Green Design for Students

A Guide to Resource Use Solutions, Grades 7-12

GARDEN · TEACH · RECYCLE · GREENMARKET
grow NYC

Introduction

The purpose of this manual is to provide high school and upper middle school students (grades 7-12)with a general background on a few key environmental/green issues and then to help them utilize that foundation to build models of green design residential buildings, commercial buildings, streetscapes and roadways, college campuses, watersheds and environmental facilities such as sewage treatment plants and organic farms.

How to :

1. We present the manual in its entirety in the form of a Power Point in our initial session with students.
2. Then divide each class into groups of four or five students.
3. Students also review printed copies of this manual. In the second session each group develops a design on paper of a green design model which is reviewed by GrowNYC staff and the teacher of the classes.
4. Once the designs have been approved GrowNYC brings in the materials necessary to start building and students begin to construct their models.
5. Schools using this manual independent of GrowNYC will obtain their own materials.
6. This can take from three to as many sessions as needed depending


LEVI'S

Introduction

8. Sample Materials:

Cardboard from pizza boxes

Aluminum foil

Plastic wrap

Construction paper of a variety of colors, sizes and thickness

Paper towel rolls

Straws

Newspaper

Popsicle sticks

Clay

Glue, tape, scissors, rulers

Any materials brought to schools by teachers and students that are deemed safe and appropriate for use

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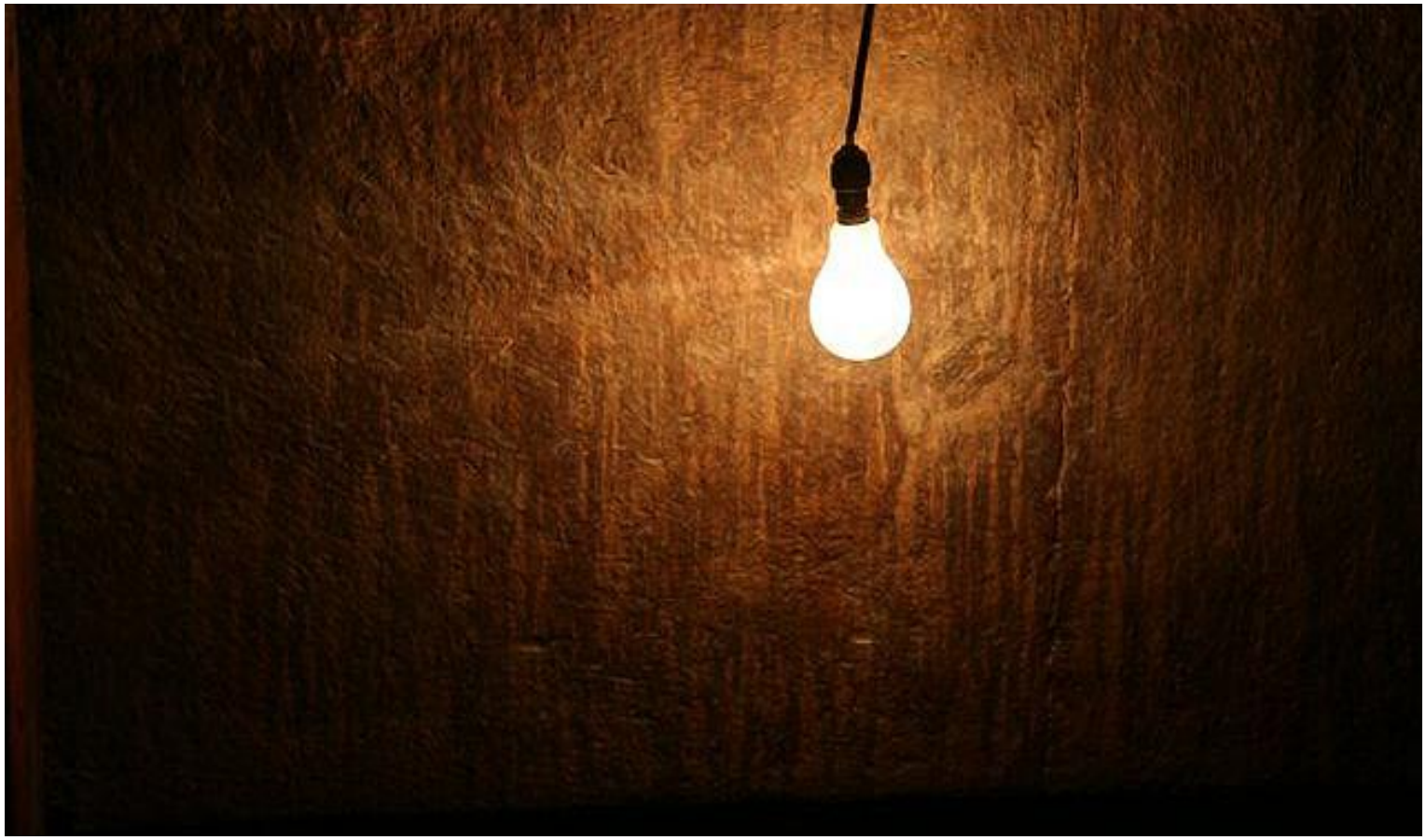
Environmental Challenges

FOSSIL FUELS, ELECTRICITY, and EMISSIONS



In our homes we use:

- Lights
- Televisions
- Refrigerators
- Microwaves
- Toasters
- Stoves
- Space Heating

But where does the energy
to power these appliances
and provide heat and hot water for our homes come from?

Fossil Fuels

Coal

Petroleum (Oil)

Natural Gas

Fossil fuels are solids, liquids and gases created through the compression of ancient organic plant and animal matter in the Earth's crust.

Fossil Fuels, cont.

Coal is a mineral formed from the remains of animals and plants over time. It is used mainly for electricity production: 37% of the U.S.' electricity in 2012 was produced from coal fired plants. Coal accounts for 20% of the U.S.' total energy consumption.

Petroleum Oil, or crude oil is recovered through oil drilling. It is commonly used in making plastic, fuel oil for heating, generation of electricity and gasoline for cars. It accounts for about 37% of the U.S.' total energy consumption.

Natural gas is a gaseous fossil fuel made primarily of methane. Before being used, it undergoes processing to remove almost all materials other than methane. It is used to generate electricity or to heat stoves and houses. It accounts for 28% of the U.S.' total energy consumption.

"Energy Consumption by Primary Fuel." *EIA*. U.S. Department of Energy, Web

Fossil Fuels, cont.

Fossil fuels are useful as they produce large amounts of energy: the United States has relied upon them for most of its energy since the Industrial Revolution 175 years ago.

However, fossil fuels damage the environment during extraction, spills, and combustion.

- Extracting coal, oil and natural gas disturbs ecosystems and habitats.
- Oil spills negatively impact ecosystems.
- The burning of fossil fuels releases greenhouse gases, which contribute to global warming.
- The burning of fossil fuels releases other toxic gases, such as carbon monoxide (CO), and harmful particulate matter into the air we breathe.

Though natural gas is the cleanest of the fossil fuels, it still contributes to
global carbon emissions.

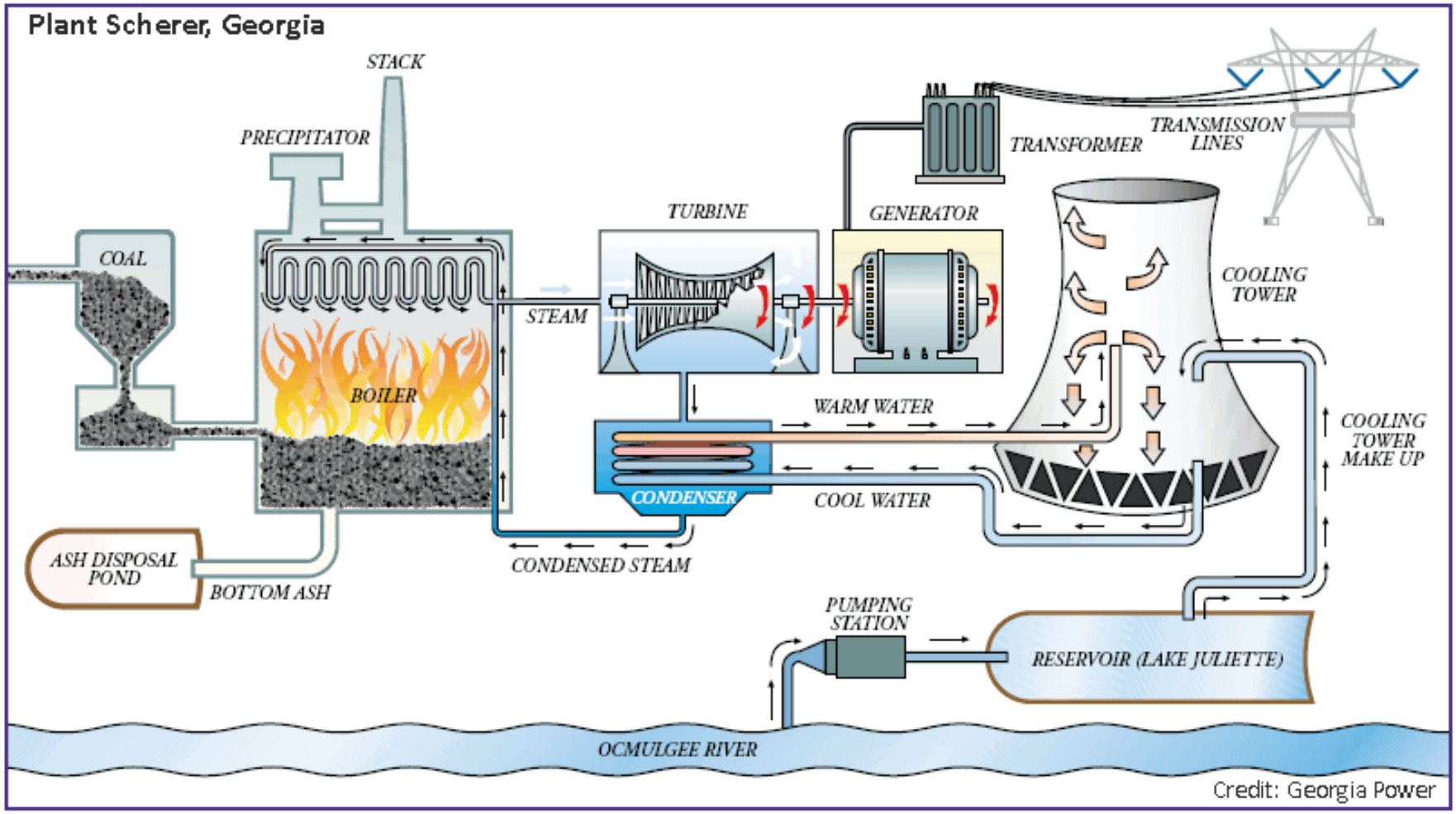
Electricity and Fossil Fuels

Electricity is a secondary form of energy unlocked in many power plants by the burning of fossil fuels

