HOW DO WE ALIGN A SOCIETY ON ISSUES RELATED TO TRANSITION

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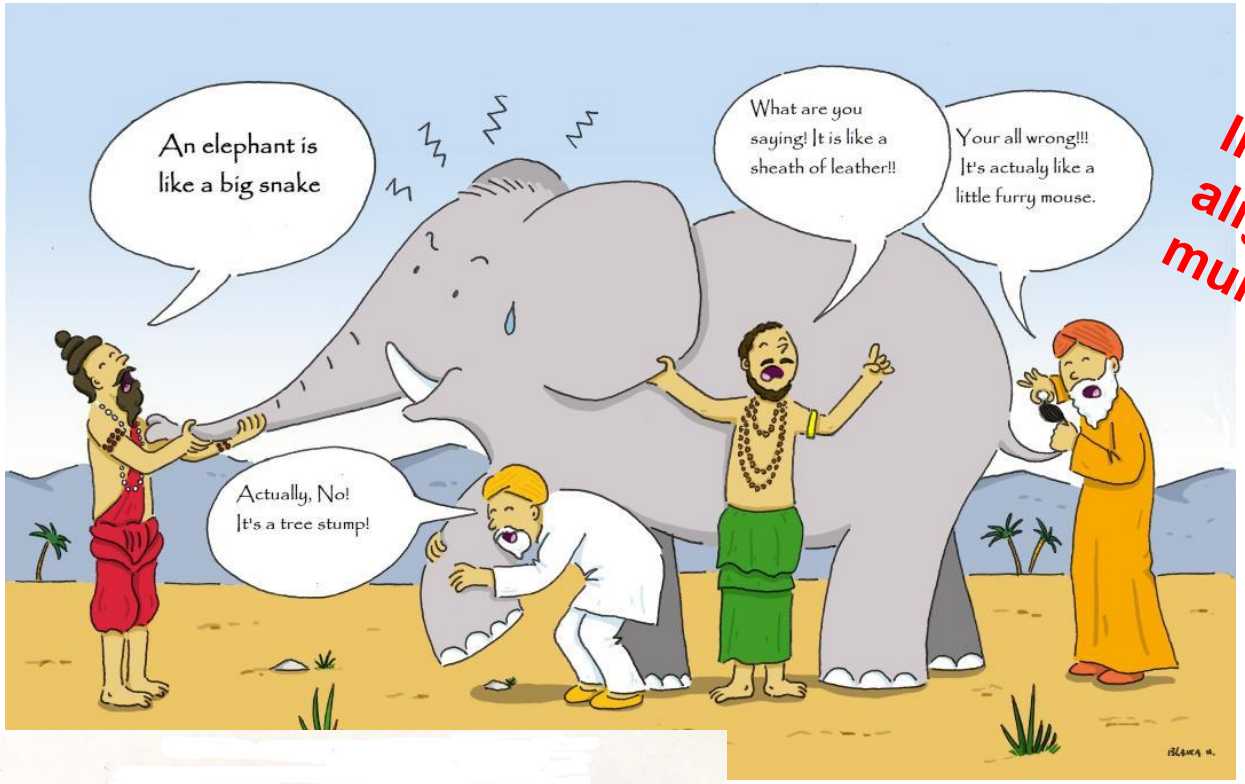
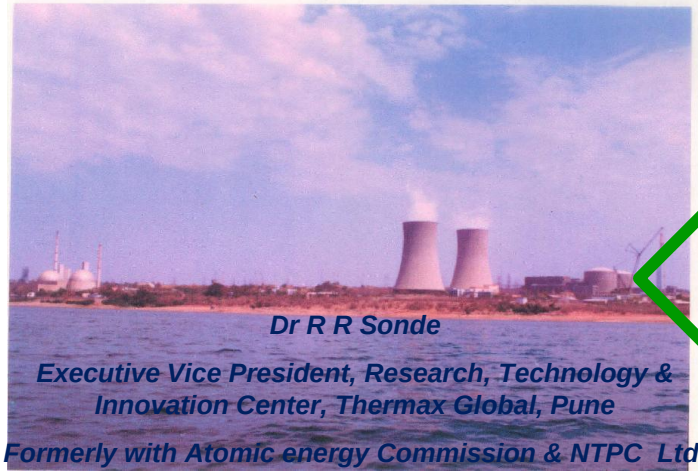


It is a big challenge in a liberal society to get alignment on issues with multiple stakeholders

