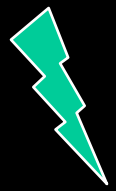


Electric Transmission

Living With(out) Power

Anna Glynn

BE 2353

Fall 2008

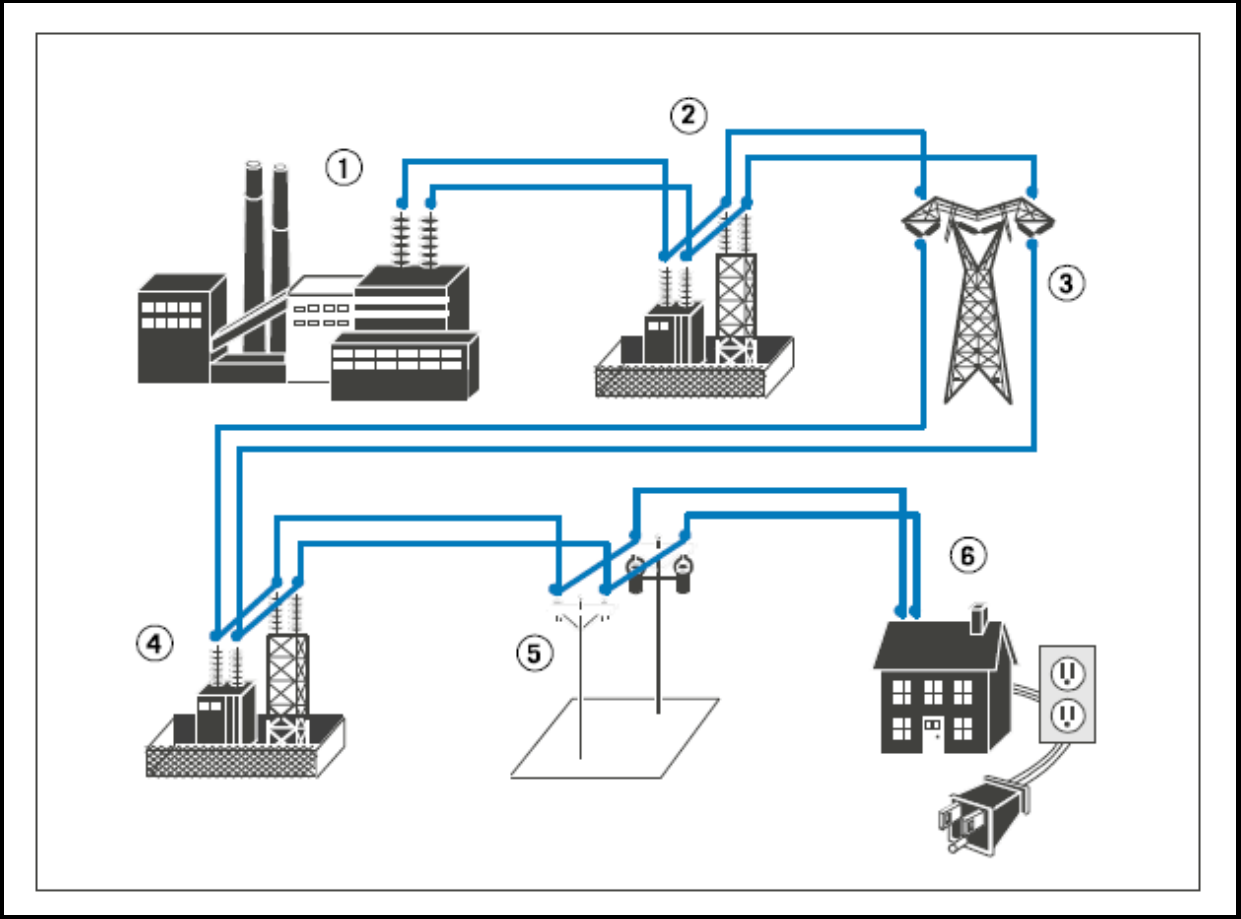
Overview

- Utility design overview
- Typical operating parts
- Fundamental laws of electricity
- Effects of natural disasters
- What can the utility do?

