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Group

ANALYSIS REPORT

LOW CARBON ENERGY LANDSCAPE

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- What is Low Carbon Energy Transition?
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- Strategies to Support Low-carbon Energy Transition
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- Investment Scenario and Global Cooperation
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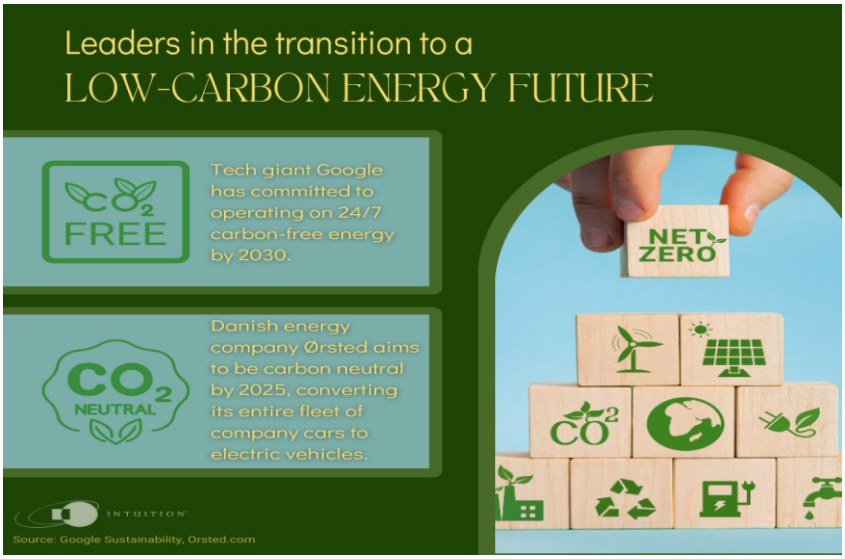
01

Overview

The world at the forefront of energy insecurity is witnessing a notable transition to tackle the underlying issue of climate change at an alarming rate. Thus, promoting a global shift towards clean energy solutions is evident for a viable future.

The global community is focusing on various renewable energy sources, including wind and Solar Photovoltaic (PV) energy.



Source: https://www.intuition.com/how-companies-can-create-a-low-carbon-energy-future/

Quick Insight on Low Carbon Energy Mix

- Due to wind energy and solar power the world will witness around 65% of worldwide power sector emission reduction of carbon dioxide by 2050.
- The above two technologies will be complimented by other technologies including nuclear power and geothermal, biomass and hydro-power contributing towards low-carbon footprints.
- The world is working towards meeting energy goals therefore focusing on the increasing production annually.
- By 2030, the annual capacity is planned to witness around 823 GW annually from solar power, 35GW from nuclear power and 318 GW from wind energy.

Wind energy is one of the sources that has low carbon intensity (11 gCO2eq/kWh). According to the government authorities, by the end of 2030, the capacity of renewable energy generation using wind energy and solar Photovoltaic (PV) panels will be tripled.

Snapshot of India's Increasing Renewable Energy Capacity

31x

Increase in Solar Power installed capacity from 2.6 GW to 84.27 GW since 2014

2x+

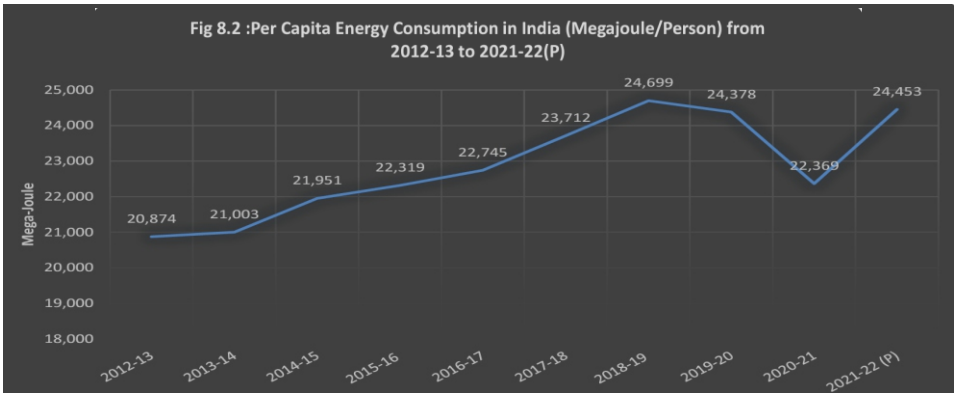
Increase in Wind capacity from 21 GW to now at 46.92GW since 2014