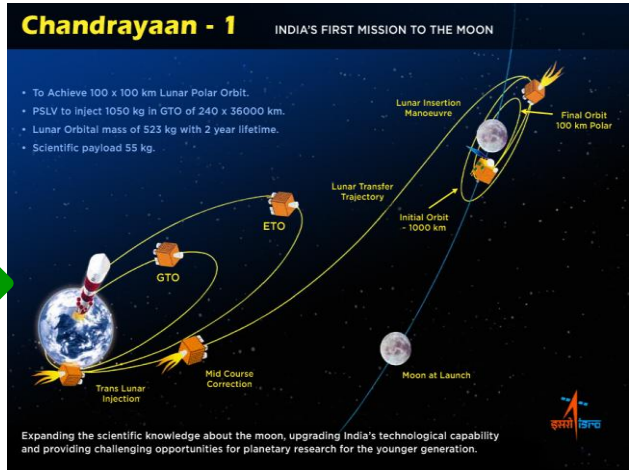


Dr R R Sonde

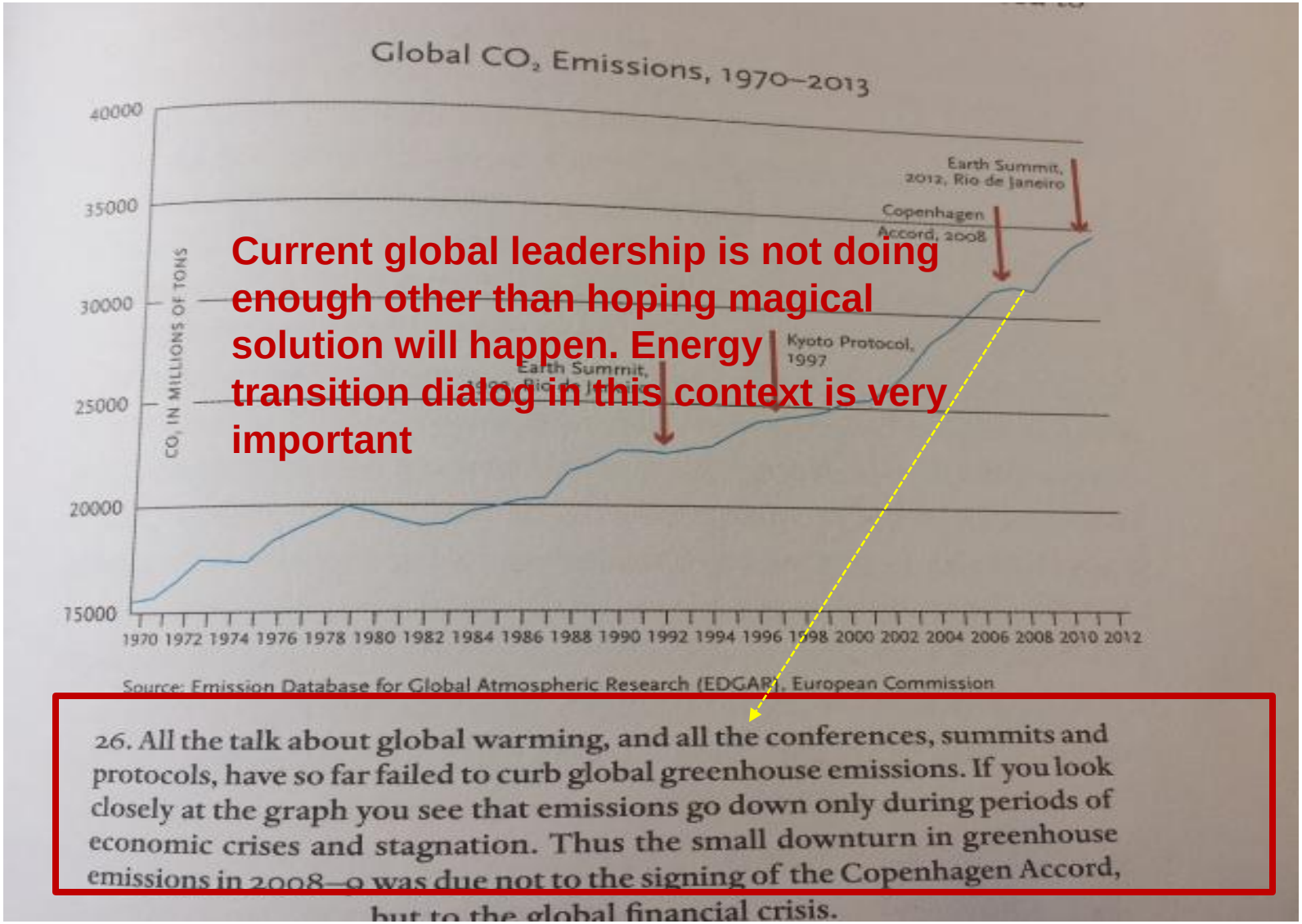
Executive Vice President, Research, Technology & Innovation Center, Thermax Global, Pune

Formerly with Atomic energy Commission & NTPC Ltd.

National pride can perhaps bring this alignment. Can we bring this element in energy transition?



IN PRACTICE HUMAN KIND IS UNWILLING TO MAKE SERIOUS ECONOMIC, SOCIAL & POLITICAL SACRIFICES TO STOP THIS CATASTROPHE: INTENSE CLIMATE EVENTS



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MY OWN EXPEREINCE IN DEVELOPING NEW ENENRGY TECHNOLOGIES FOR INDIA: THREE EXPERIMENTS

1. I thought solar energy is best utilized in India as concentrated solar thermal hybrid (CSP) with biomass as combined CHP at rural scale – Thermax- DST Shive project

2. I thought 29% of electricity for cooling (AC load) – nearly 75 GW of power for AC- can be met using a hybrid vapor absorption & CSP combination.

3. Cold storage & cold chain can be met using solar-biomass (agro residue) for India and save huge loss of our agricultural produce using fossil based energy

In reality all these experiments did not catch up the momentum as proposed and something entirely different scenario is emerging in solar…..

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India's solution to energy challenge at most fundamental level : Experiment 1

Shive
is the quintessential Indian village in Khed taluka, Maharashtra, 57 kms from Pune

The project was funded by the Department of Science and Technology, Govt. of India

Population : 3500, 500+ households

Agricultural Economy

Water Availability

Abundant radiation

Poor Grid Connectivity
Daily blackouts of up to 14 hours

Scarce industry
Labour migration

No Cold Storage
Wastage of agricultural produce

Solar + Biomass for a 24/7 power: The Vital Statistics

THERMAX

18,00,000 kWhr

Capacity to generate electricity and generated for one year.

Our system has been proven to reliably run anything from ..

Upto 500+ Rural Homes	100+ Agricultural Pumpsets	Up to 50 Small Buildings
Note: 1 fan and 2 bulbs for each home at 150 W for an entire year	Note : At 750W per pump set run for 6 hours daily, for an entire year	Note : At 2000W load run for 18 hours daily, for an entire year

Effectively, in one year..

1100+

tonnes of coal saved from being used for electricity generation

Source: CERC, New Delhi Report
Specific Coal Consumption: 0.63kg/Kwh

750+

tonnes of CO_2 displaced

Source : British Gas
CO_2 displaced : 0.422 kg/kWh

Finally, a sustainable, reliable & robust

Rural DisGen alternative

Shive Project : Unique “Model” Project

- Cost effective solar collectors
- Direct steam generation
- Hybrid solar biomass
- Organic Rankine Cycle
- Hybrid STG-ORC
- Free open access: Use of existing grid
- Local skill development: Social engineering

WHY SHIVE – SOLAR BIOMASS HYBRID – DID NOT TAKE OFF? TECHNOLOGY WAS HRADLY THE ISSUE

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1. Could not convince the villagers to build a village scale energy plant which they could sustain by themselves. The cost of power was approx. 4 ₹ / unit on a 24/7 basis.

2. Subsidy (0.75 ₹ / unit) on the electricity available to them – even if that is undependable – has made the villagers unwilling for any other options which is more expensive. In fact reliable supply of power which could enable enhanced productivity & better cash crop was not sufficient driver to them.

3. Biomass which was promised by the villagers at the start of the project as their responsibility for supply did not materialize during the operation. Cartelization started happening

At the end, we could not build a consensus with the policy makers, financial institutions that such experiments needs to be multiplied and replicated with changes based on Shive experience.

Solar based HVAC for buildings: Case study 2

Globally unique solar cooling solution using solar energy with a Triple Effect Vapour Absorption Chiller

Indigenous development of Parabolic Trough & Vapour Absorption Machine

Caters to cooling requirements of 13 office rooms in Solar Energy Centre

Co-efficient of Performance (COP) of 1.7 - highest among the vapor absorption technology

100 kW Solar Thermal Cooling project comprising of 284 sq. m. collector area generating 60000 kcal of heat to provide pressurized hot water at 210° C

Involved other stakeholders

Solar Cooling at SEC, Gurgaon- FOAK triple effect solar cooling installation integrated with indigenously developed parabolic troughs by Thermax delivering 100 KW cooling

WHY THIS DID NOT FIND ACCEPTANCE ?