A few thoughts

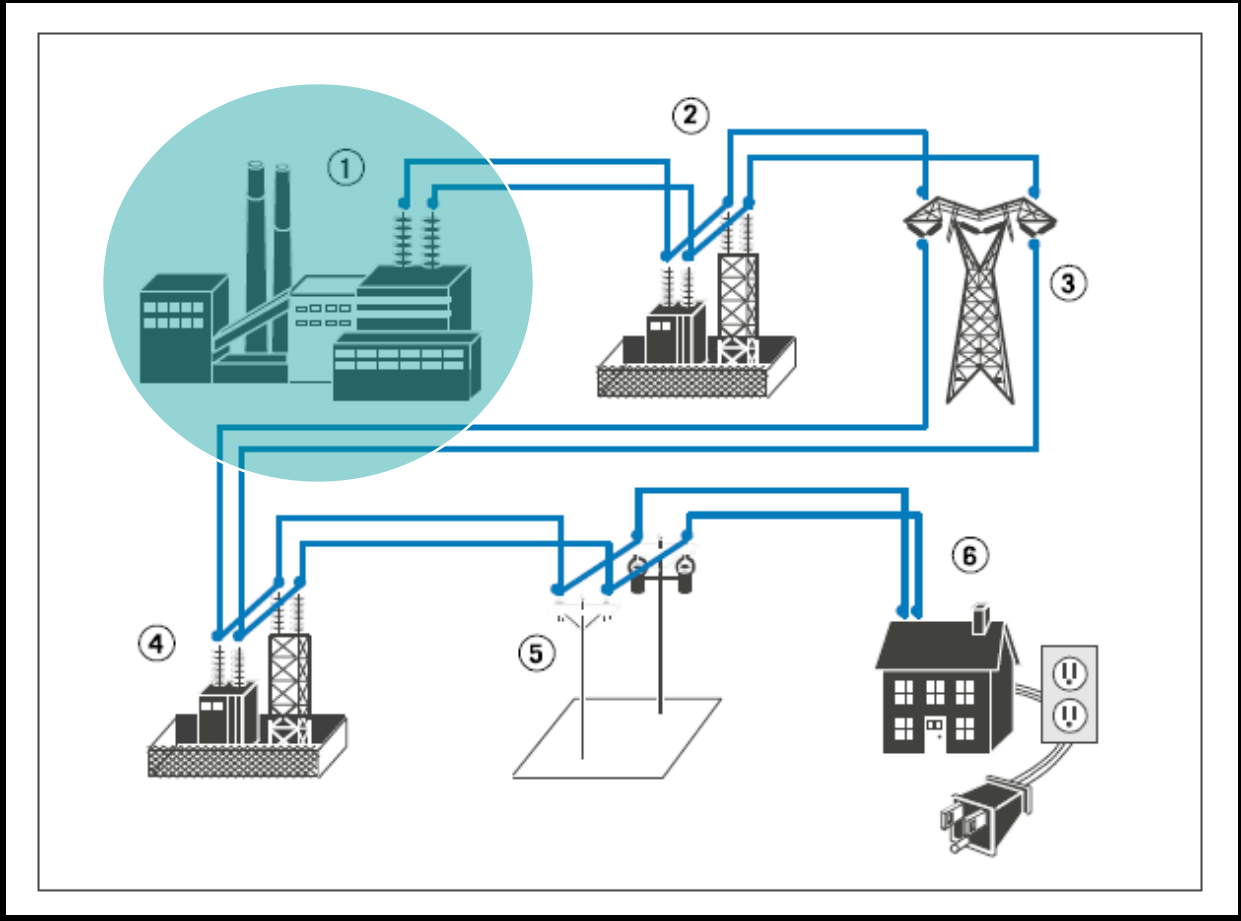
- Electricity is everywhere
- We need abundant, inexpensive and reliable amounts of electricity to lead our modern lives
- Large scale disasters (hurricanes) are inevitable
- Utility systems are exposed to the worst of the elements
- So, how does the system work?

How does electricity get to me?



How does electricity get to me?

