Climate Tech/Environment Tech and Circular Economy

Siddharth Shrimal

Objective of this presentation

The over-arching theme of the presentation is to better understand **a new disruption** in the economy that enables a more sustainable and circular future. Unlike some disruptions that created new markets or impacted a select few, the change will impact all markets and economies

Approaching the study

Where? Understanding which sectors are most concerned with this transition

How? How will they transition? Often, there is tech involved, and nuances need to be understood

What? Suitable opportunities for investment that have mature technologies

At the same time, speaking with industry experts to get a better understanding

And also exploring different companies to see the kind of business models that can exist in the ecosystem

Above, is a very simplistic understanding of the study, however, the skeleton remains the same

A theme for the presentation

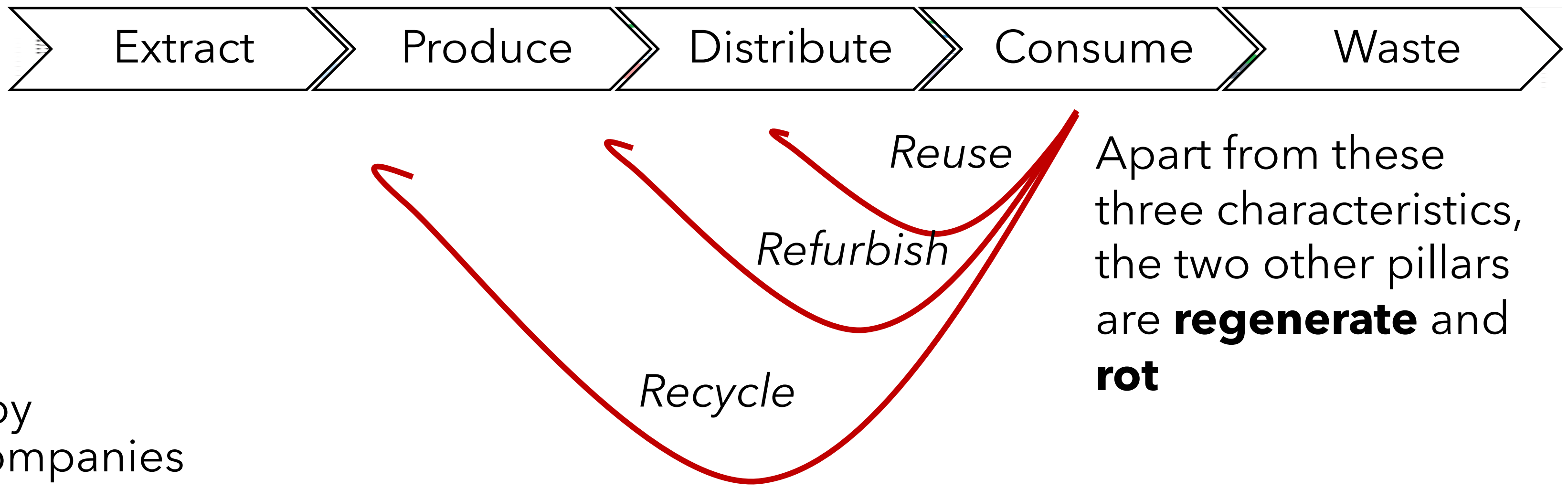
Sustainability and circularity are **vague** definitions for the evolving economic landscape. A reason could be the lack of objective outcome. To be *sustainable* could mean different things, subjectively.

The net-zero label *and* **A transition from linear to circular economy**

> To go net-zero is to (i) reduce greenhouse gas (GHG) emissions and/or to ensure that any ongoing emissions are balanced by removals

Net zero goals are usually set by institutions, governments or companies

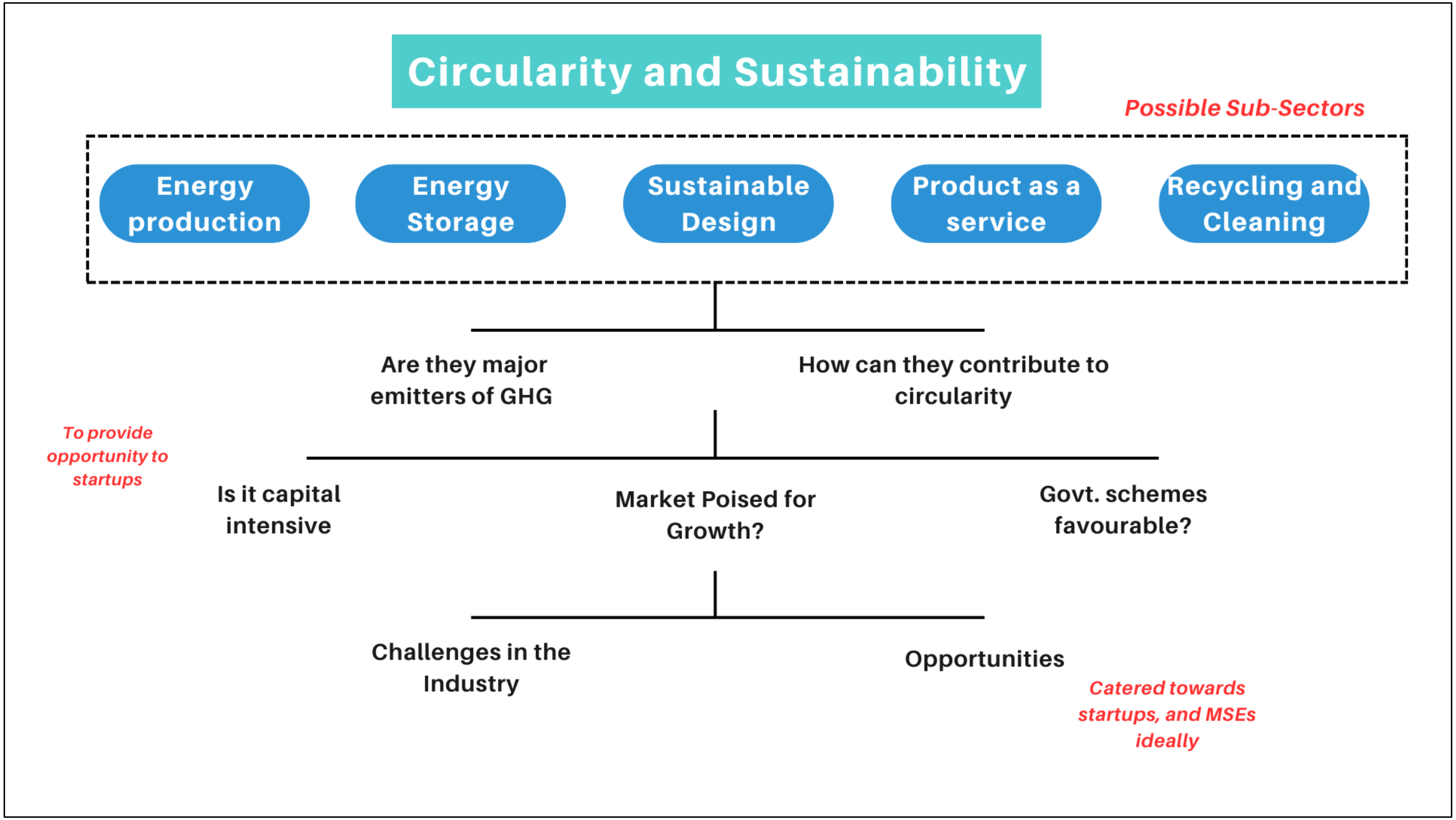
The difference between a linear economy (status quo) and circular economy involves the addition of five new pillars to our value chain



Apart from these three characteristics, the two other pillars are **regenerate** and **rot**

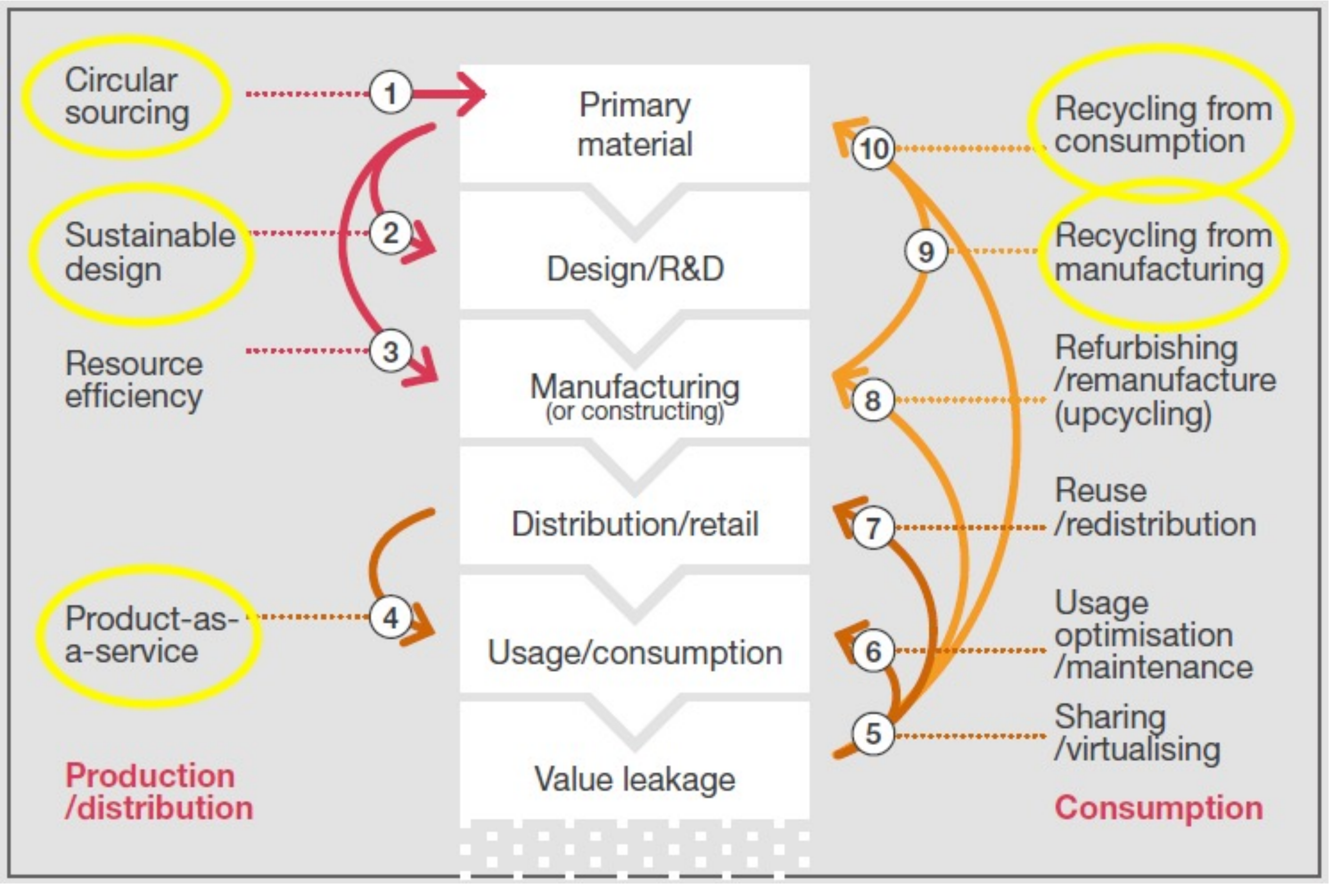
The point of establishing these two definitions for a theme will help in understanding the space better while evaluating sectors and companies

Top-down approach



Understanding opportunities in circular economy

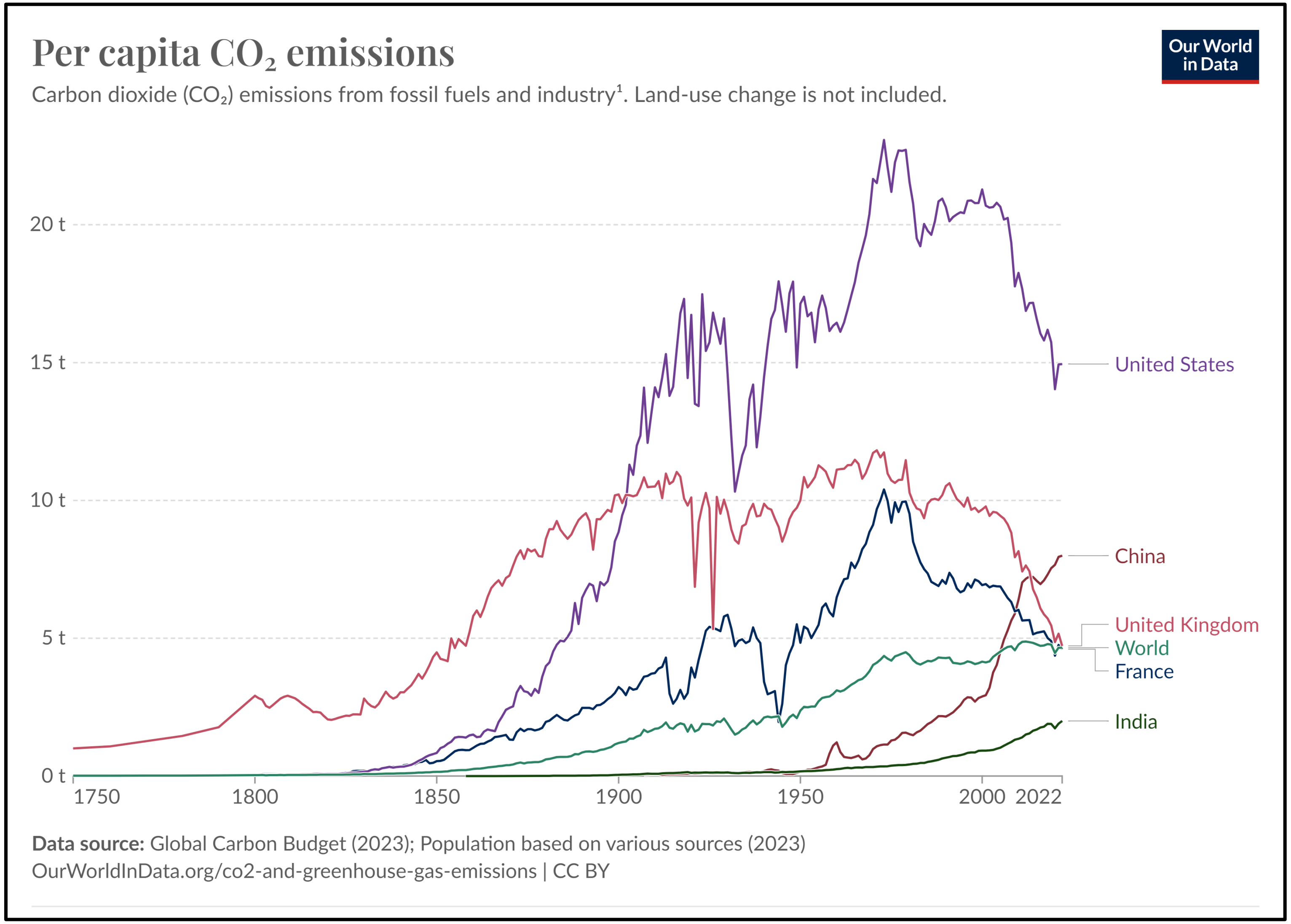
Energy generation is of course only one segment in the larger circularity ecosystem. To find opportunities within, the previous economic value chain can be modified to get a better idea:



Finding sectors with economic potential, prima facie

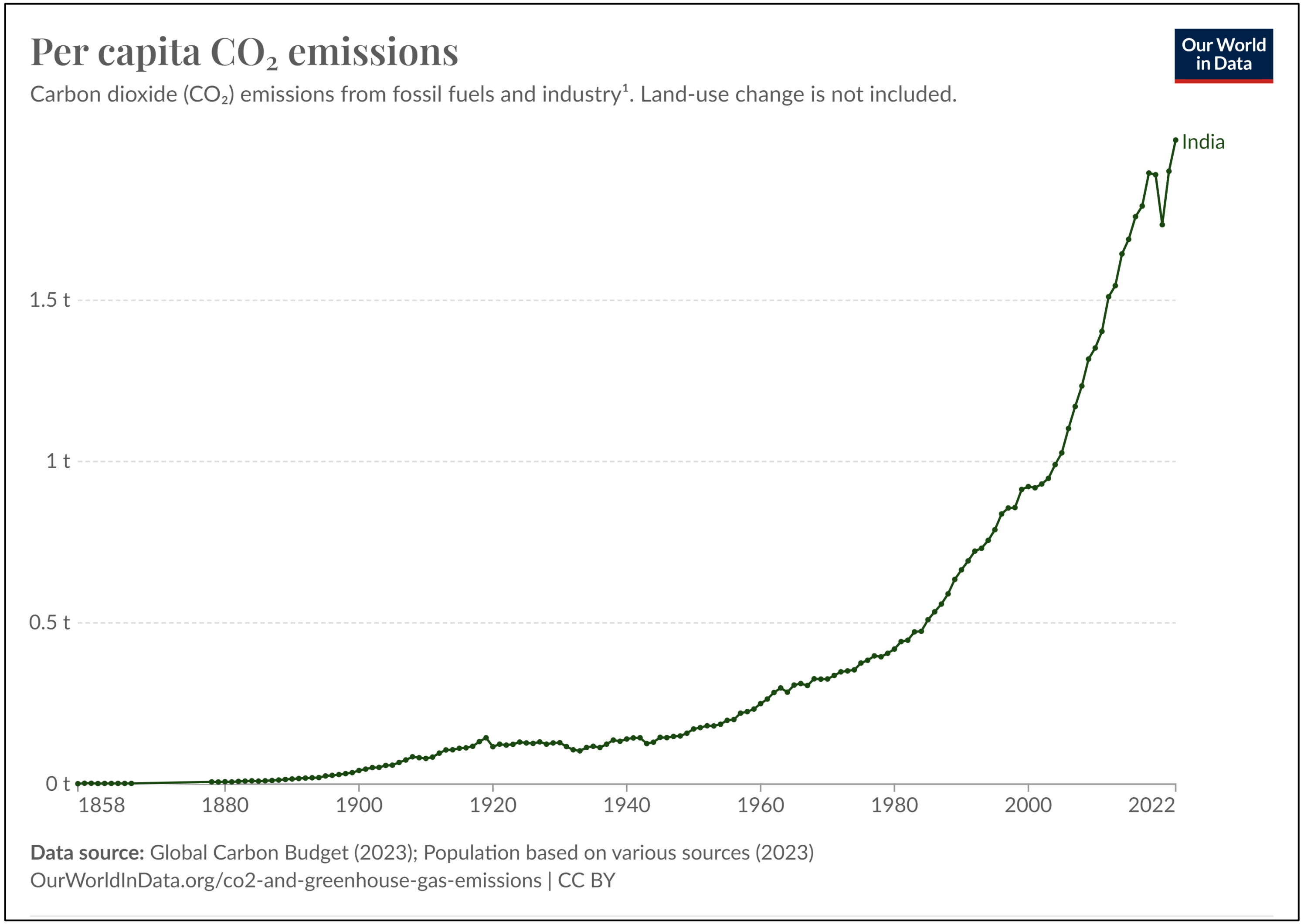
- Circular Sourcing
- Sustainable Design
- Recycling from consumption
- Recycling- Manufacturing
- Resource efficiency
- Product as a service

The context behind net-zero emissions- India and the RoW



In comparison with the world average and major economies, India is far below the average. However, we still display a growing trend while advanced countries such as the UK, France and USA have displayed signs of slowing down in this regard

The context behind net-zero emissions- India's GHG rise



Growing CO2 emissions, and increasingly. Most policies will aim to either:

- Slow the growth of p.c CO2 emissions
- Reduce it altogether

But, how big will the transition be?

