

Congratulations

- **3rd International Workshop on Renewable Energy and Development (IWRED 2019)**
- **China**
 - **Science & Technology Contributions**
 - **Economic Impact**





Renewable Energy and Climate Change

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Energy

- $\text{Work} = \text{Force} * \text{Displacement}$
- Kinetic
- Potential
- Electrical
- Thermal
- Nuclear
- Ability to cause motion



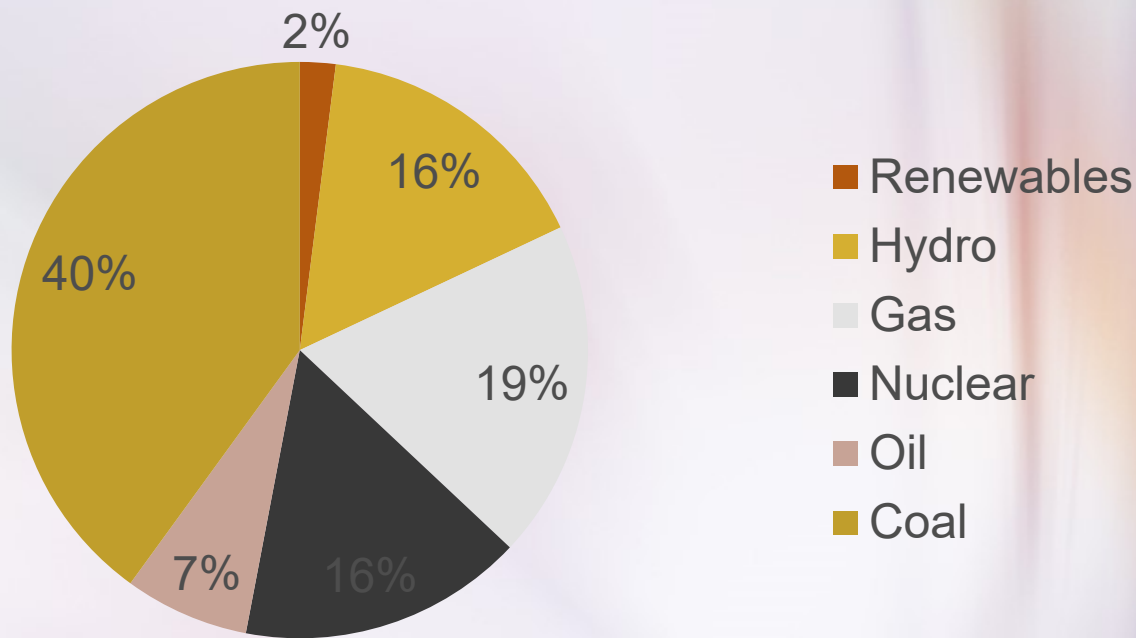
Renewable Energy

- Solar
- Wind
- Bio-Fuels
- Hydro



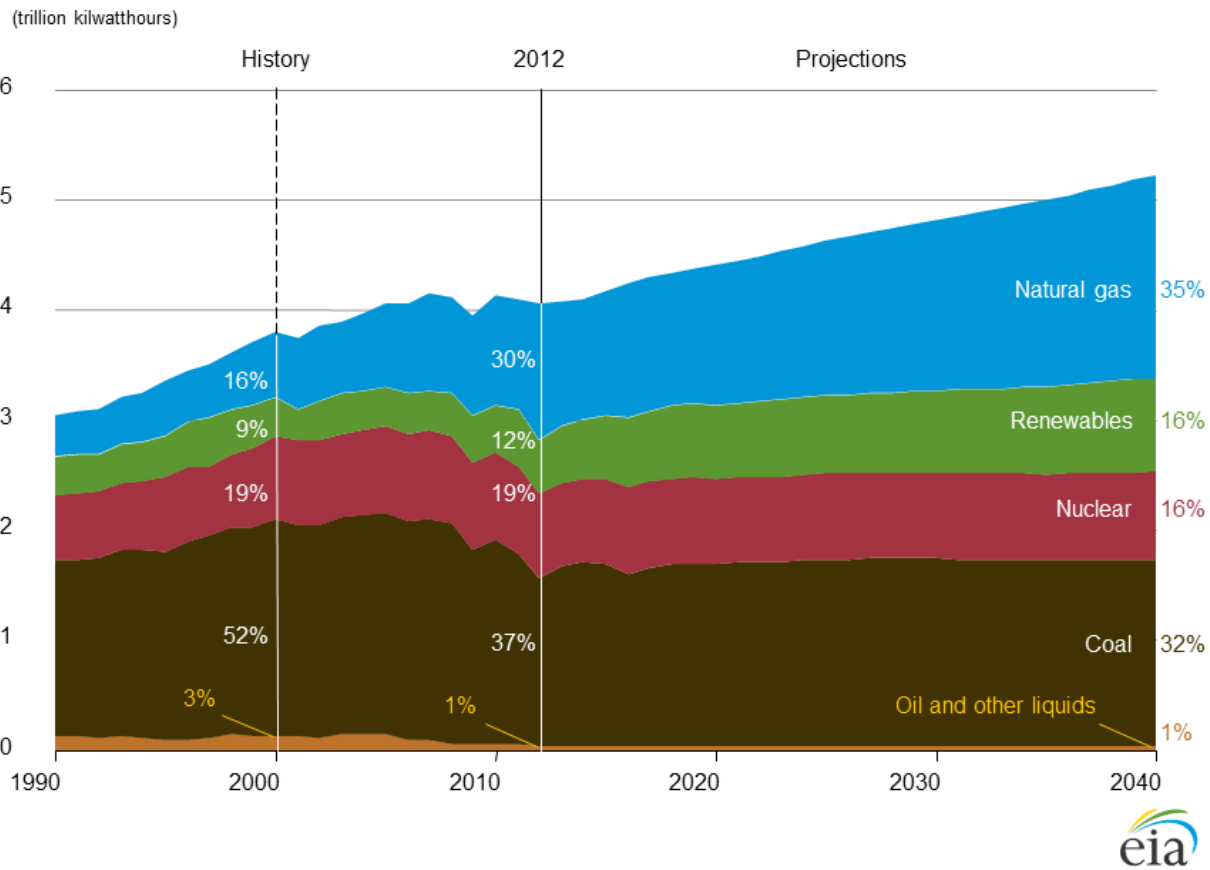
USA & European Union Energy Consumption

US & EU Energy Mix (2012)



