Innovative Thought Forum

ROUND TABLE ON "ENERGY ECONOMICS"

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1st Floor, A-7, Safal Profitaire, Corporate Road, Near Prahladnagar Garden, Ahmedabad – 380 015.

Preamble:

- Energy is central to all our activities, economic growth and sustainable development. Energy access, availability and affordability are pivotal to equitable development where the economics of energy sources plays a crucial role.
- The subject of energy economics is not developed much in this country. It is indeed intricate encompassing the concepts of financial analysis as well as economic analysis relating to demand, availability of primary energy resources, nexus between sources, technology of conversion, transmission, distribution and ultimately end energy use to satisfy a given demand. All this needs to be considered with affordable energy pricing, sensitivity of related parameters and fast changing data base which needs to be upgraded very dynamically.
- This will facilitate the real forecast which is necessary for appropriate energy policies with respect to cost and environmental impact, Energy policies and actions are thus crucial for proper governance of all societies and nations
- Due to complexities in domain of energy, priorities keep on shifting for all stakeholders. We find ourselves clueless with respect to closure of large number of power plants shutting down despite demand being a lot more than supply or wide disparity between the price to a consumer vis a vis farmer or commercial establishment. We are also baffled by poor progress of decentralised plants in remote areas despite massive support from government.
- There is a paradigm shift with renewables like solar, wind, biogas, biomass etc becoming competitive against fossil energy in most situations.
- Niti Aayog and World Bank have started work on energy, water and food nexus for enhancing rural incomes and improving water use efficiency. There is now clear realisation by that entire subsidy in energy in farming is actually subsidy on water that has distorted cropping pattern and Besides ,economics part is not paid holistic attention and costing is also not done by producers and marketers of energy who are constantly under pressure of governments and regulatory bodies

List of participants:

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- Mr. Jaydeep Malviya
- Mr. D.P Joshi
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- Mr. Nikhil Shah
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- Mr. Gaurav Mishra
- Mr. K H Pujara
- Mr. Dharmendra Gor
- Mr. J S Kochar
- Mr. Nikhil Shah
- Mr. Amal Dhruv
- Mr. D J Yadav
- Mr. J K Trivedi
- Shweta Mahajan
- Mr. D L Chandarna
- Mr. Priyesh C
- Mr. Mayur Parikh
- Mr. R K Vij
- Mr. Devang Acharya

Important discussion points:

- Energy economics paid very little attention in holistic manner. Massive distortion in policies and actions due to political compulsions to give subsidies to select segments like agriculture
- Belated realisation that subsidy on power actually subsidy on water that has caused huge distortion in cropping pattern
- Energy economics an emerging subject and all the costs like environmental, health, social etc yet to be captured (comparative table attached to this summary)
- Most policies and programmes driven by supply side. Genuine work through demand estimates and demand side interventions still to pick up
- Major paradigm shift now with several renewables producing power at lower cost than fossils such as solar, wind, biomass, biogas etc
- Constraint of intermittent power production through solar and wind a hurdle in many applications but progress in energy storage likely to solve it in medium term
- Matching of demand and supply throwing up many opportunities like pumping in agriculture or energy needs of most enterprises during day
- Embodied energy in different materials not captured accurately.
- Total embodied energy in coal power exceeds 90% that is consumed from extraction of coal to generation and delivery of power to consumer.
- International Association of energy association puts cost of pollution and healthcare due to coal power not less than 2 Euro cents for each unit. Once added in calculations,can be crucial in comparison