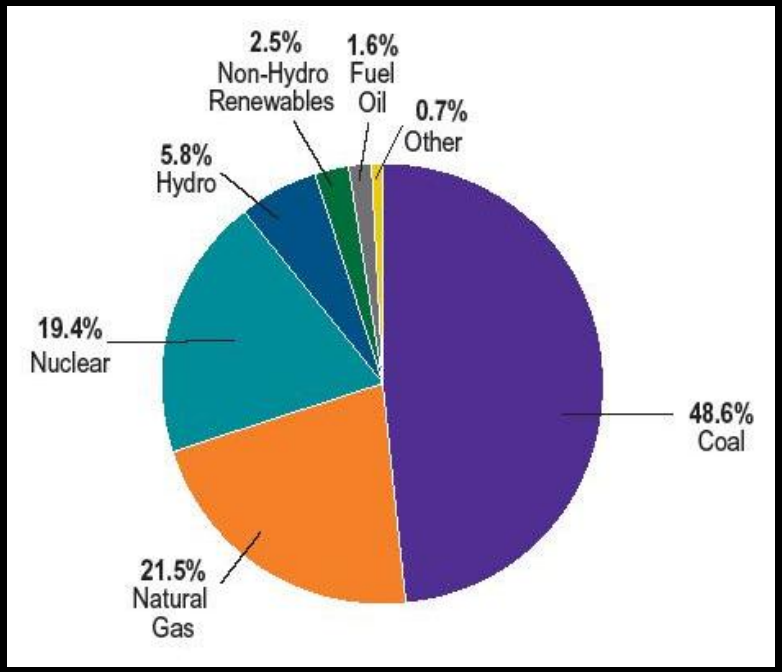
Power Plants



Types of generators

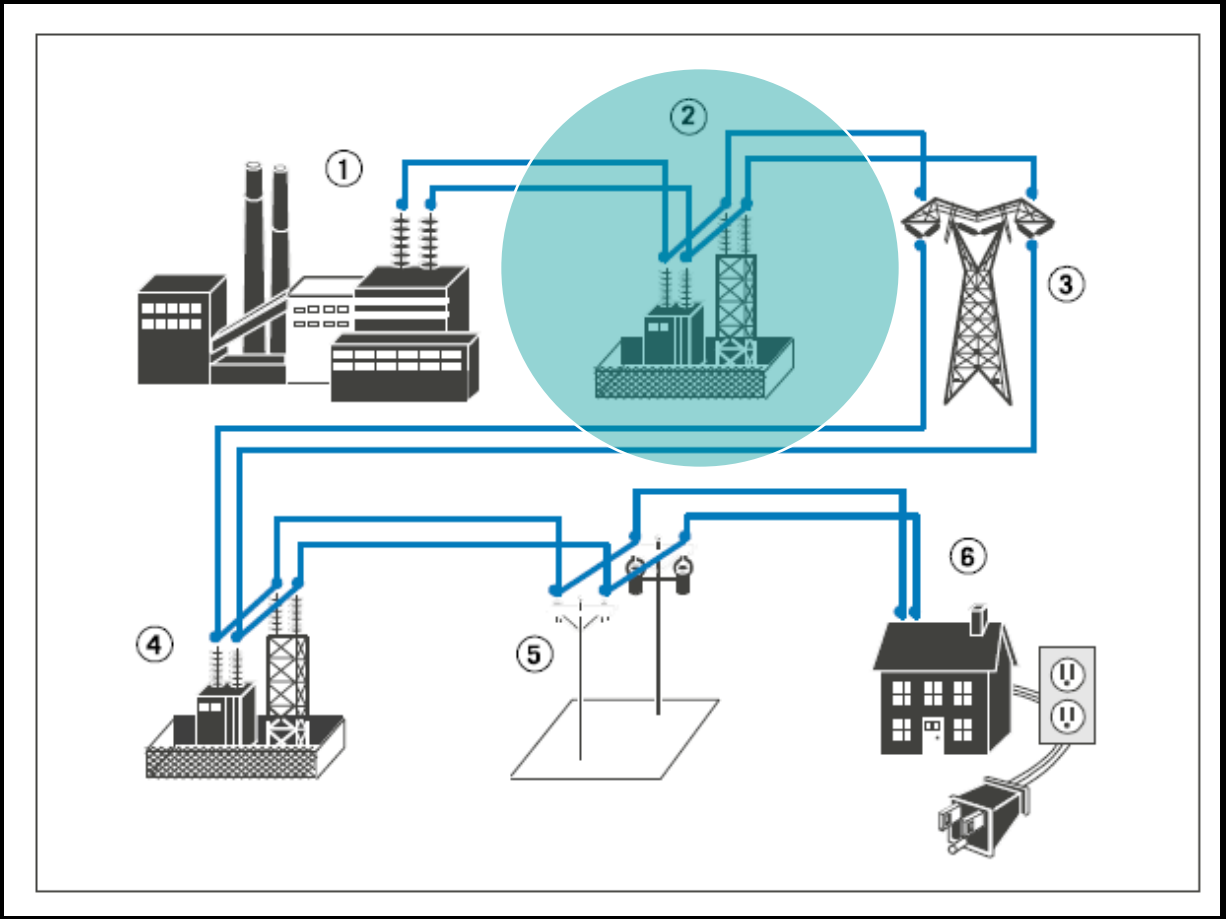
Electric generation fuels

- Production of electric energy involves a generator and some form of mechanical driver
  - Mechanical force is derived from various fuels



How does electricity get to me?

