

BHEL SAMVAAD 3.0



- सहयोग से सफलता

Indigenization of items & Development of local suppliers

9th Nov 2023

Bharat Mandapam, New Delhi

Session 9 – Carbon-fiber-reinforced polymers

Evolution of Public Procurement Policy – Make in India

PPP-MII Order,
2017

2017

Public Procurement (Preference to Make in India), Order 2017 Dtd 15.06.2017 - to promote manufacturing and production of goods & services in India

Works included

2018

PPP-MII Order partially modified on 28.05.2018 to include works (including turnkey works)

Partial modification

2019

PPP-MII Order partially modified on 29.05.2019 (only local suppliers eligible if sufficient local capacity is available)

Restriction on GTE

2020

PPP-MII Order partially modified on 04.06.2020 (Class I/ Class II local suppliers, no global tender above Rs. 5 Lakh and below Rs. 200 Cr. etc., unless approved by CA)

Notification on Countries sharing land border

2020

DoE Order dated 23.07.2020 (Bidders from countries sharing land borders to be registered with DPIIT)

Notification on Countries sharing land border

2023

DoE Order dated 23.02.2023 (Includes even TOT from Bidders from countries sharing land borders to be registered with DPIIT)

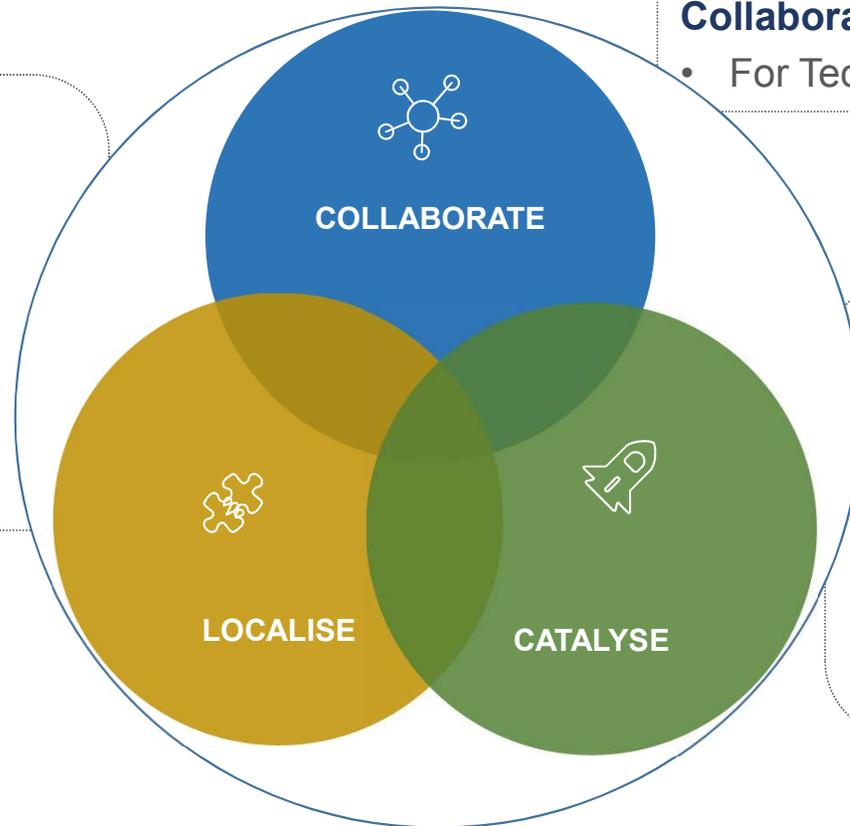
Type	Local content	Price preference
Class I	≥ 50%	✓
Class II	More than 20% but less than 50%	X
Non Local	≤ 20%	X

BHEL's Framework for AtmaNirbharBharat

Localise

Import substitution through

- in house engineering or manufacturing
- supporting domestic manufacturers for indigenization



Collaborate

- For Technology and Manufacturing

Catalyse

- Enable solutions for challenges faced in engineering and manufacturing
- Support domestic ecosystem with R&D and Testing infrastructure

Indigenized offerings with Indigenized supply chain

BHEL's Outreach Initiatives

COLLABORATE

April '20

Expression of Interest (29.04.20)

Manufacturing in India with BHEL

July '20

SANYOJAN (03.07.20)

Domestic Collaborations for Manufacturing

Aug '20

SANRACHNA (24.08.20)

Technology Innovation Platform

Nov'20

Expression of Interest (13.11.20)

for import substitution

Interaction (18.11.20)

with IEEMA

LOCALISE

Dec '20 – Oct'23

Interaction (03.12.20)

with Local industry (coordinated by DPIIT)

SAMVAAD 1.0 (21.12.20 – 11.02.22)

Workshops with Local industry

SAMVAAD 2.0 (28.10.22 – 29.11.22)

Workshops with Local industry

BHEL SAMVAAD conducted till date

SN	Category of Material	BHEL Unit	Date
1	Raw Materials-Special/ Alloy/ Electrical Steel	Corporate Office	29.12.2020
2	Consumables for Foundry Applications	Hardwar	01.01.2021
3	Welding Consumables of Special Grade	Trichy	05.01.2021
4	Castings & Forgings	Hardwar	08.01.2021
5	Components-Mechanical	Hyderabad	12.01.2021
6	Insulating Materials	Bhopal	15.01.2021
7	Components - Electrical & Electronics	Bangalore	19.01.2021
8	Components – Solar	Bangalore	22.01.2021
9	Systems, Packages & BOPs	Noida	27.01.2021
10	Components - Electrical & Electronics (with IEEMA)	Bhopal	11.02.2022
11	Alloy Steel Pipes for supercritical projects	Trichy	08.06.2022
12	Castings & Forgings	Hardwar	26.08.2022
13	Mechanical & Electrical components/ Non-Ferrous items	Hardwar	05.09.2022
14	Insulating materials	Hardwar	09.09.2022
15	BQ plates of thickness >= 150 mm and SS plates of width 1500-2500mm	Hardwar	12.10.2022
16	Fibre Optic Generator End Winding VMS, Blade VMS, Calibrated Flow nozzle	Hardwar	14.10.2022

