Pukka Partners

Carbon Capture and Storage

Executive Summary Report

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Report

PREPARED BY

Pukka Partners

ABOUT PUKKA PARTNERS

Pukka Partners provide customized intelligence solutions to C-suite executives and functional growth leaders, with sound expertise in business research, strategy consulting, advisory, business intelligence, and data analytics.

We offer advisory and actionable insights around public policies, investment tracking along with the obstacles faced by investors, innovation and strategy impact monitoring, identification of industry potential, and technology mapping through comprehensive and standardized research methodology and tools.

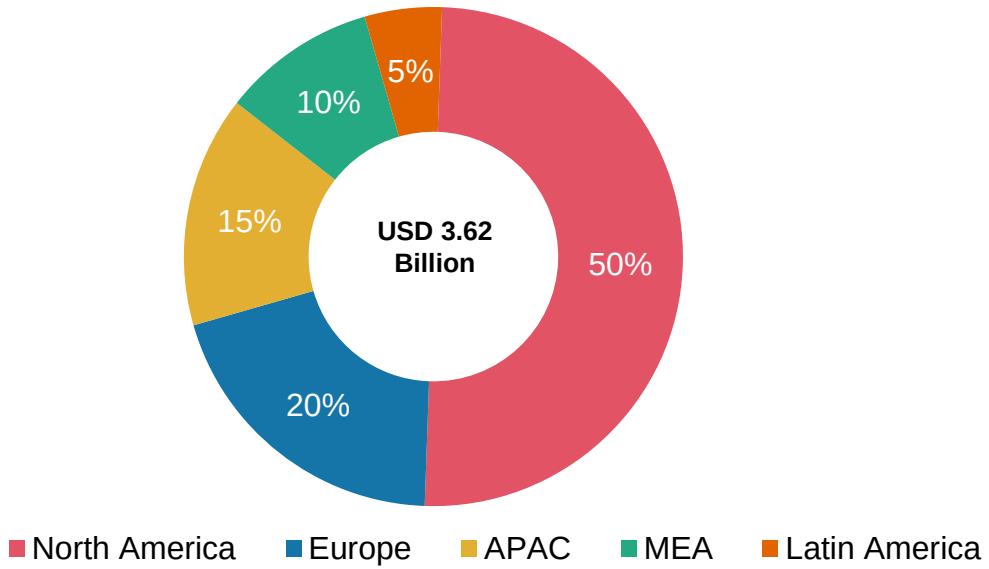
We deploy our solutions to solve prioritized and critical business challenges by leveraging our in-house expertise as well as continuous engagement with industry thought leaders in the business ecosystem.

In a short span of time, our consultants have had the opportunity to engage and deliver domain & sector specific tailor-made strategic projects to top executives and functional growth leaders, empowering them to make informed business decisions.

Our success is directly linked to our client's growth, and we ensure to exceed it every time we engage with our existing clients and future prospects. We aim to be a knowledge partner for our customers and gradually become their trusted intelligence provider.

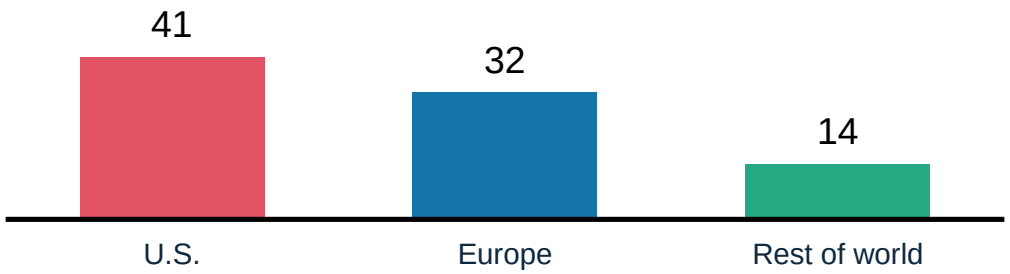
Carbon Capture – Global Market Overview

Market Size, 2020 (in USD)

