

SUSTAINABILITY AND SUSTAINABILITY DEVELOPMENT BY

**Prof. Dr. Shahlaa E. Ebrahim
Environmental Engineering
Department- College of
Engineering- Baghdad University**

Definition

The ability to meet the needs of the present generation without harming the ability of future generations to meet their needs.

Sustainability development

The use of renewable resources in a way that will not harm the environment, and at the same time, increases the standard of living for people

- ▣ Both allow future generations to survive, but sustainable development improves the quality of life.
- ▣ Sustaining is just meeting their needs, but development is improving.

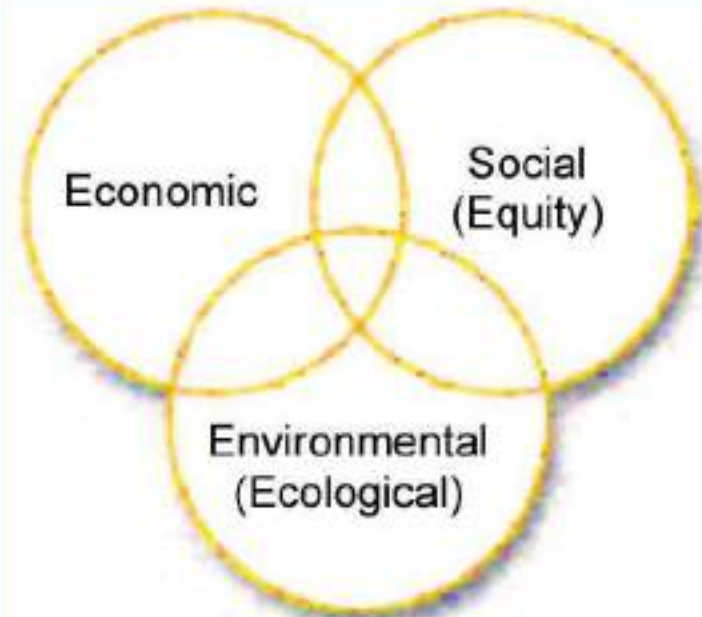
Sustainability



Meet the needs of:

- Environment
- Economy
- Society

The “Triple Bottom Line”



Environment

- **Human Environments**
- Water, wastes, food, housing, transportation, communication, health, crime
- **Natural Environments**
- Ecosystem function, biodiversity, natural capital, species, communities, ecosystems



Economy

- Natural capital
- Human capital
- Organizational (social) capital
- Financial capital
- Technological capital



(human and organizational can be linked as intellectual)

Society

- ▣ **Need to support values and goals**
 - Individual
 - Religious
 - Community
 - National
 - Global



Sustainable Development Principles

- ▣ **Integration.**
 - ensure that economic decisions reflect environmental impacts including human health,
 - environmental initiatives should adequately take into account economic consequences.

- ▣ **Stewardship.**
 - manage the environment and the economy for the benefit of present and future generations.
 - recognition that we are caretakers of the environment and economy for the benefit of present and future generations

Sustainable Development Principles

- ▣ **Shared Responsibility.**
 - acknowledge responsibility for sustaining the environment and the economy

- ▣ **Global Responsibility.**
 - think globally while acting locally
 - recognize there are no boundaries to our environment
 - work cooperatively to accelerate the merger of environment and economics in decision making and to develop comprehensive and equitable solutions.

Sustainable Development Principles

- ▣ **Enhancement.**
 - enhance the long-term productive capability, quality and capacity of ecosystems

- ▣ **Rehabilitation and Reclamation.**
 - restore damaged or degraded environments to beneficial uses.
 - Rehabilitation and reclamation require ameliorating damage caused in the past.
 - Future policies, programs and developments should take into consideration the need for rehabilitation and reclamation.

Sustainable Development Principles

- ▣ **Scientific and Technological Innovation.**
 - research, develop, test and implement technologies essential to further environmental quality
 - including human health and economic growth.

- ▣ **Prevention.**
 - anticipate, prevent or mitigate significant adverse environmental (including human health) and economic impacts of policy, programs, and decisions.