BHEL SAMVAAD conducted till date

SN	Category of Material	BHEL Unit	Date
17	Castings & Forgings	Hardwar	28.10.2022
18	Bearings	Bhopal	04.11.2022
19	Pipes, Tubes, Special steels	Trichy	09.11.2022
20	Items for Flue Gas Desulphurization (FGD)	Ranipet	11.11.2022
21	Electrical insulating materials	Bhopal	15.11.2022
22	Quality first in supplies	Corporate Office	19.11.2022
23	Electronics & Solar Items	Corporate Office	21.11.2022
24	Castings & Forgings	Corporate Office	12.05.2023
25	Seamless Pipes & Tubes (High Alloy steel Tubes/ Pipes, Alloy steel Pipes , Carbon steel Pipes)	Trichy	17.08.2023
26	Seamless Pipes (High Alloy steel, Alloy steel, Carbon steel)	Trichy	26.10.2023

Items imported hitherto where local suppliers have been developed

Orders Placed

Sl.	Item description	Source identification through	Supplier, M/s
1	2 mm sheets & 6 mm Plates of C276 grade	BHEL-SAMVAAD	MIDHANI, Hyderabad
2	C276 Cladded Plate through Hot rolling (1250 mm width)		Jindal Stainless Limited
3	Tubes of grade: SA312TP304 H/347 H, SUP 304 SS		Tubacex Tubes & Pipes
4	Tubes of grade: SA213TP347H SS, SA213TP340H SS		Welspun Specialty Solutions Ltd
5	SA312TP304 SS Tubes		Ratnamani, Gujarat
6	SA335P22 Alloy steel Pipes (upto OD 355.6 mm and thickness upto 14.27 mm)		Maharashtra Seamless Ltd.
7	Spray pipes		Sunrise Industries, Vadodara
8	Spray nozzles		Lechler, Thane
9	Synthetic Ester Oil		Savita Oil, Silvassa
10	Hydrogenerator shaft forgings (36.3 MT)		LTSSHF, Mumbai
11	Hemispherical Dished ends SA234WP91		CHW Forge, Ghaziabad
12	RIP Bushings (245 kV)		Yash High Voltage, Vadodara Massa Izolyator Mehru, Gurugram
13	RIP Bushing (420 kV)		Siemens India Ltd. Hitachi Energy India Ltd

Items imported hitherto where local suppliers have been developed

Orders Placed

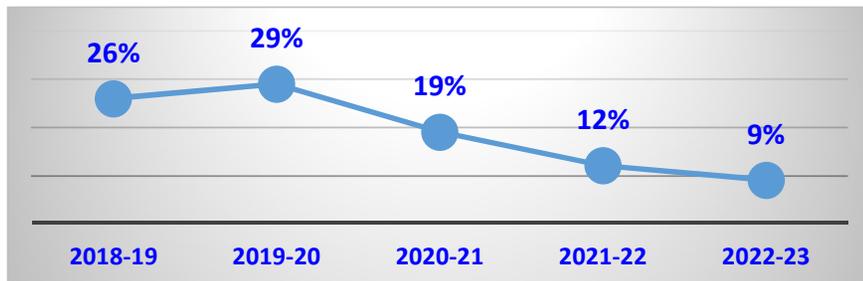
Sl.	Item description	Source identification through	Supplier, M/s
14	OIP Bushing (800 kV)	BHEL-SAMVAAD	CG Power and Industrial Solutions Ltd., Nashik
15	Insulated Rivetless Roller Bearings for Inverter side of Traction Motors		SKF India, Schaeffler India
16	Auxiliary Additive 3A 333 of VPI varnish		3A Associates, Mumbai
17	GT Blade Flats C450		Star Wire India Ltd,
18	GT Blade Flats SS403Cb		Laxcon, Ahmedabad
19	Compressor Journal/Thrust Bearings		MICHELL Bearings (INDIA) LLP
20	Maintenance Free Breather		EASUN-MR TAP Changers (P) Ltd. Precimeasure Control Pvt. Ltd.
21	Size -2 and Size-3 BUSHINGS for 36kV GIS		Radiant Enterprises
22	Absorber Re-circulation Pumps		KSB Ltd., Thane
23	Beech Wood Tangential Top Ring		Open Tender
24	Helical Wire Shock Mounting	GeM	Ridham Industries, Ahmedabad SEISMOSYS, Bangalore

