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International Conference on Petroleum-Coal-Gas
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The world's only Congress on Petroleum-Coal-Gas industries with a focus on Synergy for Energy

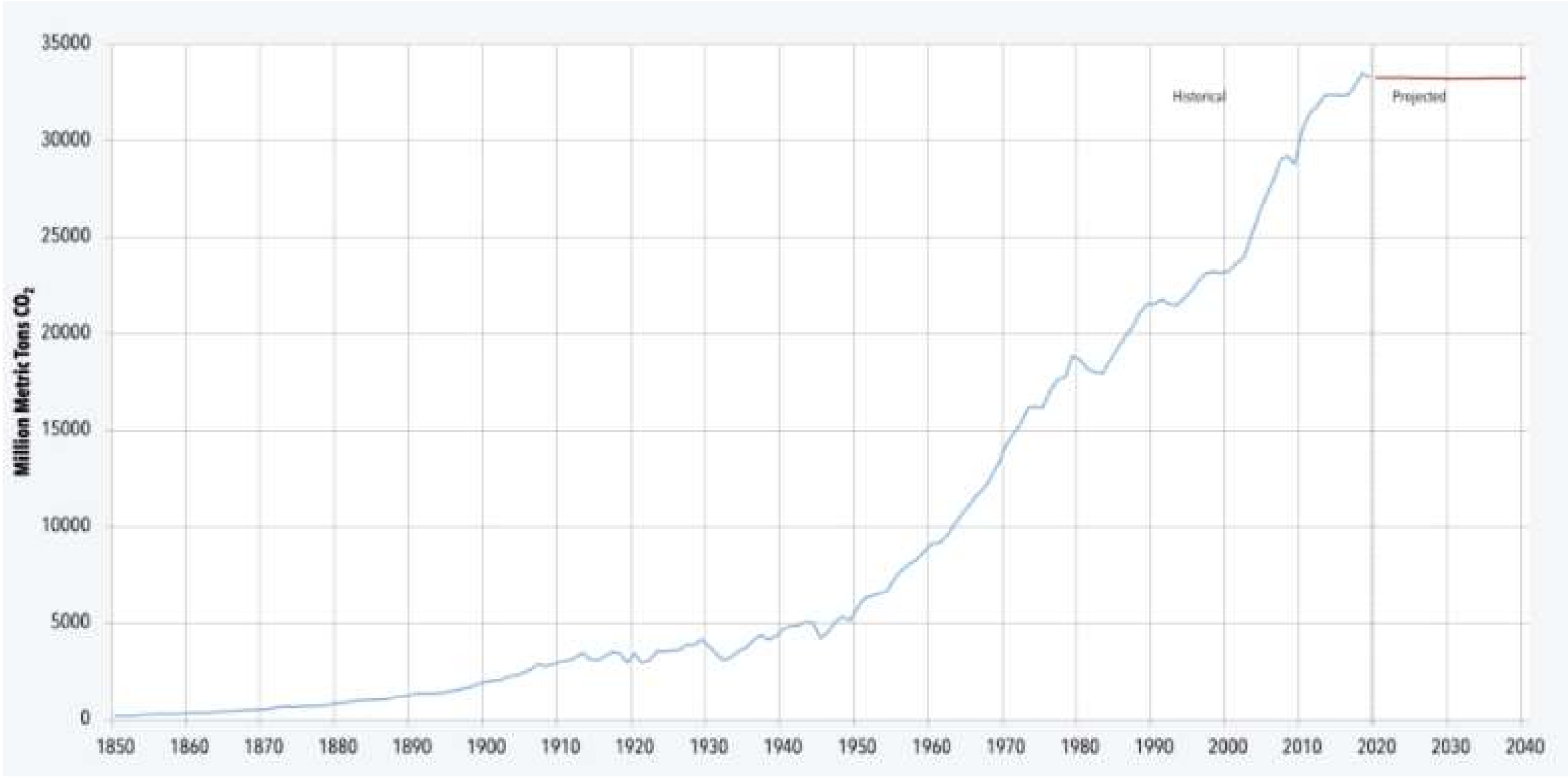
"Fossil Fuels: Transition to a Low Carbon Energy System"
Technology Innovation "S curve approach", New Commercial Technologies

Shailendra Kumar Pokhriyal, PhD.