- Fossil fuels are burned in furnaces that heat reservoirs of water
- Hot water changes into steam that is used to rotate a turbine containing a large piece of copper and a magnet, creating a magnetic force.
- Electricity is then sent through power lines to our houses, which powers our appliances

Other types of power plants exist that do not use fossil fuels. For instance, nuclear power plants rely on the splitting of atoms (fission) to produce energy to heat the water reservoirs that rotate the turbine. Hydro-electric power plants rely on the energy of falling or running water to rotate the turbine.

Power Plant Diagram



"A Coal-Fired Thermoelectric Power Plant" USGA water science School, US Department of Interior, Web.

Power Plant to Home

- Electricity produced at the power plant travels through a large transformer and through transmission lines.
- Transmission lines carry the electricity to substations.
- At the substations the electricity is carried by distribution lines to transformers connected to telephone poles.
- Then from distribution lines, electricity is brought into homes and businesses.

"Getting Power from the Plant to Your Home." *Energy Delivery*. CPS Energy, Web

Con Edison is in charge of delivering electricity to all of NYC and Westchester County; gas to Manhattan, the Bronx, northern Queens and most of Westchester; and steam from the Battery to 96th Street, Manhattan.

Con Edison produces 30 billion pounds of steam for heat, hot water, air conditioning, and humidification each year through its four steam plants. The steam is pumped into hundreds of buildings in the New York City steam system.

A Con Ed steam generating plant on the East River at 15th Street in Manhattan.

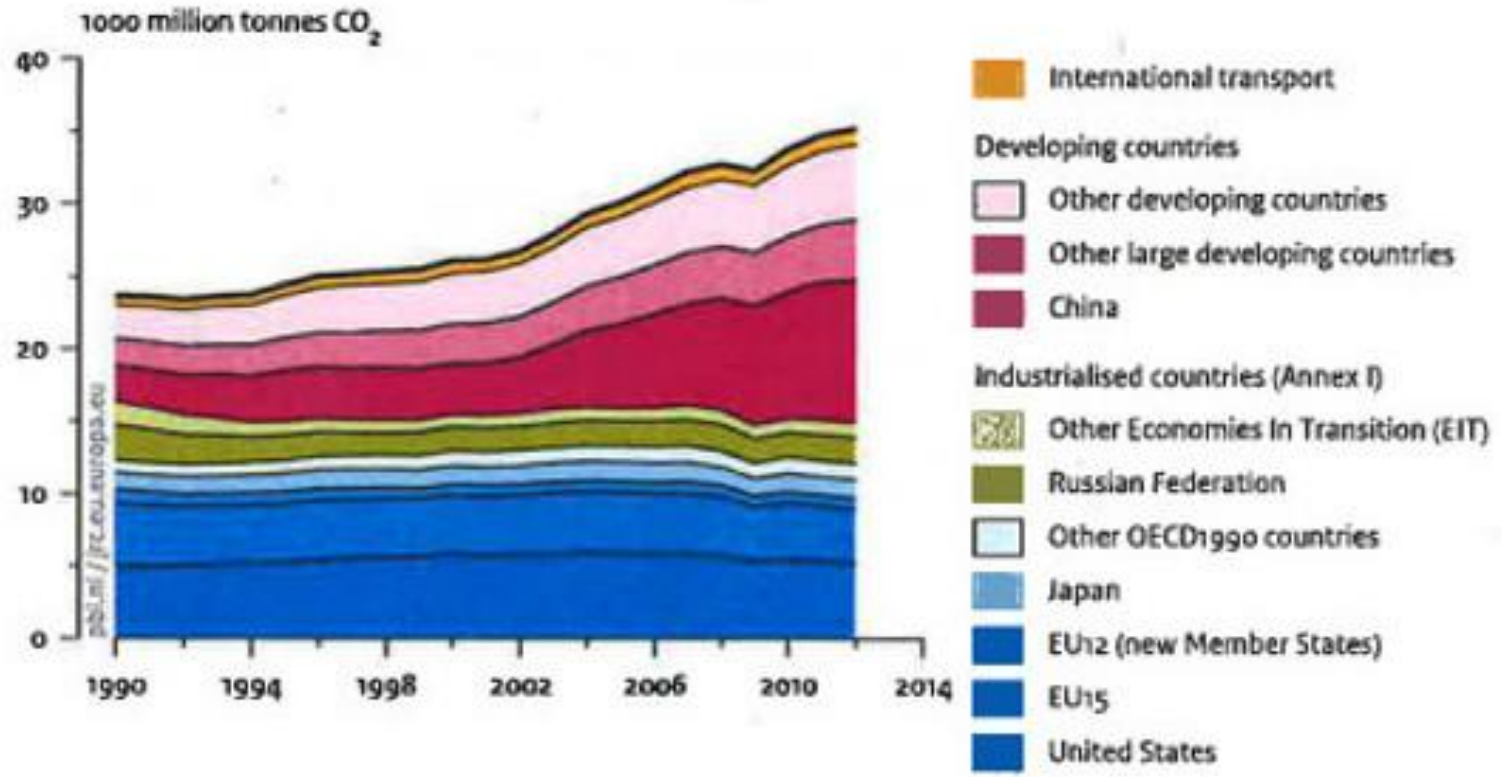
Steam is generated at the central plants by burning natural gas and low-sulfur oil. The steam is then distributed through a network of underground pipes directly to buildings.

"Why Steam." *Steam Operations*. Con Edison, Web.

Greenhouse Gases

Greenhouse gases are gases, such as carbon dioxide (CO2) and methane, that trap heat in the atmosphere. The gases are created from the burning of fossil fuels for heat, electricity and transportation, the burning of garbage, and agricultural and industrial activities

Global CO2 Emissions Per Region from Fossil-Fuel use and Cement Production



Source: EDGAR 4.2FT2010 (JRC/PBL, 2012); BP, 2013; NBS China, 2013; USGS, 2013; WSA, 2013; NOAA, 2012

"Global Emissions." *EPA*. Environmental Protection Agency, Web

Improvements in New York City's Greenhouse Gas Emissions

- From 2009 to 2010, citywide greenhouse gas emissions were reduced by 4.6% and the City's carbon footprint has been decreasing from 2005 to 2010 due to:
  - milder winters
  - new power plants and cleaner imported electricity
  - more efficient steam generation
  - reduced electricity and heating fuel use
  - reduced vehicle use with increased public transportation use
  - reduced solid waste generation
  - improved methane capture at wastewater treatment plants
  - improved streetlight efficiency
  - reduced sulfur hexafluoride emissions

Bloomberg, Michael R. "Citywide Inventory." *Inventory of New York City Greenhouse Gas Emissions - Sept 2011*. Web.

- New York City set a goal to reduce citywide greenhouse gas emissions by 30% by the year 2030
- In 2007, 17 of NYC universities, the 11 largest hospital organizations, 12 global companies and 16 residential management firms joined the Carbon Challenge.
  - The Carbon Challenge is a pledge to match the City government's GHG reduction goal and reduce building-based emissions by 30% in 10 years.
- The Green Greater Building Plan has been enacted to reduce the greenhouse gas emissions of existing buildings

"The New York City Carbon Challenge." *Green Buildings and Energy Efficiency*. PlaNYC, Web.

- In September of 2014, Mayor de Blasio announced a plan for New York City to reduce its greenhouse gas emissions by 80% of 2005's levels by 2050
- The plan, called "One City, Built to Last: Transforming New York City's Buildings for a Low-Carbon Future"
  - The plan involves the upgrading of every public building in the city with a significant energy use
  - This will generate more than $1.4 billion a year by 2025, and create approximately 3,500 jobs in construction and energy services

Chung, Jen. "De Blasio Unveils Ambitious Plan To Cut NYC Greenhouse Gas Emissions By 80%." Gothamist, 21 Sept. 2014. Web.

Air Quality in New York City

- 4th on the list of the 25 regio
  in the United States most affec
  by year-round particle pollutic
- 8th on the list of the 25 most
  ozone-polluted cities
- The city's high levels of ozone
  (an air pollutant with harmful
  effects on the respiratory system)
  and particulates (soot) causes some neighborhoods to have very high rates of asthma
- Carbon Dioxide (CO2) and Carbon Monoxide (CO) decreased 11.5% from 2005 to 2010. Sulfur Dioxide (SO2) emissions decreased from 2009 to 2012.

