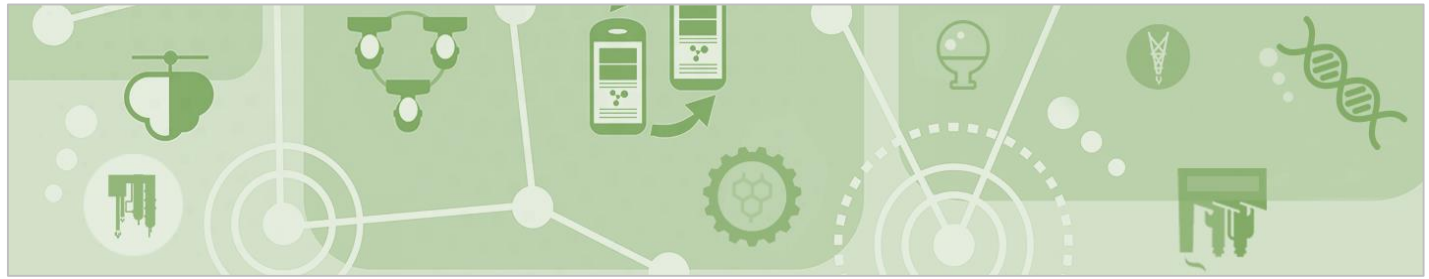
Hydrogen & Fuel Cells at RIL

Reliance Industries Limited
Growth is Life

RIL is India's largest and most profitable private company with market capitalization >$100B



Ashish Lele, Senior Vice President (R&D)

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Committing to Paris Agreement: India's INDCs

1. To put forward and further propagate a healthy and **sustainable way of living** based on traditions and **values of conservation and moderation**

2. To adopt a **climate friendly and a cleaner path** than the one followed hitherto by others at corresponding level of economic development

3. To **reduce the emissions intensity of its GDP** by **33 to 35 percent by 2030** from **2005 level**

4. To achieve about **40 percent cumulative electric power installed capacity** from **non-fossil fuel based energy resources** by **2030** with the help of transfer of technology and low cost international finance including from Green Climate Fund (GCF)

5. To **create an additional carbon sink of 2.5 to 3 billion tonnes** of **CO2 equivalent** through additional forest and tree cover by **2030**

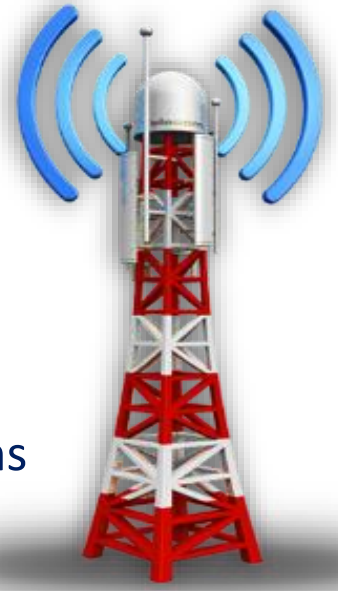
6. To better adapt to climate change by **enhancing investments in development programme in sectors vulnerable to climate change**, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management

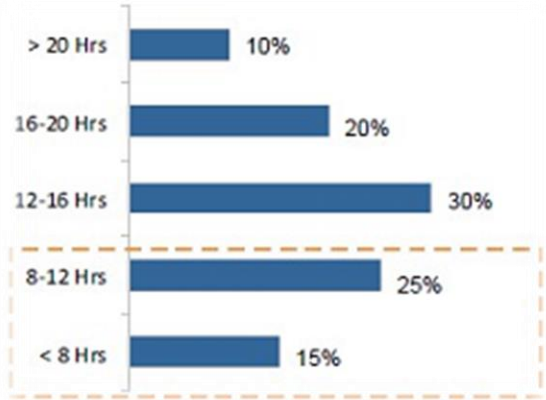
7. To mobilize **domestic and new & additional funds** from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap

8. To **build capacities**, create domestic framework and international architecture for quick diffusion of cutting edge climate technology in India and for joint collaborative R&D for such future technologies.

