Next Gen Technologies For A Greener Future

ENGIMACH 2021

Gandhinagar, Gujarat

India’s Policy Objectives

International Commitments

1. By 2030, India will reduce carbon intensity of its economy by less than 45%
2. India to achieve the target of net zero carbon emissions by the year 2070

Internal need for Energy & Environment

1. Energy Security
2. Oil Import reduction

Consideration 1: Unique Context of India

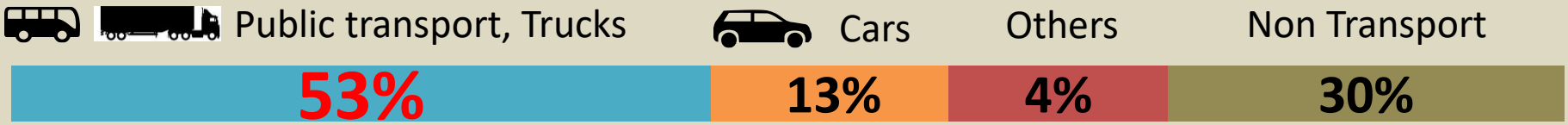
Vehicle parc : 278 Mn

Unique Distribution: Segment share different from rest of the world

75%	15%	10%
Two- Wheelers	Cars	Others

Petrol consumption in India

Diesel consumption in India



Source: ICAT/MoRTH

Unique Context of India


Two Wheeler


Three Wheeler


Small Passenger Vehicle


Big Passenger Vehicle


Light Commercial Vehicle


Bus (Intercity, Intracity)


Trucks

Consideration 2: Each vehicle segment will be served best by a different technology solution

Consideration 3: That technology solution will also change with time

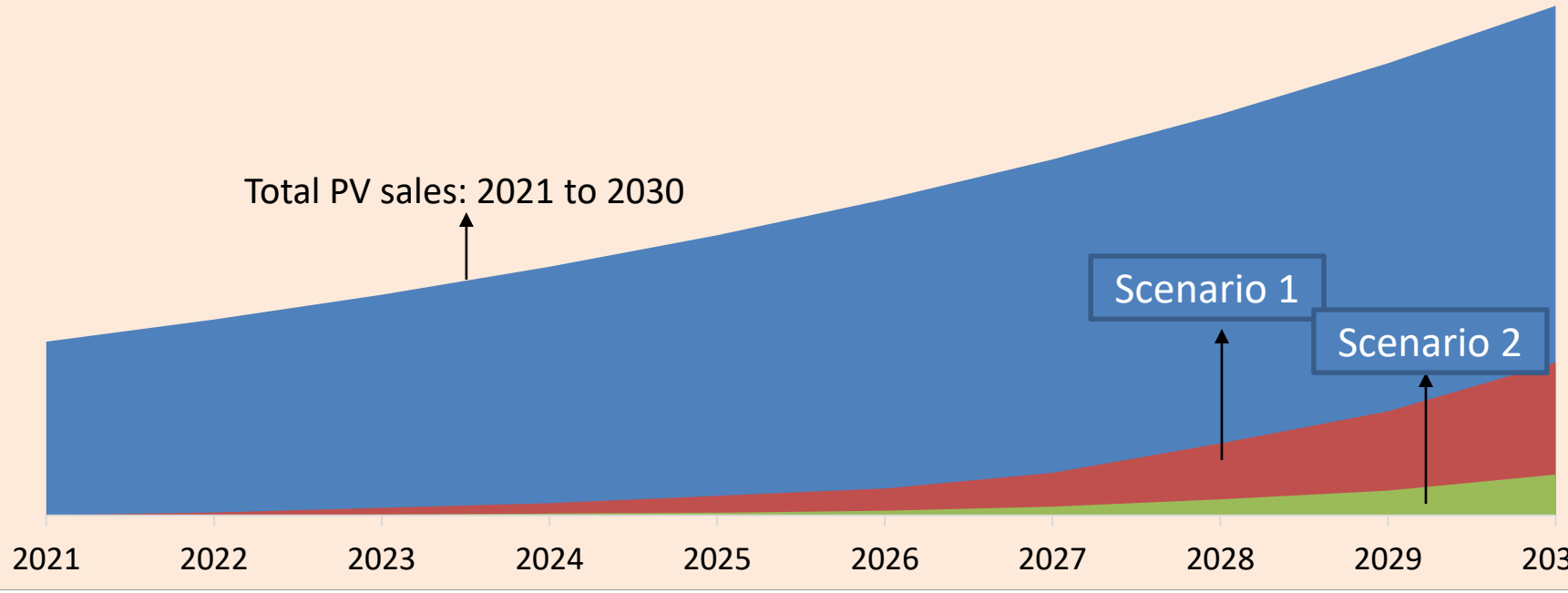
Country	GDP Per Capita in PPP terms ($)
Norway	67,978
USA	65,279
Netherlands	59,469
Germany	55,891
Japan	42,228
China	16,846
India	6,994