- Bureau of energy efficiency (BEE)doing reasonably well. Energy conservation building code (ECBC)yet to become operational on ground
- In contrast, Germany immensely successful and has reduced energy needed in many uses including built environment.Current energy level needed for comfort conditioning only 10% of level 40 years ago
- Water energy nexus clear now. Subsidy for pumping responsible for overdrawal of water and wrong cropping pattern. Punjab having 80% land in red zone due to water guzzling crops unfit for that area.
- Decentralised distributed power generation (DDG)a part of government scheme for many years. Not successful despite huge subsidies due to financial, operational and policy challenges
- Grid connectivity and stability a major issue. Mismatching of consumption and generation.
- Financial calculations constantly evolving with policy interventions mainly on supply side
- Electricity policy partly implemented. State wise regulatory hurdles rampant, arbitrary and inconsistent
- Interesting studies by CEEW (on behalf of Swiss agency) and REC to assess demand of electricity for different segments like residential, agricultural and business in rural areas giving rational directions
- Absence of organised study of energy economics in India .Very few groups or associations even outside of India reflecting lack of concern so far by policy makers
- Thermal use of energy most important. Yet not studied from angle of cost per unit of heat energy through different sources
- SKY and now KUSUM turning farmers into power producers. Will change energy scenario
- Biogas plants based on cattle manure, poultry waste, vegetable waste etc great for giving organic slurry and fertiliser .Such integrated plants profitable due to huge economic value of organic fertiliser
- Solar water heater a great application. 100 litres system saves upto 1500 units of power. Has a payback period of less than 18 months without any subsidy. Many thermal systems for process heat now available with payback period of 3/4 years.
- Windmill efficiency increasing and land demand decreasing. Wind solar hybrid installation also a reality
- With import component of over 80% for crude, 30% for coal, 60% for gas etc, high time to give extra push to renewables now for energy security
- Mini grids or micro grids worth looking at. Tatas planning large number of mini grids in India.
- Cold rooms based on renewables now technically feasible and available. Business models emerging in different formats that will change farm economics
- Though lot of successful innovations in larger, high mast and offshore windmills no credible action in small windmills
- Despite advances in renewables, coal will dominate in foreseeable future. Blending and integration hence indispensable.

Key takeaways:

- Energy sector undergoing transformation with renewables now cheaper than fossils in many contexts and situations at production level
- Solar PV most versatile of all and can be installed from micro to mega needs
- Demand in many areas discontinuous and mainly during day in agriculture and business segments. Mini grids based on solar, biogas, biomass etc feasible

- Biogas plants most beneficial when value of organic fertiliser captured. Can complement solar PV in mini grids very well
- Stability very crucial for integrating renewables in the grid but lot of technical solutions being adopted
- Pollution, environmental and healthcare costs not yet counted but surely exceed Rs 1.50 per unit of coal power as per European Union
- Solar PV found ideal for many end uses. Having big scope all over the world for
    - water pumping
    - agro processing
    - cold chain
    - rural enterprises
    - rooftop solar for homes
    - rooftop solar for enterprises
- Wind power also becoming cheaper with increase in size and height
- Big scope for feasible models of windmills of smaller sizes that can work on lower speeds
- Biomethanation technologies now proven and can be used wherever supply chain well managed
- Biomass gasification also a proven field and can be used wherever proper supplies of raw stock assured
- Taken holistically renewable power through solar, wind and biogas a lot cheaper than coal or fossils
- Battery costs coming down.
- Phase change materials (PCM)use also commercialised opening big scope for cold chains for fisheries, fruits, vegetables and perishables
- Land constraint being overcome through innovative approaches like farmtop solar, wind+solar, improved panels etc
- Minigrids or decentralised grids now feasible with consumer centric approach
- Current subsidy model for agriculture needing overhaul
- Energy and water efficiency measures needing greater push in buildings and farming
- Solar thermal applications like cooking, drying, process heating etc feasible even without subsidy but need focus and attention
- Many opportunities for ESCO models in India now with proper structuring
- Among fossils, coal indispensable upto a certain portion in the mix and gas based turbines for balancing
- Diesel based power units to face calibrated phase out
- Need for engineering of systems for hybrid mix in generation and transmission

Actionable points

1 Carry our a thorough and holistic comparison of energy through different routes to decide on the mix for meeting user needs

2 Work on the way subsidy in power can be phased out in calibrated time

3 Work on business models around mini or micro grids based mainly on renewables

4 Thrust to energy efficiency in building and farming sectors

5 Replace diesel with renewables wherever possible

6 Aggressive promotion of thermal applications of solar that are technically and commercially viable

Legend

BEE- Bureau of energy efficiency

ECBC- Energy conservation building code

DDG - Decentralised distributed generation

CEEW - Centre for energy, environment and water

REC - Rural electrification corporation

PV- Photovoltaic

SKY - Suryashakti Kisan Yojana

KUSUM- Kisan Urja Suraksha Evam Uthan Mahabhiyan

PCM - Phase change material

ESCO- Energy service company

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Comparison of Electricity Cost Produced and Delivered Through Popular Routes (As on 21/1/2020)