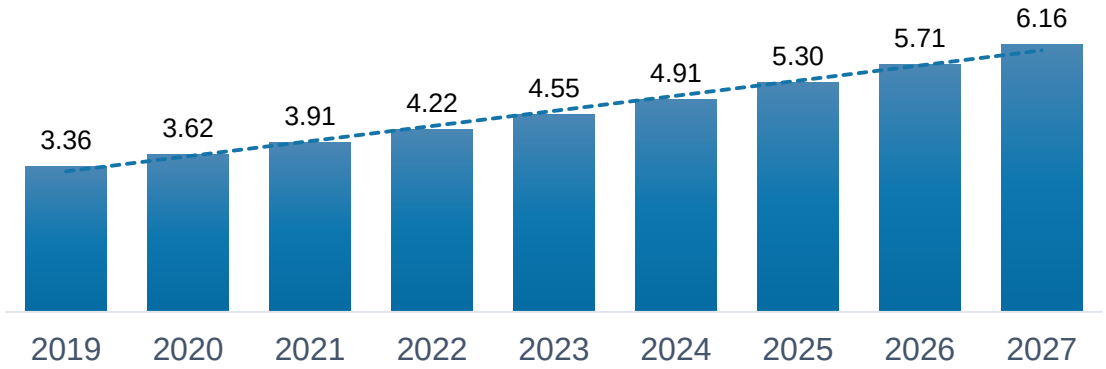


- Carbon Capture and Storage (CCS) Market was valued at USD 3.62 billion in 2020 and is projected to reach USD 6.16 billion by 2027, growing at a CAGR of ~8%.
- North America has the largest CCS market owing to the presence of multiple large-scale CCS facilities in the US and Canada (38 Large CCS facility projects)
- CO2 emissions worldwide is 36.44bn Mt, CO2 Capture capacity worldwide is 38.5m mt and number of Operational CCS facilities are 28.
- Europe is fastest growing market owing to the upcoming Carbon capture and storage projects in UK and Netherlands.
- The current line-up of carbon capture and sequestration projects in APAC is expected to create an immense opportunity for the companies operating in the CCS ecosystem.

Potential Investment in CCUS between 2020-30 (USD Billion)



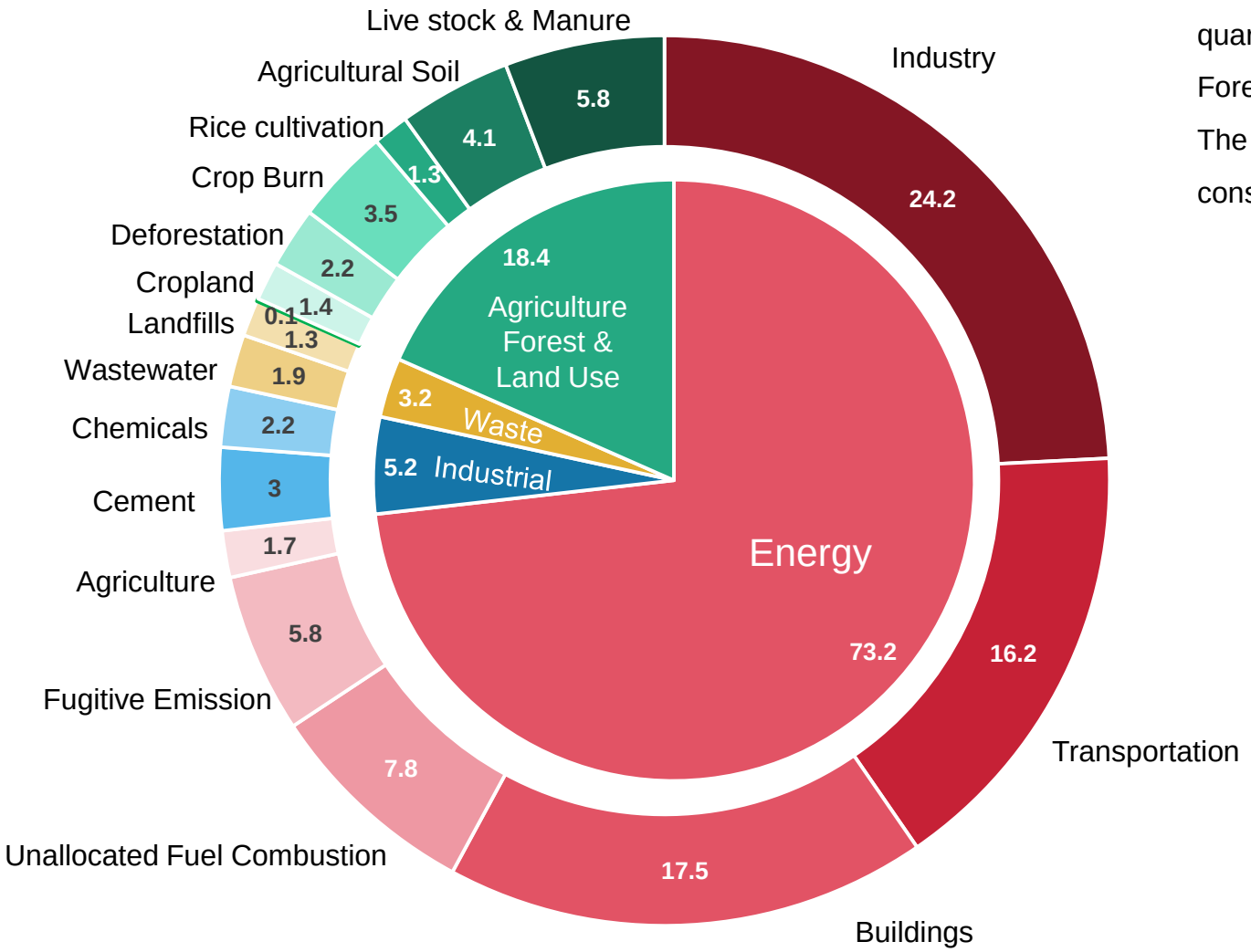
Market Size & Forecast, 2021-2027 (USD Billion



