International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163
Issue 3, Volume 2 (March 2015) www.ijirae.com

Energy Efficiency Improvements

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Abstract – Energy efficiency is "using less energy to provide the same service". Energy efficiency is not energy conservation. For example, turning off a light is energy conservation. Replacing an incandescent lamp with a compact fluorescent lamp (which uses much less energy to produce the same amount of light) is energy efficiency. Energy efficiency, therefore, describes the ratio between the benefit gained and the energy used. In this context, different levels and perspectives can be distinguished concerning energy efficiency. They will be specified in the following:

- ***The perspective of the efficiency of energy conversion in the range of energy supply resp. energy provision, which is predominantly characterised by engineering science.***
- ***The end use energy efficiency perspective on the demand side with an increase in energy end use efficiency achieved by technical, organisational, institutional, structural or behavioural changes.***

Keywords – Energy efficiency, Energy conversion, Energy conservation, Energy affordability, Energy security.

I. INTRODUCTION

The term "Energy Efficiency" is interpreted differently in national and international literature as well as in various scientific disciplines.

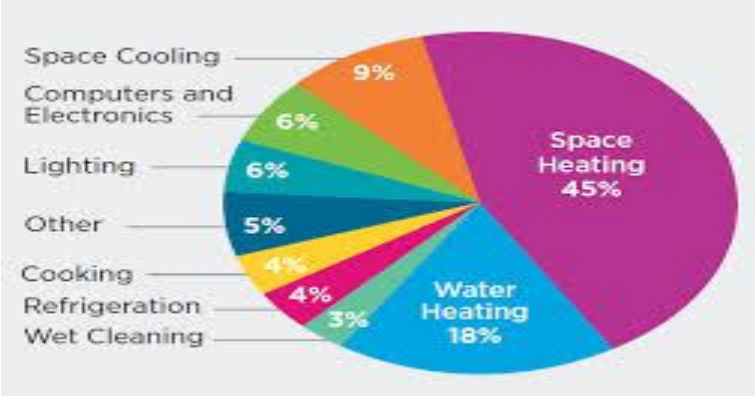

Fig.1: Percentage usage

- Energy efficiency in the context of energy conversion: The efficiency of energy conversion in the range of energy supply resp. energy provision is predominantly characterised by engineering science. In this context, energy efficiency resp. efficiency of conversion can be defined by efficiency factors resp. utilisation ratios of the conversion (input/output of the conversion), as for instance the ratio of generated end use energy in proportion to primary energy or to secondary energy used (e.g. efficiency factor of a power plant, a heating system, a cooking device or a refinery).

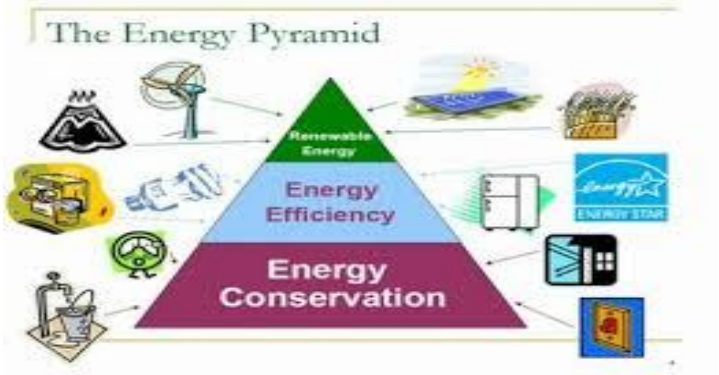

Fig.2: Energy pyramid

End use energies include those energies used by the end consumer, such as electricity, heating oil, refined natural gas, long distance heat, petrol and diesel. Useful energies comprise the forms of energy that are used during final application, e.g. radiated thermal heat in a room, process heat, light, compressed air, kinetic energy.

- End use energy efficiency: On the demand side, the term energy efficiency resp. energy end use efficiency refers to the proportion of the amount of energy used for the satisfaction of personal needs and energy use of non personal demand. Thus, the term finally refers to the amount of energy or mobility service. An increase in energy end use efficiency means consuming less end use energy for the same amount of mobility resp. energy application, and therefore, a reduction in energy intensity of the benefit resulting from using energy. This can be achieved by technical, organisational, institutional, structural or behavioural changes.
- Energy efficiency and conserving energy: The increase in energy end use efficiency is one of the aspects of energy conservation. Additionally, energy conservation resp. the avoidance of energy consumption also contains a partial or entire abandonment or substitution of the use of energy consuming products and services. Thereby, fulfilling peoples', households and companies needs with lower consumption of energy and therefore the limitation of growth regarding energy consuming products, infrastructures and services are in the centre of attention, e.g. going for a walk in the proximity instead of making a trip by car. In contrast to that, the avoidance of wasting energy by lowering a high room temperature to a comfortable temperature is a means to achieve energy efficiency.