Sustainable Development Principles

▣ **Conservation.**

- maintain essential ecological processes, biological diversity and life-support systems of our environment;
- harvest renewable resources on a sustained yield basis;
- make wise and efficient use of our renewable and non-renewable resources

▣ **Waste Minimization.**

- reduce, reuse, recycle and recover products of our society

World energy use
15 TW-yr
per year

(15 billion kilowatt-hours x 24 x 365 PER
YEAR)



15

RENEWABLES



Natural Gas



Ocean
Thermal
Energy
Conversion



Biomass



HYDRO



Geothermal



TIDES

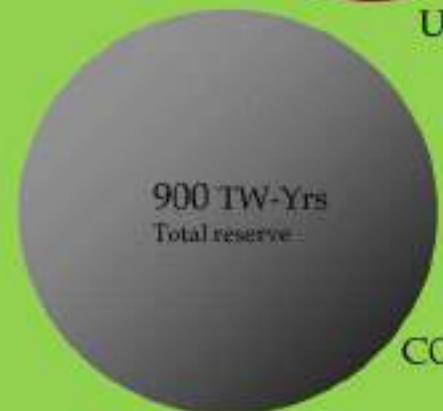


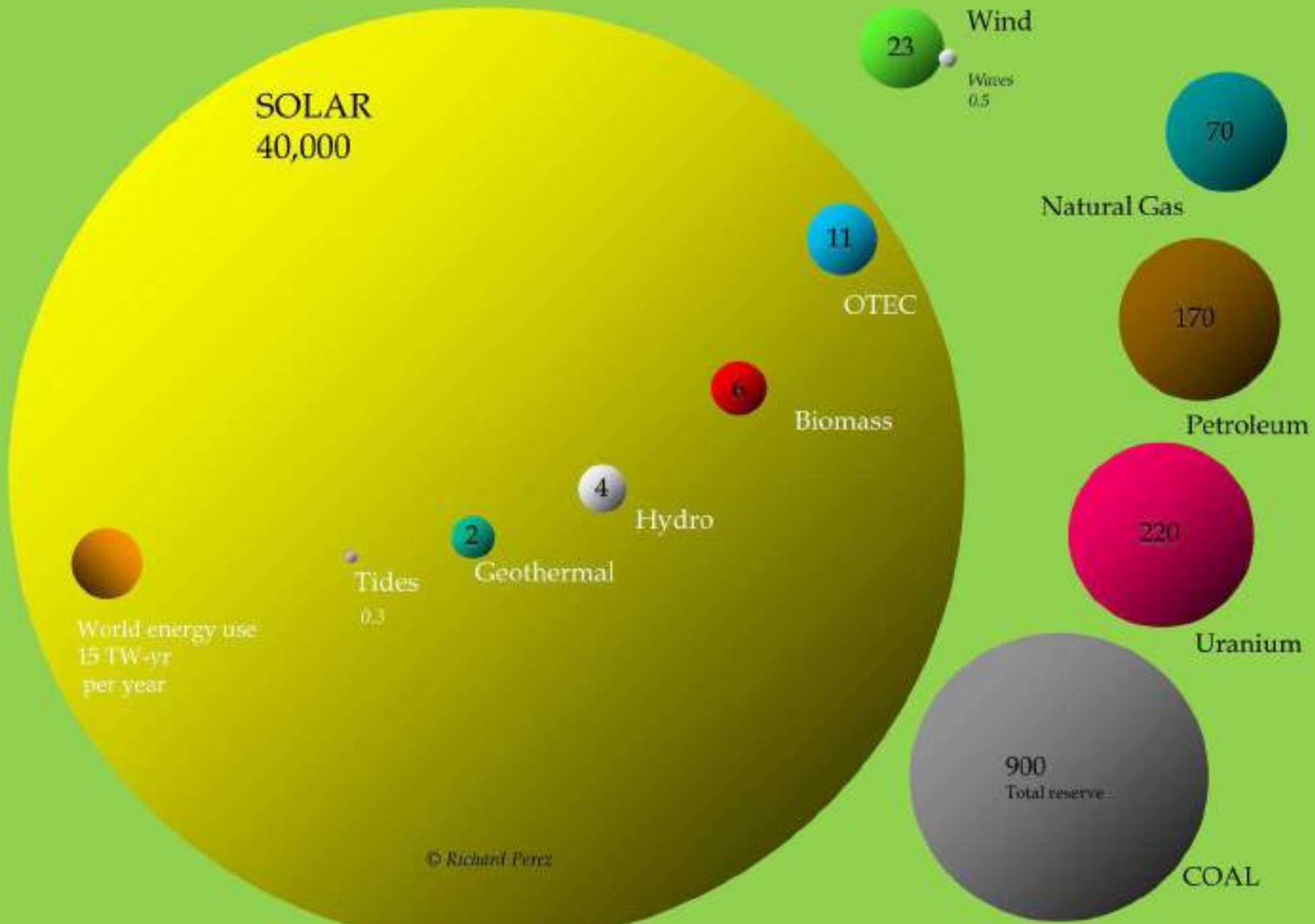
Petroleum



Uranium

FINITE ENERGY RESERVES





Renewable Energy Technology

Motivation for developing renewable sources of energy