CCUS – Carbon Capture, utilization and storage

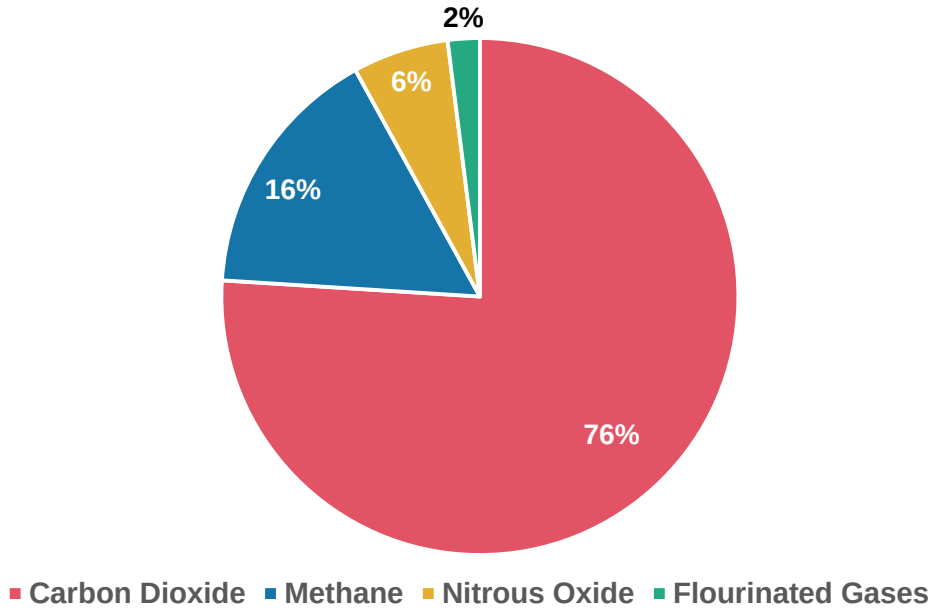
Greenhouse Gas Emissions Applications / End-User – High Level Market Split

Share of Global Greenhouse Gas Emissions (%), 2020



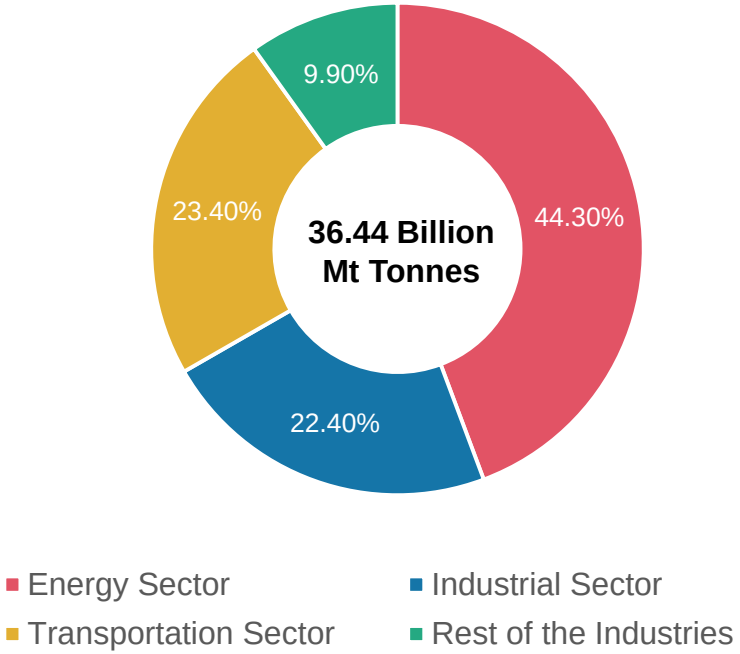
Global GHG emissions can be roughly traced back to four broad categories: energy, agriculture, industry, and waste. Overwhelmingly, almost three-quarters of GHG emissions come from our energy consumption, Agriculture Forest & Land Use is the second largest GHG emitter with the share of 18.4. The total GHG emissions reached 49.4 billion tonnes in 2019. Carbon dioxide constitutes 76% of the GHG.