Exhibit E5

Spending on physical assets for energy and land-use systems in the NGFS Net Zero 2050 scenario would rise to about $9.2 trillion annually, or about $3.5 trillion more than today.

Annual spending on physical assets for energy and land-use systems[1] in the Net Zero 2050 scenario,[2] average 2021–50, $ trillion

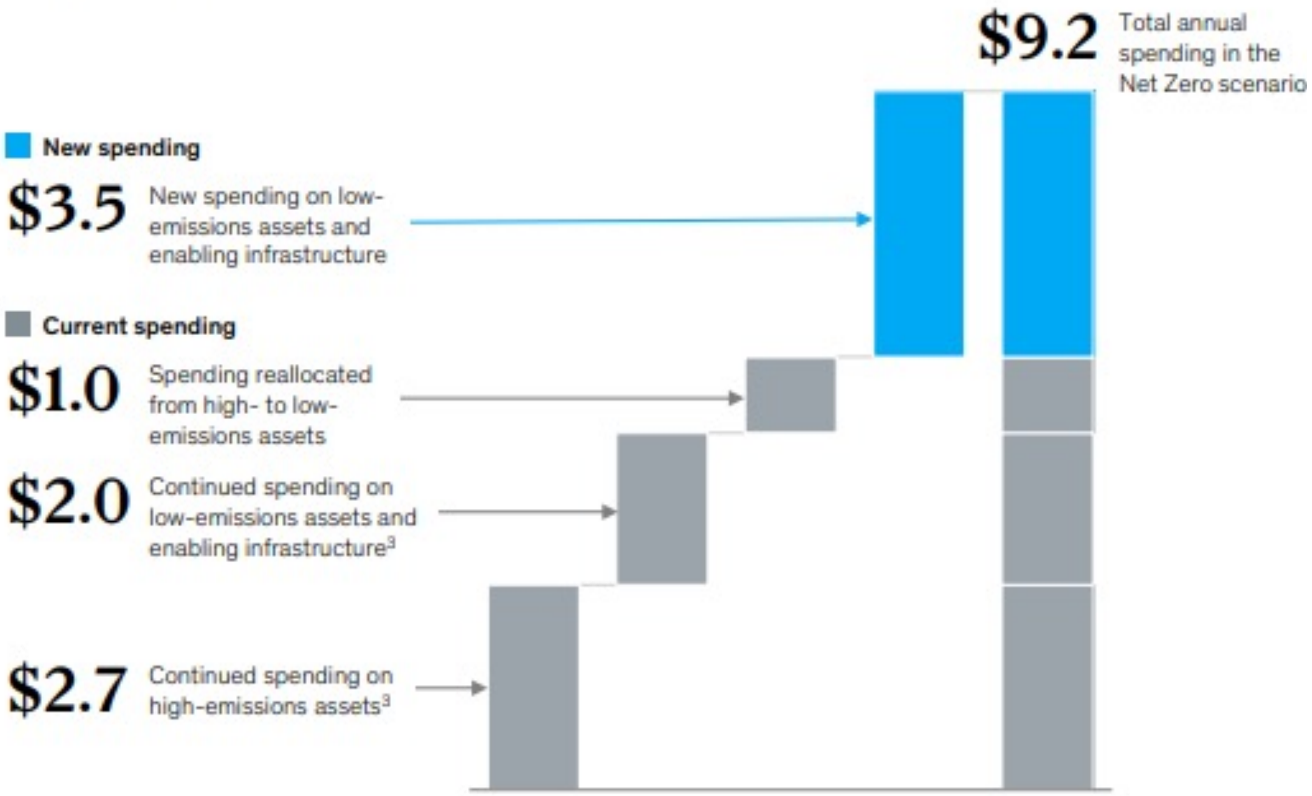
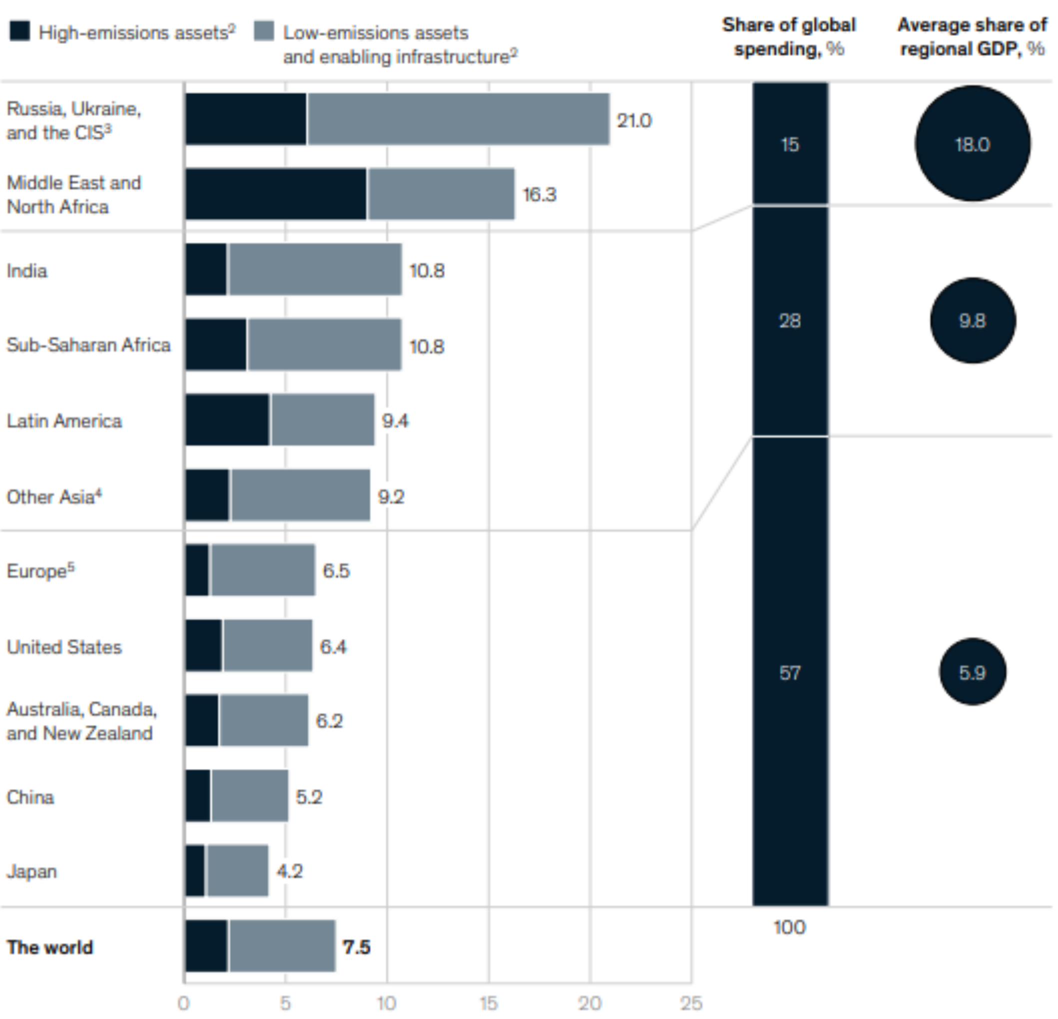


Exhibit E10

As a percentage of GDP, fossil fuel–producing regions and developing countries would spend more than others on physical assets for energy and land-use systems.

Spending on physical assets for energy and land-use systems under NGFS Net Zero 2050 scenario,[1] % of 2021–50 GDP



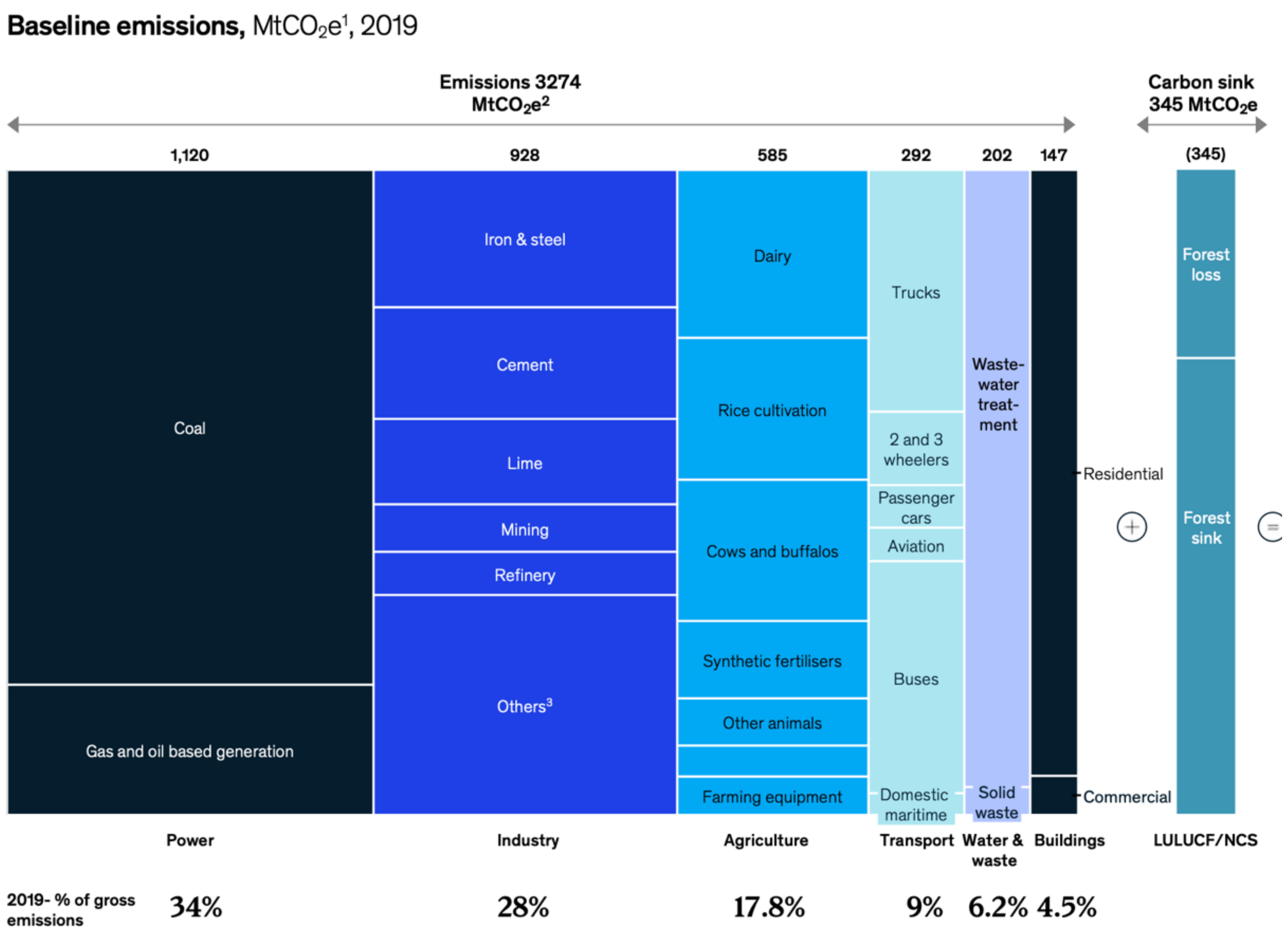
But, how big will the transition be?

As the world strives for net-zero by 2050, a study by McKinsey anticipates a global spending of **9.2 billion USD p.a**. This graph explains spending to the deployment of assets such as **energy supply systems, storage, biofuel, recycling plants, mobility and more**. Currently, we're spending about 3.5 trillion dollars on low-emission assets (such as solar panels, EVs to give examples)

India, however, is less ambitious with its net-zero ambitions. At COP26, we declared our net-zero ambitions to be reached by 2070. **The IEA estimates a spending of 28 billion USD per annum from now to 2070.**

This should not be misunderstood as a predominantly government undertaking, as there are many incentives for private sector's participation. And yes, as a percentage of GDP, **India does have to spend more than some advanced economies.**

Sectors and their emissions



Each sector has different approaches as they shift away from fossil fuels. It also shows us opportunities that haven't been tackled yet such as agri, and hard-to-abate sectors such as industry

Energy, right now

Evidently, the largest emitters of carbon dioxide, and greenhouse gases is for energy. And, the biggest shift will be towards getting renewable sources of energy. Here is a breakdown of energy in India.

Reliance on Coal

India is currently reliant on coal for 70% of the energy generation. We do have a target of achieving 50% of the energy generation from renewable energy sources by 2030, and are on track to get 60% by then.

As far as supply chain goes, we're the second largest producer of coal but still remain a net importer because of our massive energy needs

- Solar
- Wind
- Hydropower
- Geothermal
- Bioenergy
- Nuclear

Renewable Energy

Renewable energy sources (RES) are different from coal and other non-renewable energy sources that will replenish at a higher rate than we will ever consume. There are 6 main categories as labeled here

India is a world leader when it comes to renewables, coming 4th in RE generation after China, USA and Germany.

India's 3 main targets

Emissions intensity of 45% below 2005 levels by 2030	**50% of electric power capacity from RES by 2030**	**Our net-zero pledge by 2070**

Policy Tailwinds for Energy

India is currently the **third largest energy consumer** in the world. GoI has made or emphasis on sustainability public multiple times, and this comes along with goals that spurt certain sectors.

According to our NDC, India plans to reduce the emissions intensity of our GDP by 45% and reach 50% of installed electric capacity from non-fossil fuel energy sources

Key opportunities present when:

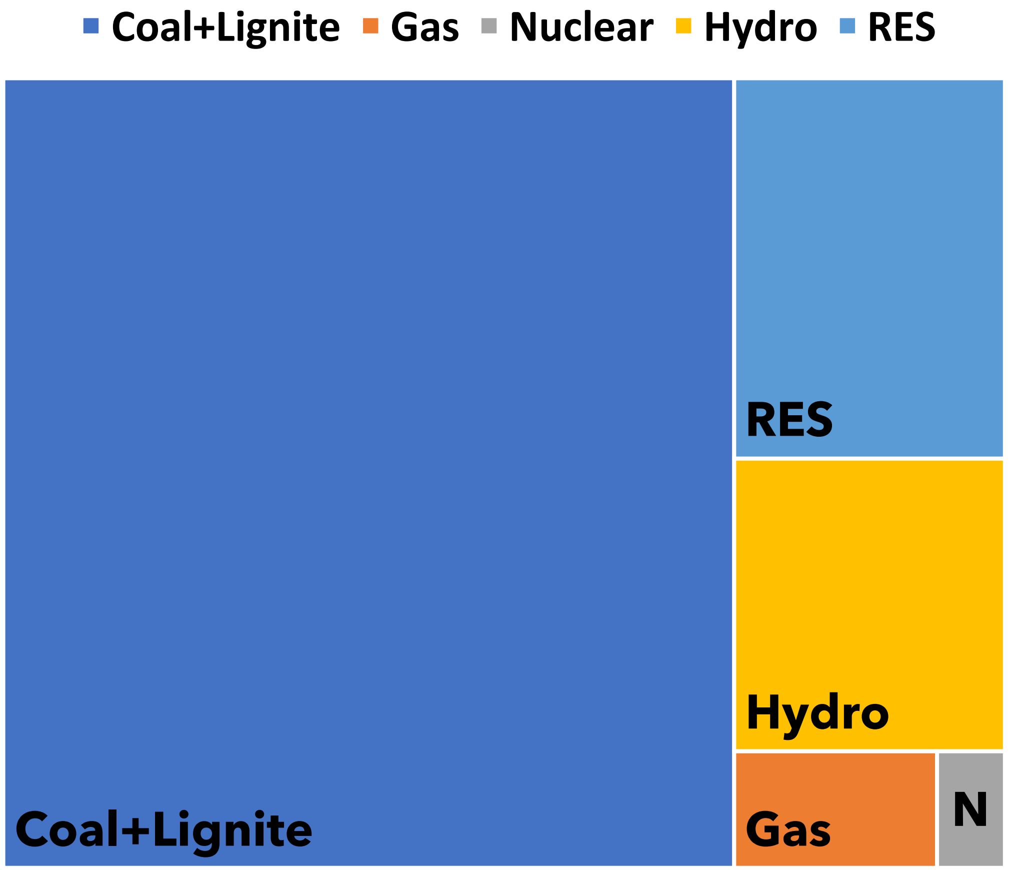
1. ***India commits to reduce the emissions intensity of its economy***
2. ***Also plans to have 50% of the installed electricity capacity to be RES***

Five goals at the COP26:

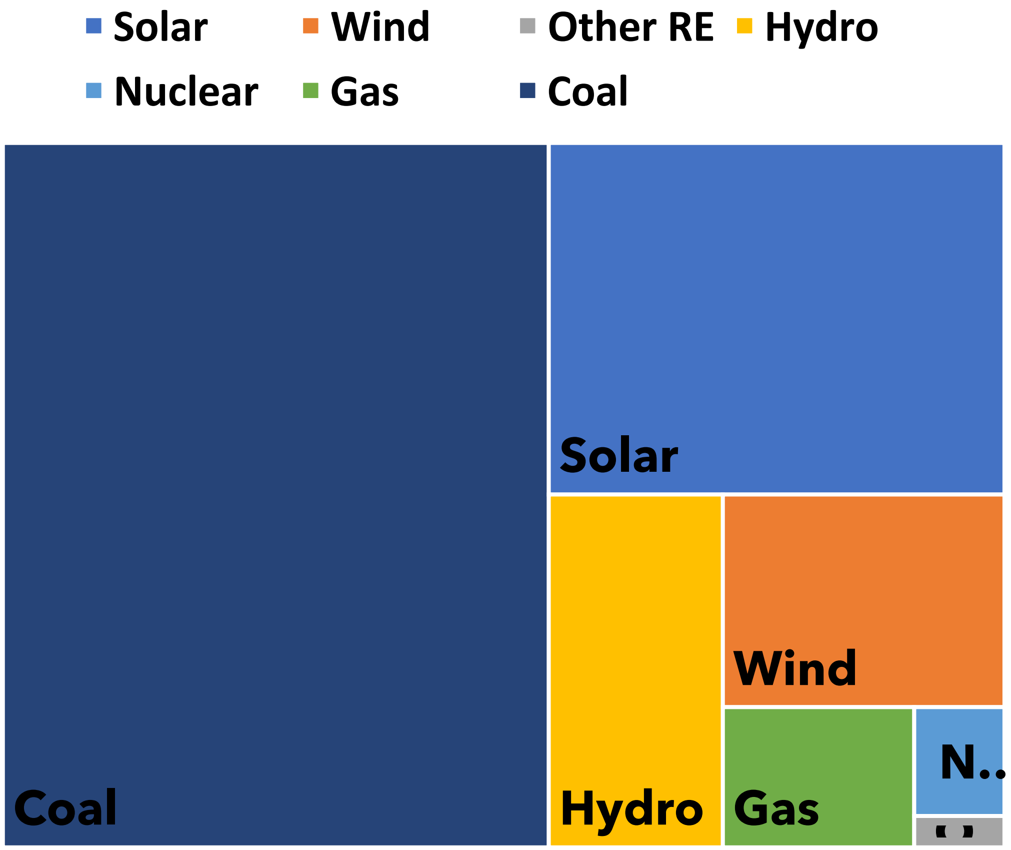
- Reach 500 GW of Non-fossil energy capacity by 2030.
- Generate 50% of India's energy requirements from renewable energy by 2030.
- Reduce total projected carbon emissions by one billion tonnes from now to 2030.
- Reduce the carbon intensity of the economy by 45 percent by 2030, over 2005 levels.
- Achieve the target of net zero emissions by 2070.