Could not convince the policy makers that the power saved qualifies as **“Virtual Power”** and must be given the same status as renewable power and give the feed-in-tariff incentive in line with what is available to solar PV

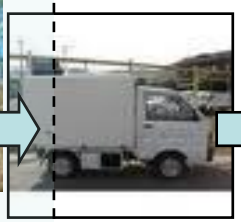
Developing a monitoring system on energy consumed other than electricity (kwhr) for FIT (feed in tariff) needed big development and multiple stakeholders

Cold Chain: Case 3

Farmer

Rural Cold Storage

Current project



Refrigerated Transport

Large Cold Storage

Food Mall

Consumer

Export

Sustainable solution to the problem of agricultural produce losses simultaneously ensuring optimal return to the farmers at the bottom of the value chain

Technological USPs

FOAK	• Globally a first-of-a-kind project
STATE OF THE ART	• Ammonia based VAM – GAX cycle – built for sub zero temperature
INTEGRATION	• Three renewable energy sources: Producer gas, Exhaust gas, Solar
SOLAR	• Fixed focus Solar Parabolic Dish
GRID INDEPENDENT	• Electricity generated from gasifier & gas engine

SYSTEM INTEGRATION

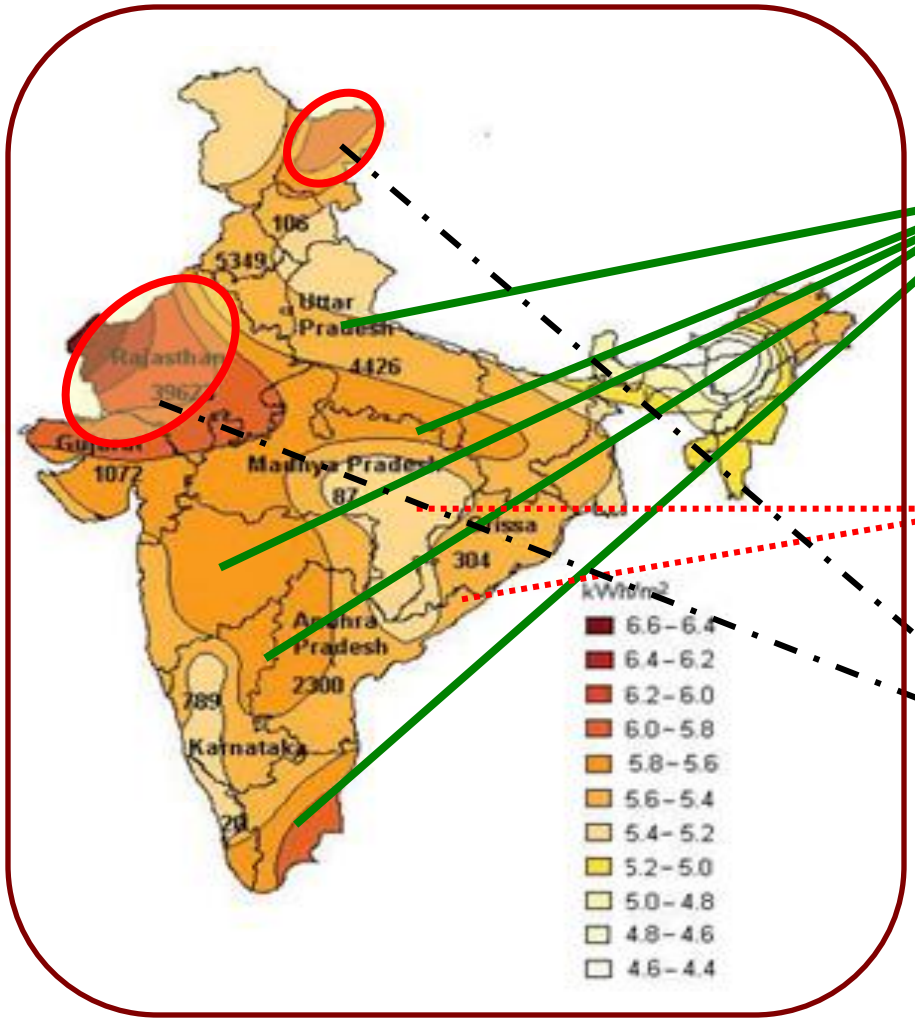
** Patents applied (under progress)*

COLD CHAIN AND STORAGE USING THE TECHNOLOGY PROPOSED DID NOT TAKE OFF….

Now this mis-alignment between technology and its translation in the field (market) is a complex interplay and appears sometimes unpredictable. And natural affinity to the technologies developments in some other part of the world (developed) gets precedence over the home grown developments

As a nation we need to develop strategy which is more self reliance driven and local while keeping a tab on the global scale developments. It is only through indigenization that country can derive total benefits of the transition. You miss it, you will loose it. And then assuming leadership position at global scale becomes a pipe dream.

We still believe the best strategy for India in Solar is:



Strategy 1:Small sized (distributed generation plants) in large numbers with & w/o grid connectivity

Strategy 2:Hybrid solar with large sized Thermal Power Plants

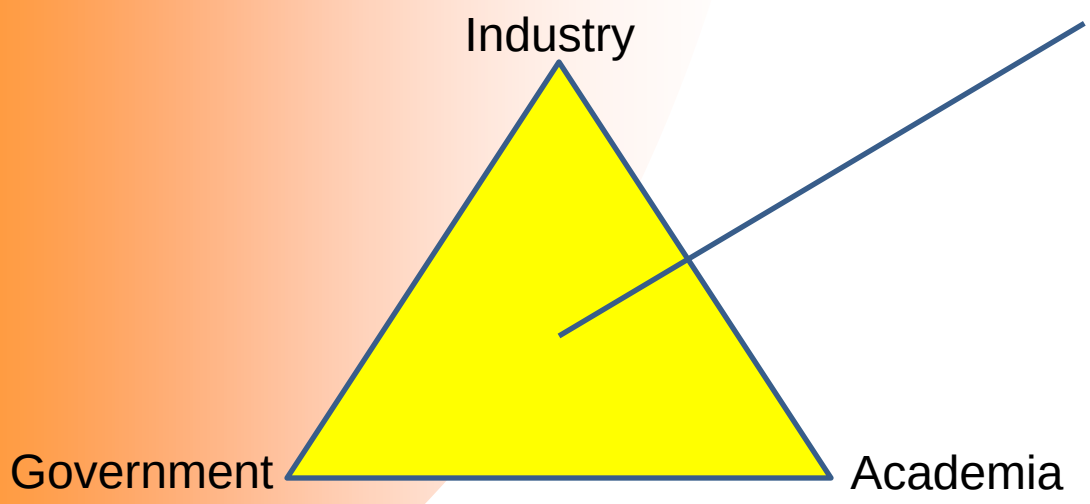
Strategy 3:Large sized CSP plants / 10 Mw clustered PV and CPV

Strategy 4: Direct solar cooling and heating

…tropical nature of solar radiation and non-availability of large land mass puts different challenge in India

IF IT IS NOT TECHNOLOGY PLAY ALONE, THEN WHAT?

We need enlightened leadership from all quarters. More particularly, Academia – Industry – Government. Alignment is not a single point destination but a complex interplay of all the interests (vested or otherwise) converging for larger good.



Golden Triangle where the three pillars decide on what is most appropriate for the country. This alignment is very critical. We still have not managed it well in India

That we need right policies, right investments and enlightened society is given but the above three must be aligned.