Greenhouse Gases Breakup (%), 2020

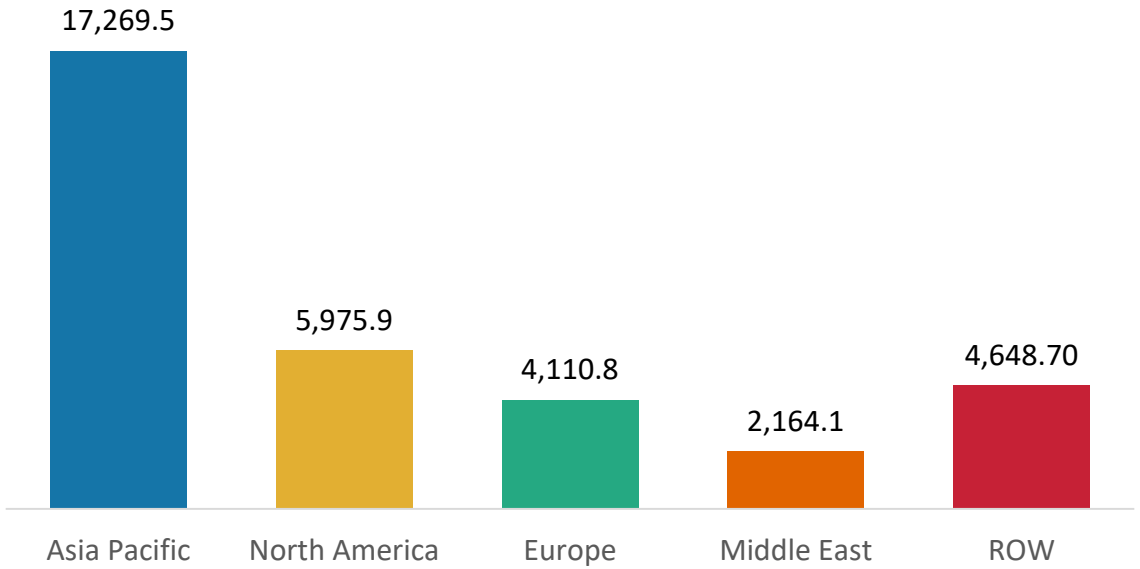


Key Applications / End-User – High Level Market Split

Carbon Emission By Different Sectors (%), 2020



Carbon Emission By Regions, 2020 (in Million Metrics Tonnes)



44.30%

Energy Sector

Energy sector is the highest carbon emitting sector. The majority of carbon emission in this sector is from burning of fossil fuels.

22.40%

Industrial Sector

In industrial sector chemical and Cement industries cause highest level of carbon emission in the atmosphere

23.40%

Transportation Sector

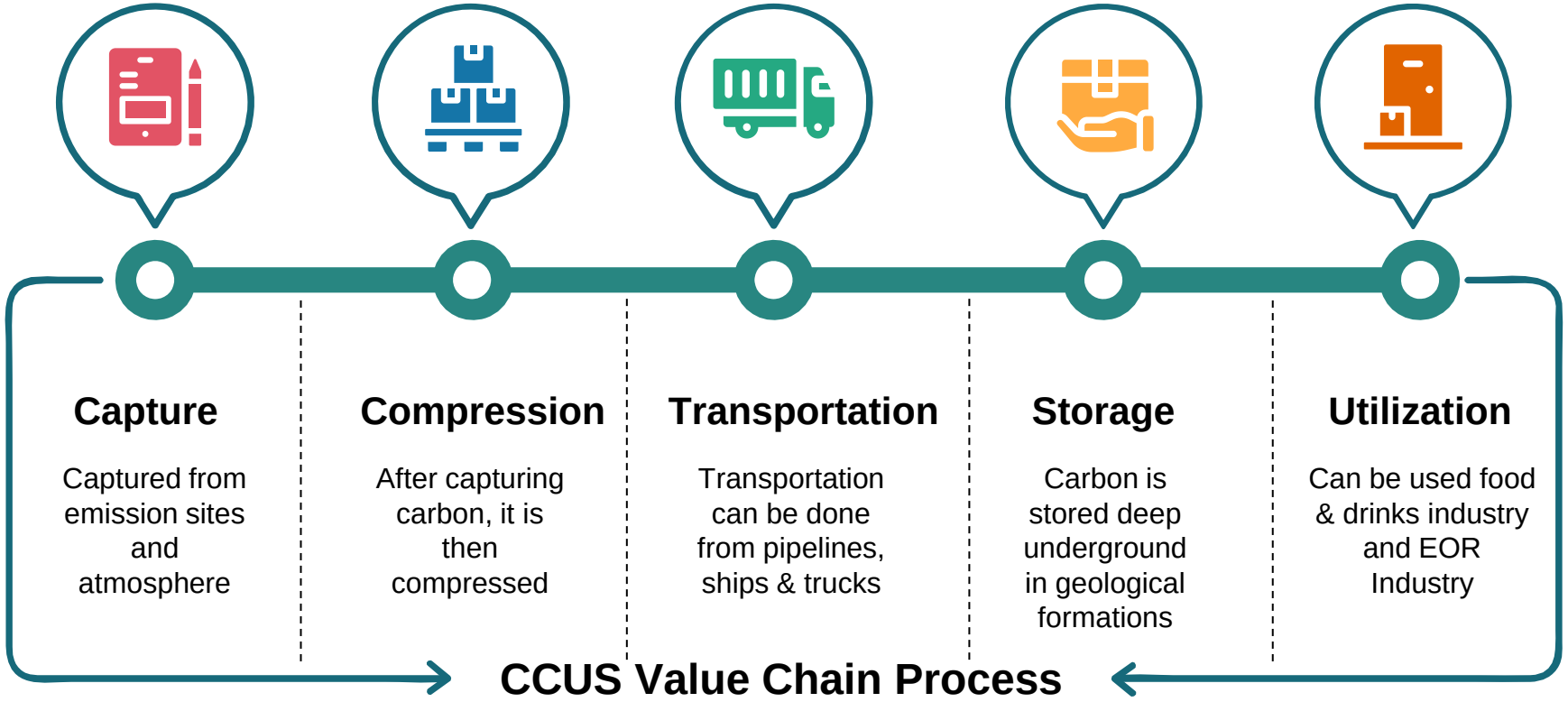
Majority of the carbon emissions is from surface transport which is 20.6%. Carbon emission from the Aviation sector is 2.8%.

