



Kenmark International

Power History, current And Future Part One

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Power Agenda

Part One:

1. History
2. Current

Part Two Next month:

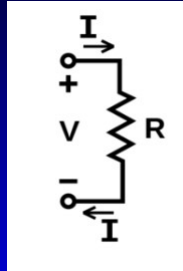
3. Home power
4. Home considerations
5. Future

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Power Ohm's Law



100 Watts Lamp
 $I = 100/120$
0.833 Amps
 $120/0.833=144$ Ohms

$$V = I \times R$$

V = Volt
I = Amps
R = Resistance

$$P = I \times V$$

P = Watts
V = Volt
I = Amps

Power History

Benjamin Franklin's electricity experiments – including his famous kite experiment in 1752



Power History

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- 1831, when British scientist Michael Faraday discovered the basic principles of electricity generation
- 1882 The beginning of power
- 400 lamps only on the grid

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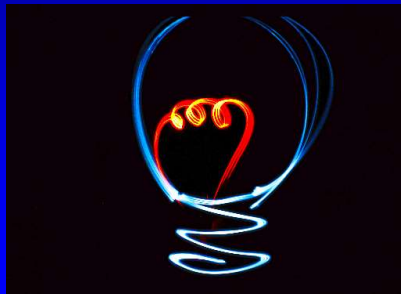
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Power History

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- Thomas Edison Invented
- incandescent light bulb in 1880
- After 10,000 failed experiments



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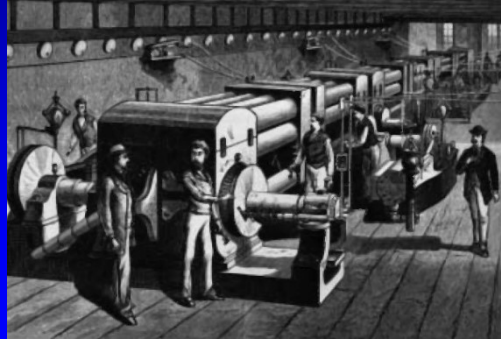
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Power History

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- Pearl Street power station
- Edison connected a large bank of generators to homes and businesses



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Power History

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- In 1881, in the form of a promising 21-year-old from England.
- Samuel Insull, who began his career in the U.S. as a personal assistant to Edison
- In 1892, Insull left his job as an executive at the lighting company Edison started (General Electric).
- Went to Chicago Edison (an electricity generation/distribution company)

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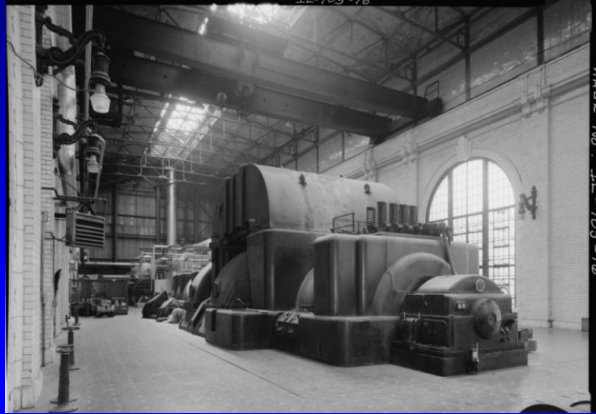
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Power History

