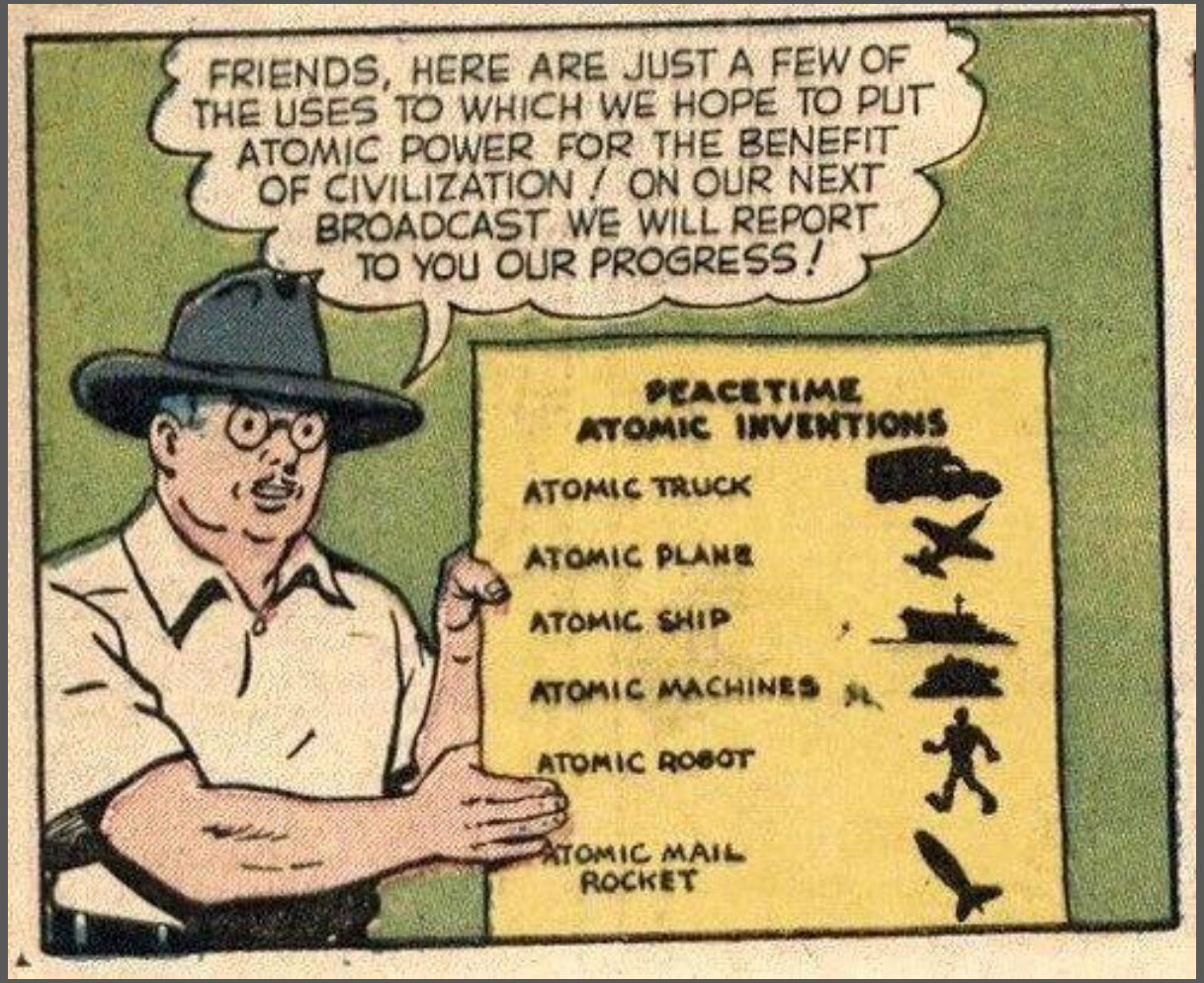
Daily Mail, Feb 3, 1910

Cembalest, M. (2016): Eye on the market. J.P. Morgan

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.



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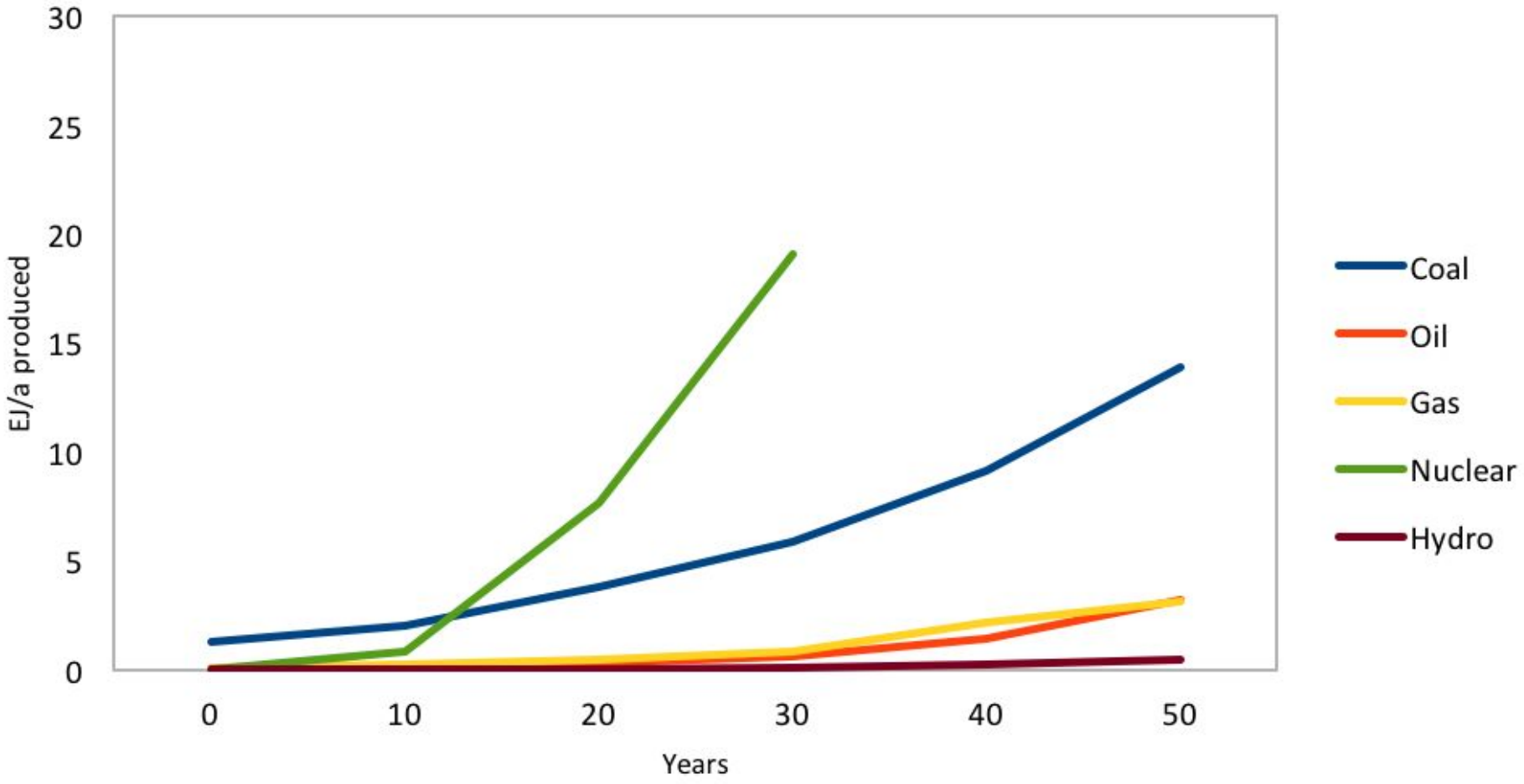
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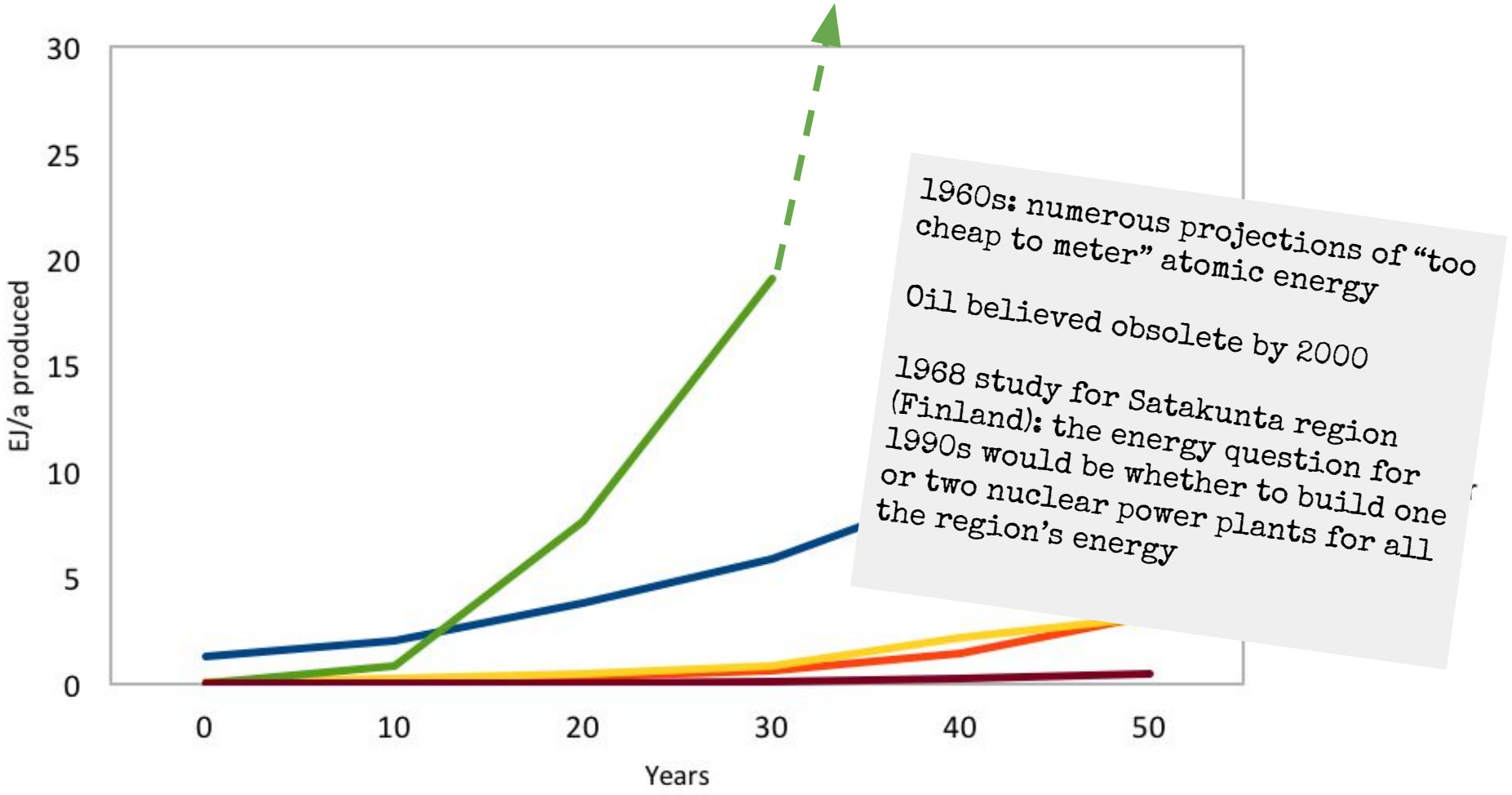
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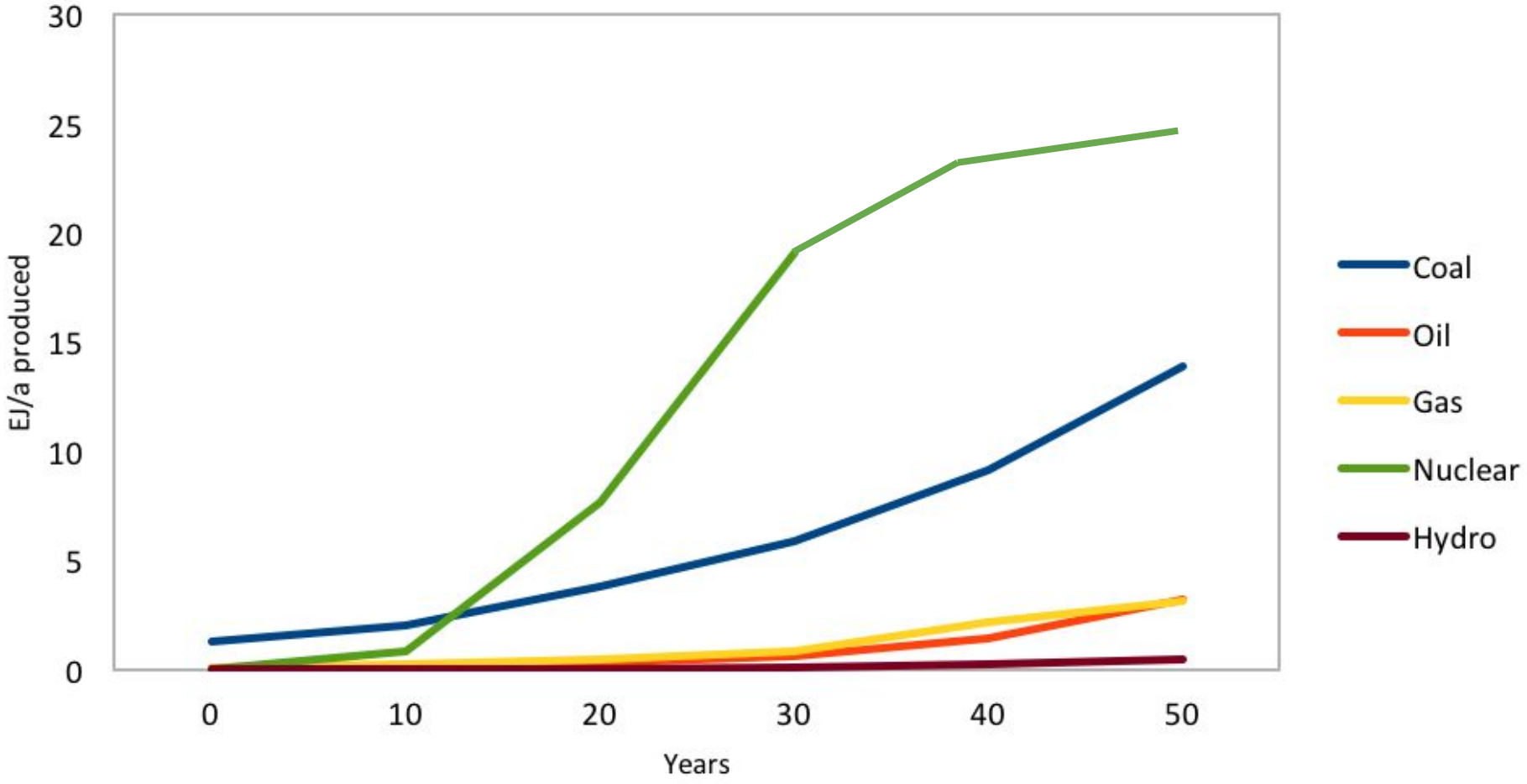
1960s: numerous projections of “too cheap to meter” atomic energy
Oil believed obsolete by 2000
1968 study for Satakunta region (Finland): the energy question for 1990s would be whether to build one or two nuclear power plants for all the region’s energy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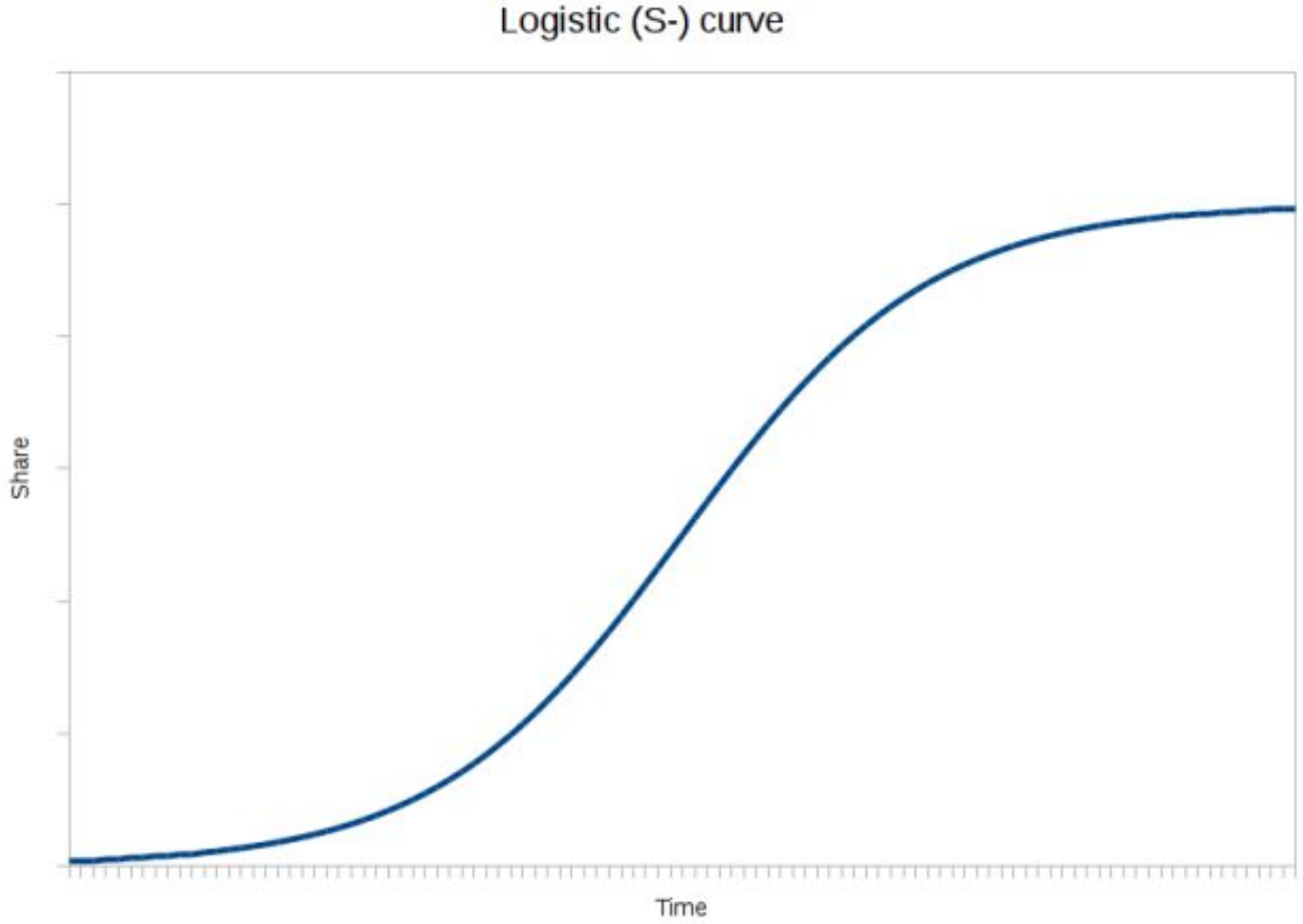
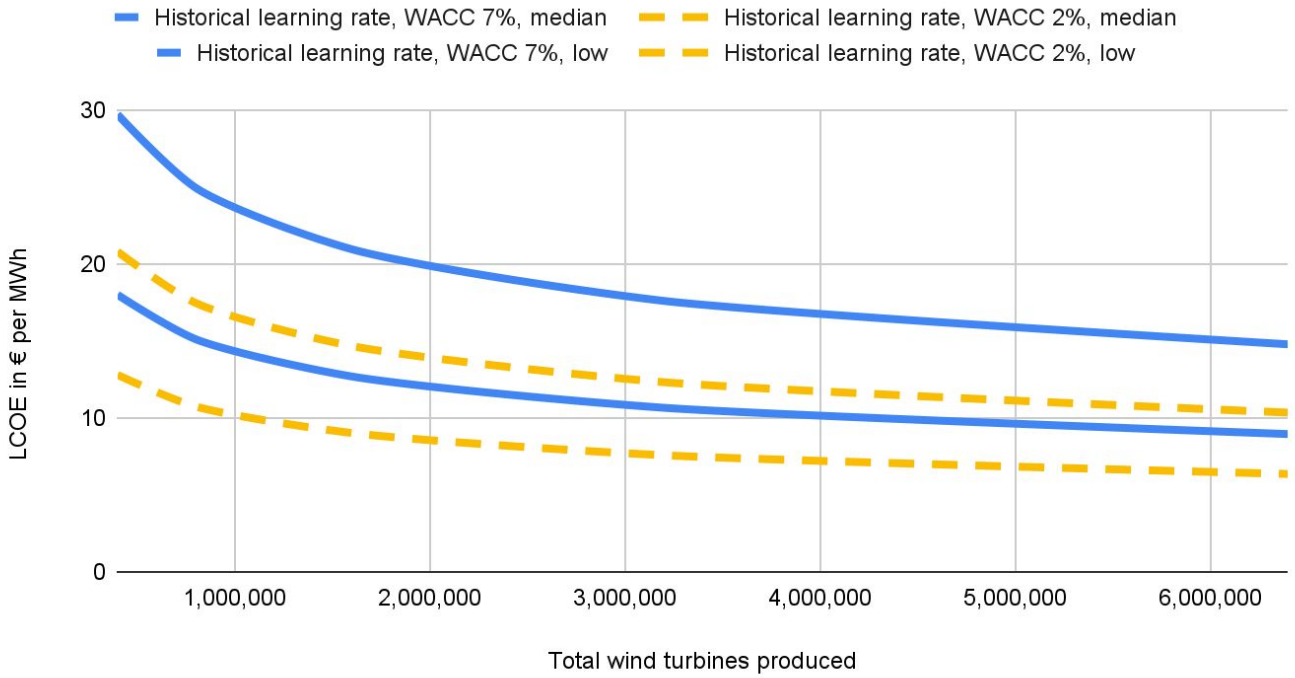