II. METHODOLOGY

i) Buying energy efficient products: Purchasing efficient products is one of simple ways to increase energy efficiency.

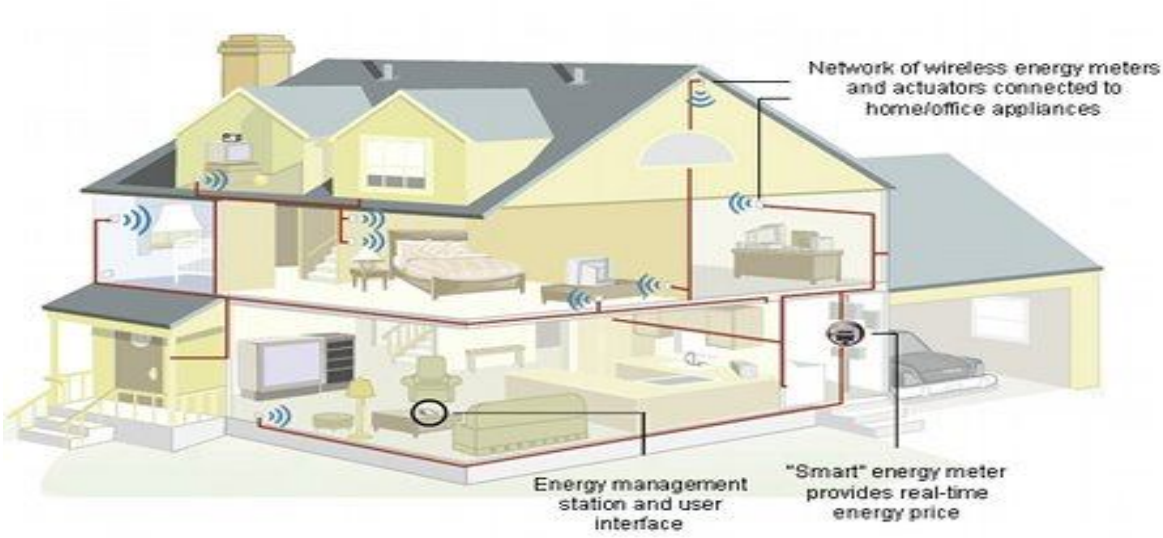

Fig.3: Relation between energy management station and user interface

New electrical appliances such as refrigerators, dryers, washers and other appliances use less energy in comparison to older ones. While purchasing those electrical appliances one should look for those rated with 'energy star'.

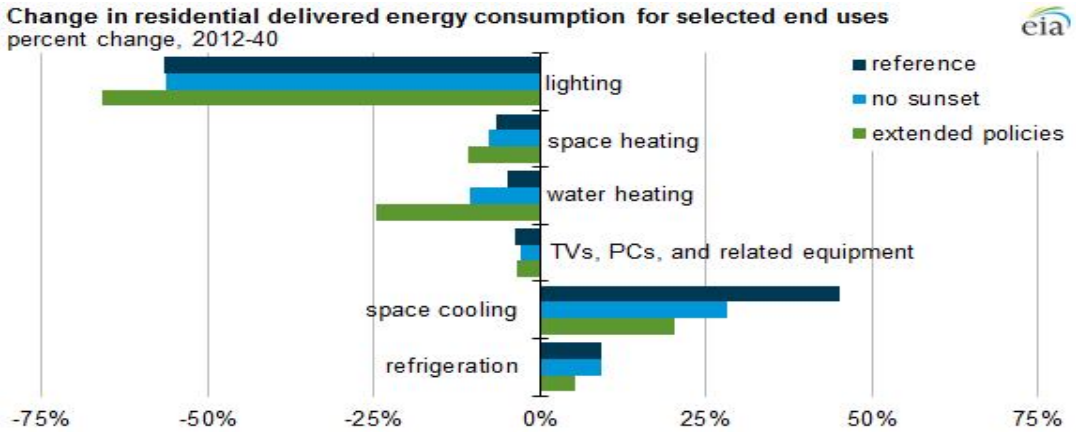

Fig.4: Residential energy consumption

ii) Reduce standby/vampire power: Many of the appliances which include televisions lamps as well as the phone chargers can continue consuming energy even when it is in off mode. One should unplug those appliances when not in use as this will save energy at the same reduce one's bill up to 20 percent.

