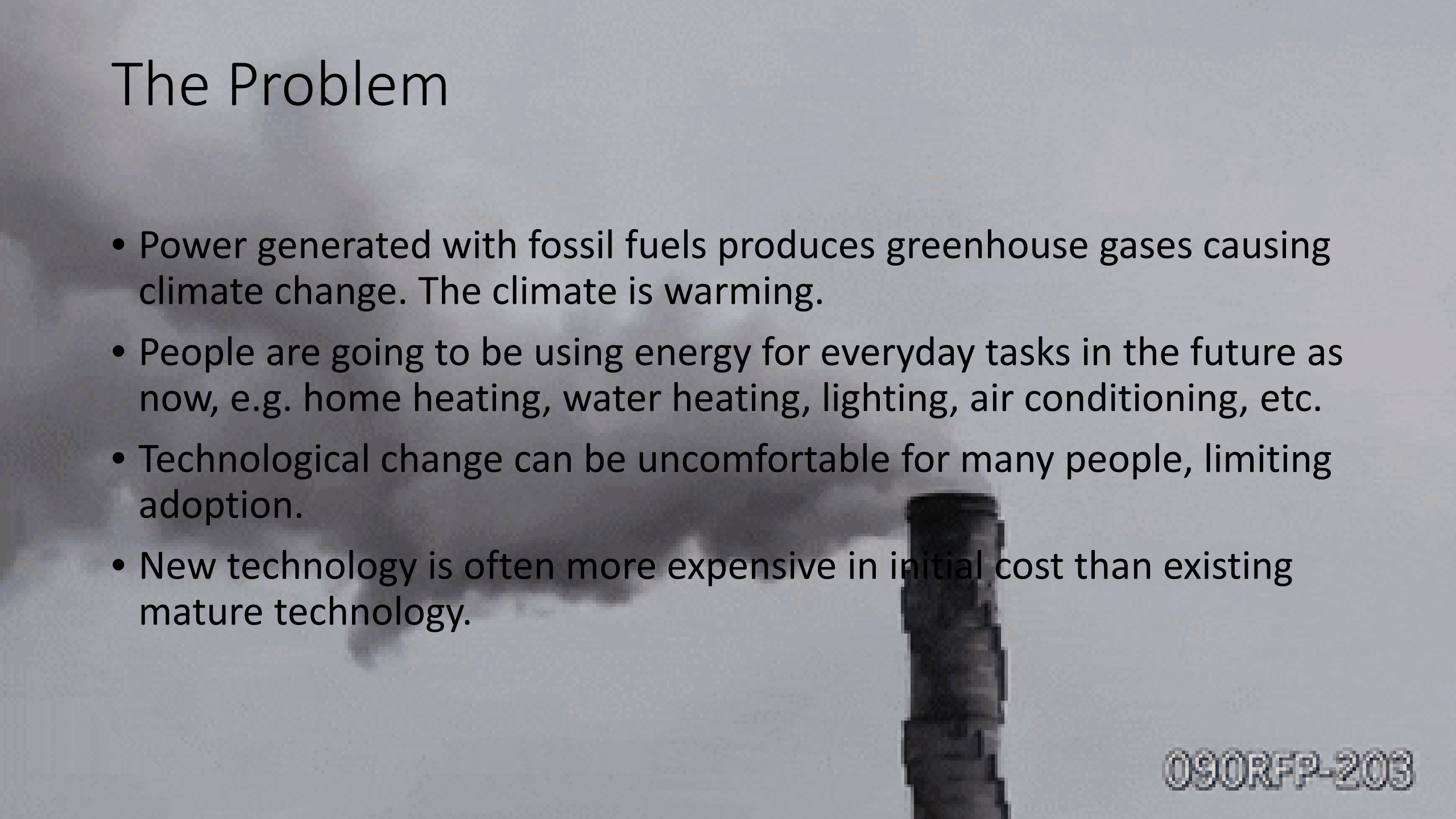
Energy Efficiency and Climate Change

“Those who cannot remember the past are condemned to repeat it.”

