current magazine

ARTIS ENERGY INTELLIGENCE / **SUMMER 2019**

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Glossary of Terms

Power Innovators **& Amazing Inventions**

artisenergy™ INTELLIGENCE

current magazine

ARTIS ENERGY INTELLIGENCE
SUMMER 2019

PUBLISHED BY
Artis Energy Intelligence

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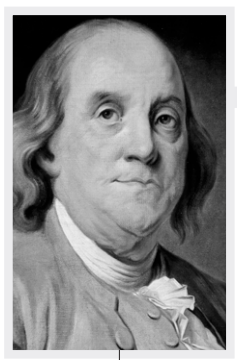
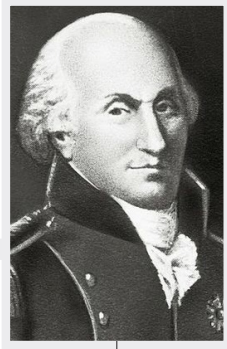


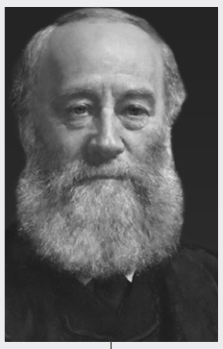
Benjamin Franklin
1706–1790



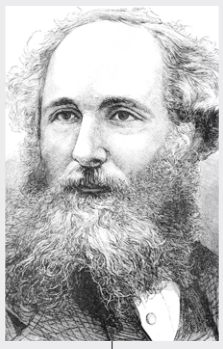
Charles-Augustin de Coulomb
1736–1806

Alessandro Volta
1745–1827

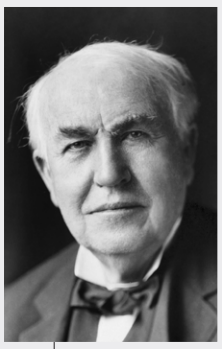
André-Marie Ampère
1775–1836



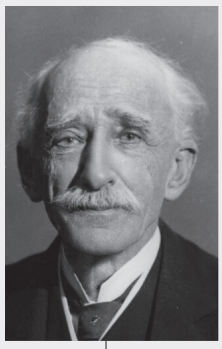
James Prescott Joule
1818–1889



James Clerk Maxwell
1831–1879



Thomas Alva Edison
1847–1931

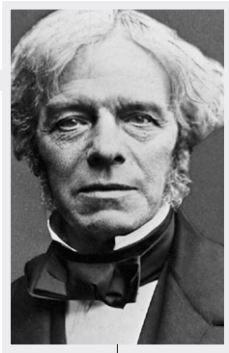


John Ambrose Fleming
1849–1945

Early Innovators: Influential Energy Scientists

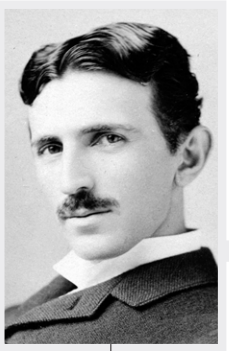
Hans Christian Ørsted
1777–1851

Georg Ohm
1789–1854



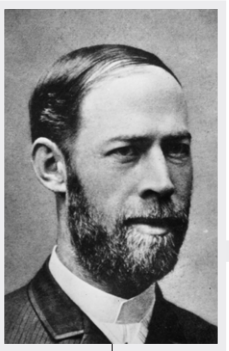
Michael Faraday
1791–1867

Joseph Henry
1797–1878



Nikola Tesla
1856–1943

Léon Charles Thévenin
1857–1926



Heinrich Hertz
1857–1894

Guglielmo Marconi
1874–1937

Edward Lawry Norton
1898–1983

André-Marie Ampère
André-Marie Ampère discovered that a wire carrying electric current can attract or repel another wire next to it that's also carrying electric current. The attraction is magnetic, but no magnets are necessary for the effect to be seen. He formulated Ampere's Law of electromagnetism and produced the best definition of electric current of his time. Ampère also proposed the existence of a particle we now recognize as the electron. The SI unit of electric current, the ampere, is named in his honor.

ALTERNATING CURRENT (AC)

Alternating current typically refers to a current that reverses its direction at regularly recurring intervals of time and that has alternately positive and negative values. Almost all electricity utilities generate AC electricity because it can easily be transformed to higher or lower voltages.

AMPERE (AMP)

The base unit of electrical current produced in a circuit by 1 volt acting through a resistance of 1 ohm. The measure of the rate of flow of electrons past a given point in an electric conductor such as a power line.

ASHRAE AUDITS

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has developed facility energy audit guidelines based on the level of detail and effort required to provide the desired energy evaluation to a facility.

Level 1: Brief on-site survey of the building; savings and cost analysis of low-cost/no-cost energy conservation measures (ECMs); identification of potential capital improvements meriting further consideration

Level 2: More detailed building survey; breakdown of energy use; savings and cost analysis of all ECMs; Identification of ECMs requiring more thorough data collection and analysis

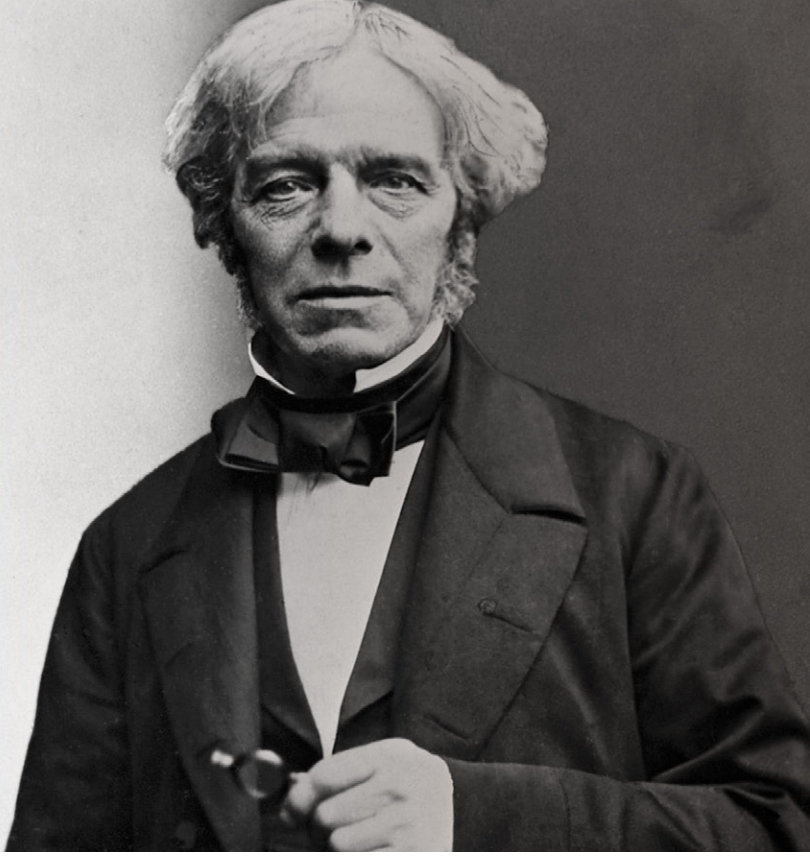
Level 3: Attention to capital-intensive projects identified during the Level 2 audit; more detailed field audit and engineering analysis; cost and savings calculations with a high level of accuracy; 3D building model; submetering

AVOIDED COST

The cost to produce or procure electric power that an electricity utility does not incur because it purchases this increment of power from a qualifying facility. It may include a capacity payment and/or an energy payment component.

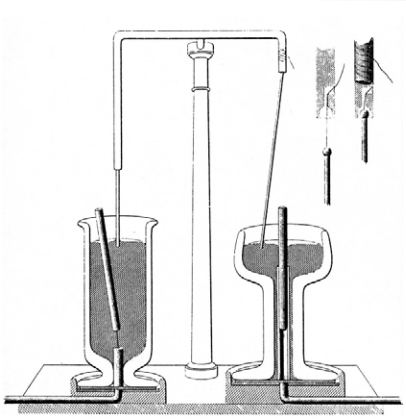
BASE LOAD

The minimum amount of electric power delivered or required over a given period of time at a steady rate. The minimum continuous load or demand in a power system over a given period of time.



Michael Faraday

Michael Faraday is credited with many notable discoveries, including electromagnetic rotation, which would eventually develop into the electric motor. Faraday is also credited with discovering Gas Liquefaction and Refrigeration, Benzene, Electromagnetic Induction, Diamagnetism as a Property of all Matter, Faraday's Laws of Electrolysis, the Faraday Cage, and the Faraday Effect.



Faraday's electromagnetic rotation experiment

BASE LOAD CAPACITY

The generation units normally used to meet demand around-the-clock.