Greening telecom – Reliance Jio Telecom

- India has second largest and fastest growing telecom market
- 650,000 towers; 85% need 8+ hours backup; 8760 litres/year/tower
- More than 20% have Diesel Generators → Low capex, but high TCO
- 2 Billion liters of Diesel per year for telecom towers in India
- 5 MT/year of CO2 equivalent emissions on account of diesel use.
- High maintenance, import & pilferage issues, environmental concerns
- TRAI pushing for cleaner alternatives





- **RIL-Jio has 230 Million user base; More than 200,000 towers**
- **30,000 diesel generators; LiB + DG backup implemented**

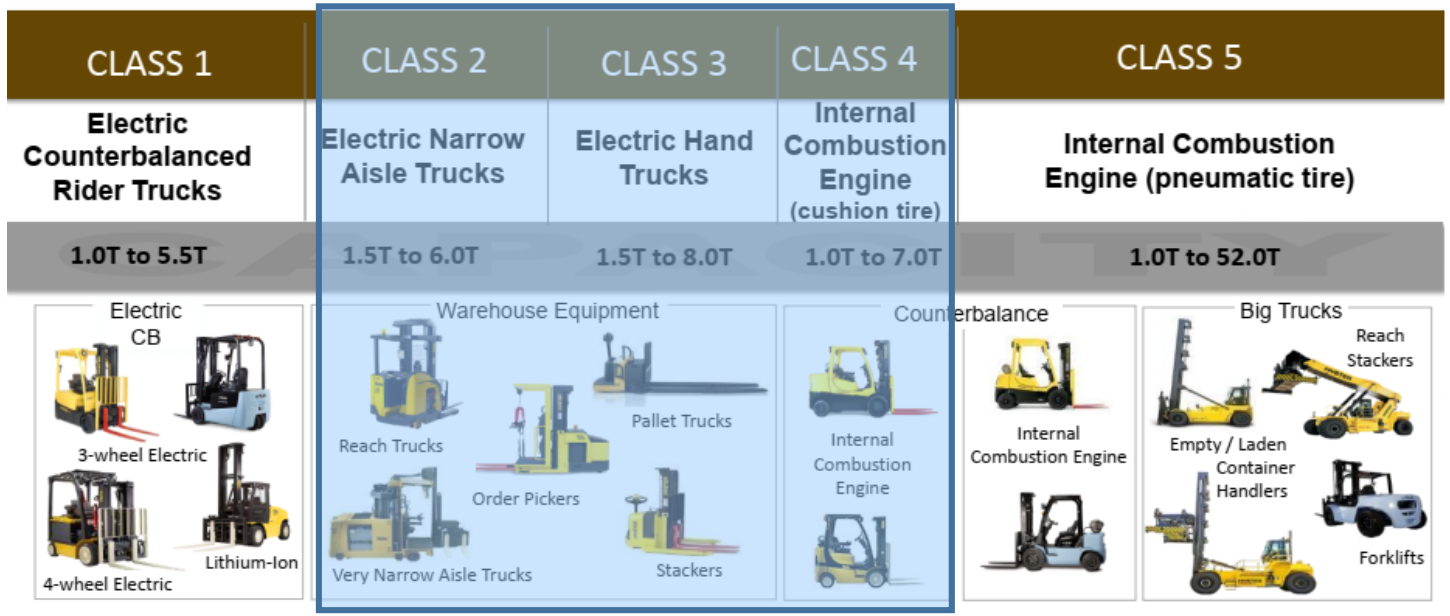
- **Validating Polymer Electrolyte Membrane Fuel Cell (LTPEM-FC) system on 100s of Telecom towers**
- **Even @ 15% of towers on FC → 100 T/Y of H2 for 6 hours of backup for 300 days in an year**

Capex and opex is a challenge

https://numerical.co.in/numerons/collection/5946673ad8be26ec238ced67

Material handling logistic – Reliance Retail

Reliance Retail has a 3,800+ stores in India today with an area of over 17.7 million square feet across 750 cities. Annual revenue of > $10B; target of 30% growth every year for next decade

