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# Alternative energy technologies: An aid to natural resource economics

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## ABSTRACT

***Despite our uncountable inventions and rat race to achieve more, we all are utterly dependent on the environment for our sustainability. And what if we're only being the cause for its exploitation? Shining lights all around do create euphoria, but we really cannot afford such a festivity at the expense of our natural reserves. Natural resource economics is constantly looking around for striking equilibrium between natural capital and natural services, and so are doing the technological advancements in alternate energy utilization, reducing the extraction load on conventional resources like coal, oil, gas etc. Such technological creations of greener energy alternatives can be an effective tool for natural resource management.***

***Keywords***— *Alternative energy, Natural resource economics, Environmental sustainability*

## 1. SHAPE AND FUTURE OF ENERGY

The fact that we largely rely on fossil fuels for our energy requirements has made us significantly vulnerable to the underlying severe energy crisis. Current statistics of energy use and the apparent exploitation pattern, irrespective of enough assessment of declining natural resources raise serious concern altogether on a global level. Exponentially hiking global environmental issues like climate change, desertification, urbanisation and biodiversity loss is calling for a greener colonisation and setting up such an environment synchronising ecosystem should be the matter of core concern. Only 10% of the world's current energy supply is backed by renewable sources and specifically the fraction of solar and wind energy is below 1%. Rest $1/9^{th}$ fraction is the result of overutilization of fossil and mineral sources, coal, oil, gas and nuclear fuels.

Dimensions of energy consumption can be discussed over many scales of time and space but intervening the use of efficient technologies and management aspects can probably help us with marking a secure future. Shifting our researches and extension programmes to a cleaner form of energy is itself a significant multiplier for natural resource conservation. The three broad disciplines that outline the shape and future of energy [1] are:

### 1.1. Sustainability

The word sustainability etymologically belongs to Latin as *'sustinere'* ('tenere'- to hold; 'sus'- up). Brutland commission of United States explains sustainability as "Sustainable development is a development that meets the need of present without compromising the ability of future generations to meet their own needs". Environmental, social and economic demands are said to be the three pillars of sustainability. [2]

### 1.2. Efficiency

Energy efficiency is a classical measure of the amount of energy that is conserved. The development and dissemination of technological methodologies, three-dimensional planning and management within the circle of minimal natural resources available should be the prime goal.

### 1.3. Equity

It refers to the optimum research, development and their equitable distribution for all humankind. The financial mechanism for exploration in the field of usage of finite and alternative energy forms. A justified appreciation of certain technology is only worth if it is extracted through limited resources and has high practical acceptability at ground zero.

 

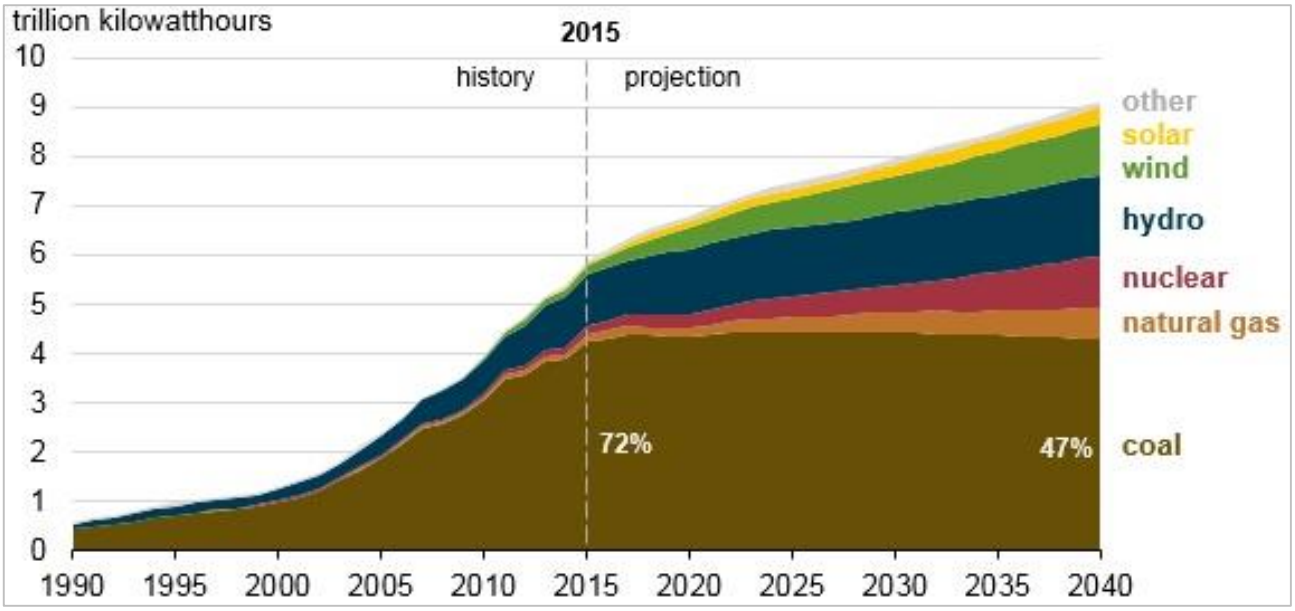


**Fig. 1: Average annual electricity generation from various energy sources**
*Source: IEO2017 Reference case (2005-2040)*