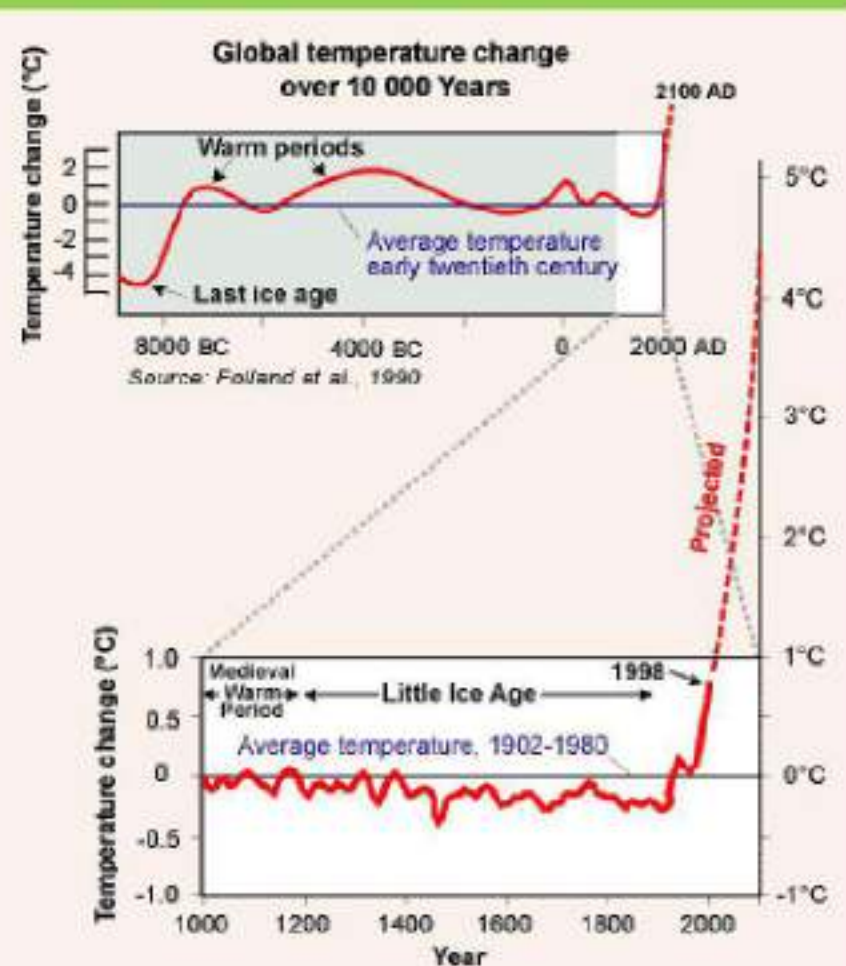
Environmental Motivations

-Climate Change

Increased levels of greenhouse gases
Warmer planet

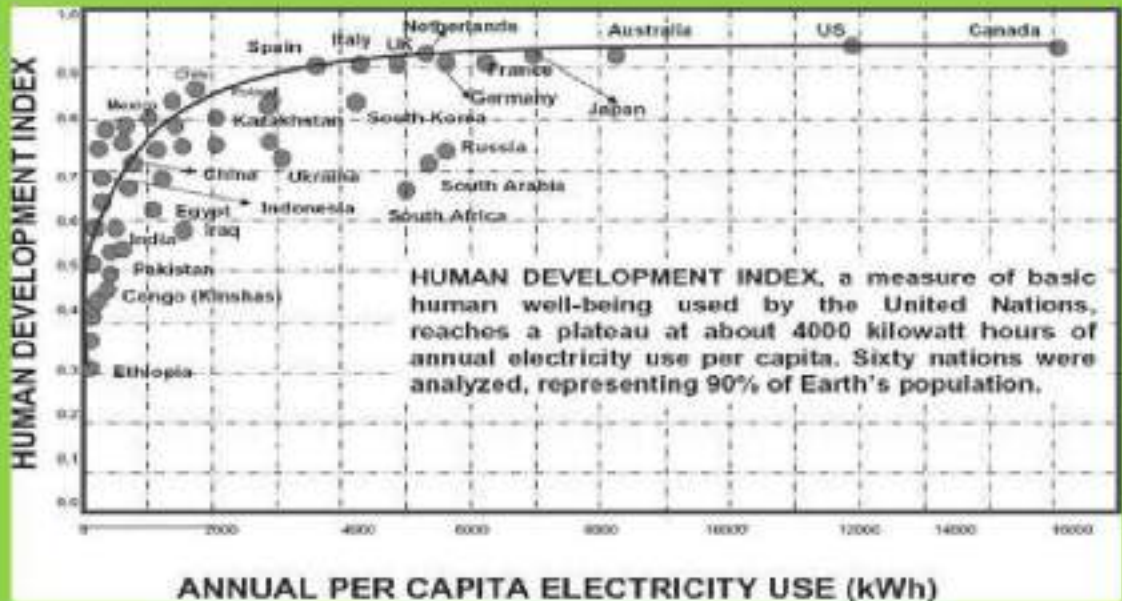
-Environmental Degradation

Loss of biodiversity
Habitat destruction



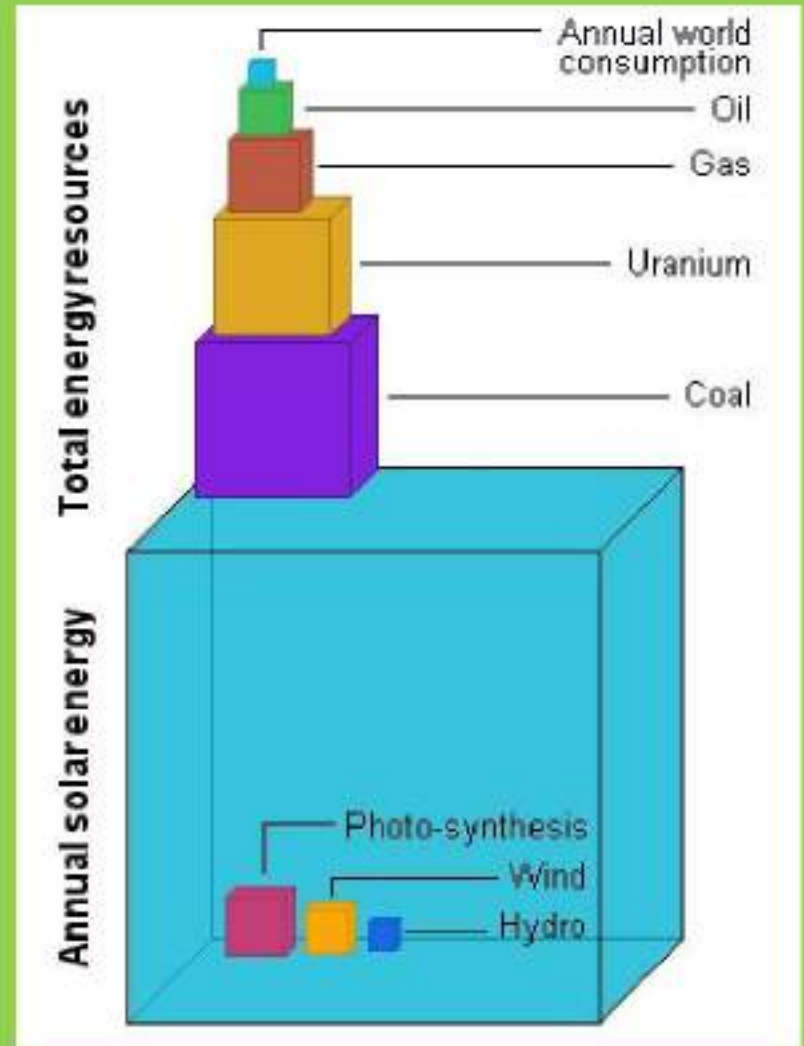
Social Motivations

- Human Welfare
 - Respiratory disease
 - Geopolitical conflict
 - Access to clean water, food