US Electricity

Figure 13. Electricity generation by fuel, 1990-2040



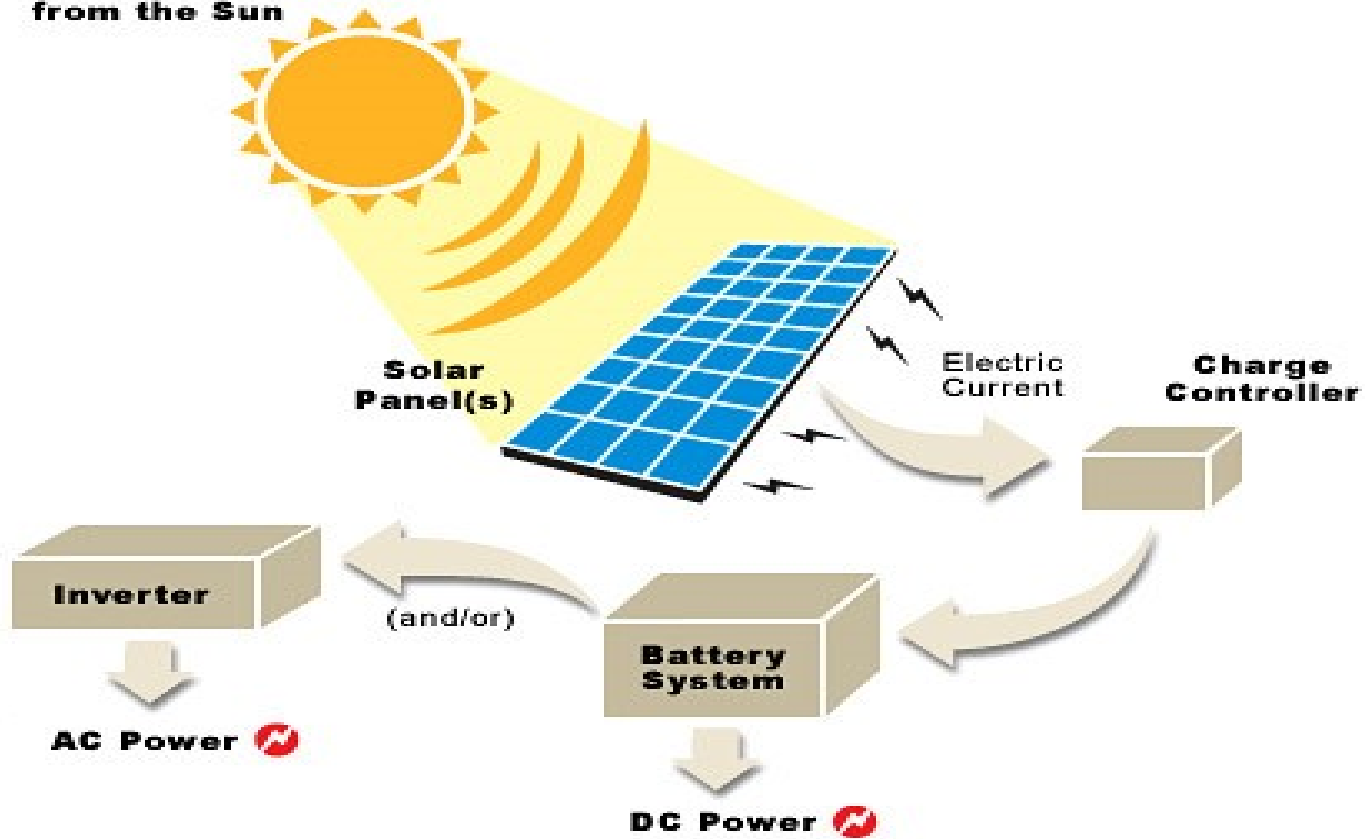
SOLAR POWER

- Electricity/Thermal
- Expensive

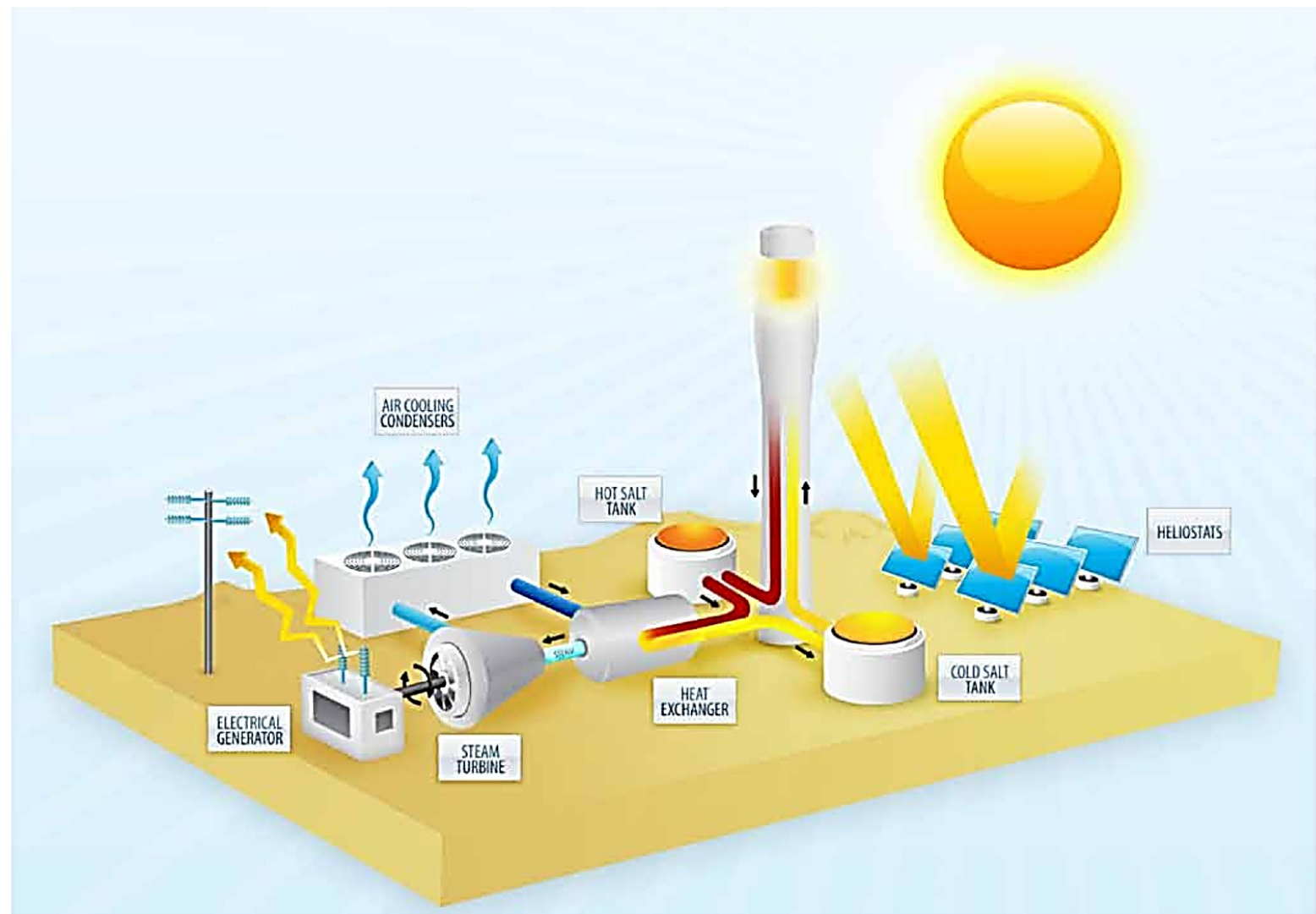


SOLAR POWER

**Solar Irradiance
from the Sun**



SOLAR POWER-THERMAL



PROS SOLAR POWER

- Widely available
- Location independent
