Introduction

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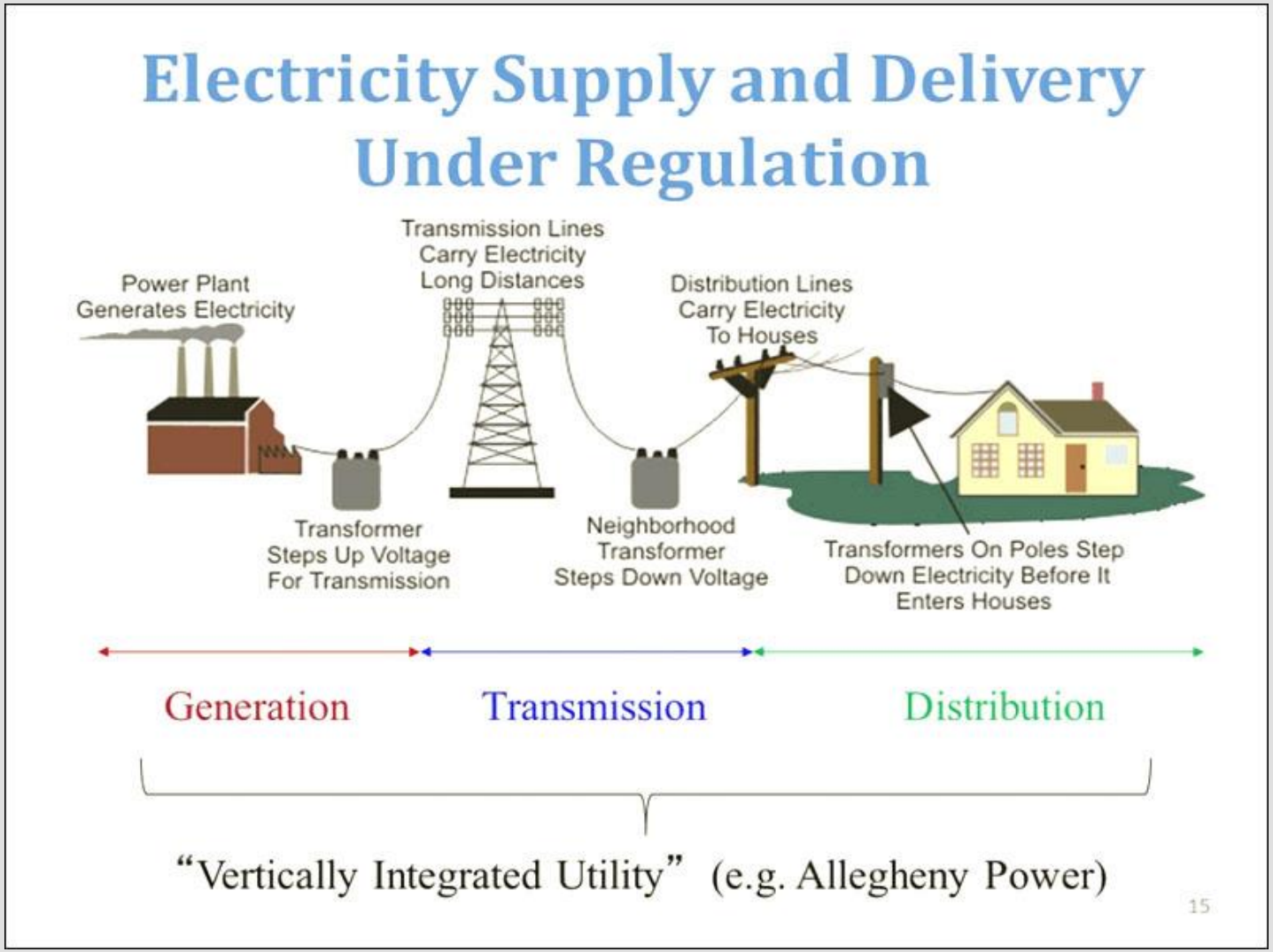
The Traditional Supply Industry

Monopoly

Optimization



https://www.e-education.psu.edu/ebf483/node/641

How is it operated? Three-way balance

What about money?