Insull Builds the Modern Power Grid 1903 turbine hall at Fisk Street Station



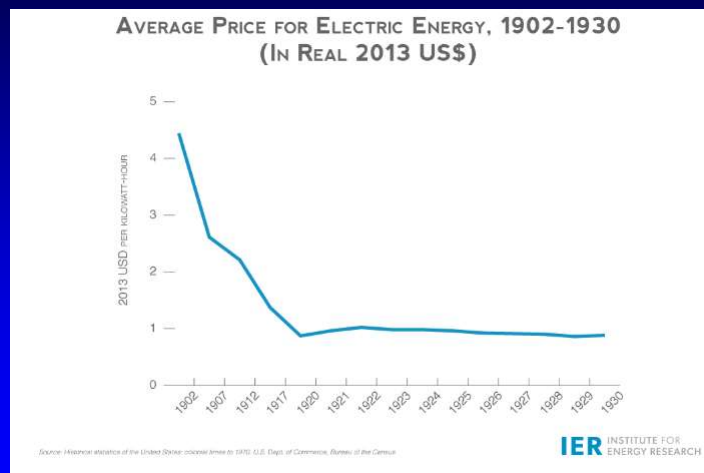
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Power History



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History - Electricity Becomes Politicized

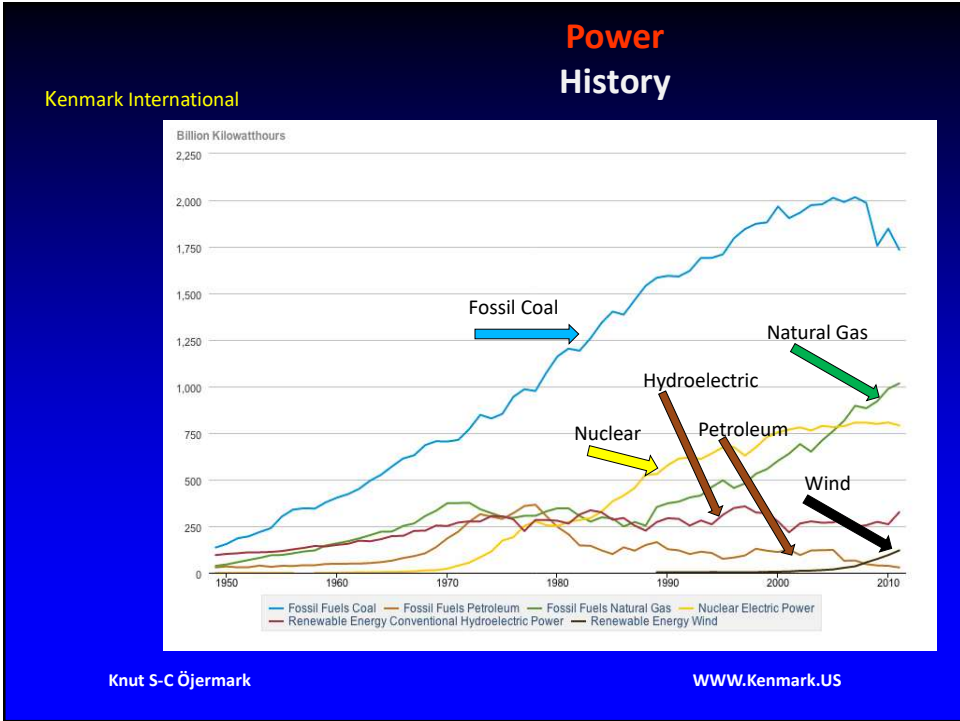
- Edison had to bribe New York politicians just to begin laying the foundations of his work
- New York's famously corrupt city government to build his proposed network on the southern tip of Manhattan
- Statewide regulation of power companies by public utility commissions
- Legal monopoly status
- Great Depression financially ruined Insull's expanding enterprises