BASE LOAD PLANT

A plant normally operated to take all or part of the minimum continuous load of a system, and which consequently produces electricity at an essentially constant rate. A base load plant typically has relatively high fixed costs and low unit operating costs. Traditionally, nuclear plants have been considered as base load plants.

BRITISH THERMAL UNIT (BTU)

The quantity of heat required to raise one pound of water (about one pint) one degree Fahrenheit at or near its point of maximum density. A common unit of measurement for gas prices. 1034 BTUs = 1 cubic foot. An MMBTU (-mil BTUs) is roughly equivalent to an MCF (a thousand cubic feet).

BUILDING AUTOMATION SYSTEM (BAS) & BUILDING MANAGEMENT SYSTEM (BMS)

Building Automation System (BAS) and Building Management System (BMS) primarily focus on real-time control of a facility. They are typically more robust in their capabilities than an energy management system (EMS), focusing on controlling facility assets such as HVAC, lighting, security automation and observation, access control, fire alarm system, elevator control, plumbing, closed-circuit television (CCTV), engineering systems, control panels, and PA systems. (see Energy Management System (EMS))

BUILDING ENVELOPE

Building envelope is the physical divide between interior and exterior environments. Energy efficiency building envelope upgrades can include windows, insulation, roofing, awnings, etc. which allow the building to better retain cooled air in the summer, and heat in the winter. Infrared exterior facility scans can be utilized to determine where building envelope performance improvements are needed.

CAPACITOR

A transmission element designed to inject reactive power into the transmission network. Also used to increase voltages, reduce loadings, and increase available kW output from generators. Capacitor ratings typically given in Megavars (MVAr).

CAPACITY

The power output rating of a generator, typically in megawatts, measured on an instantaneous basis.

Energy use in America is **doubling** every **20 years.**

Alessandro Volta
Invented the first electric battery called the "voltaic pile." Discovered "contact electricity" resulting from contact between different metals. Recognized two types of electric conduction. Wrote the first electromotive series; this showed, from highest to lowest, the voltages that different metals can produce in a battery. Discovered that electric potential in a capacitor is directly proportional to electric charge. In recognition of Volta's contributions to science, the unit of electric potential is called the volt.

Water vapor is the **most abundant greenhouse gas,** but most scientists believe that **water vapor** produced directly by **human activity** contributes **very little** to the amount of water vapor in the atmosphere.

CAPACITY (PURCHASED)

The amount of capacity available for purchase from other power systems.

CAPACITY CHARGE

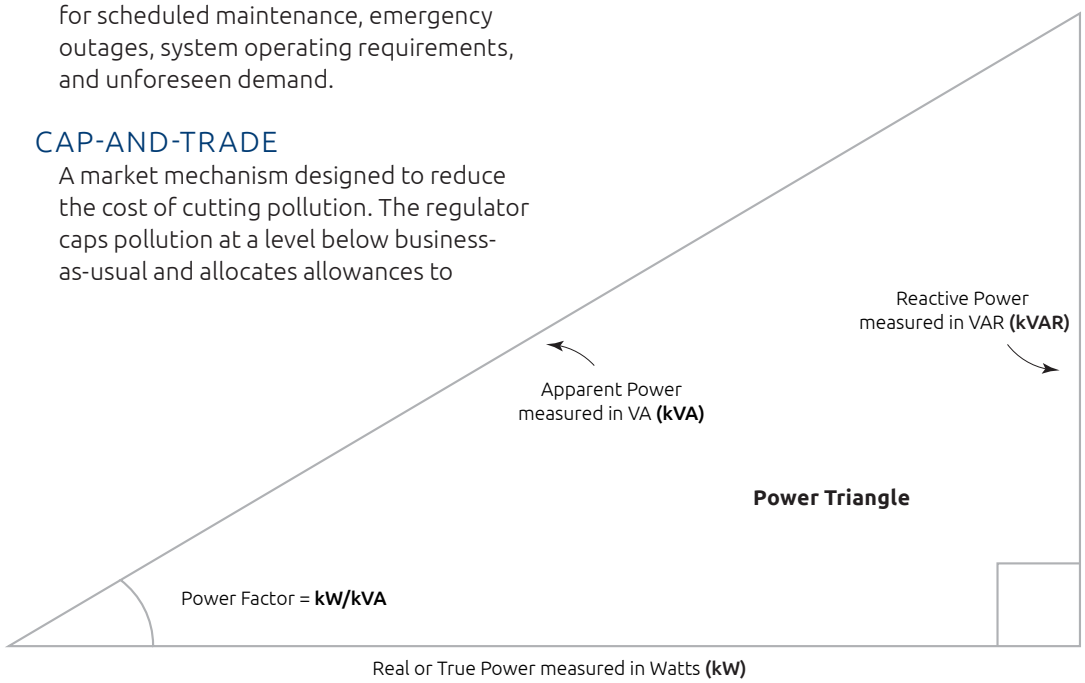
One element of a two-part pricing method used in power transactions (energy charge is the other element. Assessed on the amount of capacity being purchased, typically in units of currency per MW or kW).

CAPACITY MARGIN

The amount of capacity above planned peak system demand available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen demand.

CAP-AND-TRADE

A market mechanism designed to reduce the cost of cutting pollution. The regulator caps pollution at a level below business-as-usual and allocates allowances to industry up to but not exceeding the cap. Covered entities must have their emissions independently verified and must surrender allowances to match their annual emissions each year, normally with penalties for non-compliance. Since the overall cap is below actual emissions, this cuts the overall level of pollution and creates a scarcity of allowances, and therefore a monetary value. Those with a surplus may sell them to those with a shortfall, creating a tradable market for allowances.



COGENERATION (COGEN), COMBINED HEAT AND POWER (CHP), OR TRIGENERATION (TRIGEN)

The production of both electricity and useful thermal energy from the same energy source. Natural gas tends to be a favored fuel for combined-cycle cogeneration units, in which waste heat is converted to steam, hot water, or for use in absorption chillers for cooling.

COMBINED CYCLE

The combination of one or more gas and steam turbines in an electric generation plant. An electric generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The heat is routed to a conventional boiler or to a heat recovery steam generator for use by a steam turbine in the production of electricity. This process increases the efficiency of the electric generating unit.

COMBINED HEAT AND POWER PLANT (CHP)

Power plant, usually embedded, which produces both electric and thermal energy in the form of steam (see cogeneration).

CONGESTION (TRANSMISSION CONGESTION)

Congestion occurs when there is insufficient energy supply, or delivery capacity, to meet the demands of customers at a given point in time. When congestion conditions occur energy market prices increase. If the congestion becomes significant enough, there is risk of energy blackouts or brownouts occurring. In order to alleviate congestion, the grid can add new transmission infrastructure, increase the generation capacity, or incentivize end users to curtail energy consumption.

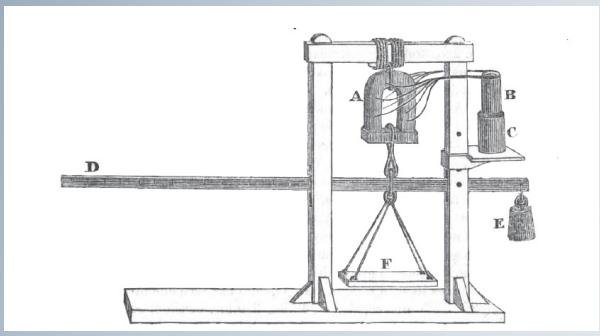
CONNECTION

The physical junction (transmission lines, transformers, switch gear, etc.) between two electric systems permitting the transfer of electricity.

CONTRACT PRICE

Periodic (monthly/quarterly/annual) price agreed between sellers and buyers of commodities for term business. Most oil and gas contract prices are "floating;" they are tied to spot market assessments published by Platts, NYMEX or other market pricing services rather than set at outright levels.

Hospitals in the **United States** rank as some of the **highest energy consumers** in the entire world.



Drawing by Joseph Henry of an electromagnet

Joseph Henry

Joseph Henry was at the forefront of the great electromagnetic advances of the 1830s. For most of the second half of the 1800s he was America's most renowned scientist. He built the world's most powerful electromagnets and made practical breakthroughs that allowed Samuel Morse to invent the telegraph. The unit of electrical inductance is named the henry in his honor, with the symbol H.

CURRENT

A flow of electrons in an electrical conductor. The rate of movement of the electricity, measured in amperes.

DEADBAND TEMPERATURE CONTROL

Deadband temperature controls limit the ability for HVAC to simultaneously heat and cool a space. For example, setting the cooling to 74º and the heating to 68º will allow for a 6º range where no heating or cooling load is requested. Deadband temperature controls can also be applied to a single setpoint. For example, setting cooling to 74º +/- 1º will tell the HVAC system to turn on when the temperature hits 75º and cool the space until it reaches 73º. This method of cooling or heating prevents the HVAC equipment from turning on/off frequently, extending equipment life and potentially reducing the energy required to cool or heat the facility.

