Energy Efficient Approaches- Regulations & Effect of Fuel Shift in Energy Conservation

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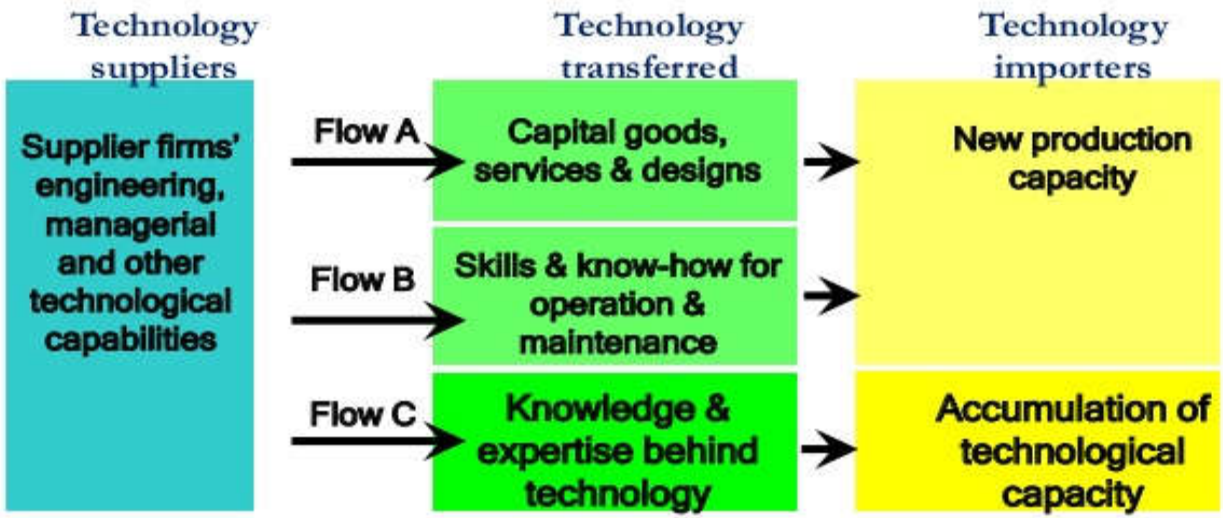
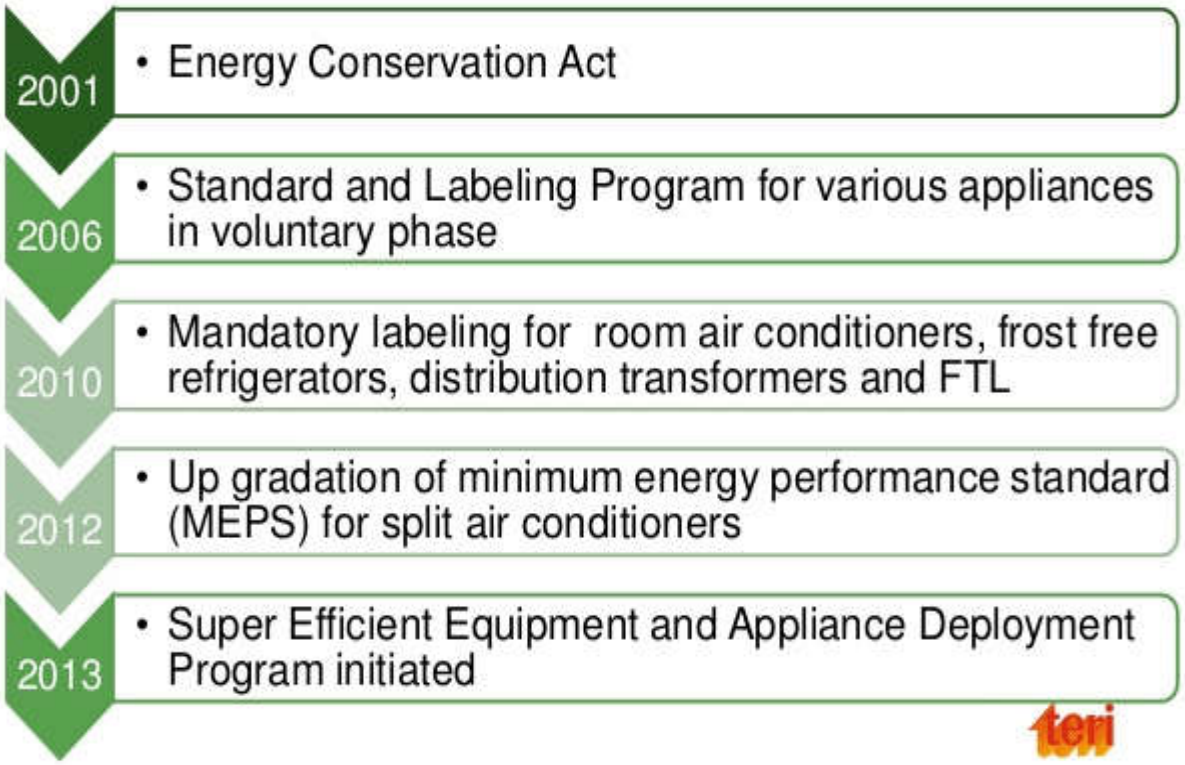
RDD&D projects (R&D, demonstration and dissemination of cleaner technologies

- Identification of sectors and energy intensive processes
- Collaborate with international and domestic experts to develop and demonstrate technologies as per local needs
- Build capacities of local experts and local service providers to disseminate the technology