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AND WE NEED TO FOCUS ON INNOVATION & KNOWLEGDE DRIVEN DEVELOPMENT

When I say innovation driven developments, I do not refer only to the technology alone but I refer to 360 degrees development cycle

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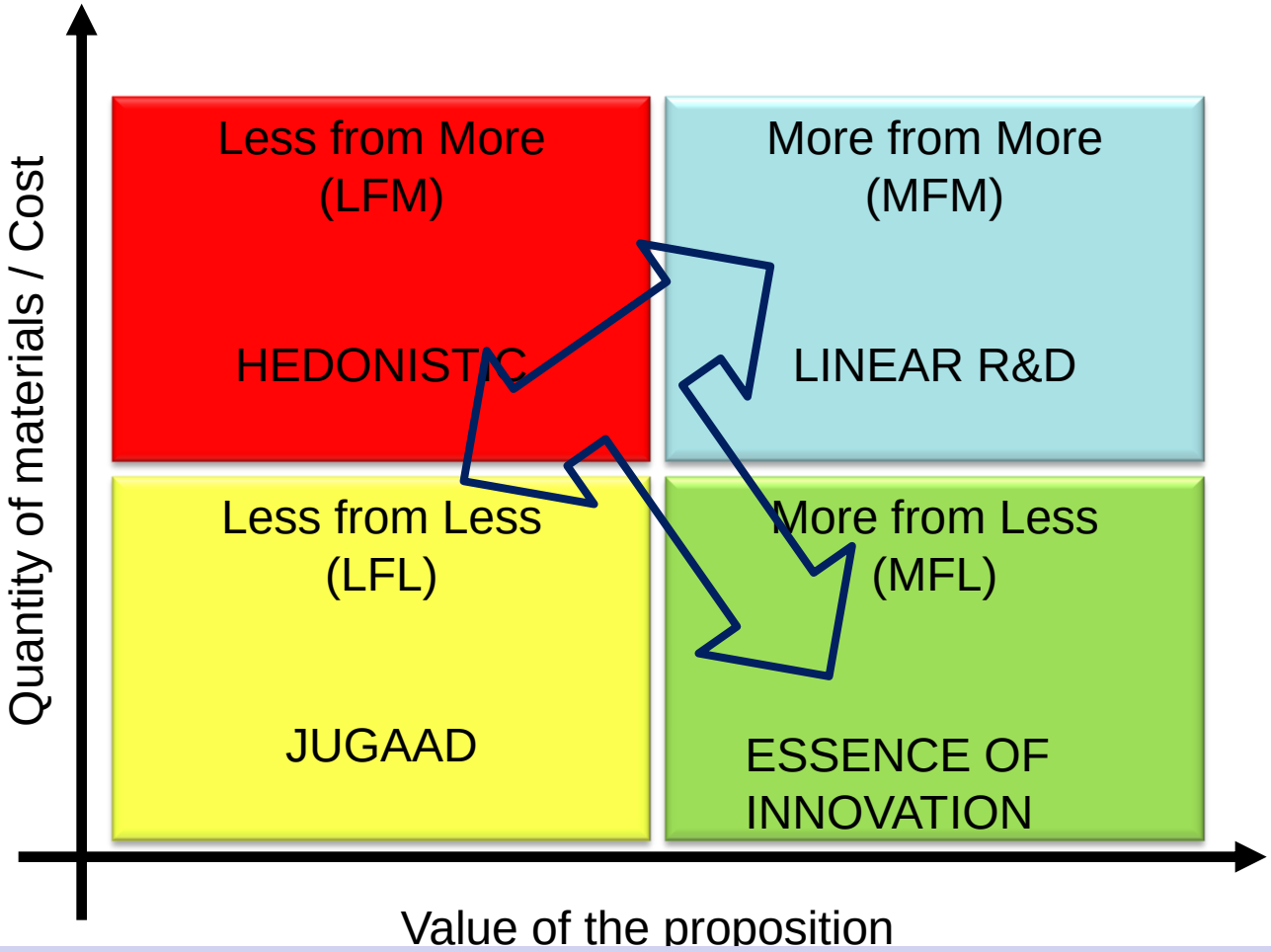
What is Innovative Thinking?



New technologies have to demonstrate that at life cycle level or TCO (total cost of ownership) level, the new technology is at par with the existing one as of today

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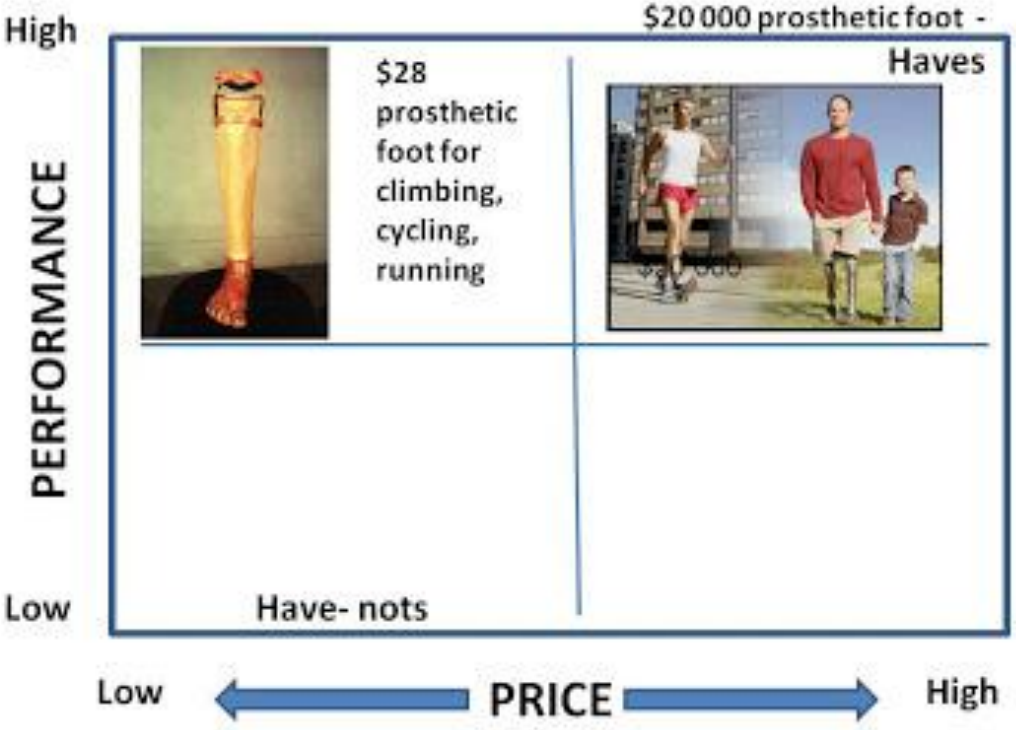
IN MANY WAYS INDIA HAS SHOWN THAT NEW TECHNOLOGIES CAN PENETRATE IN THE SOCIETY. WE NEED TO MULTIPLY SUCH SUCCESS STORIES



Aravind Eye Care

1298 Ambulance Service

1298 Ambulance Service

Mitticool, Amphibian cycle, Low cost medical diagnostics etc.. etc…..

Industry & Academia should challenge each other

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WHAT ARE THE FIVE IMPORTANT DSIRUPTIVE DEVELOPMENTS IN ENERGY TRANSITION?