Fig.5: Percentage usage for household purpose

iii) Seal and insulate home: Sealing and insulating one's home is one of the cost effective ways to make a home more comfortable, and energy efficient.

III. RESULTS & DISCUSSIONS

Improving energy efficiency can deliver a range of benefits to the economy and society. However energy efficiency programmes are often evaluated only on the basis of the energy savings they deliver. As a result, the full value of energy efficiency improvements in both national and global economics may be significantly underestimated. This also means that energy efficiency policy may not be optimised to target the potential of the full range of outcomes possible.

Summary of outcomes from improvement energy efficiency

Benefits		**Time frame for effect**		**Level at which outcome takes effect**			**Country context dependency**		**Depends on energy saving?**
		Short	**Long**	**Individual**	**National**	**Inter-national**	**Energy mix**	**Developing country**	
Social	Health	X		X	X			X	N
	Energy affordability	X		X				X	Y
	Energy access		X	X	X			X	N
	Development	X			X	X	X	X	N
	Job creation	X		X	X			X	N
Economic	Asset values	X		X	X				N
	Disposable income	X		X	X			X	Y
	Industrial productivity	X		X	X			X	N
	Energy provider benefits and infrastructure	X	X	X	X		X	X	Y
	Energy prices	X	X		X	X	X	X	Y
	Public budgets		X		X		X	X	Y

	Energy security		X		X		X	X	Y
	Macro economic effects		X		X			X	N
Environment	GHG emissions	X			X	X	X	X	Y
	Resource management	X		X	X	X	X	X	Y
	Air / water pollutants	X		X	X		X	X	Y

Below is a list of benefits:

Fig.6: Benefits of energy efficiency

Individual level (individuals, households, enterprises)

a) Health and well being impacts:

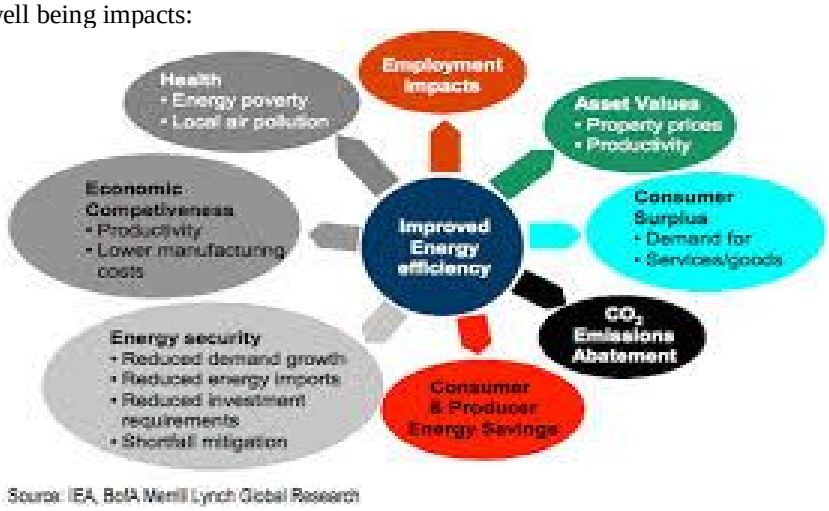

Fig.7: Improvement in energy efficiency

This mainly relates to the public health improvements observed as a result of improved heating and cooling of buildings and air quality from more efficient transport and power generation and less demand for both.

b) Poverty alleviation: Energy affordability and access: As energy demand and bills are reduced for the poor, these households have the ability to acquire more and better energy services, as well as free up income to spend on satisfying other critical needs.

In addition, as utilities (notably in developing countries) improve their supply side efficiency, they can provide more electricity to more households, thereby supporting increased access initiatives which is often an important stated objective of supply side energy efficiency activities in developing countries.

c) Increased disposable income: Across all income levels, when energy efficiency improves, reduced energy bills provide increased disposable income for households, individuals, and enterprises. Sectoral level (economic sectors – industrial, transport, residential, commercial)