Logistic (S-) curve
Share
Time

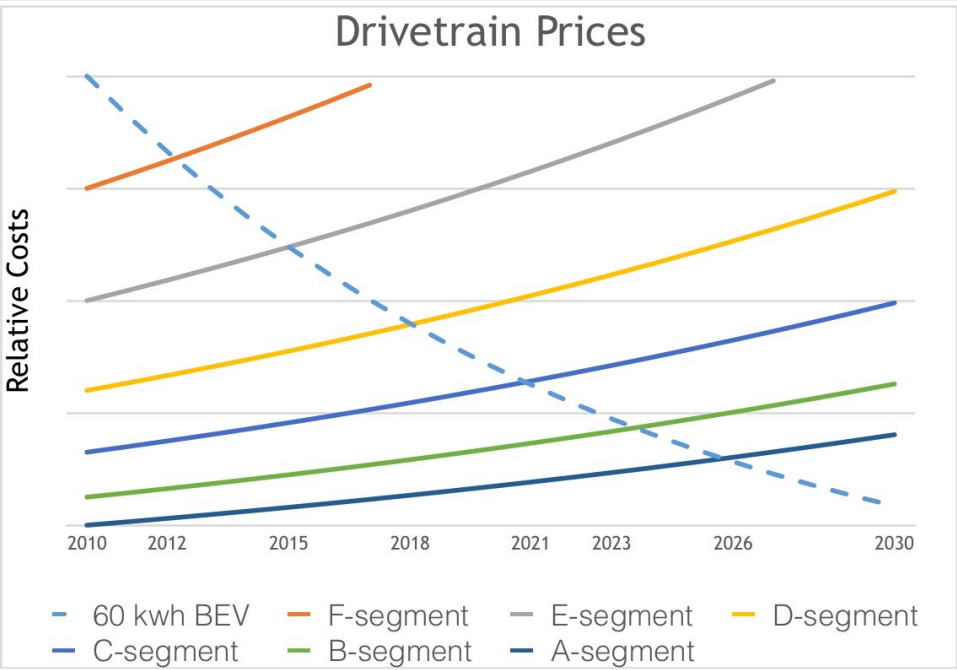
On the other hand…

IMPACT OF MASS PRODUCTION

PLAN B

Cost projections for onshore wind after 2030. From Ram et al. (2018) and own calculations. Historical learning rate 14%.





A-segment	Mini	VW Up!, Fiat Panda/500, Toyota Aygo, Japanese Kei cars
B-segment	Small	VW Polo, Renault Clio, Ford Fiesta, Toyota Yaris, Opel Corsa
C-segment	Lower medium	VW Golf, Renault Megane, Audi A3, Toyota Corolla, Honda Civic
D-segment	Medium	BMW 3 Series, Mercedes C-Class, Audi A4, VW Passat
E-segment	Large	BMW 5 Series, Mercedes E-Class, Audi A6
F-segment	Luxury	BMW 7 Series, Mercedes S-Class, Audi A8

- *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?