Step Up Substation



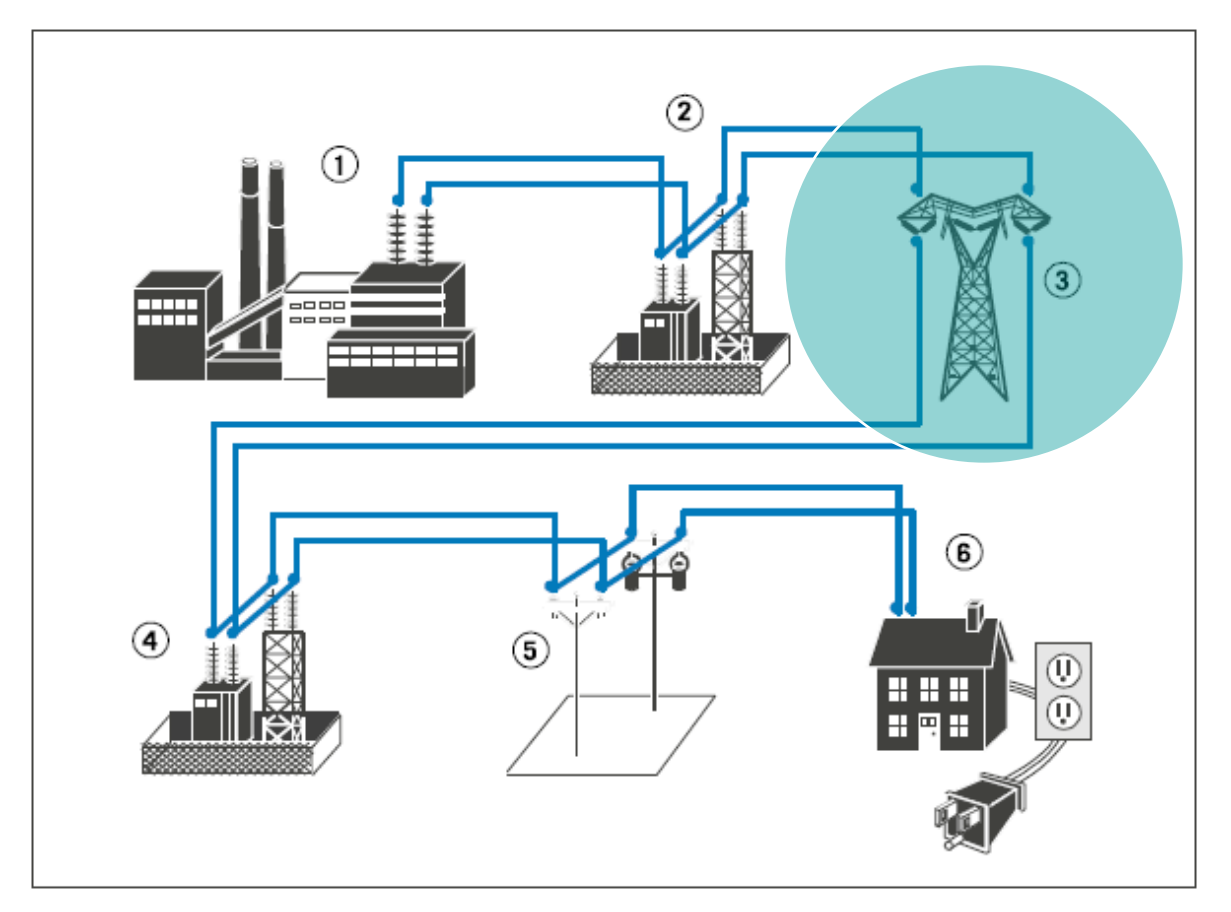
Substations

- Change voltage from one level to another
- Connect generation plants to the rest of the electric system
- There are two types of substations
- Step-Up
  - Transformer increases voltage to the right transmission level

- Step-Down
  - Source for distribution lines

How does electricity get to me?

