New impulse to synergize sustainability.

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Energy sector across the world has been a major driver of economic growth and development not only in the industrialized countries, but in developing countries as well. The energy use of the world is currently facing an exponential growth. Demand continues to grow rapidly on one hand and the finite reserve of non-renewable sources continues to get exhausted fast on the other. Oil and gas still provide more than half of the total global energy demands. So important challenge for oil and gas sector is the growing threat of climate change, which would require mitigation of emissions of Green house gases, as a result of which a reduction in use of fossil fuels would become inevitable. Therefore, urgent and renewed efforts are required to promote sustainable development of renewable energy sources. At the same time, it is a must that one saves and conserves energy for the present and future generations.

Energy can be classified into several types based on the following criteria as:

Primary and Secondary Energy: - Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas etc. Primary energy sources are mostly converted in into secondary energy sources; for example coal, oil or gas converted into steam and electricity.

Commercial Energy and Non-commercial Energy: The energy sources that are available in the market for a definite price are known as commercial energy. By far the most important forms of commercial energy are electricity, coal and refined products. The energy sources that are not available in the commercial market for a price are classified as non-commercial energy. Non-commercial energy sources include fuels such as firewood, cattle dung etc.

Renewable and Non-Renewable Energy or Conventional and non-conventional energy: Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples are wind power, solar power etc. Non – renewable energy is the conventional fossil fuels such as coal, oil and gas which are likely deplete with time.

Sustainability.

Energy and prosperity.

It is worth reminding ourselves how much our civilization depends on energy. Without energy, advanced economies cannot sustain their standard of living. Without energy, developing and emerging economies will never attain the growth and quality of life to which they aspire and to which they are entitled. Without developments in energy, millions, particularly women, will continue to spend a large part of their time simply collecting fuel. Energy fulfils human needs – although this topic intend to show how we should be moving towards a world in which we use new forms of energy and progressively only the minimum amounts of energy needed to fulfill our needs.

Four key drivers of energy future and need of non-conventional energy sources

There are four key drivers, which will shape the future of energy, determining what we might call the "solution envelope" for the next 50 years. They are the growth in demand for energy, the challenge of energy supply, concerns about energy security and environmental constraints, particularly the challenge of climate change. Technology and appropriate policies and regulations lie at the very heart of all solutions to these challenges. If we are to secure a sustainable approach we need a new engagement with society and a fresh way of thinking.

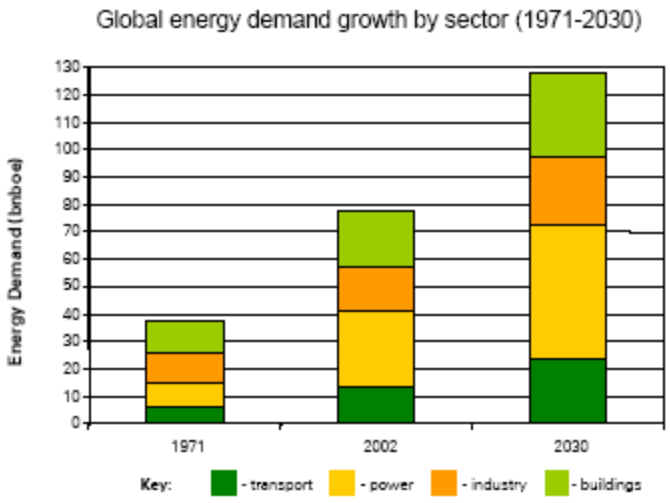
Rapid global energy demand growth

Total demand for energy worldwide has risen by around 15% during the 21st century so far. This is first because of the growth in population and second because of rapid economic growth of China, India and other countries. Most forecasts project energy demand growth of some 60% to 2030 from 2006

Demand growth by sector.

It is also interesting to look at the projected growth of demand by sector. This chart shows historical and projected energy demand broken up according to

transport, power generation and industrial uses, and then other applications which include residential, agricultural, and service sectors.



Several things are evident here, apart from the overall growth. One is that transport consumes a relatively small fraction of the energy. When you say "energy", many people immediately think "automobiles and oil". But, in fact, only around 20% of energy used is for transport: more in developed countries, less in developing countries. And you can also see on the chart that direct use of energy for industrial and residential uses accounts for about as much as the power sector.