George Santayana

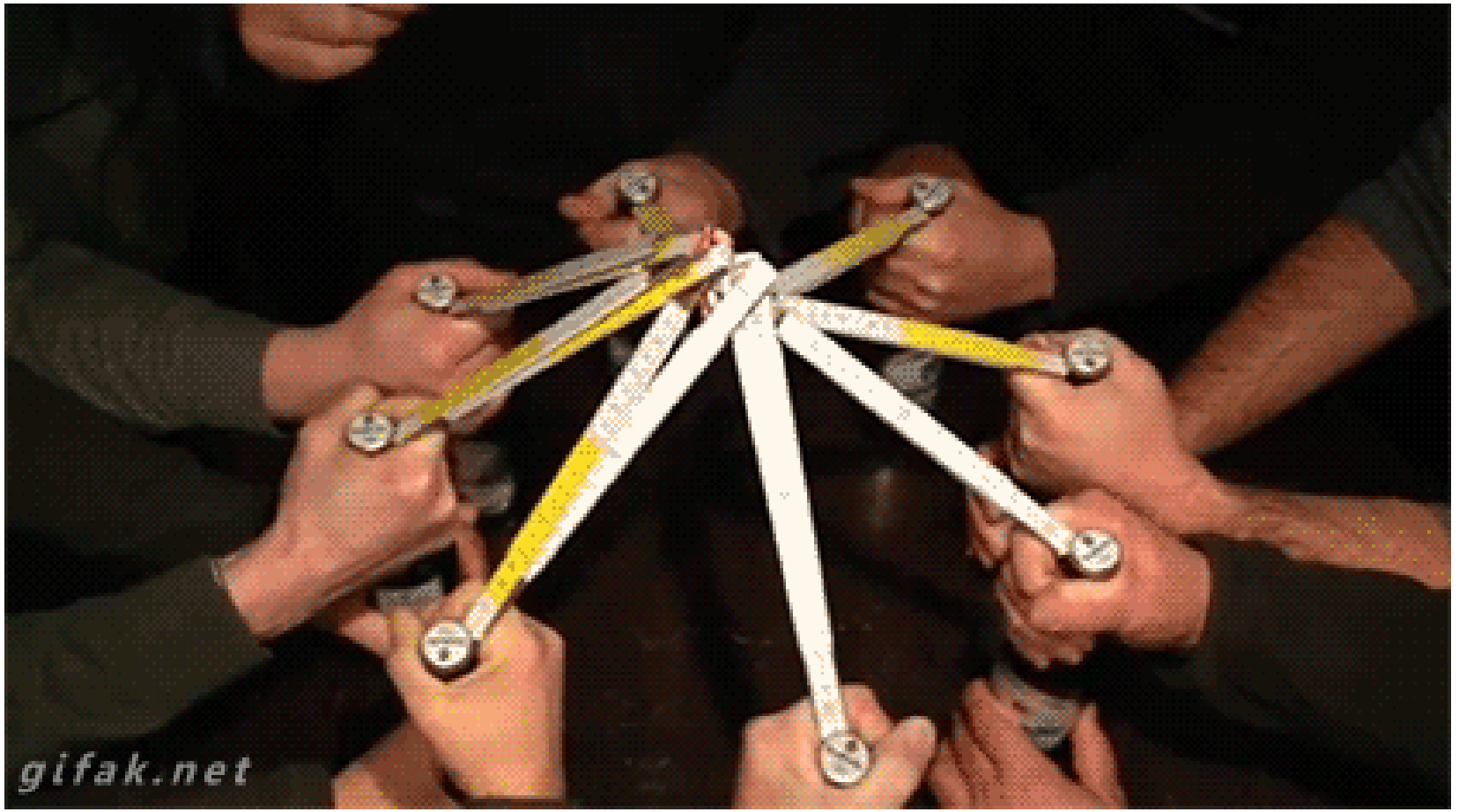
The Problem

- Power generated with fossil fuels produces greenhouse gases causing climate change. The climate is warming.
- People are going to be using energy for everyday tasks in the future as now, e.g. home heating, water heating, lighting, air conditioning, etc.
- Technological change can be uncomfortable for many people, limiting adoption.
- New technology is often more expensive in initial cost than existing mature technology.



What is Efficiency?

- % Efficiency = Output / Input * 100 (Mathematically)
- Performing the same task using less energy.



Pre-Industrial Revolution Power

Draft Animals

Wind Power

Water Power

Wood Fire for Heat and Light

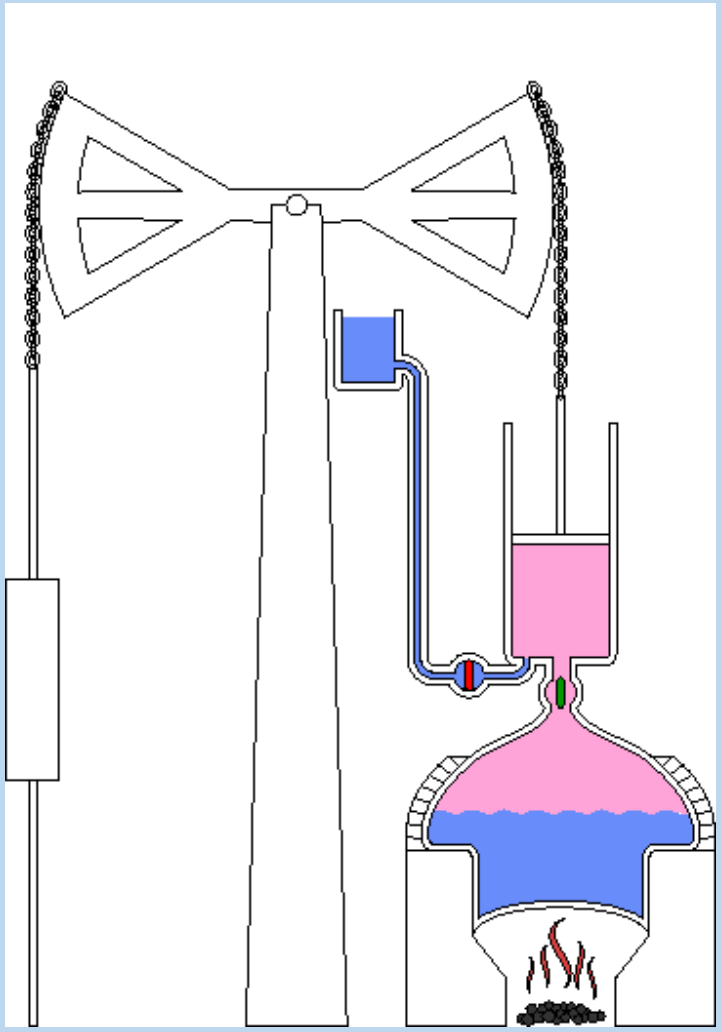
Pre-Industrial Revolution GREEN Power

Timelines

- Mid 1600's large scale deforestation-coal is used as an "alternative" fuel.
- Many coal mines are underground and full of water.
- 1698 Thomas Savery and his steam pump (about 1 hp)
- 1712 Thomas Newcomen steam engine and pump (about 5 hp)
- 1765 James Watt gets a model of Newcomen's Engine to repair at the University of Glascow.
- 1769 first commercial Watt improved steam engine.