1. The electricity generation will be renewable energy (solar + wind) and they will manifest largely as distributed power plants (100 KW to 1 MW scale)

2. Transport sector will be driven by electricity based traction & electricity FOR this sector will in turn be based on renewable energy or hydrogen

3. Hydrogen will be generated from renewable power or clean fossil. CO2 will be captured for its conversion to fuels to run more efficient devices like fuel cells. Hydrogen at 150 ₹ / KG

4. Industry will transit from the fossil dominant mode to green technologies and will be driven by carbon trading (?)

5. Energy storage technologies from grid to device level will complete the energy transition value chain

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I WOULD GIVE AS AN EXAMPLE THE WORK WE ARE DOING IN THE FILED OF FUEL CELLS

It is impossible to neglect the idea whose time has come & fuel cell is one such development which meets several challenges in energy transition dialog

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New Power Generation Technology: Fuel Cells

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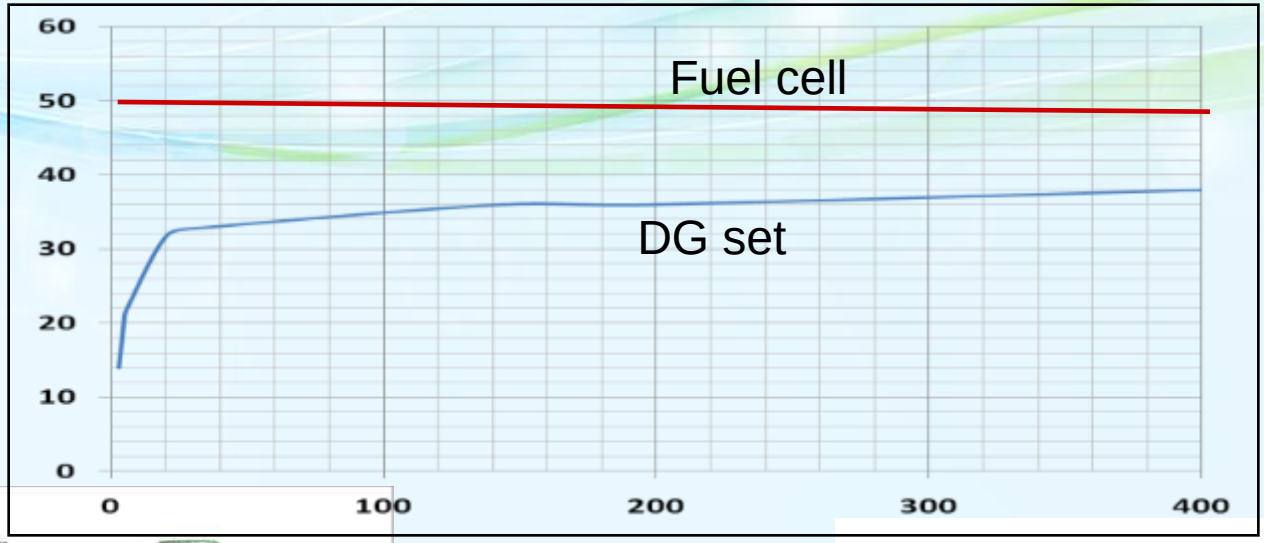
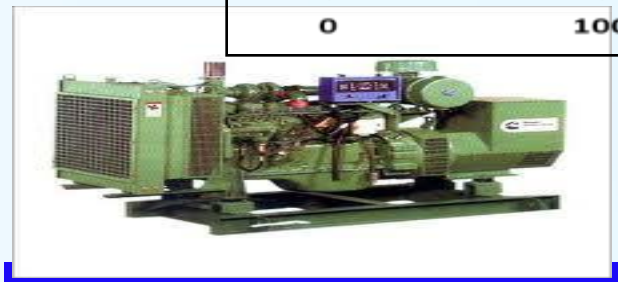




IC ENGINES

- 150 year old matured technology
- Highly optimized cost
- Efficiency still limited by Carnot cycle
- Emissions are high

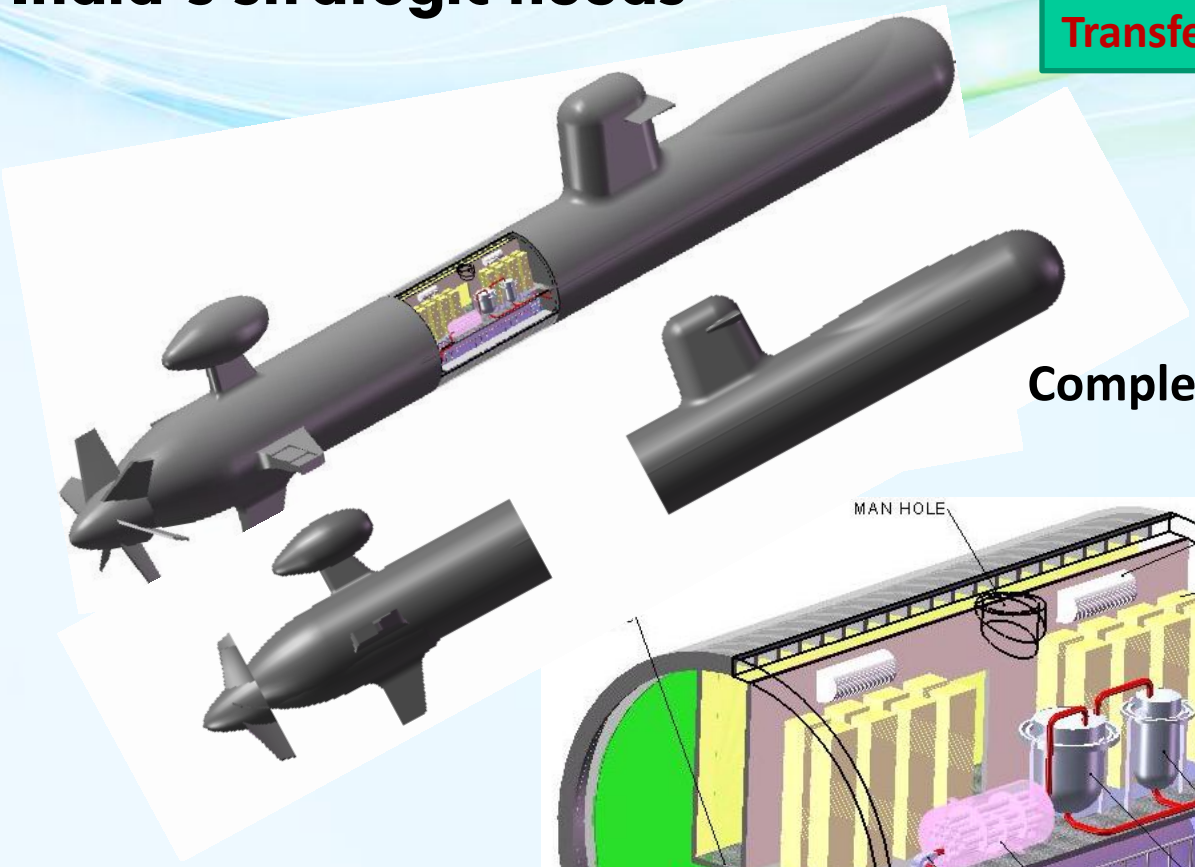
FUEL CELLS

- Disruptive technology
- High initial cost and will drop due to developments in material science
- Almost double efficient compared to IC engine
- No emissions