Opportunity for Indigenization

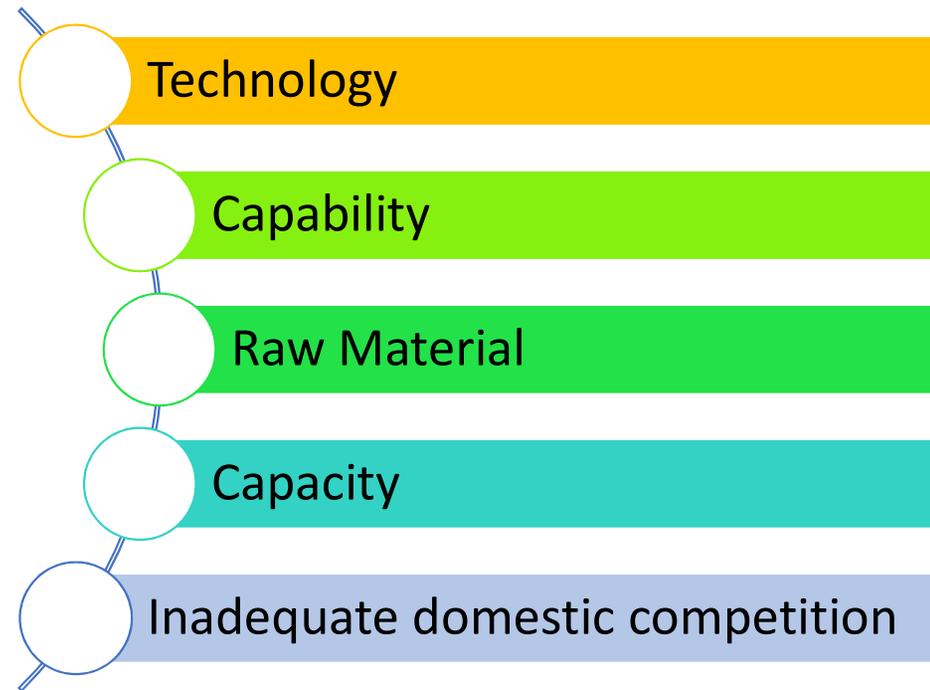
Scope in BHEL



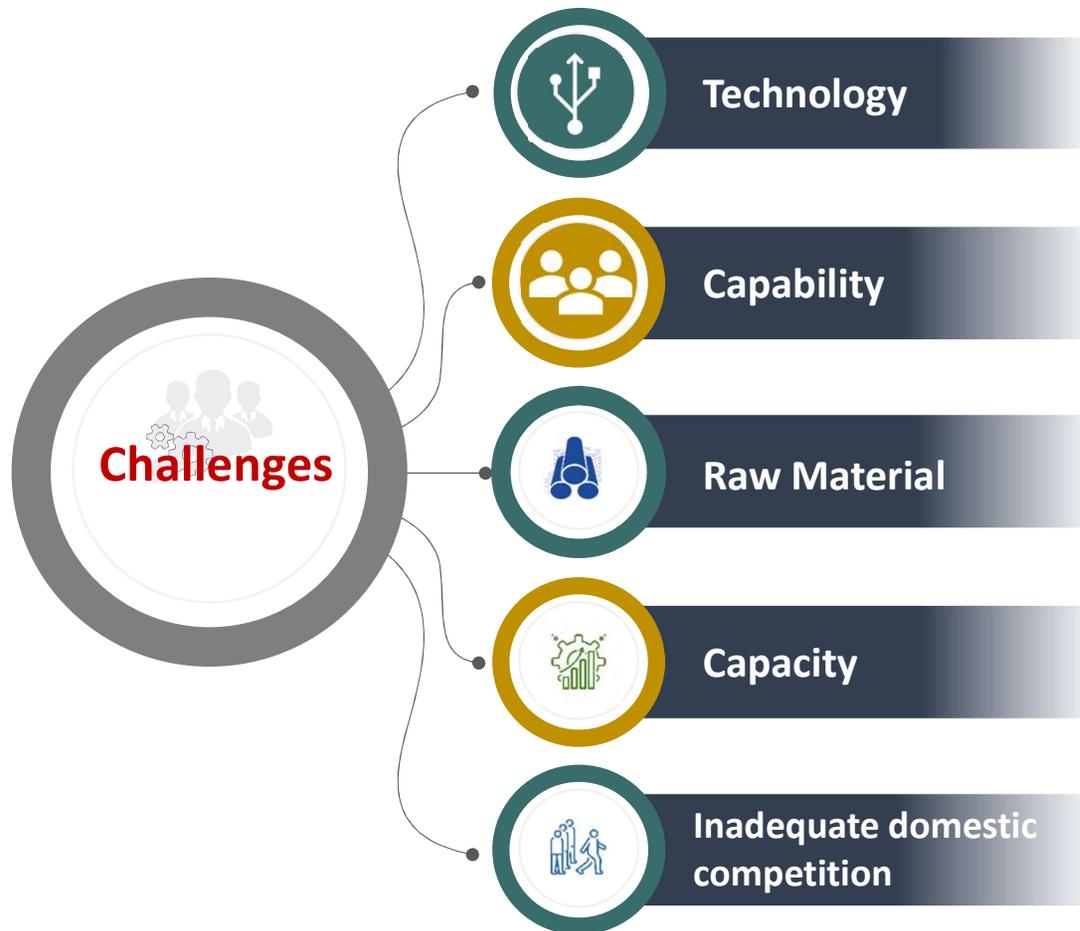
Trend of Imports in BHEL during the last few years



Overcoming the challenges...



Demand-supply gap – Few examples



Examples

Generator Circuit Breakers, Boiler Water Circulating Pumps, **Integrated Electronic devices**, Current Insulated Bearings, **Solar Ingots and Wafers**

LP & TG Forgings > 50 MT, HP & IP Forgings <50 MT, C276 sheets, Titanium Sheets

Nickel, Chromite Sand

Cladded sheets, Alloy Steel pipes & tubes (P91/ 92, T91/ 92)

Pressurization system for Motors, Armature Reversing Contactor, Mono PERC solar cells, Gypsum Dewatering System

BHEL SAMVAAD

An opportunity for local vendors to meet the Demand – Supply gap

10

Categories

200+

Items

16

Manufacturing Units

1500+

Crores per annum

- Special Alloy Steels, Pipes and Tubes (P91/ 92 Pipes, T91/92 Tubes, etc)
- Special / Alloy / Electrical Steel
- Items for FGD
- Castings & Forgings
- Insulated rivetless and antifriction bearings
- Electrical Insulating Materials
- Electrical , Electronic & Solar items, Advance propulsion systems
- Systems/ Packages
- BOP for strengthening H2 value chain
- Carbon Fibre Reinforced Composites

What's new in SAMVAAD 3.0



1.

Focus

on the core few
where gaps in
technology /
facilities are
prominent



2.

Collaborate

Invite ideas from the
domestic industry and
academic / research
institutions on how, as
part of a joint effort with
BHEL, one can minimize
the imports in the
Country



3.