DEGREE DAY (DEGREE HOURS)

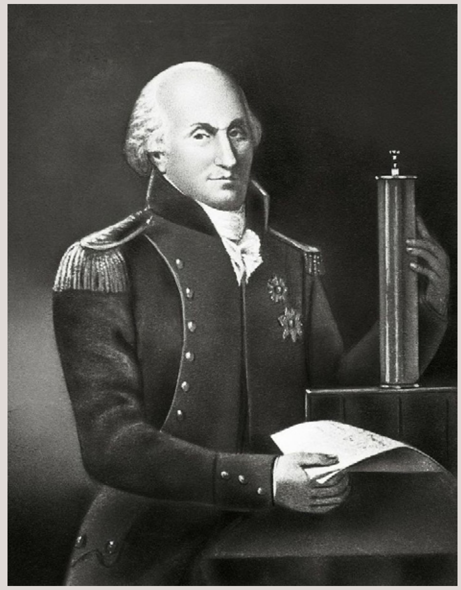
Degree days are calculated as the number of degrees above or below a standard temperature on any given day. In winter, US traders track heating degree days week by week, or month by month, normally against a standard temperature of 65°F, on the basis of how many degrees of heat are required to bring office buildings up to this temperature. Five days of heating by 2 degrees, for example, equals 10 heating degree days. In summer, the market tracks cooling degree days.

DEMAND

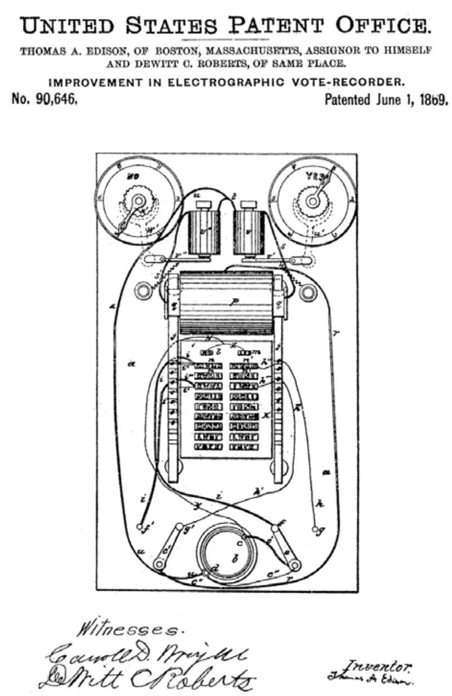
In Power: the rate at which electricity is delivered to or by a system at a given instant or averaged over a designated period, usually expressed in kilowatts (kW), megawatts (MW), or kilovolt-amps (kVA)
In Oil: the rate of consumption of refined products, normally measured in millions of barrels per day, or in million tonnes per year.

DEMAND SIDE MANAGEMENT (DSM)

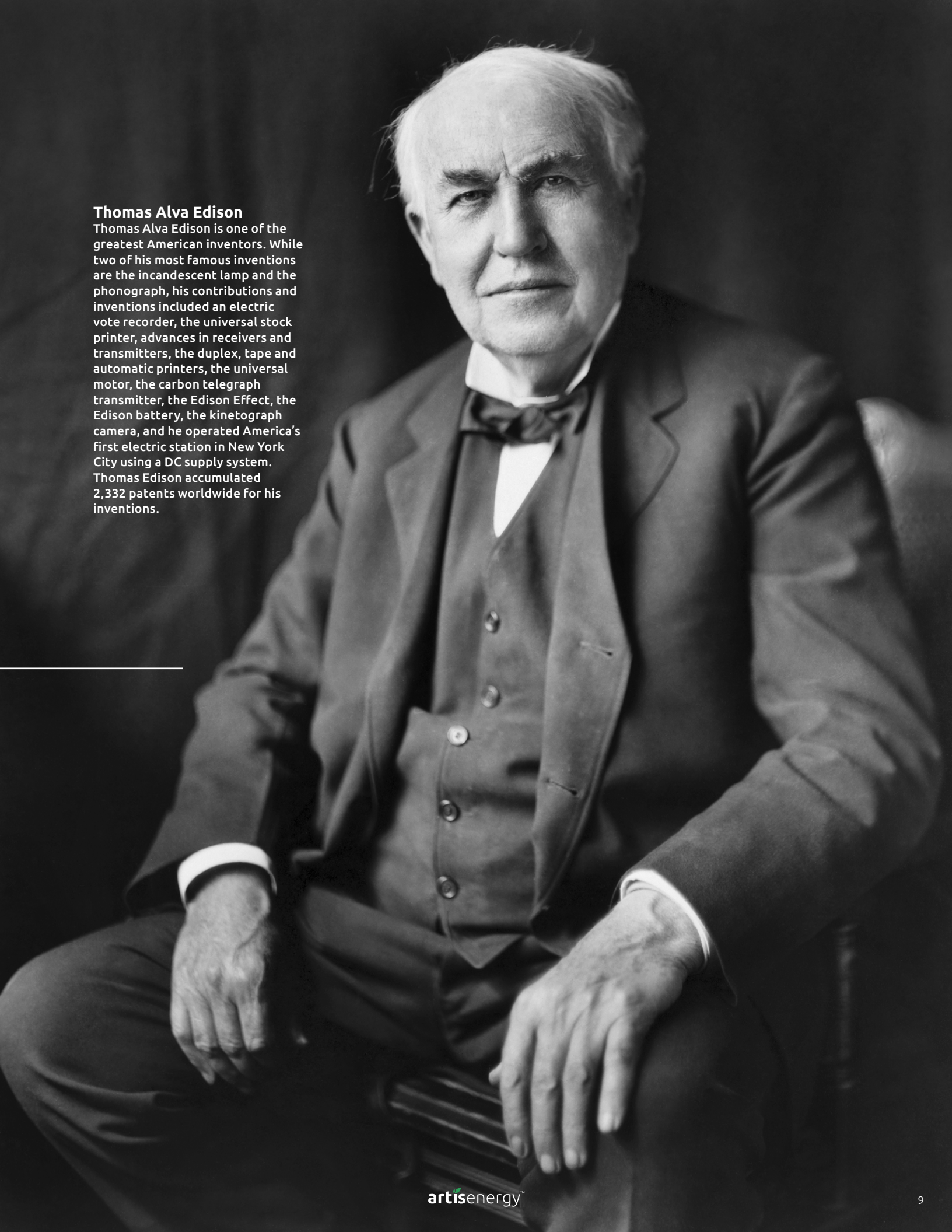
Activities or programs undertaken by an electricity system or consumers to influence the amount and timing of electricity use. The goal is to keep costs low by reducing the need for new transmission and distribution capacity additions on the grid.



Charles-Augustin de Coulomb
Charles-Augustin de Coulomb was an eminent French physicist who formulated "Coulomb's law," which deals with the electrostatic interaction between electrically charged particles. The coulomb, SI unit of electric charge, was named after him.



Edison's first patent: Electrographic vote-recorder



Thomas Alva Edison

Thomas Alva Edison is one of the greatest American inventors. While two of his most famous inventions are the incandescent lamp and the phonograph, his contributions and inventions included an electric vote recorder, the universal stock printer, advances in receivers and transmitters, the duplex, tape and automatic printers, the universal motor, the carbon telegraph transmitter, the Edison Effect, the Edison battery, the kinetograph camera, and he operated America's first electric station in New York City using a DC supply system. Thomas Edison accumulated 2,332 patents worldwide for his inventions.

James Clerk Maxwell

James Clerk Maxwell, known for Maxwell's Equations, was the first scientist ever to unify any of nature's fundamental forces. He discovered that electricity and magnetism are actually the same force — the electromagnetic force. In doing so, Maxwell proved that light is an electromagnetic wave and so linked electricity, magnetism, and optics. He introduced probability into the physics of the very small, laying the foundation for quantum theory and was the first person ever to produce a color photograph; He used mathematics to explain Saturn's rings over 100 years before the Voyager spacecraft confirmed that he was correct. In his kinetic theory of gases, Maxwell established that the temperature of a gas is entirely dependent on the speed of its atoms or molecules.

An average hurricane produces **6×10^{14} Watts** of energy, released through could/rain formation. This **is equivalent to 200X** the world-wide electical generating capacity.

DIRECT CURRENT (DC)

An electricity current that flows in one direction with a magnitude that does not vary or that varies only slightly.

DIRTY POWER

Is an abnormality in the power quality that is being delivered to a system. These abnormalities can include low power factor, voltage variations frequency variations, spikes, and surges.