Energy Generation

If the aforementioned goals were to be achieved, here is a comparison between our current and projected energy generation divided by source



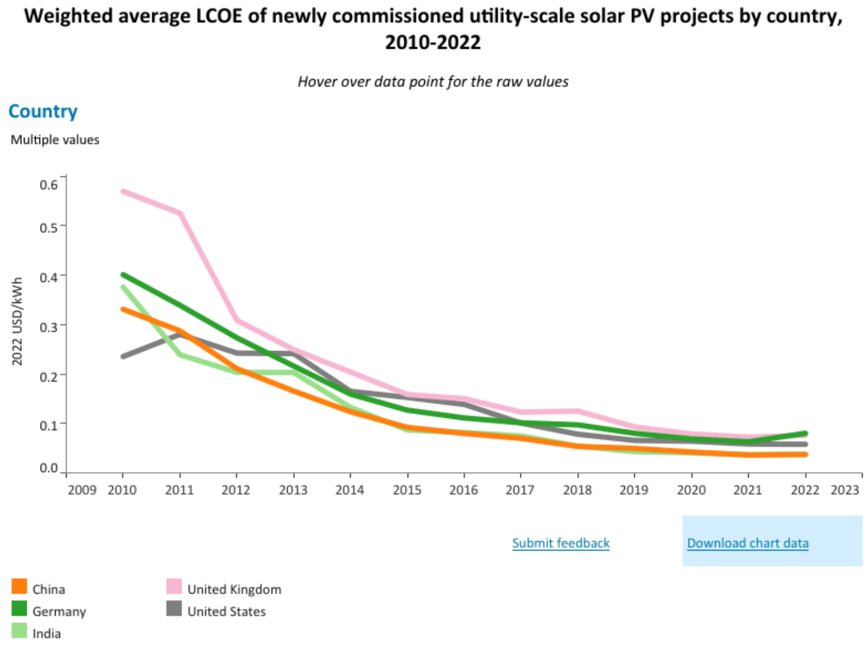
Energy generation- 2023

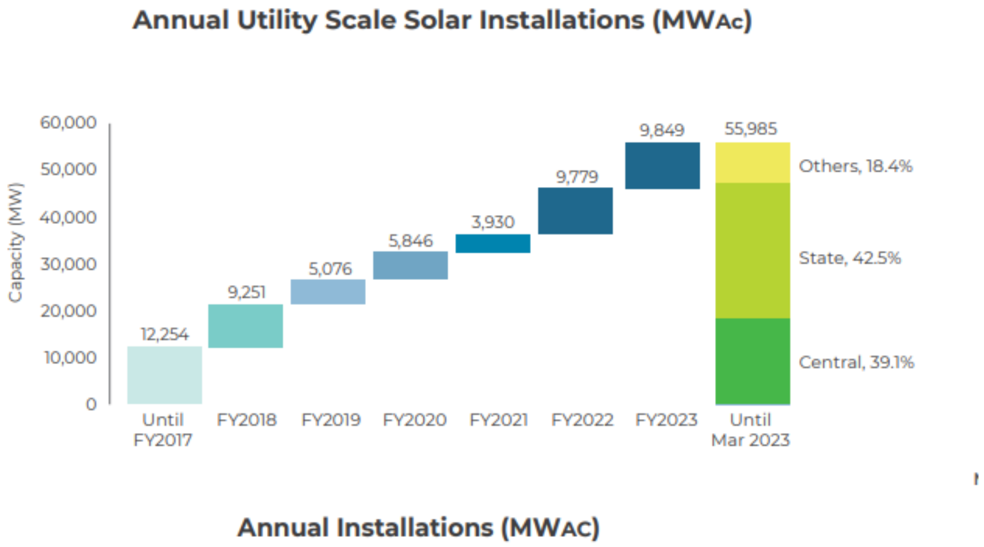


Projected energy generation- 2030

Solar Energy

Solar energy, along with wind energy is already the cheapest form of electricity, **even without subsidies. And, solar costs are the cheapest in India**





Solar prices have decreased dramatically, and the tariffs have gone down by 60% in the last two years. More than half of our solar capacity has been installed in the last four years, and we have another 4.5 GW commissioned. India also has a manufacturing capacity of 39 GW and is expected to reach 110 GW by 2026 (IEEFA), making it the second largest globally. We have an opportunity to be **self-reliant by 2030** for PV modules.

Solar Energy

Solar energy is the leader in renewable energy(RE) generation. We have the third-largest solar power generation capabilities, and it presents an ever-increasing trends. The solar ecosystem can be divided as:

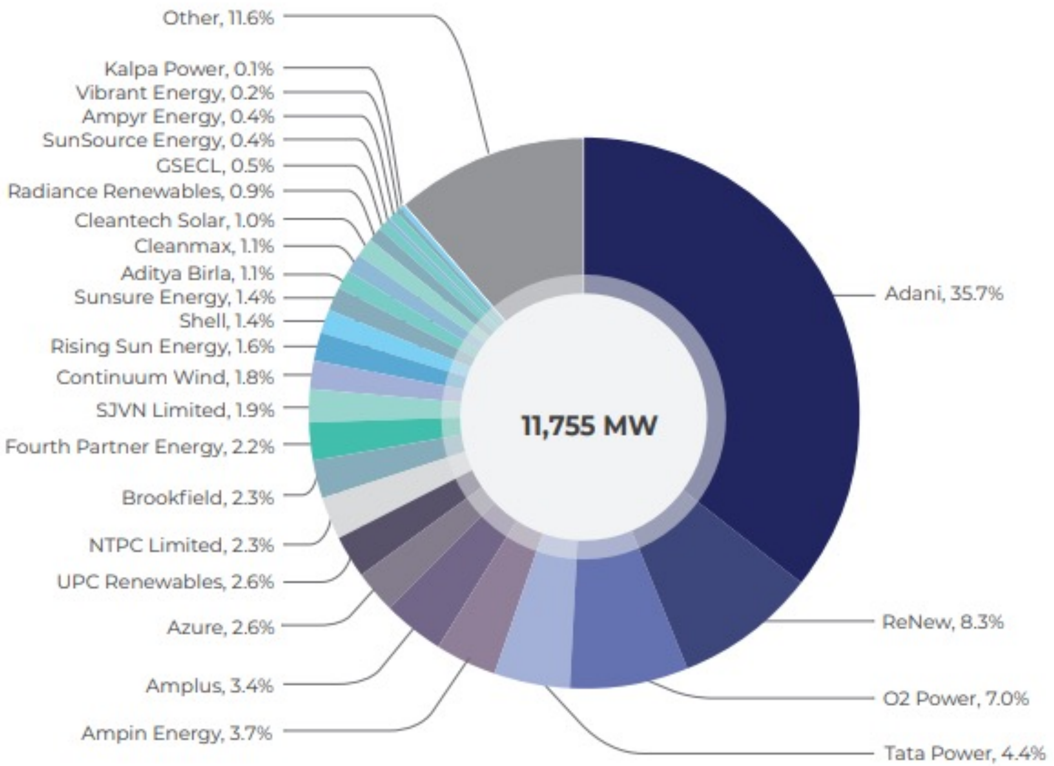
Manufacturing

Raw Materials	Polysilicon, Ingots & Wafers and PV Cells
Intermediaries	Solar Glass
Finished Products	Crystalline Modules, Thin Film Modules, Inverters, Monitoring Systems, Mounting systems, Balance of System,

Services

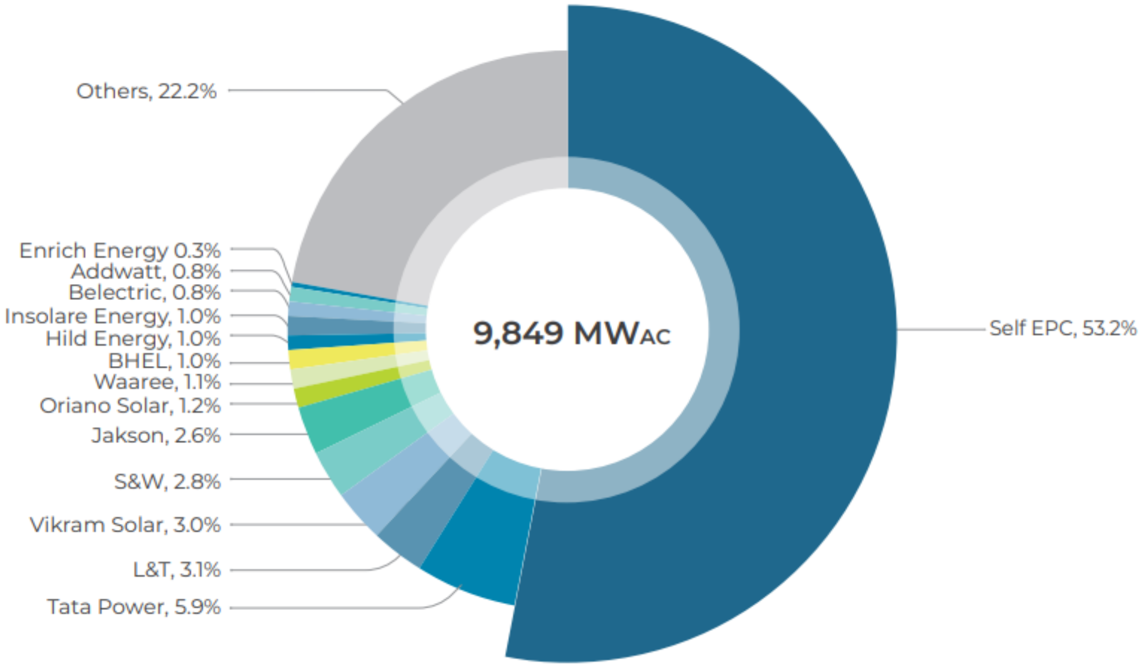
Utility Scale Solar Intermediaries	EPC, IPP
Rooftop Solar Plants	System integration

Solar Energy- crowded and competitive



Project Developers

Adani, ReNew, Tata, O2 Power, Ampin, Amplus



Utility Scale EPC

Tata Power, L&T, Vikram Solar and mostly self EPC

Solar Energy- Raw Materials and Modules

Of 2 types

Solar Modules

1 Crystalline Silicon

2 Thin Film

A module is a collection of cells with a glass and casing

- *Crystalline Si (which is the standard) market is incredibly competitive with players such as Adani, Vikram, Waaree and many more*
- *Thin film- crowded, but there is potential for high growth.*
- *Perovskite panels- efficient, cheap and versatile but a distant opportunity in terms of R&D*

Components of modules	Comments	Capex	Competition
Polysilicon	1. Very few small and medium scale companies 2. Some of the veteran players- RIL, Adani, Shirdi Sai Electrics, BHEL 3. International companies such as GCL, Hemlock, SunEdison hold most of the market share	High	High
Ingots & Wafers	1. Very few domestic players in India- Adani Solar being the only established one	High	Medium
Solar Cells	1. Few domestic players such as Vikram Solar, Insolation Energy, Tata Power, Waaree, Adani and some others	High	High
Glass	1. Handful of tier 1 players- Borosil, Allied Glasses, GSC, EMVEE Solar 2. Hard for businesses to create moats	Low	Medium

Opportunities in Rooftop Solar

Large solar PV manufacturers often employ middlemen before they reach the end-customer for residential IPP. Such inorganized methods lead to:

No standardizatio n	Limited financing options	Maintenance Hassles	Disconnect with DISCOM	Delayed installation	Middlemen commissions

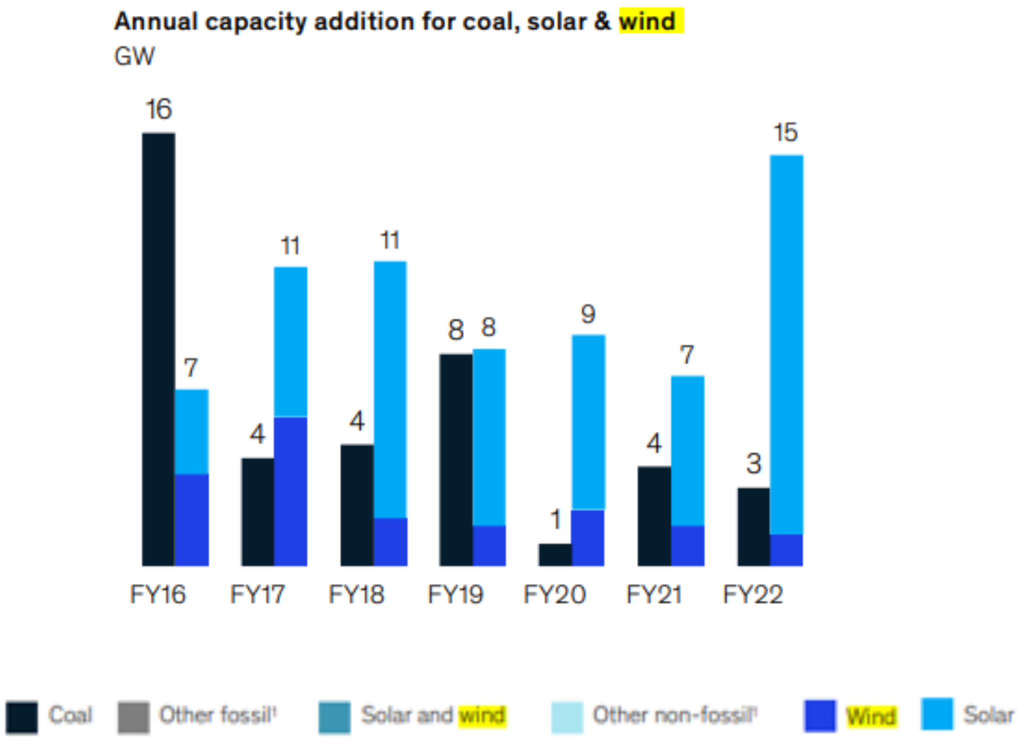
CEEW estimated the overall market that is willing to invest in residential solar to be about 11 GW. It's currently at 1.7 GW. That puts the potential market size in the next 10 years to about 15 GW

The economics from the customer end are favourable, with **payback** periods getting shorter and is currently **less than 5 years**

Although installation and maintenance might now have the highest margins, **financing and savings-sharing** models are untapped markets in the Indian context.

