

# Sustainability in the Built Environment

**Methods of designing and operating the built environment sustainably**





## Living Sustainability

What are ways that you save energy and water in your everyday lives?



# Living Sustainability

**What are ways that you save energy and water in your everyday lives?**

Examples:

- Turning off the water while you brush your teeth
- Turning off the lights when you leave a room
- Walking, biking, carpooling, or taking public transportation (bus, metro, etc.)



# Terminology

**Sustainability**

**Net Zero Energy/Carbon**

**Resilience**

**Eco-friendly**

**LEED**



# Terminology

**Sustainability** = Using resources at a rate/quantity that does not deplete those resources for future generations or the surrounding ecology

**Net Zero Energy/Carbon** = Balancing the amount of energy you consume (or carbon you emit) with the amount of energy you produce (or carbon you sequester)

**Resilience** = The ability to recover quickly and smoothly from failure or disaster

**Eco-friendly** = Not harmful to the environment

**LEED** = Leadership in Energy and Environmental Design

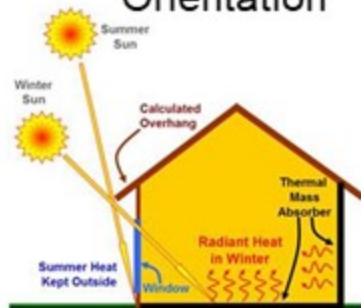


# Sustainable Buildings - Passive Design Architecture

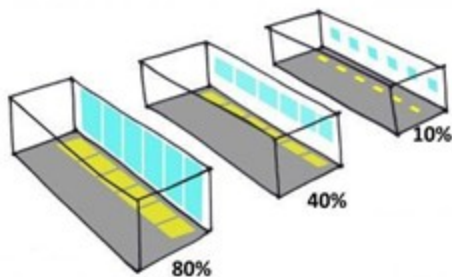
- **Orientation**
- **Window-to-Wall Ratio**
- **Natural Ventilation**
- **Building Envelope**
- **Bioretention/Landscaping**

# Sustainable Buildings - Passive Design

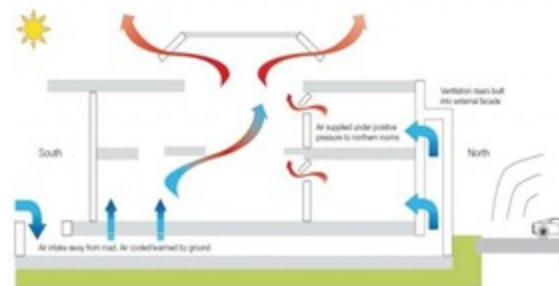
## Orientation



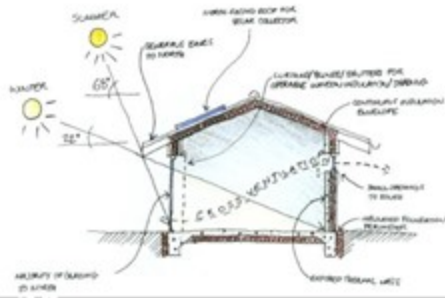
## Window-to-Wall Ratio



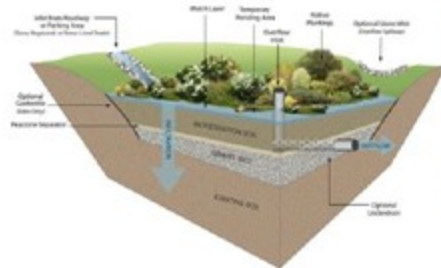
## Natural Ventilation



## Building Enclosure



## Bioretention/Landscaping





# Sustainable Buildings - Active Design Engineering

- **System Controls / Building Automation System (BAS)**
- **Light-Emitting Diode (LED) Lighting, Daylighting, Motion/Occupancy Sensors**
- **Low-Flow Water Fixtures**
- **High-Efficiency, Demand-Controlled Heating, Ventilation, and Air Conditioning (HVAC)**
- **Renewable Energy + Battery Storage**
- **Carbon Capture & Sequestration**



# Sustainable Buildings - Active Design

System Controls/BAS



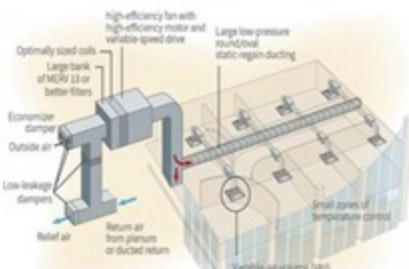
LED Lighting/  
Daylighting/  
Motion Sensors