Transmission Lines

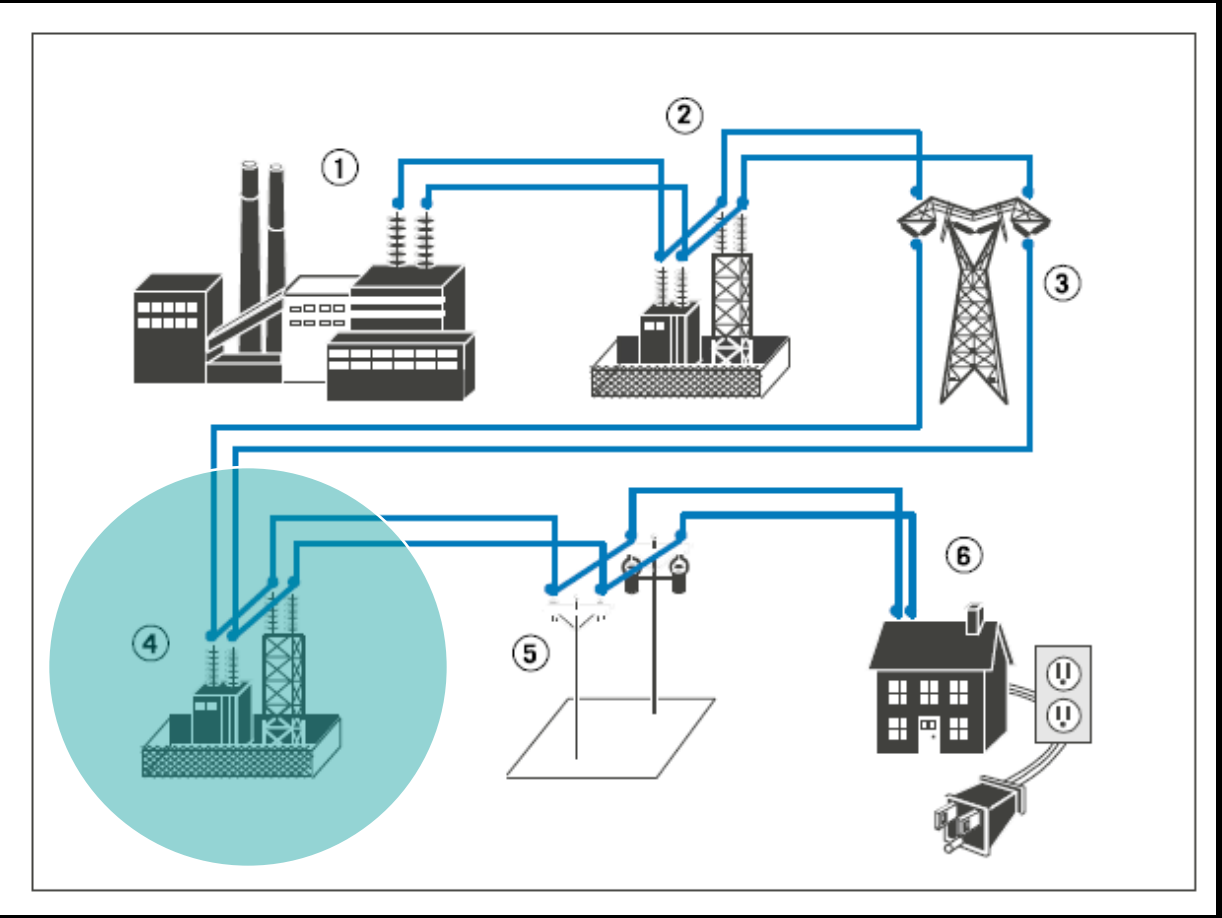


Transmission lines

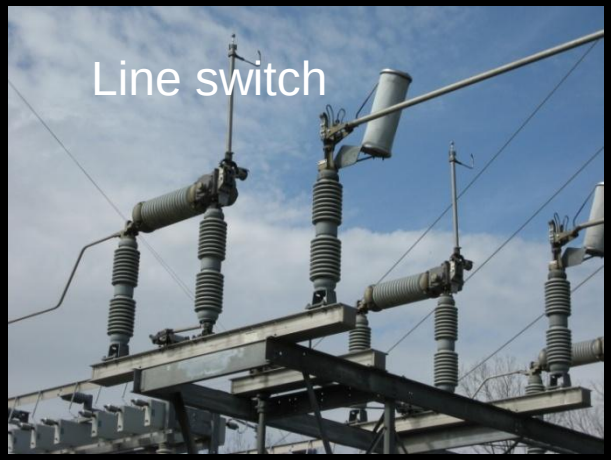
- Operate at higher voltages
- Transmit large quantities of power
- Transmit power over large distances

How does electricity get to me?