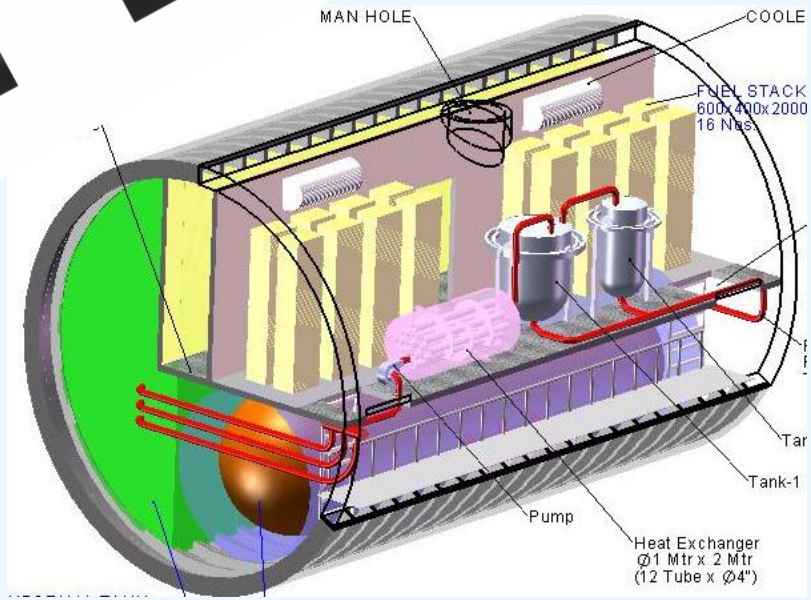
Thermax PAFC Technology for India's strategic needs

Transfer of Technology from DRDO

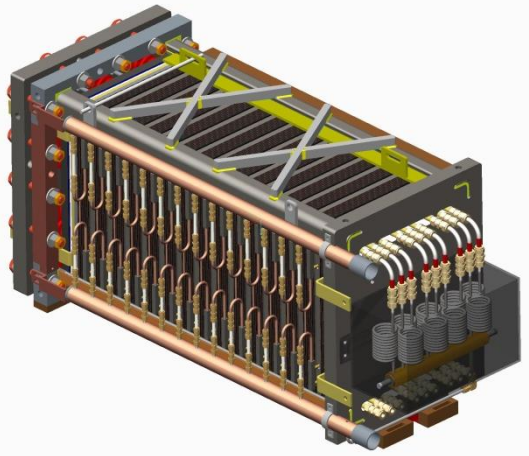
Key drivers are - higher endurance requirements pushing the developed world to move to AIP with Fuel cells



Complete Power Plant



Heart of AIP: Fuel Cell



(AIP) AIR INDEPENDENT PROPULSION SUBMARINE

Fuel Cell Power Generator

FROM STRATEGIC TO COMMERCIAL DEPLOYMENT

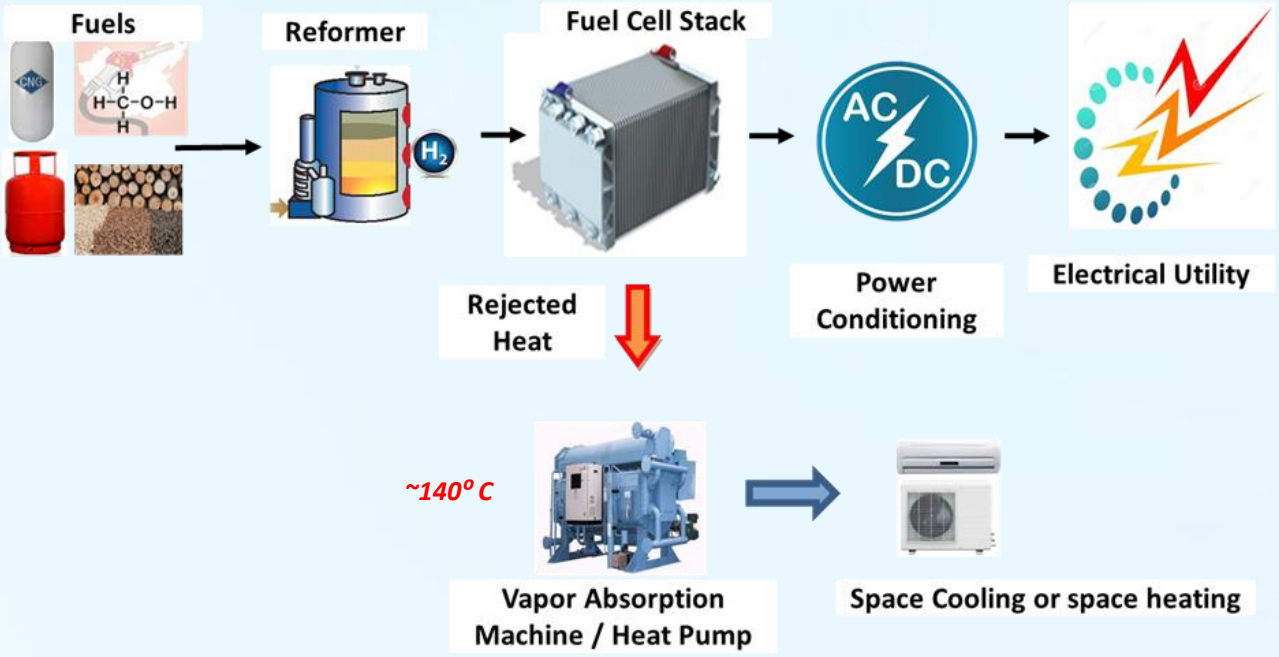
1. Telecom sector (cell phones in India itself are 600,000 numbers) on methanol as fuel supply

2. Residential (house hold) / ware housing / commercial facilities on piped NG (this is bigger opportunity)

3. **Mobility (LCV / Bus/ Truck) on HP hydrogen (using heat for heat & cool)**

The key driver remains the TCO (Total Cost of Ownership) only. Policy/ Funding/ Manufacturing follows on the back of TCO

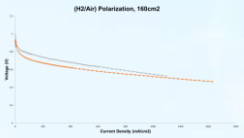
Developing a green fuel supply chain and standalone energy module is the big challenge



Fuel cell with 75% plus efficiency will perhaps be the answer to all distributed power and mobile applications

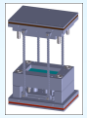
Journey from marine grade fuel cells to next generation fuel cells

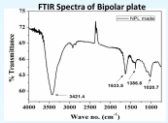
Golden triangle in full force. NMTLI – CSIR – Thermax