Rooftop solar installation in India provides a large untapped opportunities- especially in financing. Currently, it's a scrambled market with independent manufacturers, servicemen and financiers

India’s wind energy background



Lagging wind energy

In 2022 the total wind installations were 1.8GW, which is in contrast with the solar sector which added 13 GW and saw a rapid rise. The wind sector has received far less attention and

Still a major contributor

Out of the total renewable energy installed, wind energy contributes to 35%, second only to solar. Currently, it stands at 41.9 GW

Extremely High Capex

Onshore wind costs about 5.5-6.5 crore Rs per MW, and offshore costs 8.5-12 cr Rs per MW. Even the Levelized Cost of Energy (=lifetime costs/total energy) is Rs 2.8-3.3/kWh compared to solar’s Rs 2.5/kWh

All the opportunities in the aforementioned have two characteristics: (i) they can either be supplied by existing manufacturers with some tweaks (ii) very high capex requirements to break through

Wind Energy- Where we are right now

Current Capacity

A third of renewable energy electricity capacity comes from wind energy, around 41.9 GW (as of 2022)

Ambition

COP26 summit in Nov 21 had us pledge 140 GW of wind power by 2030

Potential

India has a potential of 214 GW of total wind energy potential

Understanding the Wind Energy Value Chain

Raw Material

- Steel
- Carbon Fiber
- Fiber Glass
- Machinery and Tools

R&D Services

- Design
- Engineering
- Research

Components Suppliers

- Gearbox
- Bearing
- Tower
- Generators
- Blades
- Electronic

Turbine Manufacture

- OEMs
- Large Scale Utility
- Small Wind Turbines

Construct & Installation

- EPC
- Transport
- Operation & Maintenance

Wind Farm Developers

- Project Developers

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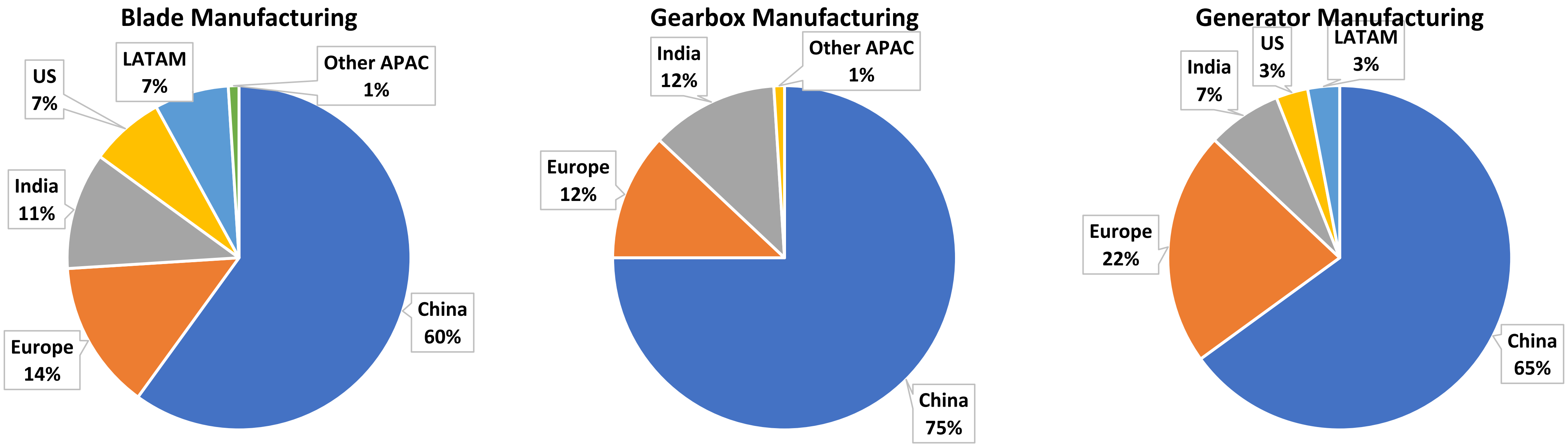
Wind Energy- Where we are right now



China Domination, Again

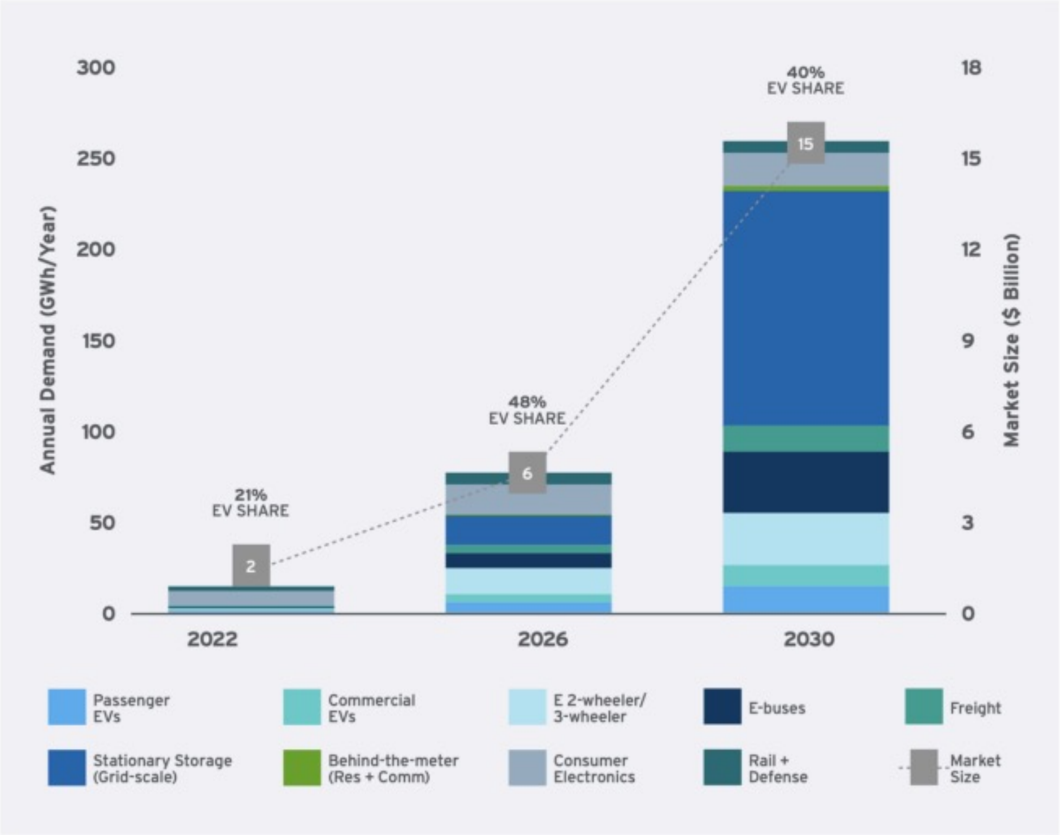
China leads in the manufacturing of the three main components- Blades, Gearbox and Generator. India is comfortably second and has an opportunity to emerge in exporting with countries adopting China + 1. However, our efforts to "de-risk" from China could lead to some bottlenecks as we increase manufacturing capacity. This would slow down the installation of wind energy projects in India. Indian turbines are also about 60% more expensive compared to Chinese ones, and components imported but assembled in India lead to 35% more expensive turbines. We still do have a long way to go w.r.t cost competitiveness

An introduction to energy storage

Stationery Applications
Used for micro-grids and to store intermittent RE

Consumer Applications
Phones, laptops, and rechargeable smaller batteries

Transport Applications
As the name suggests, batteries that are used in EVs



Why now?

- RES are intermittent, so there needs to be a way for us to capture energy when there's an excess supply and to discharge power when there's excess demand
- Further, if EVs hope to gain a larger share of the auto market batteries will play a crucial role
- The current grid system doesn't allow for the transport of RES from far distances and BESS will play a big role in upgrading the grid

Energy storage allows to capture energy produced for later to level the energy demand and supply.

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US Dept. of Treasury *in November 2023*

Beginning in 2024, an eligible clean vehicle may not contain any battery components that are manufactured by a foreign entity of concern and beginning in 2025 an eligible clean vehicle may not contain any critical minerals that were extracted, processed, or recycled by a foreign entity of concern i.e; China, Iran, Russia, N Korea

Although there is much emphasis on EVs and the market opportunity for batteries, NITI Aayog predicts stationery storage to have the lion's share. It would require more addition and investment.

The current market size is a little over 1 billion USD, and is expected to increase to 15 billion USD by 2030, which is a 40% CAGR

Energy storage allows to capture energy produced for later to level the energy demand and supply.

Types of storage matters

Category	Technology
Mechanical	Pumped Hydro Energy Storage (PHES)
	Compressed Air Energy Storage
	Flywheel Energy Storage
Electrochemical	Lead Acid Batteries, Advanced Lead Acid (Lead Carbon, Bipolar Lead Acid)
	Lithium Batteries (LCO, LMO, LFP, NMC, LTO, NCA)
	Flow Batteries (ZnBr, Vn Redox)
	Sodium Batteries (NaS, $NaNiCl_2$)
	Zinc Batteries (Zn Air, $ZnMnO_2$)
Thermal	Sensible-Molten Salt, Chilled Water
	Latent-ice Storage, Phase Change Materials
	Thermochemical Storage
Electrical	Super Capacitors
	Superconducting Magnetic Energy Storage (SMES)
Chemical (Hydrogen) electrochemical	Power-to-Power (Fuel Cells, etc)
	Power-to-Gas

Mechanical storage displaces a medium (air/water) and stores kinetic energy later converted to electricity. PHES involves moving water uphill through electricity, and via gravity powering a motor when there is demand

Electrochemical storage is the most traditional form of storage better known as battery. The emerging tech- (i) Flow batteries which use electrolyte tanks to transfer ions (large size deployment) (ii) Sodium batteries wherein the cathode is replaced and (safer) (iii) Zinc batteries wherein the cathode is Zinc and supplied with oxygen (higher energy density)

Thermal storage involves heating material to store energy in excess to be released when needed. Sensible molten salt is used for high temp, chilled water for ACs, latent heat for ice/water

Electrical storage involves supercapacitors which do not use chemical processes and are ideal for short bursts of power. Currently in R&D

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Electrical	Super Capacitors
	Superconducting Magnetic Energy Storage (SMES)
Chemical (Hydrogen) electrochemical	Power-to-Power (Fuel Cells, etc)
	Power-to-Gas

There are two end-goals to understand this distinction:

Which one of the categories will be prominent when it comes to energy storage in the stationery use case?

Any technology wherein SME can fit themselves in to create a strong presence

Mechanical

- Nascent,
- High capex,
- Usually, govt initiated

Electric, Thermal

- Capex intensive,
- Few use cases

There are three areas wherein there is (a) wide scale application (b) possibility of disruption (c) MSE and startups can participate and that is **chemical battery systems, alternative fuels and hydrogen**

A note on China's domination | Possible Disruption

75% of the world's Li-ion batteries are made in China	China is the largest importer of Lithium	CATL and BYD control 32% of battery manufacturing	China is projected to lead till 2027, **at least**

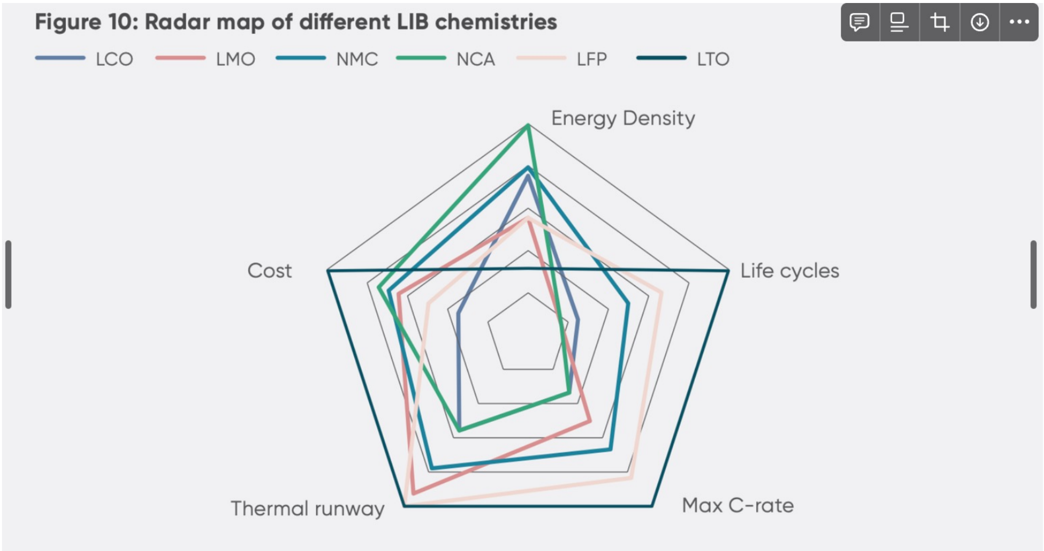
Battery tech is bound for disruption, and when new technologies emerge, they bring a sea change in terms of efficiency and improvements. At that point, it's most likely they will almost immediately replace the status quo. Here's a breakdown of **possible innovations** split into how long they will possibly emerge.

Each level indicates how easily it can transition to the status quo given safety, cycle life, current R&D

Level 1	Level 2	Level 3
Mature R&D | GTM 1-3 years	Developing | GTM 3-7 years	Nascent R&D | GTM 7-12 years
Li-Ion polymer uses a polymer instead of a liquid electrolyte **Silicon-Carbon Composite Anodes** currently anodes use graphite **Nano phosphate Technology** A safer type of LFP battery	**Silicon Anode Battery** complete shift from graphite anodes **Lithium Sulphur Batteries** emerging new chemistry of Li-S **Sodium Ion Batteries** use sodium instead of lithium to transfer energy	**Redox Flow Batteries** **Aluminum Air Batteries** **Solid State Batteries** solid electrolyte instead of liquid

Understanding Battery Tech

Lead Acid Batteries	1. Mature Technology 2. Low Cost	1. Heavy and bulky 2. Do not charge very well
Ni-Cad	1. Battery choice for small applications	1. Dangerous and environmentally hazardous
Ni-MH	1. Have been used widely in electronics	1. High cost of electronics 2. Long time to charge



The fourth category, which is lithium-ion, we have:
Lithium Cobalt Oxide (LCO)
Lithium Manganese Oxide(LMO)
Lithium Nickel Manganese(NMC)
Lithium Iron Phosphate(LFP)
There are 3 main metrics to compare batteries:

!

LFP and NMC lead the way for availability of raw materials, cost, life cycles and C-rate making it ideal for EVs and storage applications. Currently they are the ones that are most used in EVs and consumer applications.

Maximum C Rate
Highest rate at which battery can be charged and discharged

Energy Density
Energy that can be stored relative to its weight(Wh/kg)

Thermal Runway
Increase in temperature that leads to further degradation

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Radar maps are usually how different chemistries of Li-ion is compared on the 5 metrics of energy density, life cycle, cost, Mac C-rate, Thermal Runway and Cost. The closer it is to a particular edge, the better it is in that regard.

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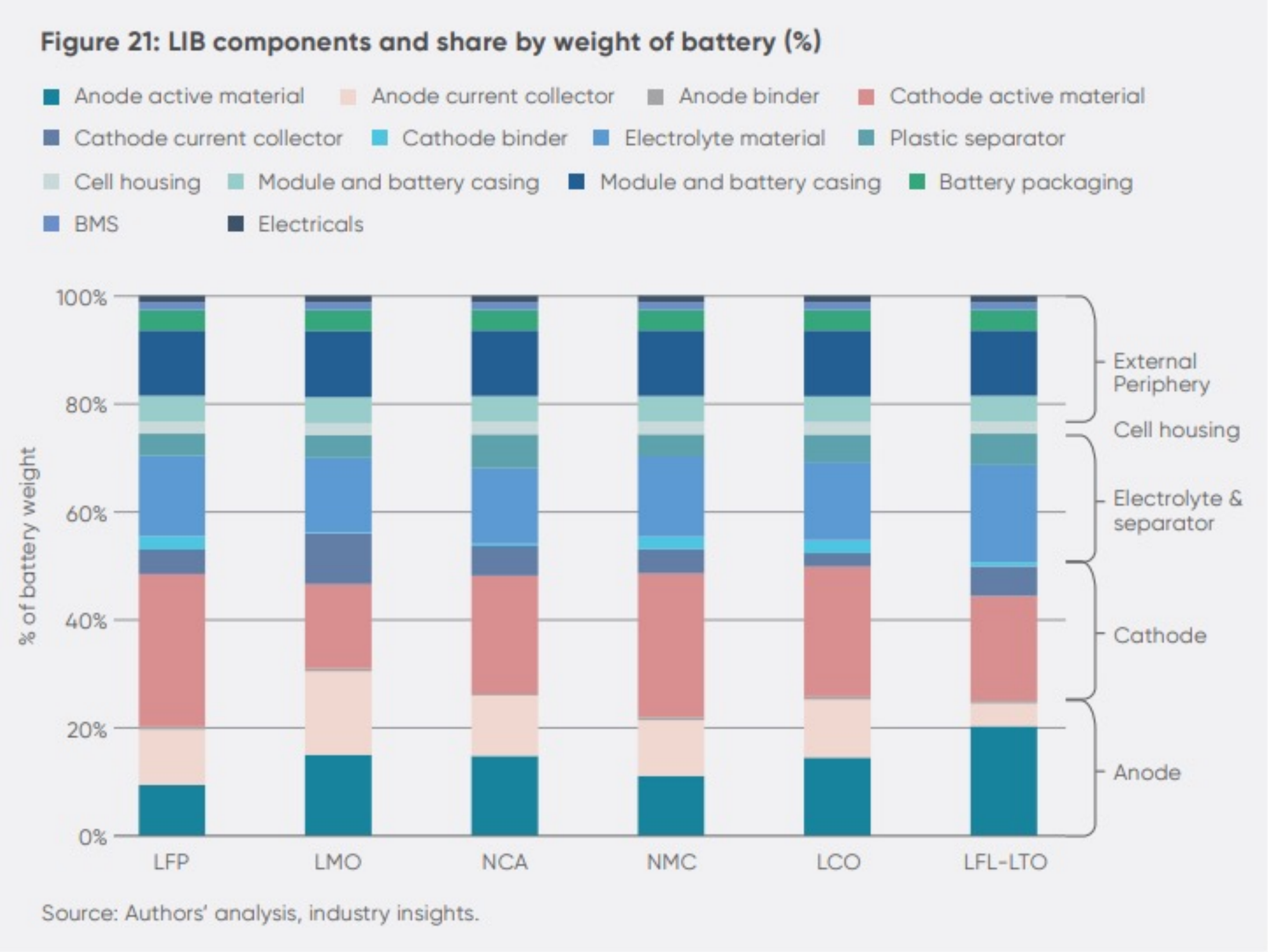
Finding opportunities in the battery components



These are all the components shown from a weight study, but it gives us a deeper dive into supply chains we can focus on. A lithium ion has 4 main components:

1. Cathode
2. Anode
3. Electrolyte
4. Separator

Each of these has sub-parts which will be further explained. We do not look at cell housing and periphery because they're rudimentary protection mechanisms with no scope for innovation

Finding opportunities in the value chain

Cathode

Sub-Sector	Comment	Companies
Cathode Active Material	The type of Li-ion chemistry is usually named after this(LFP)	Allox, Altmin
Conductive Agents	Conductive agents such as Super P Carbon/Super C-65 for efficient charge and discharge	Epsilon Carbon
Organic Solvent	Which is usually NMP (N-Methyl-2-Pyrrolidone) which is used to dissolve a binder that holds all active materials together to allow for compatibility with electrolyte	KCIL, Akshat Pure Chem Pvt Ltd, Chemex
Binder	Binder- usually polyvinylidene fluoride (PVDF)- it's a glue that holds everything together	

Anode

Sub Sector	Comments	Companies
Active Material	Natural, Artificial or silicon graphite	Epsilon Carbon
Conductive Agent	Same as Cathode	
Binder	Usually Carboxymethyl Cellulose(CMC) or Styrene Butadiene Rubber(SBR)	

Why there's a pretty big potential in Anodes? India is the second largest producer of graphite which is the key material for anode in LIBs. Battery- grade graphite is being imported from China. 25% of the bill of materials in a cell is from the anode and China controls 84% of the world's production. Further, anodes are usually cathode chemistry agnostic which makes them a reliant and safe bet. Main players remain Epsilon Carbon

Finding opportunities in the value chain

Electrolyte		
Sub-Sector	**Comment**	**Companies**
Main Material	LIFP6((Not to be confused with LFP)	GFL, Neogen, Tatva Chintan
Electrolyte Solvents	These are usually mixed with other solvents such as Ethylene Carbonate(EC), Diethyl Carbonate(DEC), Ethyl-Methyl Carbonate(EMC) or Dimethyl Carbonate(DMC) to reduce a risk of LIFP6 reacting.	Balaji Amines, Paushak, T Chintan, Vizag Chemicals

The last element is a **separator** between the cathode and anode. This separator is made of plastic and is of three types: (i) dry, (ii) coated and (iii) separated. The industry is dominated by players such as Daramic, Tora, Asahi Kasei. Indian manufacturers include Mod Plast, Sakshi Dyes and Chemicals, Poly Fluoro Ltd.