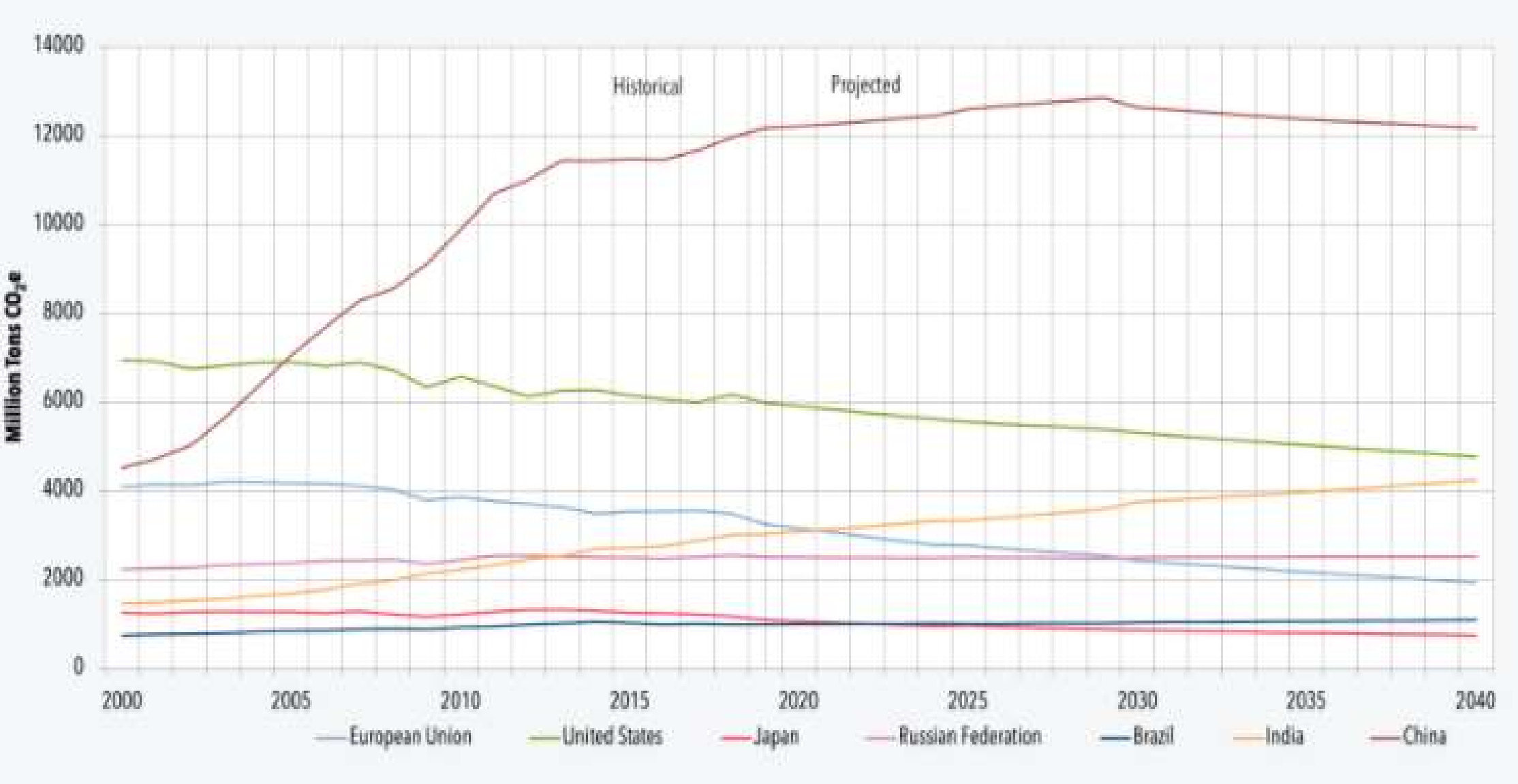
Professor & Dean – Himalayiya University

(Ex. Professor & Head - Oil and gas, University of Petroleum and Energy study)

Global Carbon Di-oxide Emissions, (1850–2040) [SOURCE - Carbon Dioxide Information Analysis Center (Oak Ridge National Laboratory, 2017), World Energy Outlook (International Energy Agency, 2020)]