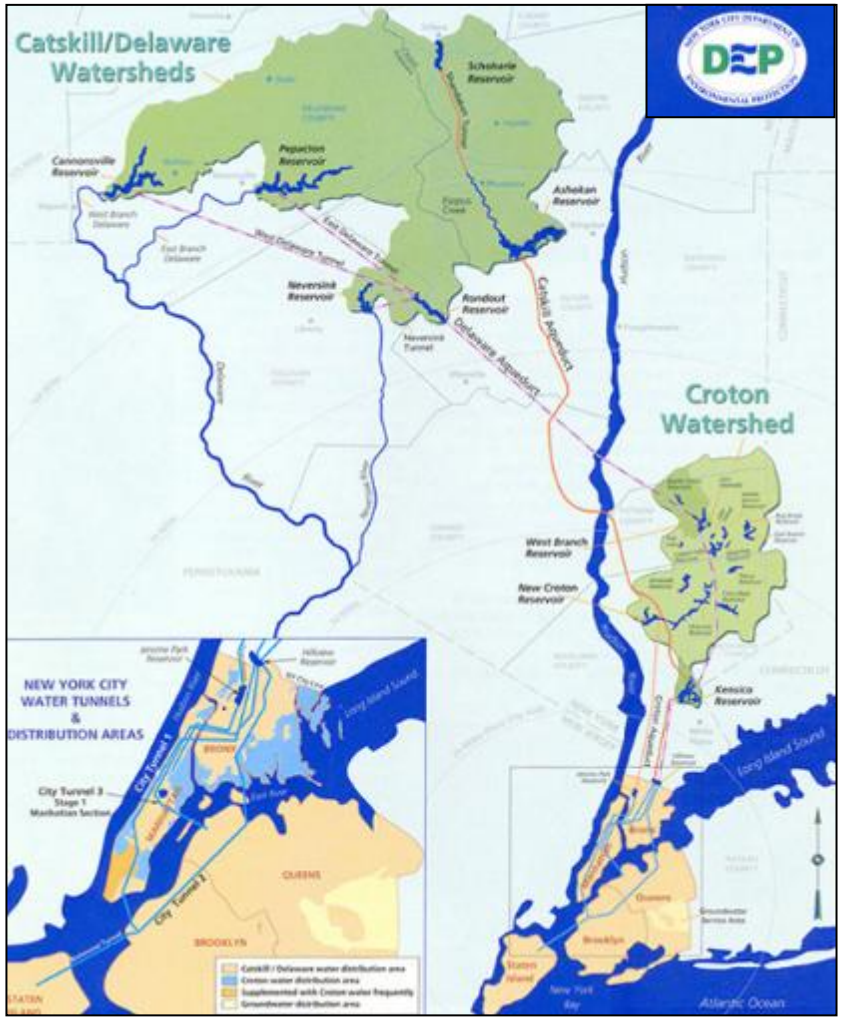
Bloomberg, Michael R. "Citywide Inventory." *Inventory of New York City Greenhouse Gas Emissions - Sept 2011*. Web

WATER USE

New York City takes pride in having the cleanest drinking water in the country.

New York City's Water Supply

- NYC's Water Supply System provides about 1 billion gallons of safe drinking water to New Yorkers daily.
- Three major watersheds in upstate New York contain a network of 19 reservoirs and 3 controlled lakes which supply New York City with water.
- Rain and snow is collected in the reservoirs and then transported to the City through a series of tunnels and aqueducts. The water is disinfected and then delivered to homes and businesses.



"New York City Watershed Program." *New York City Water Supply*. New York State Department of Environmental Conservation, Web.

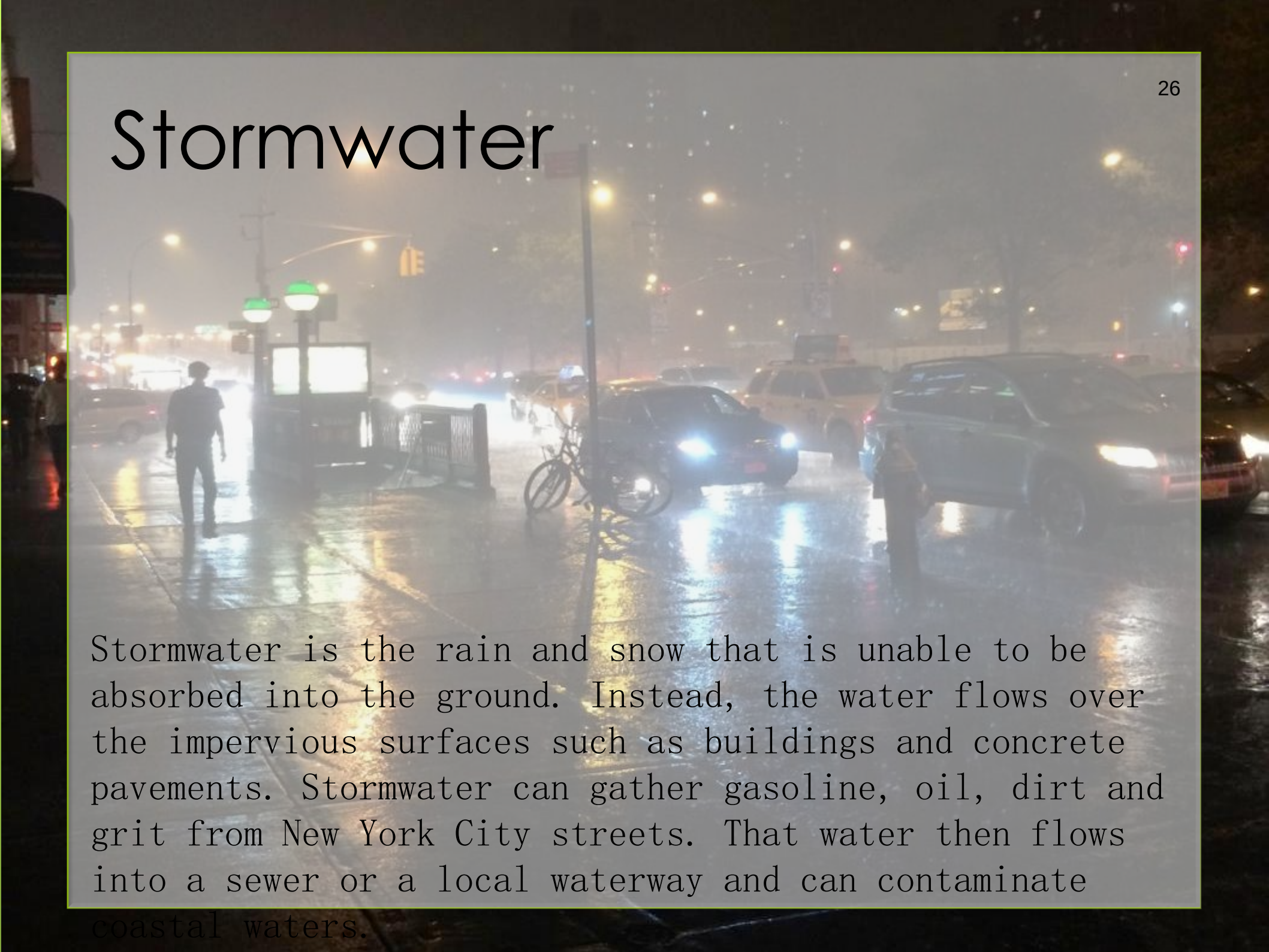
Watersheds

- A watershed is an area of land that drains into a body of water, such as a river, lake, reservoir, or estuary. It includes a network of rivers, streams, lakes, and land surfaces from which water runs off.

- Watersheds are separated from adjacent watersheds by high points, such as mountains, hills, and ridges.

"New York City's Watershed Reservoirs." *NYC Watershed Reservoirs*. New York State Department of Environmental Conservation, Web.

Stormwater



Stormwater is the rain and snow that is unable to be absorbed into the ground. Instead, the water flows over the impervious surfaces such as buildings and concrete pavements. Stormwater can gather gasoline, oil, dirt and grit from New York City streets. That water then flows into a sewer or a local waterway and can contaminate coastal waters.