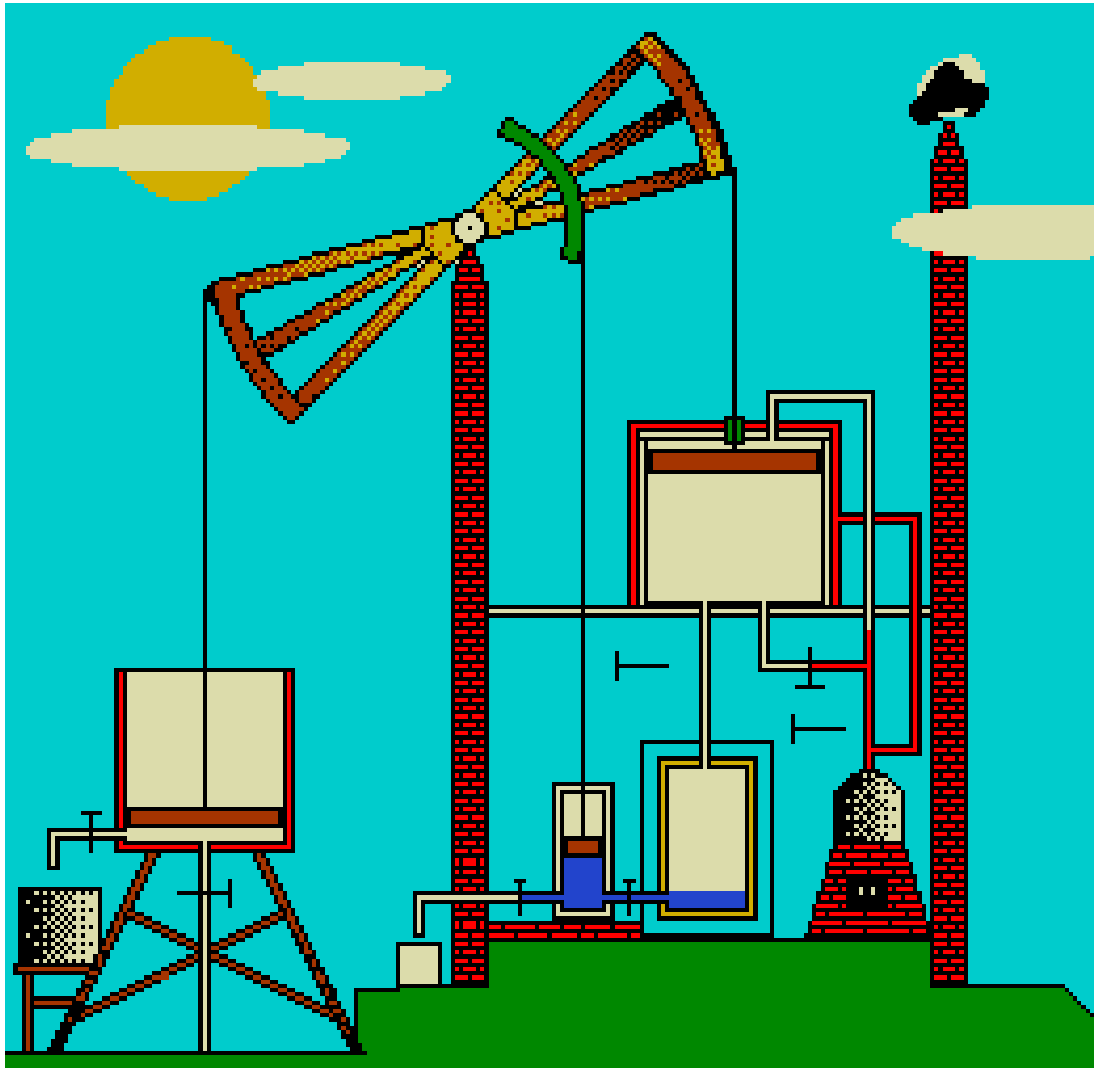
Newcomen Engine

- Slow- 12 cycles per minute
- Inefficient- cylinder had to be heated each stroke
- Used **huge** amounts of coal to operate



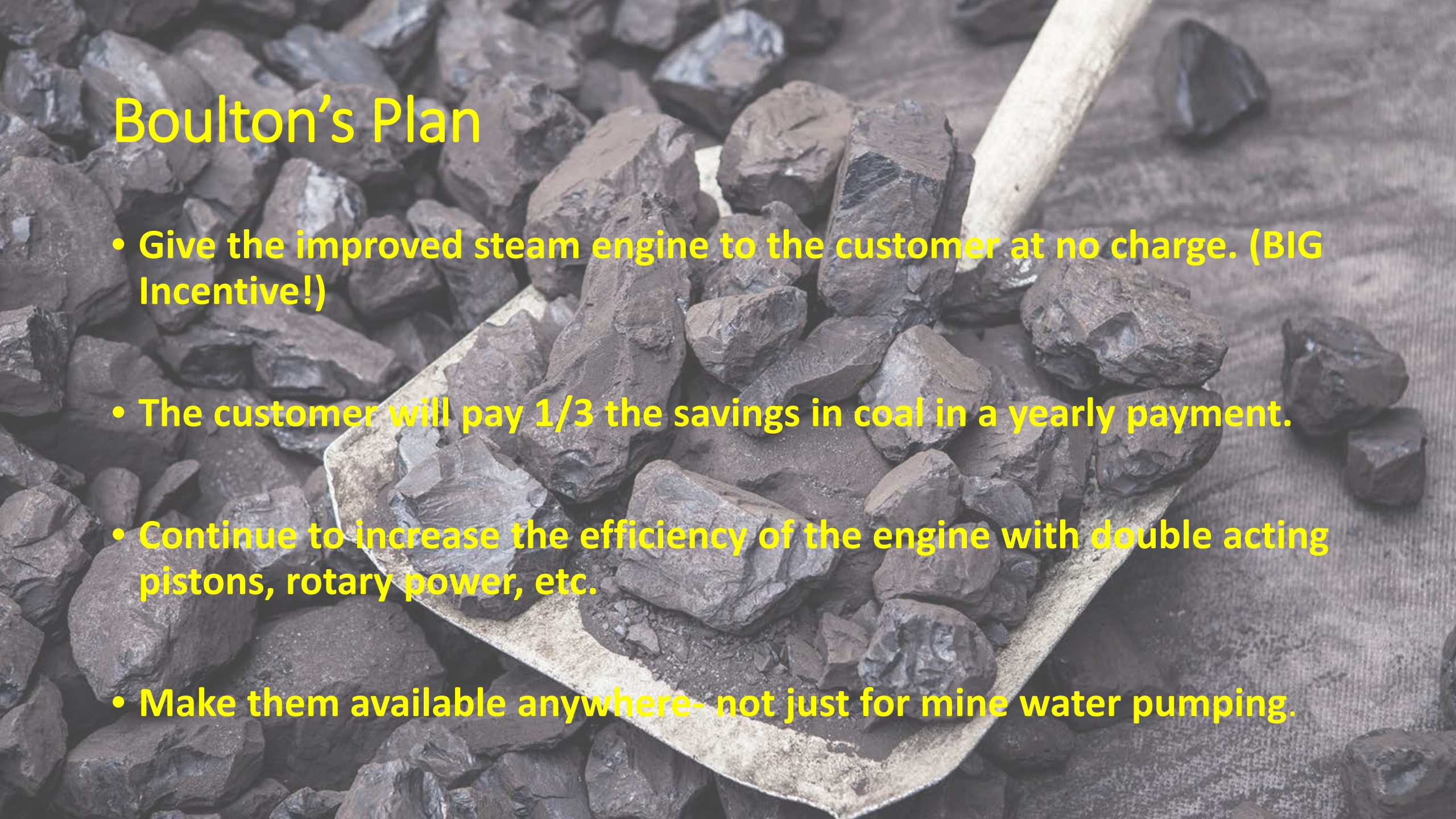
James Watt Repairs Model Newcomen Engine