DISTRIBUTION

The system of lines, transformers, and switches that connect a transmission network to customer load. The transport of electricity to ultimate use points such as homes and businesses.

DOE

Designated Operational Entity is an accredited entity engaged in Measurement and Verification (M+U) and validation of energy and/or emissions reductions.

DUCK CURVE

The Duck Curve refers to the shape of the electric grid's load curve throughout a given day. With the prevalence of renewable solar assets, the energy load on the grid throughout the middle of the day is being reduced. However, as solar assets begin to lose efficiency as the sun goes down, the strain on the grid increases, causing a duck curve shape to form. Managing the evening peak load present on the grid load curve is a challenge many power grids are currently facing.

ENERGY CHARGE

The portion of the charge for electricity based upon the electrical energy (kWh) consumed or billed. Also known as the commodity charge.

ENERGY CONSERVATION MEASURE (ECM)

A project, new technology, or CAPEX improvement made with the intention of reducing the energy consumption of a facility

ENERGY MANAGEMENT SYSTEM (EMS)

An Energy Management System (EMS) is a reporting and decision support tool for facility managers to monitor and control their building loads. Energy management systems are typically less comprehensive than building management systems

(BMS) or building automation systems (BAS) focusing on HVAC, lighting, and main/submeter monitoring. (See Building Management Systems (BMS) or Building Automation Systems (BAS))

ENERGY STAR PORTFOLIO MANAGER®

ENERGY STAR Portfolio Manager is an online benchmarking and performance evaluation tool used to track the energy efficiency of commercial facilities against comparable facilities throughout the US and Canada. Cities like New York, Seattle, and Boston have passed mandatory facility benchmarking laws, making ENERGY STAR Portfolio Manager a required tool for many facilities to use. In some regions, if an ENERGY STAR score falls below a given threshold the facility may be required to implement ECMs to improve their ranking. (see Energy Conservation Measure (ECM)

FAULT DETECTION & DIAGNOSTICS (FDD)

Using equipment level sensors and advanced understanding of how a facility should operate under normal conditions, fault detection and diagnostics software can discover/identify anomalies in equipment performance and help prioritize which operational/equipment improvements should be made first.

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

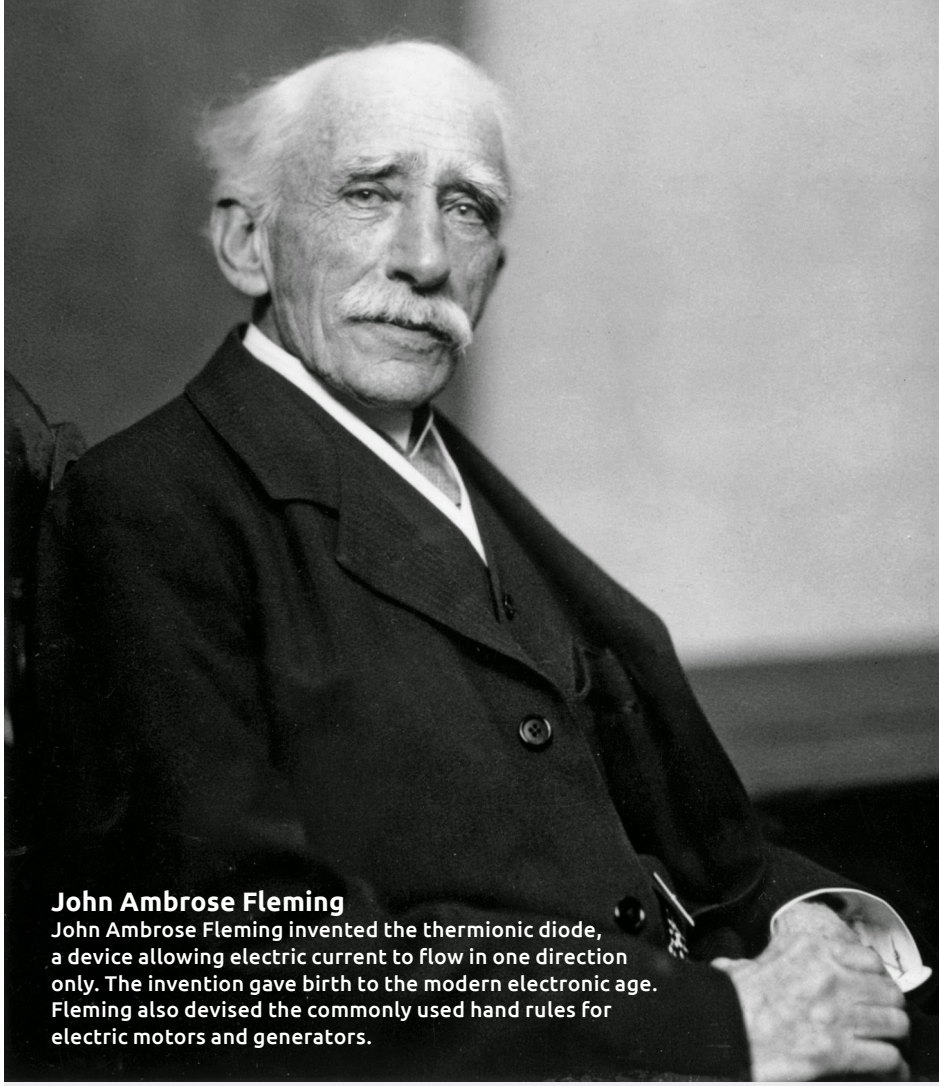
A US federal agency created in 1977 to regulate interstate wholesale gas and transportation of gas and electricity at "just and reasonable" rates.

FIRM ENERGY

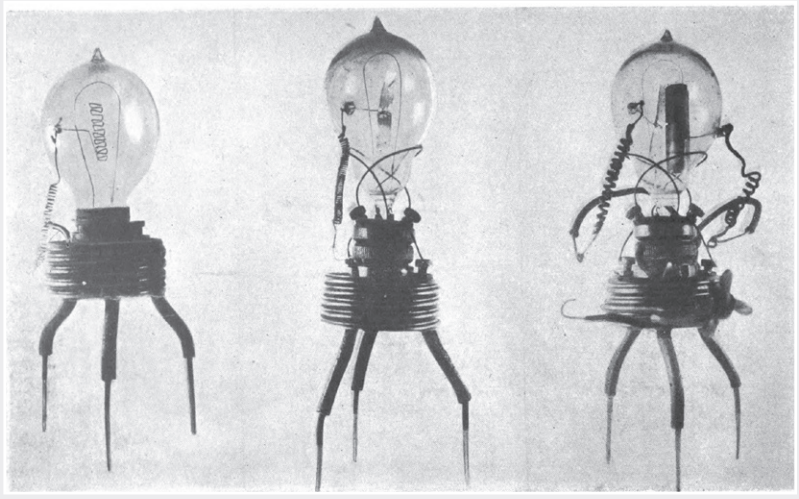
Energy sales which, although not subject to interruption for economic purposes, may be interrupted under force majeure conditions.

FIRM GAS

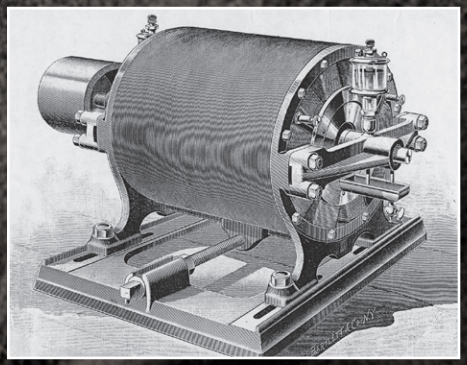
Also called uninterruptible services, are services providing natural gas supplies, that are intended to be available at all times during a period covered by an agreement.



John Ambrose Fleming
John Ambrose Fleming invented the thermionic diode, a device allowing electric current to flow in one direction only. The invention gave birth to the modern electronic age. Fleming also devised the commonly used hand rules for electric motors and generators.



First prototypes of the Fleming Oscillation Valve



Nikola Tesla

Nikola Tesla invented the alternating-current (AC) motor (image, right). He also developed the Tesla coil, a steam-powered oscillating generator, the Tesla Polyphase System, experimented with X-ray imaging, wireless power and lighting, radio remote control, bladeless turbines, and even a radio-controlled boat which he hoped to sell as a guided torpedo to navies around the world. Tesla's company was awarded a contract to Westinghouse Electric for building a two-phase AC generating system at the Niagara Falls, based on Tesla's advice and Westinghouse's demonstration that they could build a complete AC system.

FIRM POWER

Electricity capacity intended to be available at all times during the period covered by a guaranteed commitment to deliver. Firm power consists of either firm energy, firm capacity, or both.