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

INNOVATION IS NOT TECHNOLOGY

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- Technology ≠ technological change ≠ invention ≠ innovation

TECHNOLOGICAL TRANSITIONS TAKE TIME

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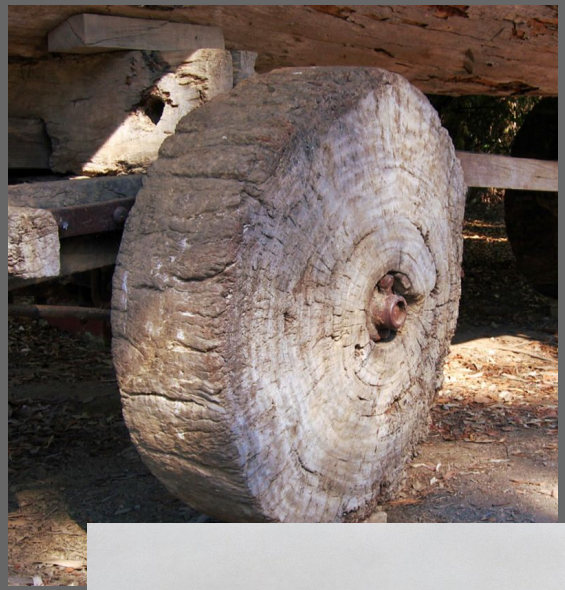
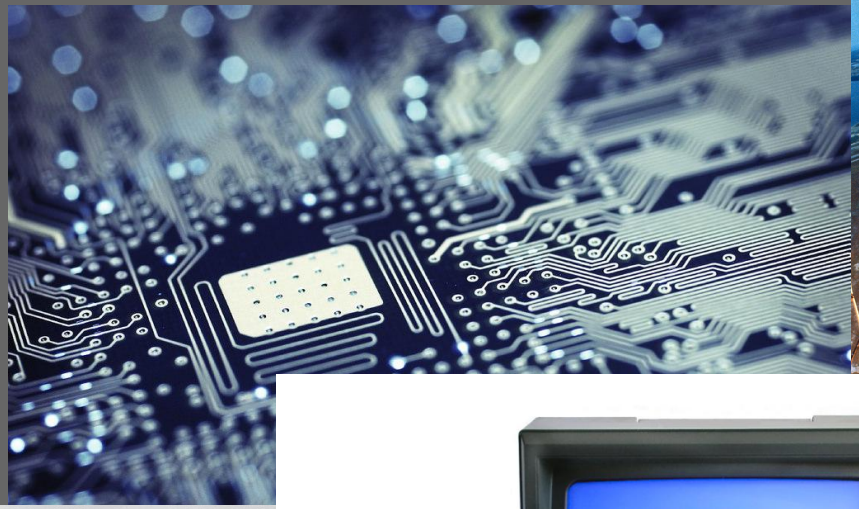
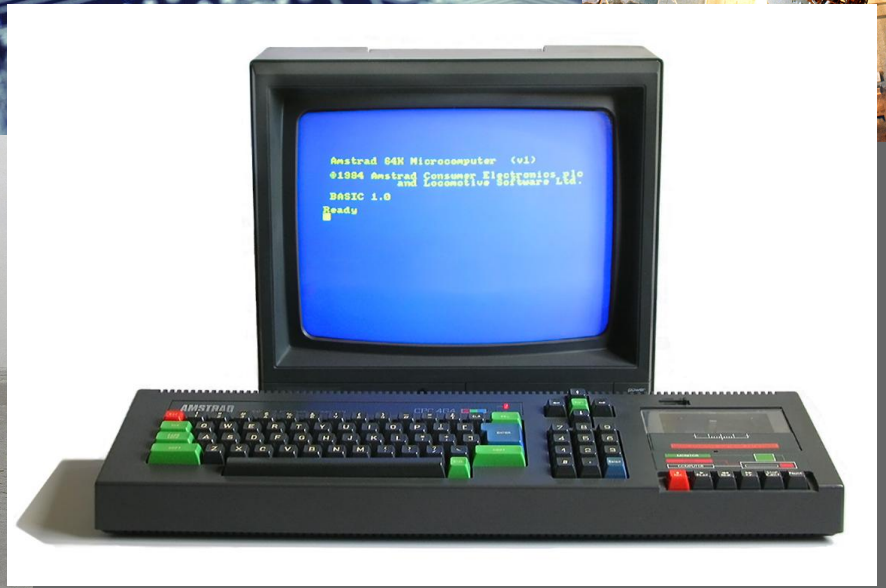
In 1968, Finnish energy supply was still dependent on horses...

What, then, *is* technology?






Amstrad 64K Microcomputer (v1)
©1984 Amstrad Consumer Electronics plc
and Locomotive Software Ltd.
BASIC 1.0
Ready

NOT JUST ARTEFACTS!

Trollbackco, Wikimedia

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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TECHNOLOGY IS…

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

Willoughby (2005)

OR...

"Things humans build and manufacture, and processes and know-how required"

Korhonen, today

DOES IT MATTER WHAT TECHNOLOGY IS?

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Technology as a language and in language:

symbolic communication

Wikipedia, user Cryonic7

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If we believe “technology develops”, then what do we develop?

Who develops technology?

HOW INNOVATION HAPPENS?

“radically novel innovation”

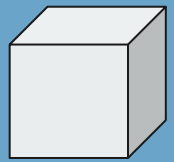
“radically novel innovation”

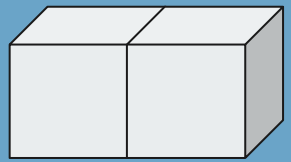
“a giant leap”

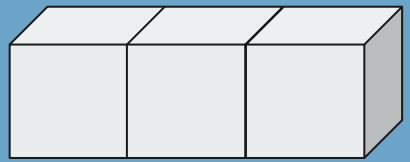
“radically novel innovation”

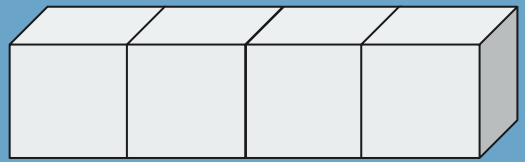
“a giant leap”

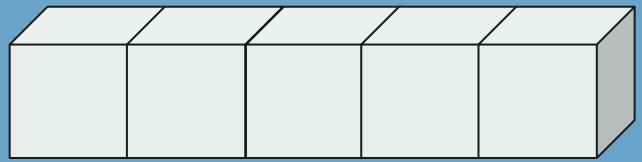
“massive breakthrough”