Watt’s Efficiency Improvements



Poor Initial Sales of Watt's Improved Steam Engine

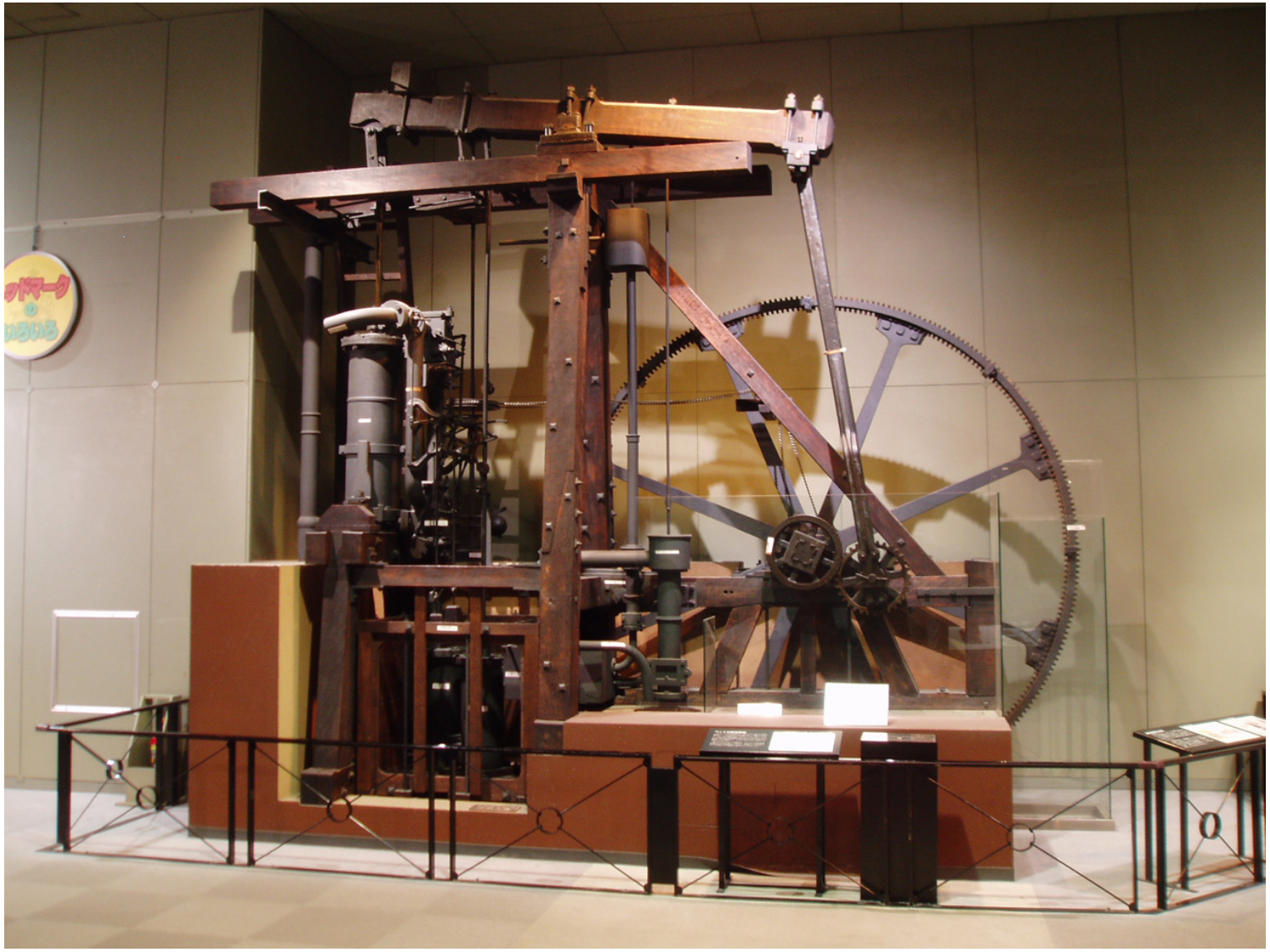
- Newcomen's engine worked- some for 50 years already.
- People did not want to change.
- Industrial revolution was still nascent – driven by iron and steel production, not textiles yet.
- Watt hated being a salesman.
- Enter Matthew Boulton!