Deliberate

on inputs w.r.t.
technical
alternatives

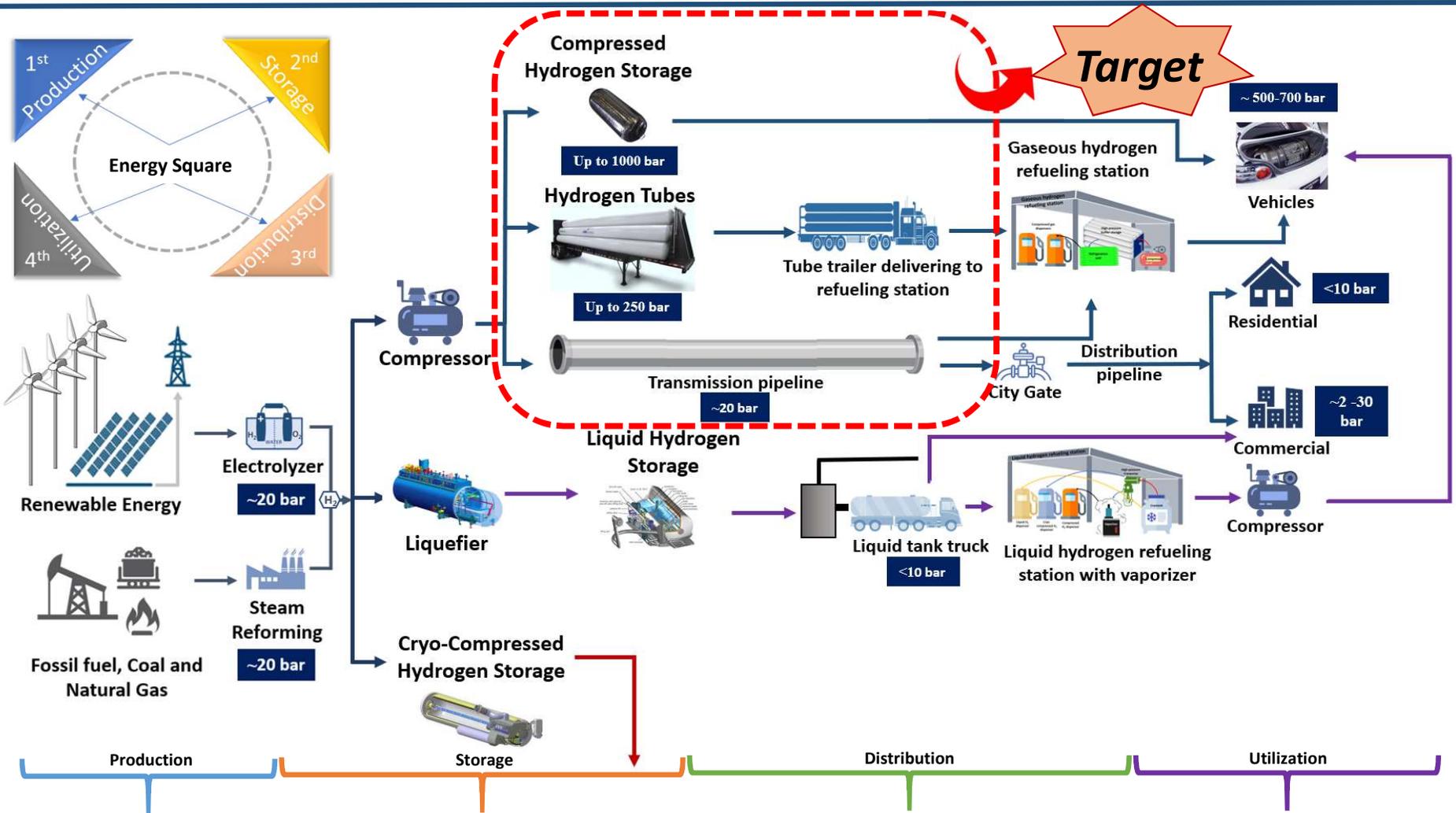


**Let's get down
to business!**

Hydrogen Storage Solutions

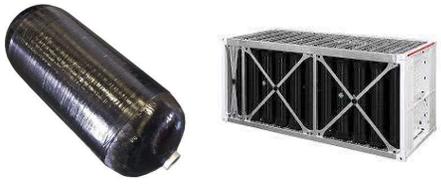
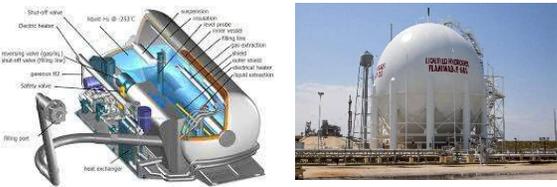
Hydrogen Storage Solutions

Hydrogen Ecosystem



Extracts from IIT Kharagpur Prof. Dr. Swati Neogi's Presentation

Hydrogen Storage Methods

Method	Compressed Hydrogen	Liquid Hydrogen	Cold/Cryo Compressed
Descriptions			
	<ul style="list-style-type: none"> • Single phase (Gaseous) • Operating pressure: up to 1000 bar • Operating temperature: -40 to 85°C 	<ul style="list-style-type: none"> • Single phase (Liquid) • Operating pressure: <10 bar • Operating temperature: -253°C 	<ul style="list-style-type: none"> • Double phase (gas-Liquid) • Operating pressure: 350 bar • Operating temperature: -253°C
Advantages	<ul style="list-style-type: none"> • Provide direct usable hydrogen 	<ul style="list-style-type: none"> • Moderate volumetric storage density • Easy to transport 	<ul style="list-style-type: none"> • High volumetric storage density
Challenges	<ul style="list-style-type: none"> • Very low volumetric storage density • Required high compression energy 	<ul style="list-style-type: none"> • Boil off issue • Complex thermal management • Degradation of insulation 	<ul style="list-style-type: none"> • Required high compression energy • Boil off issue • complex thermal management • Degradation of insulation

Hydrogen Distributions

	Gaseous Hydrogen	Liquid Hydrogen
Means	 	 
	<ul style="list-style-type: none"> • Tube Trailers • Pipelines 	<ul style="list-style-type: none"> • Tanks, Containers, etc.
Description	<ul style="list-style-type: none"> • Tube trailers are used for distance up to 350 kms. • Operating pressure: up to 250 bar • Operating temperature: -40 to 85°C 	<ul style="list-style-type: none"> • LH₂ tanks can be used for delivery up to 4000 kms. • Operating pressure: <10 bar • Operating temperature: -253°C
Advantages	<ul style="list-style-type: none"> • Simplest method in terms of infrastructure requirements. • Hydrogen loss is minor and compression cost at fuelling station is low. 	<ul style="list-style-type: none"> • Higher volumetric storage capacity than compressed gas • Fewer evaporation losses than typical compression mechanisms
Challenges	<ul style="list-style-type: none"> • High initial capital cost for pipeline infrastructure • Required high compression energy 	<ul style="list-style-type: none"> • Liquefaction requires complex technical plant • Liquefied hydrogen incurs boil-off losses.

Why Advanced Composites ?