- Minimizing costs
  - Operating costs
    - Fuel, personnel, maintenance
  - Investment costs
    - Generators, lines, transformers, switching devices, …

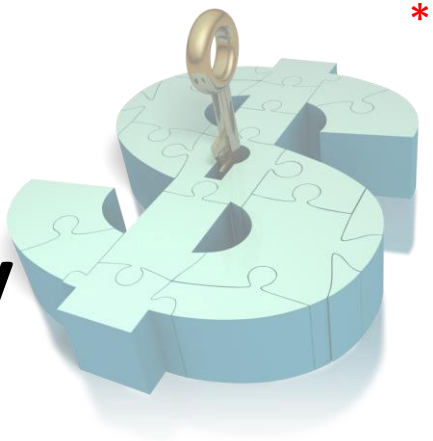
What about Reliability?

- Operational reliability (Security, Short-term reliability)
  - Withstand faults, failures, forecasting errors and other regular operational problems
  - Operate with a security margin
- Resilience (Adequacy, Long-term reliability)
  - Withstand natural disasters
  - Build a more robust system

Cost of Reliability

- Providing a security margin costs money
  - Run additional generating units to have some operating reserve
  - Limit production of some generating units to avoid problems in case of a sudden outage
- Build additional generators and transmission lines to improve resilience.

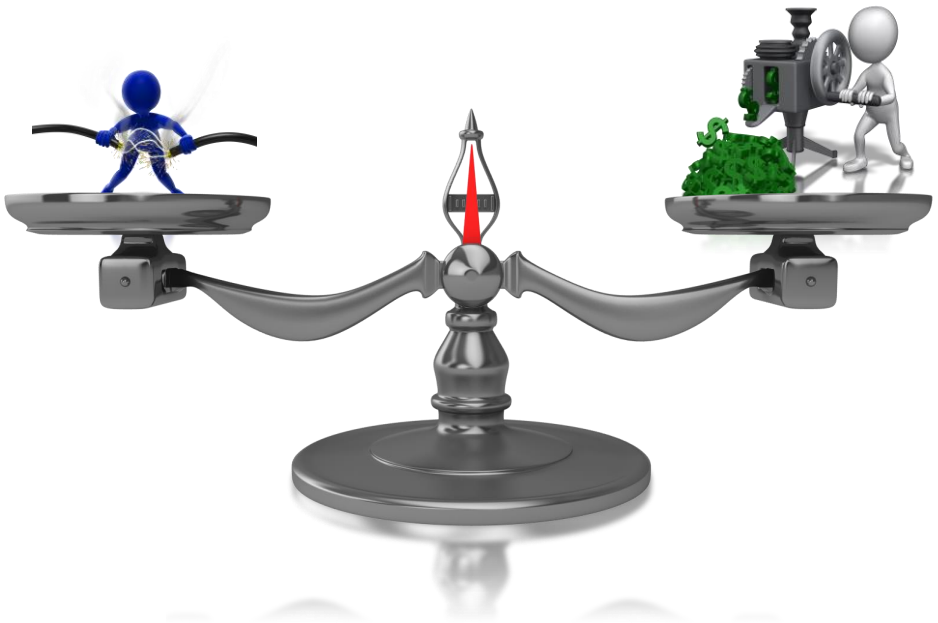
Value of Reliability



- Loss of revenue
- Loss of comfort
- Measured using surveys
  - Estimate the cost of latest outage or
  - Willingness to pay extra to avoid outages
- Value of lost load (VoLL)
- Average vale of MWh not delivered
- Estimates range from $2,400 to $20,000

  ~100 times larger than the cost of energy

Balancing the Greed and the Fear



How to model this balance?