9.90%

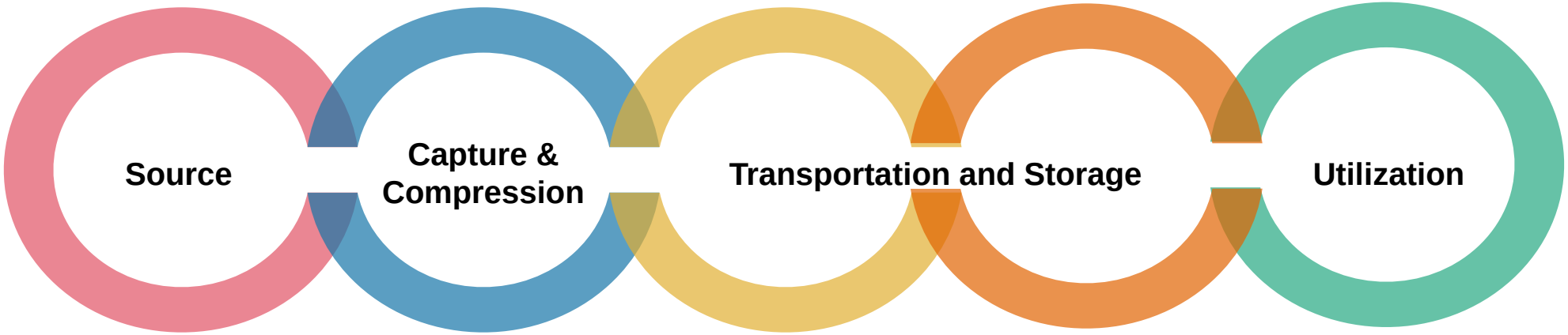
Other Sectors

Other sectors includes carbon emission from households that is 5.6% and carbon emission from buildings that is 4.3%