Source: World bank

Consideration 4: India needs to be much more cost - efficient than rest of the world

Passenger Vehicle Electrification in India

Passenger Vehicle Electrification in India



Scenario 1: 8% of BEV sales by 2030 **Scenario 2: 30% of BEV sales by 2030**

Two strategies are required:

1) Maximise BEV sales

2) There is still a Non- BEV sales of next 10 years of 86% ~ 97% that needs to be addressed. Deploy other technologies to reduce carbon/oil consumption of this 86%-97% of vehicle segment.

Multiple technology options : Need to evaluate in Indian context

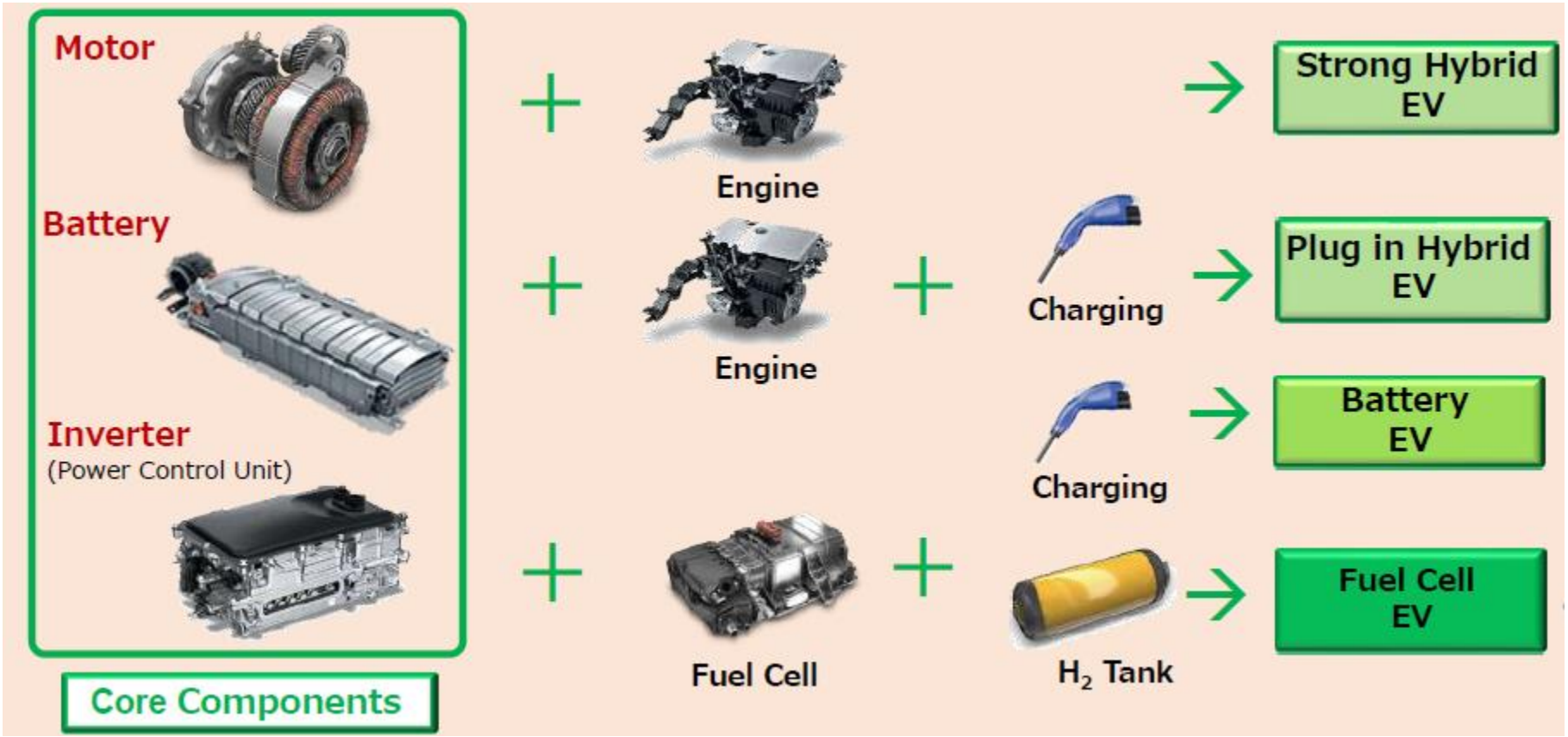
Technology options

- Electrification
  - Strong Hybrid Electric Vehicle
  - Plug-in Hybrid Electric Vehicle
  - Battery Electric Vehicle (BEV)
  - Fuel Cell Electric Vehicle (FCEV)
- CNG
- Bio - fuels

Parameters to consider

1. Well - to - Wheel Carbon reduction potential
2. Cost Increase
3. Infrastructure requirement
4. Self reliance in manufacturing / Imports
5. Scalability

EV Family: Electrified technologies



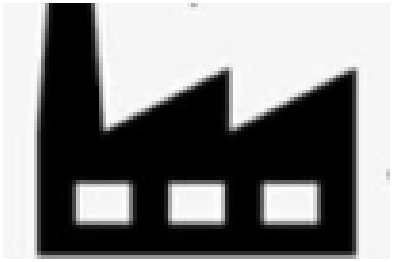
Core components of all electrified technologies are same

EV Family: Battery Electric Vehicle (BEV)

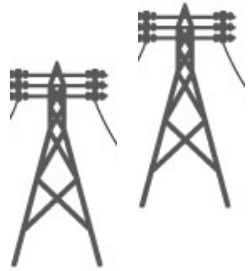
Coal

Solar

✚ Others



Power Generation