FIXED CHARGE

The charge calculated to recover all or a portion of the fixed costs of a utility, including generation facility and transmission lines, meters, and some taxes.

FORCED OUTAGE

The shutdown condition of a power station, transmission line, or distribution line when the generating unit is unavailable to produce power due to unexpected breakdown.

FORCED OUTAGE RATE

The rate of shutdown of a generating unit, transmission line, or other facility for emergency reasons or a condition in which the generating equipment is unavailable for load because of unanticipated breakdown, measured in total hours per year.

FORWARD PRICE CURVE

When plotted together, a series of forward prices creates a forward curve, reflecting a range of today's tradable values for specified dates in the future. The structure shown by the forward curve is most often used as a guide for trading and hedging within the delivery date range along that curve.

FORWARD CONTRACT

An over-the-counter transaction between two companies involving the future delivery of a commodity at a specific date and location at a fixed price, established on the date at which the contract is originated. Forwards can be customized to suit the specific needs of the counterparties involved while a futures contract is standardized and traded on an exchange.

FUEL CELL

A device that generates electricity by means of an electrochemical process.

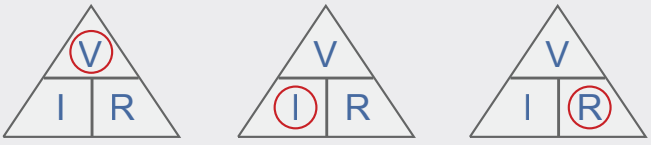
FUEL SWITCHING

Fuel switching is the substitution of one energy source for another in order to meet requirements for heat, power, and/or electrical generation.

Georg Ohm

Georg Simon Ohm was a German physicist, best known for his "Ohm's Law," which states that the current flow through a conductor is directly proportional to the potential difference (voltage) and inversely proportional to the resistance. The physical unit of electrical resistance, the Ohm (symbol: Ω), was named after him.

Ohm's Law



Voltage (V) =	**Current (I) =**	**Resistance (R) =**
Current (I) × Resistance (R)	Voltage (V) ÷ Resistance (R)	Voltage (V) ÷ Current (I)

Voltage: (measured in volts) is the electric potential between two points in an electric field; **Current:** (measured in amperes) is the amount of electric charge transferred per unit of time; **Power:** (measured in watts) is the rate at which electric energy is tranferred by an electric circuit.

K-12 school districts in the US spend **$6 billion** annually on energy. That's more than they spend on computers and textbooks combined.

GENERATION

The process of producing electricity by transforming other forms of energy such as steam, heat, or falling water. The amount of electricity produced is usually expressed in kilowatt-hours (kWh) or megawatt-hours (MWh).

GENERATOR

A dynamo or similar machine for converting mechanical energy into electricity.

GEOTHERMAL

Power generated from heat energy derived from hot rock, hot water, or steam below the earth's surface.

GIGAWATT (GW)

One gigawatt equals 1-billion watts, 1-million kilowatts, or 1,000 megawatts.

GIGAWATT HOUR (GWh)

One billion watt-hours.

GREENHOUSE GASES (GHGS)

The six GHGs recognized and regulated by the Kyoto Protocol are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

GRID

The layout of an electrical transmission system or a synchronized transmission network

HVAC (HEATING VENTILATION AND/OR AIR CONDITIONING)

Variable Air Volume (VAV): A VAV system is a type of HVAC that keeps supply air temperature consistent but varies airflow through damper controls. This setup allows for zoning of a facility.

Constant Air Volume (CAV): A CAV system if a type of HVAC that keeps airflow consistent but varies temperature of the supply air. CAV systems are generally considered to be less efficient than VAV systems and do not allow for individual zoning of a facility

HYDROELECTRIC PLANT

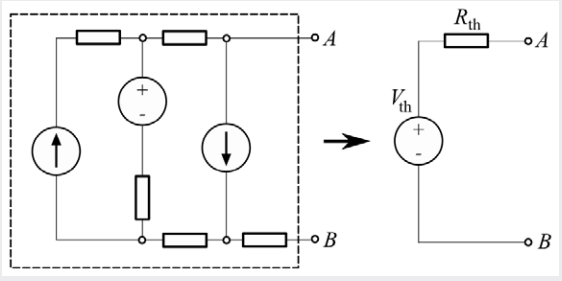
A plant in which the turbine generators are driven by water. There are three types of hydropower facilities: impoundment, diversion, and pumped storage. The most common type is an impoundment facility. An impoundment facility, typically a large hydropower system, uses a dam to store river water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity. A diversion, or run-of-river, facility channels a portion of a river through a canal or penstock. Pumped storage works like a battery, storing the electricity generated by other power sources like solar, wind, and nuclear for later use.

IMPEDANCE

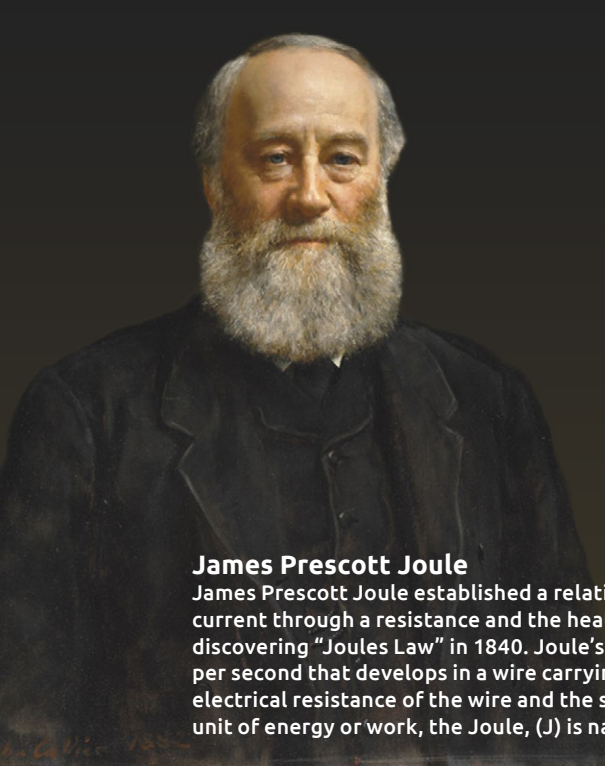
The opposition in an electrical circuit to the flow of alternating current (AC).

Léon Charles Thévenin

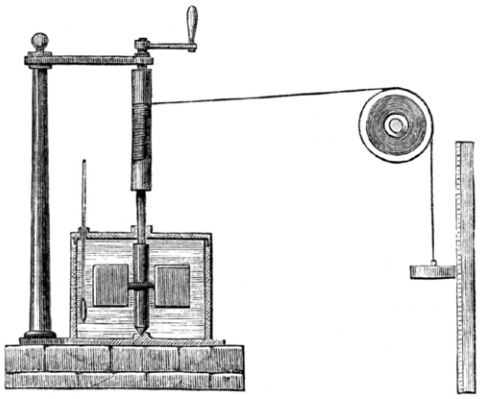
Léon Charles Thévenin developed Thévenin's Theorem, which made it possible to calculate currents in more complex electrical circuits and allowing people to reduce complex circuits into simpler circuits called Thévenin's equivalent circuits



Thévenin Equivalent Circuit: Any black box containing resistances only and voltage and current sources can be replaced by a Thévenin equivalent circuit consisting of an equivalent voltage source in series connection with an equivalent resistance.



James Prescott Joule
James Prescott Joule established a relationship between the flow of current through a resistance and the heat generated. This led him to discovering "Joules Law" in 1840. Joule's law states that the amount of heat per second that develops in a wire carrying a current is proportional to the electrical resistance of the wire and the square of the current. The derived unit of energy or work, the Joule, (J) is named after him.



Paddle-Wheel Experiment. Calorimeter used by Joule in his 1876 determination of the mechanical equivalent of heat

Enough sunlight reaches the earth's surface **each minute** to satisfy the world's energy demands — for an **entire year.**

INTERCONNECTION

Facilities that connect two electricity grid systems, gas pipelines, or control areas.

INTERMEDIATE LOAD

The range from base load to a point between base load and peak load. This point may be the midpoint, a percent of the peak load, or the load over a specified time period. (see Base Load and Peak Load)

INTERMEDIATE LOAD PLANT

A plant which has lower fixed costs than a base load plant, but higher variable costs, and is used to cover the intermediate load requirements. Traditionally, intermediate load plants are gas fired and coal power plants. (see Base Load Plant and Peak Load Plant)

INTERRUPTIBLE DEMAND

The amount of customer demand that, in accordance with contractual arrangements, can be interrupted by direct control of the system operator, remote tripping, or by action of the customer at the direct request of the system operator.

INTERRUPTIBLE GAS

Gas sold to customers with a provision that permits curtailment or cessation of service at the discretion of the supplier.