Power Generation: Solar

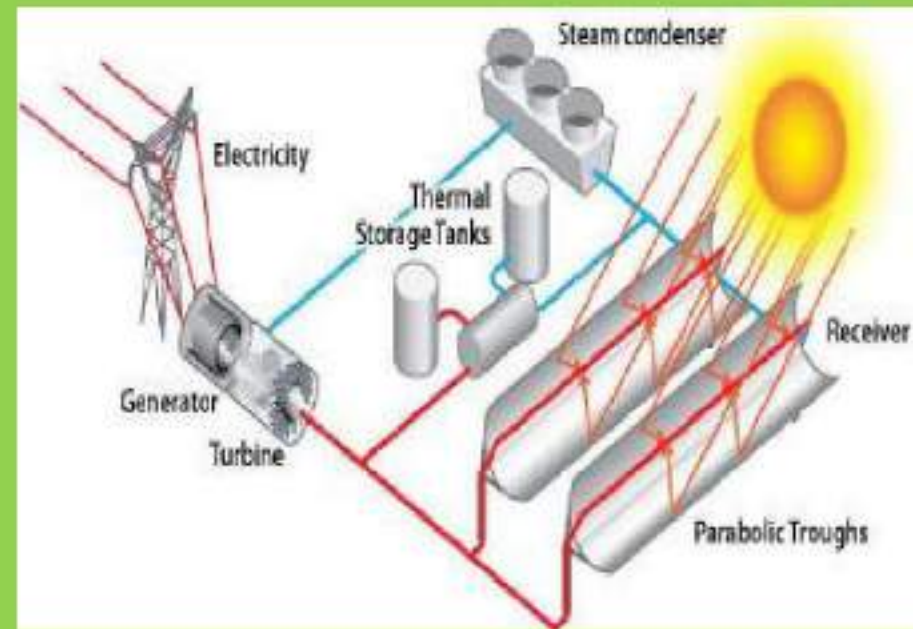
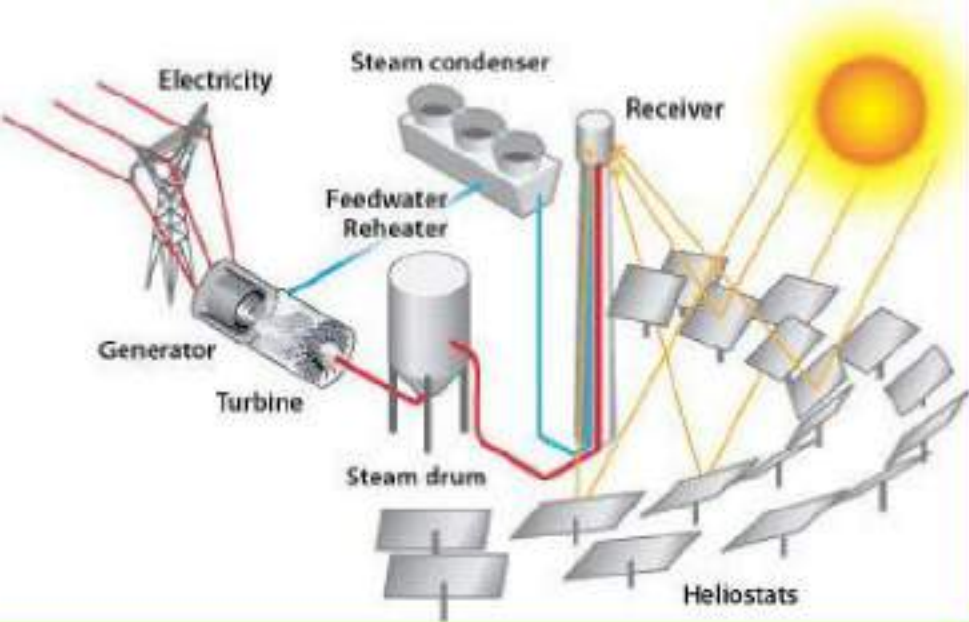
Solar energy is the most plentiful source of energy. Every year we receive 5 orders of magnitude more energy from the sun than we consume. A number of techniques can be used to harness it, and certain techniques are better than others depending on the situation.



Photovoltaics Solar Cells (PV)

PV cells are the most popular or common technique of harnessing solar energy. Commercially available silicon PV's are still quite expensive to produce but are seeing good





Two main types: Central Receiver and Parabolic Trough. Water, or another working fluid is heated by concentrating sunlight on a receiver. Usually steam is created then expanded through turbine to generate electricity. Most solar power plants have some kind of storage system where hot fluids can be kept hot for later use (when the grid needs electricity).

Barstow, California USA
10 MW
Molten Salt energy storage
82,750 m² heliostat area



Here the mirrors, or heliostats, direct rays to a central receiver where a molten salt absorbs heat. This plant produced 10 MW until its decommissioning in 1999. This is obviously a large scale, centralized power plant connected to a massive electrical grid, which contrasts with PV panels which can be placed remotely.