Technology Transfer – Essential Knowledge Flows



Standard and Labeling Program in India – key milestones



Regulatory and institutional structure- Standard and Labeling program

- Key Nodal Agency – Bureau of Energy Efficiency
- State Designated Agencies at the state level created for implementation of the Act
- Act has the powers to
  - Set minimum energy standards for, and affixing energy – consumption labels on appliances and equipment
  - Prohibit manufacture or sale or import of equipment and appliances that do not meet standards
  - Ensure display of energy performance labels on equipment and appliances

Institutional structure – other important stakeholders

- BIS – National Standards Body
  - Formulation and Implementation of National Standards
  - Production certification, Quality system certification, EMS certification etc.
- Laboratories accredited by National Accreditation Board of Laboratories
- Educational institutions
- Manufacturers and manufacturing associations
- Consumer organizations
- Ministries and departments

Products covered under Indian S&L Program

Appliances under mandatory labeling

- Room air conditioners (split and window), Distribution transformer, TFL and Frost free Refrigerators

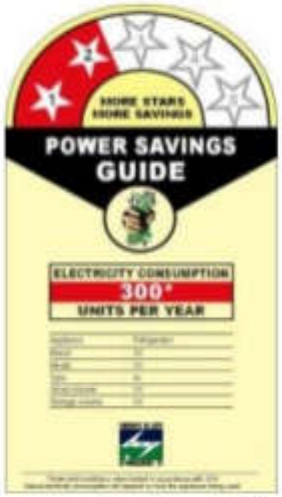
Appliances under voluntary labeling

- Room air conditioners (Cassette, Tower), *Direct cool Refrigerators*, Induction motors, Agricultural pump set, ceiling fan, *Electric Geysers, Color TV*, Washing machines, Computers (Notebook/Laptop), Ballast, Office equipment (Printer, copier, scanner), Gas stoves, Diesel based pump sets, DG sets

Future Equipment for S & L program

- Vehicles, Boilers, Industrial fans & blowers, compressors, Commercial freezers, kerosene stoves, Heat pumps, Uninterrupted power supply (Total – 27 appliances by end of 12th plan)

Source: 12th five year plan report, planning commission of India
Bureau of Energy Efficiency



Launched on 18th May 2006 , for 4 products by BEE

National Mission on Enhanced Energy Efficiency

- The National Action Plan on Climate Change was released by Prime Minister of India in June 2008
- The Action Plan Outlines **8 Missions** including National Mission for Enhanced Energy Efficiency (**NMEEE**)
- The basic objective of the NMEEE mission is to ensure a sustainable growth by an approximate mix of 4 E's, namely-Energy, Efficiency, Equity and Environment

Perform Achieve and Trade (PAT)

- The key goal of the PAT scheme under NMEEE, is to mandate specific energy efficiency improvements.
- These units consume about 165 million ton of oil equivalent energy, which is 50% of energy used in the Industrial sector in India
- By the end of the first PAT Phase-1 (2012-15), the energy savings of 6.686 million ton of oil equivalent /year is expected to be achieved.
- The energy intensity reduction target mandated for each unit is dependent on its current efficiency

Elements of PAT

- **Incentivization and trading of excess savings**
  - Energy Saving Certificates (equivalent to1 toe) issued for savings in excess of target ;
  - Certificates can be traded with other designated consumers who can utilize them to show compliance
  - Certificates can be banked for one more cycle
  - Trading platform on the two power exchanges (IEX & PXIL)
- **Penalty for Non-Compliance**
  - Quantum of non compliance is deficiency in meeting target at the end of the cycle
  - Penalty is the energy cost of quantum of non-compliance
  - Quantum of non-compliance is provided in verification report and penalty is adjudicated by the State Electricity Regulatory Commission
  - Converted energy cost is Rs 10,154 per toe (2011-12) shall be periodically updated

Technology Innovations Needed to Mitigate CO_2 Emissions

- **More efficient technologies** for energy conversion and utilization in all end-use sectors (transportation, industry, buildings, agriculture; power generation)
- New or improved technologies for utilizing **alternative energy sources** with lower or no GHG emissions (such as natural gas and renewables)
- Technologies for **CO_2 capture and storage** (for large-scale industrial processes like electric power generation and fuels production)

Facilitating Energy Efficiency

- New investments in power, industry, transport and building infrastructure can be substantially more efficient than existing stock; economic growth is powering a rapid increase in these sectors, and associated emissions.

- Almost all countries exhibit declining energy intensity trends for the economic sectors; most countries have some initiatives to promote energy efficiency in these sectors
- Technology integration, support, and financing risks are high
- Adoption is driven by quality and productivity increases