Transmission

Charging station

Battery

Motor

Wheel

1. **Carbon emissions**: Depends upon power generation mix of India
2. **Cost**: at factory level, BEV is 2 to 2.25 times costlier than ICE car
3. **Manufacturing in India** : Currently low local manufacturing of major parts- need more volumes
4. **Scalability**: Challenges due to low charging infrastructure

Charging infrastructure biggest hurdle to BEV penetration

- Charger to BEV stock ratio in key countries like Germany(1:6), Netherlands(1:3), China(1:4), USA(1:11), Korea(1:2), Japan(1:4)
- Alternative Fuel Infrastructure Directive (AFID) of the European Union (EU) recommends a minimum ratio of 1:10 (at least one charger for 10 BEVs)
- Even if we take the Minimum Ratio, basis this, India would need:
  - **1.3 lac chargers for BEV penetration of ~8% in 2030**
  - **6 lac chargers for BEV penetration of 30% in 2030**
  - Currently India has ~ 3,000 chargers
- FAME and PLI schemes will help

EV Family: Strong Hybrid Electric Vehicle (SHEV)

Petrol pump

Engine

Self charging

Battery

Motor

Wheel

- SHEVs run about 60% Time on Electric Mode (with Engine shut-off).
- Since SHEVs are Self-Charging vehicles (do not need External Charging), there is NO Range Anxiety for the customer.