- **Tailorable mechanical properties to meet high pressure requirement due to low gravimetric density**

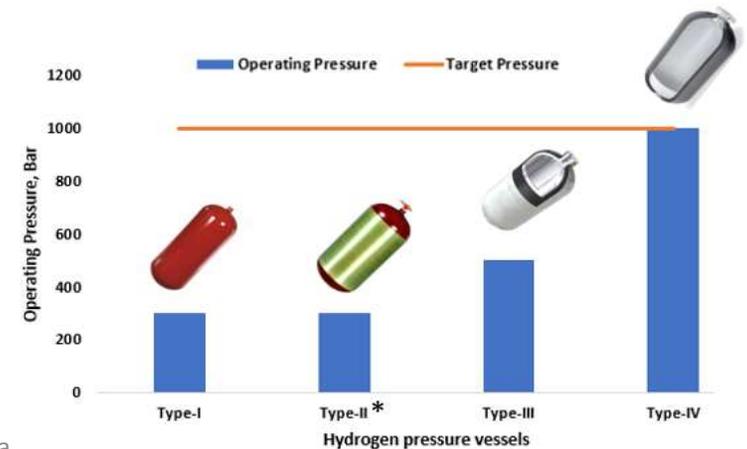
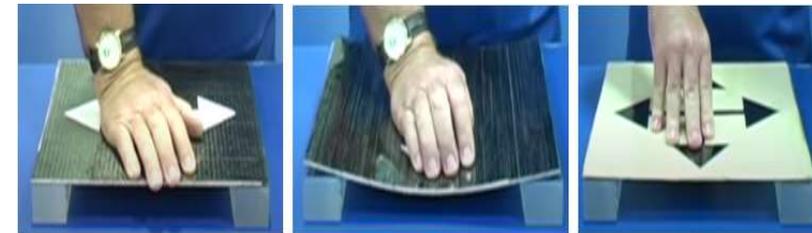
Traditional material cannot be used due to the limitation of strength to store Hydrogen at a pressure as high as 700 bar.

- High specific Strength/fatigue resistance/Longer life
- Superior weight performance

- Resistance to hydrogen embrittlement

- Corrosion resistance

- Tailorable thermal transport properties

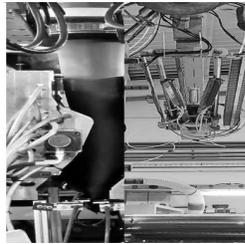


Composite Solutions: Immediate Challenges for India



Polymeric/Metallic material for liner
Carbon fiber

Material



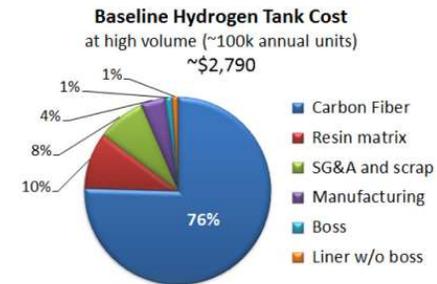
Liner Geometric non uniformity
Blow mold
Roto Mold

Polymeric Liner Forming



Burst Test, Fatigue Test, Pressure cyclic test, Bone fire Test

Vessel Testing facility

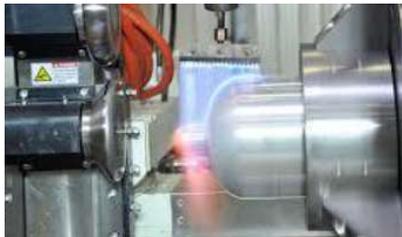


Expensive carbon fiber

Cost

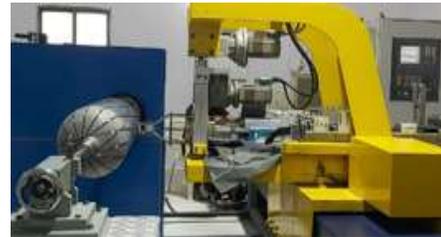
Metallic liner Forming

Spin forming
Chances of scratch and geometry deformation



Vessel Manufacturing

Filament winding process



Safety

H₂ detection sensor
TPRD (Thermal Pressure Relief Device)