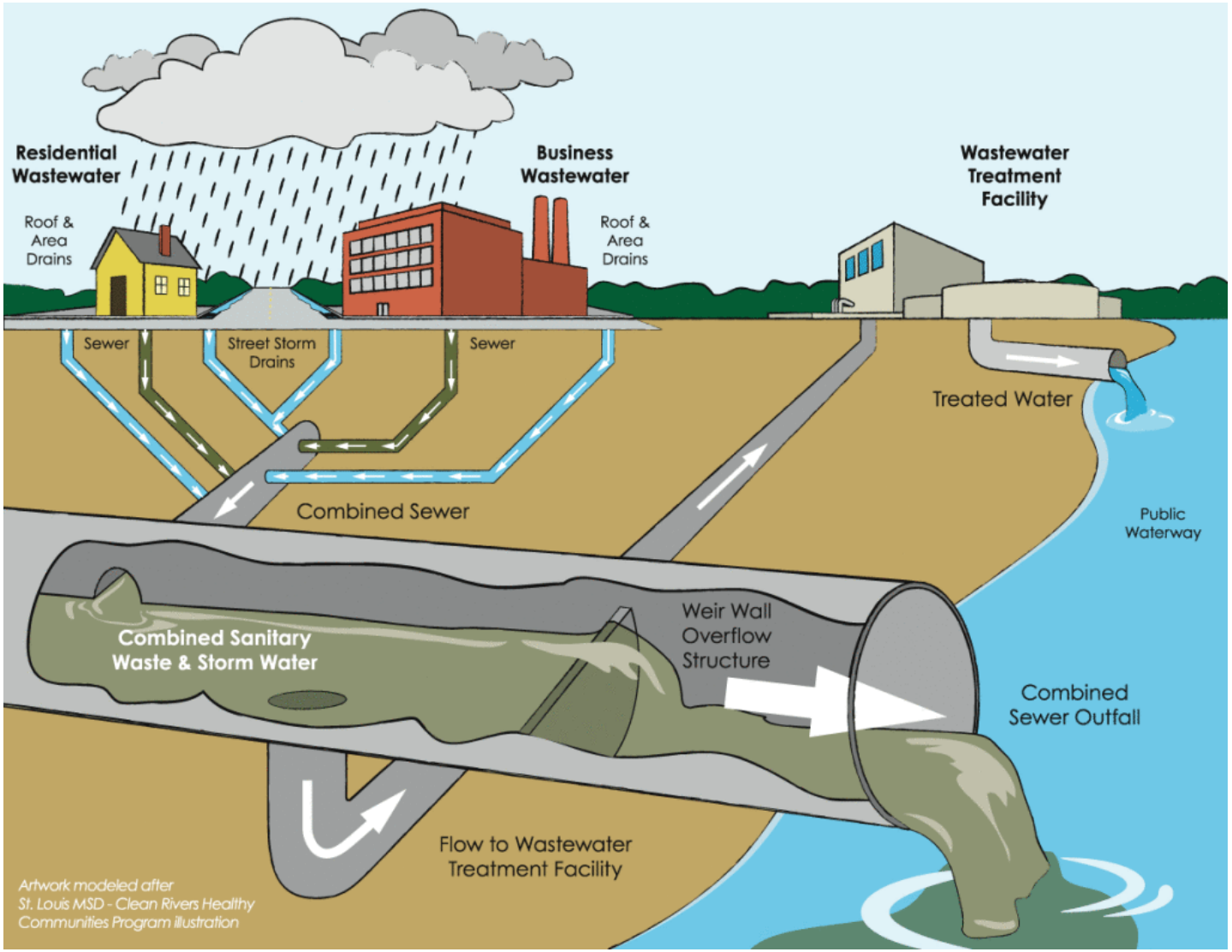
Stormwater, cont.

- The combined sewer system is used to collect storm water runoff, domestic sewage, and industrial wastewater into the same pipe and carry it all to the sewage treatment plants.

- During storm events the capacity of sewers is exceeded, causing the excess, untreated water to be discharged directly into a body of water. This is called combined sewer overflow, or CSO.

- This untreated water can have negative effects on human health and water quality

Combined Sewage Overflow



WASTE MANAGEMENT

The United States produces 70% of the world's solid waste. Americans generate a lot of waste: an average of 4.4 pounds per day per person. In New York City, approximately 10,000 tons of residential waste is produced everyday. Every New Yorker produces about 868 pounds of garbage a year!

"12 Things New Yorkers Should Know About Their Garbage." Citizens Budget Commission. Web.

New York City Waste Management

- All of the landfills in New York City have been filled to their limits. Fresh Kills landfill in Staten Island was the last landfill closed in 2001.
- In the 1990s, the incineration of garbage was prohibited. Municipal incinerators were torn down and apartment incinerators were shut down.
- Today garbage is transferred out of state, as there is no place left within New York City's limits to burn or bury garbage.

New York City Waste Management, cont.

- Since 1997, residential garbage from Manhattan, Brooklyn, the Bronx and Staten Island has been sent by truck to landfills in Ohio, Pennsylvania, South Carolina, and Virginia.

- In 2000, Queens began sending residential garbage to transfer stations in New Jersey. These transfer stations receive waste that will be transferred to another facility for further processing, treatment, transfer or disposal.

- Movement of NYC trash to out of state locations costs the city $300 million each year and releases tons of greenhouse gases

Florio, Antonia. "New York City Trash: Where Does It All Go?" *Sierra Club New York City Group*. Sierra Club, Web

Waste Management and the Environment

- The gas and diesel used by trucks transporting residential waste to transfer stations contributes to the release of greenhouse gases.
- If not lined correctly, landfills can leak toxic liquids into the ground and release methane gas.
- Garbage that is incinerated releases carbon dioxide. Nitrogen oxide and sulfur dioxide are also emitted and cause smog and acid rain.
- Even though New York City no longer incinerates garbage, solid waste incinerators can be found around the country, including in those towns and cities that New York City pays to dispose of its garbage.

Kulpinski, Dan. "Where Does All the Stuff Go?" *Human Footprint*. National Geographic, Web.

FOOD

Food: Environmental Impacts

- Fossil fuels, especially petroleum, are heavily relied upon in the agricultural sector
- The U.S. food industry accounts for about 10% of the nation's total energy used in 2009
- Fossil fuels are needed for operation of machinery, irrigation, production of fertilizers, pesticides and herbicides, and transportation of crops and livestock

Tomczak, Jay. "Implications of Fossil Fuel Dependence for the Food System. "Resilience. Tompkins Country Relocalization Project, Web.

Industrial Farming

Large-scale, industrial farms operate in ways similar to factories in order to
produce large quantities of food at once. Most meat, poultry, dairy, eggs, vegetables, fruits, and baked goods found in supermarkets are produced in this way.

Advantages of Industrial Farming

- Lower monetary cost
  - Intensive agriculture often produces food that can be sold at a lower cost per unit to consumers
- Standardization
  - Factory farming methods permit increased consistency and control over product output
  - Over the last 130 years, the US has increased agricultural productivity. As a result, fewer people are needed to work on farms. Additionally, the growing industrial economy forced workers off of farms into other jobs and/or induced them into other sectors of the workforce.

Advantages of Industrial Farming, cont.

- Availability
  - Decreased costs in production of crops sometimes allows farmers to invest in raising a variety of crops
  - Transportation and preservation of food allows for a larger variety and quantity of produce and

"Fossil Fuel and Energy Use." *Serving Up Healthy Food Choices*. Sustainable Table. Web.

Disadvantages of Industrial Farming

- Machine use
  - Increased use of machinery in large scale farming means that a much larger amount of fossil fuels are being consumed by the industry.
- Chemical use
  - The use of chemical fertilizers, pesticides and herbicides on crops results in pollution of soil, water and air, as well as soil erosion and depletion.
  - The use of hormones, antibiotics and vaccines on livestock results in contamination of soil, water and air by increasingly concentrated animal waste.
- Packaging
  - By over-packaging food, industrial farming creates excess waste

Disadvantages of Industrial Farming, cont.

- Genetic modification
  - Genetically modifying plants and animals to increase productivity or other marketable traits presents health risks for humans, animals, and the environment.
  - It can also cause a loss of biodiversity.

- Monocultures
  - **Monocultures**: agricultural systems in which only one crop is grown over a large area every growing season.
  - Monocultures lead to a loss of biodiversity, an increase in crop failure, a decrease in animal health and welfare, an increased dependence on pesticides, and depletion of soil nutrients.

Greenmarkets

- NYC Greenmarket farmers markets consist of small family farmers that sell their products to urban consumers.

- This can provide many advantages to the local community and reduce the disadvantages listed for industrial farming.

Greenmarkets, cont.

Advantages	Disadvantages
Access to fresh local produce	Local agriculture is subject to local weather, for example, drought, blight, flood can all have heavy disproportionate impact
More nutritious, freshly harvested foods	Less year round availability due to seasonality of produce
Reduction in use of fossil fuels, as food is shipped from the local area	
Reduction in packaging waste	
Support of local community, both socially and economically	

Ramage, Nicole. "The Pros and Cons of Local Farmers Markets." *Food and Drink*. Examiner, Web.

Local Food for NYC

There are now 54 greenmarkets in New York City,

with over 230 farmers and fishermen

Special Focus: NYC - The Concrete Jungle

- Cement is one of the least sustainable building materials
- Its production results in 5% of mankind's carbon dioxide emissions
- It is the second most-used product on the planet after water
- Half of the world's supply of cement is produced in China where approximately 35,000 million tons of CO2 was released in 2012*.
- It also traps heat, which contributes to the urban heat island effect

Green Solutions
GREEN DESIGN

The Central Park complex in Sydney, Australia is an example of a green design building.

Green design is the approach to building and everyday living that minimizes harmful effects on human health and the environment. The designs attempt to safeguard air, water and earth by utilizing sustainable materials and construction practices and reinforcing environmentally benign behavior.

The Heliotrope building in Freiburg, Germany was the first green building to capture more energy than it uses

Green Roofs

Green roofs are rooftops that house plant life such as flowers, grasses, or even fruits and vegetables. They create a heat control system by absorbing the heat energy from the sun, provide a habitat for local species, absorb rainwater from storms, and are a source of locally grown fruits and vegetables for our communities.

Brooklyn Grange

The Brooklyn Grange is a one-acre organic farm in New York City that grows over 50,000 pounds of organic produce on the rooftop of a six-story industrial building. Their goals are to improve access to healthy and sustainable food, provide urban populations with agricultural and environmental education, and make urban farming a viable enterprise.