Source: https://www.investindia.gov.in/sector/renewable-energy

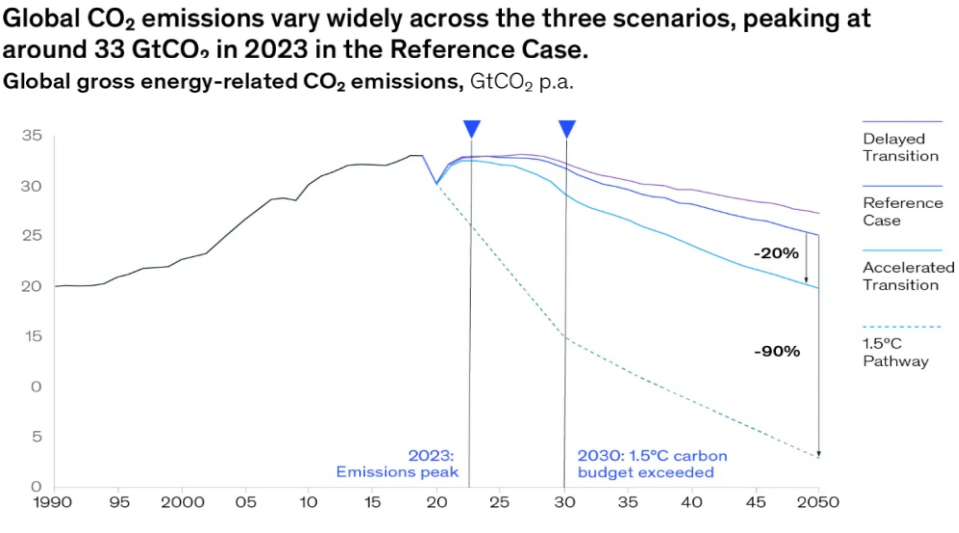
The official data reveals that technological advancement will increase the low-emission percentage from 39% (2022) to 71% (2030) during electricity generation, and gradually reach 100% by 2050.

So, it's evident that to drive a global shift towards a diminished carbon energy landscape we need an all-inclusive effort from stakeholders, individuals, industries, and government to support clean energy transitions through smart investments for a better tomorrow.

Year-wise India's Per Capita Energy Consumption



Source: https://www.mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2023/Chapter-8_07022024.pdf



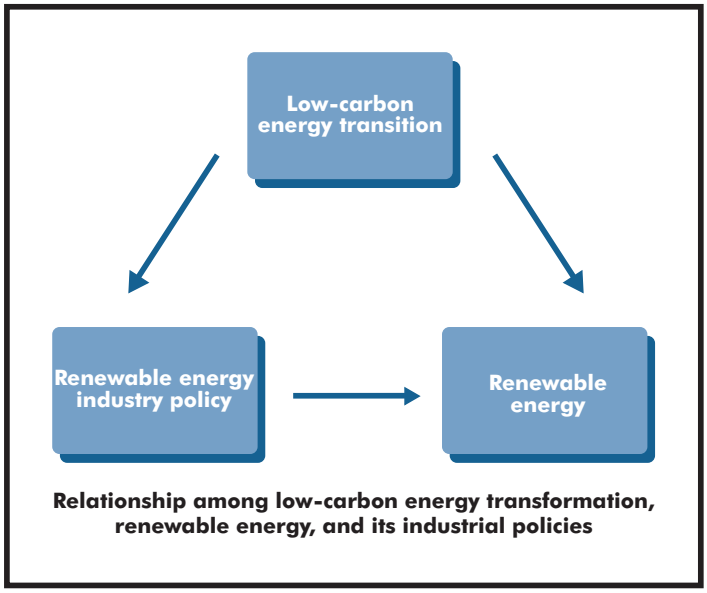
Source: https://www.mckinsey.com/industries/oil-and-gas/our-insights/oil-and-gas-blog/the-global-energy-landscape-is-going-through-major-shifts-what-does-this-mean-for-energy-value-pools

02

What is Low Carbon Energy Transition?

The energy sector is one of the prime sources for elevating GHG emissions that impact climate change. By adopting low-carbon energy alternatives, we can overcome this issue and contribute towards a sustainable future.

The idea behind low carbon energy transition is to minimize the dependence on fossil fuels (coal, natural gases, oil, etc) and make a global shift towards a green economy that will be low on carbon emissions. The ultimate aim is to drastically diminish the production of greenhouse gases and advance the production of clean energy through the adoption of sustainable practices in energy consumption.