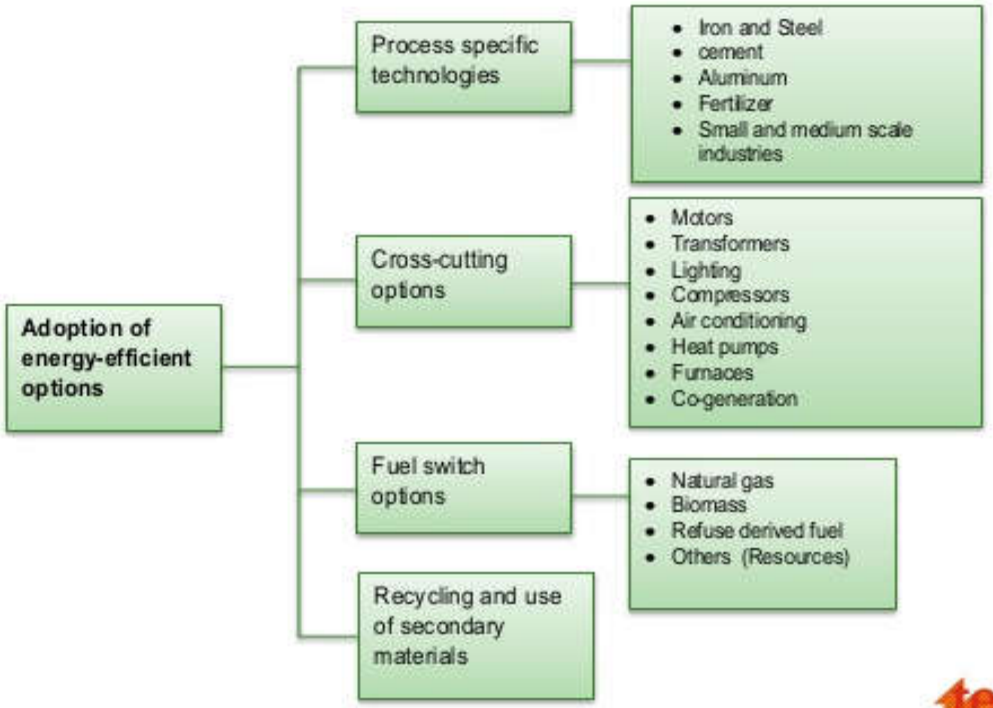
Picture: Courtesy of Emerson Process Management

Energy Supply Sector: Technical Options

- Advanced conversion technologies
  - advanced pulverized coal combustion
  - fluidized bed combustion (atmospheric and pressurize
  - coal gasification and combined cycle technology
  - combined heat and power systems
  - cogeneration
  - fuel cells/hydrogen
  - Synthetic fuels from fossil resources w/CO2 sequestration *in situ*.
- Switching to lower carbon fossil fuels and renewable energy
  - hydropower
  - wind energy
  - biomass
  - geothermal
  - photovoltaics (PV)
  - solar thermal
- Power station rehabilitation
- Reduction of losses in transmission and distribution electricity and fuels
- Improved fuel production and transport
  - recovery of coal mine methane
  - coal beneficiation and refining
  - improved gas and oil flaring

Picture: NREL

Adoption of Energy Efficient Technologies



Energy Supply:
Renewable Energy Technologies

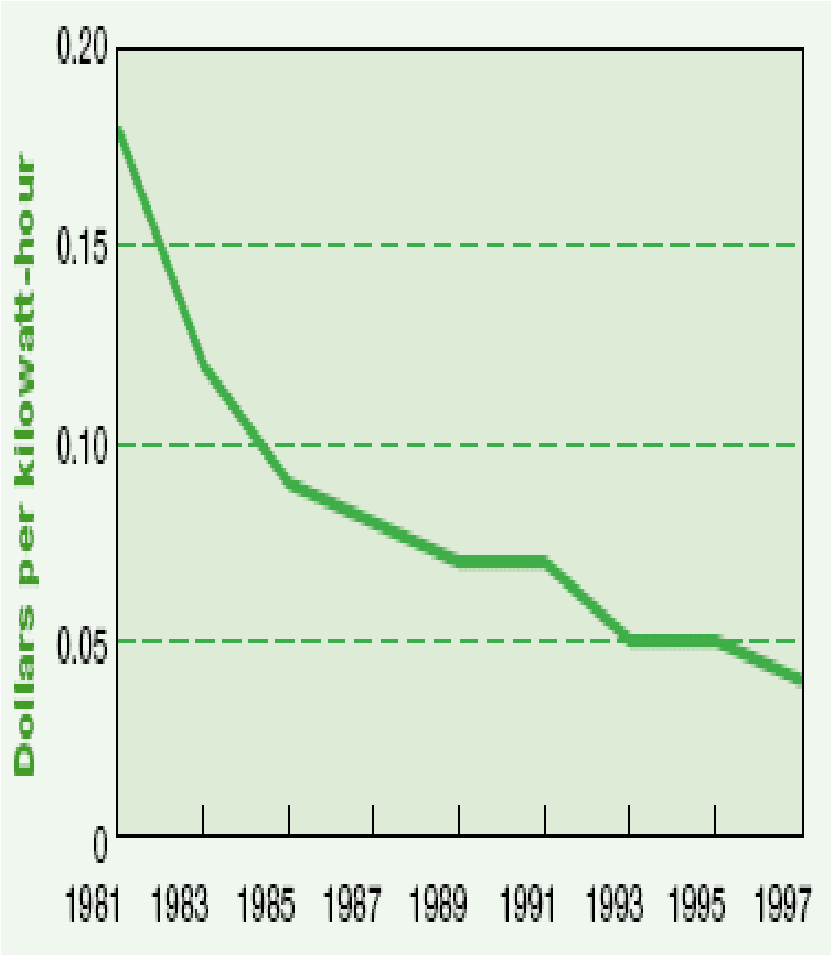
- Solar
  - Photovoltaics - Flat Plate
  - Photovoltaics - Concentrator
  - Solar Thermal Parabolic Trough
  - Solar Thermal Dish/Stirling
  - Solar Thermal Central Receiver
  - Solar Ponds
- Hydropower
  - Conventional
  - Pumped Storage
  - Micro-hydro
- Ocean
  - Tidal Energy
  - Thermal Energy Conversion
- Wind
  - Horizontal Axis Turbine
  - Vertical Axis Turbine
- Biomass
  - Direct Combustion
  - Gasification/Pyrolysis
  - Anaerobic Digestion
- Geothermal
  - Dry Steam
  - Flash Steam
  - Binary Cycle
  - Heat Pump
  - Direct Use