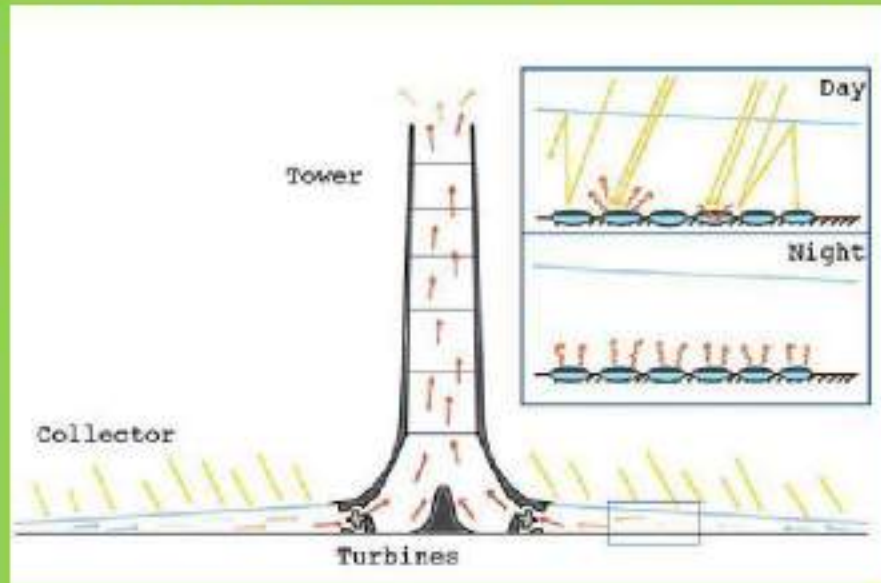
Other systems under development



Solar highways



Other systems under development



Solar Chimneys

Air temperature differential creates draft to power turbines

Area around chimney is heated by sunlight, creating a greenhouse effect. The ensuing wind that is created by air escaping through the chimney passes through turbines that generate electricity.

Solar Energy Outlook

- In principle, greenest and most sustainable energy sources
- Very large potential
- Most expensive technology
- More research is needed to reduce costs
 - *Thin film
 - *Reel-to-reel production



Wind Power

Principle:

Sunlight causes differential heating of atmosphere creating pressure gradients (wind). Wind power can be harnessed using wind turbines.

Wind power might ultimately provide 10 to 15% of our energy needs



Wind Power Outlook

-Wind power has few drawbacks
Can be "unsightly"/"noisy"



-Wind power can be relatively inexpensive (\$0.07/kW.h)

-Currently most economical in remote areas



Wave + Tidal - in development

Since water is 1000 more dense than air, a wave is much more powerful than a gust of wind.

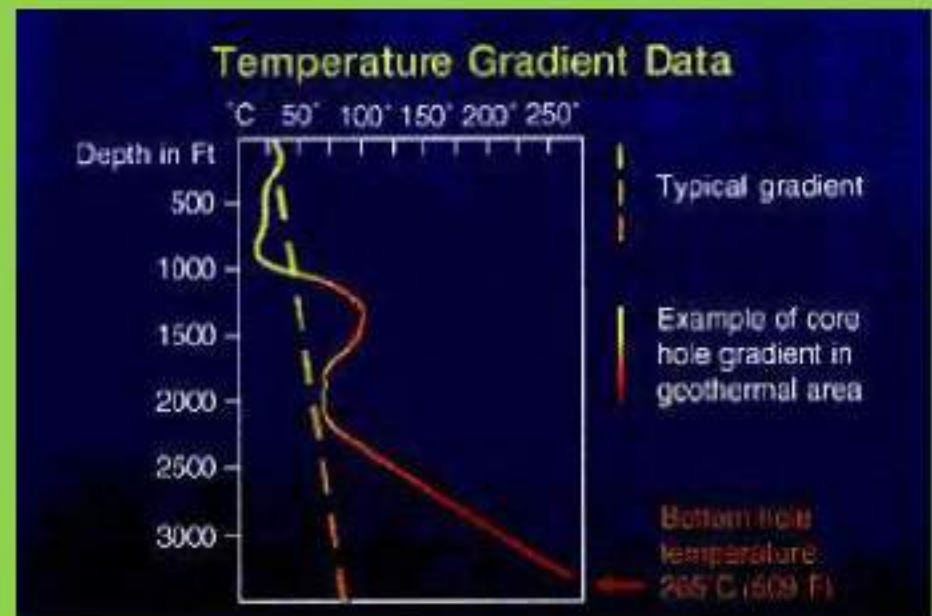
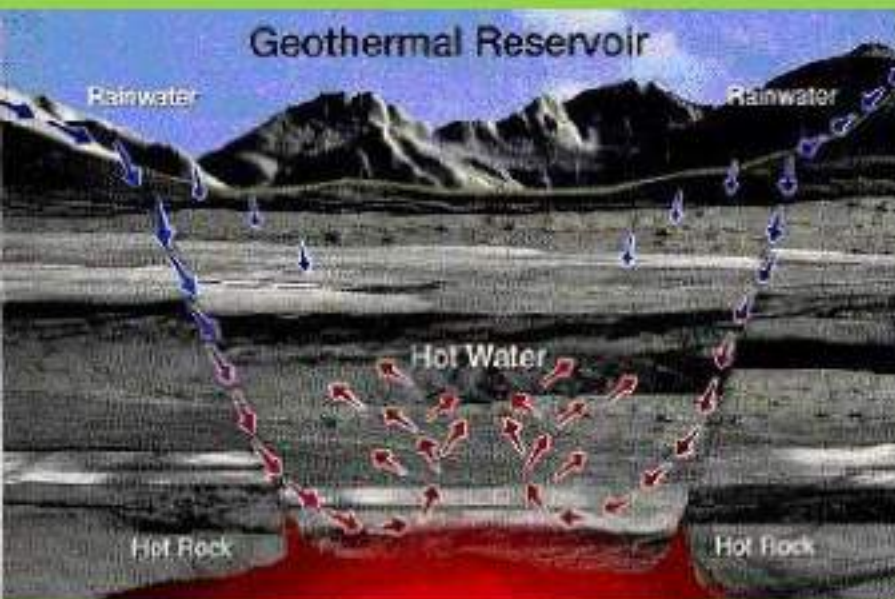
The first wave energy patent is 200 years old.