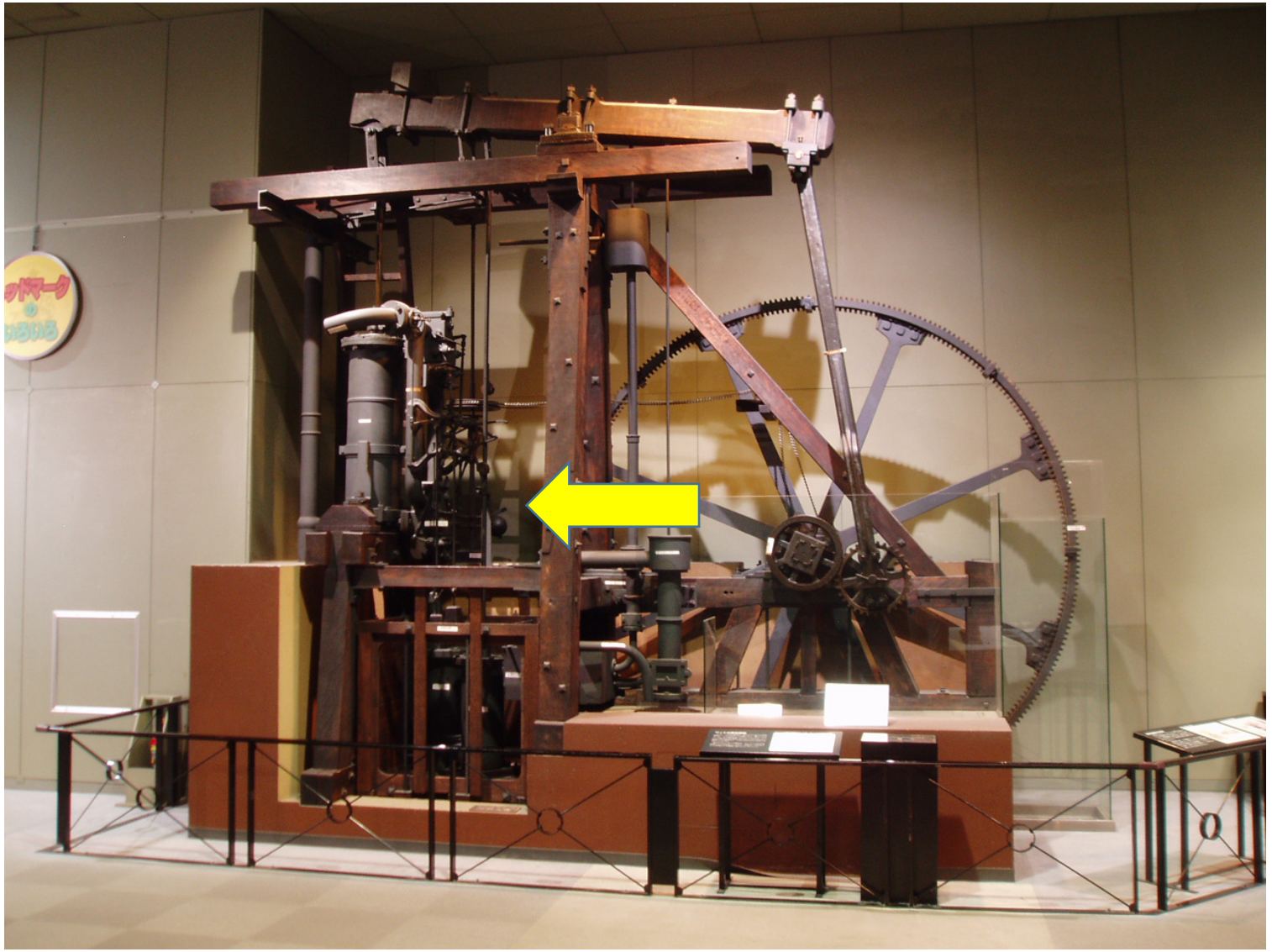
Boulton's Plan

- Give the improved steam engine to the customer at no charge. (BIG Incentive!)
- The customer will pay 1/3 the savings in coal in a yearly payment.
- Continue to increase the efficiency of the engine with double acting pistons, rotary power, etc.
- Make them available anywhere- not just for mine water pumping.

Boulton & Watt Steam Engine-Rotary Power 1782



Rotary Power
1782



Speed Regulator- Negative Feedback Device!