Power
History

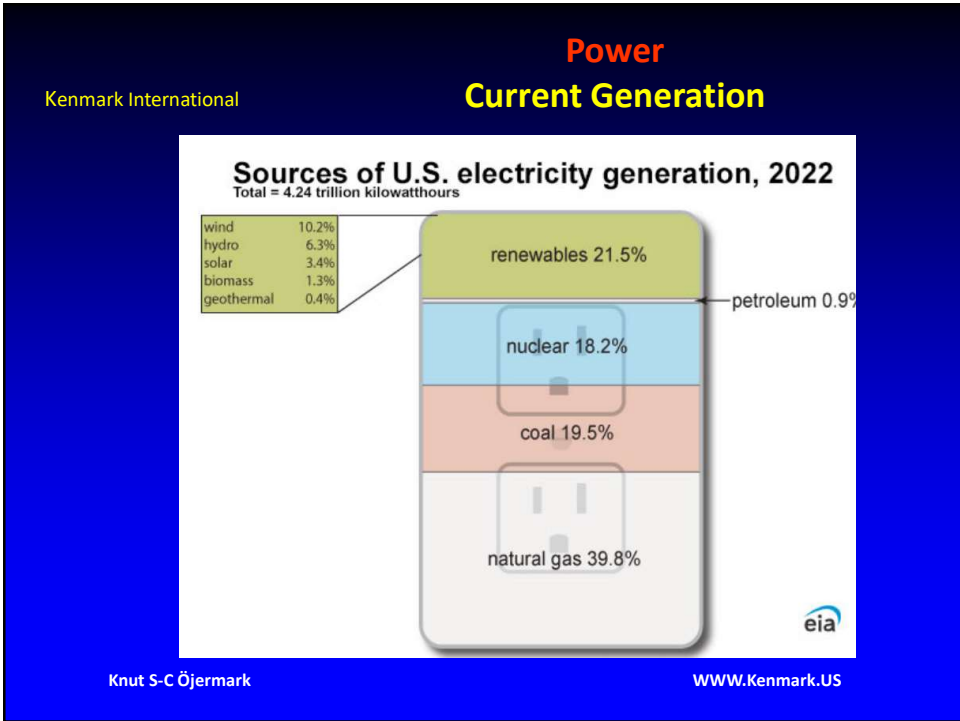
- ✓ Currently, the electric power sector faces an unprecedented amount of federal intervention:
 - ✓ Environmental Protection Agency (EPA)
 - ✓ FERC (FERC is a federal agency Commission)
 - ✓ Department of Energy.

By 2030, the rule is estimated to increase electricity bills by a combined \$290 billion.

Nearly every aspect of electricity is now heavily regulated by multiple federal agencies



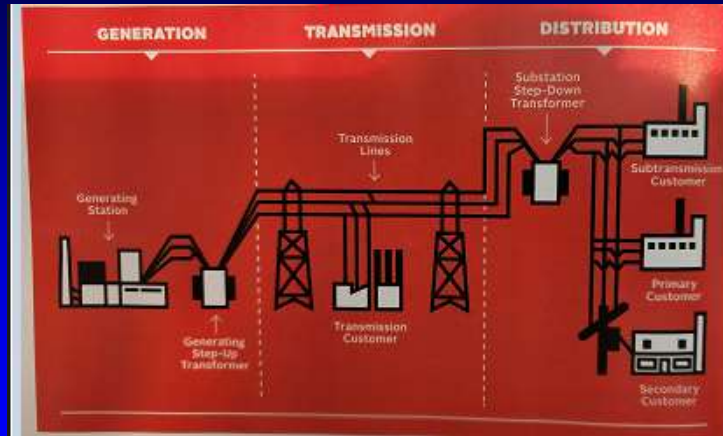
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Power Current Generation

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Power Current Generation

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- Generation through turbines
 - Originally coal
 - Now more Natural gas
 - Fission

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Power
Current Generation

how many hours a 100 watt light bulb can run on 1kg of various fuels

	WOOD	= 1.2 days
	COAL	= 3.8 days
	OIL	= 4.8 days
	Nuclear	= 25,700 years


Nuclear

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Power
Current Generation
Wind Energy

- **Wind** energy provided **more than 10%** of total in-state electricity generation in 16 states.
- Cumulative U.S. distributed wind **capacity** stands at **1,055 MW** from more than **87,000 wind turbines** across all 50 states, Puerto Rico, the U.S. Virgin Islands, and Guam.
- Wind turbine cost \$770-\$850 per kilowatt (kW) now.