Fig.8: Relationship between cost & saving

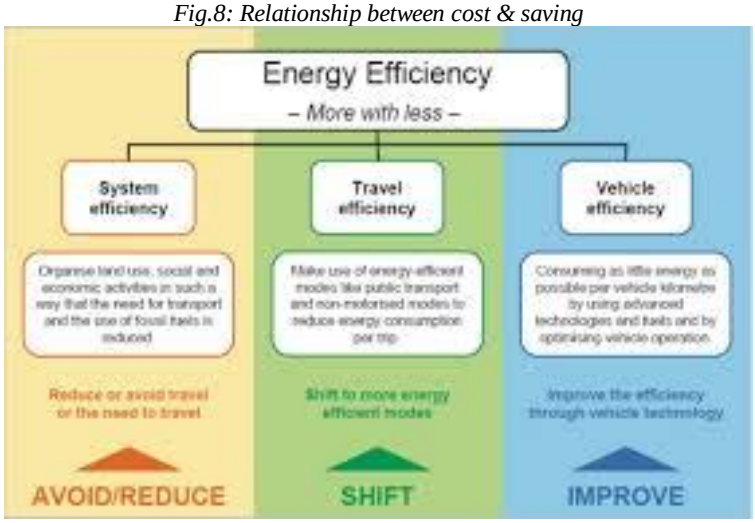

Fig.9: How to reduce, shift & improve energy efficiency

d) Industrial productivity and competitiveness: Benefits for industrial firms from improvements in energy efficiency improvements include reductions in resource use and pollution, improved production and capacity utilisation, and less operation and maintenance, which leads to improved productivity and competitiveness.

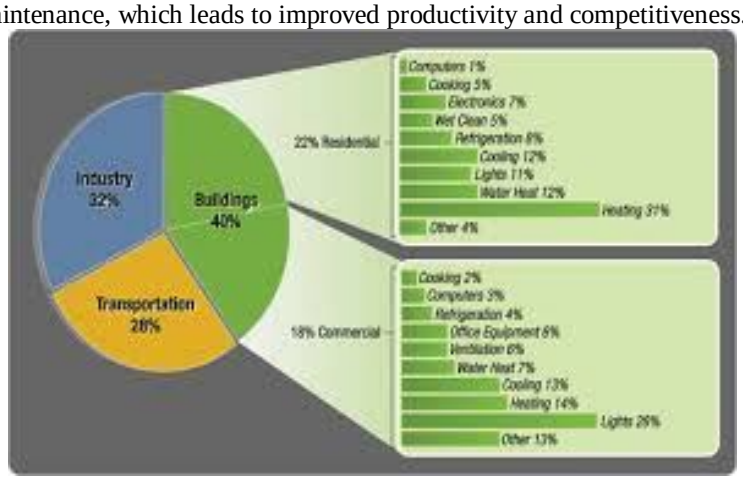

Fig.10: Industrial usage

e) Energy provider and infrastructure benefits: Improved energy efficiency can help energy providers provide better energy services for their customers, reducing operating costs and improving profit margins.

National level:

f) Investment in energy efficiency and the increased disposable income can lead to direct and indirect job creation in energy and other sectors. This makes energy efficiency an important part of governments' green growth strategies.

g) Energy security:

Fig.11: Energy security

Improvements in energy efficiency leading to reduced demand for energy can improve the security of energy systems across the four dimensions of risk: fuel availability (geological), accessibility (geopolitical), affordability (economic) and acceptability (environmental and social).

International level

h) Reduced GHG emissions: Greenhouse gas (GHG) emissions are reduced when energy efficiency improvements result in reduced demand for fossil fuel energy. Many climate change mitigation strategies put energy efficiency measures at their core as the most cost effective way to reduce greenhouse gas emissions.

Fig.12: Relation between gas emission, energy saving & cost cutting

i) Natural resource management: At an aggregated international level, less demand can reduce pressure on resources, with potential beneficial impacts on prices (at least for importing countries), as well as overall resource management.

IV. CONCLUSION

It is clear that the outcomes from improved energy efficiency are not limited to energy savings, but include a wide range of other benefits. They cross areas as disparate as improvements in health to industrial productivity and imply welfare gains across the whole of society. This can be generally described as a pattern of growth in which resource use meets human needs while preserving the environment so that these needs can be met for generations to come. Therefore when examining the benefits of energy efficiency, it is not enough to solely look to the energy savings achieved but rather at the outcomes in terms of economic, social and environmental development.

Estimating the wider benefits of energy efficiency improvements can also assist with putting a value on the return on investment in energy efficiency. A longer term goal would be to begin to calculate this for different countries and regions and ultimately for the global economy. This can help channel funds into investments in energy efficiency. Recognition by governments that energy efficiency is a fundament of economic policy would be a first step in maximising the welfare gains that can be achieved through energy efficiency improvements.

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