Energy Supply: Solar Photovoltaics

- Solar panels using silicon PV conversion have efficiencies in excess of 15 percent, and thin film modules are typically 10 percent.
- PV panels are available in sizes from a few watts to 300 watts and produce DC electricity in the range of 12 to 60 volts, and can be used for applications such as:
  - charging electric lanterns and laptop computers (4 - 6 watts);
  - packaged systems (20 - 100+ watts) for off-grid residential lighting and entertainment (radio/ cassette, TV/VCR); and
  - grid-connected power (hundreds of kilowatts to a megawatt or more).
- Current costs make solar PVs prohibitive in most situations.
- Can be attractive in niche applications, especially for off-grid electrification.
- Good prospects for further increases in efficiency and reductions in costs.

Energy Supply: Changes in Wind Electricity Generation Costs in Denmark

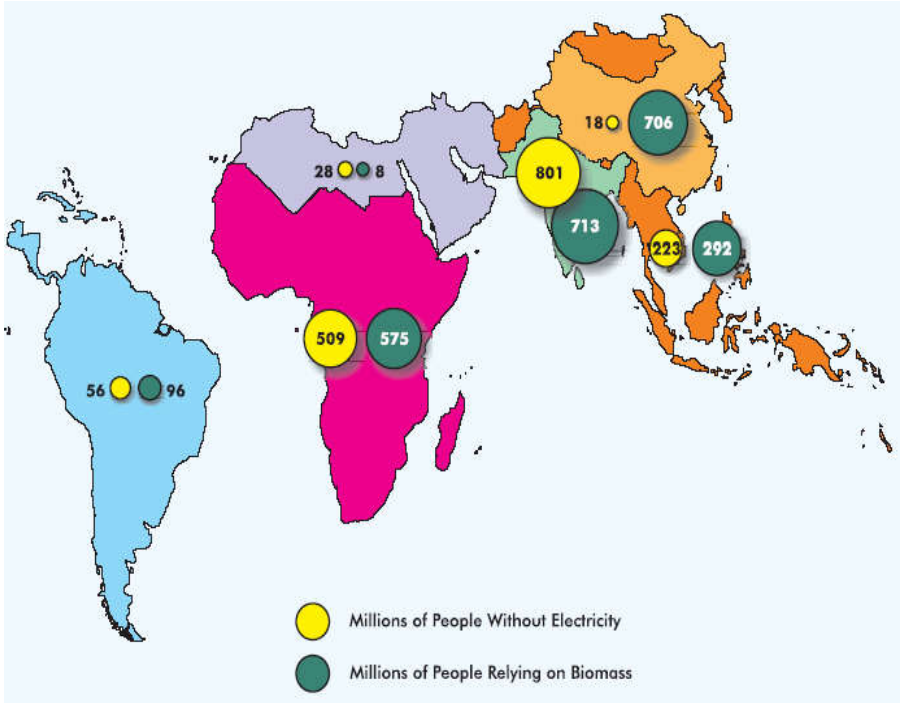
- Wind power accounts for 0.3% of global installed generation capacity.
- It has increased by an average of 25% annually in recent years.
- The cost of wind has fallen dramatically, following a classic learning curve.



Energy Supply: Biomass

- For mitigation, focus should be on renewable biomass, which has no net CO2 emissions.
- Modern conversion of biomass into electricity, liquid and gaseous fuels shows great promise.
- In addition, co-firing 10-15% biomass with coal can reduce GHG emissions

In developing countries, biomass is a major source of energy services for the poor.



Source: IEA

Introduction

Economic growth is the increase in the market value of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP.

Energy

Economic development implies changes in income, savings and investment along with progressive changes in socio-economic structure of country (institutional and technological changes).

Inclusive Growth

Sustainable Development

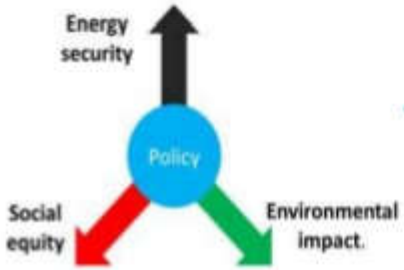

Sustainable energy is the sustainable provision of energy that meets the needs of the present without compromising the ability of future generations to meet their needs. Technologies that promote sustainable energy include ***renewable energy*** sources, such as ***hydroelectricity***, ***solar energy***, ***wind energy***, ***wave power, geothermal energy***, and ***tidal power***, and also technologies designed to improve ***energy efficiency***.
"Energy which is replenishable within a human lifetime and causes no long-term damage to the environment

Sustainability

Sustainable Development:

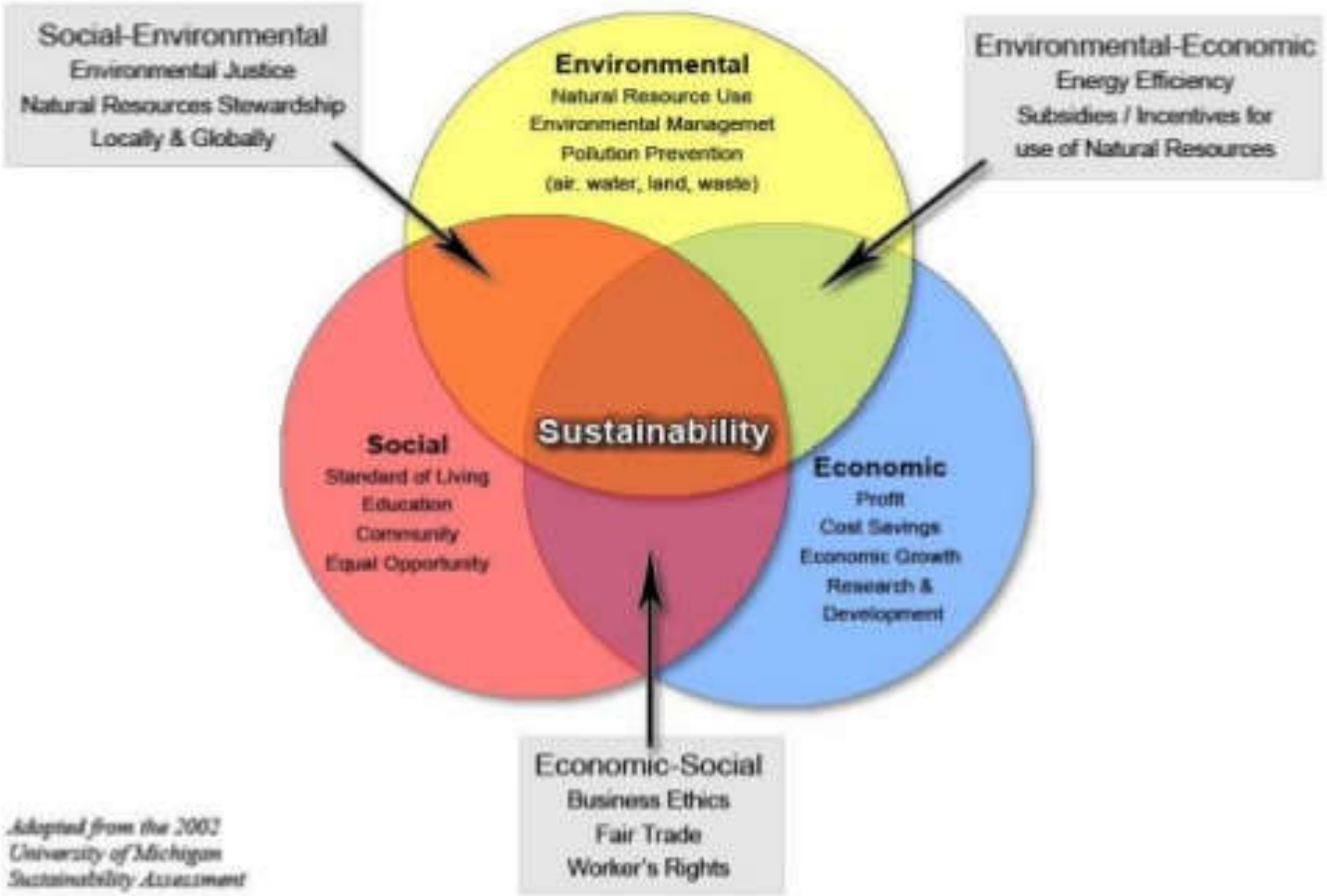
"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

— from the World Commission on Environment and Development's (the Brundtland Commission) report Our Common Future (Oxford: Oxford University Press, 1987).