Assumptions:

1. Coal based power plant cost : Rs.7 crore per MW or Rs.70,000/- per KW
   Solar power based plant cost : Rs.4 crore or less per MW and can be taken at Rs.40,000 per KW
   Biogas plant with turbine cost : Biogas plant of 20 Cu.M. Rs. 3,00,000
   : Turbine of 5 KVA Rs.1,00,000
   : Total Rs. 4,00,000

2. PLF for coal based plant is around 60% and in a year it normally works for 300 days. Solar plant has efficiency of 20% and works for 350 days.

   Biogas plant is expected to work for 350 days

   20 cubic meter capacity plant will generate 30 units of power in a day.

3. 20 Kg. of gobar produces 1 Cu.M. biogas and in comparison 1.5 units of power. Thus, for producing 1 unit of power 13.33 Kg (20 ÷ 1.5) of cow dung will be needed.

4. Additional investment required in Biogas Plant has to be made available at around 5% through interest subvention. NABARD has already been asked to give interest subvention for renewable energy plants.

5. With the above assumptions, CAPEX component in the calculation comes as: (Given on next page)
   Biogas - 5.70
   Coal - 2.43
   Solar - 3.20

6. To the CAPEX component, we have to add following:
   (a) OPEX
   (b) Recovery from byproducts (biogas plant gives out slurry, which has market value of Rs.2/- per Kg. in the country. This can be bettered with certain improvements in the slurry processing such as dewatering, vermi-composting, fly ash + vermi-composing.
   (c) Environmental cost
   (d) Healthcare cost

7. From a holistic comparison it emerges that biogas plant should be put up wherever we have availability of putrefiable or organic waste emerging from animals, food, vegetables or human routes.

8. Biogas plants should be put up for families, communities or corporate level depending on market driven facility.

9. For coal based power plants, additional investment will be needed for transmission and distribution lines.

10. There are substantial losses in transmission and distribution. A general estimate of 10 - 20% of loss for giving electricity to rural areas is realistic. This will increase cost of delivered power in the villages substantially.

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Comparative cost and gains per Kwh or unit

11.

	Biogas	Coal	Solar
Investment	4,00,000 for a biogas plant of 20 cub meters and 5KVA turbine	70,000 per KW	40,000 per KW
Output per day	30 Kwh	14.4 Kwh	5 Kwh
No. of days per year	350	300	350
Annual output	10500 Kwh	4320 Kwh	1750 Kwh
Life	20 years	20 years	25 years
Depreciation	20000	3,500	1,600
Depreciation per unit	1.90	.81	0.92
Rate of interest on the capital	10	10	10
Interest for the year	40000	7,000	4,000
Interest cost per unit	3.80	1.62	2.28
CAPEX component for generation	5.70	2.43	3.20

12.

OPEX:	Biogas	Coal	Solar
Material & maintenance cost	Rs.1.00 / unit	Rs.2.80/unit	-

13.

Manpower & labor cost:	Biogas	Coal	Solar
	0.50	0.25	0.25

14.

Environmental & healthcare cost:	Biogas	Coal	Solar
	- Rs. 2.00 / unit (notional gain through waste management & sanitation)	Rs.1.00 / unit	-

15.

Recovery from by-products:	Biogas	Coal	Solar
	-Rs.26.00 (Rs. 2 Per Kg. for 13 kgs. of Slurry)	-Rs.0.25 (for fly ash)	-

16.

Total cost or gain	**Biogas**	**Coal**	**Solar**
	Gain of 20.80 per unit (Gain of 28 - cost Rs. 7.20)	**Cost of Rs. 6.23 (Overall cost of Rs.6.48 - gain of 0.25)**	**Cost of Rs.3.45**

Note: If recovery of slurry is priced at Rs.1.00 per Kg. gain will still be Rs.7.80 per unit in biogas.

Important Note: Coal based electricity will be costlier due to Point No.9 & 10. This can also be quantified later.