- Largest potential for decentralized power generation
- Scaling up (& down) very easy



CONS

- Expensive
- Large up-front Capital investment
- Imposes great stress on the grid owing to fluctuating nature
- Difficult to store energy in electric form



WIND POWER

- KE to Electrical energy
- Broadly Used in USA and Europe



WIND POWER PROS

- Smaller Land requirement when compared to Solar, Hydro
- Can be built off-shore
- Fluctuates less than solar
- Cheaper than Solar



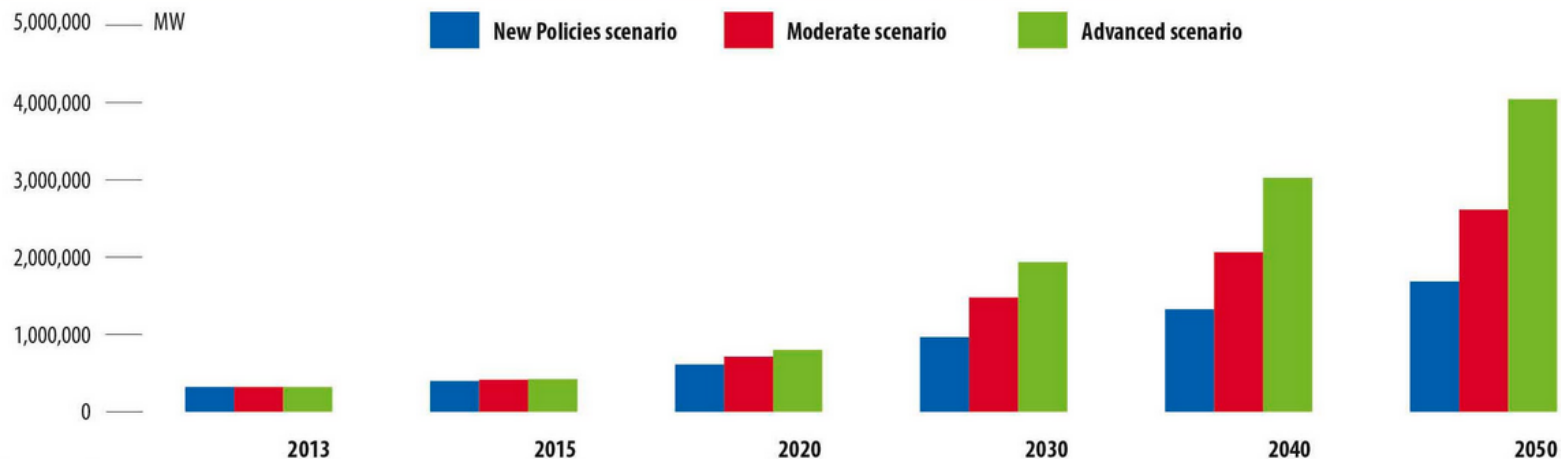
WIND POWER CONS

- Premium Onshore sites saturated
- Intermittency issue
- Offshore towers more expensive
- Energy Storage not viable
- Cause Noise pollution