Second, it is evident that power is going to be a key driver of energy demand growth. It is expected to account for around 40% of primary needs by 2030, twice as much as transport. By that date the world will use well over 50% more power than it does today. However 40 to 50% of the power capacity required by that date is yet to be built. The choices selected for power therefore require great focus in the next few years.

Sustainable global fossil resources

Let's now look at fossil fuel resources, which include proven reserves but also estimates of additional resources likely to be found, and unconventional resources – i.e. those other than conventional oil and natural gas.

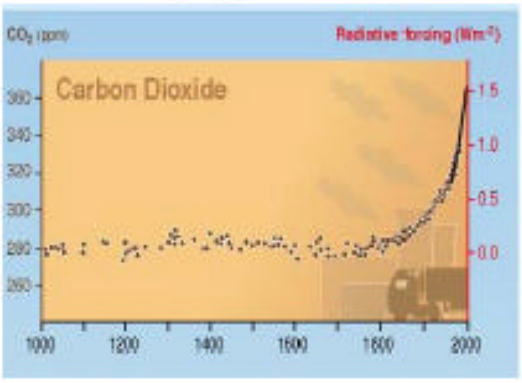
Working from today's official data, we believe there is about 50 years' worth of conventional oil reserves at the current production rates. That is based on the ratio between the world's total proved reserves at the end of a given year and the production in that year – the so-called R/P ratio. In addition, there are plausibly significant yet to find reserves and considerable potential unconventional resources.

For gas, we know of about 60 years' worth of reserves at the current rate of consumption and again material yet to find reserves. There are also significant resources of unconventional gas including a potentially enormous resource in the shape of gas hydrates. Finally, for coal, the R/P ratio is at least 235 years, with estimates up to 1,000 years because no one has gone seriously exploring for coal.

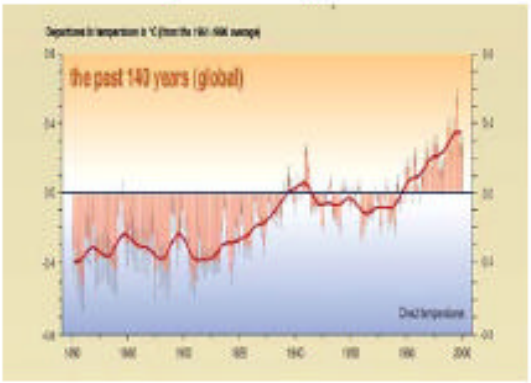
In total, we estimate there could be at least 3 trillion barrels of recoverable oil, at least as much gas and significantly more coal. In short, there is still an awful lot of fossil fuel.

Growing concern about climate change.

Rising CO_2 concentrations



Rising Global Temperatures



The atmospheric concentration of carbon dioxide (CO2) was 280 parts per million (ppm) before the Industrial Revolution, but is now about 380 ppm. The left panel of the chart shows the change in CO2 concentrations over the last 1000 years and the dramatic rise in the last 200 years. We also know that this rise is due to fossil fuel use through an analysis of the isotopic ratios of the carbon.

Studies advocates a coordinated global precautionary effort to limit average global temperature increases to less than around two degrees Celsius relative to late 19th century levels, which the IPCC (Intergovernmental Panel on Climate Change) estimate would require stabilizing atmospheric CO2 concentrations at 500 – 550 ppm. Beyond that temperature rise, one could start to interfere seriously with the world's climate.

Research indicates that the target level of 500-550ppm can be attained by using a range of existing technologies, including carbon sequestration, energy efficiency, increased capacity in solar, wind and gas-fired power, as well as nuclear power.

Sustainability

Sustainable development is a meaningful blend of Clean Development Mechanism (CDM) and Energy conservation. Only the Clean Development Mechanism (CDM) allows developed countries and developing countries to work mutually in Green House Gas (GHG) emissions reduction project and to fulfill two goals: a developed country can use the emission reductions to fulfill its commitments and the host country will benefit through the sustainable development achieved from the project implementation. Energy conservation does not mean that stop using energy sources, whenever, whatever you use with an objective to preserve for future is energy conservation.

It is obvious that GHG are the main offender pulling down the sustainable development. Growing concern towards climate change leads to Critical analysis of GHG and have realized that Carbon Dioxide is the main culprit which enhances global warming. Contribution of various gases towards global warming is shown below. At present fossil fuels are the main energy sources which are rich in carbon content they liberate Carbon Dioxide during combustion. Fossil fuel usage of various sectors are clear from the below chart.