Sustainability

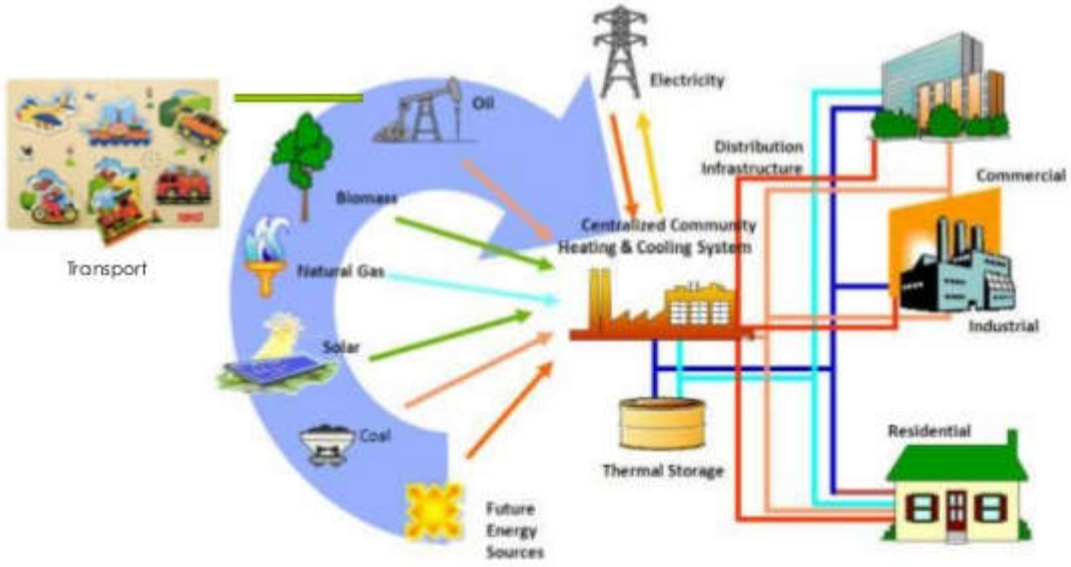
The Three Spheres of Sustainability



Adapted from the 2002 University of Michigan Sustainability Assessment

Role of Energy

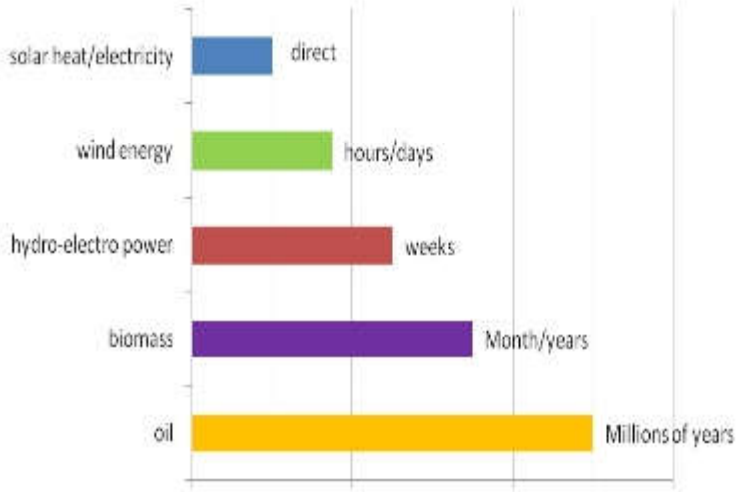
- Driver of Growth
- Critical infrastructure for development
- Prime mover of development



Sources

Key to Sustainability:

Utilize primary energy resource at the same rate at which it is naturally replenished on earth and without externalities.



Primary Energy: All we use comes from the sun.

Sources

Non Renewable

1.Fossil Fuels-
- 1.Coal
- 2.Gas
- 3.Oil

2.Nuclear Power-
- 1. Uranium
- 2. Plutonium
- 3. Thorium

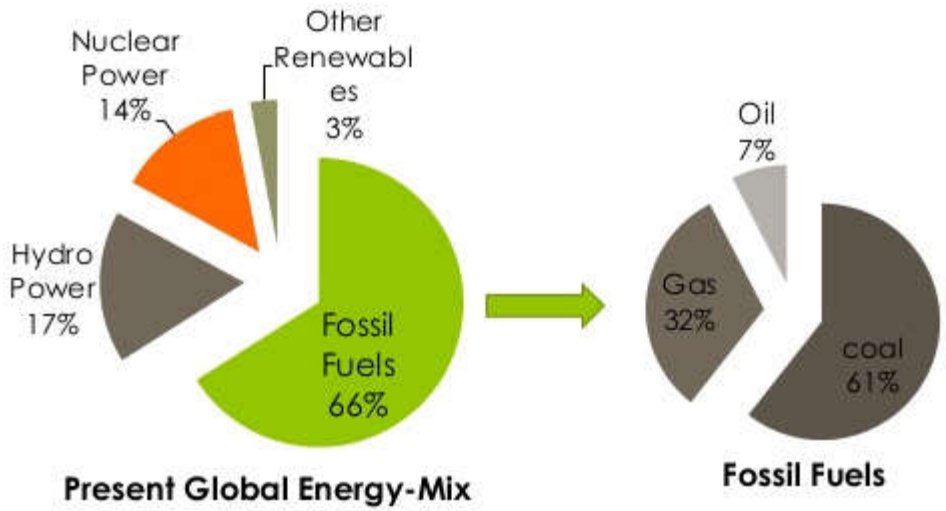
Renewable

- Hydro Power
- Small Hydro
- Wind Energy
- Solar Energy
- Tidal Power
- Sea wave Power
- Ocean Thermal Power

- Bio Energy
- Co-generation
- Geo Thermal
- Draught Animal Power
- Energy from Waste
- Hydrogen Energy

Statistics

About 2 billion people in the world have no access to commercial energy and in India about 400 million.



How & What

Energy Dilemma:

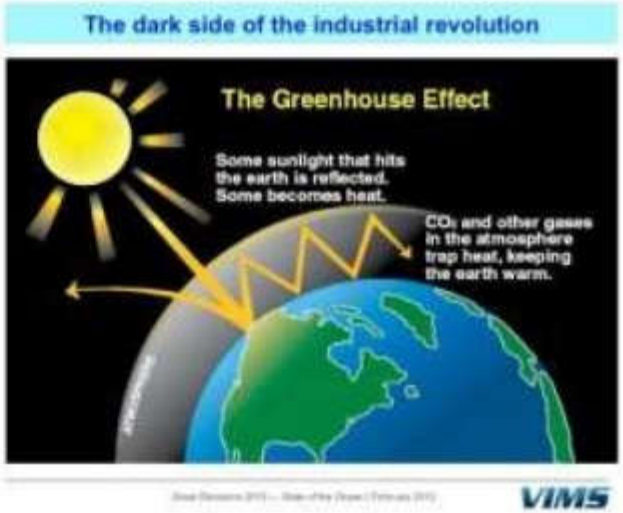
1. Lack of focus on renewables
2. Population Explosion

Results:

1. Large scale energy deficit.
2. Fast depletion of Fossil fuels.
3. Serious environmental repercussions.
4. Higher cost Demand.