1. **Carbon emissions**: 30% ~ 45% less than ICE car
2. **Cost**: at factory level, SHEV around 1.4 ~ 1.5 times costlier* than ICE car
3. **Scalability**: highly scalable because of self charging
4. **Manufacturing in India** : high volumes can make local manufacturing viable

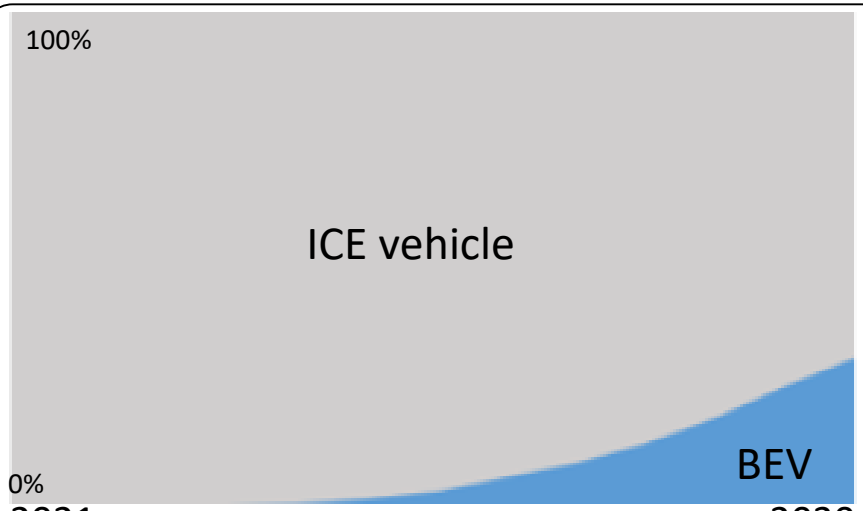
*at full economies of scale

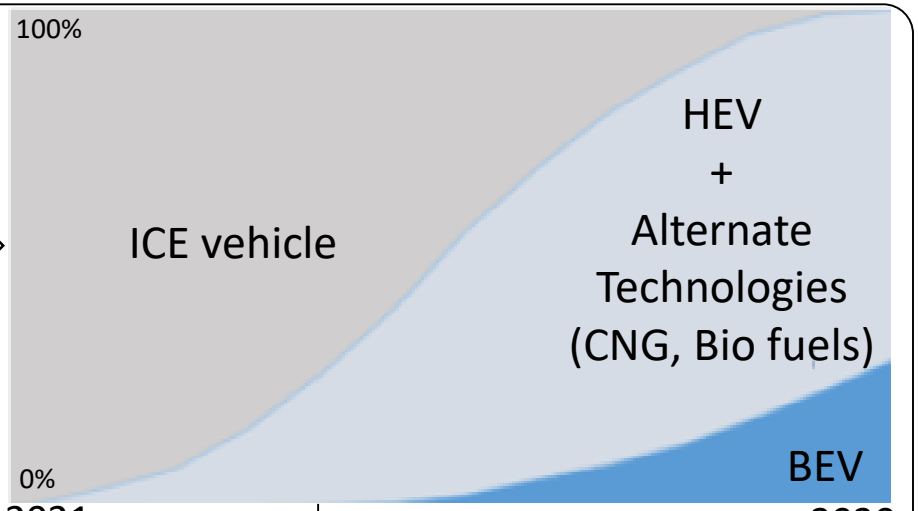
Global Volumes of BEVs and HEVs

Major Countries	Sales in CY 2020 (lacs)		
	BEVs	PHEV	HEV
USA	2.6	0.7	4.5
Germany	1.8	2.2	0.6
Norway	0.7	0.2	0.1
China	9.9	2.2	0.6
Japan	0.1	0.1	9.0
Rest of the world	5.1	3	6.3
Total	**20.4**	**8.9**	**23.1**