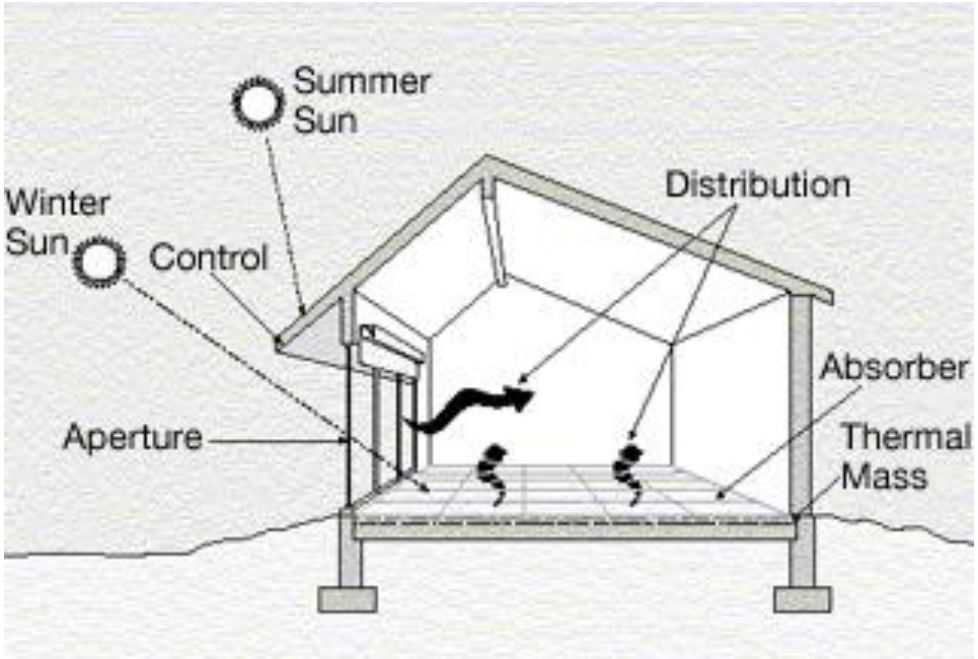
Passive Solar Design

- Passive solar building design uses the sun's energy for the heating and cooling of living space.
- Such design takes advantage of a building's site, climate and materials to minimize energy use.
- Windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter (passive solar heating) and reject solar heat in the summer (passive solar cooling).

Fosdick, Judy. "Passive Solar Heating." *Whole Building Design Guide*. National Institute of Building Sciences, Web.

Passive Solar Design, cont.

- Aperture: a large glass window, typically facing south to allow ample sunlight to enter, especially during the winter
- Absorber: the hard darkened surface (wall or floor) that absorbs heat from sunlight
- Thermal Mass: material below or behind the absorber that stores the solar heat
- Distribution: solar heat is transferred from its collection point to different areas of the building by conduction, convection, and radiation. Small fans and blowers are used to distribute heat.
- Control: The elements that help control passive solar heating and cooling such as overhangs, vents that restrict heat flow, and blinds



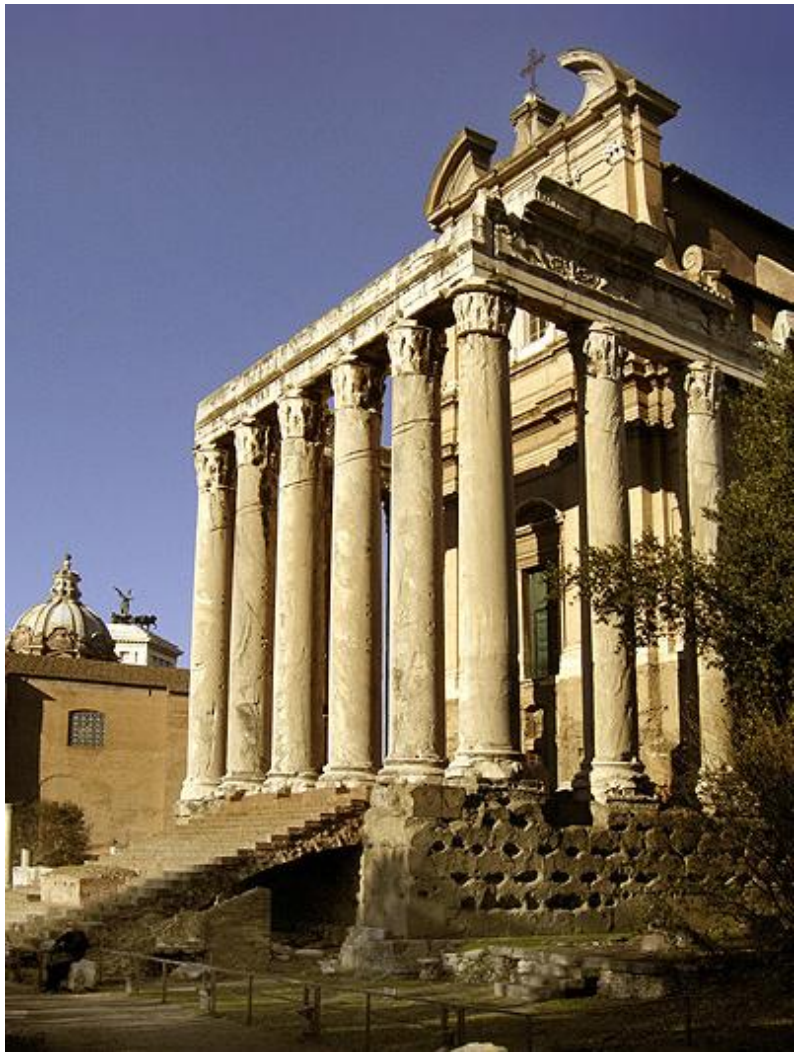
Fosdick, Judy. "Passive Solar Heating." *Whole Building Design Guide*. National Institute of Building Sciences, Web.

Passive Solar Design in History

The Jan Martense Schenck House, 1891. Photograph by the Reverend William Edward Schenck

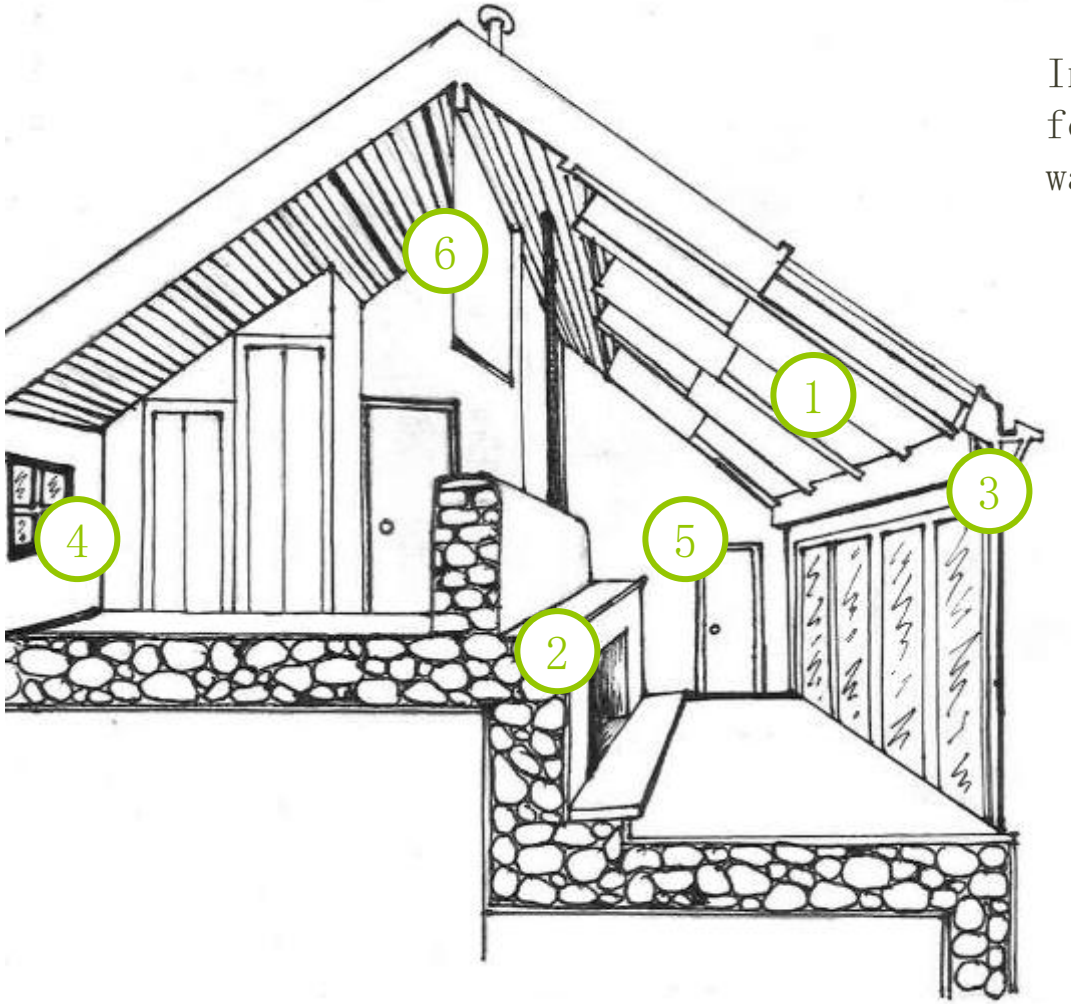
This 18th Century Brooklyn house utilizes passive solar design features. The trees surrounding the house provide shade in the summer, and the porch allows for sunlight in the winter and shade in the summer.

Passive Solar Design in History, cont.



Porticos were commonplace in Ancient Greek architecture. These structures, in which large, separated columns took the place of walls, allowed for sun to enter in the winter, and created shade in the summer.