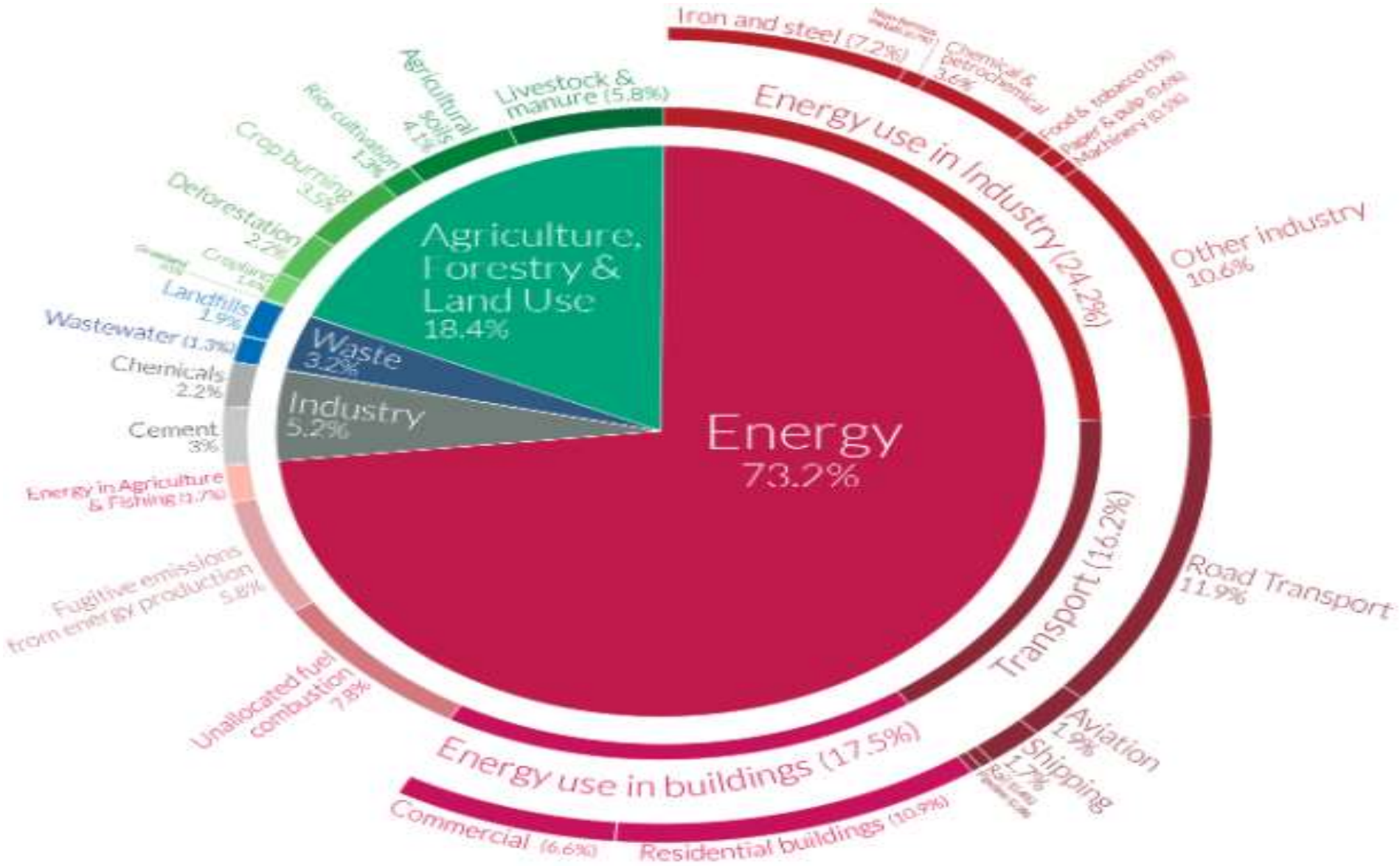


Greenhouse Gas Emissions for Major Economies, 1990–2040. (SOURCE : *World Energy Outlook* (International Energy Agency, 2020), *CO2 Highlights* (International Energy Agency, 2021), *Global Non CO2 Emission Projections* (U.S. Environmental Protection Agency, 2019)



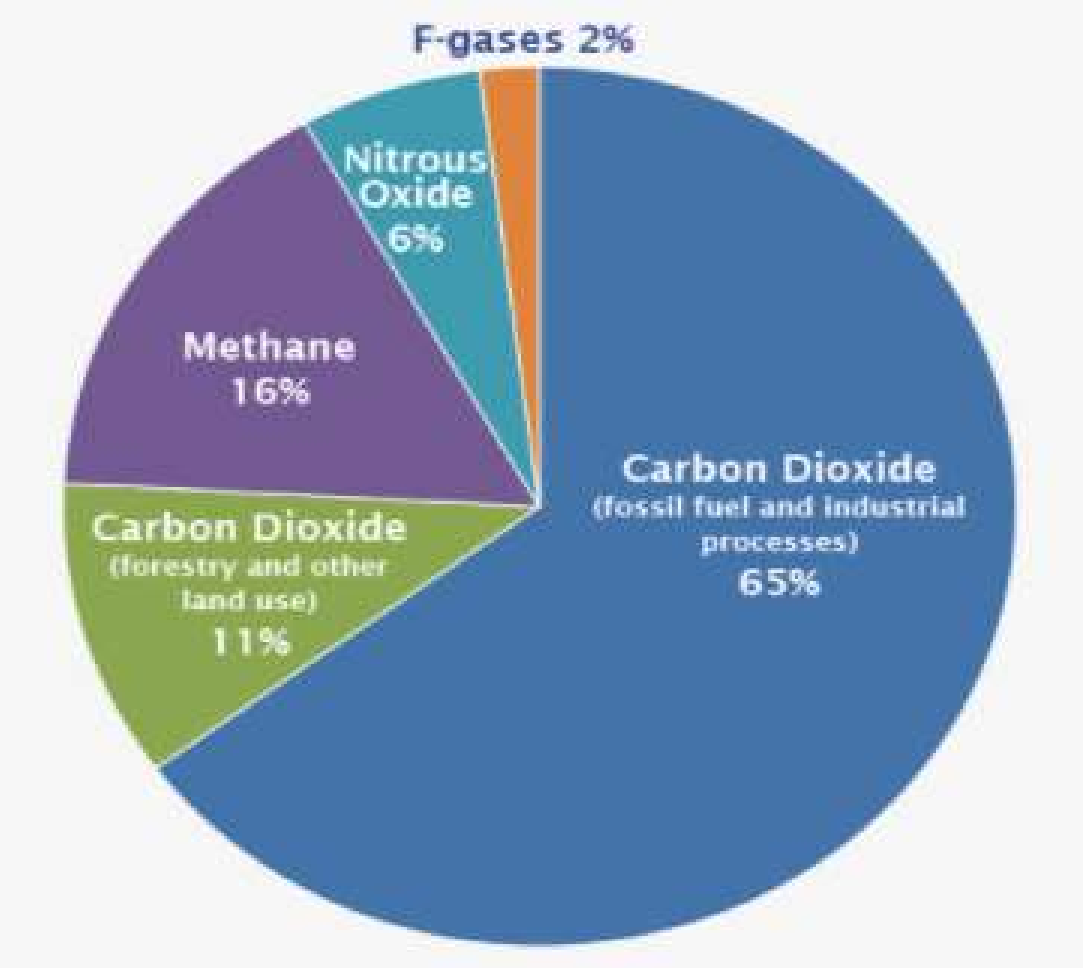
Global Green House Gas Emission by Sector