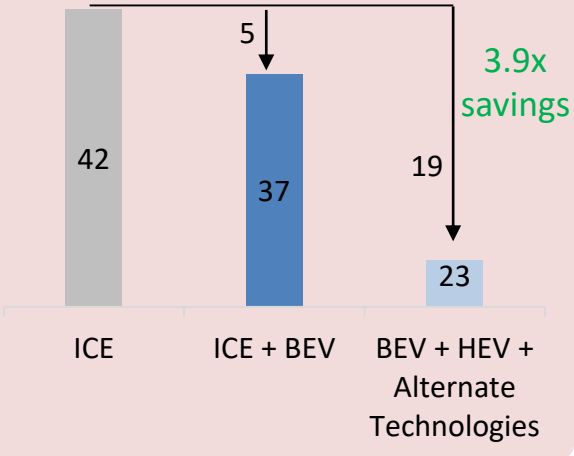
Source: Marklines

Addressing the non-BEV segment to maximize CO2 reduction & efficiency improvement

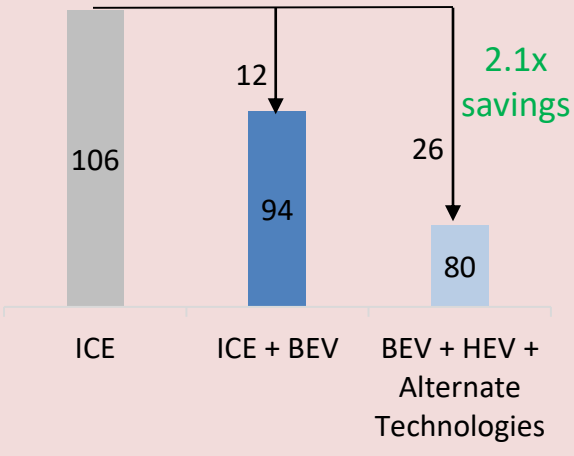




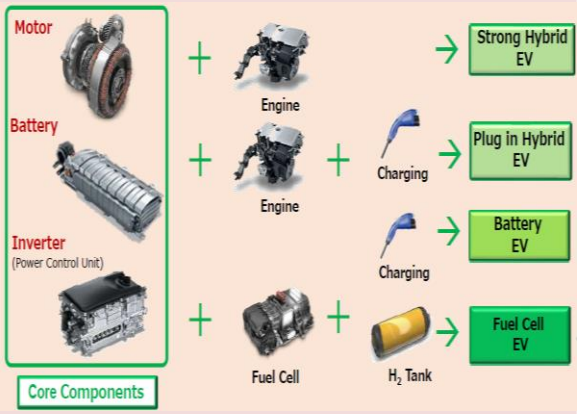
Fuel Consumption (Bn Litres)