- Mathematical optimization problem
  - Cost minimization or profit maximization
  - Reliability introduced through constraints
    - Explicit costing of reliability is still controversial

Upholding the Delicate Balance

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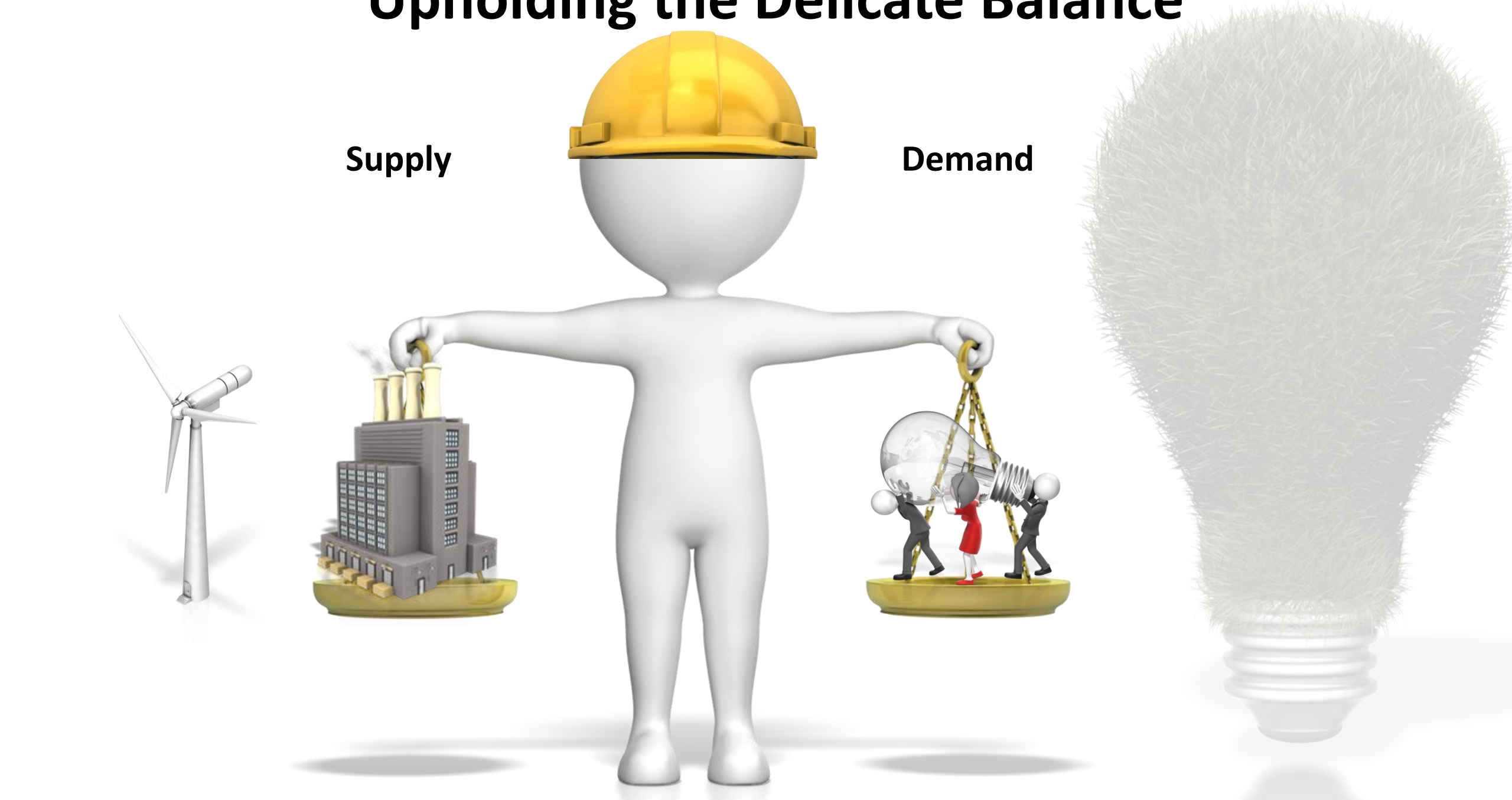