*"Contemplation of the world's disappearing supplies of minerals, forests, and other exhaustible assets has led to demands for regulation of their exploitation. The feeling that these products are now too cheap for the good of future generations, that they are being selfishly exploited at too rapid a rate, and that in consequence of their excessive cheapness they are being produced and consumed wastefully has given rise to the conservation movement."* [Hotelling (1931)] [3]

## 2. NATURAL RESOURCE ECONOMICS (NRE)

In a holistic perspective, the economy and societies are the subsets of the environment. The existential dependence of one over the other calls for the insights of Natural resource and energy economics, study of which should be the issue of utmost concern especially now when the bulk of anthropogenic actions are turning our natural reserves into ashes. Natural resource economics uphold the concepts of demand, supply and allocation of natural resources (their sustainability) in its prime prospects of study and simultaneously aims at devising better sustainable methods for managing resources and consumption habits, making sure to leave a large fraction of them for the future generations.


**Fig. 2: Prospects of Natural Resource Economics [4]**

### 2.1 Exploitation of natural resources

Our desire for more has left us barely standing empty-handed in terms of natural resources in several parts of the world. Human activities at the global level, including the likes of mining, urbanization, agriculture, fishing etc., has resulted in extreme degradation of our natural resources. While urbanization and mining have caused large-scale deforestation, fishing has triggered the drastic downfall of the marine ecosystem. If the trends continue, we will supposedly exhaust those of our natural resources on which we are dependent, and thus land upon digging our own graves. [5]

**Table 1: Six globally most drained out resources.**

| Worldwide degradation rank | Natural resource | Statistics |
|---|---|---|
| 1 | Freshwater | Only 35 million cubic km. left |
| 2 | Oil | Can only sustain for next 46.2 yrs. |
| 3 | Natural gas | Can only sustain for next 58.6 yrs. |
| 4 | Phosphorus | Can only sustain for next 50-100 yrs. |
| 5 | Coal | Can only sustain for next 188 yrs. |
| 6 | Rare earth elements | Most exploited: Scandium and terbium |

*Source: The Guardian*

 

## 3. ALTERNATE ENERGY TECHNOLOGIES

Alternate energy is the energy derived from non-traditional sources/energy sources that do not exploit earth's exhausting natural resources or otherwise harm the ecosystem, especially by avoiding the use of nuclear power and fossil fuels. In the context of climate change, the alternative energy concept refers to those sources of usable energy that could replace fossil fuels such as oil and coal reserves. It is must to harness the alternative energy technologies in order to cease the adversities of climate change and creating a more sustainable future. Innumerable trials and attempts to tap the full potential of these sources are in progress, and our future largely depends on these attempts.[6]

*Alternative energy encircles renewable energy*, i.e., all renewable resource are alternate energy sources but not necessarily vice versa. According to *Howe*, alternate energy resources are "naturally occurring resources and systems that are useful to humans or could be under plausible technological, economic, and social circumstances."[7]

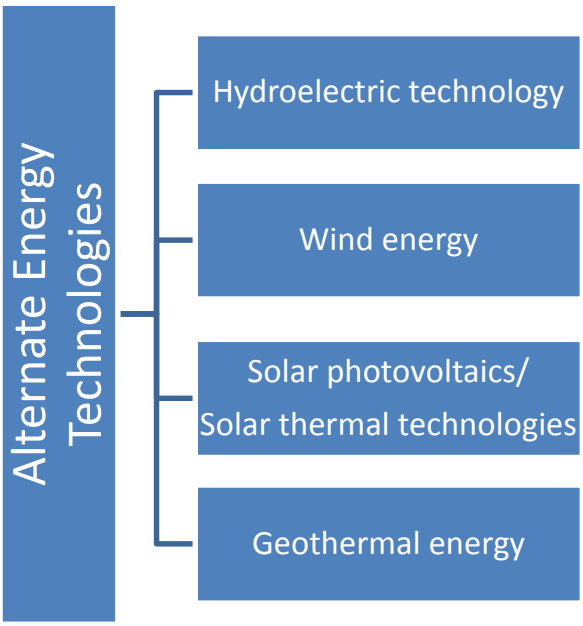


**Fig. 3: Alternate energy technology examples**

### 3.1 Hydroelectric technologies

Hydropower is a mature and commercially proven technology. Hydropower puts in use a relatively simpler concept to transform the energy potential of the flowing water or stream to turn a turbine, which thereafter provides the required mechanical energy to generate usable electricity by driving the generator. Large hydropower plants may produce up to 80 – 100 TWh/year. [IPCC, 2011]

Hydroelectricity does pose some water impacts, but only minimal land use and air pollution impacts, also contributing almost null to climate change. There is no involvement of fossil fuel combustion in any kind of hydropower plant, so they cause little to no air depletion as compared to fossil fuel based power plants. In assistance of the sustainable fuel source, hydropower emerges with numerous benefits such as flood control, irrigation and water supply. Studies have yielded that typical emissions of greenhouse gases for hydropower sources are still 30 to 60 times less than those from similar fossil fuel based stations.[8]

### 3.2 Wind Energy

Wind energy/ Wind power is a mechanism by which the wind is used to produce electricity. The kinetic energy of high wind velocity is converted into mechanical energy by turbines and further this mechanical energy with the help of generators produce electricity. Wind energy has minimal environmental impacts on all possible dimensions and supplies a clean fuel source. As compared to conventional coal plants, wind energy systems produce considerably less amount of particulate matter, nitrous and sulphur dioxides.