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Power Current Generation Solar Energy

- Solar energy provided about 3.4% of total U.S.
- Photovoltaic (PV) and solar-thermal power are the two main types of solar electricity generation technologies.
- PV conversion produces electricity directly from sunlight in a photovoltaic cell.

Power Current Generation Solar Energy

- Most solar-thermal power systems use steam turbines to generate electricity.
- Cost per home between 15,000 to 20,000
- 20- to 30-year lifespan of your solar power system
- Maintaining your solar system costs \$150-\$300 annually

Power Current Generation Battery

- Solar energy draw back:
 - Nothing at night
 - Clouds little to nothing
 - Need battery storage. **One per sub panel.**
- Cost **between \$7,000 and \$18,000, each per home**
- Home solar battery units last anywhere between 5 and 15 years

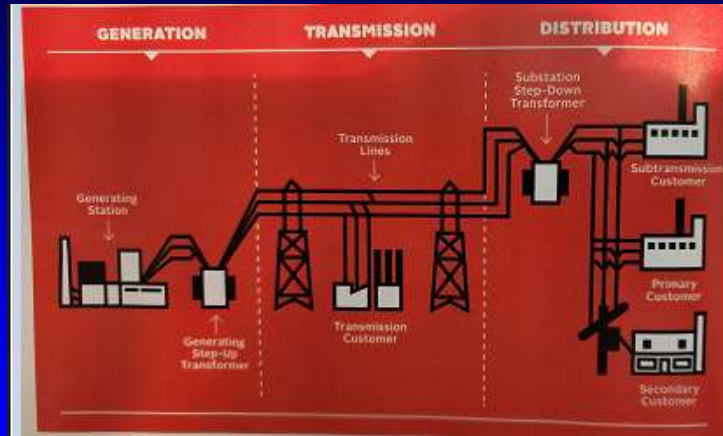
Power Current Generation Battery

Example solar battery prices

Here's a look at the prices of some popular solar batteries.

Battery	Total capacity in kilowatt-hours	Price before incentives*	Cost after 30% solar tax credit
Renogy REGO	10kWh	\$7,327.99	\$5,129.59
Tesla Powerwall (includes Gateway and accessories)	13.5kWh	~\$8,700	~\$6,090
BLUETTI EP900 + B500 Home Battery Backup (includes inverter)	9.92kWh, 14.88kWh or 19.84kWh	\$12,298, \$13,798 or \$17,298	\$8,608.60, \$9,658 or \$12,108
SunPower SunVault (includes installation)	52kWh	\$12,000 to \$18,000	\$8,400 to \$12,600
Generac PWRcell system (includes solar panels, inverter and installation)	9kWh	~\$18,000	~\$12,600

Power Current Transmission



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Power Current US transmission

- 4.24 (kWh) Trillion Kilowatt Hours
- 600,000 Miles of transmission wires
- 5.5 million of distribution wires
- Transmission 155,000 to 500,000 volts

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Power
Current US transmission

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Why high voltage?
The higher the Amps (I) the thicker the wire

Remember
 $V = I \times R$
 $I = V / R$

Why transmit power using DC vs AC?

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Power
Current US transmission

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The higher the Amps (I) the thicker the wire
<http://wiresizecalculator.net/calculators/wiresize.htm>

Quick Wire Size Calculator

Enter the information below to calculate the appropriate wire size.

Enter maximum amps in circuit:

Select wire insulation:

Select conductor type:

Is wire in a raceway or cable, buried in Earth or in open air?

Appropriate Wire Size: 14 AWG

AWG	Diameter (MM)
14	1.628
16	1.291
18	1.024
20	0.812
22	0.644

Knut S-C Öjermak50 Amp need 10 AWG wireWWW.Kenmark.US

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Power
Current US transmission
Skin effect

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For longer distance DC is better, typically 500,000 V.
Using the entire wire

Steel wire
inside

Copper wire
outside

High Frequency
Transmitter

Cross-sectional area of a round conductor available for conducting DC current
"DC resistance"

Cross-sectional area of the same conductor available for conducting low-frequency AC
"AC resistance"

Cross-sectional area of the same conductor available for conducting high-frequency AC
"AC resistance"

Skin effect: skin depth decreases with increasing frequency.