So careful strategies shall be considered to enhance sustainability by limiting Carbon Dioxide emission to atmosphere. This can be made possible by implementing vision oriented action plans in industries as well as exploring the possibilities of promoting non-conventional energy sources.

Industrial Energy conservation strategies.

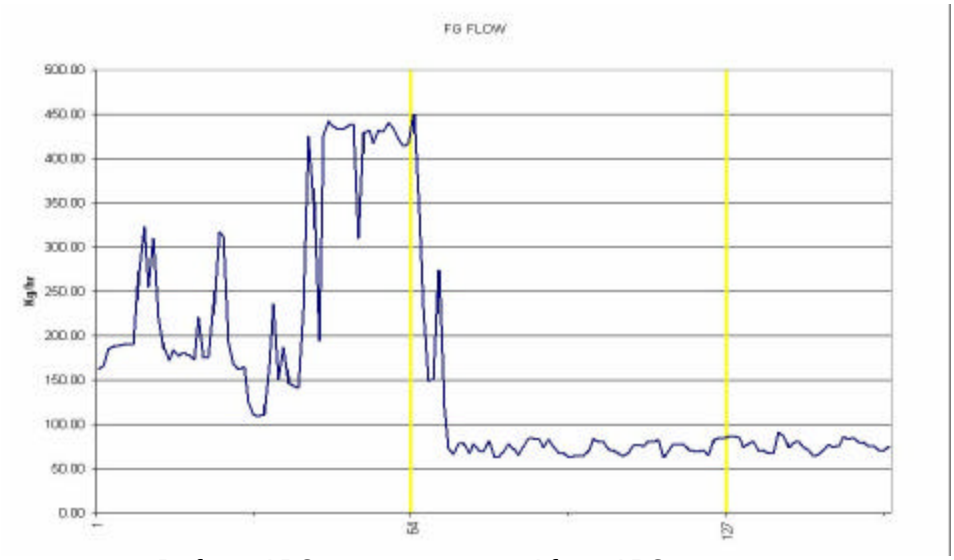
Energy Optimization using Advanced Process controllers

Optimization is a technique used for maximizing the product which gives maximum profit or maximize the profit through effective utilization of scarce resources. Advanced Process Control (APC) is an excellent tool for process optimization.

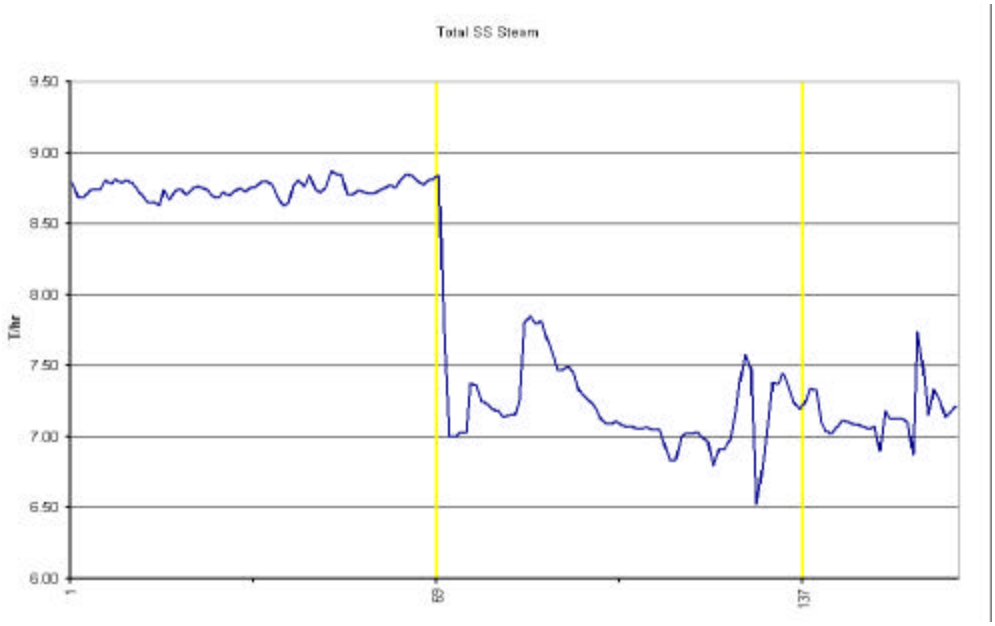
Advanced process Control is that layer of control implemented above the base regulatory control system in order to achieve higher level operation / control / economic objectives. It involves the use of special algorithms, Models, Knowledge etc. It can be defined as "A smart operator who predicts the plant behavior and controls to utilize every opportunity for operational optimization. Every minute, twenty four hours, all the year". APC systems generally make use of software packages for Multivariable predictive Control (MVPC) and