- Year 2016

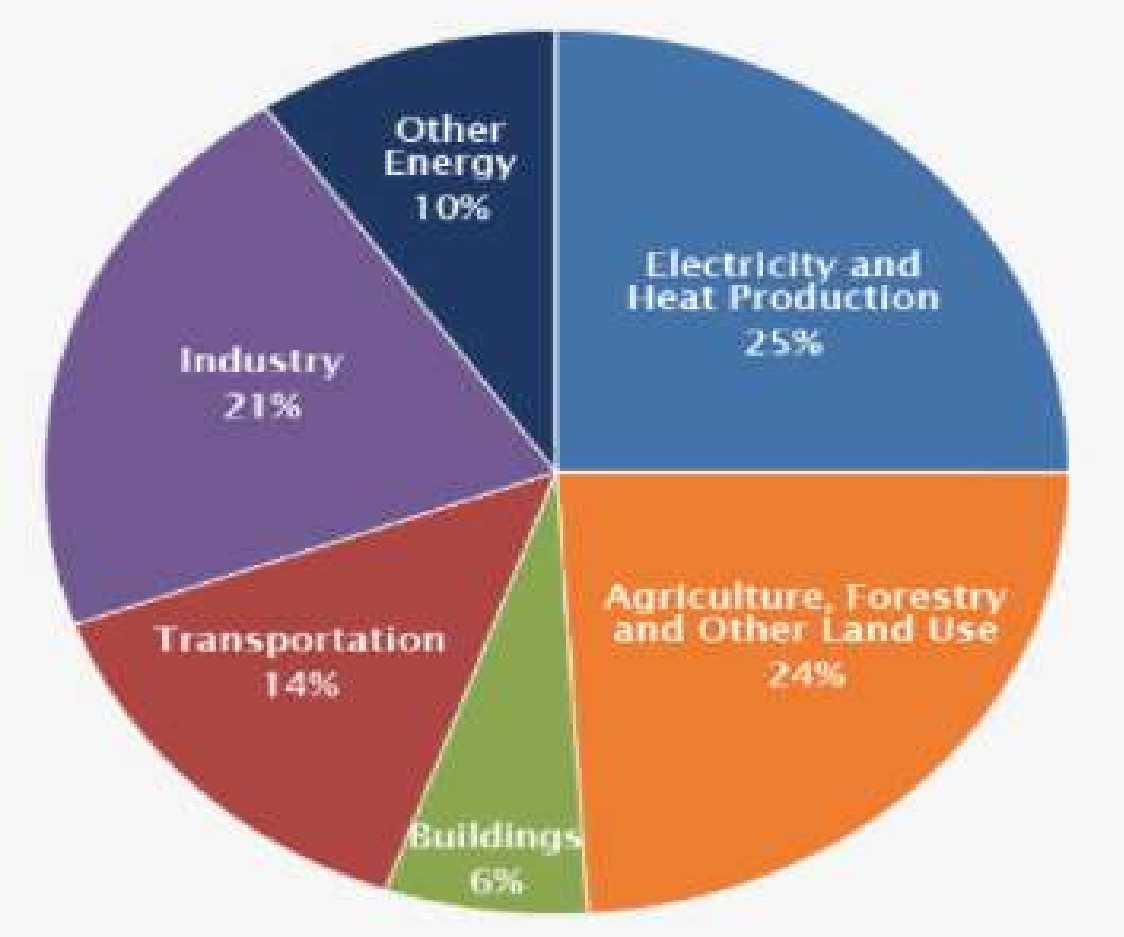


Global Green House Gas Emission by Sector

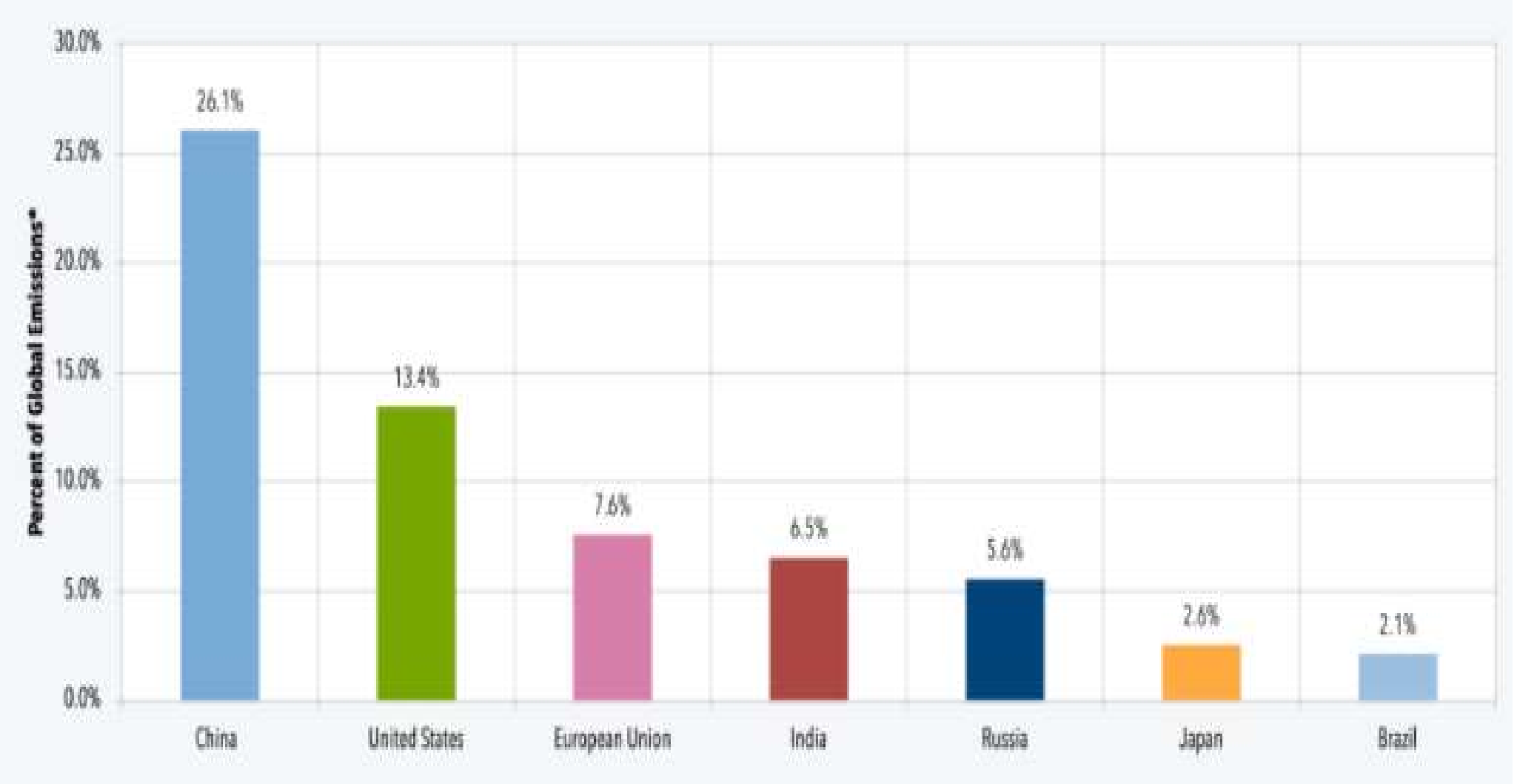
Global Greenhouse gas Emissions by Gas (Source: IPCC 2014)