PROJECTED WIND POWER

GLOBAL CUMULATIVE WIND POWER CAPACITY



New Policies scenario

MW	318,128	396,311	610,979	964,465	1,324,814	1,684,074
TWh/a	620	972	1,499	2,535	3,482	4,426

Moderate scenario

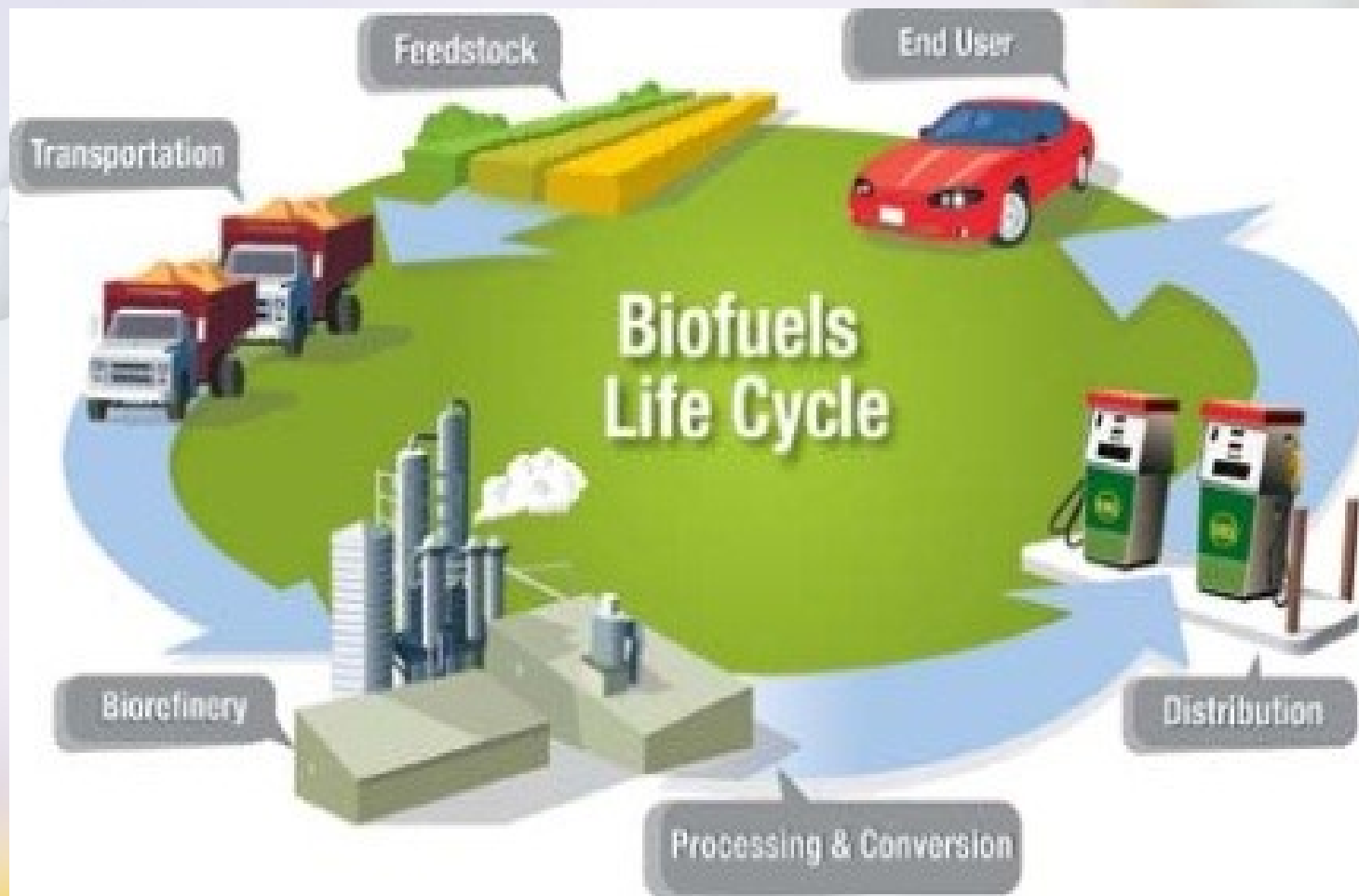
MW	318,128	413,039	712,081	1,479,767	2,089,261	2,672,231
TWh/a	620	1,013	1,747	3,889	5,491	7,023