Environment

- Climate Change
- Global Warming
- Ozone layer Depletion
- Rise in Sea Levels
- Changes in amount and pattern of precipitation
- Extreme weather
- Glacier Retreats
- Biological Extinction
- Health Hazards
- Agriculture distortions



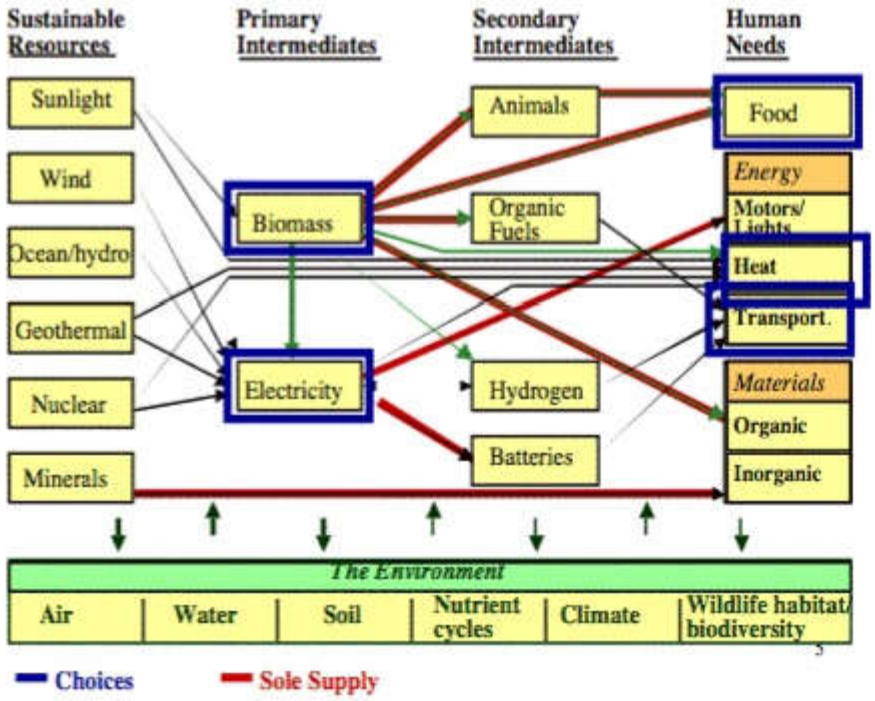
IPAT Formula for Environmental Impact

I=P x A x T

I= Environmental Impact
P= Population Numbers
A= Affluence or Average Consumption
T= Impact per unit resource used

Use

Sustainable Energy



Why & How?

Why Sustainable Energy:

1. Fixed Capacity of Earth.
2. Unsustainable life styles.
3. Millennium declaration of UN.

How Sustainable Energy:

1. Inter-generational equity.
2. Decoupling economic growth from environmental degradation.
3. Integration of all pillars.
4. Preventing long term damages.
5. Education and Grass-root involvement.
6. Technological advancement.
7. Changes in life styles i.e. energy conservation.
8. Green energy.

India : MNRE

What More:

1. Improve Policy environment.
2. Co-ordination with states.
3. Bankability of PPAs.
4. Selection Criteria for Developers.
5. Localization of equipment and technology.
6. Monitoring Technology developments.
7. Reviewing and adjusting incentives.
8. Managing Funding arrangements.

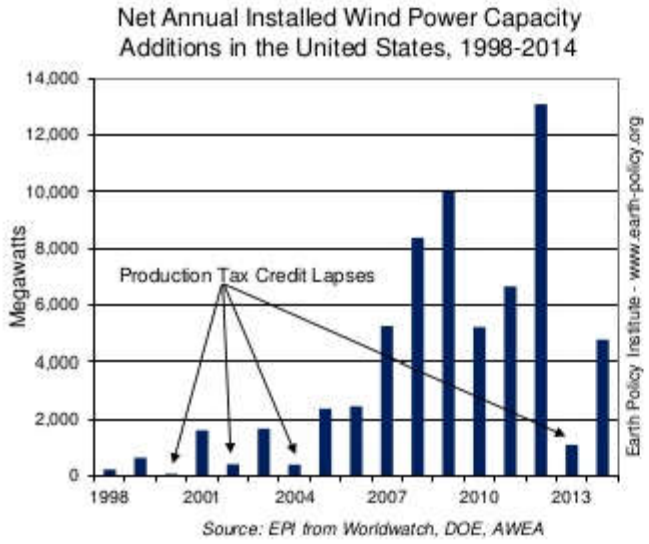
RPO (Renewable Portfolio Obligation)

FITs (Fit In Tariffs) for promotion of Renewable energy.