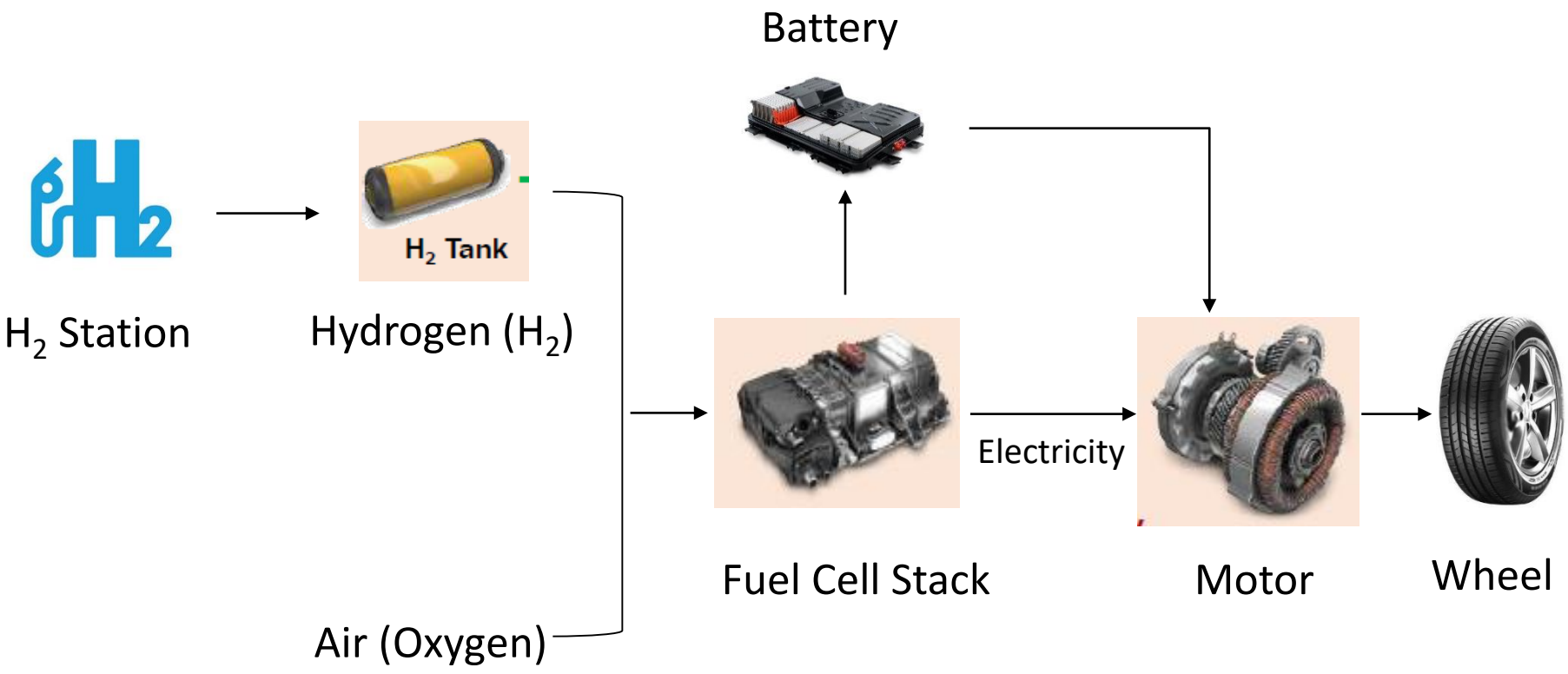
CO_2 Emissions (Mn Tons)



Support local manufacturing of xEV parts, Boost EV manufacturing



EV Family: Fuel Cell Electric Vehicle (FCEV)

