

Research and Development Needs and Future Challenges (Indian

Hydrocarbon Industry – Entire Supply Chain)

Authored by Shri S K Chawla, CEO Winnerspitch Energy Private Ltd.

Abstract:

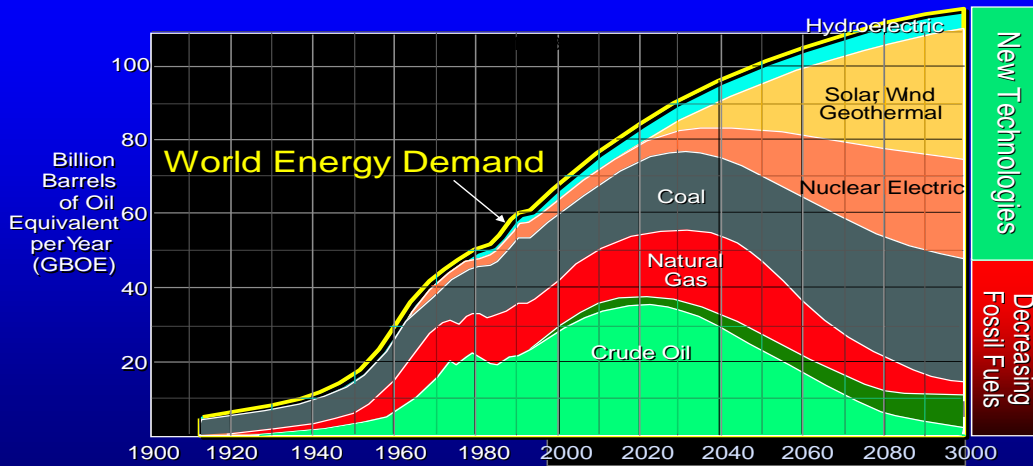
The last century saw Petroleum as a key Energy source. It dominated the scene as a life line for progress not only as a fuel but also as a feedstock for Petrochemicals. The dependence on this vital commodity has changed the Power Equation in the world. However the spiraling prices and environmental impact puts a question mark on things to come. Till such time, Renewables and other Energy sources show-up in a big way the pressure on dealing with new challenges in Research and Development of Hydrocarbon will continue. In a short write-up below we try to peep into the newer vistas of technology which govern the sustenance of Petroleum as an Energy source, inspite of enormous pressure on society.

The Hidden Treasure

Quest for Energy and Power has been perennial in human beings. Knowledge of Science and Skills to add value has been his uniqueness over other living beings. The geo-scientific evidences, changing in Earth's climate over million of years taught us all about Formation, Migration and Accumulation of Petroleum. Tectonic activity in deeper domains – conversion of seas into mountains over million of years gave us this valuable resource. What didn't change was the quest for more and more knowledge about its abundance or otherwise. Having realized during the last three decades that Easy Oil Era is nearly over the human mind is now in search of alternates which will change the face of Energy Scenario.

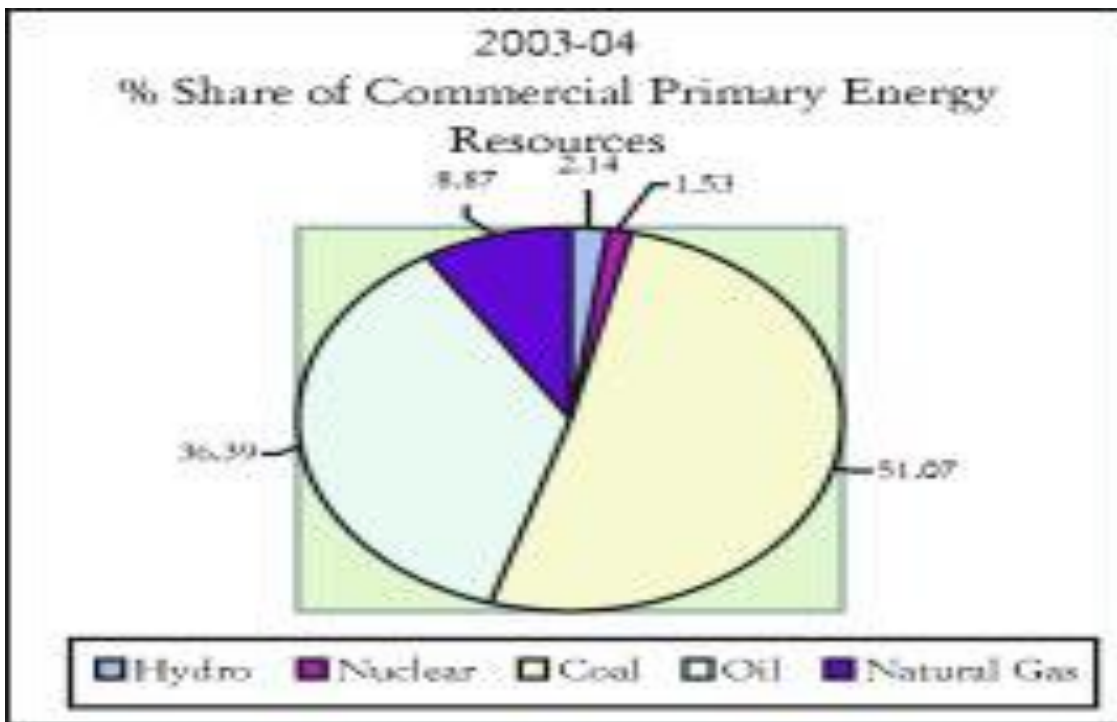
The following self explanatory diagrams show the trends of Indian Energy as compared to the worlds Scenario. Although the projections for Oil & Gas till 2050 are not yet cleared, these are likely to go down as compared to other sources.