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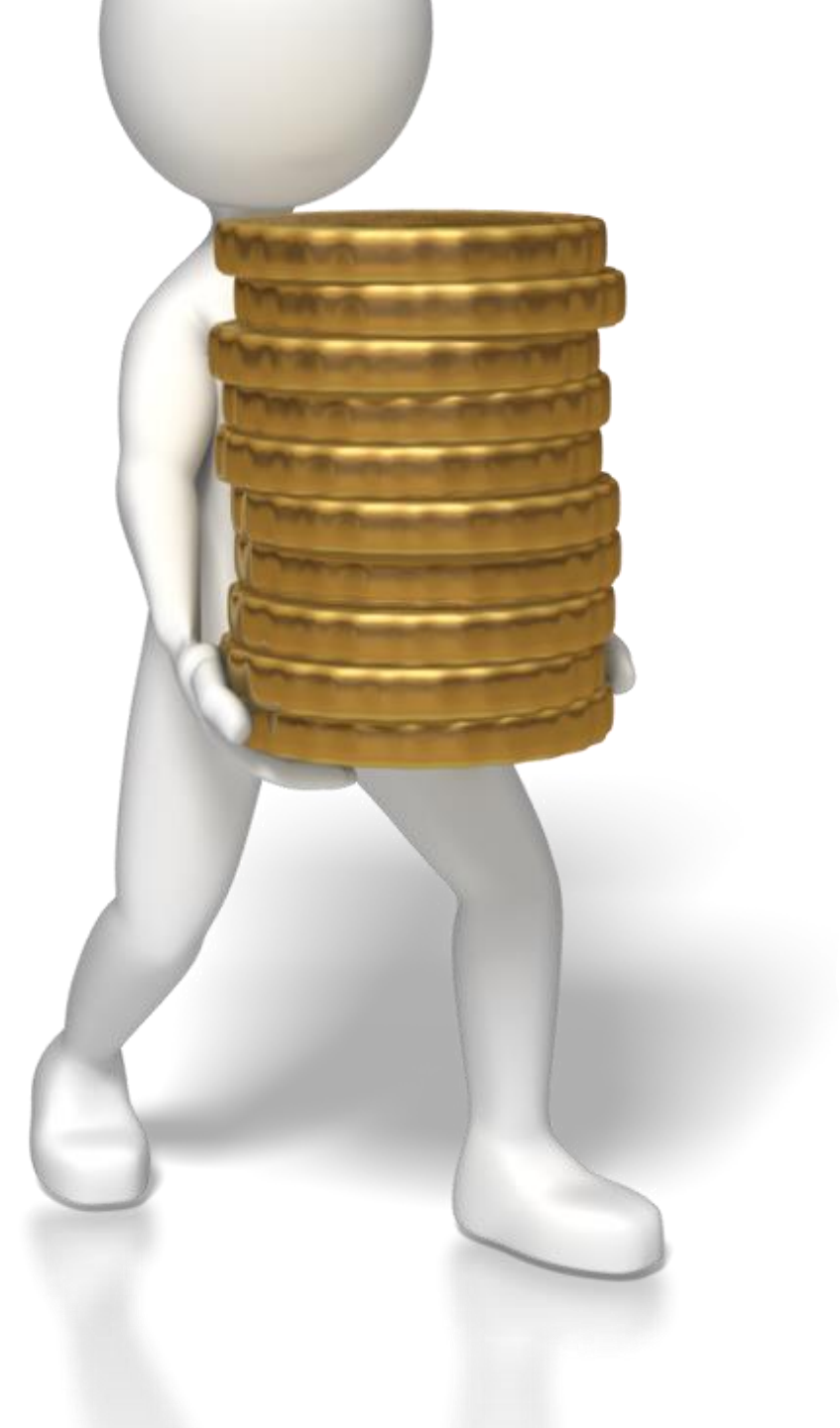
Three-way balancing

- More complex optimization problems.
- Some environmental effects can be monetized
  - Operating cost of renewable generation is essentially zero
  - Carbon tax or carbon trading to reflect the effect of CO_2 emissions.
- Other can not be monetized
  - Effect of hydro generation on salmons.
  - Modeled using additional operating constraints.