Research MEA's comparable to commercial MEA's

2015





Indigenous component development initiated

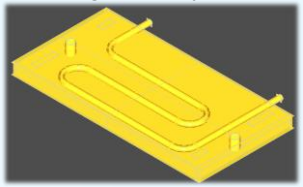
2015

Indigenous membrane Development

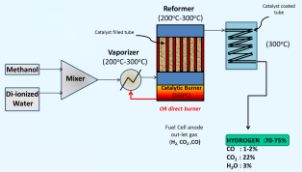
2016

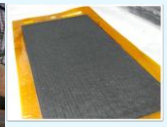
New Millennium Indian Technology Leadership Initiative Project on HTPEM Fuel Cells awarded to Thermax in collaboration with CSIR

Development of Thermal management system



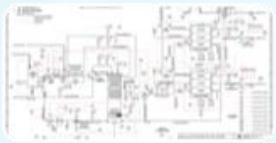
Methanol reformer Development





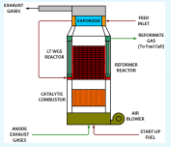
Proof of concept of Indigenous components, engineered MEA's and systems

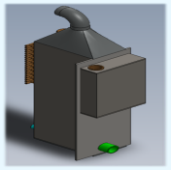
2016



Integrated design of reformer and Fuel Cell

2017





System level Prototypes for telecom Sector

2018

ENERGY TRANSITION ON THE BACK OF HYDROGEN PATHWAY

CO2 EMISSION CONUNDRUM: HYDROGEN AS THE BEST PATHWAY

instead uses surplus electricity from renewable power generation.

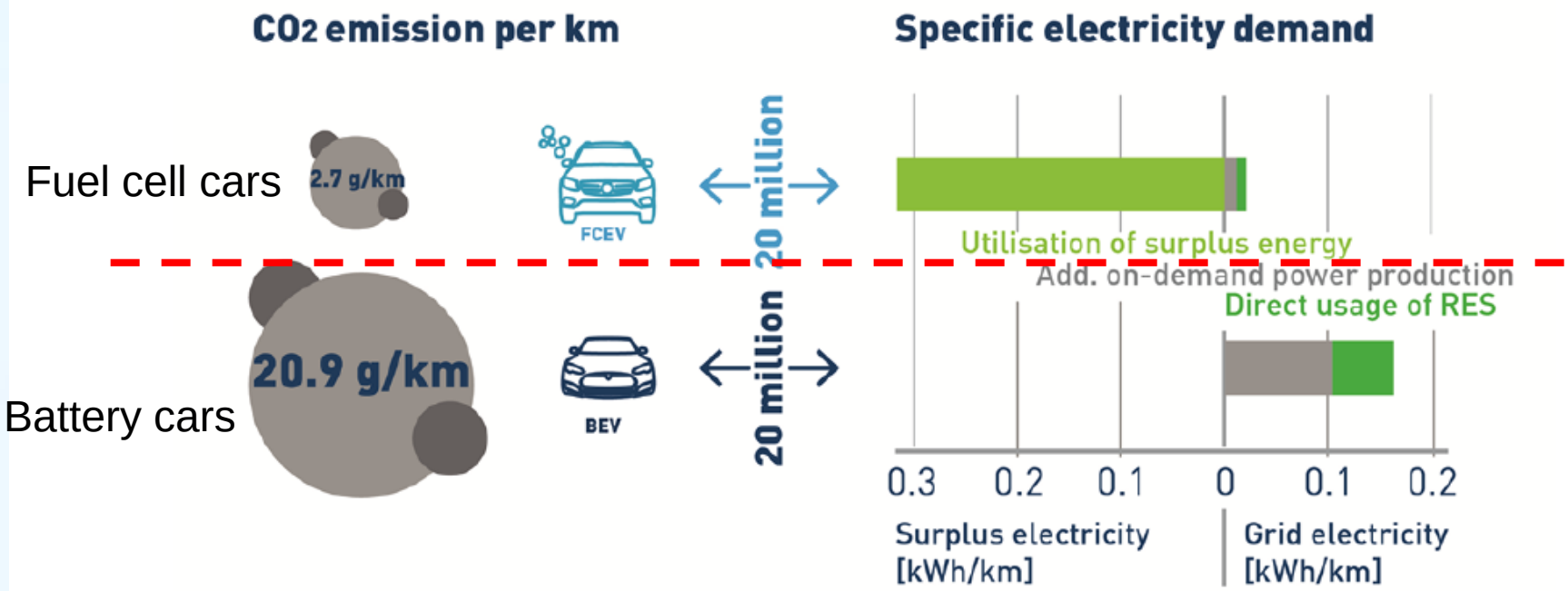


Figure 6-34: Comparison of specific energy demand and CO_2 emissions per kilometer related to the 20 million cars scenario.

Hydrogen Pathway and alternate options

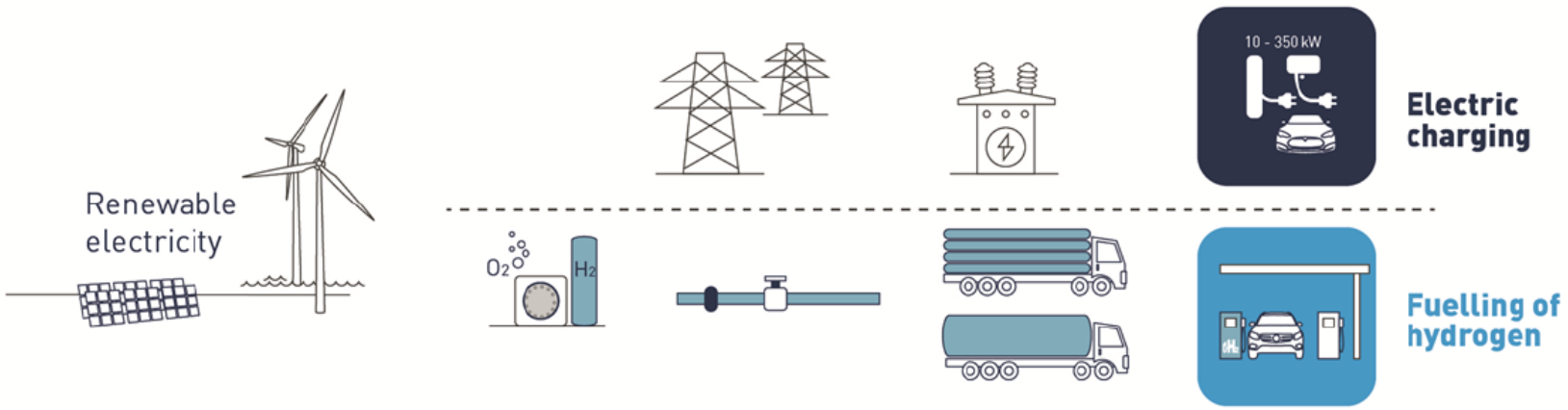


Figure 0-1: Schematic diagram of considered infrastructure set-ups.

Hydrogen from electrolysis or gasification can be produced at an economically attractive price and made it as a backbone of energy carrier in India.