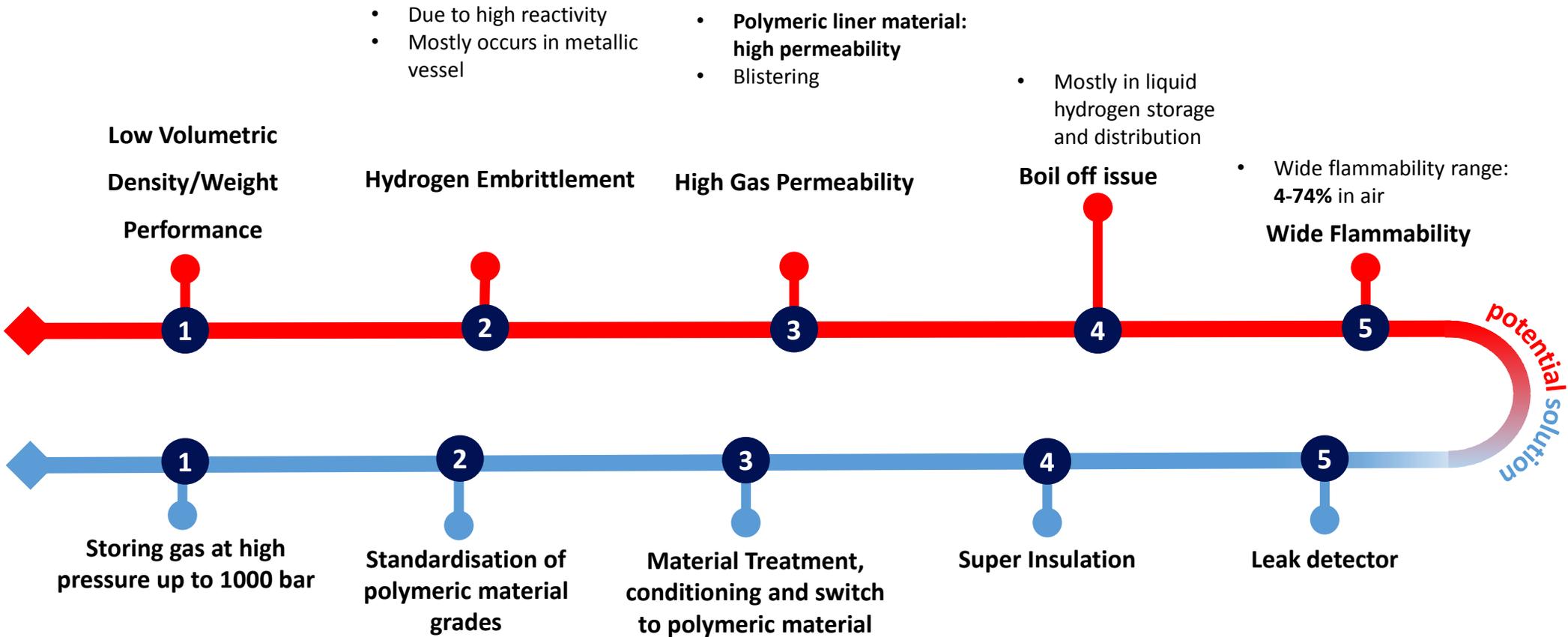
CARBON FIBRE



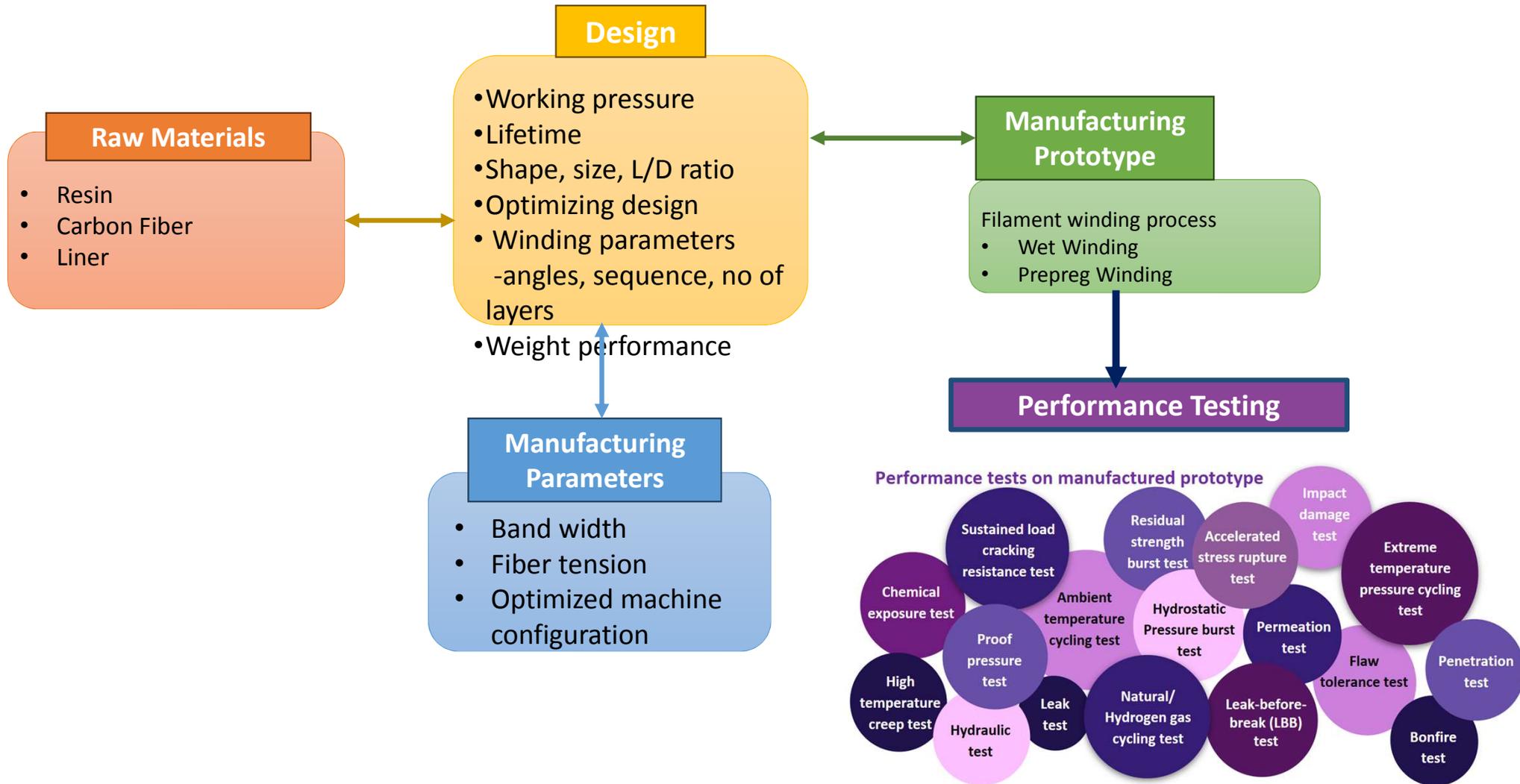
Key Challenges:

- **Limited manufacturer/ No Domestic Manufacturer capacity**
- **High Production Cost**
- **Limited Design Flexibility**
- **Environmental Concerns**

Material challenges and Composite Solutions



Technology Developmental Pathways



Research Activities at IITKGP: Hydrogen Storage & Distribution

Development of Type-2 CNG Pressure vessel of 70 litre capacity.

Completed

Type-II (CNG)

Sponsored by: GAIL India Ltd. (Gas Authority of India Limited)

Developed Type-2 pressure vessel is manufactured of carbon fiber hoop wrapped over a metallic vessel.



Final prototype

Development of Type-4 CNG Pressure vessel of 70 litre capacity.

Completed

Type-IV (CNG)

Sponsored by: GAIL India Ltd. (Gas Authority of India Limited)

Vessel Type : Type-IV (CNG)
Liner : Nylon-6
Composite : carbon-epoxy
Volume : 70Lt
Operating pressure: 350 bar
Burst Pressure : >750 bar
Driving Range : 149Km
Patent granted: 2020



Final prototype

Development of Type 3 Hydrogen Pressure Vessel of 70 Litre Capacity

Completed

Type-III (H₂)

Sponsored by: IOCL (Indian Oil Corporation Ltd)

Vessel Type : Type-III (H₂)
Liner : Aluminium Alloy
Composite : carbon-epoxy
Volume : 57Lt
Operating pressure: 350 bar
Burst Pressure : >700 bar
Driving Range : 177Km
Patent filed : 2021 (Under revision)



Final prototype

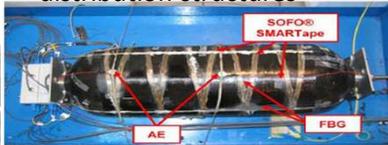
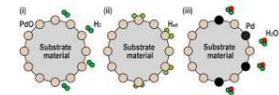
Sensor technology: Physical and Chemical Hydrogen Sensing

INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship

Ongoing

- Develop sensor technology and methodology to integrate with composite structure
- Chemo chromic hydrogen detection pigments supported on composite structures to detect leakage

- Structural Health Monitoring of Hydrogen storage and distribution structures



Liner Development Technology: Type-IV

Ongoing

- HDPE/PA6/PET are common materials for liner.
- HDPE and PA6 (Ube nylon 1218IU and DSM FEL 40HP* are commercialised materials.