Final products are battery packs, and battery cells. Battery cells are individual units of electrolyte, anode and cathode, whereas battery pack is a collection of battery cells or modules along with a BMS, thermal management systems and casing.

Battery pack assembly

Amara Raja (Rev: 6,800 cr)
Exide (Rev: 15,200 cr)
Okaya Power Pvt Ltd (Rev: 1002 Cr)

Battery cell manufacturers

LG Energy (32 GW)
SK On (27 GW)
CATL (24 GW)
BYD (20 GW)

India does not have any battery cell manufacturers, but three companies have been awarded PLIs- Rajesh Exports (5 GWh), Ola Electric (20 GWh) and Reliance (5 GWh)

Battery Recycling

Current scenario

95% of the materials can be recovered from Li-Ion waste

50000 tons of battery waste is generated in India- bound to grow

90% of the world's batteries are produced in China

Why it would make sense to recycle

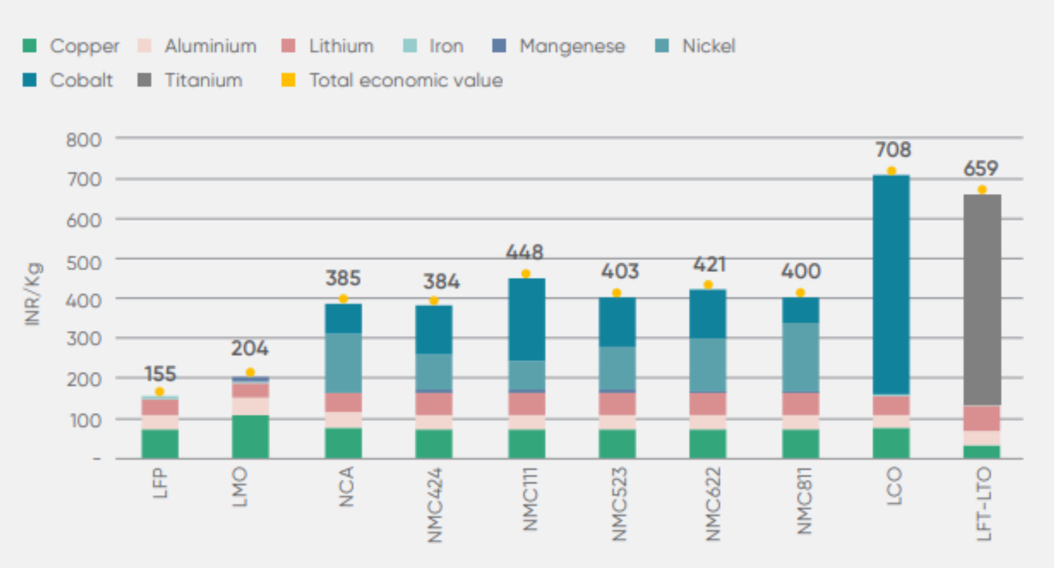
Limited resources

Self-dependency

Circularity

Not all battery recycling is the same. They differ in two main aspects: (a) type of battery that's recycled and (b) the method of recycling. There are 4 ways of recycling batteries

Figure 65: Economic value of recycling of different battery chemistries



Recycling Tech

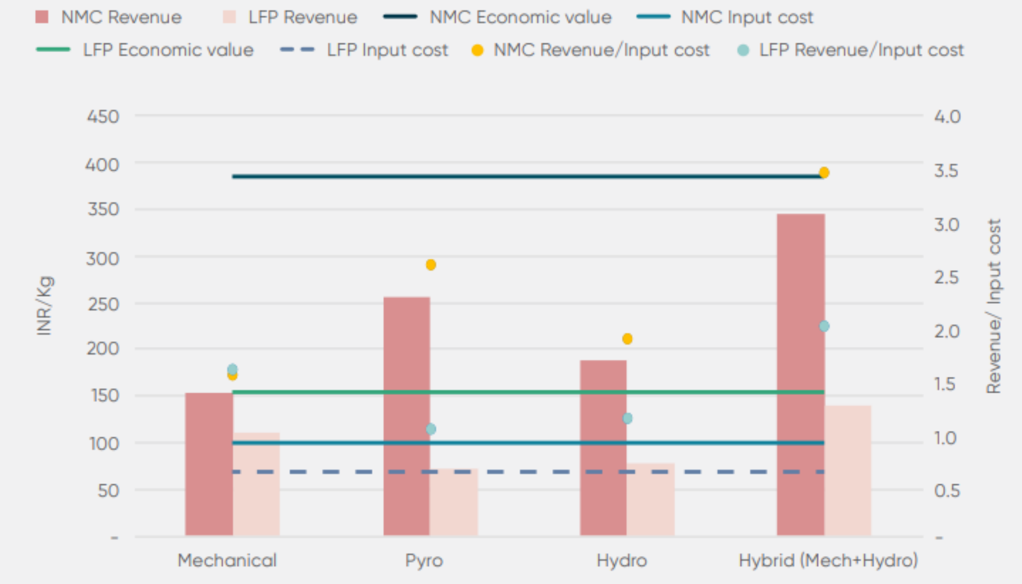
Pyro

Mechanical

Hydro

Hybrid

Figure 66: Comparison of recycling technologies



Source: NITI Aayog

Battery Recycling

Current scenario

95% of the materials can be recovered from Li-Ion waste	50000 tons of battery waste is generated in India- bound to grow	90% of the world's batteries are produced in China

Why it would make sense to recycle

- Limited resources
- Self-dependency
- Circularity

Not all battery recycling is the same. They differ in two main aspects: (a) type of battery that's recycled and (b) the method of recycling. There are 4 ways of recycling batteries

This graph explains the economic value of different chemistries. Although, LFT-LTO and LCO have the highest values, they're uncommon in the industry. **LFP has the least economic value, and is most widely used**

Recycling Tech

Pyro

Mechanical

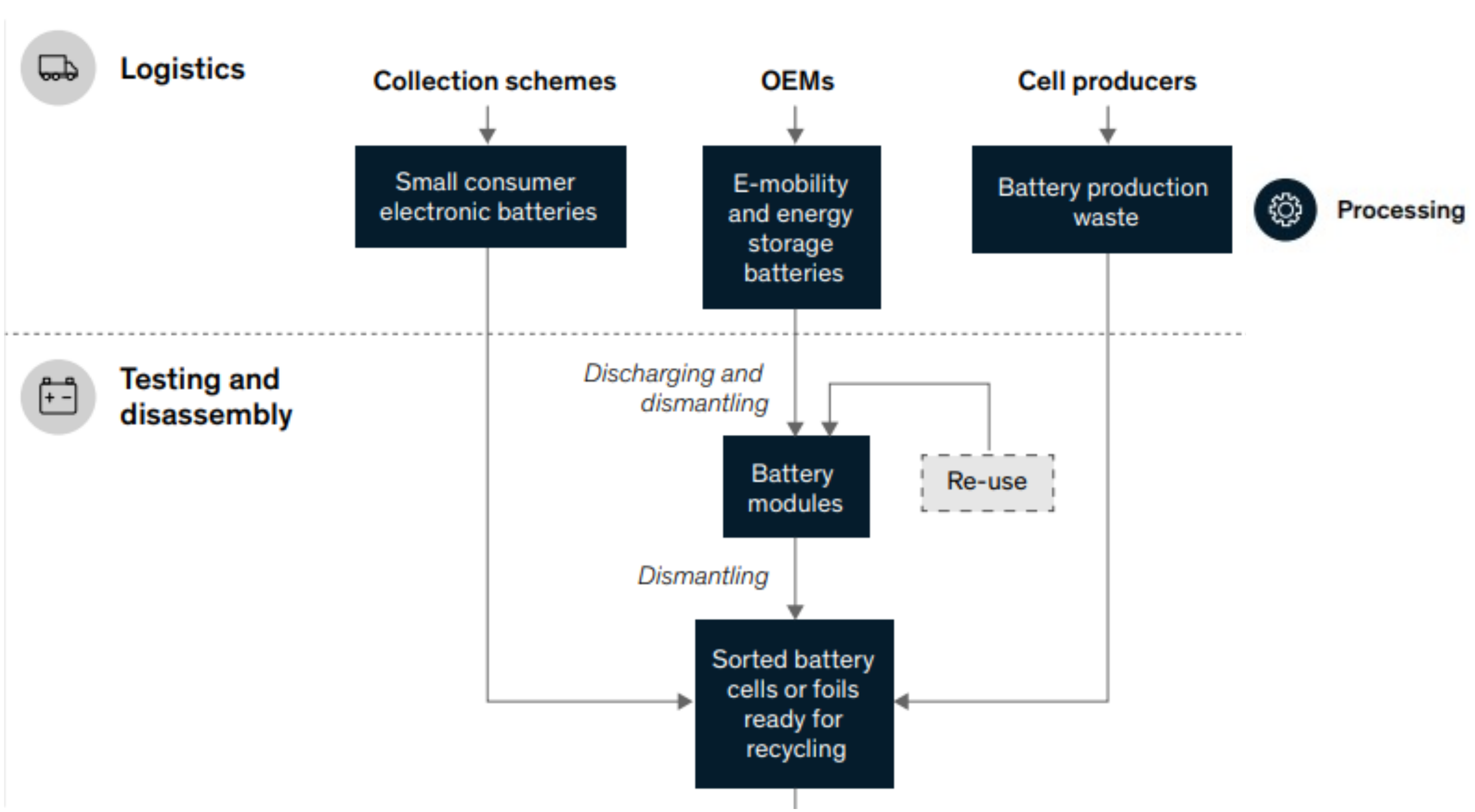
Hydro

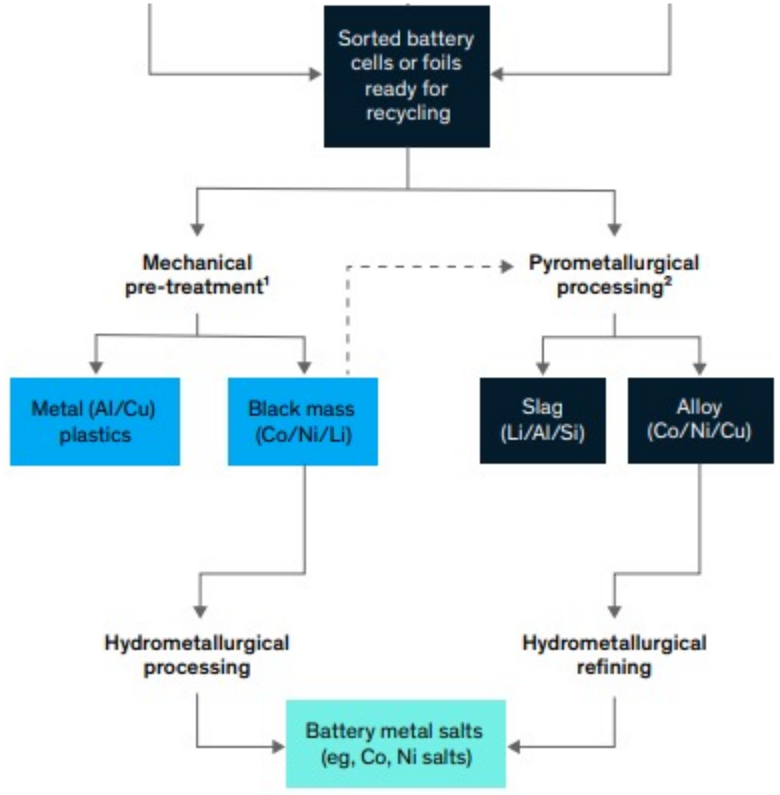
Hybrid

This shows the economic value using different techniques in recycling comparing the two main Li-ion chemistries- LFP and NCM

Source: NITI Aayog

Battery Recycling





Battery recycling has 4 main steps: (i) preparation, (ii) pre-treatment, (iii) pyro-metallurgy and (iv) hydrometallurgy. The four technologies- pyro, mechanical, hydro and hybrid can be seen after the sorting process. Hybrid involves different permutations of post treatment processes

However, all recycling isn't end to end and usually has the final process as Black Mass which is exported. There are new technologies emerging such as Direct recycling and hydro-to-cathode-active-material recycling (characteristics unknown)

Battery Recycling

For recyclers, chemistries like NMC, NCA, LCO and LTO are very attractive because they contain valuable metals like cobalt, nickel, titanium and lithium. Also, the supply of these resources is limited and concentrated in a few regions. Therefore, it makes more economic and business sense for them to focus on the extraction of these chemistries rather than LFP or LMO. This is one aspect of the value addition. The other aspect is what type of recycling methodology they use. A comparison shows that ***revenues from NMC with a Hybrid mechanism of recycling yield the most.*** *Attero uses Hybrid whereas BatX uses mechanical.*

Top recyclers in India

Name	***Capacity***	***Pipeline***
Attero	700	20000
BatX	5000	
Exigo	450	10000

Other startups: LOHUM, RUBAMIN

Recycling Tech

Pyro

Mechanical

Hydro

Hybrid

Potential Red Flags

1. There are very few *end- to-end* battery recyclers in India
2. Most of the times we export the black mass to countries in Europe
3. LFP does not have the most attractive economic value; and it will likely dominate in the future

Green Hydrogen

Remember the breakup of **carbon emitting sectors?** Iron, steel and industry contributed a very significant amount to that. Green hydrogen would be key in driving about 90% of the required reductions.

Electrification in buildings, industry and heavy transport → Powered by green hydrogen → Reduced emissions intensity and GHG emissions

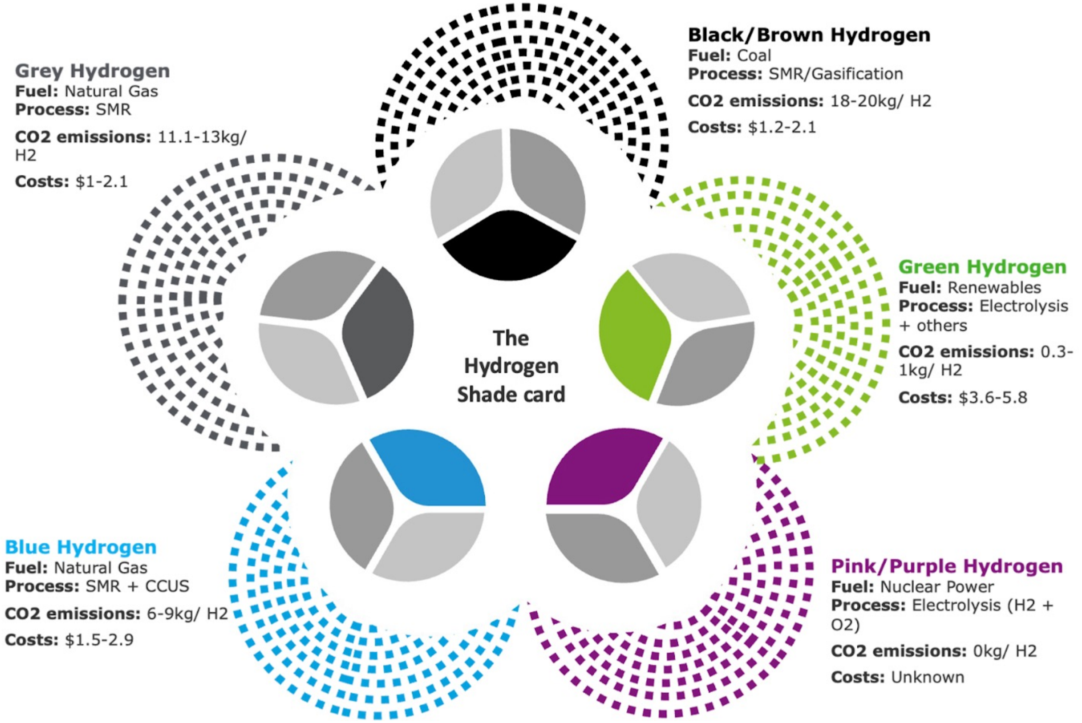
End-Use Sectors

- Power
- Freight
- Iron & Steel
- Cement

But not all hydrogen is made the same!