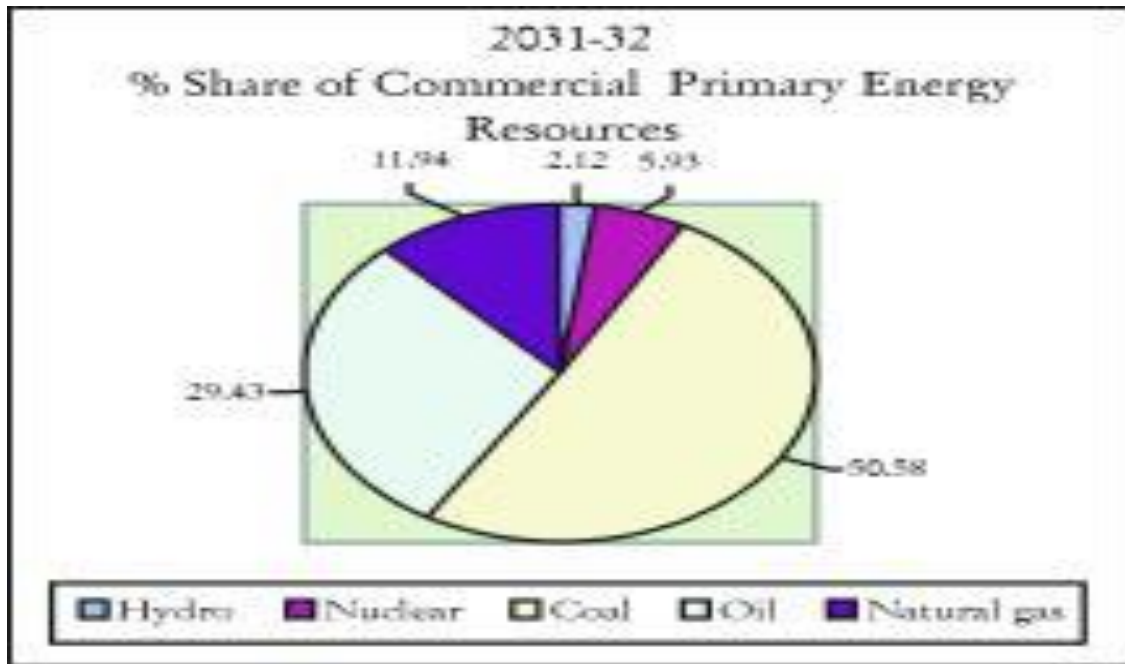
Projected World Energy Supplies



Ref: Oil & Gas Production – The Future is Bright, Tim Carr, Kansas Geological Survey and University of Kansas, Energy Research Center

Indian Scenario:

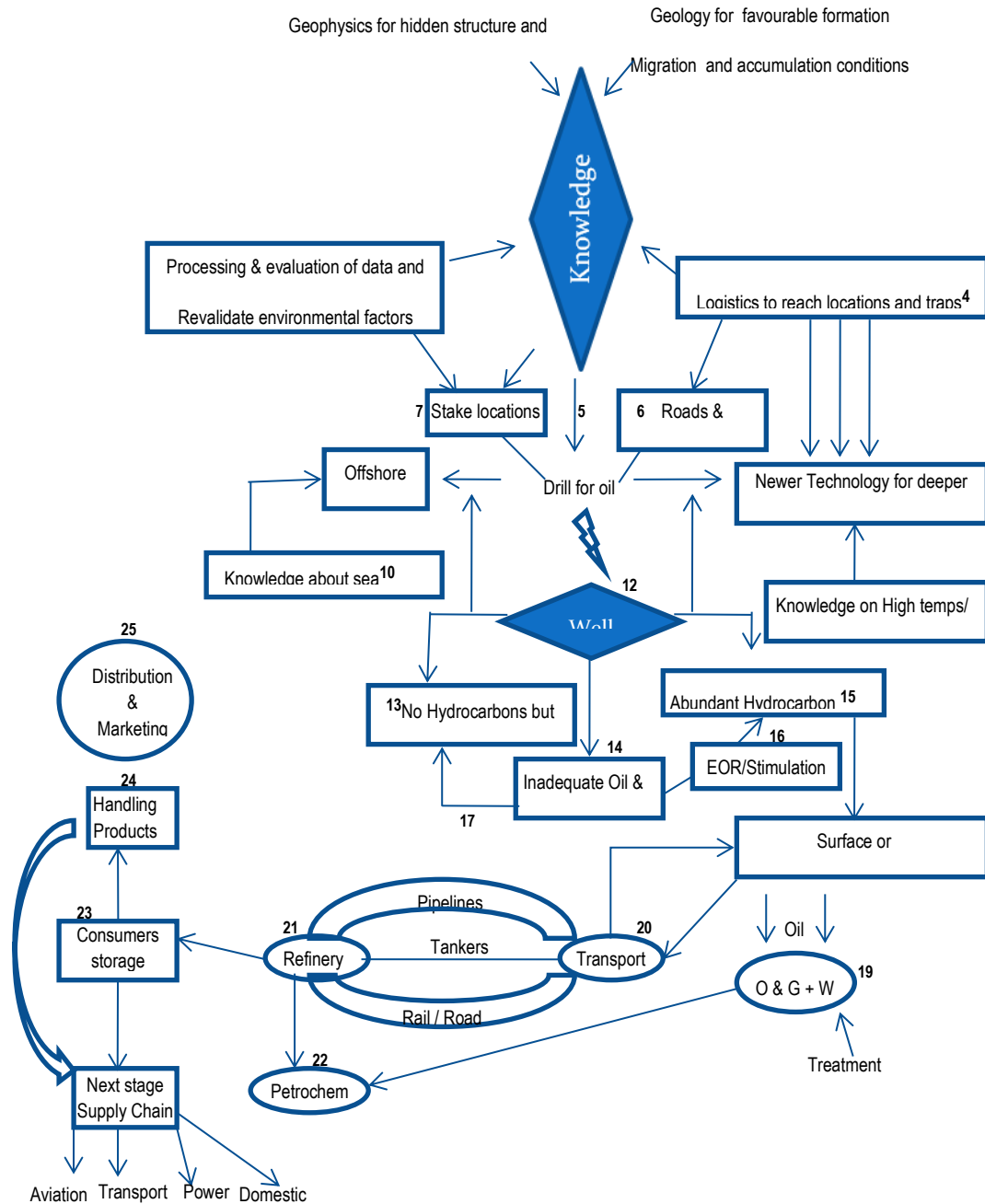




Ref.: Integrated Energy Policy, Planning Commission, Government of India

No doubt, the period of zero oil will however be a "doom", Human ingenuity is thus likely to be diverted towards Energy Efficiency, Conservation, Change in life style, up-gradation of Science to probe into unexplored areas. Deep seas and Oceans, more difficult terrain, Colder zones, remote lakes and Completely unknown geographical areas are his interests now. Application of advanced Physics, Mathematics, Chemistry, Geology, Computer, Artificial Intelligence, Robotics and several other skills are in his mental arsenal to conquer whatever Petroleum and other Energy Sources are there in the subsurface. Keeping full regard to the space availability for this article, we shall give below a few graphical representations to tell the tale:

Fig. 1: THE PETROLEUM INDUSTRY FLOW CHART



N.D. The numbers in the superscript show different stages, each one of which has a series of underlined R&D prospects for modernization and increased efficiency and efficacy.

Research & Development Issues

At this point it is pertinent to name some target areas for Research in each of the segment given in the chart. The following table will elaborate the issue:

Sl. No.	Subject	Area of Research & Development	Leads Expected or Achieved
1.	Upstream <ul style="list-style-type: none"> • Geology • Geophysics • Logging • Reserve Accretion • Geochemistry 	New areas not Covered so far 3D GM, Magneto-telluric Surveys, Modern Computational Technology New tools for Formation Evaluation Explore difficult area and reevaluate old data Chemostratigraphy and Reservoir characterization	Inter-trappeans, Mesozoic, Basement Oil and deeper zone information To study deformation and structural balancing Ensure that no prospects are missed More Hydrocarbon from existing areas could be discovered To rediscover existing fields with different approach to identify basement highs and subtle traps
2.	New Frontiers	Alternate Oil, Oil Shales, Tar Sands, Heavy Oils, Tight Gas, Basin Centered Gas, Shale Gas, Coal Gasification, SCG & UCG, CBM, Gas Hydrates and Biofuels	These areas are still new and will lead to use of alternate fuels in near future. They are at different stages of experimentation to commercialization
3.	Drilling	Digital Oilfield, Virtual Platforms, LWD, Amplitude Variation with offset, Vertical Seismic profiles, Smart wells and spar technologies	These technologies are meant to get online information from offshore wells at base for instantaneous decision taking and well control.
4	Production	a. Enhanced Oil Recovery (EOR) through In-situ Combustion.	These techniques are over and above the ones already known

		<ul style="list-style-type: none"> b. Viscosity reduction & pour point depression c. Special Pipes pre-protected inside d. Process Control and maximizing liquids e. Talking wells f. Use of RCVs and robotics for Sub-sea completion and installations of Oil Collecting Station. 	and under Practice. Emphasis is on base control and online management.
5.	Midstream Sector	<ul style="list-style-type: none"> a. Liquefaction Technology by application of APICI-APX Process, Shell DMR, process, Linde Process and IFP/Axens Liquefin process etc. b. Process Selection Parameters in LNG Technology c. Pipeline Corrosion prevention by internal treatment beside cathodic protection d. Telemetry e. Sub-sea Pipe Laying by special barges and coiled Pipe handling f. Magnetic in-line inspection data collection 	<p>Better understanding of equipment required to handle LNG and similar products by using more efficient cooling process.</p> <p>Long working life for pipeline and capacity maintenance as well as failure prevention.</p> <p>For distant measurement of parameters</p> <p>For offshore applications.</p> <p>For leaks in submarine pipelines</p>
6.	Refinery Sector	<ul style="list-style-type: none"> a. Computational Fluid dynamics, Reactor Design, 3D models. b. Residue up-gradation, Thin film evaporator, Natural 	For better Engineering of processing units and value

		Gas Refinery, Hydrogen Management	addition of higher fractions as well as well residue.
7.	Petrochemical Sector	Debottlenecking, upgradation of existing refinery projects and new green field complexes	Crude oil based Raw materials can be expected by new technology adoption.
8.	Integration of Refineries and Petrochemical & Fertilizer Complexes	a. SYN GAS use b. Using high ash content of Indian Coal	Emission captured and converted to SYN Gas which can be further converted to Diesel, Methanol and Olefins and further to Ethanol and Ethylene & Polyethylene For Conversion to Tar
10	Miscellaneous Issues	a. Nano Technology b. Climate Change c. Carbon Sequestration d. Hydrogen, Tidal, Wind, Solar and other Non-conventional sources of energy like Geothermal e. Biofuels	CO ₂ Injection for TOR CO ₂ recovered from capture points and transported. Nano-tech Membranes for capturing CO ₂ Fast Research on Global Warming and its all ill effects (Emissions) Recycling emissions for earning Carbon Credits & EOR Minimize use of thermal energy from Fossil Fuels and make use of Energy from earth (geysers) and oceans Hybrid vehicles Use of Bio-diesel and Ethanol instead of Diesel and Gasoline at least in parts

		f. Energy Efficiency in Buildings and Conservation	Research is already showing result in terms of reducing pressure on thermal energy use.
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Conclusion:

From the above write-up a few point stand out prominently

- a. Petroleum as a fuel will find its minimal application as an Energy Source by the end of the century.
- b. New Energy mix will dominate their use in different countries depending on their availability.
- c. The time lag between "a." and above being large, there will be enormous pressure on users of Petroleum driven vehicles and Power houses etc which will change the societal life style.
- d. For the next 20 – 30 years R&D in Petroleum Sector (entire supply chain) must accelerate to cope with the demand, to avoid near "Energy – famine" conditions.
- e. The evil affects of indiscriminate Energy waste must be avoided at all costs in the interest of health of our coming generations.
- f. Pro-active governance, regulations and punitive measures should find place in suitable slots.
- g. The developing economies like ours have extremely low elasticity of supply and demand thereby meaning that much more efforts has to go into Supply end to cater for the demand of energy, Petroleum in particular and dependant products in general.
- h. Combinational technologies of conversion of abundant resources to rare over must be commercialized soonest. (CTL. CBM etc.)
- i. De-centralization of grids at selected isolated places should be considered and combinational local systems (wind and Solar for example) tried.
- j. Mass Rail Transport and infrastructural improvement must accelerate.

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