- Low hydrogen gas permeability (ISO 15869/ISO 15105/ASTM 1434)
- Manufacturing

- Blow mold [A]
- Roto mold [B]
- Injection mold



A



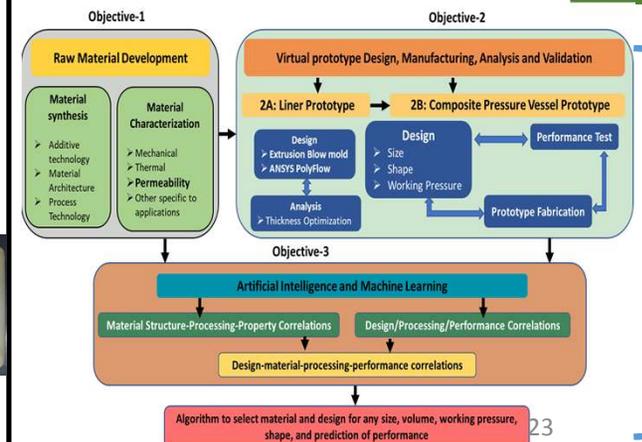
Blow mold in ANSYS



Roto molded liner

IC-MAP on Bioenergy and Hydrogen

Ongoing



Scale-Up

Extracts from IIT Kharagpur Prof. Dr. Swati Neogi's Presentation

Future opportunities & Challenges

Development of other composite structures besides Type IV for storage and distribution

- Cylinders for stationery storage
- Tubes (composite tubes can replace metallic tubes, resulting weight and cost reduction)
- Composite pipe structure for future hydrogen infrastructure dev



Development of diagnostic tools for periodic testing of the cylinders being used for mobile applications



Development of non-standard investigative test methodology for materials/prototypes/components such as hydrogen embrittlement at high pressure, high pressure permeability, polymer liner buckling, the effect of heat and humidity prevalent in India.

This investigative methodology and testing will help in determining

- Reliability of the materials/components,
- India specific requirements additional to the requirements mentioned in the ISO standards.

Opportunities & Challenges

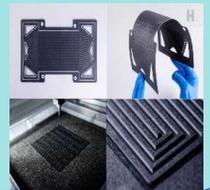
Development of sensor technology and integration of the sensors with the composite structures for health monitoring



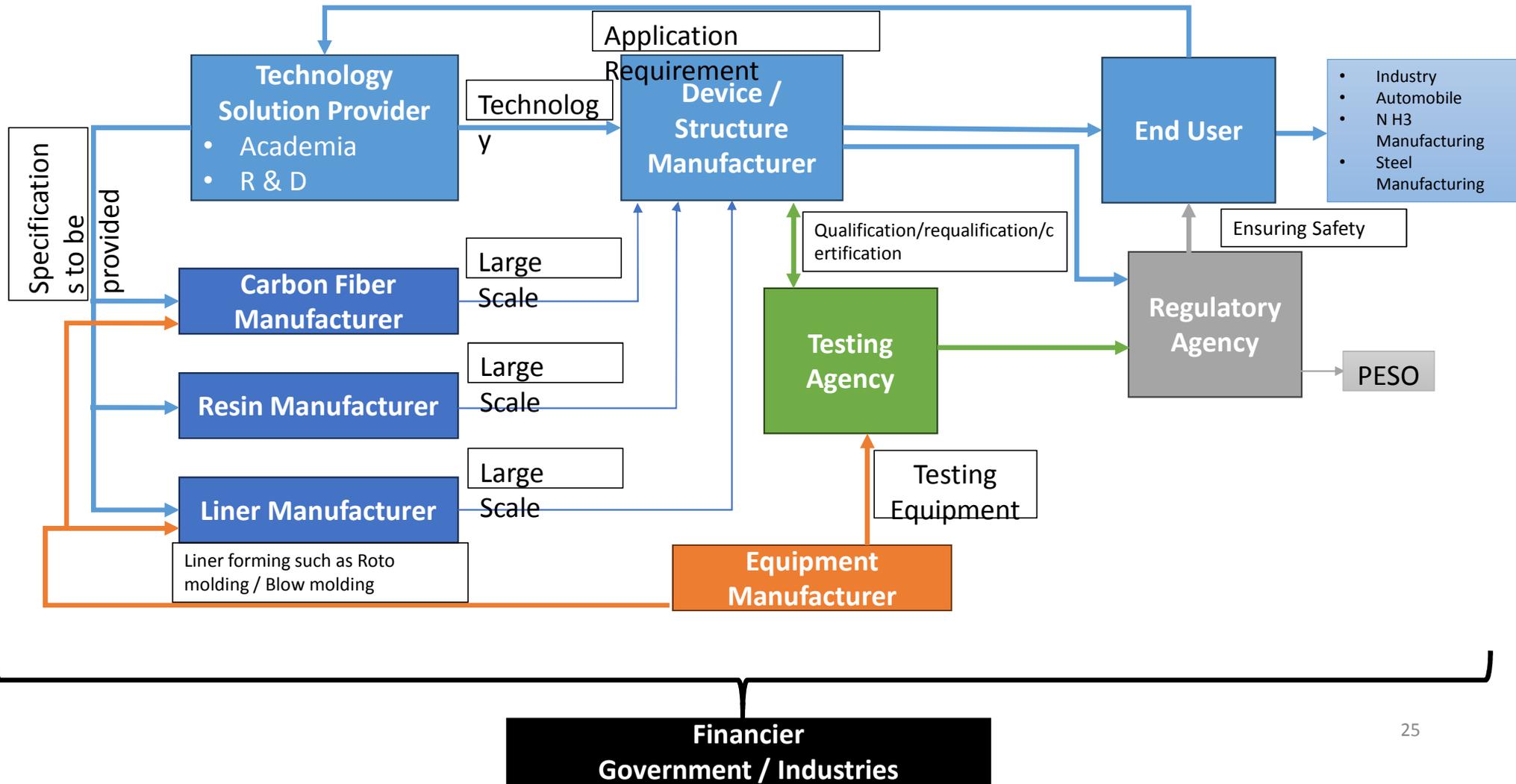
Reviewing the ISO/country-specific standards available and recommendation for India specific requirements additional to the requirements mentioned in the ISO Standards.