INDEPENDENT POWER PRODUCERS (IPP)

An independent power producer (IPP) or non-utility generator (NUG) is an entity, which is not a public utility, but which owns facilities to generate electric power for sale to utilities and end users.

KILOVOLT-AMP (kVA)

kVA is kilo-volt-ampere. kVA is a unit of apparent power, which is electrical power unit. 1 kilo-volt-ampere is equal to 1000 volt-ampere

KILOVOLT-AMPERE REACTIVE (kVAR)

A unit of reactive power. Actual power consumed by loads is called Kilowatt Power. All the power given to the load is not utilized as useful power, some power is being wasted. The power which is not consumed is called reactive power i.e. kVAr. Apparent power kVA is the vector sum of kW and kVAr.

KILOWATT (kW)

kW is a kilowatt. A kW is a unit of electricity equal to one thousand watts.

KILOWATT-HOUR (kWH)

kWh is a kilowatt-hour. A kWh is the basic unit for pricing electric energy, equal to one kilowatt of power supplied continuously for one hour (or the amount of electricity needed to light ten 100-watt lightbulbs for one hour). One kWh equals 1,000 watthours.

Guglielmo Marconi
Guglielmo Marconi was awarded the Nobel Prize in Physics with Karl Ferdinand Braun in 1909 for their development of practical wireless telegraphy. He established the world's first microwave radiotelephone link, and later he devised the microwave beacon for ship navigation.

LEAK DETECTION

Leak Detection can refer to discovering leaks/inefficiencies in compressed air systems, steam systems, and/or HVAC ductwork. In each of these scenarios, the leaks may not be noticeable to the human eye/ear but can represent 20% or more of the energy consumed by the respective load.

LEED CERTIFICATION

LEED (Leadership in Energy and Environmental Design) is a worldwide building rating system which allows facilities to certify that they are a green building. LEED focuses on a holistic approach to sustainability including energy, water, waste, and air quality.

LIGHTING RETROFITS

Exchanging less efficient fluorescent lighting with more efficient LED lighting is a simple CAPEX investment which will increase the value of the property, lower energy costs and electricity consumption when the lights are being utilized, and can provide better light coverage than traditional lighting solutions.

LOAD

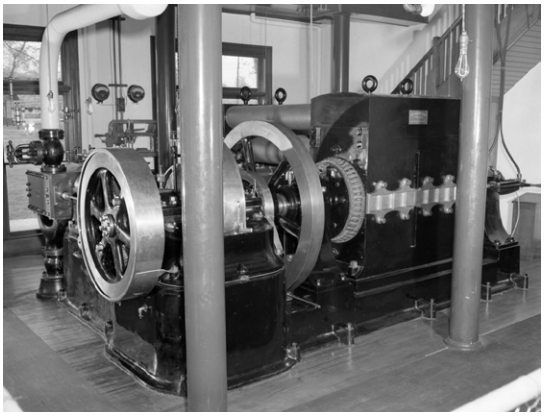
The amount of electricity delivered or required at any specific point or points on a system. The load of an electric system is affected by many factors and changes on a daily, seasonal, and annual basis, typically following a pattern. System load is usually measured in megawatts (MW).

LOAD CURVE

In a power system, a load curve or load profile is a chart illustrating the variation in demand/electrical load over a specific time. Generation companies use this information to plan how much power they will need to generate at any given time.

LOAD FACTOR

The ratio of average load to peak load during a specific period of time, expressed as a percent. The load factor indicates to what degree energy has been consumed compared to maximum demand or relative total system capacity.



First Power Plant: Thomas Edison's Jumbo Dynamo on display at the Henry Ford Museum.

LOAD MANAGEMENT

Load management, also known as demand side management (DSM), is the process of balancing the supply of electricity on the network with the electrical load by adjusting or controlling the load rather than the power station output.

LOAD SEQUENCING

Load sequencing is a strategy of reducing demand peaks by staggering the start-up of large electrical loads. For energy consumers with demand charges on their electric bill, load sequencing strategies can be an easy low/no cost way of lowering monthly energy charges.

LOAD SHAPE

A method of describing peak load demand and the relationship of power supplied to the time of occurrence.

LOCATIONAL MARGINAL PRICING (LMP)

A way for wholesale electric energy prices to reflect the value of electric energy at different locations, accounting for the patterns of load, generation, and the physical limits of the transmission system. Generally, LMP rates are updated every 5 minutes.

MARGINAL COST PRICING

A system of pricing designed to ignore all costs except those associated with producing the next increment of power generation. Sometimes referred to as "incremental cost pricing."

MARGINAL PRICE OF ENERGY

Marginal prices, from a consumer perspective, are those prices consumers pay (or save) for their last units of energy

Thomas Edison built the **first power plant,** and in 1882 his Pearl Street Power Station sent **electricity to 85 buildings.** People were initially afraid of electricity and parents would not let their children near the lights.

What is the Difference Between kWh and kW?

A kilowatt-hour (kWh) and a kilowatt (kW) may sound similar, but they're actually quite different. Technically, the difference is that **a kWh is a measurement of energy, while a kW is a measurement of power;** however, the terms power and energy are often mistakenly used interchangeably. Energy refers to the ability to do work — power refers to the rate of energy production or consumption. To really understand kWh and kW, you also need to consider time. **The equation** is simply **(kW x Time = kWh).**

Hans Christian Ørsted
Hans Christian Ørsted discovered that electricity and magnetism are linked. He showed by experiment that an electric current flowing through a wire could move a nearby magnet. The discovery of electromagnetism set the stage for the eventual development of our modern technology-based world.

used (or saved). For utilities, marginal electricity costs are the costs experienced by utilities for the last kilowatt-hour (kWh) of electricity produced.

MEGAWATT (MW)

MW is a megawatt. MW is a unit of electrical power equal to one million watts or one thousand kilowatts.

MEGAWATT-HOUR (MWh)

MWh is a megawatt-hour. MWh is one million watt-hours of electricity. A unit of electrical energy which equals one megawatt of power used for one hour.

MMBtu

MMBtu is one million British thermal units (Btu).

MMcF

MMcf is one million cubic feet of natural gas.

NAMEPLATE CAPACITY

The full-load continuous rating of a generator or other electric power production equipment under specific conditions as designated by the manufacturer. Installed generator nameplate rating is usually indicated on a nameplate physically attached to the generator.

NATURAL GAS

Naturally occurring gas, predominantly methane, but usually containing some proportions of ethane, propane and butane. Natural gas can be either associated gas, found in association with oil, or non-associated, found in a reservoir only containing gas.

NATURAL GAS MEASUREMENTS

CCF: A hundred cubic feet
MCF: A thousand cubic feet
BCF: A billion cubic feet
TCF: A trillion cubic feet
CBM: A cubic meter
BCM: A billion cubic meters
TCM: A trillion cubic meters
Quad or Quads: A quadrillion cubic feet
MMBtu: A million British thermal units
Dekatherm (DTH): 10 therms or 1,000,000 British thermal units

NET GENERATION

Gross generation less the electric energy consumed at the generating station for station use.

NIGHTTIME/WEEKEND SETBACKS

Nighttime/weekend setback strategies are a simple energy efficiency measure where temperature setpoint are increased for cooling loads and decreased for heating loads to prevent the HVAC system from being utilized then the facility in unoccupied. For example, changing cooling setpoints from 74º to 78º and heating setpoints from 68º to 64º during scheduled unoccupied periods.