Carbon Capture, Utilisation and Storage Value Chain Process



Key Companies Operating Under Each Nodes of the Value Chain



- LafargeHolcim
- Anhui Conch
- BASF
- Sinopec
- Enel
- Electricite de France

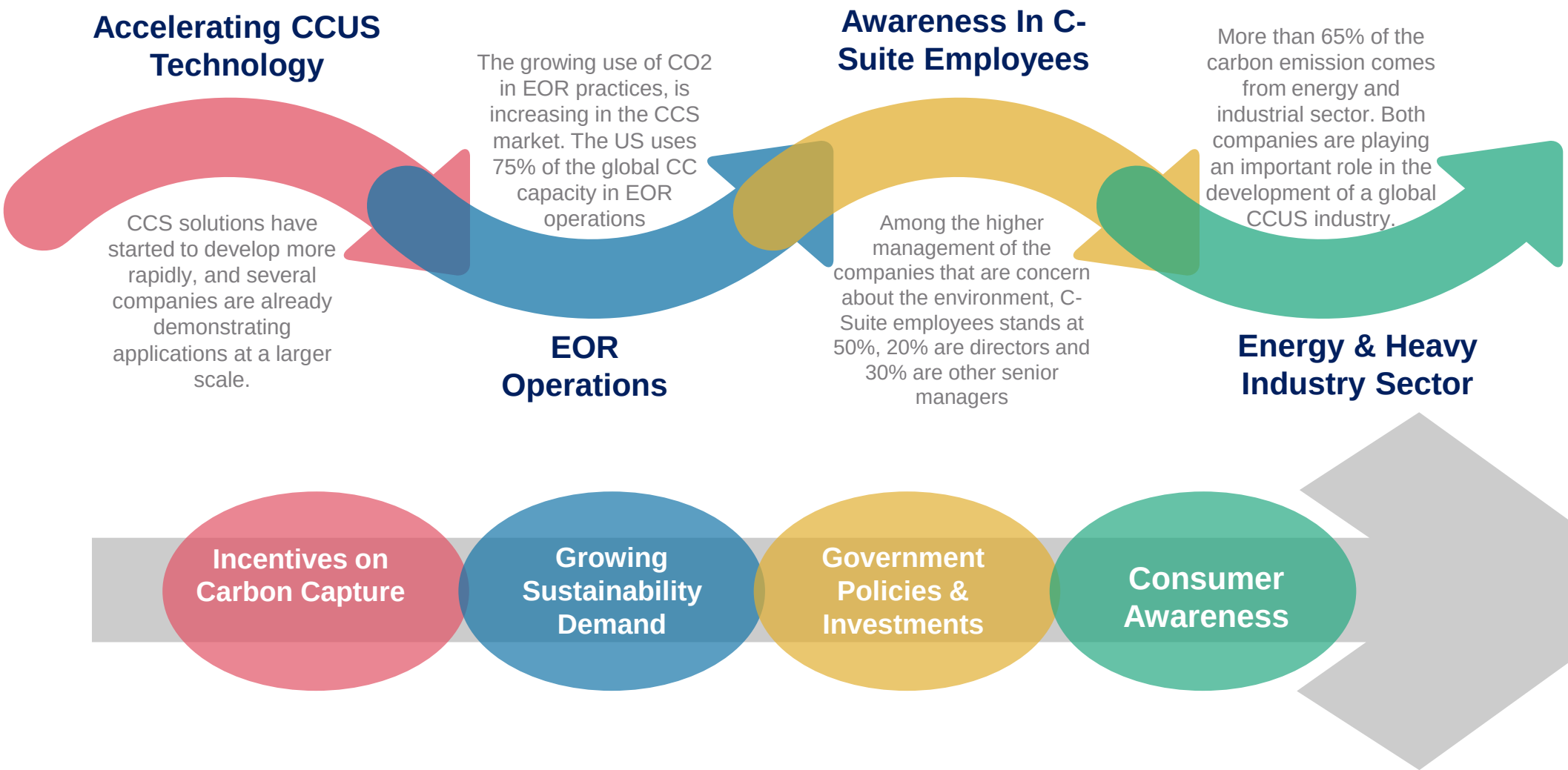
- Shell
- Chevron
- NRG Energy
- Net Power
- Quest
- Carbon Engineering
- Global Thermostat
- Climeworks
- CarbFix

- Mitsubishi Heavy Industries Ltd
- Air Products & Chemicals, Inc.
- Air Liquide
- Babcock & Wilcox Enterprises, Inc
- Fluor Corporation