Revisiting hydrogen & its derivatives pathway with coal & solar

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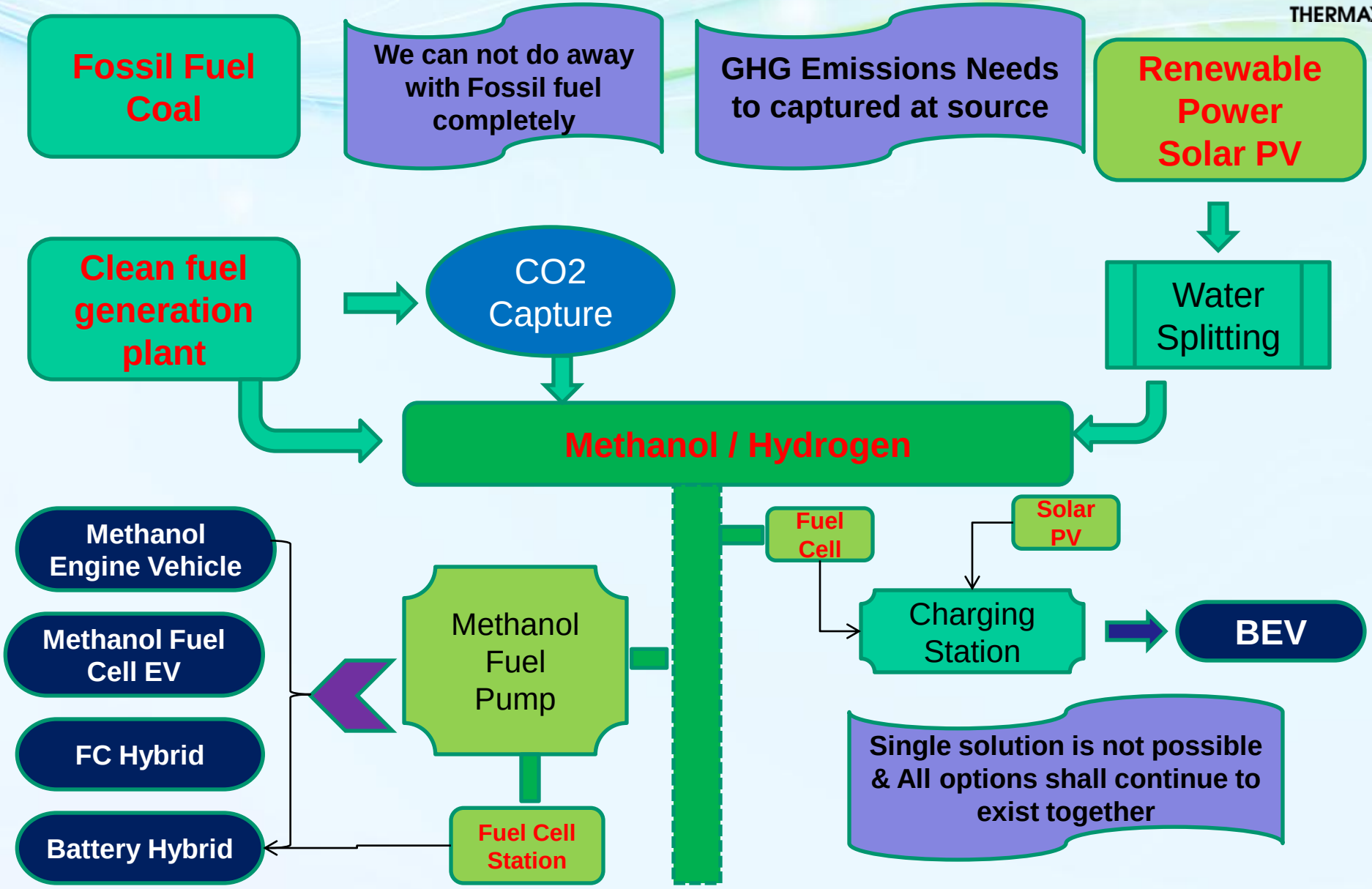


IN CONCLUSION

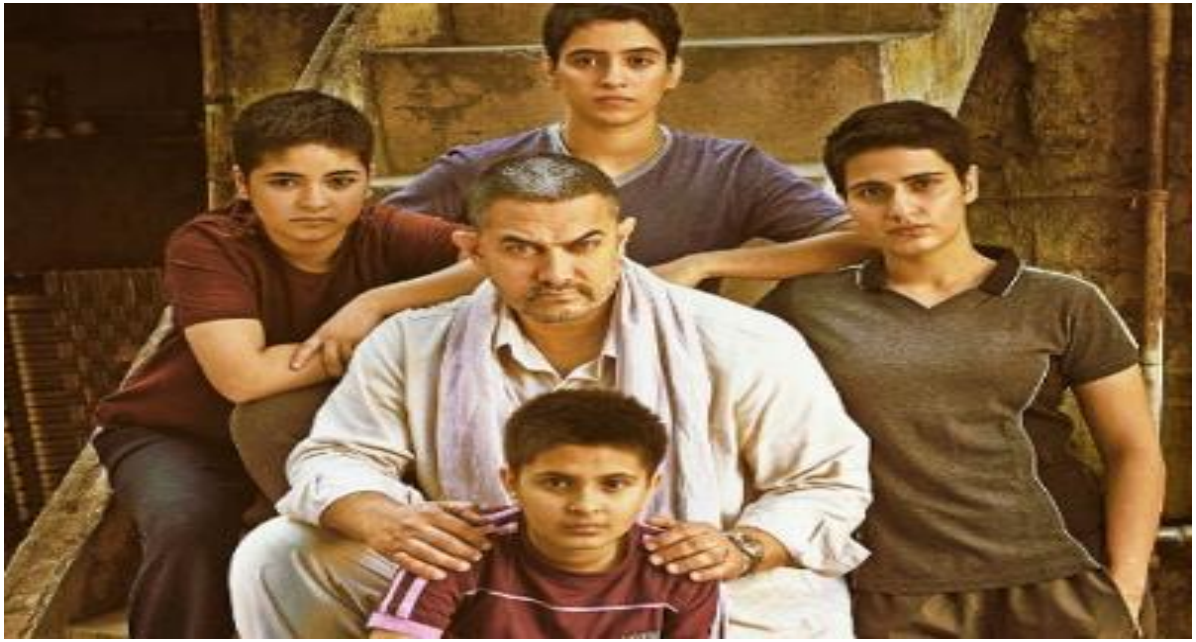
1. Different metrics for economic analysis for the new energy systems. Alignment between the key stakeholders is a must we need to create multiple ways of bringing this engagement

2. The diversity of the country makes it clear that there can not be a single silver bullet for all our energy problems & hence solutions should be LOCAL.

3. Building innovation spirit by the “start up” initiative by the young & passionate entrepreneurs will be the hope that India will not only adapt to the new energy transition but become a leader amongst the pack of global nations.

We need to change the NORM that our society measures the transition and its willingness to sacrifice some comfort…….

Finally it is all in the Attitude: “Can do it” ATTITUDE



We need to curb our natural affinity of imported technologies Global scale collaboration is must but not any other way…..

Thank You!


We must learn to happily progress together or miserably perish together. Man can live individually but can survive only collectively *Atharva Veda*