The gap existing in ESS

batteries and other systems alike can only provide energy for days, maybe weeks at max. However, some industries like the mentioned above **require an uninterrupted source** of energy over an elongated period of time. Consider running an Iron & Steel plant that requires temperatures north of 1500 degree celsius



Mapping the current SoA

Bigger conglomerates like Reliance and Adani are expected to end up owning **60-70% of the green value chain. ~$80-100bn+** investments announced in this space by veterans like Adani, Ambani and Tata in the upcoming decade

Veteran Domination

Electrolysers seem to be the fastest-growing production tech, which also invites huge capex commitments. We believe much of the electrolyser stack in the country **would again be owned by the veterans**

Spotlight on Electrolyser

India has 6 alkaline electrolyser manufacturers and a few PSUs manufacturing components, but domestic production of electrochemical stacks remains muted- India will need **~50 GW of electrolyser capacity (installed)** to achieve 5 mn tons of production target for green hydrogen by 2030

Growth of electrolyser

For MSEs- Red Flags

Very high entry capex, about 20 billion USD for a million ton of H2

Technical know how

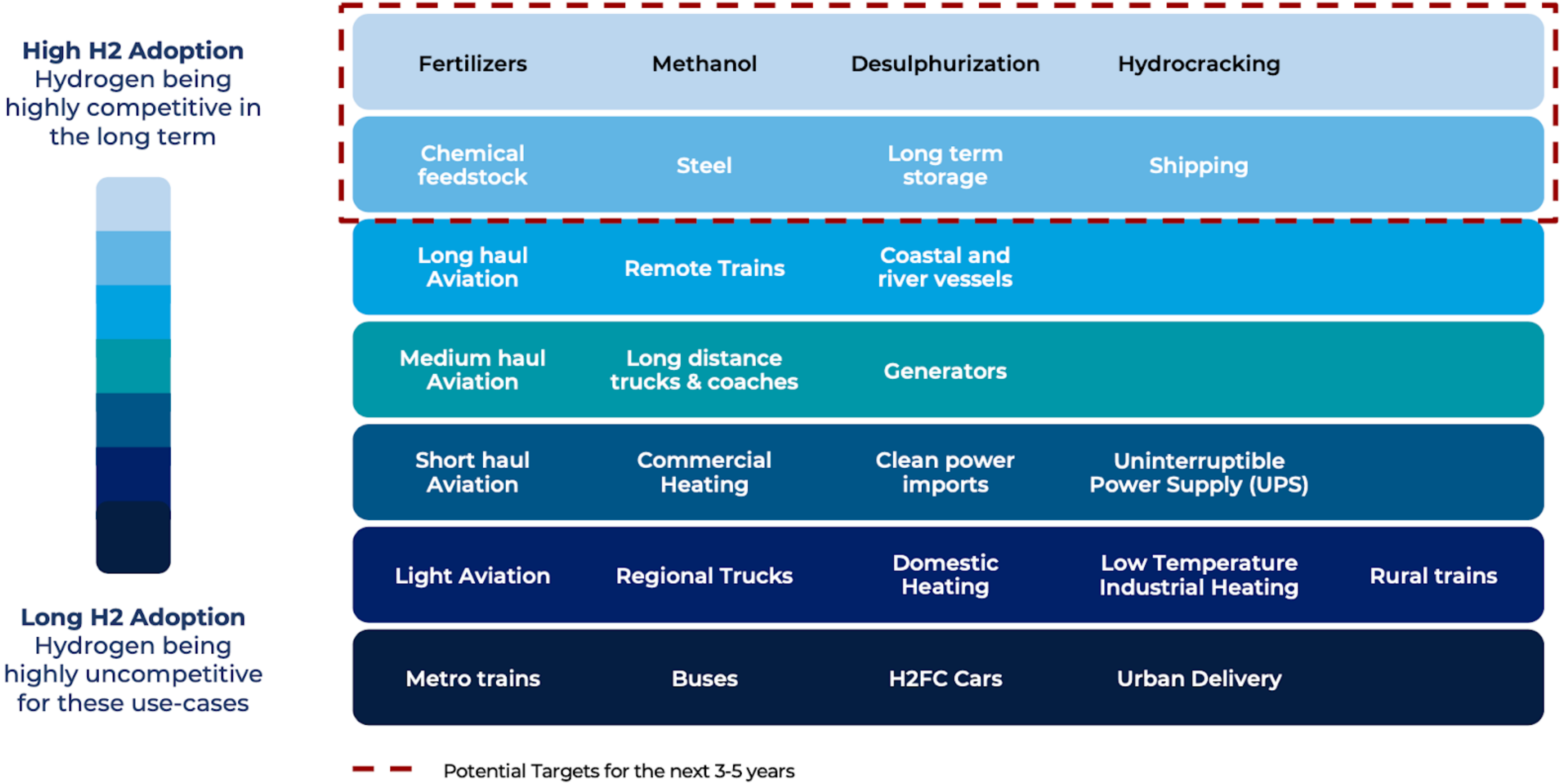
Existing RES to produce green H2

Electrolyzers	Newtrace, H2 Next
Electrolyzer Components	Sungreen, Vimano
BioMass	BioVikas
Biological H2	OSSUS
Fuel Cells- H2	H2C0, H2PRO

newtrace

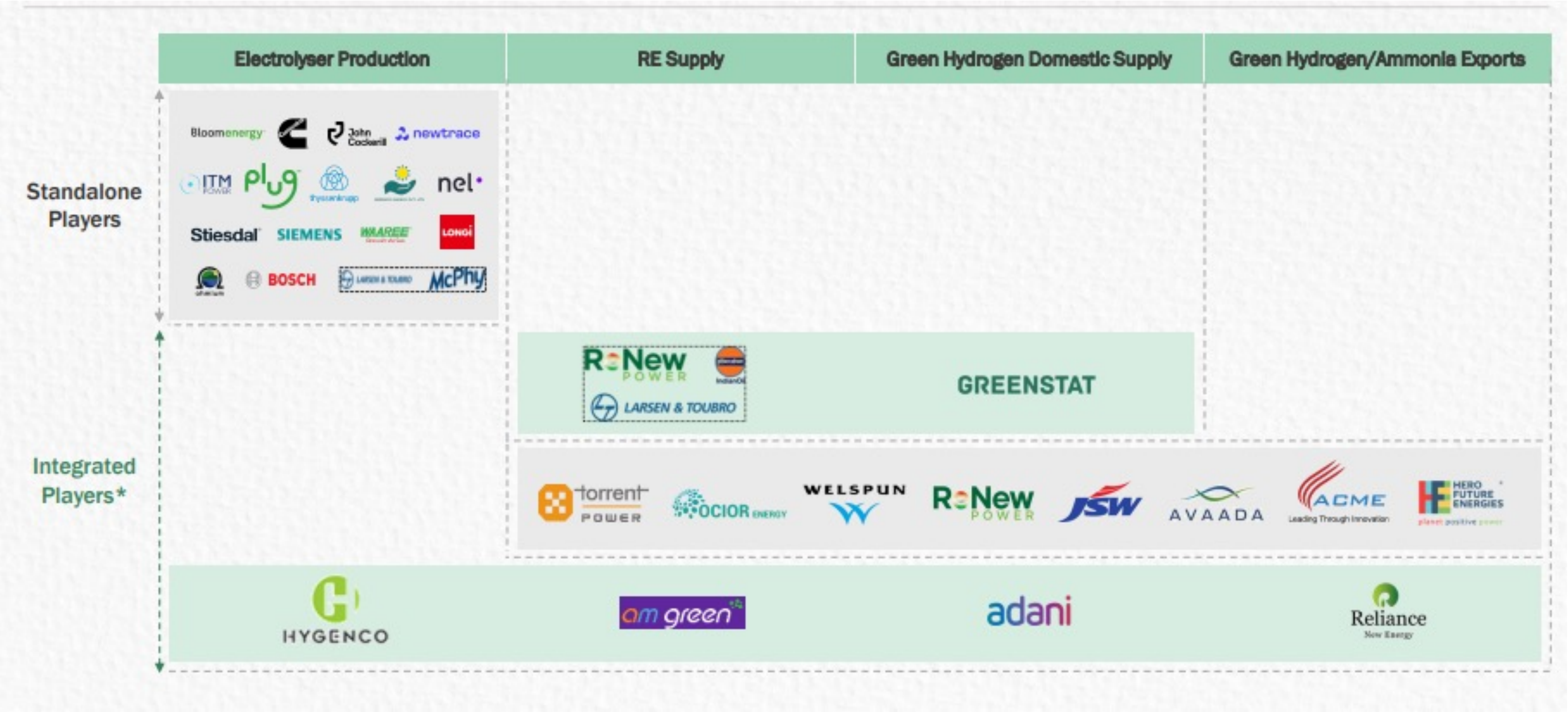
Newtrace is an electrolyser company with improved technology, better electrocatalyst and promises to reduce capex

Mapping the current SoA



Source: Blume Hydrogen BLUprint

Mapping the current SoA



The Case for Energy-as-a-Service(EaaS)

Benefits to Customers

- **Capex -> Opex**
- **Subscription models**
- **Guaranteed Savings**

Energy Advice	Asset Installation	Energy Management
Benchmarking and identifying the best practices	Setting up microgrids for RE, and ESS	Monitor and optimize energy use with IoT and AI

Enabler	*Comment*
Net-Zero/Decarbonization Pledge	Many MNCs have pledged to reduce emissions aligning with ESG values. Eventually, it shall involve a complete shift to renewable energy and materials, but the first step is to upgrade their energy mechanisms to be more efficient and suitable to work with RES
Government Push	With the introduction of the Energy Conservation Act(2022), there is a push towards energy efficient solutions geared for industries, buildings, agri and transportation
Cheapest way towards Decarbonisation	Even though the long-term goal is net-zero, the cheapest way to realize the pledge towards reducing emissions intensity by 2030.
It's actually cheaper	Apart from helping brands go green, energy efficient solutions do allow corporations to save significant amount and recover their RoI within a couple of years

The Case for Energy-as-a-Service(EaaS)

Energy Advice

This is usually more of a consulting exercise that need not be done very often. Recurring revenue models are hard to find here.

Asset Installation

Asset installation for industry/factories as well as for households. Revenue models could involve opex and financing

Energy Management

Use IoT and data analytics to save electricity and energy costs. Allows for savings-sharing revenue models with clients.

The EaaS market is a rather nascent and less-understood market in India. The government hasn't planned much in terms of energy efficiency and asset installation, but what can spurt its growth is the private sector's pledges to reduce emissions. The overall global market is estimated at USD 94.16 billion, and expected to grow at 12.48% for the next 5 years

GoI policies and intiatives

Energy Efficiency Act- promote energy efficiency and optimize demand

Perform Achieve and Trade energy intensive industries required to reduce energy consumption

17% of Total Power (2019)

Possible gains from energy efficiency- an untapped potential

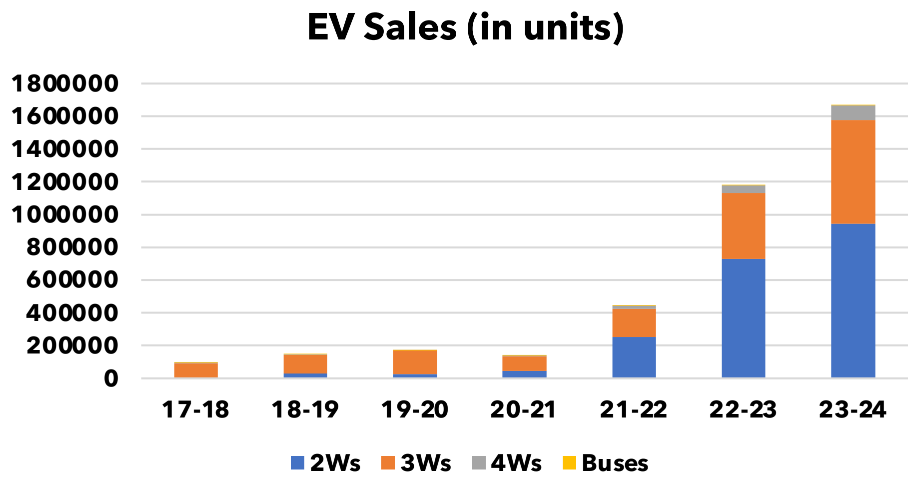
FOURTH PARTNER ENERGY

SHERU

SMART JOULES

Prescinto

Electric Mobility- Background



High growth

EV sales have increased at a 50% CAGR from 2018 to 2023. Yet, the penetration is 6.8% and the scope is high

Govt Support

NEMMP, FAME I & II as well as State policies aim to provide subsidies and create EV charging infrastructure

Are they cheaper- without subsidies?

Km/Day	***Tata Nexon Diesel***	***Tata Tigor- EV***
10km	39.13	45.1
20km	21.98	22.93
30km	16.26	15.54
40km	13.39	11.84
50km	11.69	9.63

Are EVs really cheaper? Background- this is the 10-year Total Cost (in Rs)/Km for various distances travelled per day- without subsidies

Corporates and OEM supply

Tata Motors- Net Zero by 2040 (PV) and 2045 (CV)
Hyundai- 100% EV by 2035
Mahindra & Maruti- Plans to launch new EV lineup
Kia- plans to launch 11 Evs

OEM Pledges

Ola and Uber- required to have 40% of fleets electric by 2030
Zomato/Swiggy/Amazon- pledge to add EVs to last mile delivery (eg- Zomato has committed 3 lakh EVs)

Corporate Pledges

Electric Mobility- Traction worldwide

For low distance users from 10-50km a day, EVs aren't that much cheaper, and would require you to drive at least 30-35 km a day for the economics to work. For cab drivers, however, driving about 200km a day is a lot more cost-effective with EVs; using the same measure the total cost/Km for 10 years comes to Rs 6.54 v/s Rs 2.96 favouring EVs even without subsidies.

Bloomberg, in there Global EV outlook for 2024 laid out their key findings in the global EV market, which would put some context to the outlook in India

Bloomberg's Global Outlook

Slower growth rate ahead	EV sales grew at an average rate of 61% in the last 3 years, but are expected to grow (globally) at an average rate of 21%
Tech can get a lot cheaper	In the last 10 years, lithium-ion battery packs fell by 81%, down to $189/kWh. And, with cheaper tech many new low-cost models shall arise
ICE has peaked	Sale of Internal Combusion Engine (ICE) peaked in 2017, and sales in 4 years would be 30% below the peak
India can grow	With the mix of better & cheaper tech and policies, India's EV segment is poised to triple in the next 3 years

Finding opportunities in EV- Service and Ancillaries

EV OEM markets have become **extremely saturated** in the last half-decade be it 2Ws, 3Ws or 4Ws. However, as companies shift to newer modes of transport, the **EV supply chain** is bound to benefit

Segment	Comment	Participation
Cell Manufacturing	High Competition from China | Veterans' presence	No key payers
Cell Assembly	Scope for Innovation	Log9, GODI
OEM	High R&D | Currently reliant on subsidies	Aether, Ola, Euler
Dealers	No moat creation	Local
Charging Point Operators	Mostly slow chargers currently | Opportunity to setup in India	EESL, Statiq, Electricpe
BMS	Allow for greater efficiency	Vecmocon, Exponent
Financing	Supported by GoI | Can emerge with fintech	Alt Mobility, Aerem
Mobility as a Service	Better understanding of TCO > More uptake	BluSmart, Shoffr, SnapE

EESL has 400+ chargers compared to Statiq which has over 1000. *Will EESL be a monopoly is the main question for private players* ?

Key industries that can see mid-market growth opportunities are in **assembly (particularly BMS and vehicle intelligence), charging point operators and mobility as a service**.

Battery Swapping & Mobility

<40km
Most routes are lesser in cities making it ideal

Battery Wt.
Increased weight, hence inconvenient

Lower TCO
With battery swapping > high adoption

Efficient
Small batteries can increase efficiency

The case for **battery swapping** is simple yet powerful. When customers switch from a capex model (on batteries) to a subscription service with swappable batteries, the economics are usually in their favour. Especially for commercial vehicles which have lesser downtime due to negligible charging time

What about mobility-as-a-service? Cab fleets are more likely to take up EVs as unit economics significantly improve. But business models for EVs are different to accommodate the high-capex hesitation from drivers. Hence, it's much harder for established platforms such as Ola and Uber to shift completely. It gives some gap for new EV focused companies to emerge

EV cab companies need to finance fleets. Shifting from driver-owned to self-owned models. This presents an opportunity for EV financing:

1. *Require Lease Financing*
2. *Financing companies have more data for better underwriting (Why?)*
3. *EV fleets have better margins*
4. *Allows predictable and safe(r) payback*

Green Finance and Fintech

Sub-Sector	Comment
Asset Financing	• RBI designated RE as a priority sector for lending in 2015. SIDBI now offers 100% financing for solar installations in MSMEs at 7-7.3% interest rates • India possesses a huge potential for RE and this benefits financing for battery storage and utility-scale hybrid • Renewable energy is easily divisible allowing for fractional ownership, and that opens up the space for fintechs
Carbon Tracking, Offsets and Trading	• The global carbon footprint management market is projected to grow by a CAGR of 10.3% from $9 billion in 2020 to reach $16.4 billion by 2027. • New-age startups have emerged across the globe to help individuals calculate, track, and reduce their carbon footprint, and offset the same by financing green projects. • The government has recently notified a draft framework for India's first carbon market, which includes the constitution of the National Steering Committee to govern the market's functioning.
Insurance and Risk Management	• This presents an opportunity for risk tech and insurtech firms to develop products and solutions that address volatility and facilitate a transition to net-zero emissions. Insurers can focus on three major areas: i) insuring the net-zero transition; ii) providing risk transfer solutions for rising physical risks; and iii) offering adaptation and resilience services.
ESG Reporting and Analytics	• Companies with environmentally friendly goals and stakeholders can boost credibility by better tracking ESG • SEBI introduced the BRSR framework for investors

Green Finance and Fintech

FinTech-enabled platforms, where the core technology has a Digital Finance component

Carbon Tracking, Offsets and Trading

Global

Pachama, eco.mio, reewild, SUSTAINCERT, Ecologi, KORA, carbonclick, vaayu, minimum, Doconomy, CREED, EcoCart, Carbon Chain, YAYZY, ecolytiq

Indian

varaha, CLIMETO, myplan8, LOW SOOT

Asset & Project Financing, Sustainable Investments

Global

bettervest, KYOTHERM, tulipshare, ethic., CLIM8, powerhive, ecoligo, eko, Toucan, ALTER 5, ETHO CAPITAL

Indian

alt. mobility, Neufin, AEREM, ecofy, RenewShare, Revfin, VIDYUT, TURNO, GRIP

Other data tracking platforms (Satellite, Carbon emissions, AI) which serve the Finance Industry (FinTechs, Banks, NBFCs etc.)

Climate Risk Management and InsurTech

Global

cervest, Kita, kWh analytics, sust, kettle, °CelsiusPro, FATHOM, Banyan, Apollo Agriculture, DEMEX, JUPITER, DESCARTES

Indian

Blue Sky Analytics, ambee, MISTEO, GRAMCOVER, Climate Connect Digital

ESG Data Reporting and Analytics

Global

ecovadis, Normative, YvesBlue, SINAI, clime, SUSTAINALYTICS, greenfi, Circulor, SATELLIGENCE, impaakt, PERSEFONI, CLARITY AI, TRUVALUE LABS

Indian

ESGDS, Sangti, accacia, nextj, sentra.world, carboledger, Smarter Dharma, PZC

Solid Waste Management

Waste management is critical for India to get right as it faces rapid urbanization and population growth. Apart from cementing the circular economy, it's crucial for better sanitation, public health and efficiency

A look at the process of waste management across municipalities in India

Municipal Solid Waste Generation

Collection and Transport

Transfer Station

Types of Waste

Organic	**Recyclables**	**Inert**
Composting Bio-Methanation	Gasification Incineration Pyrsolysis Reuse/Recycle	Landfilling Biomining

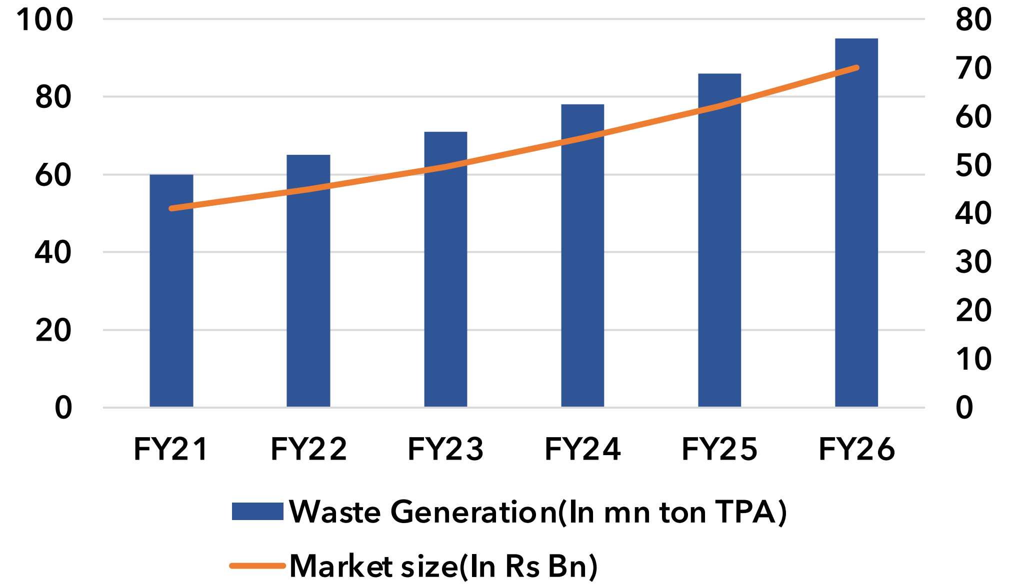
Types of processing

India generates 2 lakh tons of waste per day, of which **only 50% is processed** implying a significant opportunity for expanding waste generation. Apart from Municipal Solid Waste(MSW), industrial, e-waste and medical waste make a market which is half the size of MSW

Rs 35,000 Bn vs **Rs 45 Bn**

World *India*

India's extremely opportunistic **Waste Management industry**



Solid Waste Management | URBAN & ANTONY Case Study

Urban Enviro Waste Management(NSE: URBAN) and Antony Waste Handling(NSE: AWHCL) are micro-cap waste management companies. I found them to be interesting picks with strong fundamentals, tailwinds albeit with few prominent risks.