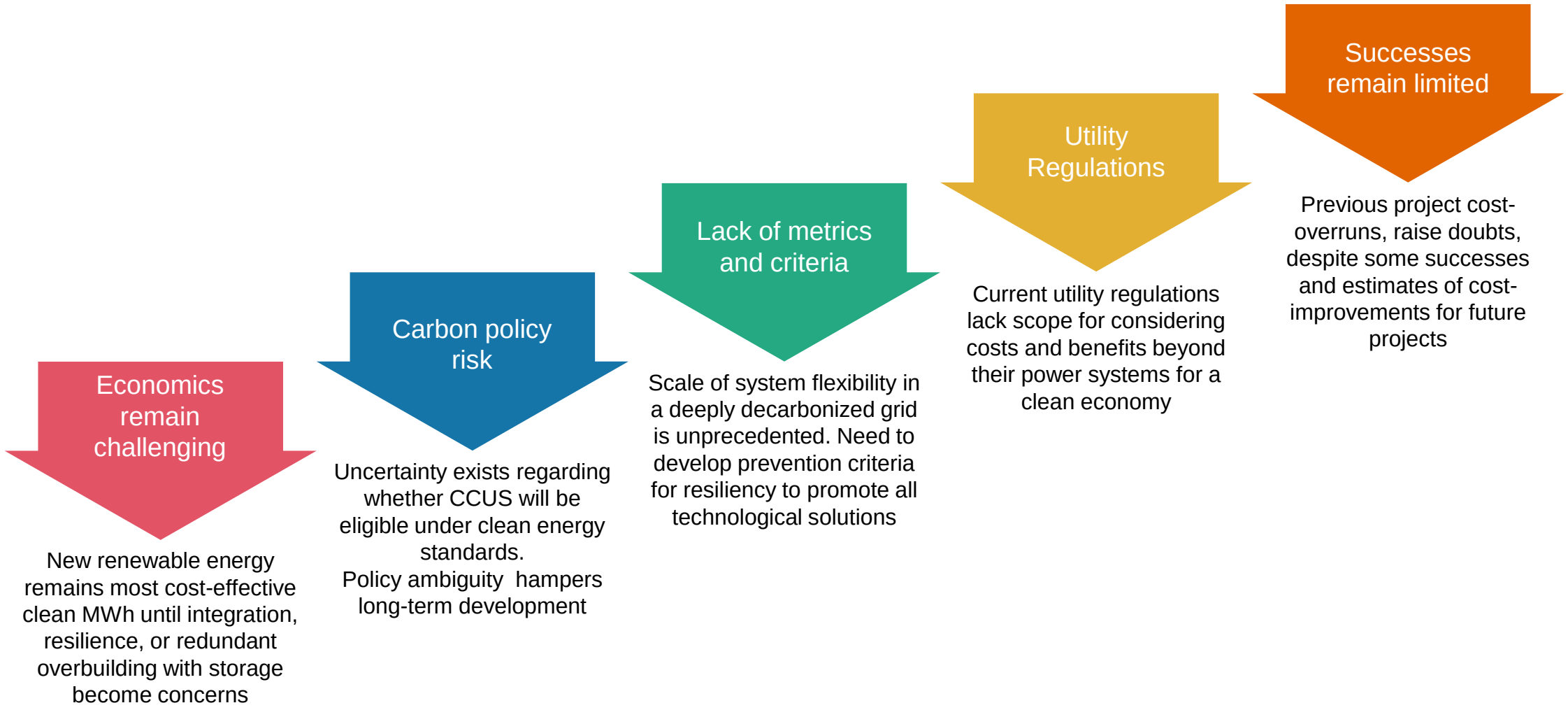
- General Electric Company
- The Linde Group
- Kinder Morgan, Inc.
- Halliburton Company
- Schlumberger Limited

- ExxonMobil
- ADNOC Group
- China National Building Materials (CNBM)
- Dakota Gasification Company

Market Dynamics – Trends & Growth Drivers (1/2)



Market Dynamics – Challenges (2/2)



Strategic Focus of Market Players

What are Big Companies Doing?

NRG Energy has partnered with JX Nippon Oil & Gas Exploration to develop CCS project at NRG's WA Parish generating station southwest of Houston, Texas. This project is designed to capture around 90 percent of the carbon dioxide from a 240 MW slipstream of flue gas, and use or sequester 1.6 million tons of this greenhouse gas annually

Chief Industries, Inc. and Catahoula Resources have entered into an agreement to jointly develop carbon capture and permanent sequestration (CCS) within Nebraska, USA.

Shell has world's largest CCS project, in Alberta, Canada. The partnership between Shell, Canada Energy and Chevron, has resulted in a fully integrated CCS project designed to capture, transport and store deep underground more than a million tons of carbon dioxide annually.

Drax Group and Mitsubishi Heavy Industries have agreed a long-term contract for Drax to use its carbon capture technology. Drax Group's purpose is to enable a zero carbon, lower cost energy future and in 2019 announced a world-leading ambition to be carbon negative by 2030, using Bioenergy with Carbon Capture and Storage (BECCS) technology.

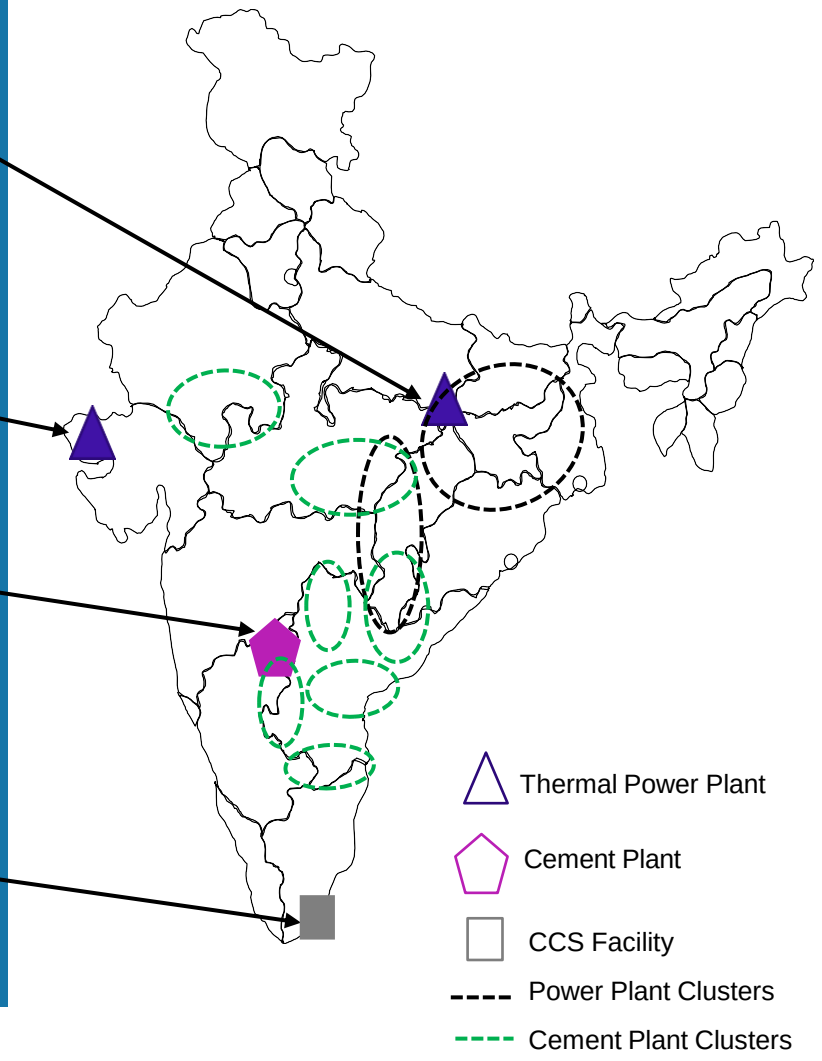
PT Pertamina (Persero) continues to contribute supporting the commitment of Indonesian government to reduce Greenhouse Gas (GHG) emissions by 29% or for international support is targeted to reach 41% by 2030. Pertamina collaborates with Japanese companies & ITB in Carbon Capture Utilization & Storage