Advanced scenario

MW	318,128	420,363	800,615	1,933,989	3,024,473	4,042,475
TWh/a	620	1,031	1,964	5,083	7,948	10,624



BIOFUELS



BIOFUELS PROS

- Inherently renewable
- Less emissions

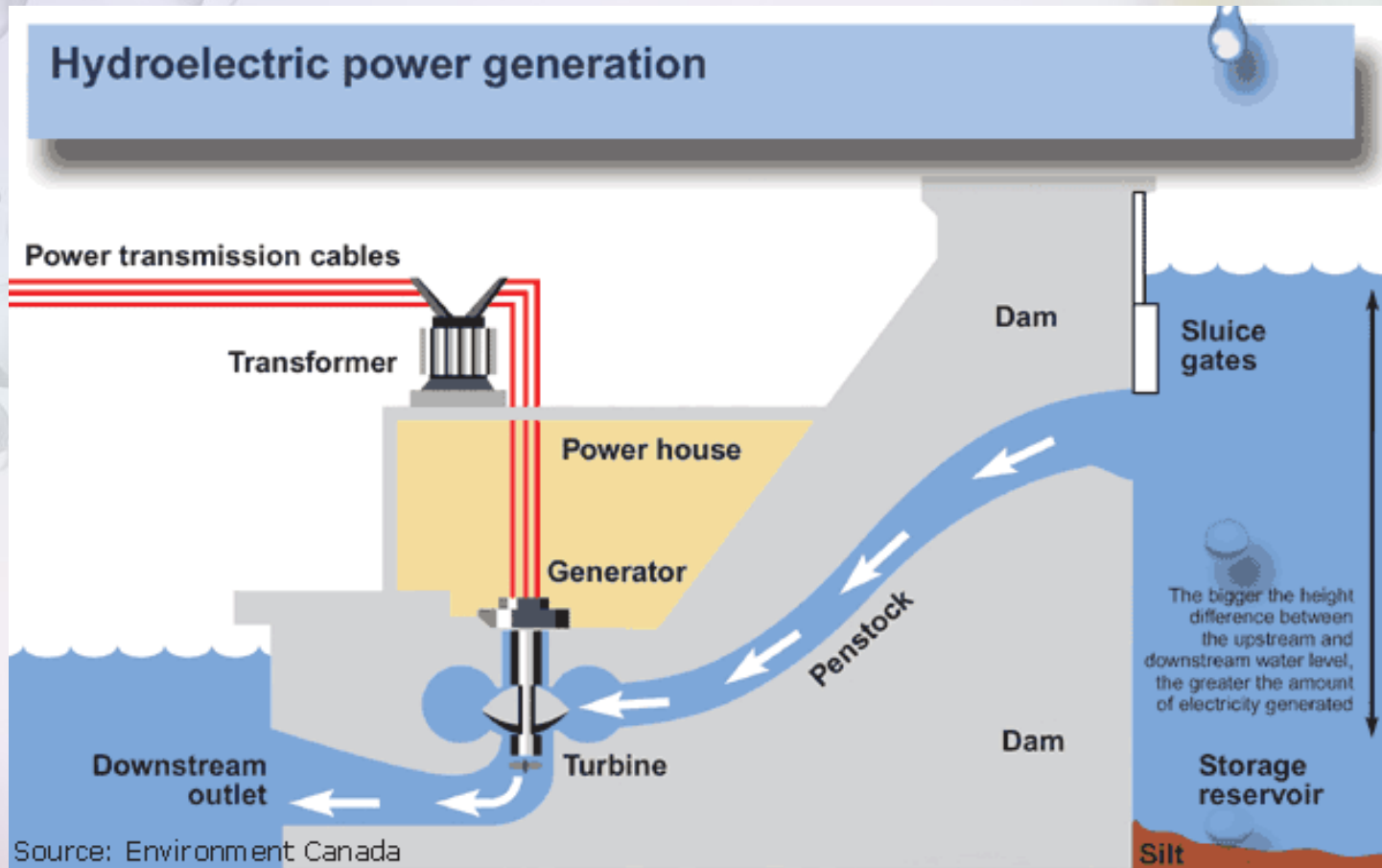


CONS-BIOFUELS

- Land Space
- Energy Input/output issue
- Still polluting when compared to wind or solar