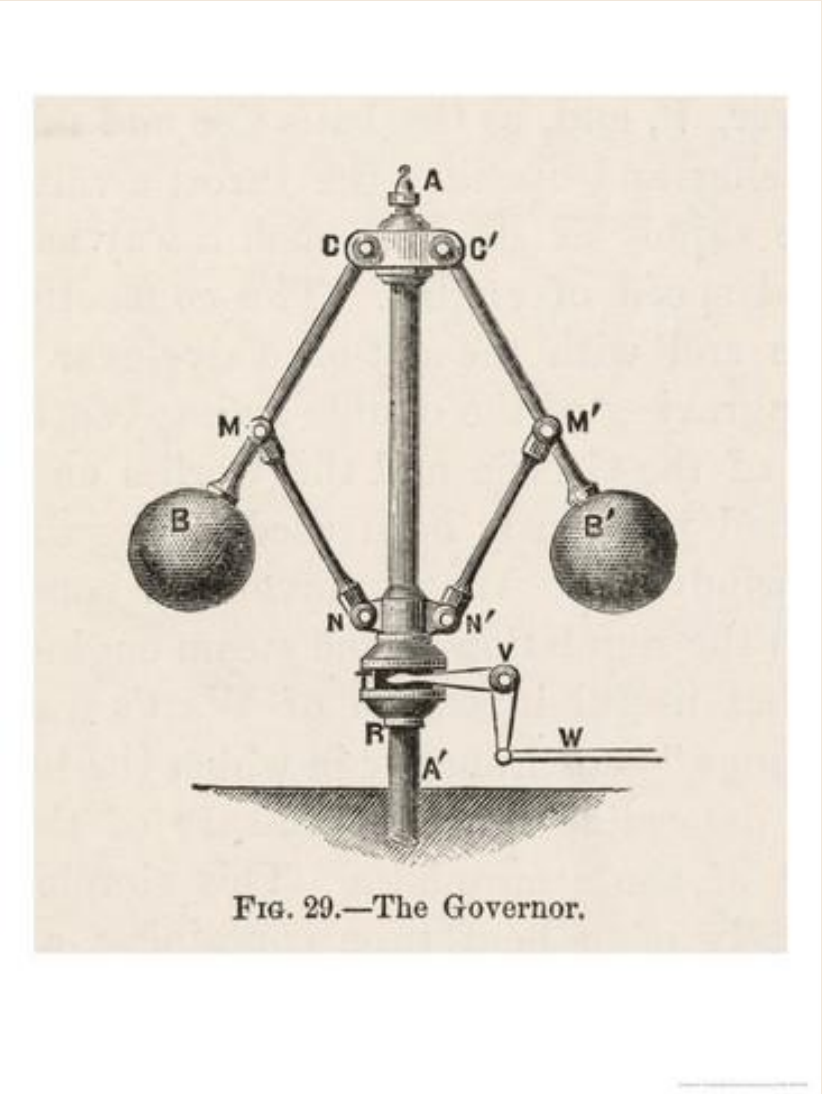
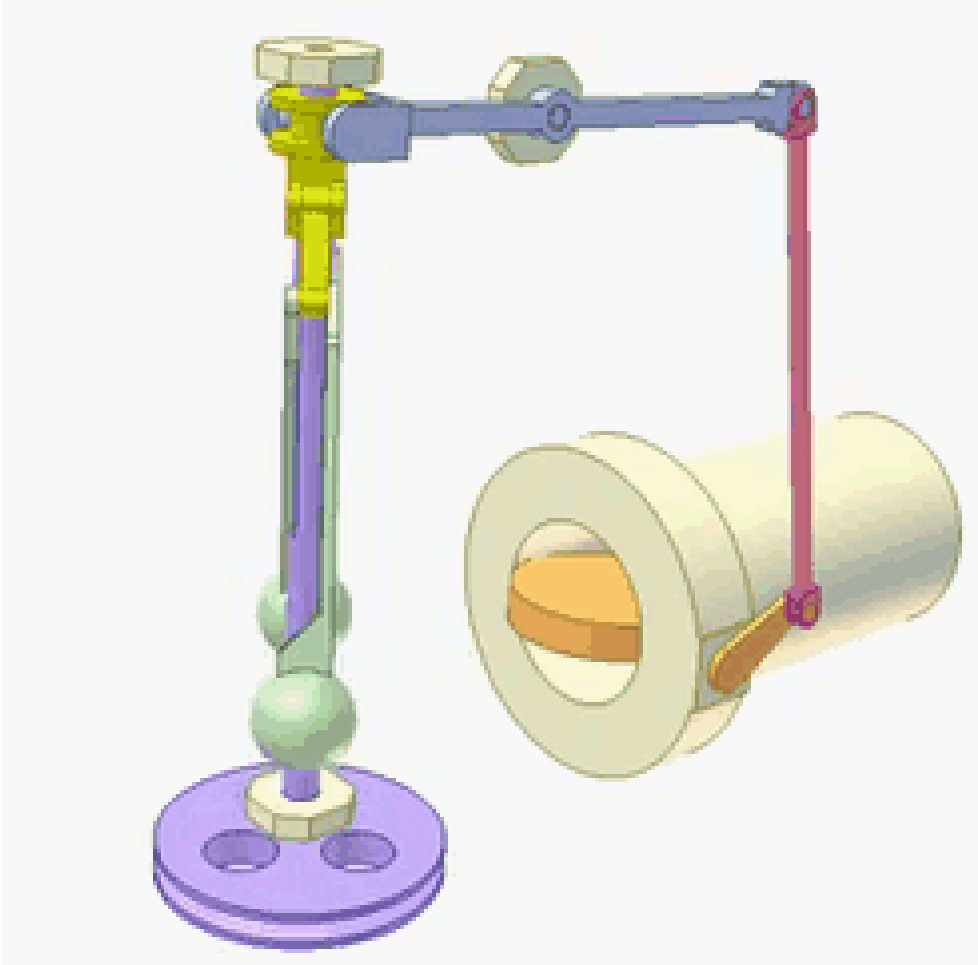