Aker Solutions has secured a contract from Aker Carbon Capture for engineering, procurement, and management assistance to realize the CO2 capture plant at Norcem's cement factory in Brevik, Norway. The project involves storing the captured CO2 under the seabed. The contract has a value of about $57,6 million.

India Advantage

States Landscape

- The Vindhyachal Thermal Power Station in Madhya Pradesh, with an installed capacity of 4,760MW, is the biggest coal-based power plant thermal power plant in India by NTPC.
- Mundra Thermal Power Station located in the Kutch district of Gujarat is currently the second biggest operating thermal power plant in India. It is a coal-fired power plant owned and operated by Adani Power.
- The Wadi cement plant of ACC Limited, in India's southern state of Karnataka, now enjoys the distinction of being the world's largest cement plant.
- A plant at the industrial port of Thoothukudi is capturing CO2 from its own coal-powered boiler and using it to make baking soda. It will lock up 60,000 tonnes of CO2 a year. The technology runs without subsidy or any other government policy support in India.



Central Government Policies & Schemes

- India's Department of Science and Technology has established a national programme on CO2 storage research and, in August 2020, made a call for proposals to support CCS research, development, pilot and demonstration projects.
- India is a member of CSLF & IEA GHG R&D Programme & It is participating in the Future Gen Programme.
- The Government of India has plans to invest in CCS related activities in the XI & XII Five Plan (report of the related activities in the XI & XII working group on R&D for the energy sector)
- Institute of Reservoir Studies is carrying out CO2 capture and EOR field studies in Gujarat
- India has committed 1 million euro to support Indian participants part of the accelerating CCS technologies (ACT) initiative.

Conclusion

Climate change is now a top if not the leading issue for consumers and governments around the world. The research in recent years that suggests that in order to limit warming of the Earth, we will have to remove carbon from the atmosphere, in addition to decreasing greenhouse gas emissions. According to the top global authorities on climate and energy modeling, like the IPCC, IEA, and NASEM, we'll need Carbon capture, utilization and storage (CCUS) to achieve our climate goals.

Policy and tax changes in the US and Europe look set to change that by giving the technology the boost it needs to become commercially viable in a growing number of low-cost applications. They could also be the first step toward transforming CCUS into a mature industry. According to IEA, Carbon capture, utilization and storage CCUS contributes 15% emissions reductions in Iron and steel industry, 18% to emissions reductions in cement industry and 38% of overall emissions reductions in chemical sector.

Global investment in carbon capture, utilization and storage could reach up to 90 billion U.S. dollars until 2030. Much of this would be invested in the United States and Europe. Carbon capture, utilization and storage (CCUS) is the process of capturing carbon dioxide (CO2) and storing it in a site, primarily an underground geological formation, where it will not be able to enter the atmosphere. Carbon capture technology is decades old, but because high costs the number of carbon capture and storage projects worldwide is relatively low.

India actively supports research in CCUS, political backing for large-scale deployment has not been strong. However, recent rapid growth in coal power capacity and more ambitious climate targets present a more favourable environment for CCUS.

The increasing investments and policy changes all around the globe are making the Carbon capture, utilization and storage (CCUS) an upcoming industry. The number of CCUS projects has grown over the last few years. This has led to the entry of many new players in the market.

THANK YOU

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