Business Operations

- Collection and Transportation
- MSW Processing
- Mechanized Sweeping
- Scrap/Recyclables Sales

Favorable Govt outlook? Yes

Govt is promulgating public-private partnerships in Waste Management 1

Swachh Bharat Mission to scale operations, along with Smart City Mission 2

WM solutions come under a priority for municipalities budget and responsibility 3

Some **key business characteristics;** Revenue is mainly driven by govt. contracts for districts or cities. These contracts last for 7-10 years. It's 100% BGP, which is the single biggest risk. Revenue is highly dependent on regulation.

Key risks involves:

1. Regulatory risks
2. Since it's govt based, receivables days tend to be high -> poor working capital
3. Publicly listed | PE firms' outlook towards such investments should be requestioned

Solid Waste Management | URBAN & ANTONY Case Study

Particulars	URBAN	ANTONY
Revenue from Operations (in Rs in crore)	39	856
EBITDA (In Rs Crore)	77.97	148.1
EBITDA Margin	19.9%	17.3%
Gross Profit (In Rs Crore)	35.6	709.1
Net Profit (In Rs Crore)	2.1	85
Net Profit Margin	5.51%	10%
Debt / Equity	3.84	0.5
Receivables (In Rs Crore)	6.2	232
Working Capital (In Rs Crore)	2.8	86

Last 5 years Sales Growth(CAGR): Antony 14% | URBAN 51%

A perfect segue into Biogas/Biofuel

Biogas is a renewable energy source which is obtained by breaking down organic matter such as plant & animal waste and food waste by microorganisms. Biogas contains 60% CH4 and 40% CO2 and is upgraded by removing CO2 to obtain biofuel.

A Kick Start for the Industry

Previously, biogas was used in the following way:

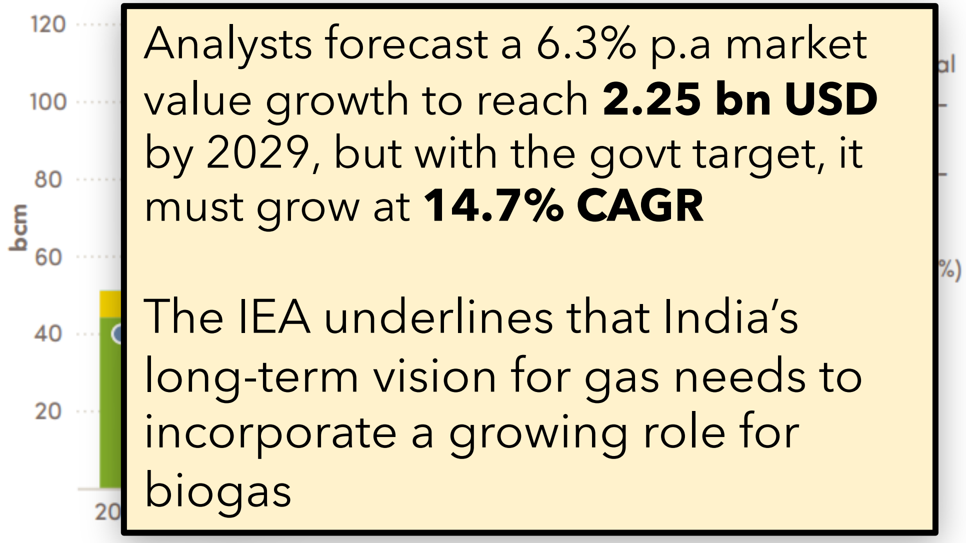
Biogas ⇒ Steam ⇒ Electricity

Unfortunately, it led to the following hurdles: **Expensive Electricity, Supply chain mismatches, and price hikes by farmers**

What eventually allowed to industry to start again was the emergence of biofuel which introduced a **viable business** in the industry

Potential for biomass

1. India is an agricultural powerhouse allowing for strong and independent supply chains
2. Readily available feedstock is enough to meet 9% of energy needs
3. GoI's goal to have 15% of the energy share under natural gas



Analysts forecast a 6.3% p.a market value growth to reach **2.25 bn USD** by 2029, but with the govt target, it must grow at **14.7% CAGR**

The IEA underlines that India's long-term vision for gas needs to incorporate a growing role for biogas

Feedstocks | Policies | Case Study

Feedstock	Comment
Crop and Process Residue	Crops, which would otherwise be burnt can now be valuable feedstock | Helps combat air pollution as well
Manure	India has the highest cattle herd in the world
Pressmud	Pressmud, which is a byproduct of sugar | India is the world's largest sugar producer
Municipal Solid Waste	**A perfect ancillary to biogas- 50% of MSW is organic waste**
Sewage	50% of sewage goes untreated, solving two problems at once

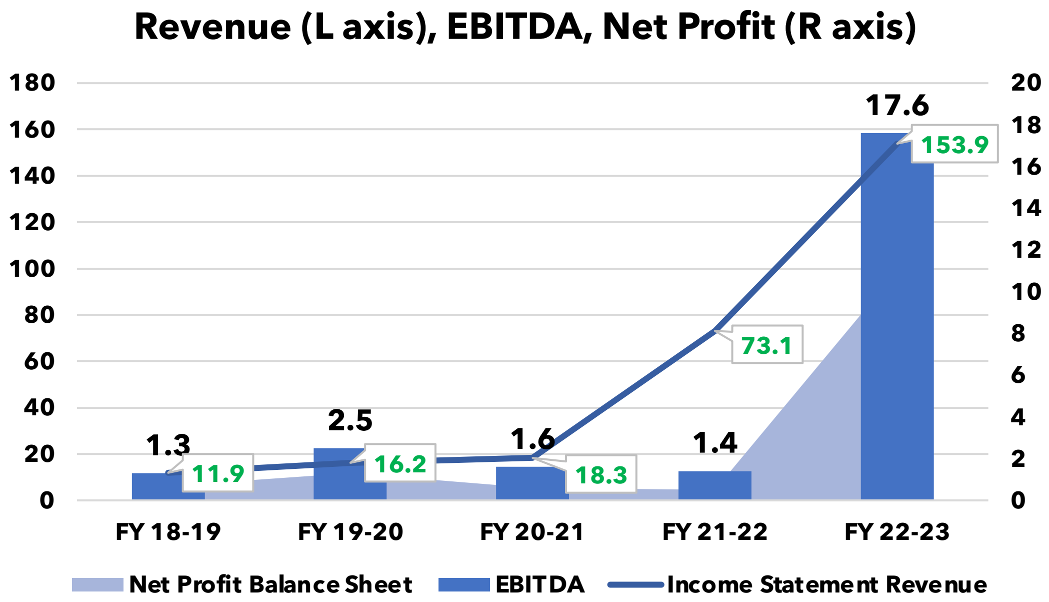
Policies and Initiatives in Support

1. Sustainable Alternative Towards Affordable Transportation (SATAT)
2. Ethanol blending goals
3. National Biogas Program and more

Biogas and Biofuel is one answer to a question company's have to answer: **energy transition,** and there is a **sweet spot of EaaS, waste management and biogas** as a business model. Companies which set up full-stack clean fuels for companies find themselves in a lucrative position.
GPS Renewables, Gruner Renewable Energy, Biezel Green, Swaraj Energy, Watamo, Praj Ind.

Feedstocks | *Policies* | Case Study- GPS Renewables

GPS Renewables is a Full Stack Clean Fuels Technology & Engineering company, specialising in RNG/CBG, 2G Ethanol, and Green Hydrogen. Our extensive expertise spans from special microbes to operating in-house design & engineering offices in India (Bangalore) and Germany (Stuttgart).



What do they do?

Biofuel Technology GPS has focused to create a moat and leverage their technology expertise in design, project engineering, IP development- all of which they use in their offerings

Project Execution Bespoke design, streamlined value chains, project maintenance and remote monitoring for clients that wish to incorporate clean fuels

Climate Infra Owner They own and manage large-scale biofuel plants

Specialised Biofuel products They also work towards SAF, bioCNG and biogas via equipment that focus on manufacturing of the same

Last year revenue : 154 cr Rs | Last Valuation: 36.2 mn $ | Cap Table includes: The Neev Fund, Triodos, Caspian

Coming to Sustainable Design- Chemicals

When we spoke about a top-down approach to circular economy, we had sustainable design as one of our sub-sectors. Sustainable alternatives to most design usually require looking at the chemicals they use. There are certain characteristics in the chemicals sector that set it apart.

Current Contribution

Currently, the global contribution of the chemicals industry is 6% to the CO_2 emissions. A third of these emissions are due to direct energy consumption and chemical transformation.

Pharma
Fertilisers
Plastics
Paints
Adhesives
Coatings
Electronics
Cleaning
Toiletry

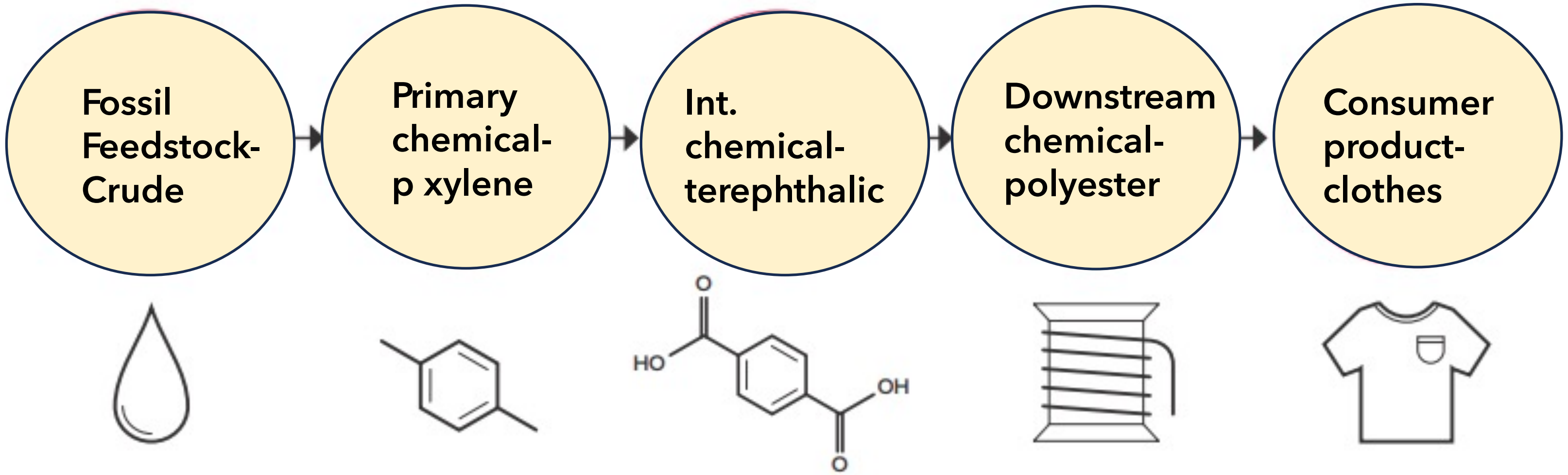
Solar Panels
Wind Turbines
Battery
Insulation

Can we decarbonize?

Most chemicals contain carbon-based structures, so we can't really decarbonize. We can however shift from fossil feedstocks to non fossil feedstocks- **defosillise**

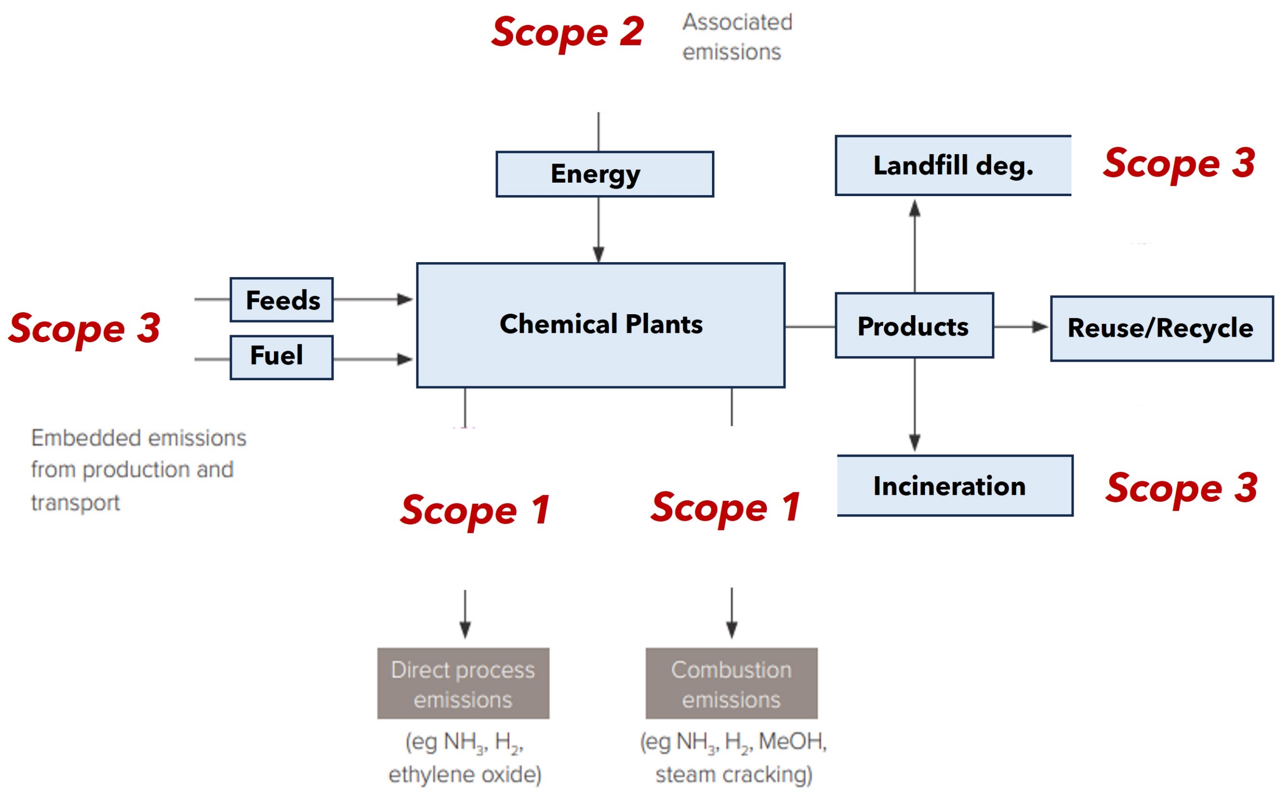
Two approaches

There are two ways to go- greener chemicals themselves, and greening the chemicals industry which is the first step- since the chemicals industry birthed from petrochemicals



Coming to Sustainable Design- Chemicals

There are three types of emissions when it comes to the chemicals sector- Scope 1, Scope 2 and Scope 3



Scope 1

Direct emissions associated with the processes involved in making the carbon-based chemical. This includes emissions related to the combustion of fossil fuels to produce energy as well as direct process emissions.

Scope 2

Upstream indirect emissions associated with purchased electricity for chemical conversion processes.

Scope 3

Indirect emissions associated with upstream and downstream processes. Upstream processes include the extraction and production of feedstocks. Downstream processes include product use and end-of-life disposal, such as degradation and incineration

Coming to Sustainable Design- Chemicals

Here, is a further understanding of where the emissions are concentrated in the chemicals industry.
Essentially, where do the emissions come from?