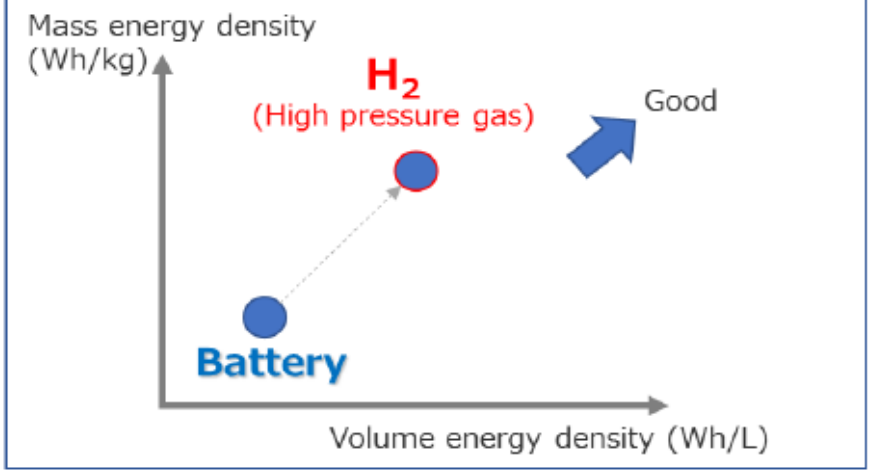


1. **Carbon emissions**: Zero. Key long term solution to meet national goals
2. **Cost**: Currently high, expected to be viable in 10 ~15 years
3. **Manufacturing in India** : Currently no manufacturing but xEV volumes can help make technology viable. Long haul trucks and buses are a priority area.
4. **Scalability** : Hydrogen production big Govt focus; multi sectoral approach required

Opportunities with Hydrogen

- **Hydrogen compared to Batteries**

1. High Energy Density



2. Storage duration

Battery
Short-time (hours ~ days)

Self-discharge

Hydrogen
Long-time (days ~ seasons)

- Easy conversion of Hydrogen to electricity makes it a super energy source with versatile usage like in cars, trucks, buses, industries etc.
- India can competitively generate Hydrogen without any dependence on imports

Significant developments around hydrogen globally to gain big momentum in next 10 years

HFCV growth targets			
	Current	**Targets**	**Target Year**
California (USA)	Vehicles: 4,410 Stations: 36	Vehicles: 1 million Stations: 1,000	2030
South Korea	Vehicles: 2,000 Stations: 14	Vehicles: 6.2 million Stations: 1,200	2040
Japan	Vehicles: 2,000 Stations: 100	Vehicles: 200,000 Stations: 320	2025
China	Vehicles: 1,000 Stations: 12	Vehicles: 1 million Stations: 500	2030
Germany	Vehicles: 519 Stations: 69	Vehicles: 300,000 Stations: 1,000	2030