Geothermal Resources

Principle: Heat in earth's core can be tapped for human use. Near-surface access to this heat is a potential energy source.

Geothermal energy is free and virtually in constant supply. Makes use of thermal gradients in the earth's crust.



Alternative Energy Media

Hydrogen

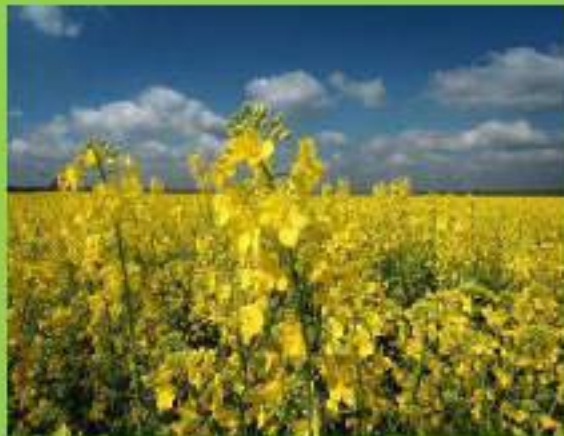
Hydrogen is an energy carrier, not an energy source. When used in a fuel cell, it emits only water. This is attractive from an environmental point of view as well as an efficiency standpoint since fuel cells can be 2-3 times more efficient than an internal combustion engine.

Currently hydrogen is usually produced via steam reformation of natural gas, which does not do anything to help curb fossil fuel use. It can also be produced via electrolysis of water, but this is not efficient. The hydrogen economy will likely start with hydrogen produced via electrolysis using electricity from solar or geothermal energy, or natural gas combined with carbon capture. Need infrastructure in place before adoption of hydrogen.

Alternative Energy Media

Biofuels

Biofuels can become an important transportation fuel and heating oil. Upon combustion they still produce CO₂, however since the feedstocks are all must absorb carbon dioxide to grow, they are considered to be carbon neutral sources of energy. The entire life cycle of the fuel must be analyzed-if fertilizers, pesticides, and energy intensive processing is used, some biofuels are only marginally beneficially to the planet.



Building the World's Most Sustainable City

What is Masdar City?

A Sustainable City
providing the highest quality of life with the lowest
environmental footprint.

- * **100% Renewable Energy**
- * **Zero Waste**
- * **Net Zero Carbon**
- * **Fossil Fuel Free Zone**

What is Masdar City?



Initiative of the Leadership of the
Emirate of Abu Dhabi



Site area: 700 hectares / 7 Sq/KM



Mixed use city



Population:

40,000 residents

50,000 commuting= 90,000 people



Abu Dhabi

Abu Dhabi Airport

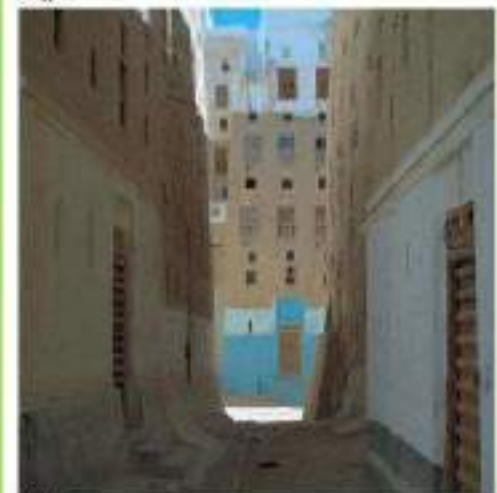
MASDAR

What makes Masdar City Unique?