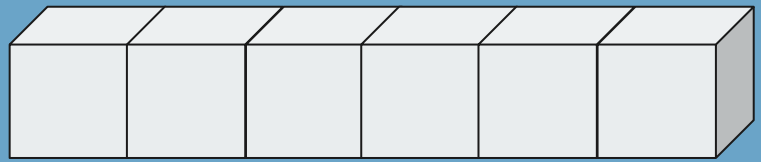


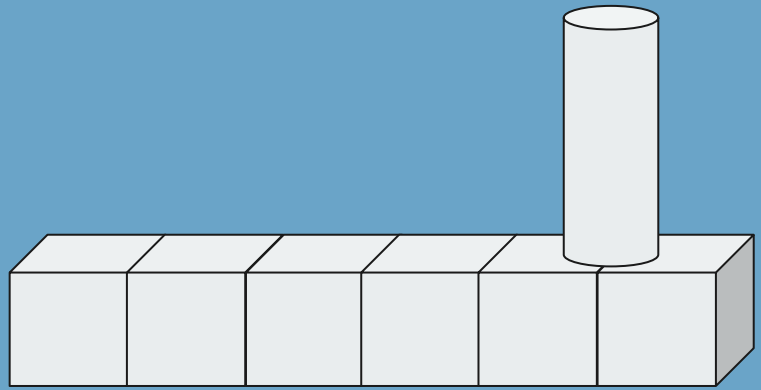


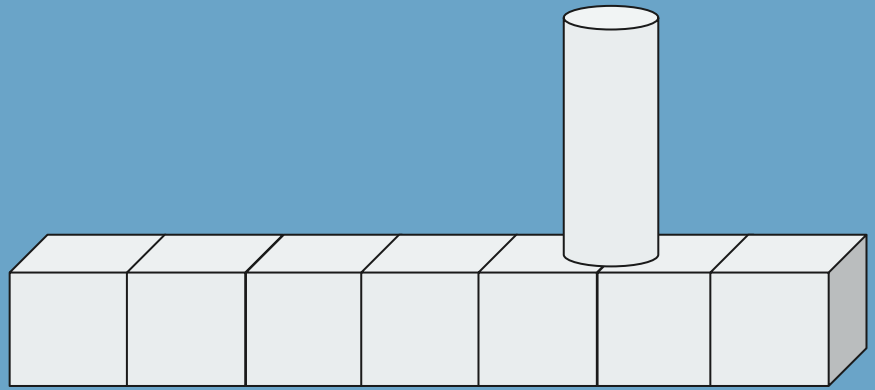


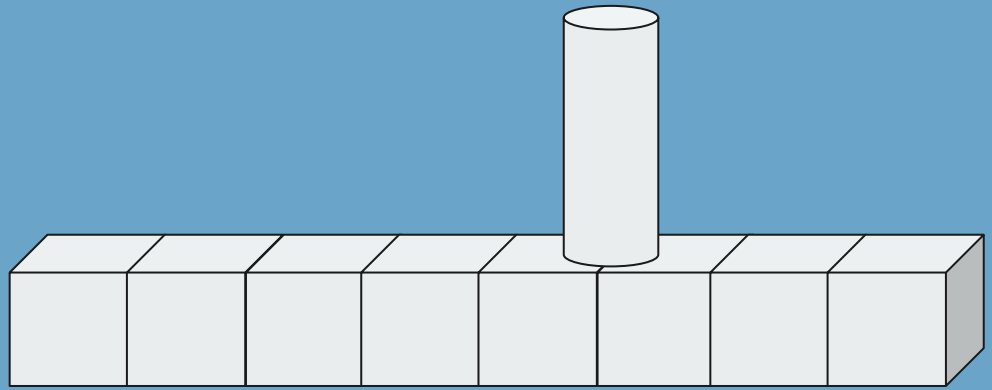


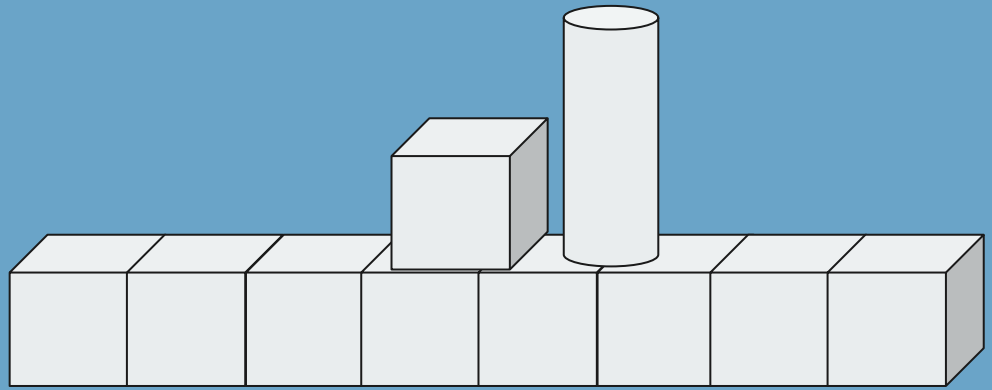


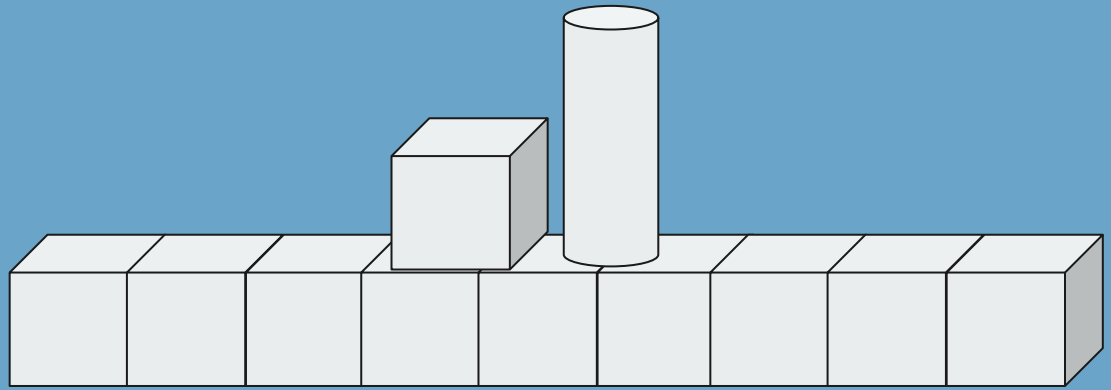


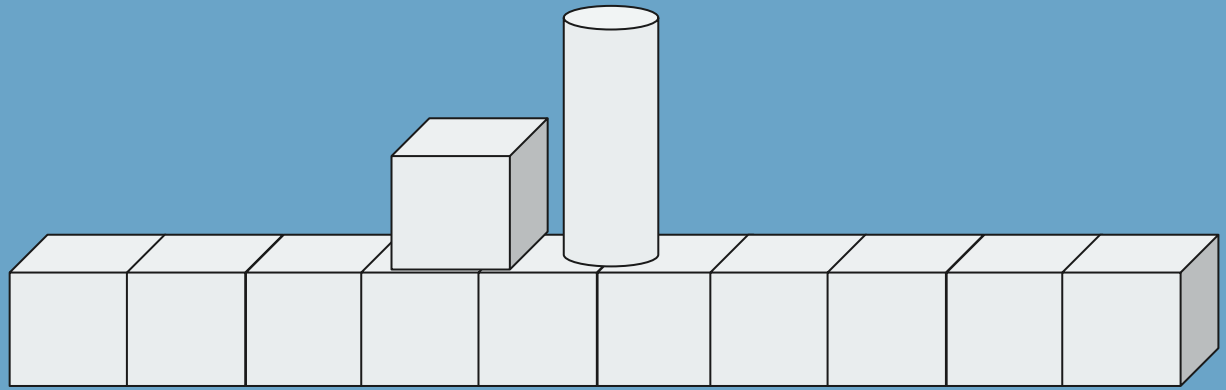


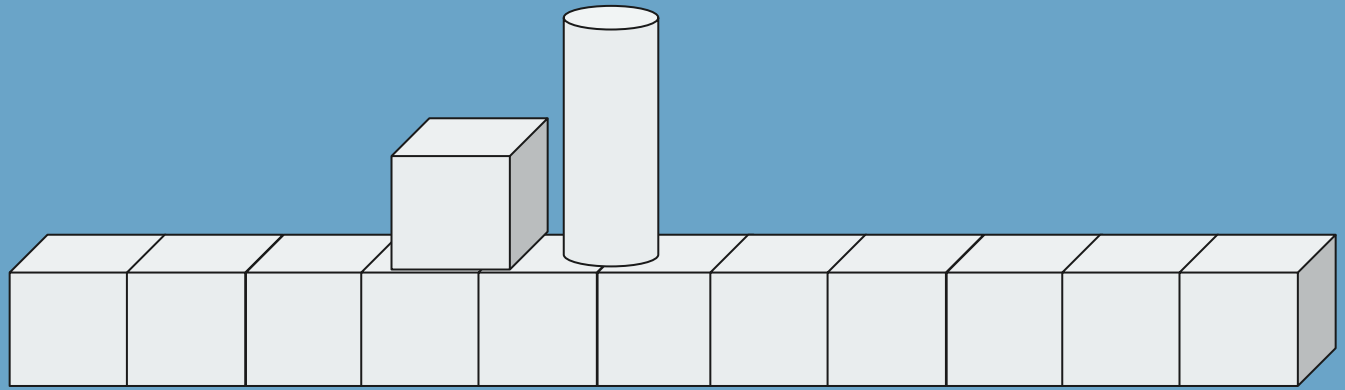


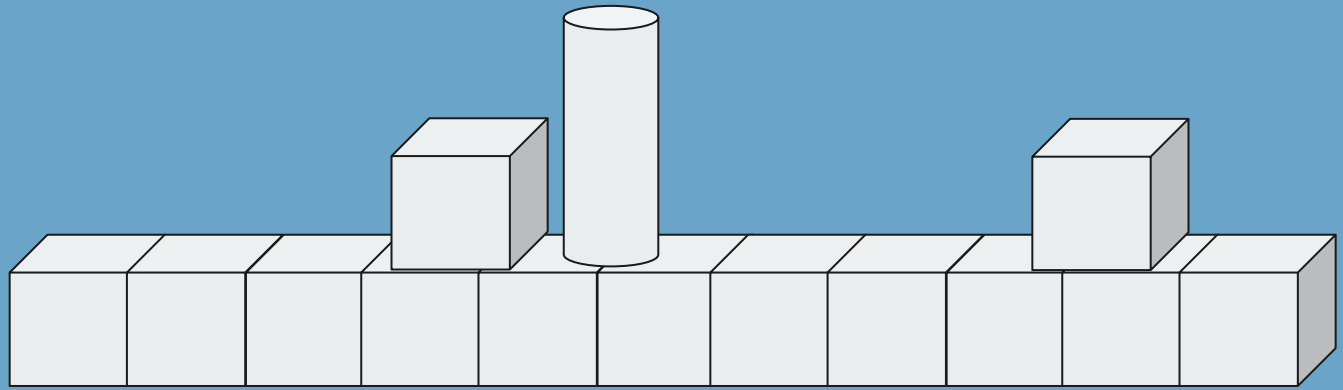


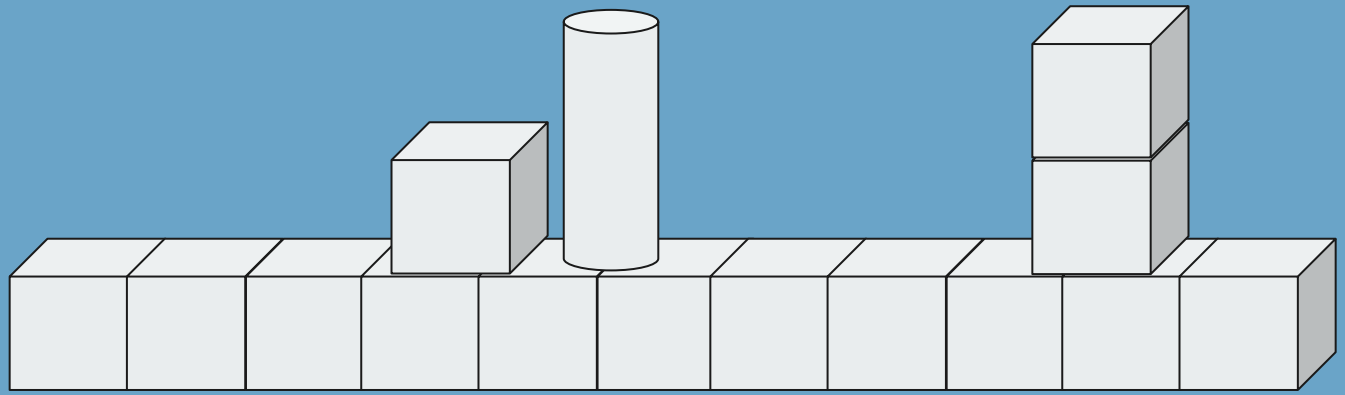


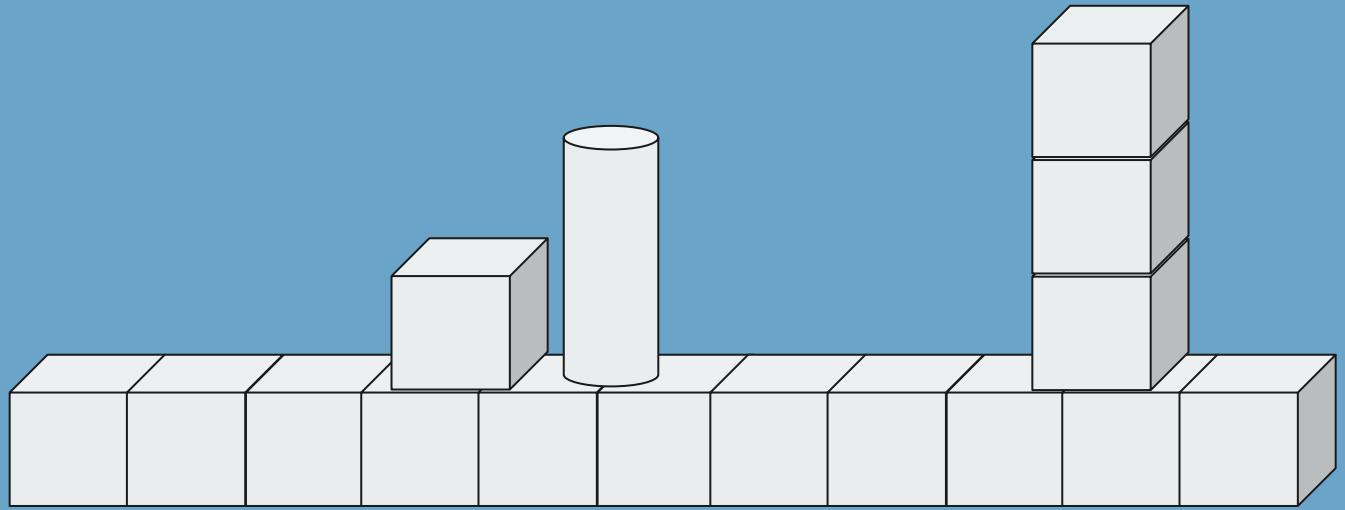


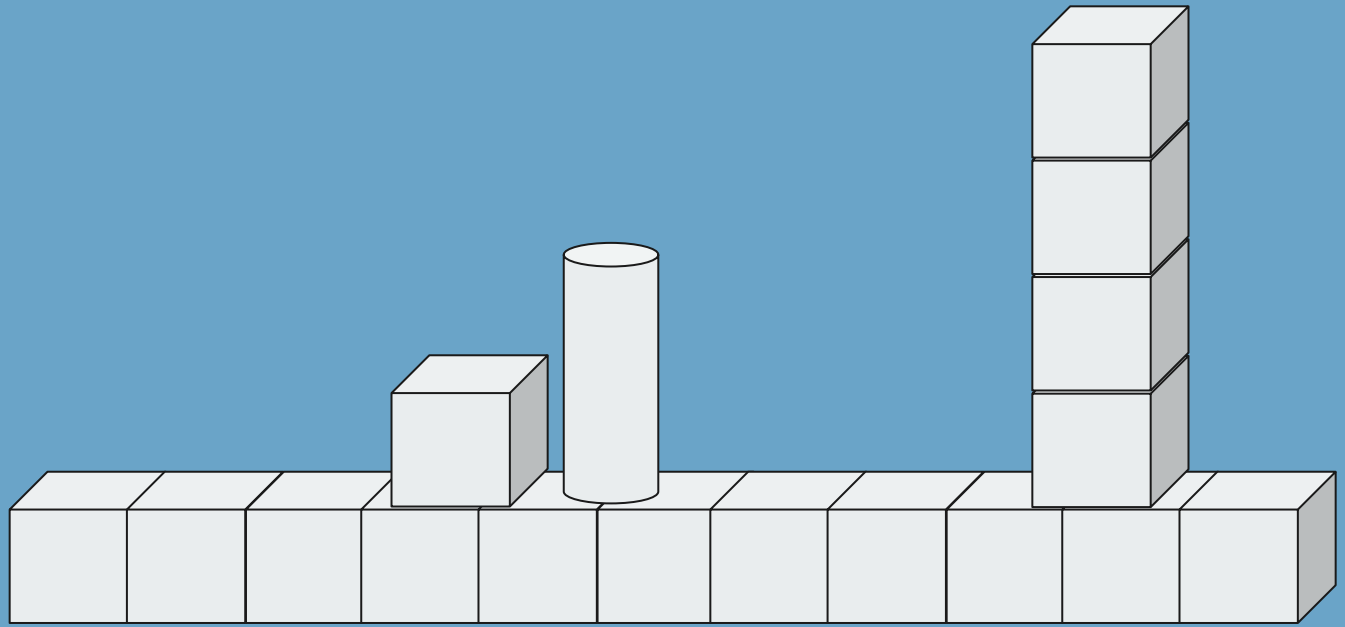