Step Down Substation

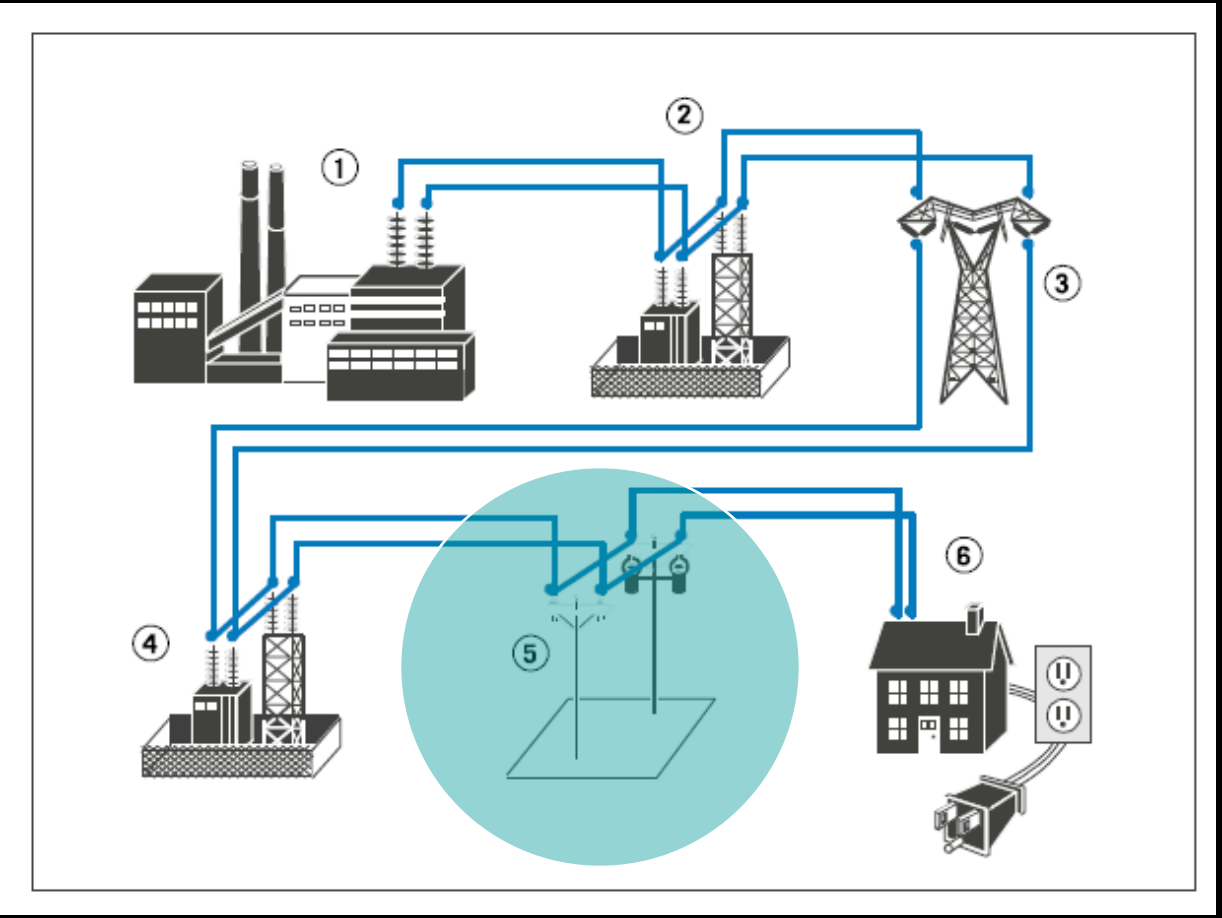


Substation components



How does electricity get to me?