NUCLEAR POWER PLANT

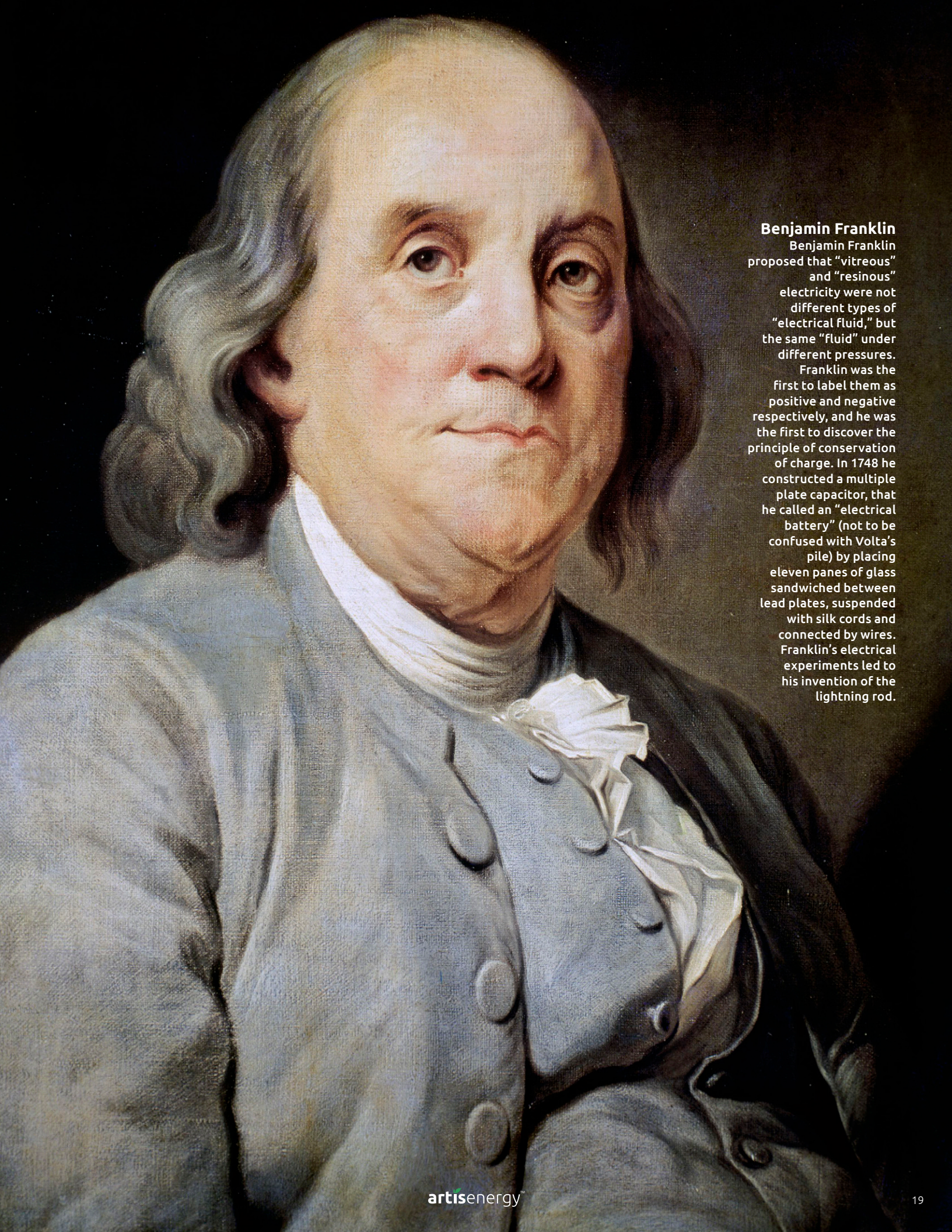
A nuclear power plant is a facility that converts atomic energy into usable power. In a nuclear electric power plant, heat produced by a reactor is converted to steam, which is used to drive a turbine, which in turn drives an electric generator.

NYMEX

New York Mercantile Exchange. Also known in the energy industry as "the NY Merc."

OFF-PEAK

Refers to lower, discounted electricity prices during the time of day when a power system would experience its lightest load, typically during early morning, nights and weekends.



Benjamin Franklin

Benjamin Franklin proposed that "vitreous" and "resinous" electricity were not different types of "electrical fluid," but the same "fluid" under different pressures. Franklin was the first to label them as positive and negative respectively, and he was the first to discover the principle of conservation of charge. In 1748 he constructed a multiple plate capacitor, that he called an "electrical battery" (not to be confused with Volta's pile) by placing eleven panes of glass sandwiched between lead plates, suspended with silk cords and connected by wires. Franklin's electrical experiments led to his invention of the lightning rod.

Heinrich Hertz

Heinrich Hertz discovered radio waves and established that James Clerk Maxwell's theory of electromagnetism was correct. This discovery was the basis for much of our modern communications technology; radio, television, satellite communications, and mobile phones all rely on it. Microwave ovens also use electromagnetic waves. Hertz also discovered the photoelectric effect, providing one of the first clues to the existence of the quantum world. The unit of frequency, the hertz, is named in his honor.

Approximately **30%** of energy used in buildings is used **inefficiently** or **unnecessarily.**

OHM

An ohm is an electrical resistance between two points of a conductor when a constant potential difference of one volt, applied to these points, produces in the conductor a current of one ampere, the conductor not being the seat of any electromotive force.

ON-PEAK

Refers to higher, more expensive electricity prices during the time of day when a power system would experience its greatest load, typically during the late morning to evening hours on weekdays.

OPERATING RESERVE MARGIN

The amount of unused available capacity that can be applied to the system within ten minutes at peak load for a utility system, expressed as a percentage of total capacity.

PEAK DEMAND

The maximum electrical load during a specified period of time. Usually expressed in kilowatts (kW), megawatts (MW), or kilovolt-amps (kVA).

PEAK LOAD

The maximum electrical load demand in a stated period of time. On a daily basis, peak loads occur at midmorning and/or in the early evening.

PEAK LOAD PLANT

A plant usually housing low-efficiency, quick response steam units, gas turbines, diesel, or pumped-storage hydroelectric equipment normally used during the maximum load periods. Characterized by quick start times and generally high variable costs, but low fixed costs.

PEAKING CAPACITY

Capacity of generating equipment normally reserved for operation during the hours of highest daily, weekly, or seasonal loads.

POWER FACTOR

The ratio of the actual electrical power (kW) to apparent electrical power (kVA). The difference between the two is caused by reactance in the circuit and represents power that does no useful work.

POWER TRIANGLE

The three circuit elements (kW, kVA, and kVAR) which make up the electrical power consumed in an AC circuit can be represented by the three sides of a right-angled triangle.

POWER QUALITY

Power quality is the relationship of voltage, frequency, and waveform. when good power quality is present, voltage and frequency are steady, and the waveform represents a smooth sine wave. When poor power quality is present, equipment may require irregular maintenance, circuits may frequently trip, high equipment temperatures may occur. To isolate the cause of poor power quality, sub-second data loggers should be installed and analyzed at the facility.

Edward Lawry Norton
Edward Lawry Norton is credited with the development of Thévenin's theorem, which held, in part, that any linear electrical network with voltage and current sources and resistances only can be replaced at terminals A-B by an equivalent voltage source Vth in series connection with an equivalent resistance Rth.

RENEWABLE ENERGY (SOURCE)

Any naturally occurring, theoretically inexhaustible source of energy, such as biomass, solar, wind, tidal, and wave, that is not derived from fossil or nuclear fuel. Hydroelectric power is generally not counted as a renewable energy source due to the potential for negative environmental impacts of hydroelectric dams.

RESERVE CAPACITY

Extra generating capacity available to meet unanticipated demands for power or to generate power in the event of loss of generation.

SOFT STARTERS

Soft starters are similar to variable frequency drives in that they limit the amount of power provided to a motor to allow for more efficient equipment operation. Soft starters extend the life of electric motors by limiting the current used to start and/or stop an electric motor, they also can significantly reduce peak power loads. (see Variable Frequency Drive (VFD).

SOLAR PHOTOVOLTAIC

A method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons by the photovoltaic effect. Solar cells produce direct current electricity from sunlight which can be used to power equipment, charge battery storage, or is directed back to the electric grid.

SPOT MARKET

A market where goods are traded for immediate delivery.

STORAGE

Battery: Storing energy during low cost off peak times to be used during high cost on peak periods. Battery storage can reduce the times that costly peak load plants need to be in operation, having the effect of significantly lowering the cost of electricity during historically high cost times.
Hydroelectric: Water can be stored in large reservoirs to be used to meet grid demand during peak load times. In some cases, water is pumped uphill into reservoirs using excess solar/wind generation, then dispatched during peak periods to meet grid demands.
Oil: Typically on land tankage facilities for short- or long-term storage of crude or products; sometimes used in economic parlance interchangeably with the concept of oil stocks.
Natural Gas: Facilities used to store natural gas which has been transferred from its original location. Usually consists of natural geological reservoirs like depleted oil or gas fields, water-bearing sands sealed on top by an impermeable cap rock, underground salt domes, bedded salt formations, or in rare cases, abandoned mines.