Relationship among low-carbon energy transformation, renewable energy, and its industrial policies

Source: https://www.researchgate.net/figure/Relationship-among-low-carbon-energy-transformation-renewable-energy-and-its-industrial_fig1_365661224

Key Details of Low Carbon Energy Scenario

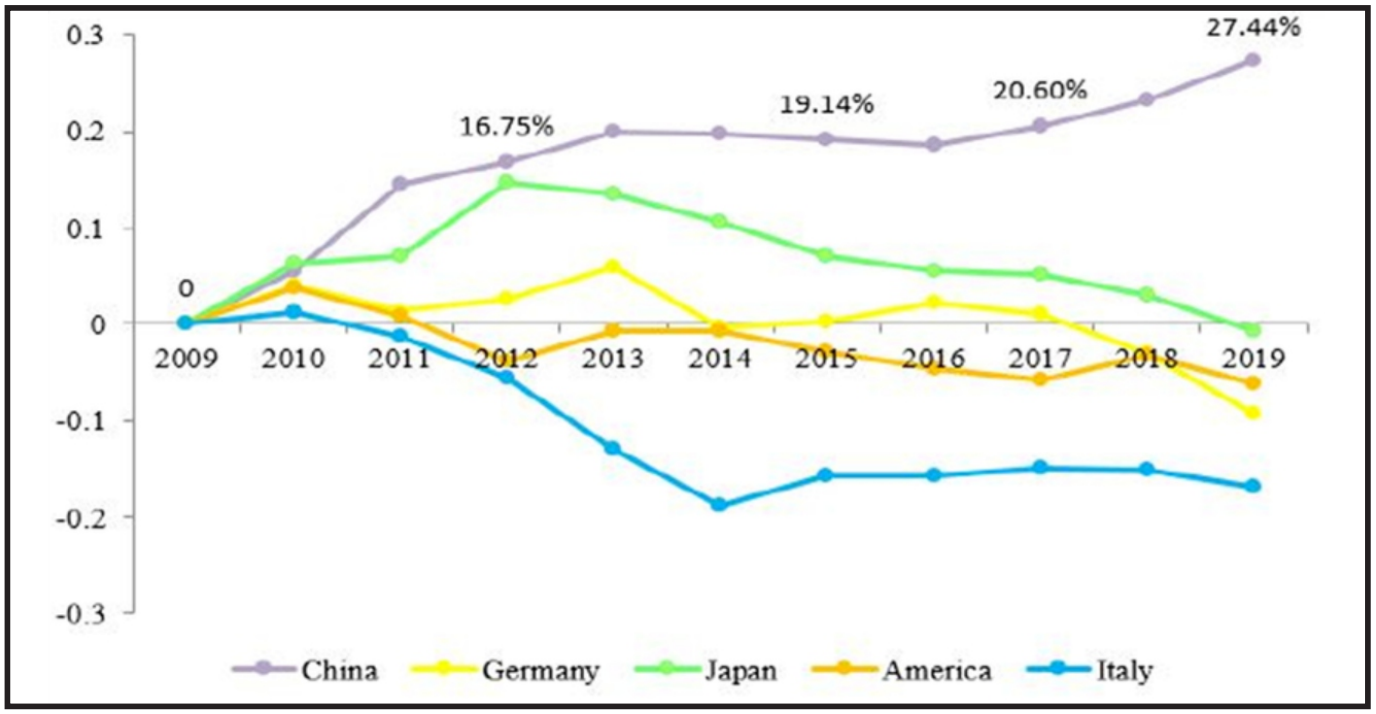
- Effective management of energy efficiency will lessen energy demand to some extend.
- Global shift from legacy fuels to electricity via renewable sources
- Focused approach to balance economic growth and emission administration.
- Promotion of low carbon innovations and setting time efficient targets.
- Public understanding and acceptance to boost transition process.
- Higher investment to grow renewable energy infrastructure for rapid transition.

The need for this transition is urgent because the traditional fuels used for energy production generate many harmful gases including GHG and impact climate change.

	1992	.....	2000	2001	2002	2003	.....	2011	2012	2013	2014	.....	2017	.....	2020	Target/Plan
Germany			FIT								FIP		Auction			2035:55-65%
Japan						RPS			FIT							2030:22-24%
California		RPS/MGPO														2020:33%
Italy	FIT			RPS							Auction					2030:28%

Source: https://www.researchgate.net/figure/Implementation-of-renewable-energy-industry-policies-in-major-countries_fig3_365661224

Therefore, generating energy from renewable sources like solar, wind, nuclear power, and hydro helps to counter this irreversible damage. It will also keep a check on our dependence on the limited reserves of fossils on the planet.