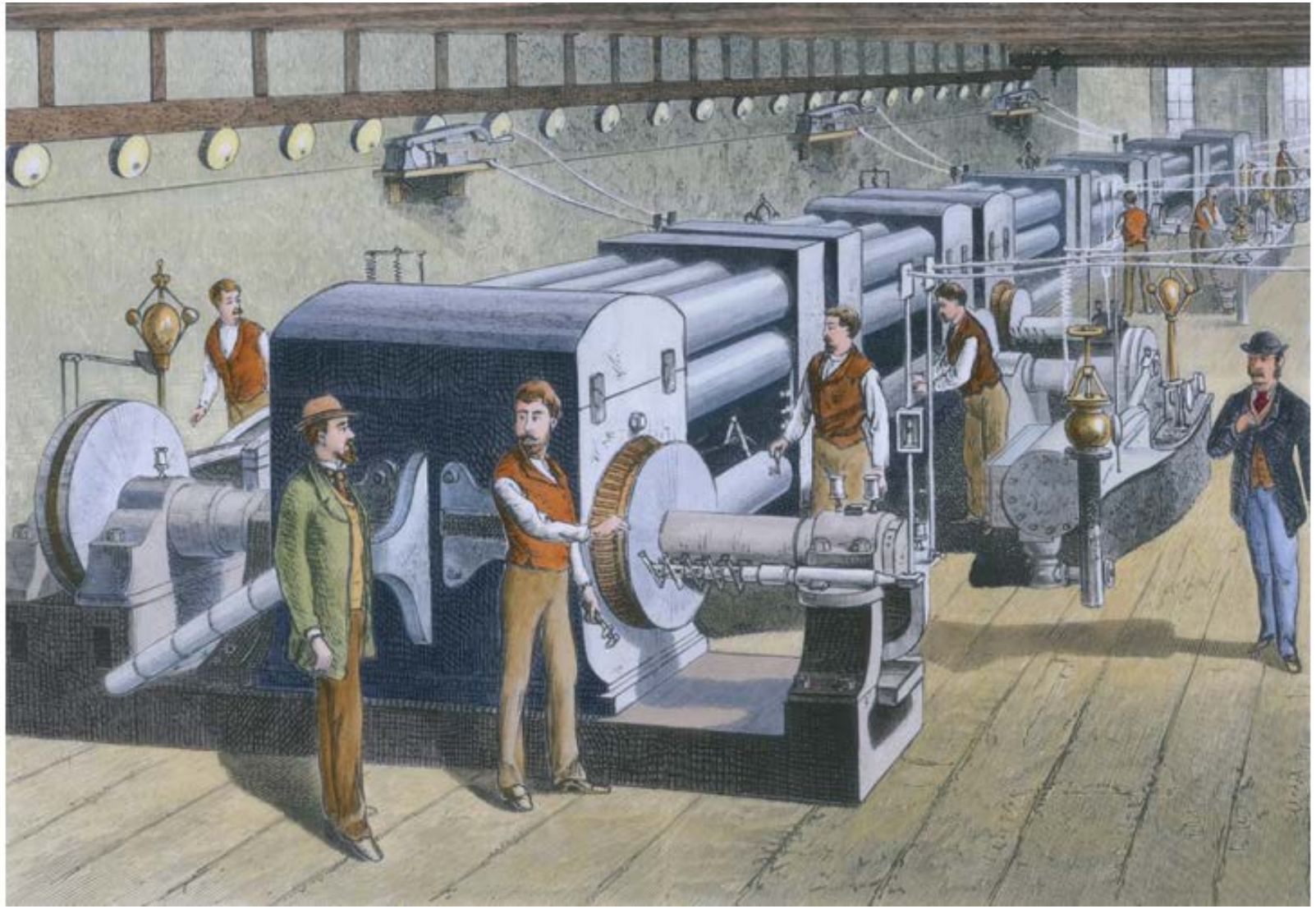