What is wrong with the traditional approach?

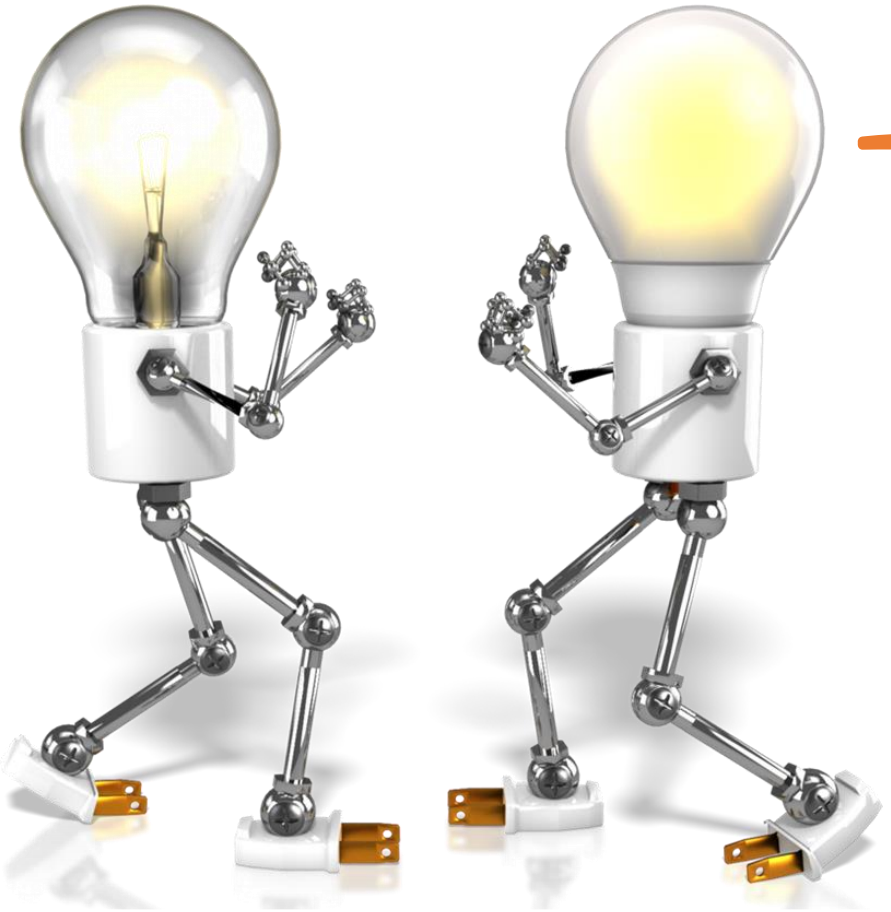
- Removed the incentive to operate efficiently.
- Encouraged unnecessary investments.
- The cost of the mistakes that utilities made are passed on to the consumers.
- Linked to governments: Politics could then interfere with good economics.
  - Public utilities were treated as cash cows.
  - Public utilities were prevented from setting rates at a level that reflected costs or were deprived of the capital that they needed for essential investments.

What is the alternative?

- Deregulation
- Free market
- Competition
- Treat electricity as a commodity

Competition and privatization:

- Privatization is the process by which publicly owned utilities are sold by the government to private investors.
- Privatization is not a prerequisite for the introduction of competition.
- Public utilities can coexist with private companies in a competitive environment.
- In many cases, competition is accompanied with privatization.



Why Competition?

- Prices would be lower
- The overall economy will be more efficient.
  - Competing companies would choose different technologies.
  - Less likely to make unwise investment.

Can we treat electricity as a normal commodity?