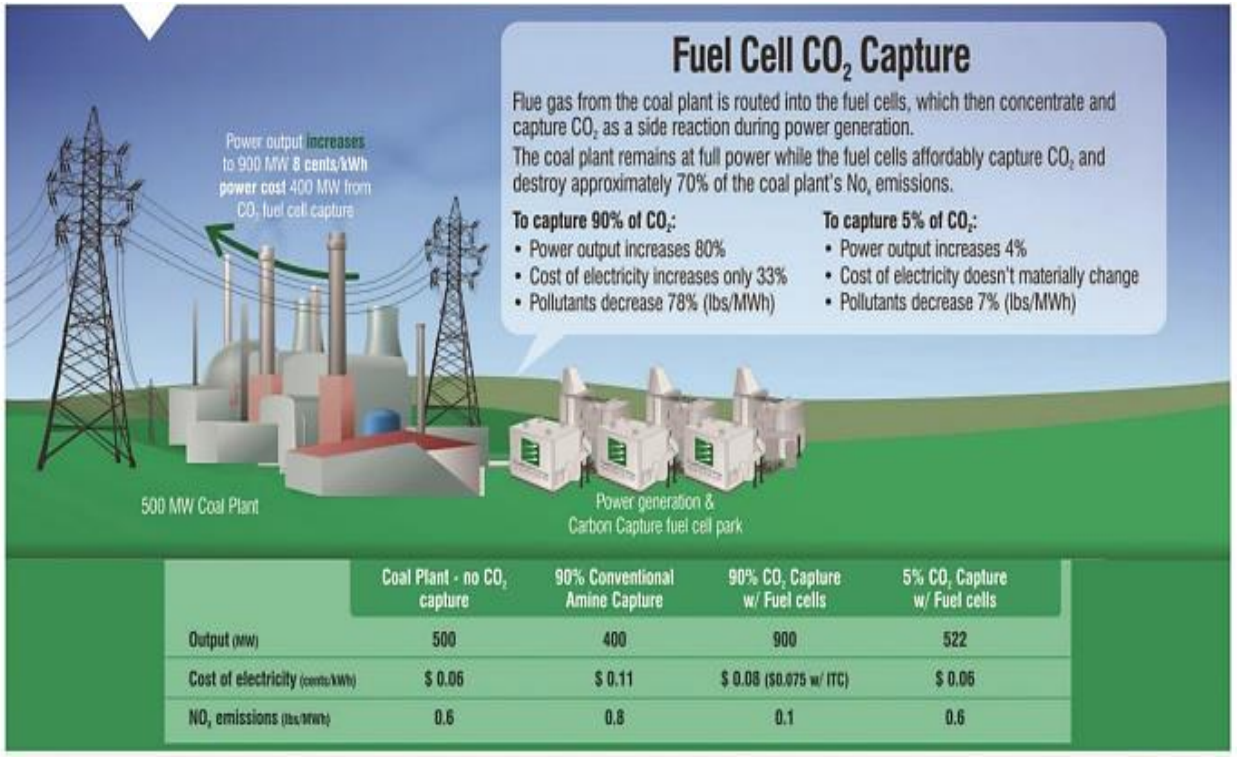


- MHE market globally was around $130B in 2017 and to reach $ 190B by 2024
- Fuel Cell powered MHEs can target 60% of total MHEs in RIL Retail if
  - Utilization exceeds a tipping point
  - Downtime penalties become high
- **Capex, opex, safety are challenges**

Green refineries and petrochemicals – Reliance Industries Ltd

- The Jamnagar refinery is the world's largest integrated refinery at a single location with crude processing capacity of 1.24 million Barrels Per Stream Day (BPSD)

- Jamnagar houses some of the world's largest units, such as the Fluidised Catalytic Cracker (FCC), Coker, Alkylation, Paraxylene, Gasifiers and Polypropylene plants



	Coal Plant - no CO_2 capture	90% Conventional Amine Capture	90% CO_2 Capture w/ Fuel cells	5% CO_2 Capture w/ Fuel cells
Output (MW)	500	400	900	522
Cost of electricity (cents/kWh)	$ 0.06	$ 0.11	$ 0.08 ($0.075 w/ ITC)	$ 0.06
NO_x emissions (lbs/MWh)	0.6	0.8	0.1	0.6

- **Jamnagar produces in excess of 25 MMTA CO_2**
- **RIL has developed unique knowhow on MEA based process for CO_2 capture.**
- **Other processes include for e.g., MCFC based process piloted by Exxon Mobil and FuelCell Energy.**

Capturing and sequestering CO_2 presents a challenge and an opportunity for H_2

http://news.exxonmobil.com/press-release/exxonmobil-and-fuelcell-energy-inc-pursue-novel-technology-carbon-capture

Thank You