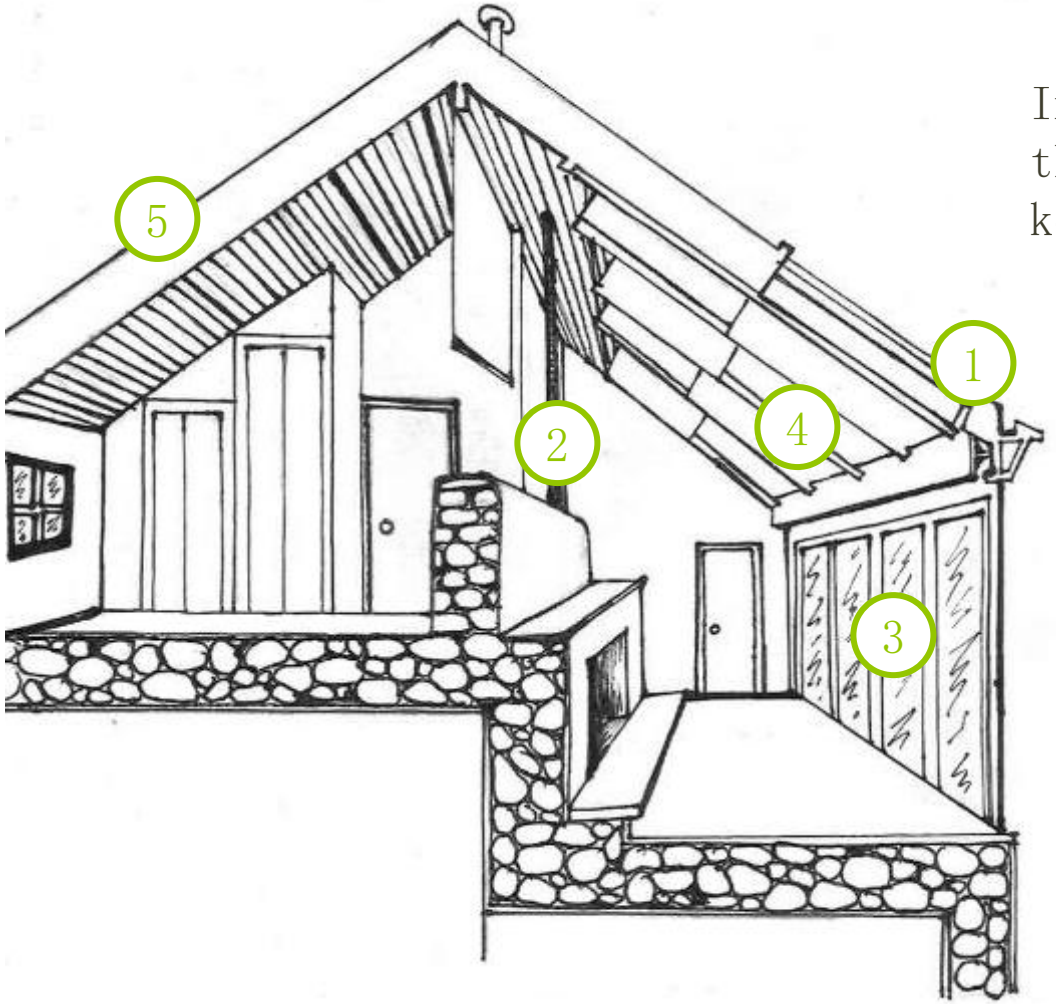
Passive Solar Design Model



In the winter, this building has the following design features to keep it warm

1. Ceiling hatches open on sunny days, warming thermal mass
2. Stove during normal operation and/or fireplace heat occupants and thermal mass
3. South wall has insulated shades and night drapery to resist heat loss
4. North wall windows small to minimize heat loss
5. Weather-stripped doors isolate the unheated areas of the house
6. Heavy curtain isolates bedrooms from main room at night

Passive Solar Design Model, cont.



In the summer, this building has the following design features to keep it cool

1. Adjustable awnings allow for varying levels of shade and sunlight
2. Shape and open concept of rooms allows for cross-ventilation
3. South wall windows are large to allow for increased air flow when opened
4. Ceiling hatches open on cooler days, cooling thermal mass
5. Light-colored, slanted roof reflects sunlight

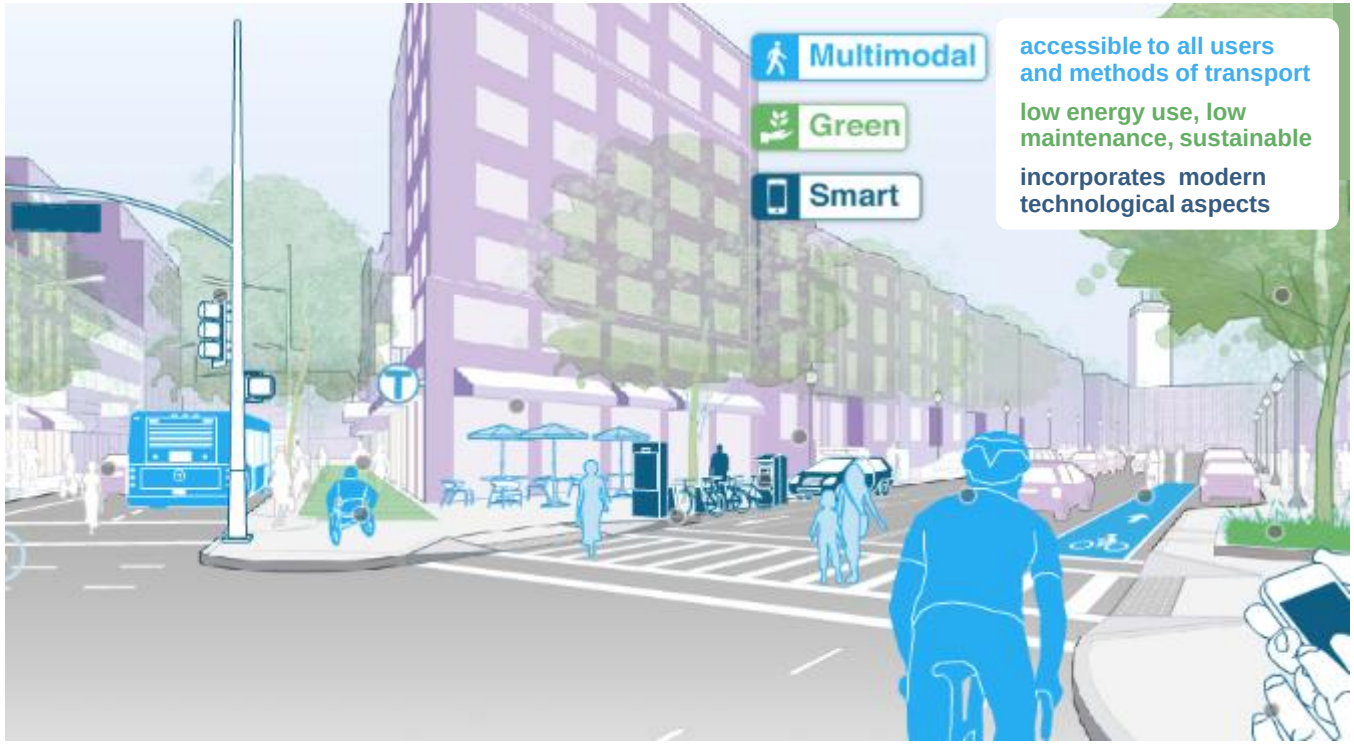
Sustainable Materials in Green Design

Eco-friendly materials waste fewer natural resources during production stages

- Cob: consists of clay, sand, straw, water, and earth; provides a natural way to insulate
- Flooring: cork (renewable kind of wood), recycled plastics, and carpet made by interface (can be replaced and recycled as carpet wears)
- Reclaimed wood: salvaged from old buildings
- Eco-concrete: fly ash recovered from gases created by coal-fired electric power generation; can offset the amount of raw materials needed for cement and reduce the amount of fly ash dumped in landfills

This house is made of cob.

Complete Streets



Complete streets are roadways designed and operated to enable safe, attractive, and comfortable access and travel for all users, including pedestrians, bicyclists, motorists and public transport users of all ages and abilities.

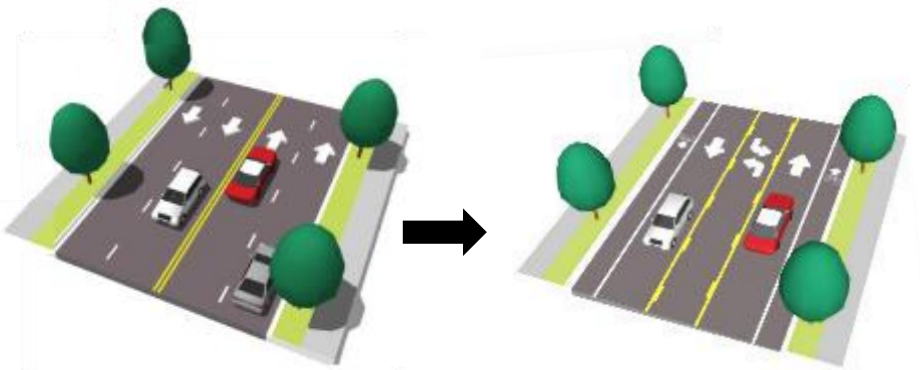
Elements of Complete Streets

- Pedestrian infrastructure
  - sidewalks, including sidewalk bulb-outs
  - crosswalks, including median crossing islands and raised crosswalks
- Accessible pedestrian signals
  - cues for people with low vision
  - push buttons reachable by wheelchair users
- Traffic calming measures to lower speeds and define driving space
  - road diets
  - center medians
  - shorter curb corner radii
  - no free-flow right-turn lanes
  - staggered parking
  - street trees
  - planter strips
  - ground cover

Elements of Complete Streets, cont.