Saving Energy Saves Money

- Investing in efficiency is less costly than building new generating capacity
- Efficiency measures by 11 industrial countries since the 1970s saved $740 billion in avoided energy costs in 2011 alone
- A systemic switch from incandescent bulbs to efficient lighting solutions worldwide could allow closure of some 270 coal-fired power plants
- Japan's Top Runner Program is a model for ratcheting up efficiency standards on lighting, electronics, vehicles, and more

Policy Matters



- Artificially cheap fossil fuels still heavily subsidized
- Renewable feed-in tariffs, tax credits, and energy mandates help level playing field
- Unpredictable policy environment has led to boom-bust cycle in U.S. wind industry

Putting a Price on Carbon

- Can supercharge the transition by systematically pricing carbon to better reflect fossil fuels' true social and environmental costs
- Cap-and-Trade
  - Regulators set a limit on emissions and polluters can either reduce their emissions or buy permits on the carbon market
  - EU had first international Emissions Trading System (ETS)
- Carbon Tax
  - Tax levied on each ton of carbon dioxide emitted
  - Far simpler than cap-and-trade
  - Potentially revenue-neutral – can be offset by reductions in income taxes

Carbon Pricing in Action

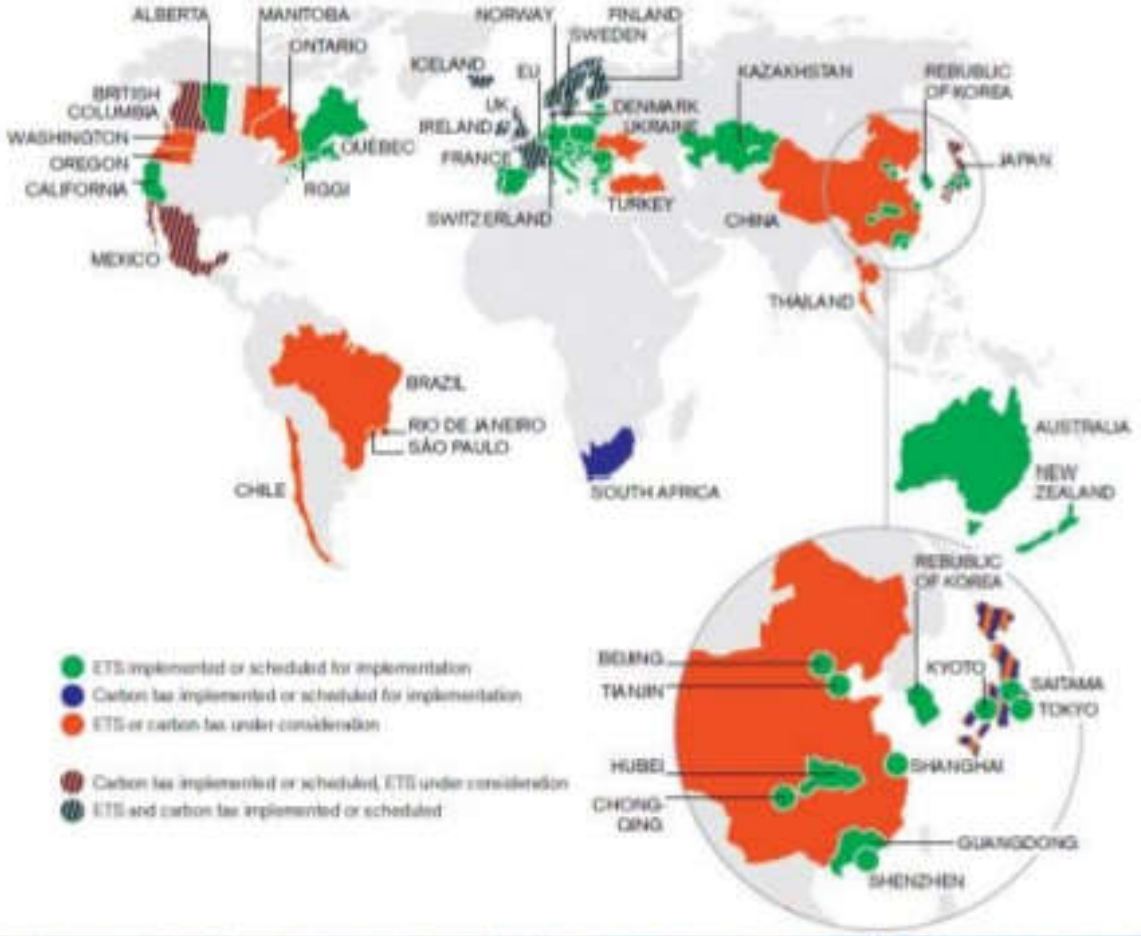


Image Credit: World Bank

Carbon Tax Successes

- **Ireland:** set carbon tax on natural gas and oil consumption in 2010; by 2013, emissions had fallen some 6% while economy grew
- **British Columbia:** set economy-wide carbon tax in 2008; per person consumption of gasoline and other petroleum products fell 15%, three times the national average, while economic growth has kept pace

The Future of Energy

- Unlike fossil fuels, energy from the wind and the sun
  - is clean
  - is inexhaustible
  - the costs are falling fast
  - the fuel is free

Photo Credit: MrRenewables via. Wikimedia Commons

Renewables Make Business Sense

"It's a business decision. The renewable energy we buy meets or beats prices from the grid." – Walmart CEO Bill Simon, 2014

- Walmart has 260 PV systems on its U.S. buildings, aiming for 400 more by 2018
- Apple's 25-year, $850 million solar power purchase agreement with First Solar to supply CA operations
- Large investment institutions like Morgan Stanley and Goldman Sachs channeling tens of billions of dollars into renewable energy

Energy Independence

- Rooftop solar panels power homes and recharge car batteries, delivering a degree of personal energy independence not known for generations
- The old energy economy was tightly controlled by those who held fossil fuel deposits; the new energy economy is much more democratic
- Results we can live with: Cleaner air, cleaner water, and a more stable climate