Participating in the formulation of

Composite solutions for the corrosion problem of bipolar plates and other components, such as casings of electrolysers/fuel cells



Stake Holders



CAL Group



Prof. Swati Neogi
PI of CAL
Chemical Engg. Dept
IIT Kharagpur, India

**“Taking
Composites
Mainstream”**



Current Research Scholars

Energy Storage/Distribution Group



Akash



Ananya



Uma



Mohit



Mukesh



Rakesh (M.Tech)

Bio Composite



Sangeeta

TPS Group



Yash

Armour Group



Rinku



Umavarun



Rohan



Bhonu (M.Tech)

Technical Support



Hafijul Hossain Sardar
Technical Superintendent



Vijay Sharma



Aditya Sharma
Lab assistant

Alumni



Dr. Raghu Rajan



Dr. Victor



Dr. Santoshi



Dr. Yashwanth



Dr. Nitai



Dr. Pranjali



Saurav

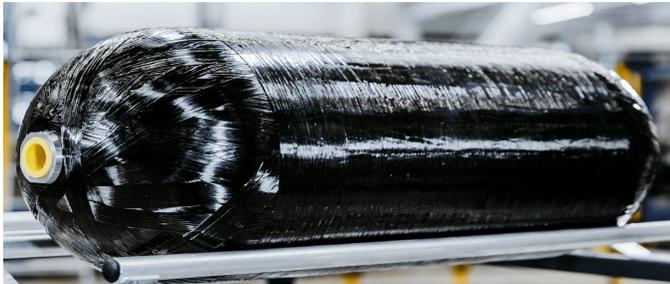


Abhiram



Sarga

BHEL TARGET PRODUCTS



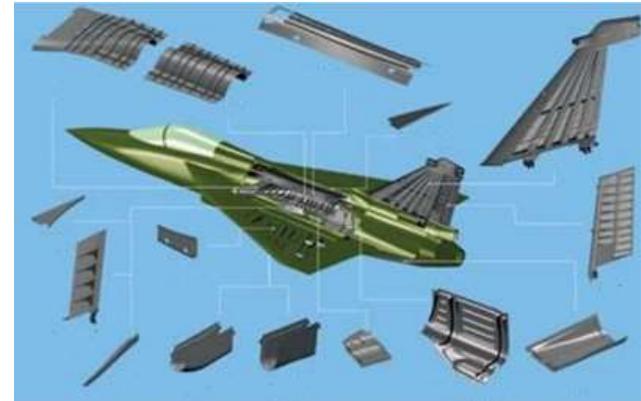
**Type-IV Composite H2
Cylinder**



Rocket Motor Casing

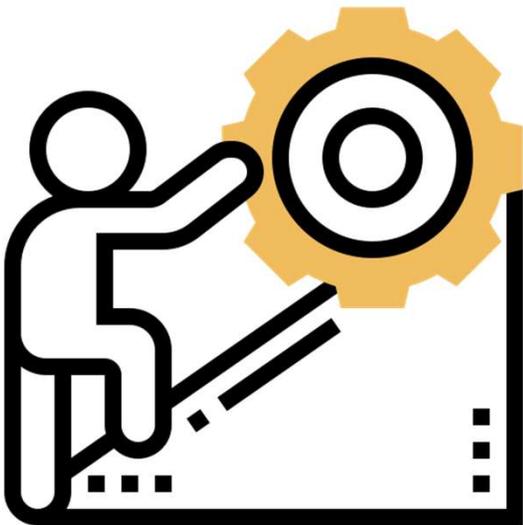


**Type IV Composite CNG
Cascade**



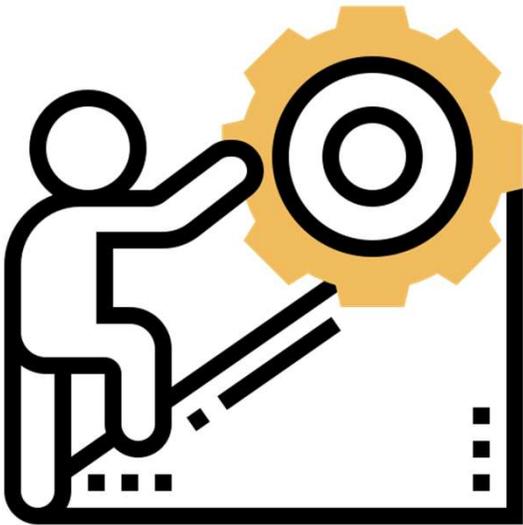
Aerostructures

Key Challenges for Hydrogen storage/ distributions:



- Suitable material for storage
- Sourcing of raw material
- Technology for the High pressure storage
- Cost Effectiveness
- No guiding qualification standards

Key Challenges for Type-IV cylinder development technologies



- Liner Geometric non uniformity
- Blow mold vs. Roto Mold
- HDPE vs. PA-6
- Boss design and geometry
- Reliable high pressure test equipment
- PESO certification of the facility and process
- Safety Issues

Carbon Fibre as Raw Material

BHEL					HSN Code	Details of other clients in India who require the job
Classification	Application	Specification	Unit	Requirement p.a. (Rs Cr)		
Fiber	High Pressure Hydrogen/CNG Cylinders	T700, 12 K (Grade)	Kg	800 MTA by 2030 (Approx.)		DRDO, ISRO, HAL etc
Special Features of the job		NA				
Sl.	Requirements of the job			Facility /Technology	Whether available in India (Yes / No)	
	NA			NA	NA	

Technology intensive item. Only general information mentioned.

samvaad@bhel.in

Efforts & Status Of Indigenization

Number of indigenous vendors under approved category	Number of indigenous vendor under trial/ development category	Status of indigenization
<ul style="list-style-type: none">• NIL	<ul style="list-style-type: none">• NIL	<ul style="list-style-type: none">▪ NAL has developed T300 Grade carbon fiber and they are likely to start the development of the T700 Grade Carbon fiber very soon▪ BTRA (Bombay Textile research Association) Mumbai is likely to start Pilot precursor line very soon▪ HAL has commissioned the Pilot precursor line▪ Reliance has made announcement in FR22-23 for establishing the manufacturing of the carbon fiber line. The current Status is not known.

ACTION POINTS DISCUSSED IN BHEL SAMVAAD 3.0

Carbon-fiber-reinforced polymers

Sl.	Suggestion	Recommended by	Responsibility	PDC	Remarks



THANKS