Global Greenhouse gas Emissions by Economic Sector (Source: IPCC 2014)

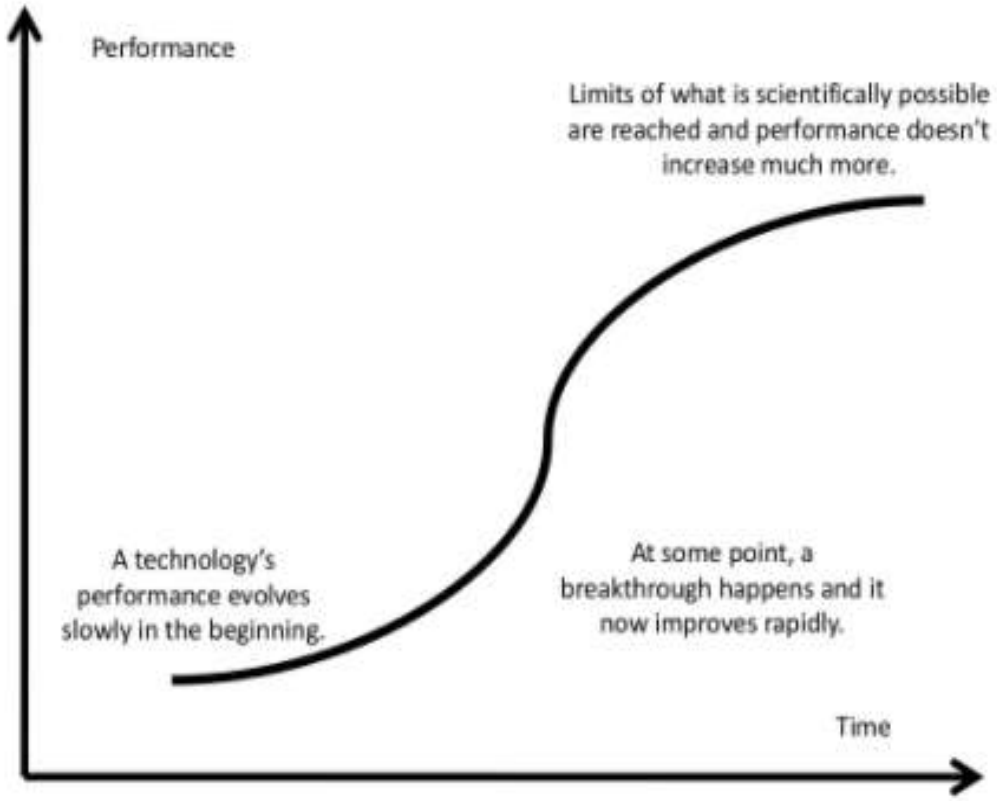


Greenhouse Gas Emissions By Top Emitters, 2018.