Energy Driven	Notably for energy intensive processes within the chemical industry such as steam cracking, reforming and gasification. Currently, it depends heavily on fuel
Fossil Feedstock	Chemicals that are petrochemical derived (which are most) are carbon-based by definition. Their respective manufacturing leads to GHG emissions
Base Chemicals	Emissions are also produced via feedstock production, base chemical and intermediate chemical production. Most emissions are through the production of base chemicals
Process Emissions	These produce greenhouse gases (GHG) as a byproduct of the chemical reaction. Examples could be methane reforming to produce ammonia for fertilisers emit significant amounts of CO2
Electricity and Heat	Electricity consumption represents 1/3rd of emissions in the chemical sector, and for some processes extreme amounts of heat (up to 800 degree Celsius) emit 25% of all GHG emissions

Coming to Sustainable Design- Chemicals

A non-exhaustive list from where chemicals are derived from

Feedstock/Fuels
Natural gas
Petroleum
Coal

Base Chemicals
Ammonia
Nitric acid
Methanol
Olefins
Ethylene
Propylene
Butadiene
Aromatics
Benzene
Toluene
Xylenes
Chlor-atkali
Chlorine
Sodium hydroxide
Sulfuric acid

Intermediates
PET
Polyethylene
Polyvinylchloride
Styrene
Acetone
phenol
Butanol
Ethylhexanot
Acrylonitrile
Polypropylene
MDI/TDI
Cyclohexane
Ethylene oxide
Propylene Oxide
Acrybc acid
Methacrylic acid
Acetic acid
Formaldehyde

Final products*
Specialty chemicals
Polymers. plastics
Industrial chemicals
Electronic chemicals
Adhesives/sealants
Cosmetics materials
Flavorings, fragrances
Food additives
Inks, dyes, printingchemicals
Packaged bottles, container
Paints. coatings, resins
Polymer additives
Life science chemicals
Surfactants, cleaningagents
Construction chemicals
Agrochemicals
Pharmaceutical drugs
Water treatment chemicals

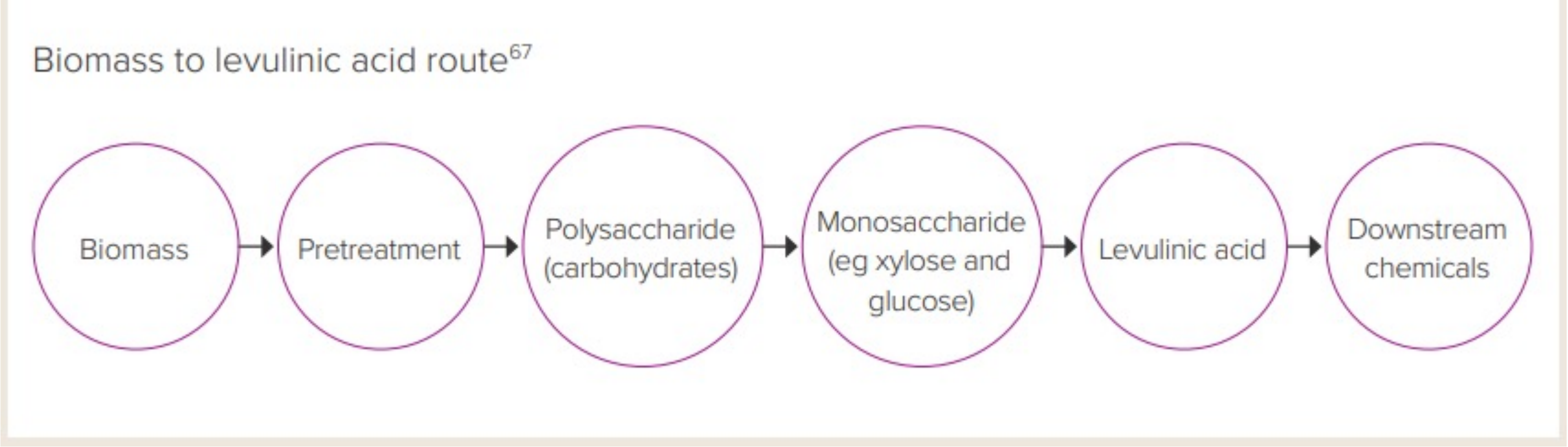
Coming to Sustainable Design- Chemicals

Road to Decarbonisation

Short term	Medium term	Long term

Decarbonization technologies	Application	Scope	Development stage§	Disruptive level	Estimated cost	Impact
Energy efficiency	All processes	All processes	Adoption	Low	Low	Embedded in interim CO2 reduction targets at reasonable cost ≈ one third of total footprint
Electric power	Renewables sourcing*	All processes	Demonstration	Low	Moderate	
	Electrification	Non-intensive processes	Demonstration	Moderate	Moderate	
		Steamcracking	R&D	High	High	Unlikely to achieve net zero on olefins
Low carbon fuel/feedstock	Blue hydrogen > Ammonia	Steam reforming	Demonstration	Moderate	Moderate	Potential 70% reduction CO2 on ammonia (fertilizers)
	Green hydrogen* > Ammonia		R&D	High	High	Potential 90% reduction CO2 on ammonia (fertilizers)
	Hydrogen* as fuel	Steamcracking	R&D	Moderate	Moderate	Potential 75%-80% CO2 reduction on ethylene (olefin)
	Hydrogen* + CO2 > methanol-to-olefins		R&D	High	High	Potential net zero with CO2 management infrastructure
Carbon capture	CCUS	Steamcracking and reforming	Demonstration	Moderate	High	Likely in conjunction with CO2 management infrastructure

Coming to Sustainable Design- Chemicals



Example of how low-carbon feedstock can result in upstream chemicals which is used widely in polymers, electronics, solvents and fuel. It's commercially viable and being produced via biomass. Focus areas for green chemicals should be **energy efficiency, alternative feedstocks, carbon capture technologies, renewable power generaton.**

There is a little more to carbon capture. Carbon Capture and Utilisation(CCU) involves capturing CO2 from point sources such as steel and cement industries. Apart from negating GHG, it also creates a feedstock for carbon-based chemicals such as urea, methanol, carbonates and polymers which already use CO2. The potential chemistries to convert CO2 into chemicals are almost all catalytic processes and often require both vast energy input and other chemicals to work.

Chemicals and Sustainable Manufacturing

Green chemicals, or chemicals which are alternatives to petrochemicals open up opportunities for various segments to go green. There are various incentives and outcomes for such markets: (i) government regulations to end single-use waste products (ii) global MNCs pledging to go green and use sustainable alternatives (iii) increased consumer awareness in the high-income strata (India 1)

Sustainable Packaging

Packaging is the 5th largest sector in the Indian economy and has grown by 26.7% CAGR in the last 5 years. GoI and FSSAI have promoted it via their waste management and Extended Producer Responsibility

BAMBREW

BOLLANT where everyone counts

BARE necessities

Fibmold

EnviGreen A Tribute to Mother Earth

Sustainable Clothes

Set to be a 9 billion $ by 2026 (BCG), and organic cotton 6 billion supported by increasing consumer willingness and shift to less water consuming materials (bamboo, hemp, organic cotton)

no nasties + PLANET POSITIVE CLOTHING

COTTONWORLD

Organic Farming and Agriculture

Market set to reach 2.6 billion $ by 2026, getting a push from environmental and consumer concerns. Involves bio-fertilizer and farming practices that don't compromise the output quality.

Simply fresh PREMIUM GREENHOUSE PRODUCE

TWO BROTHERS ORGANIC FARMS

absolute

IPL Biologicals 30+ Years of trust

Barrix One for everyone

Industry Experts and their views

Prabhakar Sharma Amplus Solar | NIT | Battery tech and storage	**Akshay Gattu** TERI | Pmanifold | Climate and Energy

JMK Research and IEEFA
Energy Storage and Power in India

Prabhakar was optimistic on rooftop solar opportunities in India, and services allied with it such as installation, financing and maintenance. There was an evident supply crunch as per his understanding. Displayed caution in stationery storage for an MSE opportunity due to the govt driven tendering procedure- which had no presence of small companies (ReNew, Greenko). Battery storage technologies he looked out for were Na-Ion being a possible replacement for PHS

NITI Aayog and PWC
ACC Battery Reuse and Recycling

Akshay's research covers most sub-sectors in the climate and energy theme. He emphasized the scale of battery waste that would emerge given the astounding adoption of EVs and other battery tech. A little about the battery recycling landscape: Attero having proprietary technology and end-to-end recycling, Lohum's reusing capability and BatX's collection moats.

Recommended conferences held by CES (Customized energy Solution)

Industry Experts and their views

Rakind Gupta IIM Shillong | Bain and Company	**Mudit Narain** NITI Aayog | Atal Innovation | MIT (Boston)

Bain and Company and WEF
Roadmap for Green H2 in India

Rakind shed light on the differences of batteries and green hydrogen- and that they're not competitors. Batteries and green h2 have different focus areas- transport and industry accordingly. India has an opportunity, and is currently exporting green h2, but capex costs for power producers remain extremely high. MSE opportunities can be found in technologies for solutions rather than scale. And this space is concentrated in electrolysers

Blume VC
Hydrogen, Battery, Climate and VC

Blume's portfolio has been focusing on climate tech and deep tech much before the recent trend in the same. Mudit has played a key role in researching the sector and finding companies. Mudit was bulling on mitigation processes in the evolving climate space- especially energy efficiency and HVAC tech. He found the most value in startups that leverage tech moats. Some moat creation areas- electrolysis & storage (green h2), chemistries, geometry, process (battery). He mentioned his interest in tech wrapped around service (Smart Joules)

Industry Experts and their views

Shantanu Srivastava
CFA | ESG and Sustainable Finance

IEEFA
Emerging Investment Opportunities in Energy

IIEFA's report was useful in providing a bird's eye view of the upcoming themes under climate tech. Shantanu expanded on the same and proposed EPC to have massive opportunity. Energy markets are an untapped and promising avenue (such as IEX). With traction towards ESCOs and EaaS, Shantanu found funding ESCO projects to have an opportunity as their clients do not fund the projects.

Startups mentioned: Sheru, FDRE, Indigrid Tech

Vineet Jain and Preetesh Singh
ISB | Nomura Research- Auto Head

Nomura Research
India's Opportunity in Battery Swapping

Vineet heads the automotive segment at Nomura research and shared his thoughts on NRI's views on the battery swapping opportunity in India. His optimism on the sector was towards B2B opportunities for fleet operators. Vineet was also convinced of a customer play in the long shot after seeing the success in Taiwan with Gogoro.

Startups mentioned: Sun Mobility, Yulu, Rubamin, Lohum, Attero

Industry Experts and their views

Manas Majumdar
IIM Calcutta | Partner at KPMG

KPMG
Green Chemicals in Inda

Manas has had 7 years of experience in Oil & Gas in India. Subsectors within green chemicals: green fuel, green services (which he thought was an interesting play- recycling and waste mgmt.), technology for chemicals, B2B supply chains. He noticed a trend wherein established players are remolding themselves for greener value chains within biochemicals (personal care, textile, home and appliances, detergents and fertilisers). Battery and green h2 involve more materials than chemicals and the latter was a white-space with little production

Narasimhan Santhanam
IIT M, IIT C | Director and Founder- EAI

Energy Alternatives India
India's first Energy Consulting company

NS is the director and founder of EAI- India's first climate and energy focused research and consulting company. He gave his thoughts on various industries- greener alternatives to chemicals, efficiency and non-core inputs of chemical industries, specialty chemicals in India; NS was most excited about the second opportunity examples of which are shifting from coal to biomass and improving heating/cooling efficiency. India, finds itself perfect in the China+1 opportunity for specialty chemicals- mid priced and decent tech stack.

VCs | Organisations | Research Orgs in the space

List of VCs, incubators, research institutes in India who are prominently in the climate tech/sustainability space and have done noteworthy work. For VCs, also listing down their marquee companies

The Sustainability Mafia

The SusMafia is an organization which connects companies and climate focused individuals. They allow them to share resources, access investment and business opportunities. They've had some really good startups in their community- and aren't necessarily early stage but have also reached growth and profitability, even some very established players. By joining the "Investado" initiative you will, as an investor have access to high-potential climate startups

Some marquee "mafias"

zerocircle

proklean
CLEANER HOMES, GREENER PLANET

String Bio

SMART JOULES

Access to high potential start-ups

Events and webinars with industry experts

Have an "Investado" initiative just for investors

VCs | Organisations | Research Orgs in the space

RMI
ENERGY. TRANSFORMED.

The Rocky Mountain Institute, or RMI has an Indian arm primarily focused on research and working with GoI. While they don't have any platforms to connect/mention companies in energy tech/sustainability, their reports are useful in industry insights in understanding trends and policies. Some interesting reads:

Distributed Solar

EV Charging Infra

Green Logistics

Green Hydrogen

Some startups, such as Sheru, have also partnered with RMI. As an energy focused institute, their contacts can be valuable

THIRD DERIVATIVE™

Third derivative was founded by RMI and New energy nexus in 2010. They have a vast network of industry stalwarts, research institutes and investors. Some of their startups (India) and companies include: Ace Green Recycling (battery recycling), Alt Mobility (EV financing). They have investors such as Shell, BP, Microsoft, Avaana. Also publish research and insights. Newsletters are informative to understand the global sustainability startup ecosystem.

ACE Green

alt. mobility

VCs | Organisations | Research Orgs in the space

BLUME

https://blume.vc is one of India's first VCs to focus on climate tech and allied, even before the thematic started gaining traction. They've had a track record of companies leveraging technology and creating actual moats. We spoke with Mudit who leads climate tech at Blume. Apart from their investments, they also have in-depth industry reports and newsletters that help in keeping up. Have referred to some of their research in this presentation.

Name	**Description**	**Valuation**	**Revenue**
Aerem	One stop solution for solar installation, loans and management	Rs 140 cr (FY23)	Rs 2.14 Cr (FY23)
Ati Motors	All electric cargo vehicles for transporting in factories	Rs 86.4 Cr (FY23)	Rs 0.187 cr (FY23)
Bambrew	Sustainable packaging	Rs 118.69 Cr (FY24)	Rs 44.32 Cr (FY23)

VCs | Organisations | Research Orgs in the space

Name	Description	Valuation	Revenue
Battery Smart	India's largest network of battery swapping stations for 2Ws/3Ws	Rs 2976 Cr (FY24)	Rs 63.6 Cr (FY23)
Carbon Clean	Carbon capture technology for hard-to-abate industries	Rs 4755 Cr (FY23)	NA
Cashify	Second-hand market for phones enabling reuse	Rs 2058 Cr (FY22)	Rs 825 Cr (FY23)
ElectricPe	Battery charging platform	Rs 85.49 Cr (FY21)	Rs 0.67 Cr (FY23)
Euler Motors	Electric 3Ws	Rs 792.65 Cr (FY24)	Rs 65.5 Cr (FY23)
Vecmocon	BMS and Battery OS	Rs 161.85 Cr (FY22)	Rs 5.03 Cr (FY23)
Yulu	Electric scooter and micro-mobility	Rs 1743 Cr (FY24)	Rs 46.6 Cr (FY23)

Where else can we look for companies?

The cleantech group holds an event known as **APAC Cleantech 25** (also 50 and 100). The aim of this event is to explore and research the Asian-Pacific cleantech/environment tech industry and curate a list of 25 startups that they believe have the potential to impact the ecosystem in the next 5-10 years. Also gives valuable insights regarding VC/PE and where the industry is focusing in funding. Although it covers Asia/pacific, you usually have few startups and companies in the Indian market

Indian companies that featured in APAC Cleantech 25 (2024)

Exponent, Varaha, Probus, Edgedrid, Sheru, Canvaloop, Alt.M

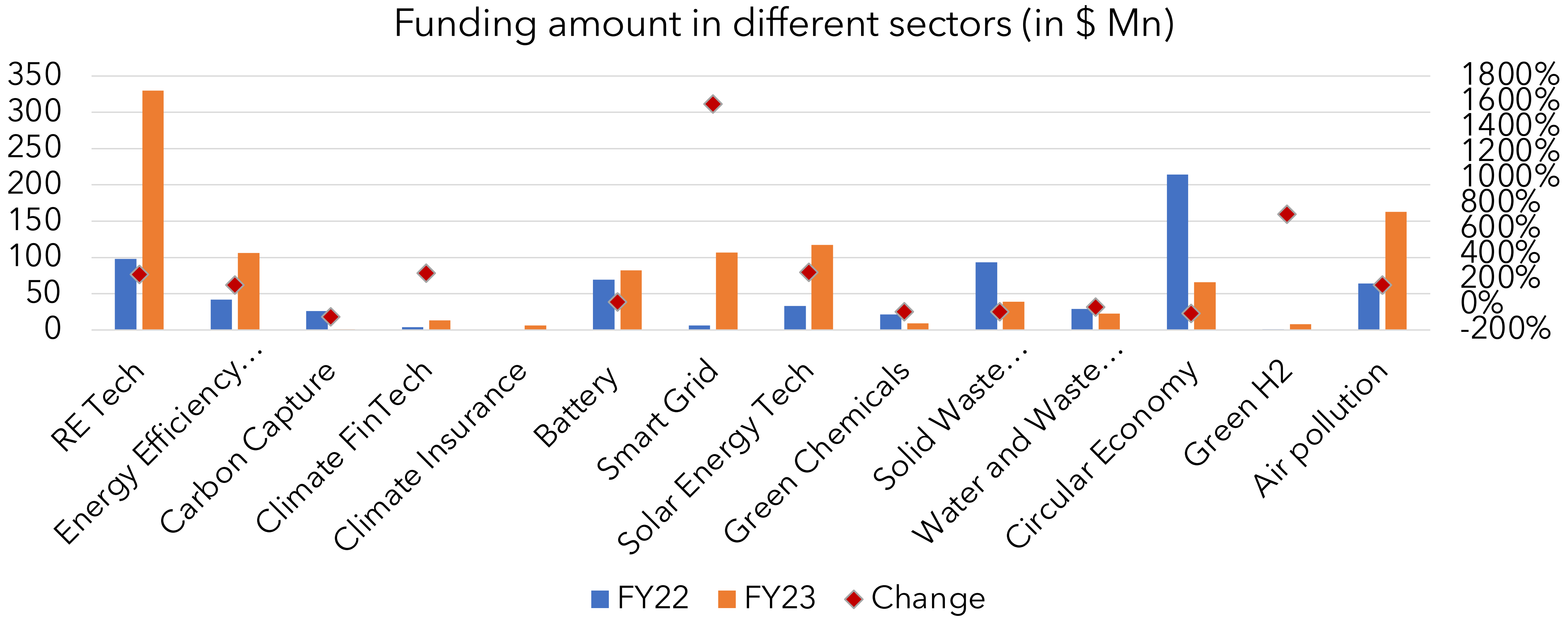
Not India focused | Ion energy labs, Sheru, Statiq Mobility, Sheru, Stepchange

JSP Enviro, Strawcture, Saaf, Canvaloop

Private Equity Funds with a strong presence: Anicut Capital, Baring PE, British International Investment, Forum Synergies, Chattisgarh Investments, Neev Fund, Temasek,

Where the money flows

A look at total funding amount across various sectors in environment tech, and YoY change. Note: list is not exhaustive



What did the Budget say on Tuesday?

Most of the details regarding renewable energy, climate and sustainability that was presented in the budget will be revealed in the finer details, however there are some announcements that would benefit the industry. Here is a list of some of them, and their impact

Import Duties on Minerals

The FM announced waiving of import duties on certain critical minerals including lithium (of which basic duty was previously 15%). This will help reduce the cost of batteries, which is the largest cost component in an EV. Will also help battery cell manufacturing in India.

Energy Transition Policy

Nothing concrete yet, but the FM plans to announce a policy regarding the energy transition focusing on three areas- availability, affordability and sustainability.

Regarding EV costs

The budget announced a reduction in the allocation for FAME (Faster Adoption of Manufacturing of EV) by 44% to Rs 2,671 cr. However, they increased the PLI benefits to auto manufacturers by 6.5 times (Rs 3500 cr for FY25)

The announcements had one main theme: shifting benefits from consumers to manufacturers hoping they will trickle down. Some expectations do remain amongst industry leaders- mainly the continuation of FAME and keeping the GST on EVs at 5%