Inferential Property Prediction. Implementation of APC involves generation of a dynamic model of the process and configuration of the controller using off-line module of the software. Step tests are conducted in the unit and process data collected during the testing period is used for modelling. Models for property predictions are generated using historical laboratory and process data. On-line monitoring and tuning of the APC are done on remote PCs networked with the APC computer using client displays of the controller/ property predictor. User displays of the controllers and property predictions are provided on the DCS.

Industrial experience in Fuel gas and steam consumption optimisation is given below to show the contribution of APC in optimising conventional energy usage and there by controlling carbon dioxide emission to atmosphere.



Before APC After APC



Before APC After APC

Preheat optimization using Pinch Technology.

Variable Frequency Drives (VFD)

Heat insulation

Industrial Energy Audit – excellent tool for energy optimization.

Future Energy Strategies – Non-conventional Energy sources

Solar Energy

Solar energy is the most readily available and free source of energy since prehistoric times. It is estimated that solar energy equivalent to over 15,000 times the world's annual commercial energy consumption reaches the earth every year.

India receives solar energy in the region of 5 to 7 kWh/m^2 for 300 to 330 days in a year. This energy is sufficient to set up 20 MW solar power plant per square kilometre land area.

Solar energy can be utilized through two different routes, as solar thermal route and solar electric (solar photovoltaic) routes. Solar thermal route uses the sun's heat to produce hot water or air, cook food, drying materials etc. Solar photovoltaic uses sun's heat to produce electricity for lighting home and building, running motors, pumps, electric appliances, and lighting.

Wind Energy

Wind energy is basically harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. When solar radiation enters the earth's atmosphere, different regions of the atmosphere are heated to different degrees because of earth curvature. This heating is higher at the equator and lowest at the poles. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these airflows that are harnessed in windmills and wind turbines to produce power.

Biomass

Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from numerous sources,

including the by-products from the wood industry, agricultural crops, raw material from the forest, household wastes etc.

Bio fuels

Unlike other renewable energy sources, biomass can be converted directly into liquid fuels— biofuels— for our transportation needs (cars, trucks, buses, airplanes, and trains). The two most common types of biofuels are *ethanol* and *biodiesel*.

Hydro Energy

The potential energy of falling water, captured and converted to mechanical energy by waterwheels, powered the start of the industrial revolution. Wherever sufficient head, or change in elevation, could be found, rivers and streams were dammed and mills were built. Water under pressure flows through a turbine causing it to spin.

Tidal Energy

Tidal electricity generation involves the construction of a barrage across an estuary to block the incoming and outgoing tide. The head of water is then used to drive turbines to generate electricity from the elevated water in the basin as in hydroelectric dams.

Ocean Energy

Oceans cover more than 70% of Earth's surface, making them the world's largest solar collectors. Ocean energy draws on the energy of ocean waves, tides, or on the thermal energy (heat) stored in the ocean. The sun warms the surface water a lot more than the deep ocean water, and this temperature difference stores thermal energy.

The ocean contains two types of energy: thermal energy from the sun's heat, and mechanical energy from the tides and waves

Gas hydrates

Gas hydrates are special combination of two common substances, water and natural gas. The gas hydrates are formed as solid, ice-like substance when gas and water mixtures are subjected to high pressure or low temperature conditions (Temperature 150C and below, Pressure 200-400Kg)

Conclusion

The world needs more energy, more choice of energy sources, more security of that energy and energy that is less harmful to the environment. This will mean a preference for more local energy sources, more affordable energy and for

those sources, which have the least impact on climate change that is need of a proactive step towards non-conventional energy sources. Finally, we can't reduce all of the issues and potential solutions to a formulaic recipe for the future. As we pursue that future, we need the best talent capable of ingenuity, imagination, well-judged investment, and committed to mutual and shared benefit. It also comes down to a very human combination of brains, brawn and bravery-all equally vital.