Hydroelectric



Characteristics

- Low cost
- Most mature of renewable energies
- Largest contributor amongst all renewable energies
- Easy “switched on-off” at almost immediately



PROS- Hydroelectric

- Cheap electricity
- Capable of providing base load power
- Capable of large scale production

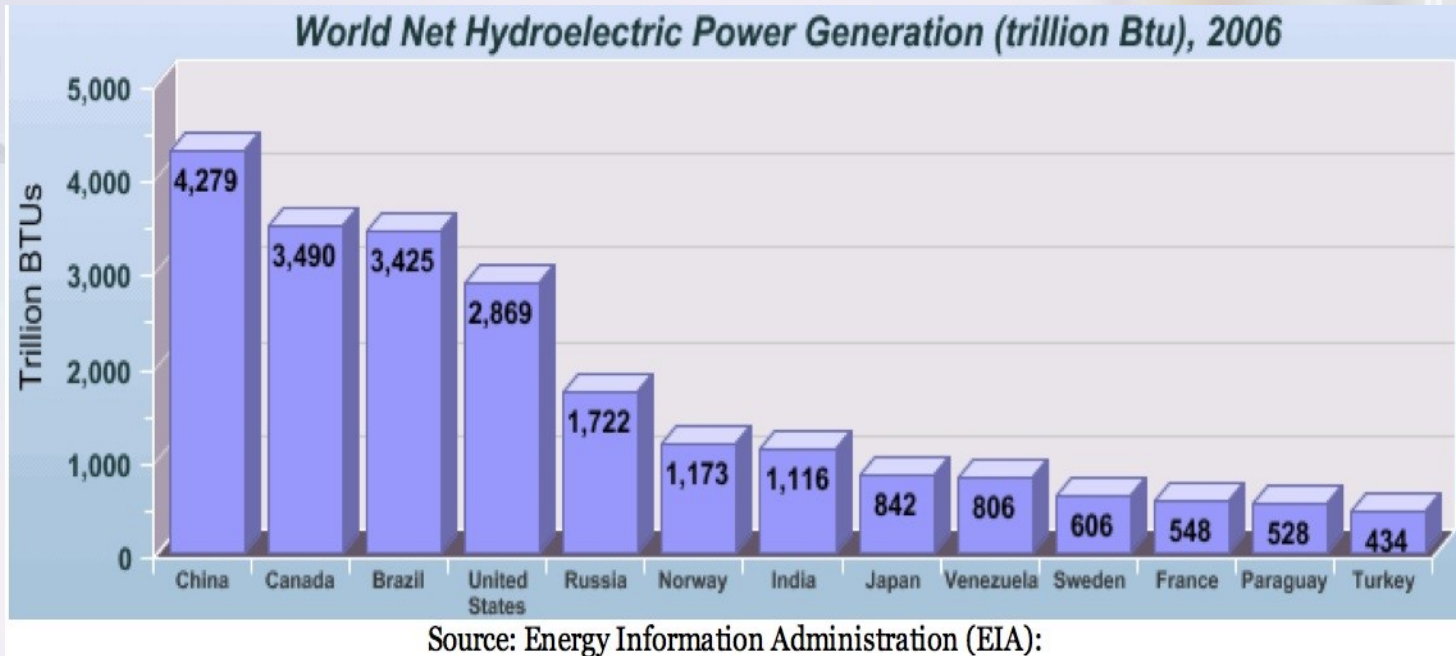


CONS Hydroelectric

- Environmental concerns./Ecology
- Humanitarian implications. Settlement relocation
- Depends upon rain fall
- High upfront capital investment costs



Trends Hydroelectric



INITIATIVES

- Core Course at College level
- Sustainability plans
- Support of Green Businesses



THANK YOU

- Have a great Conference