SUBSTATION

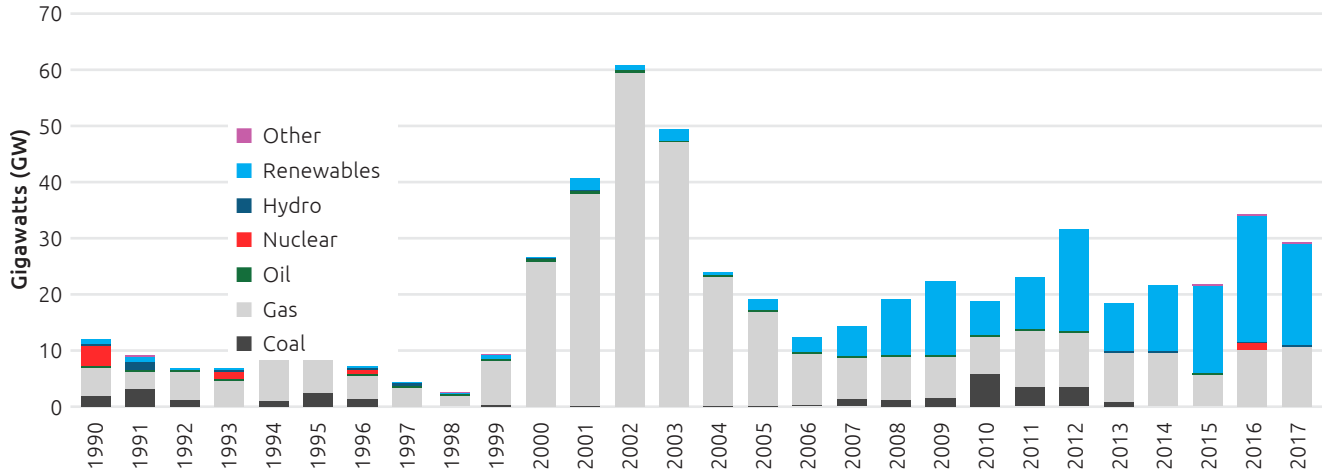
Facility equipment that switches, changes, or regulates electric voltage. An electric power station which serves as a control and transfer of power flow, transform voltage levels, and serve as delivery points to industrial customers.

TARIFF

Rates a regulated entity will charge to provide service to its customers as well as the terms and conditions that it will follow in providing service.

A "watt" is a unit of power that **measures** the rate of producing or **using energy**. The term was named after Scottish engineer **James Watt** (1736–1819), who developed an improved steam engine. Watt measured his engine's performance in horsepower. **One horsepower equals 746 watts.**

U.S. Energy overview: Electric generating capacity build by fuel type



Source: Bloomberg, Sustainable Energy in America Factbook.

The **United States** has more nuclear reactors, **more nuclear** power **capacity** and generates more nuclear **power** than any other country in the world.

THERM

Is a unit of heat energy equal to 100,000 British thermal units (Btus). It is approximately the energy equivalent of burning 100 cubic feet of natural gas. United Kingdom regulations were amended to replace therms with joules in 1999; however, the wholesale UK gas market currently trades in therms.

THIRD PARTY SUPPLY RATE COMPONENTS

Energy: The cost of actual energy consumed (kWh). How much energy is consumed, how consistently energy is consumed, and when energy is consumed can all influence the cost of energy

Capacity: Capacity payments are required by system operators to ensure that there is an adequate amount of generation assets available to meet grid demand. Capacity payments help fund the future expansion, replacement, or improvements of grid generation assets.

Transmission: Charges associated with moving the power consumed from the generation asset to the end user.

Energy Losses: Energy losses occur through transmission/distribution of energy from the generation asset to the end user. Customers who receive power at higher voltages typically incur less energy loss charges.

Ancillary Services: Charges to support and maintain reliable transmission of power from the seller to the purchaser of power.

Renewable Portfolio Requirements: The costs associated with obtaining power from renewable energy assets mandated by state government regulations.

TIERED RATES

A rate design which divides customer use into different tiers, or blocks, with different prices charged for each.

TRANSFORMER

An electrical device for changing the voltage of alternating current.

TRANSMISSION

The network of high voltage lines, transformers and switches used to move electricity from generators to the distribution system or used to interconnect different utility systems and independent power producers together into a synchronized network. Transmission is considered to end when the energy is transformed for distribution to the consumer.

TRANSMISSION LOSS

The power lost in transmission between one point and another. It is measured as the difference between the net power passing the first point and the net power passing the second point.

TRANSMISSION VOLTAGE

Voltage levels utilized for bulk transmission systems: generally 69 KV - 750 KV AC or DC.

TURBINE

The part of a generating unit usually consisting of a series of curved vanes or blades on a central spindle, which is spun by the force of water, steam, or hot gas, to drive an electrical generator.

VARIABLE FREQUENCY DRIVE (VFD)

Traditionally, electric motors either operate at 100% capacity or are off. This is like driving a car by flooring the gas and slamming on the breaks. VFD's can control the energy input to a motor (speed of the motor) depending on how much output is required. It is a much more efficient way of operating a motor which will save energy and can improve the longevity of the equipment it is controlling.

VOLT

The unit of measurement of electromotive force. It is equivalent to the force required to produce a current of one ampere through a resistance of one ohm. The unit of measure for electrical potential. Generally measured in kilovolts or kV. Typical transmission level voltages are 115 kV, 230 kV, and 500 kV.

VOLTAGE CONTROL

The control of transmission voltage adjustments in generator reactive output and transformer taps, and by switching capacitors and inductors on the transmission and distribution systems.

VOLTAGE REDUCTION

Any intentional reduction of system voltage by 3 percent or greater for reasons of maintaining the continuity of service of the bulk electric power supply system.

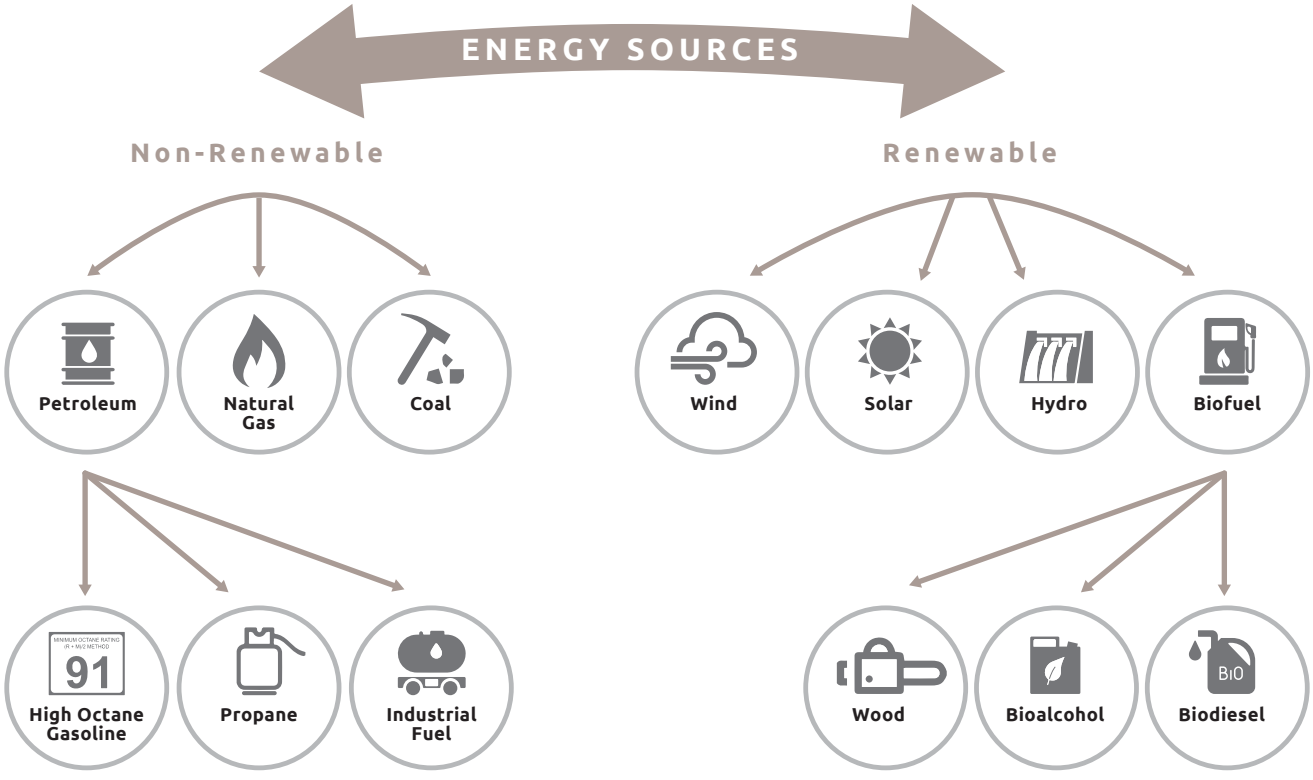
WATT

A measure of real power production or usage equal to one Joule per second. The rate of energy transfer equivalent to 1 ampere flowing under a pressure of 1 volt.

WATT-HOUR (Wh)

A Wh is an electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

The word **"energy"** comes from the **Greek energeia,** meaning **operation, activity.**



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Idle Load Management

Utility Cost Optimization

Load Factor Monitoring

Power Factor Monitoring

High Cost Period Mitigation and Curtailment

Load Shifting Opportunity Monitoring

Measurement and Verification

Trending Analysis

Real Time Grid Composition GHG Contributions

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