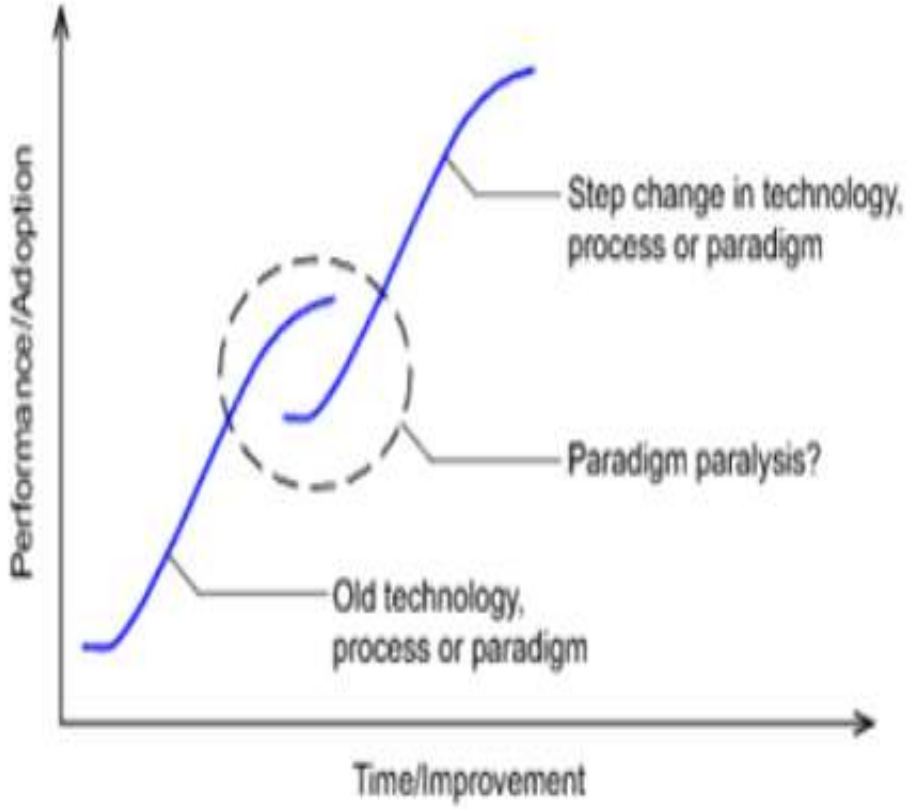


The S – Curve Concept

The S-Curve Pattern of Innovation highlights the fact that as an industry, product, or business model evolves over time, the profits generated by it gradually rise until the maturity stage. These new products are often upgraded or related versions of products approaching the maturity stages of their S-Curves. (Source : Chris Sandström)

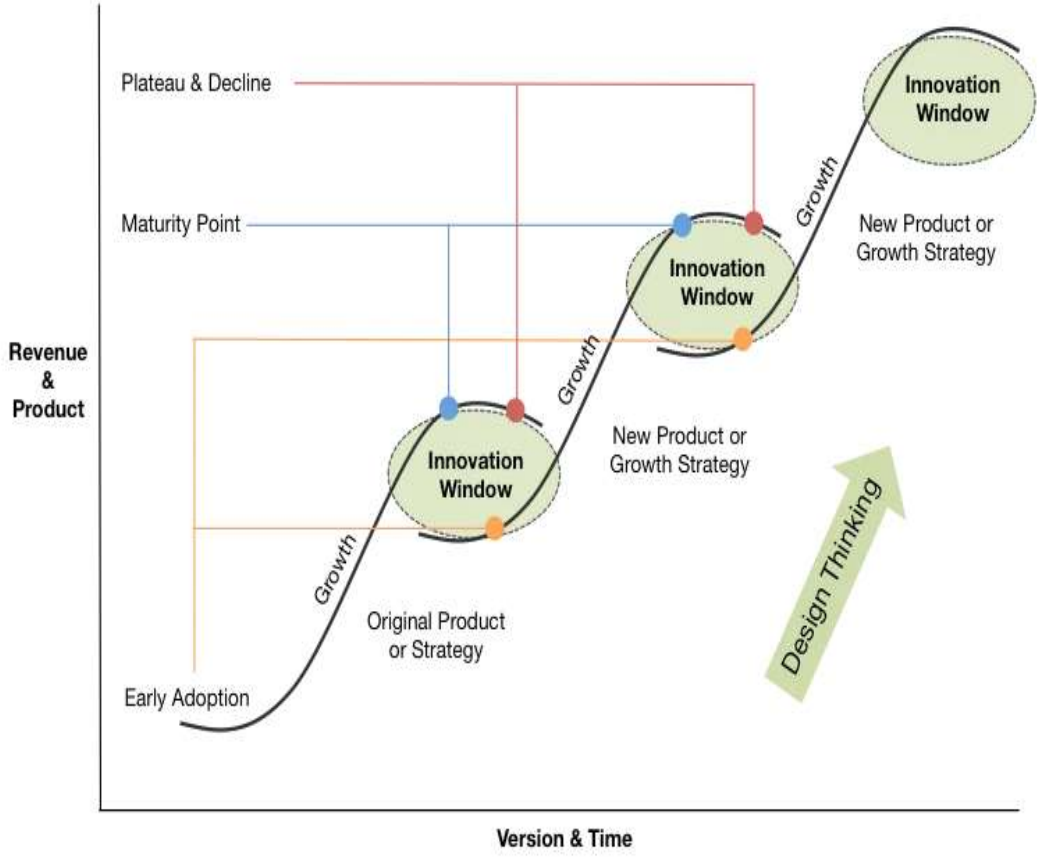


As a technology reaches its mature stage, it becomes increasingly vulnerable to substitute technologies. (Source : Chris Sandström)