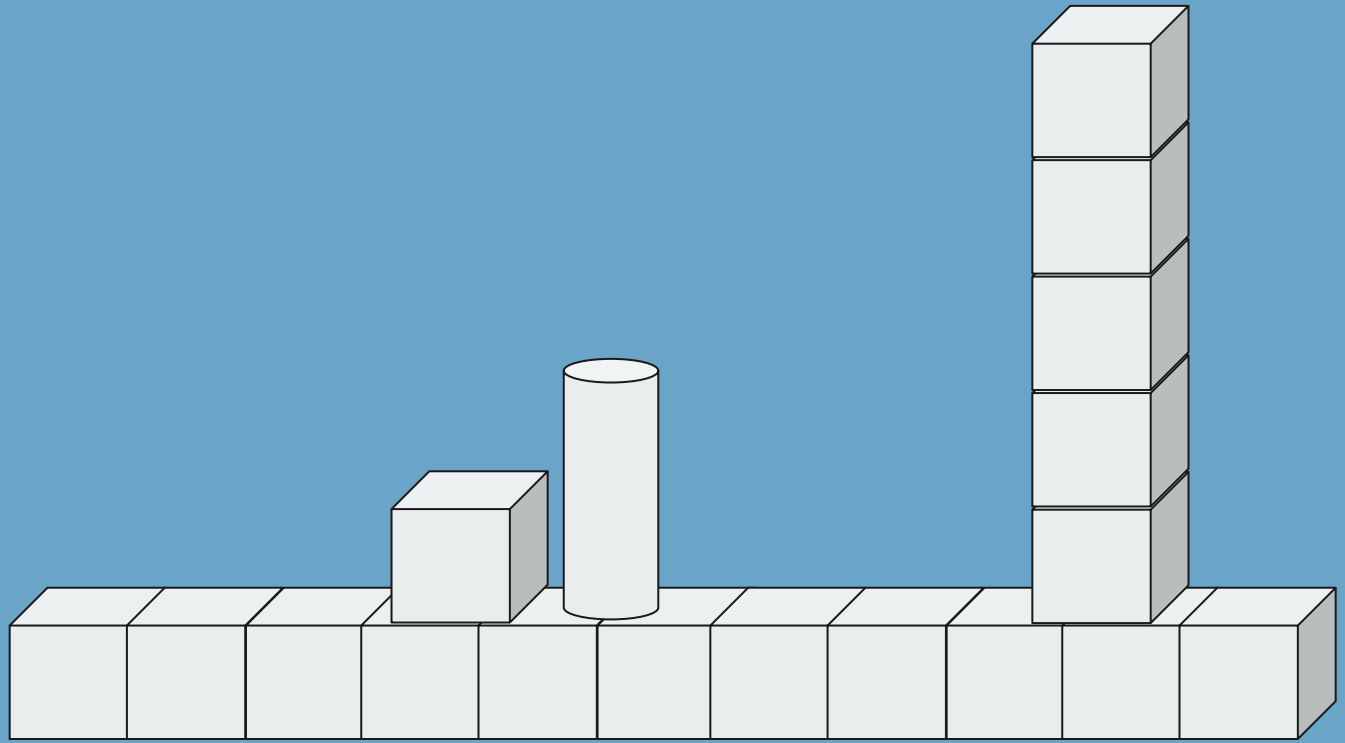


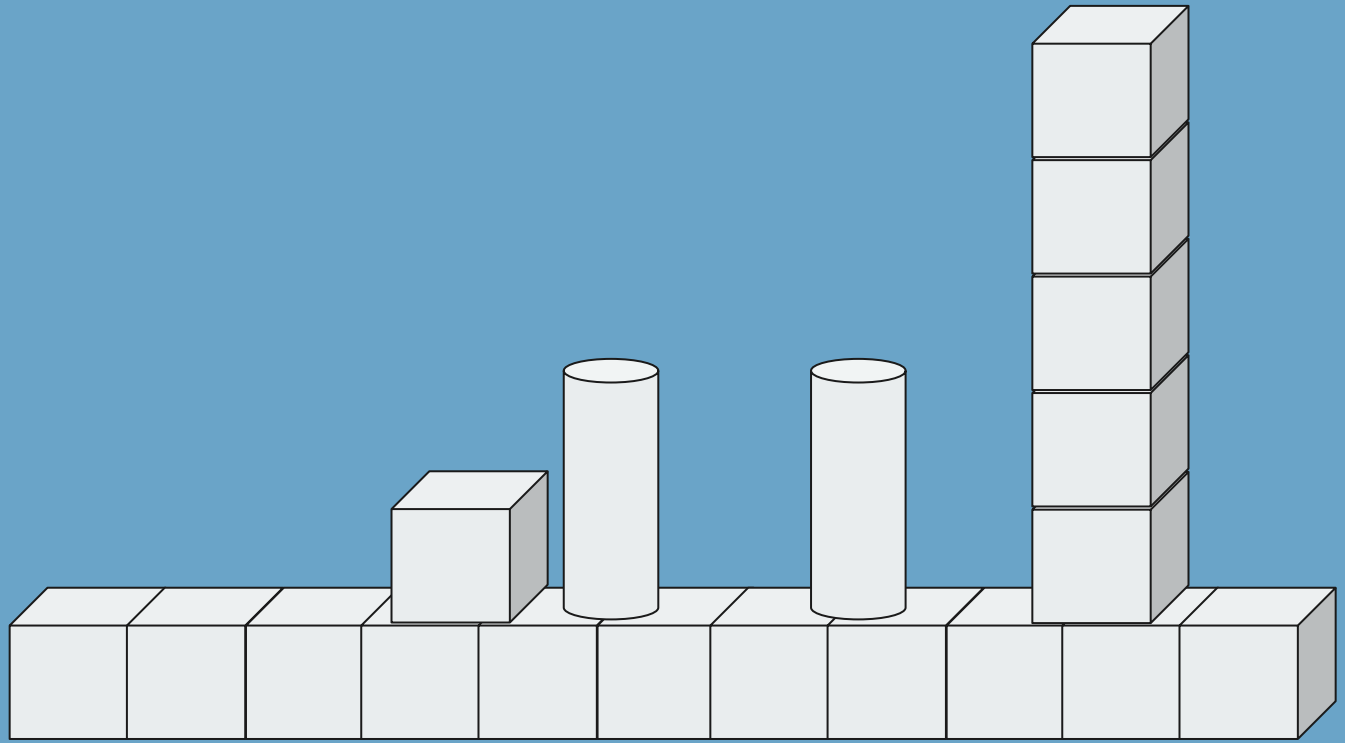


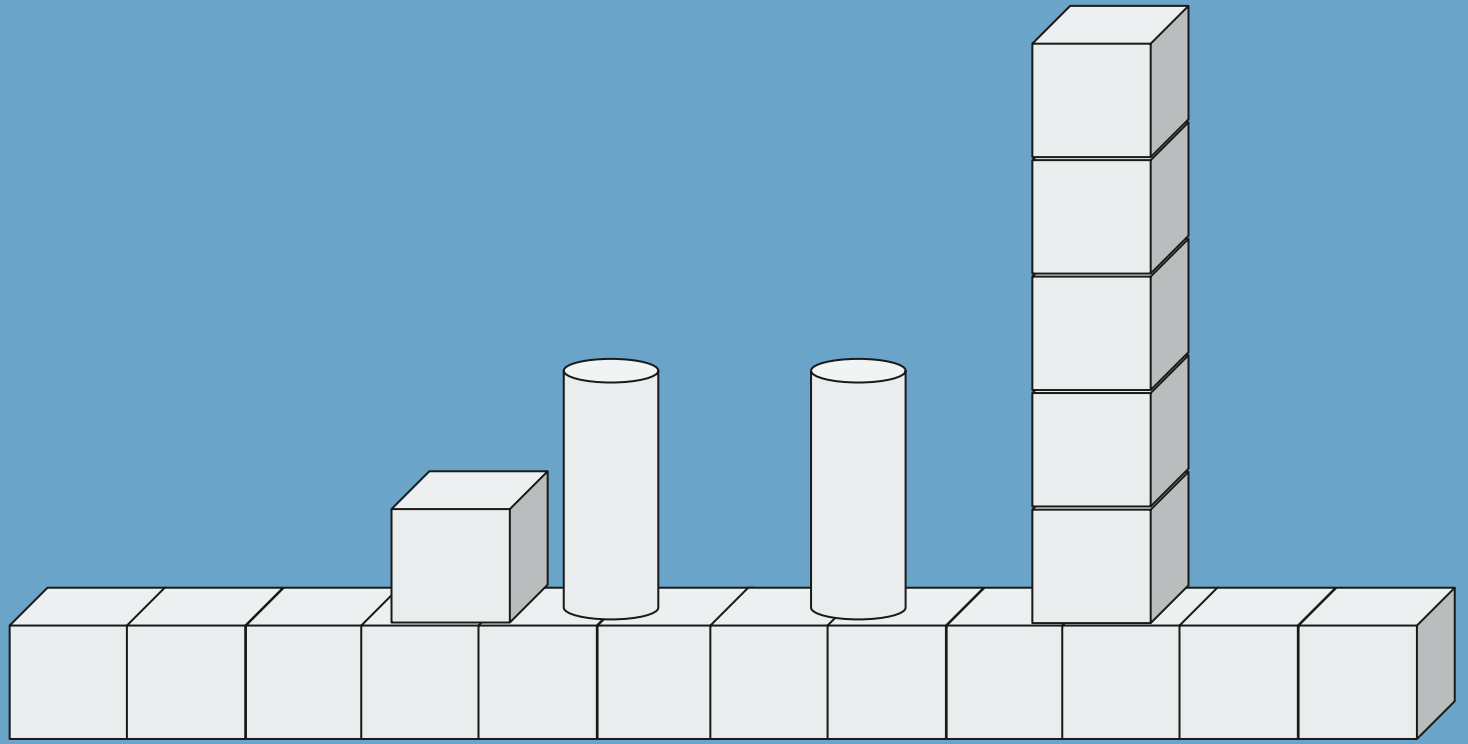


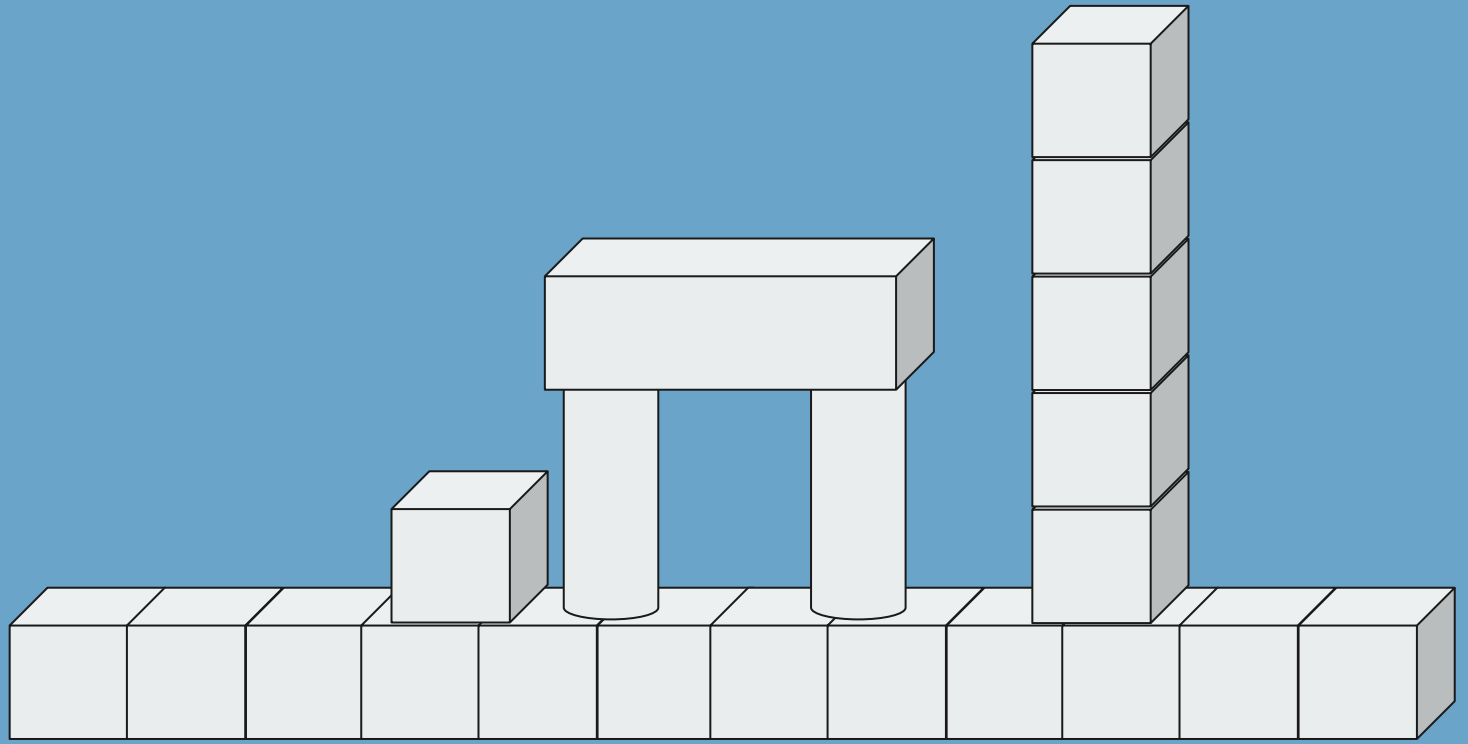


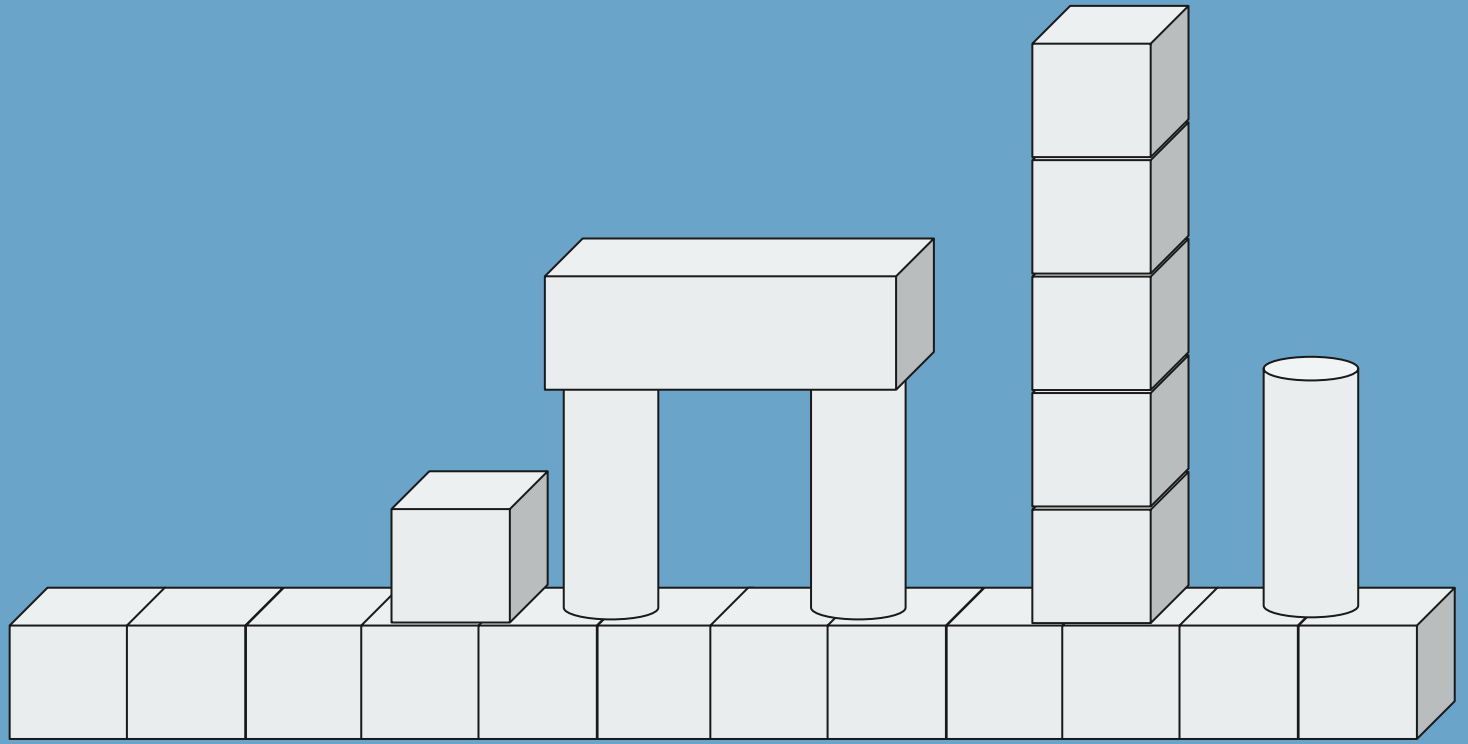


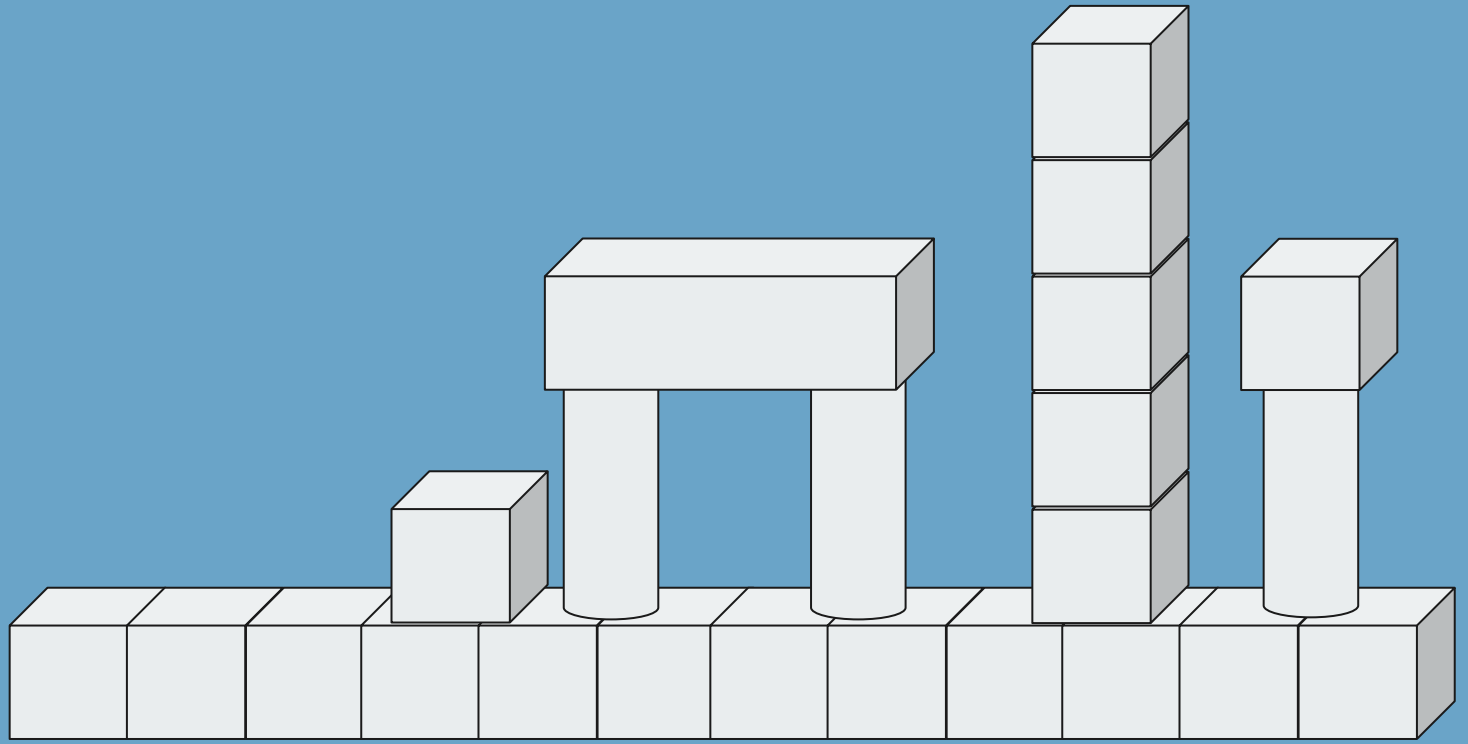


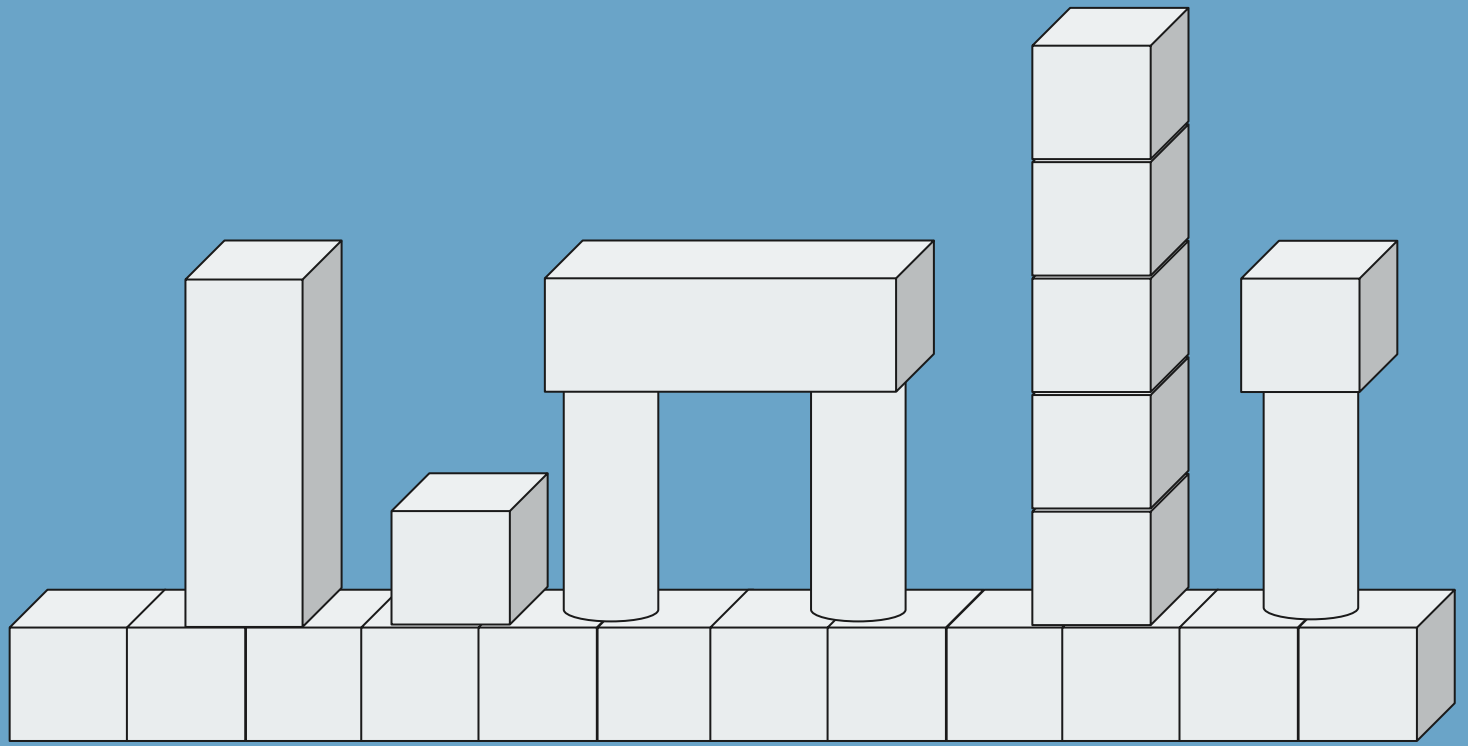


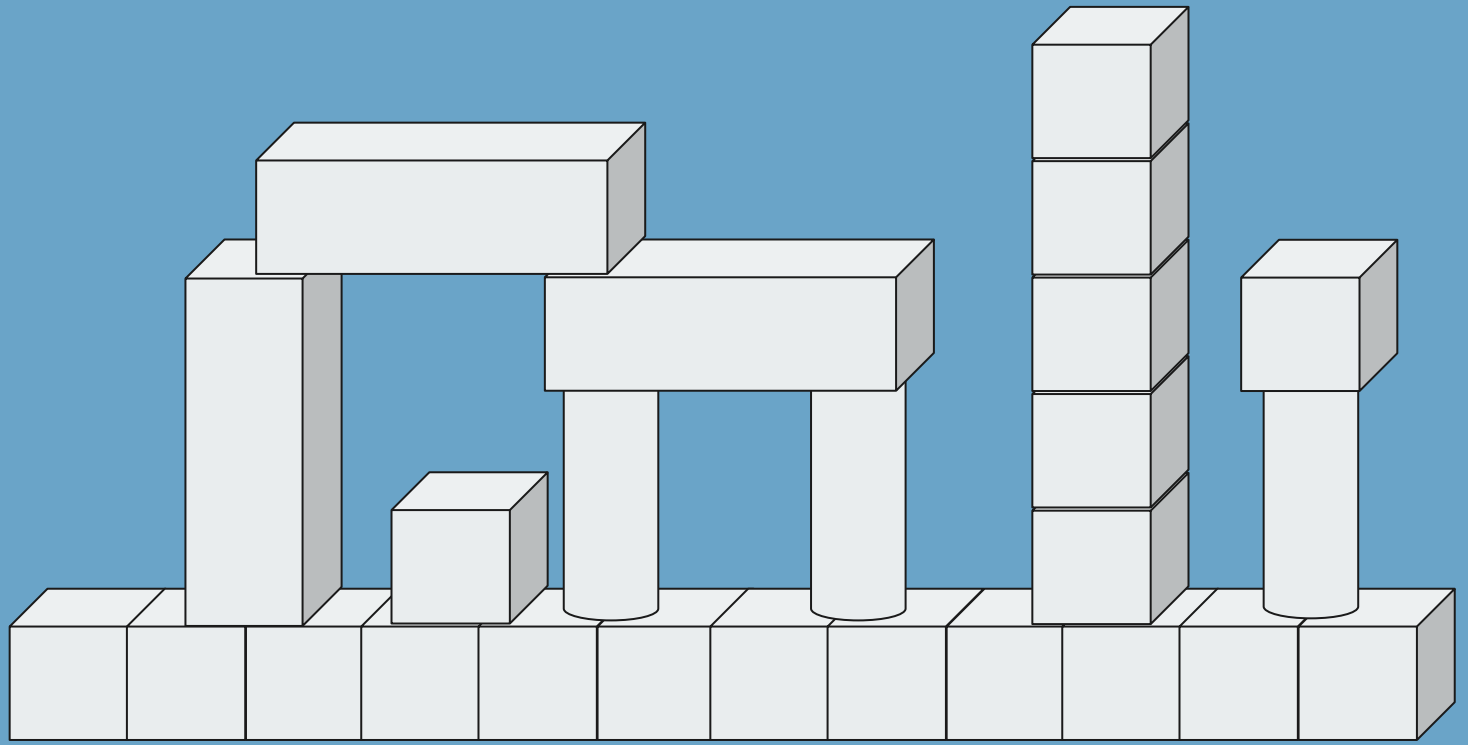


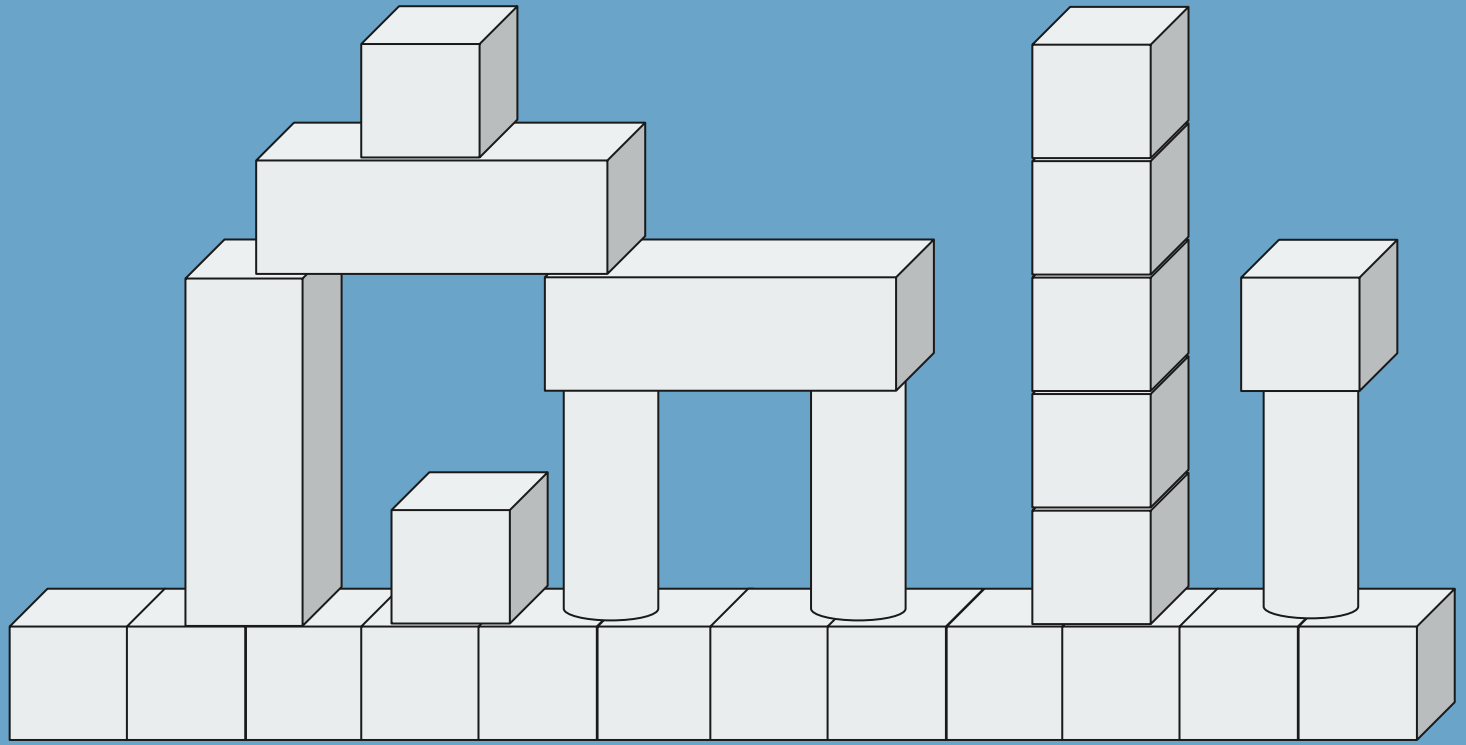


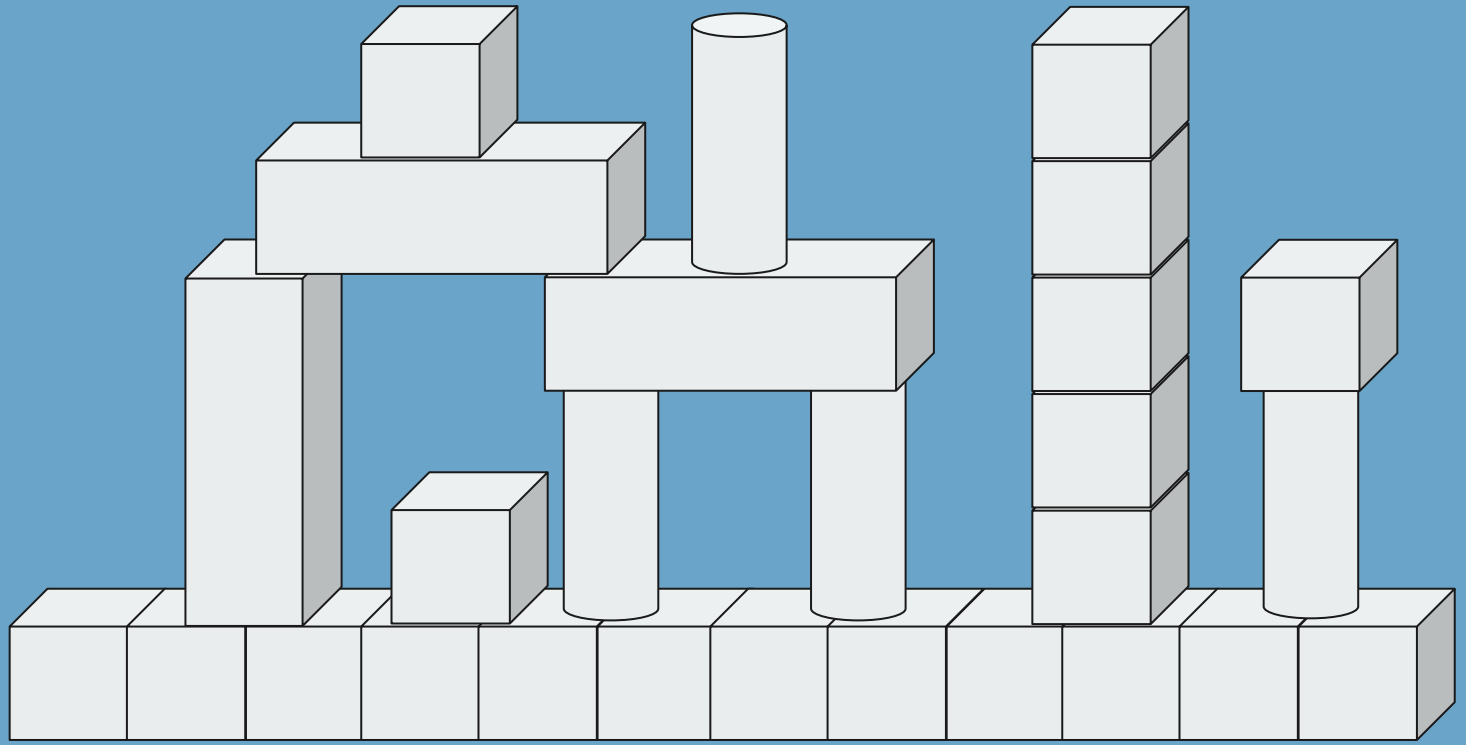


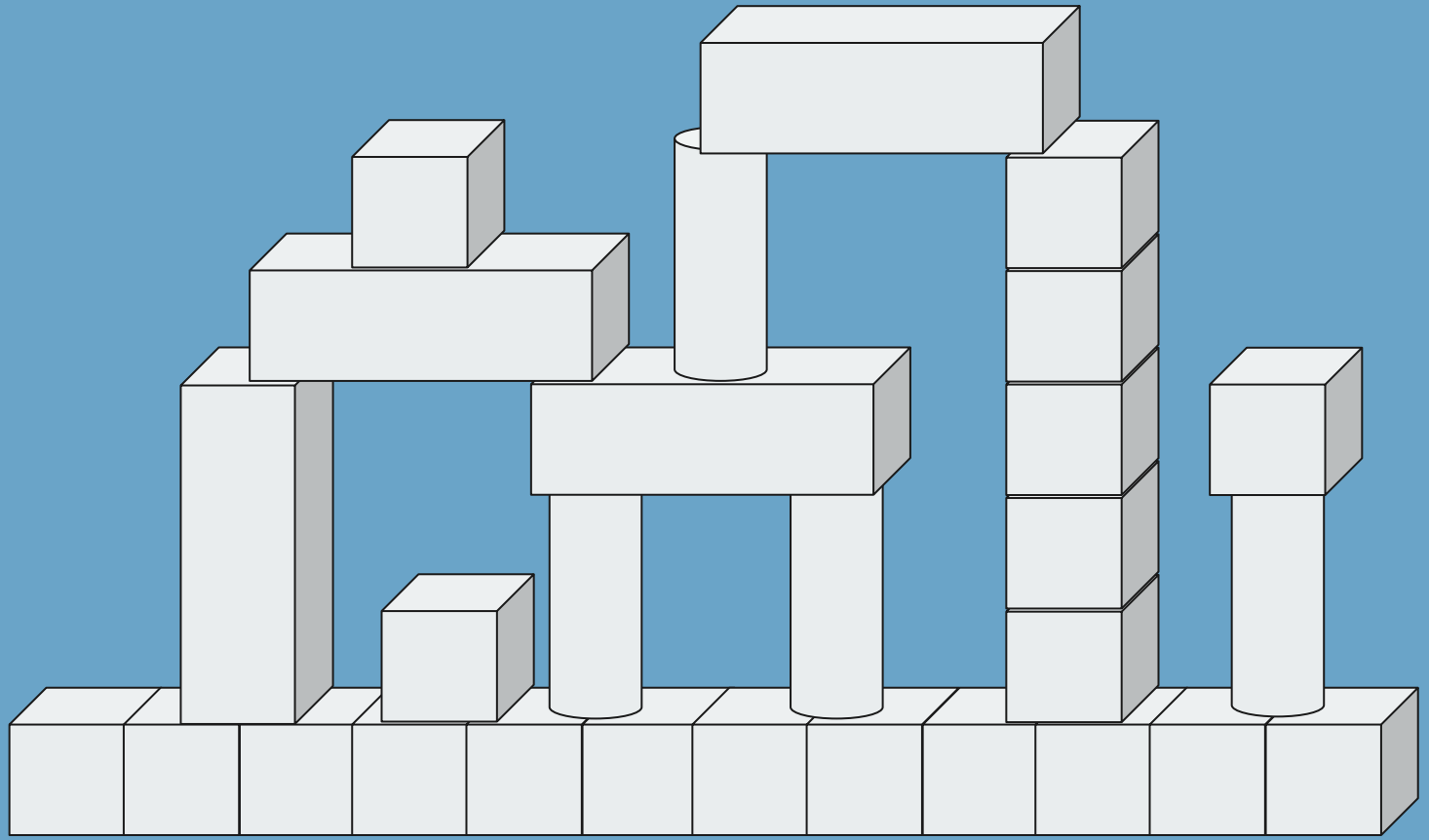