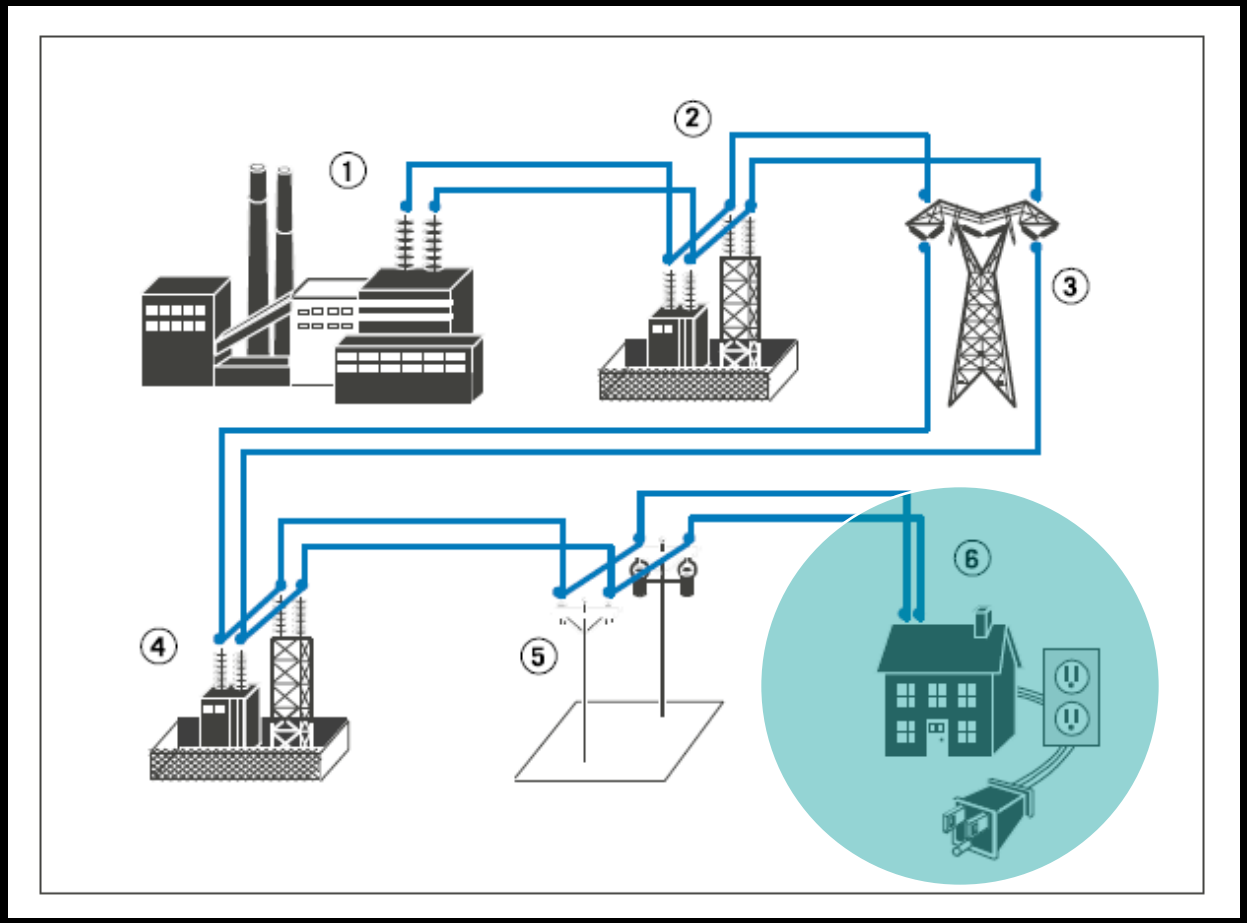
Distribution Lines



Distribution

- Lines, poles, transformers and other equipment needed to deliver electric power to the customer at the required voltages

How does electricity get to me?



Utility service ends at the meter

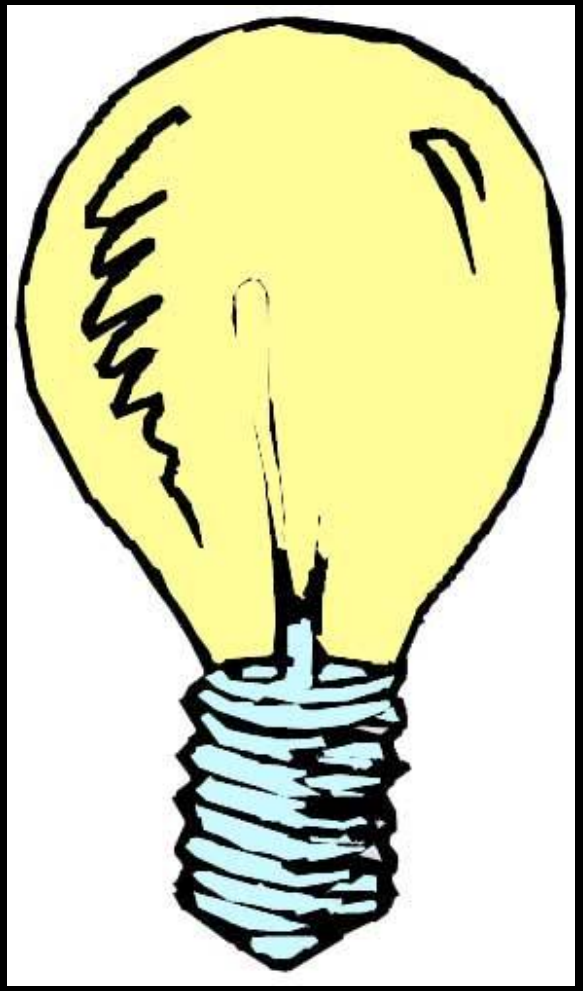
- Meter measures current and voltage over time
- Utility bills customers for kilowatt hours of electric power used

Basic electrical equations

- Ohm's Law:
- E = IR
- where E is voltage, I is current, and R resistance
- The power equation is:
- P = IE
- where P is power, I is current, and E is voltage
- Let's look at a basic household example

Let's turn on a light bulb

- P = IE
- Assume a 60 watt bulb
- 60 watts = IE
- 60 watts = I(120 volts)
- Where 120 volts is the normal house voltage
- I = 60watts / 120 volts
- I = 0.5 amps consumed



What does the light bulb cost?

- Assume 13 cents is the cost per kilowatt hour
- Assume 5 hours of use per day
- 30 days per month
- Monthly cost of 60 watt light bulb
- (13 cents)(5 hours)(30 days)(60 watts)/1000 = $1.17
- We can use these equations to estimate monthly electric costs

What does it cost to be without?

Galveston Island, Hurricane Ike

Conclusions

- Mother nature cannot be controlled
- We can
  - Trim trees near lines
  - Strengthen existing exposed line structures
  - Explore option for more underground lines
  - Report outages to local utility
  - Encourage reliability improvement at the utility level…and be willing to pay for it
  - Have flashlights and patience!

Questions?