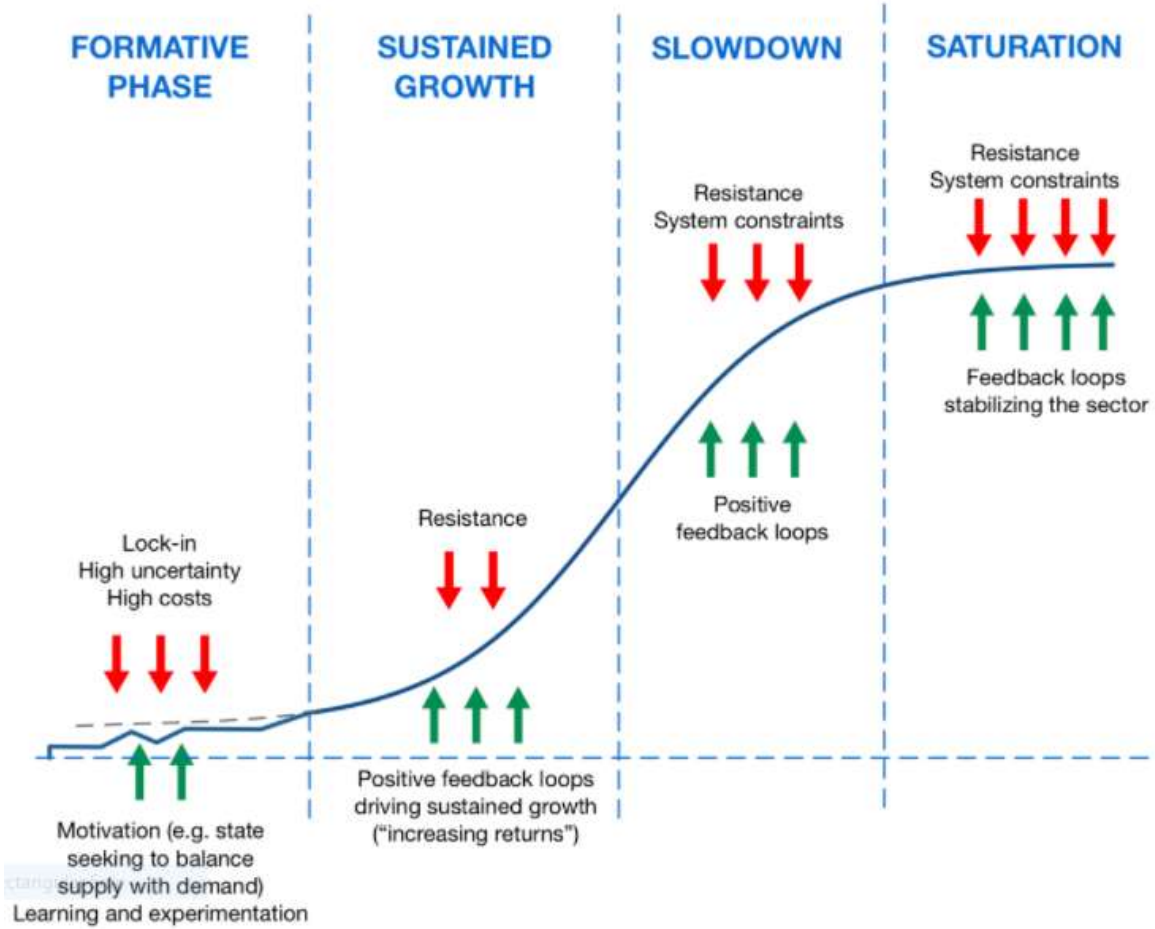


Technology S-Curves in Renewable Energy

Growth Trajectories of S-Curves

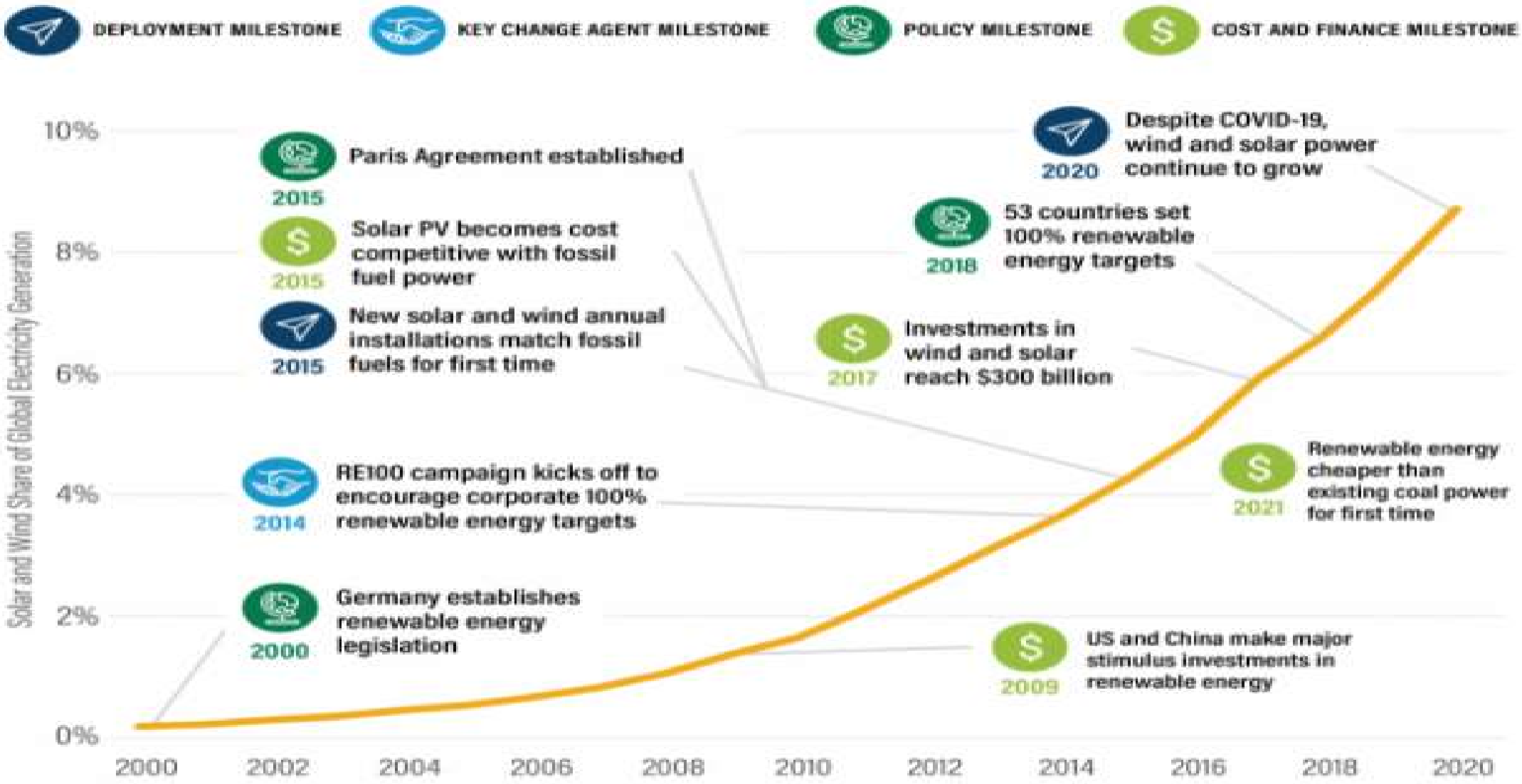


Riding the S-curve: the global uptake of wind and solar power - Due to a common pattern of new technology deployment ("S-curve"), the takeoff time can largely explain the subsequent growth of renewable energy : Dr. Vadim Vinichenko