Median Crossing Islands

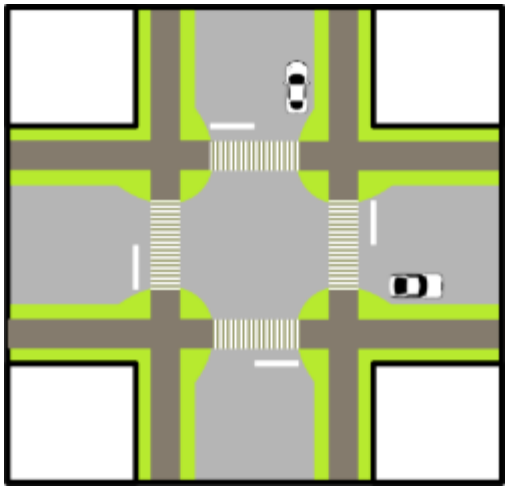
Road Diet



existing 4-lane street

3-lane street with bike lanes

Street Bulb-Outs



Shorter Curb Corner Radii

Bus Lanes

Mass transit accommodations: bus pullouts or special bus lanes speed up public transportation that would otherwise be held up by traffic.

Separated Bike Lanes

Bicycle accommodations: dedicated bicycle lanes or wide shoulders are safer for bikers. Biking is also an environmentally friendly mode of transportation.

Adding More Green Spaces

- Green spaces, such as Central Park, filter pollutants and dust from the air, lower temperatures in urban areas, reduce energy consumption by countering the urban heat island effect, and absorb rainwater runoff.
- Trees provide shade on hot summer days and drop leaves to allow for solar warming in the winter. They also remove carbon dioxide from the atmosphere.
- More vegetation (plants, grass, and gardens) in areas such as playgrounds and sidewalks provide a nice alternative to cement and rubber

Solutions to Stormwater Runoff

- Recycle and properly dispose of household products that contain chemicals such as paint.
- Contained planter boxes reduce impervious area and stormwater volume
- Vegetated swales are gently sloping, vegetated depressions that collect and treat stormwater runoff

"Stormwater Solutions" environmental services, the city of Portland Oregon

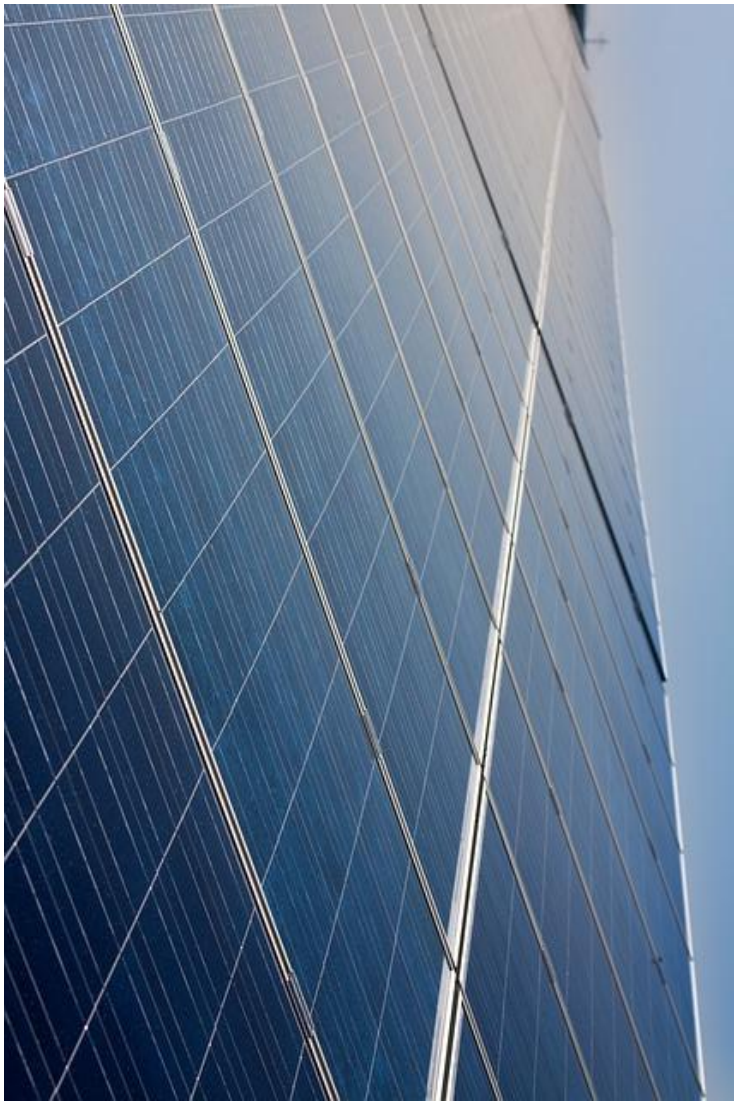
Solutions to Stormwater Runoff, cont.

Eco-roofs manage stormwater with vegetated roof systems

Rain barrels collect roof runoff for reuse

RENEWABLE ENERGY

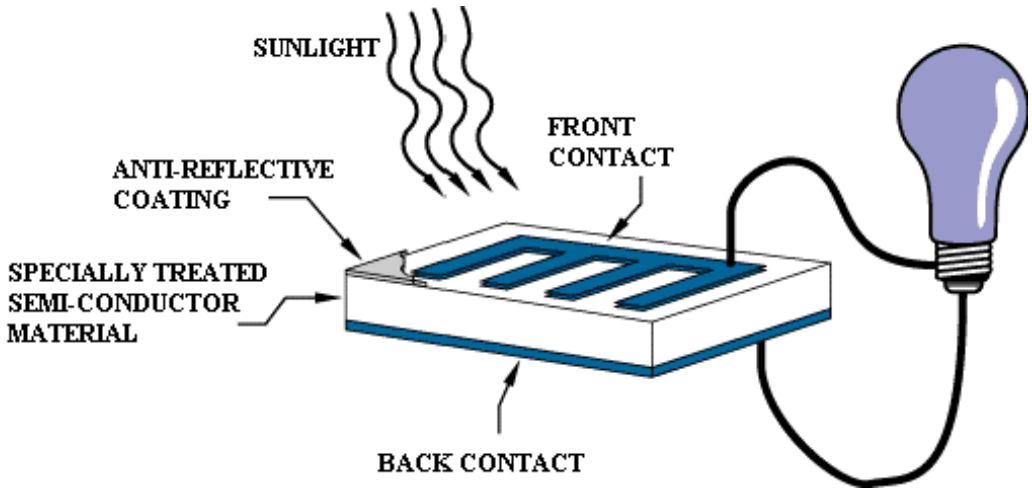
Active Solar Energy



- Every hour, the sunlight that reaches the earth is greater than the amount of energy used by every person on the planet in an entire year.
- We can utilize this energy for solar panels by using light energy (photons) from the sun to generate electricity through the photovoltaic effect.
- Solar panels can be used as a component of a larger system to generate and supply electricity in commercial and residential applications

Photovoltaic Effect

- The photovoltaic effect is the conversion of light into electricity by absorbing photons of light and releasing electrons.
- Solar panels use photovoltaic cells or solar cells, which are made of semiconductor materials (e.g. silicon) with a positive charge on one side and negative on the other.
- Electrical conductors are attached to each side of the cell. This forms an electric current when light energy strikes the solar cell.



Knier, Gil. "How Do Photovoltaics Work?" *Science News*. NASA, Web.

Solar Power on Cloudy Days

- Efficiency decreases as less sunlight is able to pass through the clouds.
- Depending on cloud density, panels can produce 10-25% of expected capacity.
- Germany, which gets less sun than parts of the U.S., is the world leader in producing electricity from solar energy.
- Residential battery systems can be installed to store some solar energy for emergencies or on cloudy days. However, sometimes back-up energy from fossil fuels must be used.

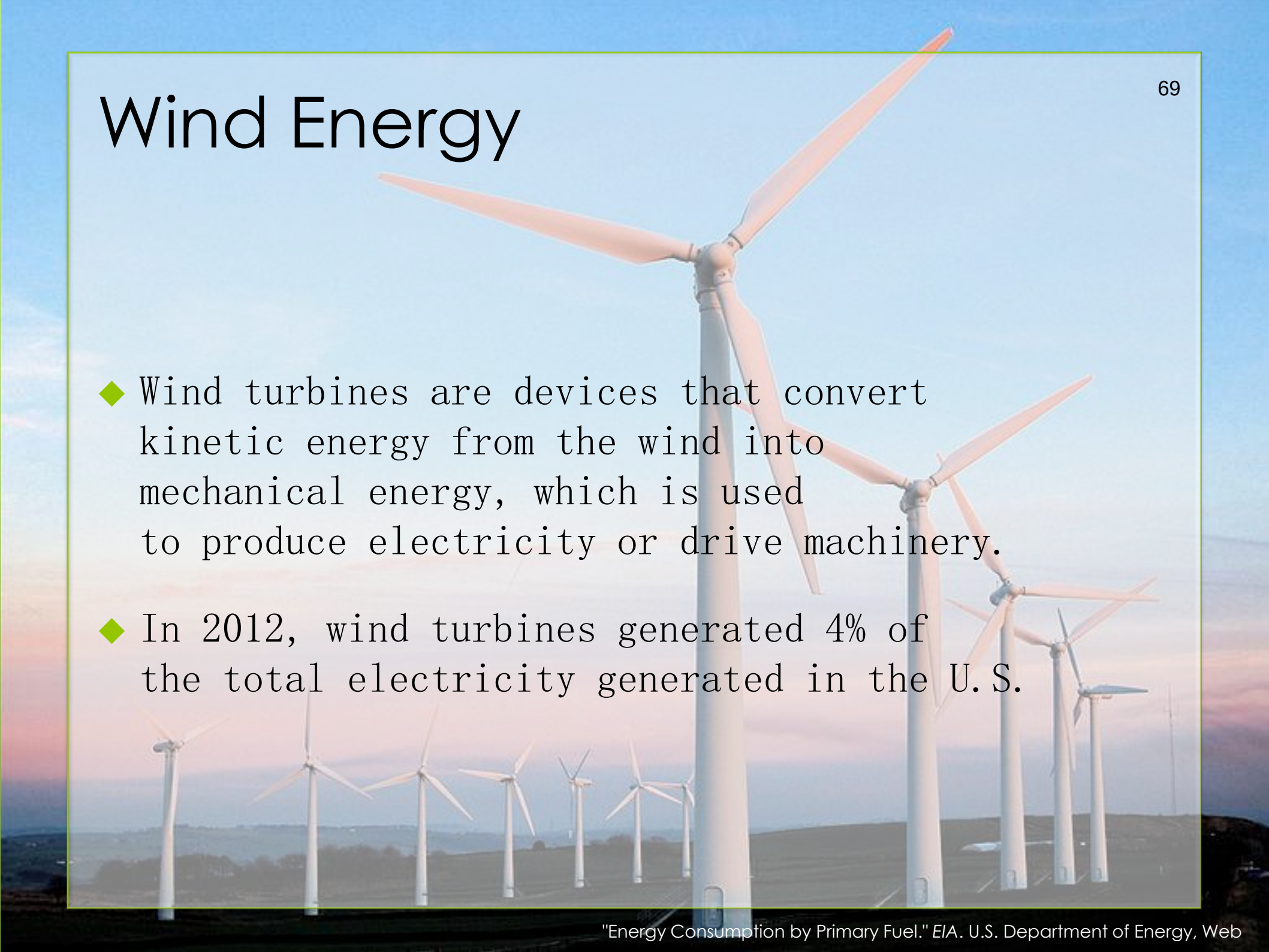
Llorens, Dave. "Do Solar Panels Work in Cloudy Weather?" Solar Power Rocks, Web.