Traditional Arabic City Design

- Narrow streets
- Natural shading
- High Density
/Low Rise Living
- Public spaces
- Mixed Use
- Walkable





Life in Masdar City – Masdar HQ Exterior



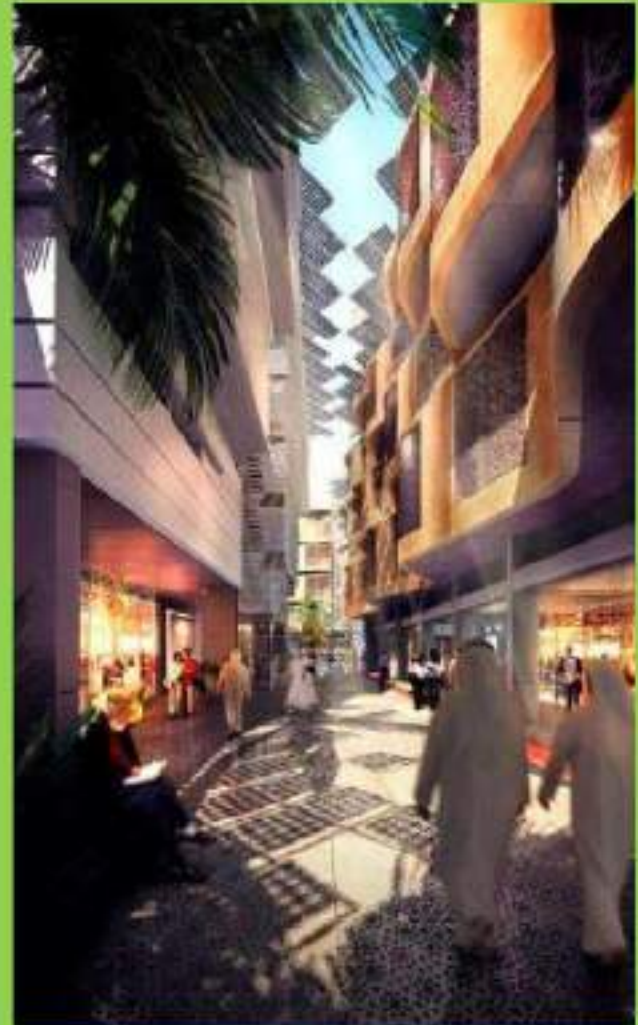
Life in Masdar City – Masdar HQ Interior



Life in Masdar City – Civic Square



Life in Masdar City – Streetscapes



Life in Masdar City - Terrace



What makes Masdar City Unique?

Renewable Energy

- The City will be powered with Renewable energy

Building Design

- Building design will ensure the latest use of energy efficient technologies and smart design

Innovative Transportation System

- The City will contain pioneering public transportation systems

Recycling/Waste to Energy

- The City will strive towards a zero waste objective

Masdar Institute

- A graduate-level, research-driven institution in partnership with MIT

Design of a conventional city

Building Design



Conventional

Energy Generation



Oil &
Gas

Waste



Landfill

Transportation



Fossil fuel

80%

13%

7%

1,100,000 Tonnes CO₂

Design of Masdar City

Building Design



Energy Efficient

-56%

Waste



Recycling/
Waste to Energy

-24%

Energy Generation



Renewable

-12%

Transportation



Electric /
Solar

-7%

-1%



Carbon offsetting/
Carbon
Sequestration

= 0 CO₂

Waste Management

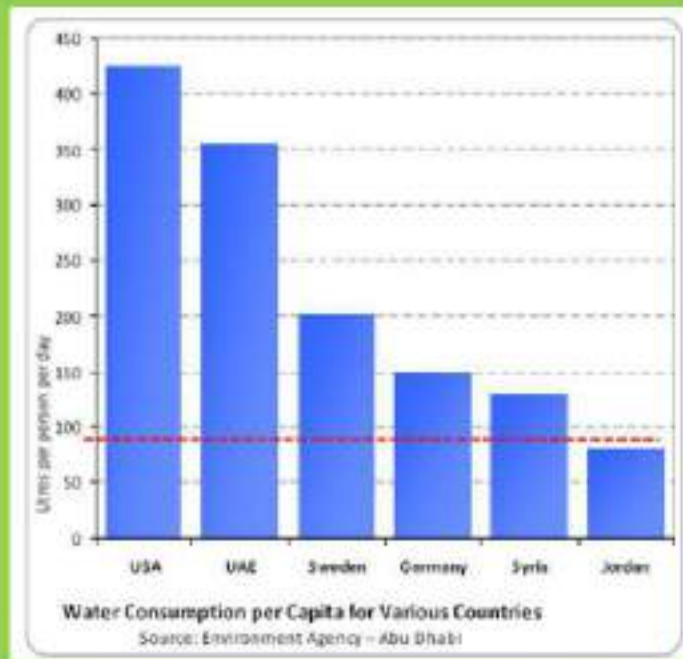
 60% Materials Recycled

 30% Waste-to-Energy

 10% composting



MASDAR Water Strategy



**Reduce consumption to
<80l/p/d**

**Recycle 90%
of grey water**

**Reduce water
leakage to 3%**

Masdar City – Under Construction





THANK YOU!