Low-Flow Fixtures



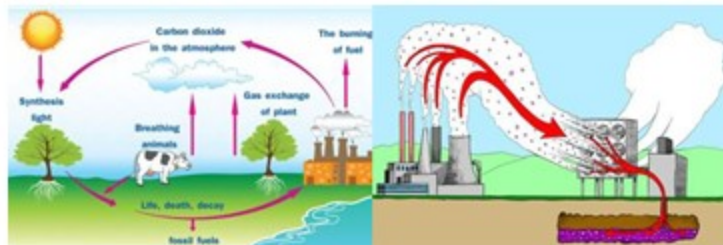
High-Efficiency HVAC



Renewable Energy +  
Battery Storage



Carbon Capture  
and Sequestration





## Utilities

- **Electricity**
- **Natural Gas**
- **Water**
- **Propane**
- **Diesel Gas**



# The Basics of Electricity

**Watt**

**Kilowatt (kW)**

**Kilowatt-hour (kWh)**





# The Basics of Electricity

**Watt** = 1 Joule/second  
(unit of energy)

**Kilowatt (kW)** = 1,000 Joules/second  
(rate at which electricity consumed)

*Example:* 60 miles per hour

**Kilowatt-hour (kWh)** = Rate x Time  
(amount of electricity consumed)

*Example:* 60 mph x 1 hour = 60 miles driven



# How to Read an Electricity Bill

## Service Information

Account Number: 6723359452  
 Account Name: XXXXXXXXXX  
 Service Address: XXXXXXXXXX  
 Next approximate date to read meter: 03/19/18

## General Service Information

Rate: General Service Demand / Winter  
 Billing Period - 32 days: From 01/14/18 to 02/15/18

Rate/Tariff

	Forward kWh	Reverse kWh	kWh
Meter Number: KZG020834943			
On 02/15/18 your meter reading was:	2109	0	
On 01/14/18 your meter reading was:	1832	0	
Meter Multiplier:	40	40	
Your total energy usage (kWhF, kWhR & kW) was:	11080	0	35.20
Your billing period net kWh usage was:	11080		

Historic Consumption & Demand

## Standard Offer Service - Price to compare for electricity supply

Energy Charge	<span style="border: 1px solid red; padding: 2px;">11,080.00 kWh x <del>0.0500</del></span>	<del>554.00</del>
Energy Demand	35.20 kW x \$4.82	169.66
Power Cost Adj - Energy	11,080.00 kWh x \$-0.00226	(25.04)
Power Cost Adj - Demand	<span style="border: 1px solid red; padding: 2px;">35.20 kW x <del>0.00</del></span>	<del>0.00</del>
<b>Total</b>		<b>\$720.86</b>

kWh Consumption

kW Demand

## Distribution Service

Facilities Charge		26.15
Distribution Charge	11,080.00 kWh x \$0.01276	141.38
Distribution Demand	35.20 kW x \$5.26	185.15
Bill Stabilization Adjustment	11,080.00 kWh x \$0.00328	36.34
EmPOWER Maryland Charge	11,080.00 kWh x \$0.00439	48.64
<b>Total</b>		<b>\$437.66</b>

## Regulatory, State, and Local Taxes

Public Serv. Co. Franchise Tax	11,080.00 kWh x \$0.00062	6.87
Electric Universal Service Charge		17.71
MD Environmental Surcharge	11,080.00 kWh x \$0.000151	1.67
<b>Total</b>		<b>\$26.25</b>

## Total Current Charges

**\$1,184.77**

## General Service Energy Usage History

	Jan 18	Dec 17	Nov 17	Oct 17	Sep 17	Aug 17
kWh	12280	7960	8720	6800	10280	6320
kW	45	28	23	26	24	25
	Jul 17	Jun 17	May 17	Apr 17	Mar 17	Feb 17
kWh	8840	8400	6320	8360	8440	7920
kW	28	26	22	32	31	34



# How to Read an Electricity Bill - Rates

## kWh rates

Energy charge	\$0.0508/kWh
Distribution charge	\$0.01276/kWh
EmPOWER Maryland Charge	\$0.00439/kWh
Public Serv. Co. Franchise	\$0.00062/kWh
Tax MD Environmental	<u>\$0.000151/kWh</u>
Surcharge	<b>\$0.068721/kWh</b>

## kW rates

Energy demand charge	\$4.82/kW
Distribution demand charge	<u>\$5.26/kW</u>
	<b>\$10.08/kW</b>