### 3.3 Solar Photovoltaic/ Solar thermal technologies

Ipso-facto Solar energy is the most available form of energy also is the most feasible and acceptable alternative on the grass root level. Photovoltaic cells have a large market and even its efficiency is up to the mark. Solar panels and similar substitutes are now available as an alternative almost in all small and large electrical equipment. Solar energy extraction causes no side effects and causes minimal disturbance to other water and air resources, it has only some moderate land use impacts so as to set up solar power plants.[9]

Solar thermal or concentrated solar power shares many of the same climate and air benefits of the solar photovoltaic system.

### 3.4 Geothermal energy

Geothermal facilities do have some water impacts but minimal environmental effects in all other ecological dimensions. It is yet another alternative energy form that is a clean and sustainable source of power. In the simplest meaning, geothermal energy is nothing more than the internal heat that is reserved in the rocks and fluids beneath the earth's crust, and most of this heat energy is resultant of sub-surface processes which are likely to be replenished continuously, unlike oil and coal.

 

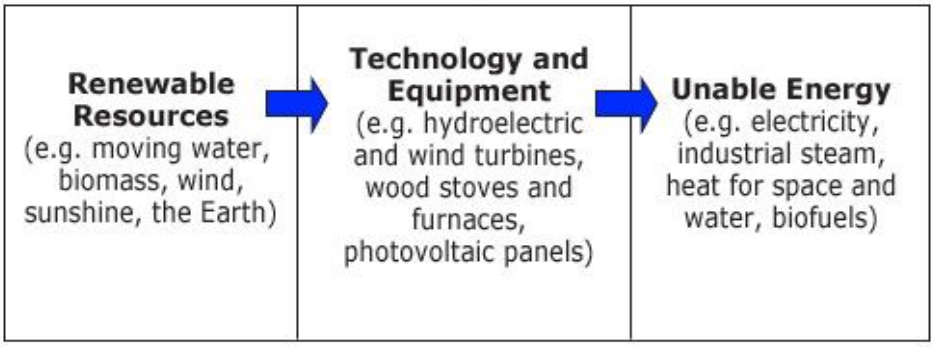


**Fig. 4: Utility creation out of renewable resources**

## 4. ANALYSIS OF ALTERNATE ENERGY SOURCES AS A TOOL FOR NATURAL RESOURCE ECONOMICS

The critical feature of exhaustible resources is that its supply is finite and the constantly rising demand of it is hindering the equilibrium state of nature. With every one unit consumed today causes the reduction in one unit for the consumption in future.[10] If the increasing energy demand in the global prospect is met by the traditional practices and sources then the possible implications in terms of greenhouse gases emission, global warming, and availability of fossil fuels would not be sustainable.[11] This is a matter of topmost priority to figure out best of the current alternative energy technologies that could substitute the existing pattern of natural resource exploitation for energy extraction.

**Table 2: Comparative impacts of energy sources on climate change, water resources, air pollution and land-use pattern**

| Energy System | Climate Change | Air pollution | Water | Land use |
|---|---|---|---|---|
| **Conventional sources** | | | | |
| 1 Nuclear power | Moderate | Minimal | Severe | Severe |
| 2 Shale gas | Severe | Severe | Severe | Severe |
| 3 Coal | Severe | Severe | Severe | Severe |
| 4 Oil and gas | Severe | Severe | Severe | Severe |
| **Alternative Energy Sources** | | | | |
| 1 Hydroelectricity | Minimal | Minimal | Moderate | Moderate |
| 2 Wind energy | Minimal | Minimal | Minimal | Moderate |
| 3 Solar PV/Thermal | Minimal | Minimal | Minimal | Moderate |
| 4 Geothermal | Minimal | Minimal | Moderate | Minimal |

*Source*: *Benjamin K. Sovacool, 2014*

## 5. CONCLUSION

All across the globe, potentially renewable forest cover is shrinking, deserts are spreading, soils are eroding, and agricultural lands are being replaced by mushrooming suburbs. This cumulative deterioration of ecological functionaries is far too scary than it appears, the lower atmosphere is warming, the glaciers are melting, sea levels are shooting up and floods, droughts and forest fires are increasing. In many geographical divisions, water tables are falling, rivers are running dry which simultaneously is taking down fisheries, coral reefs are collapsing and various species are on the cutting edge of extinction.[12] If not now, it will be too late to substitute the conventional energy resources with more sustainable alternatives. The only big picture that stands ahead is to watch our Eco-diversity crashing to the ground or to stand up together and cumulatively adopt the alternative and more perpetual sources of energies, foster our non- renewable natural resources and call for a greener colonisation.

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