Source: IHS Markit

CNG

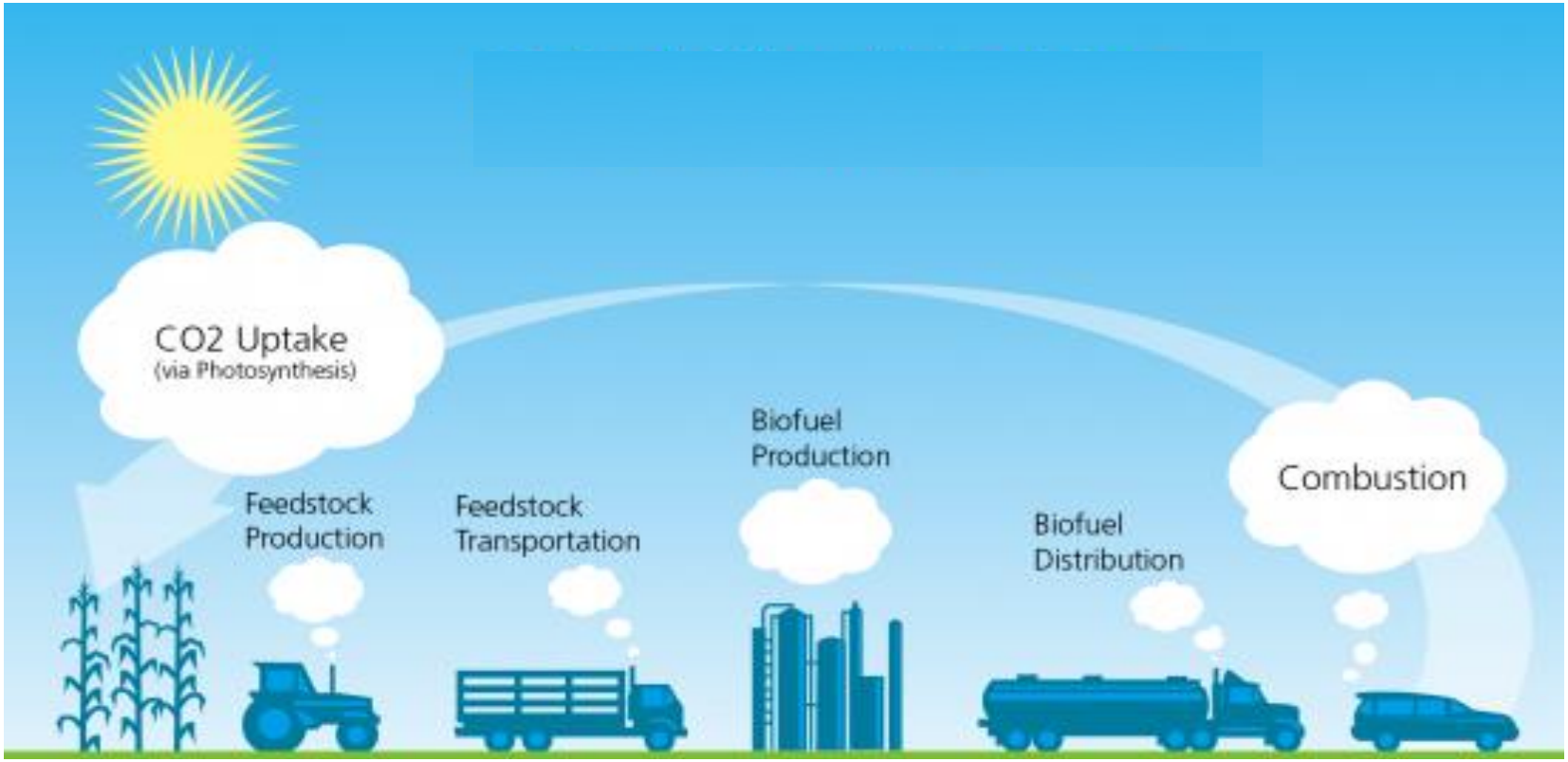
1. **Hon'ble Prime Minister's vision of Gas Based Economy - 15%**
   - 900 CNG stations (2014) 3,400 stations (2021) 10,000 stations (2027)

2. **High Scalability and deep localization possible in India**

3. **Significant Impact to National Objectives**
   - Carbon Reduction per vehicle : 20~25%
   - Oil Import reduction per CNG car : 10,000 Litres

4. **Boost to Indian economy**
   - Investments in CNG / LNG Supply Chain by 2030: > Rs 50k cores
   - Additional employment in the value chain by 2030 : > 4 lacs

Bio – Fuels



1. **Carbon emissions**: Least carbon emissions among other commercially available technologies
2. **Scalability**: Sustainable availability of fuel across the country
3. **Manufacturing in India** : Large part of the supply chain exists in India

Summary

1. Multiple technologies will need to be deployed to meet the objective of reduction of carbon footprint and oil import

2. Different vehicle segments will be served best by different technologies. These will also change with time.

3. In Passenger vehicles, in the next 10 years, despite best efforts in maximizing BEV sales, a large segment of ICE cars (87% -97%) will be left unaddressed.

   A mix of all possible technologies should be deployed

4. There is tremendous synergy among BEV, PHEV, SHEV and FCEV

5. This is aligned with the policy direction of Government

Hon'ble Prime Minister's address on 75th Independence Day: Bouquet of technologies to make India energy independent

"To build a self-reliant India, India's energy independence is the need of the hour. Therefore today, India has to make a resolution to make India energy independent before the completion of 100 years of independence and our roadmap is very clear for the same"

1. "It should be a gas based economy. There should be a network of CNG & PNG across the country"
2. "There should be a target of 20 percent ethanol blending"
3. "India has also made a move towards Electric Mobility"
4. "We have to make India a Global Hub for Green Hydrogen Production and Export in the 'Amrit Kaal'"

Thank you