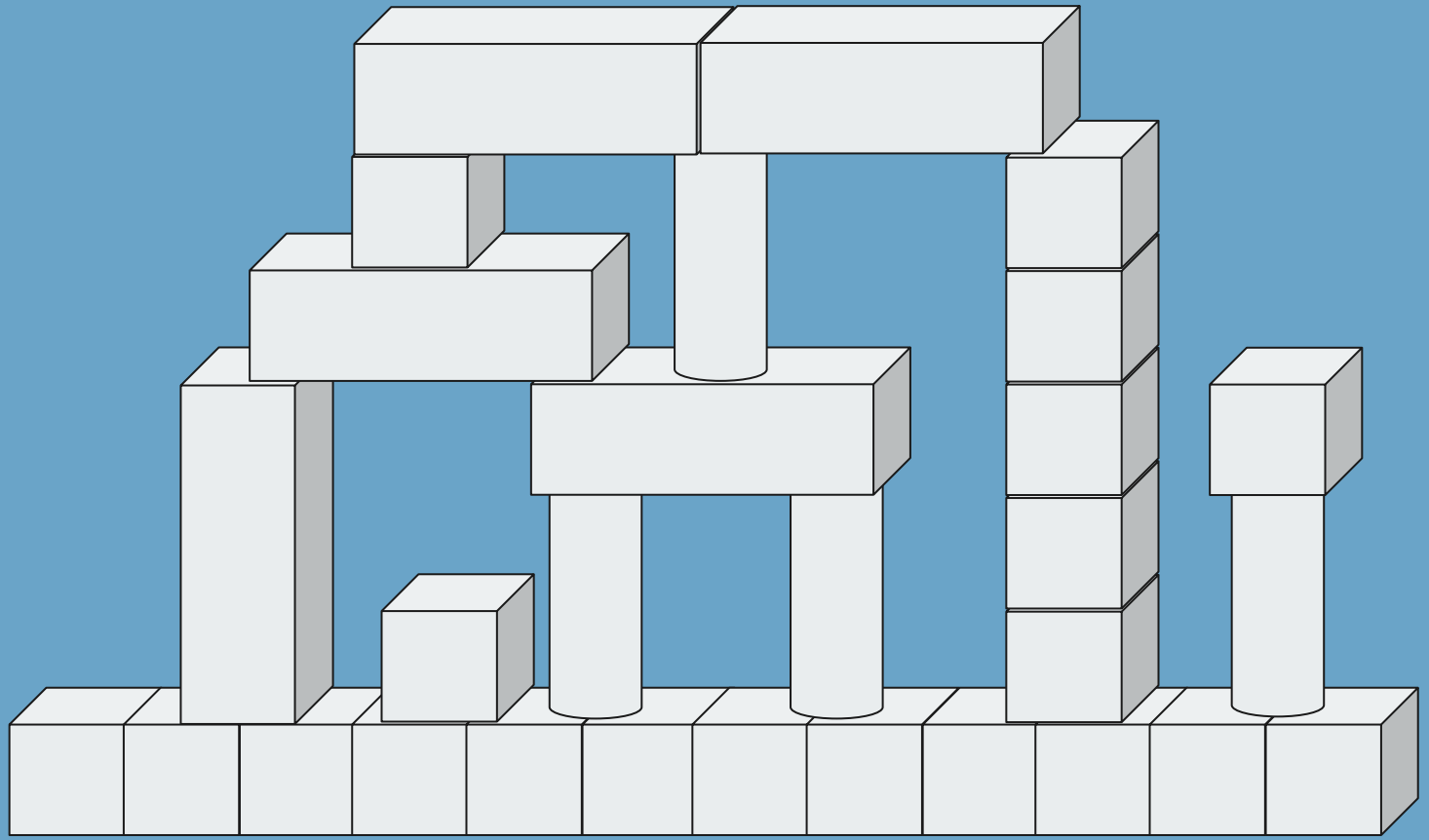


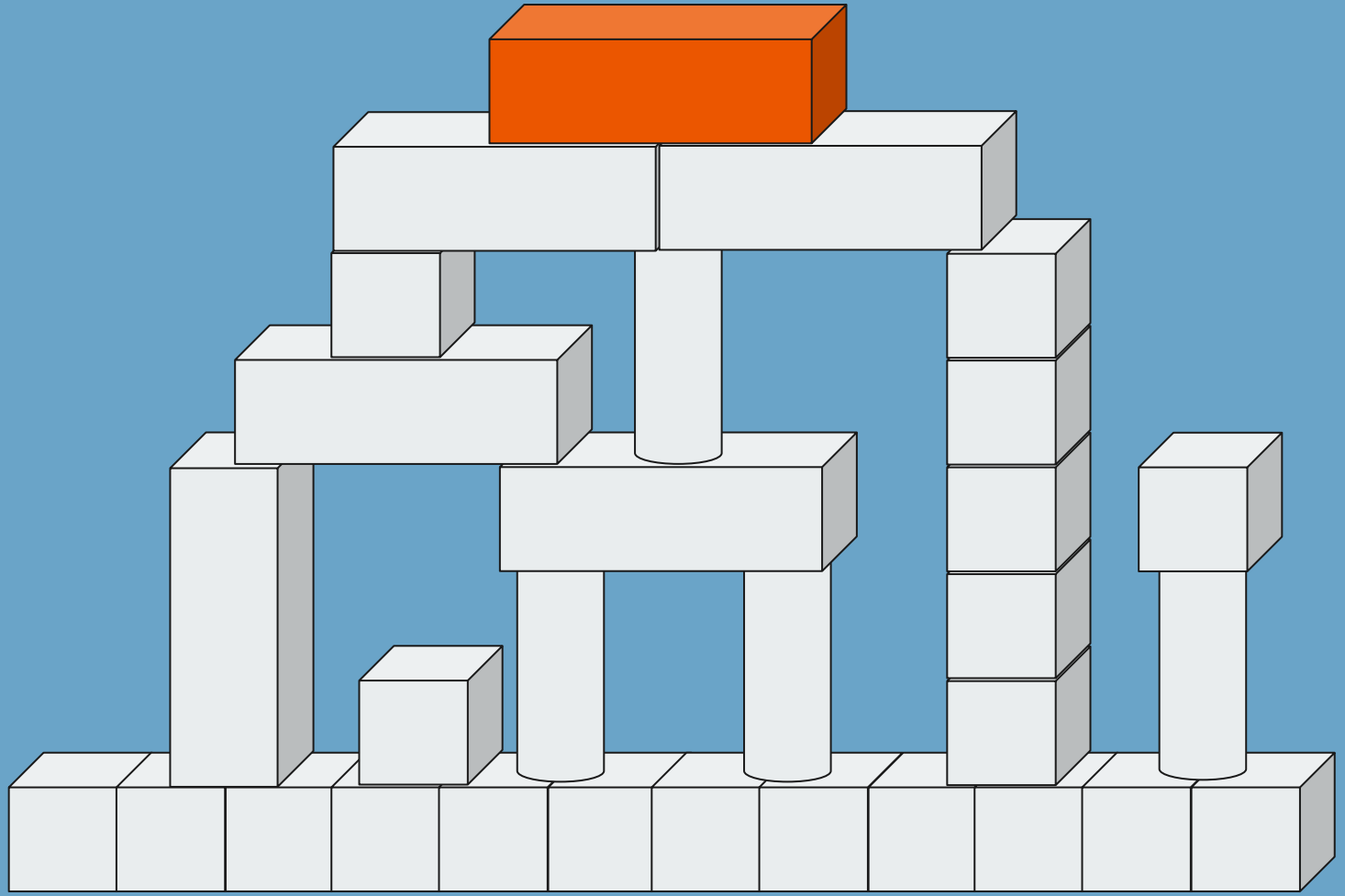


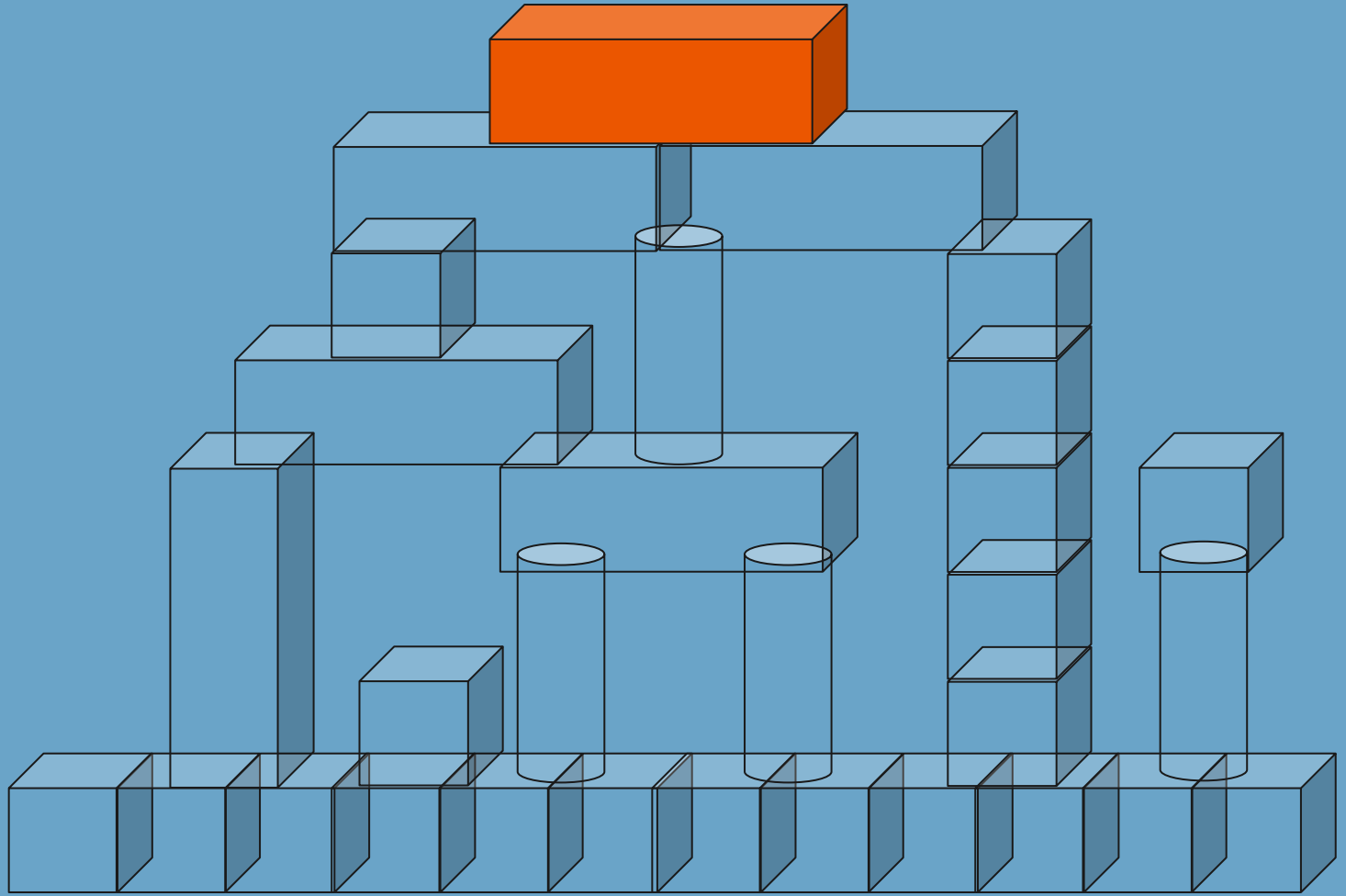












Was this a radical innovation?

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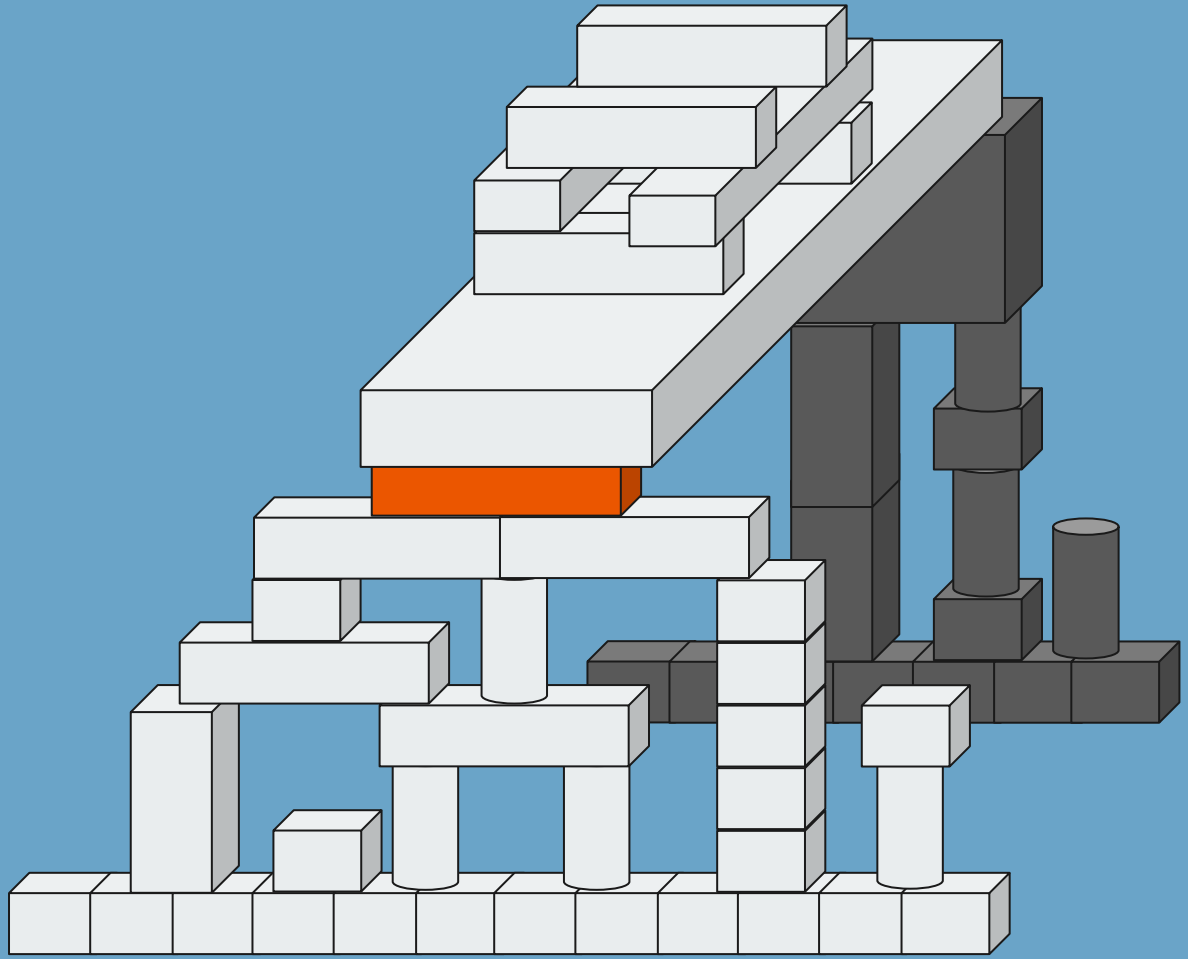

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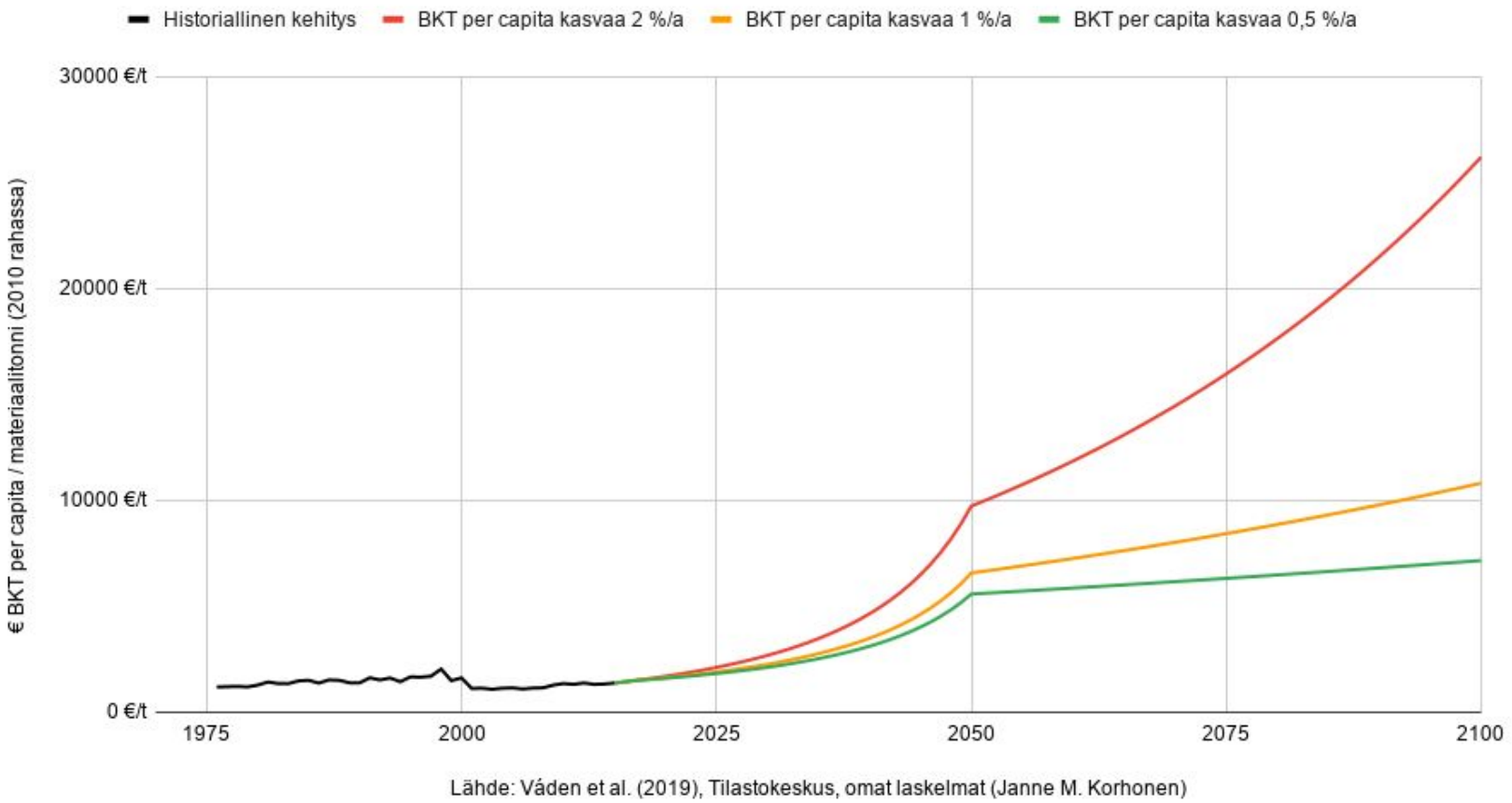
- New technologies become new building blocks for further advances
- However: are there infinitely many combinations?

See Arthur (2009), Kasmire et al. (2012)

Suomen talouden vaadittu materiaalitehokkuus

Kun kestävä materiaalinkulutus (n. 7t/lö) saavutetaan 2050



Lähde: Väden et al. (2019), Tilastokeskus, omat laskelmat (Janne M. Korhonen)

PERPETUAL GROWTH?

- The idea that economic growth can continue in perpetuity rests on the assumption that there is a Vast amount of recombinations
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- 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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    - We don't have the components for either
- "Fortune favors the prepared mind" (Louis Pasteur)

INVENTION IS A SOCIAL PHENOMENON

TECHNOLOGY IS SOCIALLY SHAPED

TECHNOLOGY AND POWER RELATIONS:

"Technology is neither good nor bad,

nor is it neutral"

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- LUDDITES WERE RATIONAL

See e.g. Frey (2019), The Technology Trap

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.

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