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Power
Current US transmission
AC Transformer

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DC can NOT be stepped down.
Need a transformer, using AC

In: 1,200v
Winding 10
Times More

A basic transformer consisting of two coils of copper wire wrapped around a magnetic core

Out: 120v

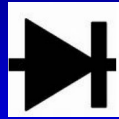
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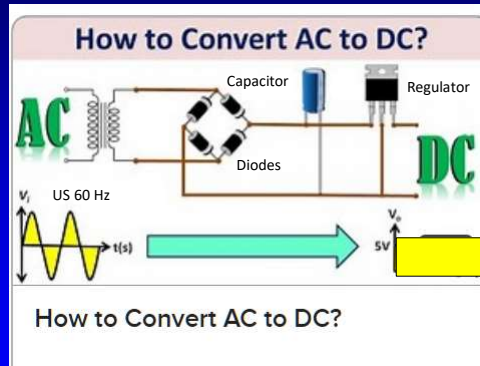
Power Current US transmission Convert AC to DC

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The DC to AC converter, often referred to as an inverter



Diode



DC and can NOT be stepped down by transformer

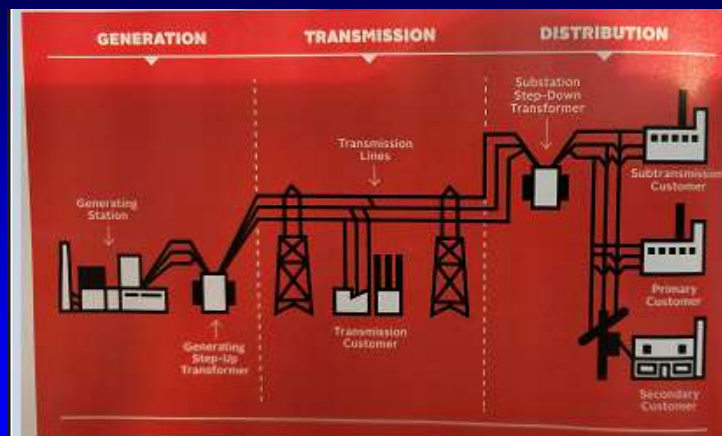
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Power Current Distribution

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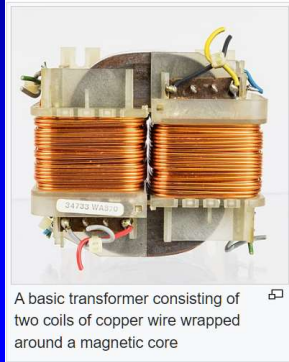
Power Distribution

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Electric power Distribution

Final stage in the delivery of electricity

AC transformer



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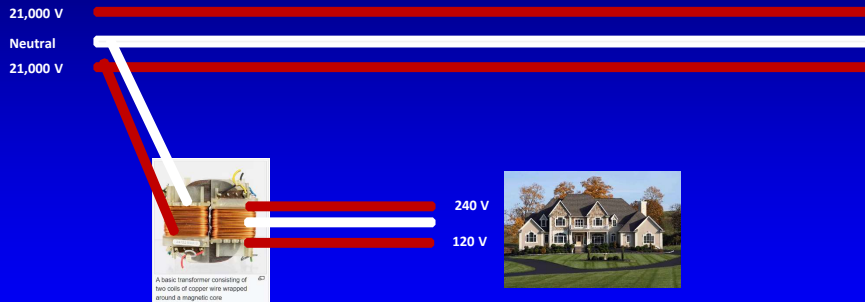
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Power Distribution

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Typical Area distribution. Transmission line



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Questions

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