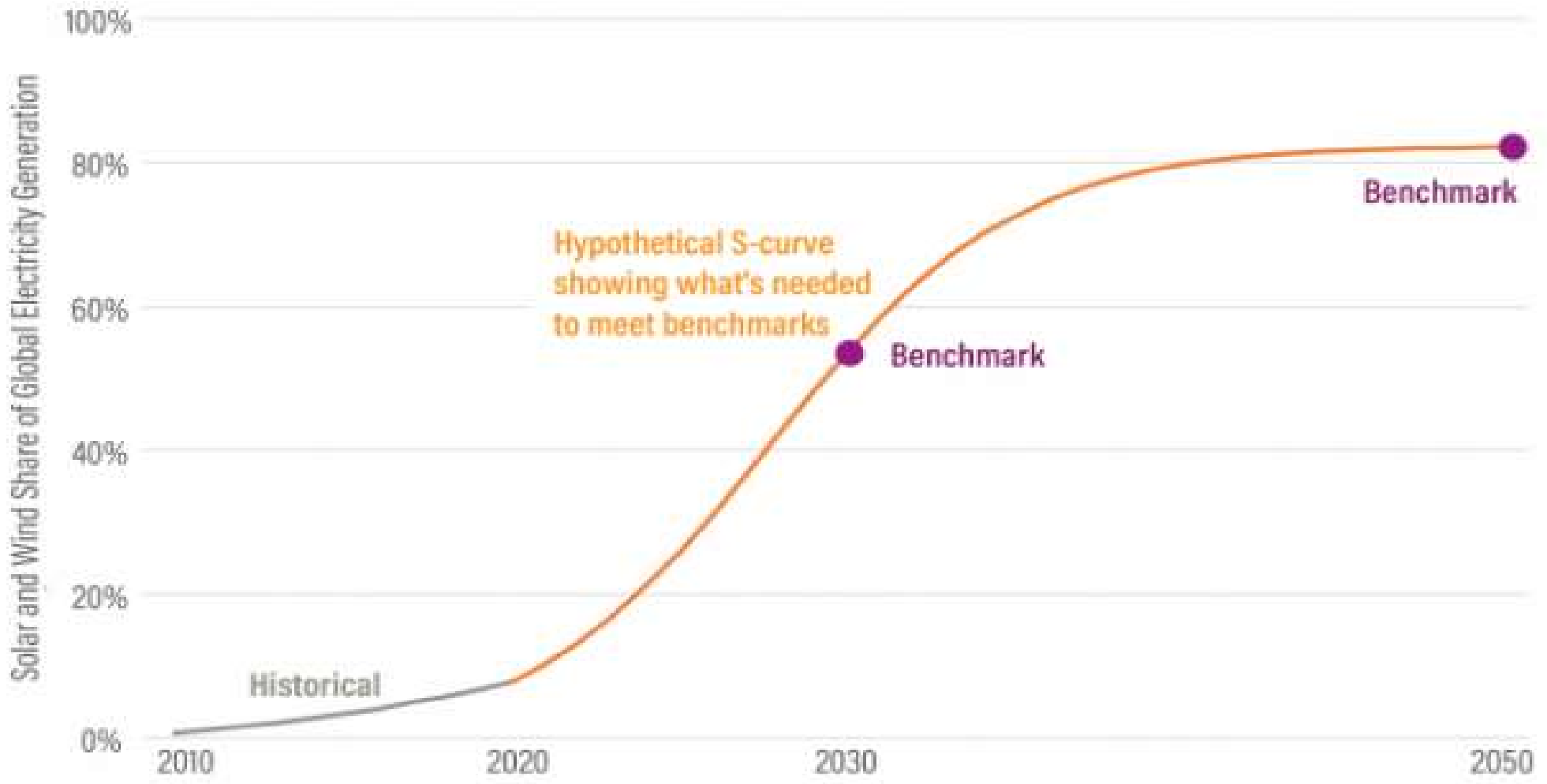
Key milestones in the exponential Growth of Solar and Wind Energy : Joel Jaeger

Source : World Resources Institute



Possible pathway for Solar and Wind growth to Align with 1.5^0 Goal : Joel Jaeger

Source : World Resources Institute



Fossil Fuels: Transition to a Low Carbon Energy System – New Technologies

- **IMO 2020 regulation**
- **Examples of Fast-forward to mega-scale refinery pet-coke gasification projects for the 2020s - Saudi Aramco's Jazan Refinery**
- **Gasification route to make hydrogen- China, India,**
- **Carbon Capture and Storage to produce blue hydrogen-UK, Norway, Middle East, Saudi Arabia**
- **Blue Ammonia , Saudi Aramco**
- **Policy of Hydrogen and Ammonia**
- **From Petcoke to blue Hydrogen**
- **Hydrogen fuels Vehicles**
- **Incentives from the Government of India**

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Energy System Models Technologies

- **Solution Algorithms**
- **Technology Cost**
- **Exogenous and Endogenous cost reduction**
- **Techno Commercial Energy models**
- **Economic function of models**
- **IoT in Petro Retail**
- **Education 4.0: A Systematic Industrial Case Based Review of Barriers and Applications of Decentralized Trust Using Blockchain**