Fig. 29.—The Governor.

Ball Governor at Work



Thomas Edison’s First Electric Generator 1882



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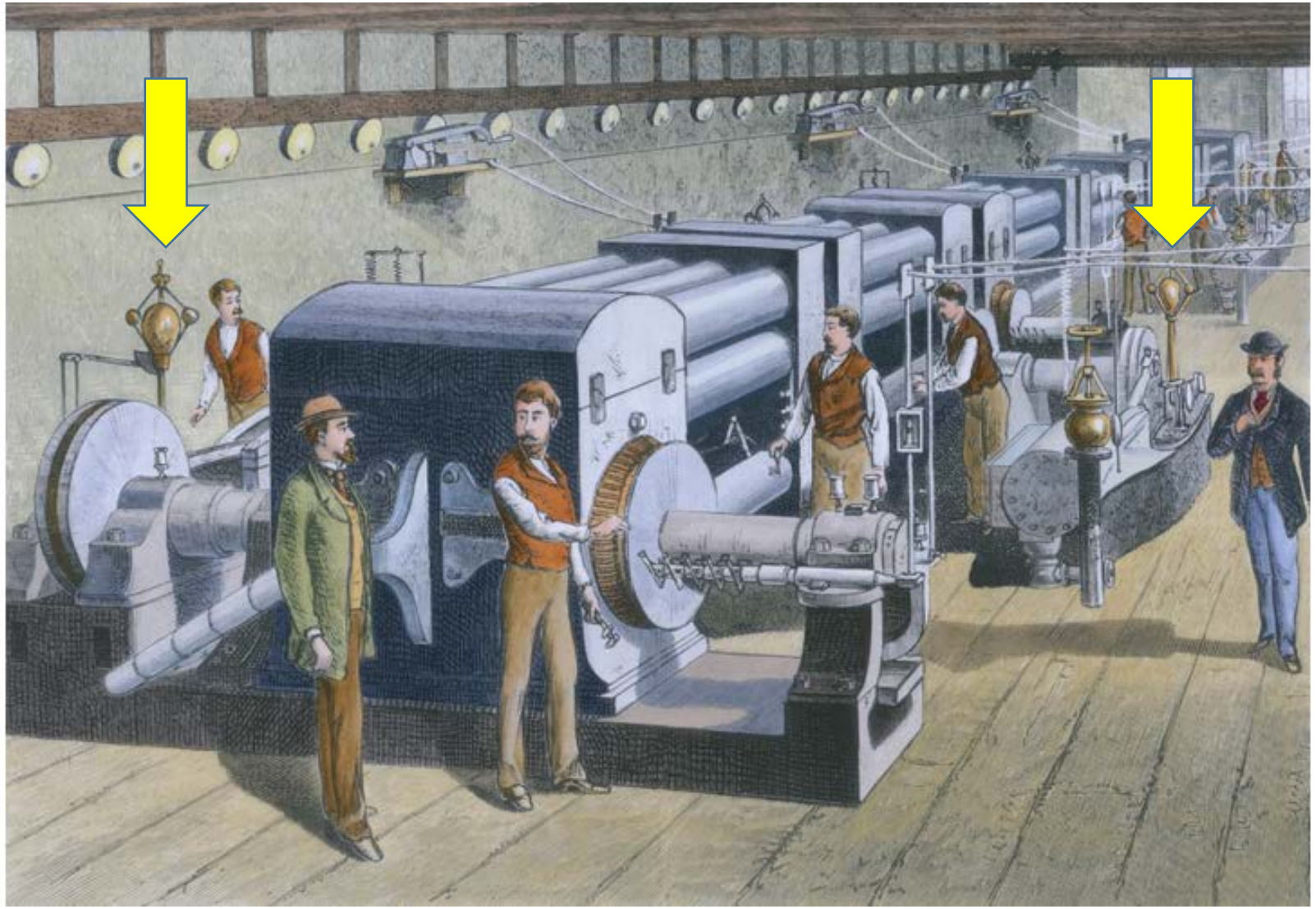
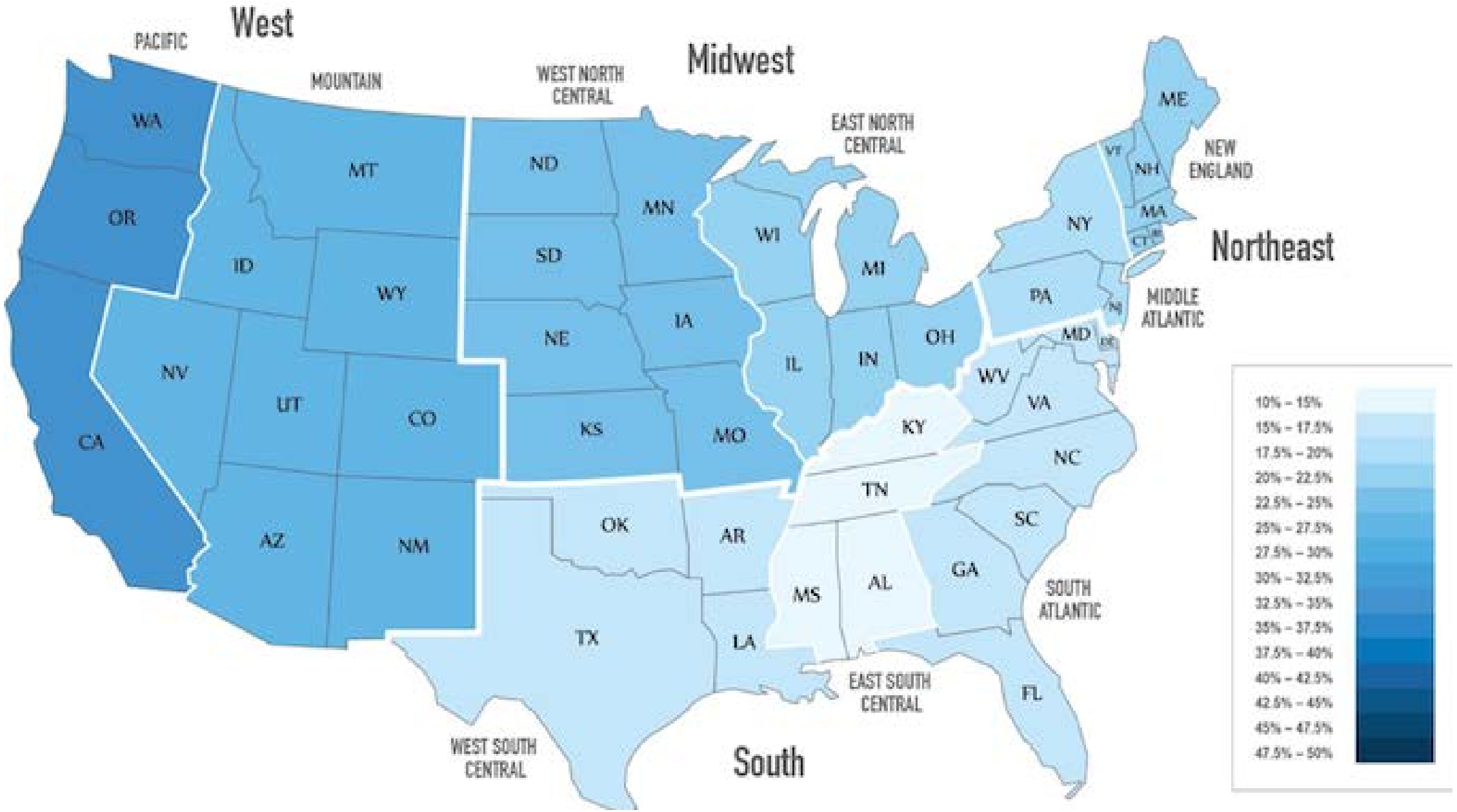


Another Negative Feedback Device!

British £ 50 Note

Lessons From This Story

- Many people do not like change – new light bulbs for example.
- Adoption of new technologies to save energy may require *incentives and education campaigns to be effective*.
- Efficiency can be a great selling point if people realize cost savings $$$.


West
PACIFIC
MOUNTAIN
Midwest
WEST NORTH CENTRAL
EAST NORTH CENTRAL
Northeast
NEW ENGLAND
MIDDLE ATLANTIC
South
SOUTH ATLANTIC
EAST SOUTH CENTRAL
WEST SOUTH CENTRAL
WA
OR
CA
ID
NV
MT
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MD
DE
10% – 15%
15% – 17.5%
17.5% – 20%
20% – 22.5%
22.5% – 25%
25% – 27.5%
27.5% – 30%
30% – 32.5%
32.5% – 35%
35% – 37.5%
37.5% – 40%
40% – 42.5%
42.5% – 45%
45% – 47.5%
47.5% – 50%

The Climate Change Connection

- In the future, people are going to continue to perform the same energy- related tasks they do today, such as:
- Space heating
- Water heating
- Illumination
- Cooling / air conditioning
- Travel, etc.

Efficiency and Climate Change

- To mitigate CO2 emissions while using fossil fuels we have to use the fuels more efficiently.
- Programs such as Weatherization reduce fuel use while still maintaining comfort through building and appliance efficiencies.
- A warming climate means there will be more air conditioning demand in the warm season of the year. Replacing old air conditioners is an opportunity for broad reductions in power use.
- Small changes in power saving multiplied by millions of users has a great effect on power consumption and reduced greenhouse gasses.
- Incentives and education work the same now as they did 230 years ago.

Thank You!