Concentrated Solar Power

- Concentrated Solar Power systems use mirrors and lenses to focus a large amount of solar thermal energy onto a small area, thus producing more energy from the increased heat levels

Solar thermalpower plants, which produce heat or electricity are one example. Solar cookers (also called solar ovens) like this one use lots of carefully angled mirrors to concentrate the sunlight on the pot, which in turn cooks the food without any emissions or pollution!

Wind Energy

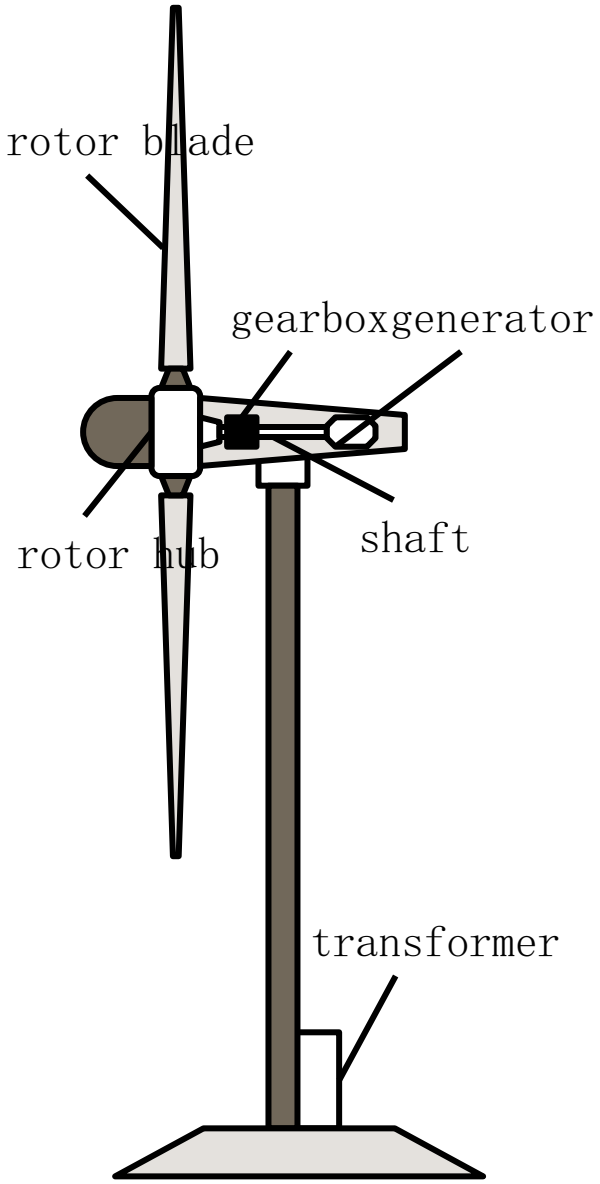


- Wind turbines are devices that convert kinetic energy from the wind into mechanical energy, which is used to produce electricity or drive machinery.
- In 2012, wind turbines generated 4% of the total electricity generated in the U.S.

"Energy Consumption by Primary Fuel." *EIA*. U.S. Department of Energy, Web

Wind Turbines

- When wind turns the blades of a wind turbine, a shaft connected to the rotor of the generator begins to spin.
- When the rotor causes the shaft to spin, the shaft spins a series of magnets surrounding a coil wire, which generates voltage and thus produces electricity.

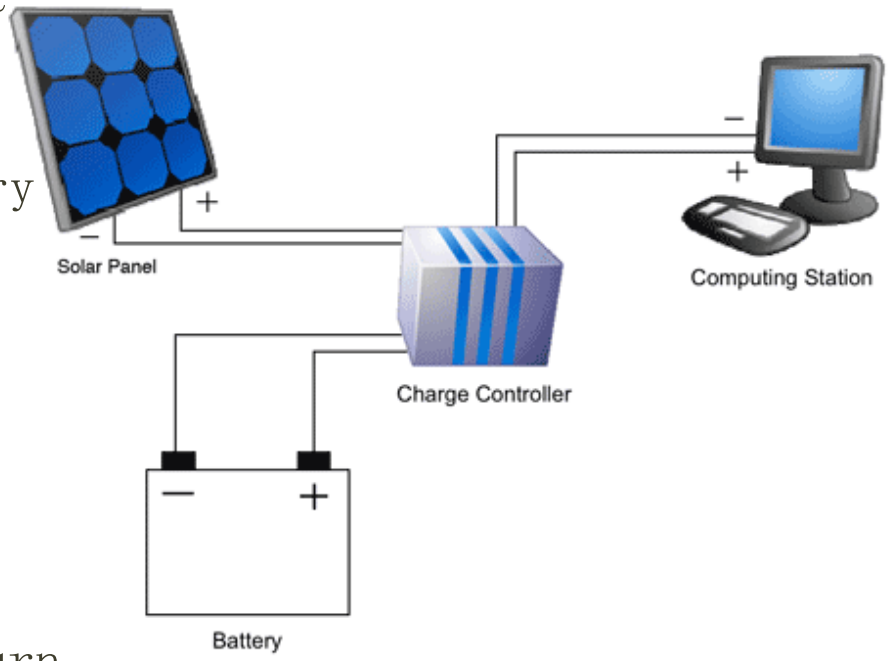


Layton, Julia. "How Wind Power Works." *Green Science*. HowStuffWorks.com, Web.

Storing Alternative Energy

- Batteries store energy produced by renewable energy (solar and wind) for times of low or no renewable energy production.

- The amount of electric current added to the battery from the solar
panel or taken from the battery is controlled by the charge controller,
which protects against overcharging
and overvoltage.



- The charge controller is in turn controlled by a computing station, to make sure the system stays safe and efficient.

"Batteries for Storing Your Solar Power." *The Use of Batteries for Storing Solar Power*. Solar Facts, Web.

RECYCLING

Recycling

- Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash, and turning them into new products.
- Recycling reduces the amount of waste sent to landfills and incinerators and reduces greenhouse gas emissions.
- Energy is saved because it takes less energy to produce materials from recycled material than from new resources.
  - For example recycling of aluminum cans saves 95% of the energy required to make the same amount of aluminum from fresh sources (bauxite)

"Recycling Basics" Recycling, US BPA, Web

New York City Recycling

Other Green Cycles

Cyclical processes reduce the amount of waste we put in landfills

Precycling
thinking ahead before you buy new items

Composting
decomposing organic matter like food scraps to make rich, fertile soil

Freecycling
giving away items instead of throwing them away

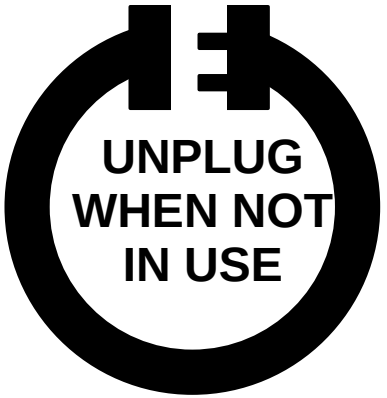
Upcycling
creating useful items from waste material

Downcycling
making a less useful or valuable item from waste items

"The Green Cycles: Recycling, Precycling, Freecycling, Upcycling, Downcycling and E-cycling." Examiner.com. Web.

How can **you** help reduce greenhouse gases?

- Use energy efficient appliances, lighting, heating and cooling equipment; greenhouse gas emissions will be reduced.
- Use water efficiently: take shorter showers, fix leaky faucets and toilets and don't let the water run when brushing your teeth. These behaviors will save water and the energy needed to heat water.
- Use public transportation, carpool, walk or bike. Carbon dioxide and other emissions will be reduced.
- Turn off lights and unplug chargers when you're not using them.
- Reduce, Reuse, Recycle!



Sample Student Green Designs

Past examples of green designs students have developed with GrowNYC

Green Streetscape

Student Green Design, cont.

Student Green Design, cont.

Rooftop Garden

Student Green Design, cont.

Green Streetscape and Green Commercial Buildings

Student Green Design, cont.

Green Streetscape and Green Commercial Buildings

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