Technology development imperatives for India

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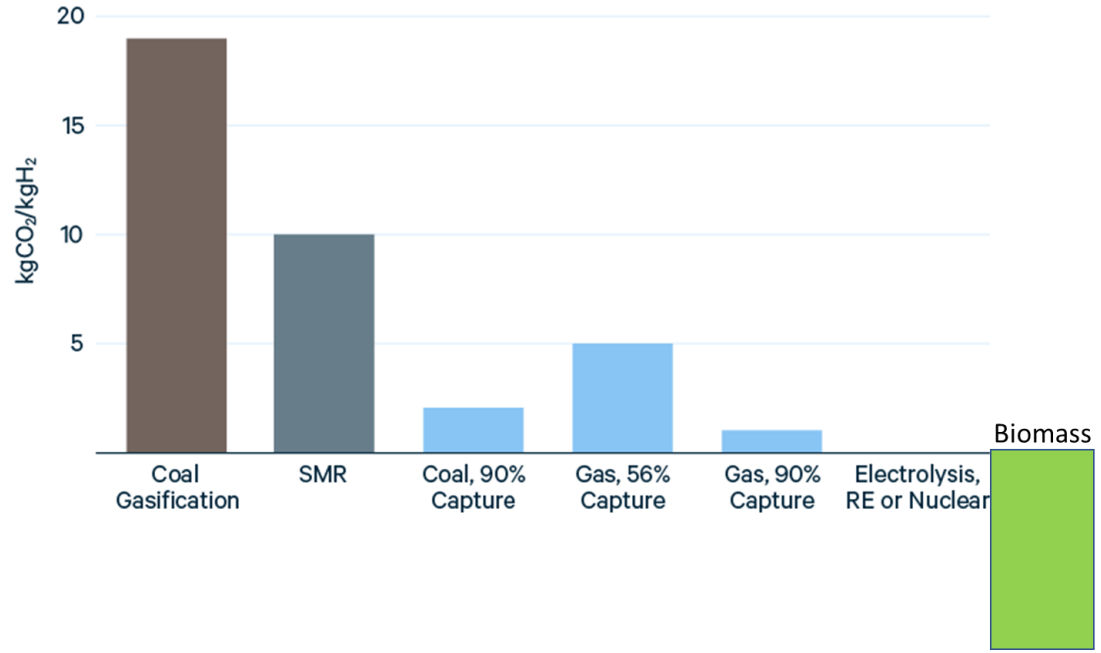
- Important to identify that these are two major sources of energy
  - Currently, energy is linked to electricity
  - In my view, electricity is important for economic sustainability in Indian conditions,
    - adopting to poly generation is important
  - MSW and some of the biomass (industrial, agro residue need both biochemical and thermo-chemical routes)

- Bio-chemical
  - With digestible matter (biomass or MSW) through fermentation route – biogas and value added products
    - Biogas to BioCnG is paving way for economically sustainable future
      - Moved from demonstration to large scale implementation stage with good support price
    - The ethanol route needs additional work to establish economic sustainability
- Challenges
    - Addressing the sludge obtained and value addition – Not easy with large scale implementation
      - Lignin as in the case bio-ethanol
    - Meeting the environmental standards – Solid, liquid and gaseous emissions

- Thermo-chemical route
  - Necessary to handle a range of industrial, agro residue and MSW
  - 1.2 to 1.5 kg of biomass (sorted MSW) about 1 kW ~ 0.8 to 10 USc/kWh with efficient conversion system – large capacity or efficient gasification
    - Challenge in ensuring economic sustainability
  - Same amount of biomass to other products through bio-refinery concepts
    - Value added products like – Hydrogen, Methanol, ethanol – GREEN Fuels
    - Green Ammonia – Green Fertilizers
  - This approach will ensure to sequester carbon

Bench marking for bio-derived fuels

Item	SMR	OSG
Fuel	CNG	Biomass
Fuel quantity, kg	4.15	14.5
Energy Input, MJ	207.5	224
Water, kg	8.2	5.3
Oxygen, kg	--	3.7
Efficiency	58	54
Hydrogen classification	GREY	GREEN



Expected outcome

1. What is the current status of biogas and MSW-to-energy in India in terms of deployment, challenges to date and policies?
2. What is the potential role of biogas and MSW-to-energy in India in terms of energy potential, deployment potential and future policies?
3. What government actions, such as policies, technology support and regulations, have been most successful at accelerating the deployment of biogas and MSW-to-energy in leading countries?
4. What biogas and MSW-to-energy technologies have proved most successful in countries with high-levels of biogas and MSW-to-energy deployment?
5. What international examples are most relevant to helping accelerate biogas and MSW-to-waste technologies in India?