Source: https://www.researchgate.net/figure/Percentage-of-carbon-dioxide-emission-reduction-data-source-BP-2019_fig5_365661224

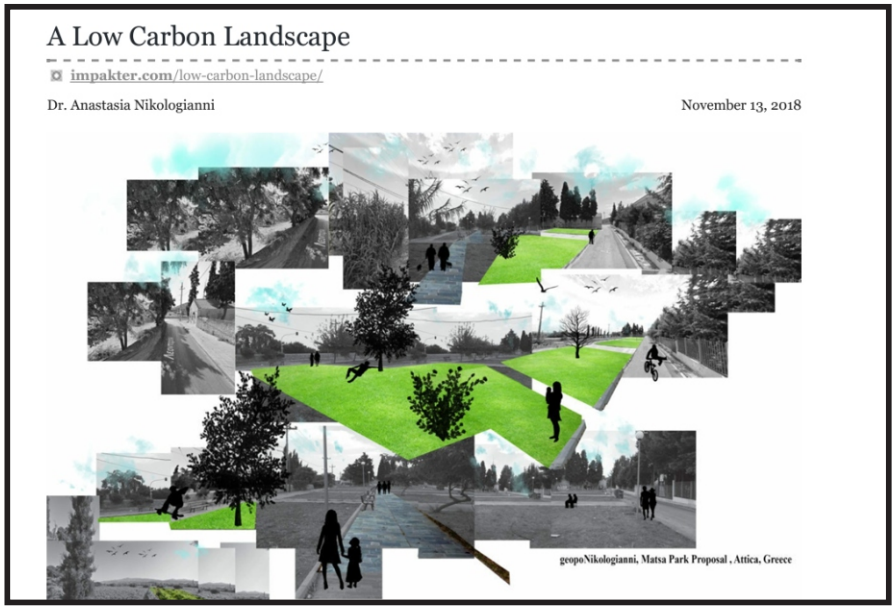
Low-carbon energy transition is a multi-dimensional prospect that is a viable way towards achieving a sustainable and green energy mix. As per above figure, the percentage of carbon dioxide emission reduction varies across countries.

03

Elements of Low Carbon Energy Landscape

Introducing viable designs like low-carbon energy landscapes is the key attribute to minimizing carbon emissions in our ecosystem. These designs will promote a harmonious relationship of individual actions with the surrounding biosphere.

The designs of the low-carbon energy landscape address climate change issues and support green strategy at the root level.



Source: https://impakter.com/low-carbon-landscape/

In the photo:
Potential of a low carbon landscape and the impact of water and green strategy in Stoke Harbour

Photo Credit:
DR Anastasia Nikologianni

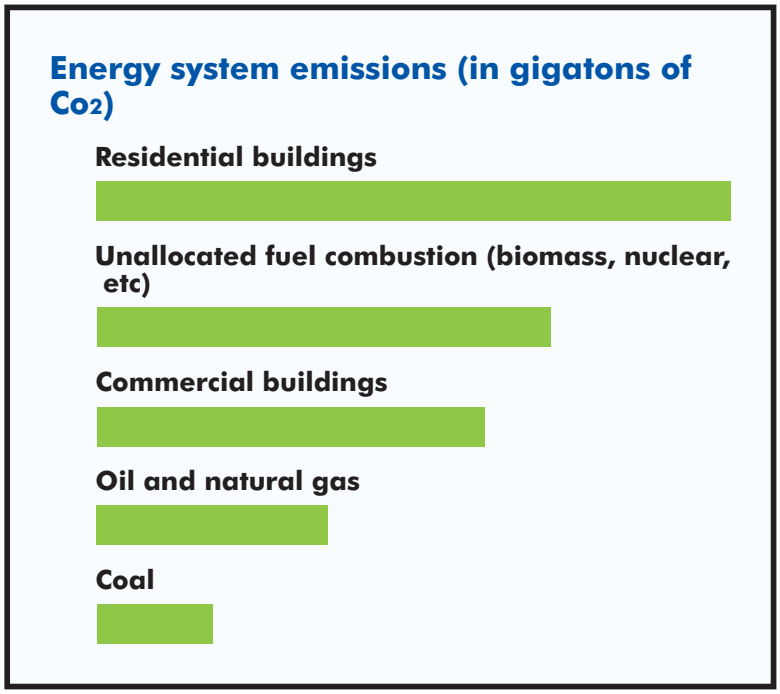
Source: https://impakter.com/low-carbon-landscape/

In the photo: Climate adaptation project in the city of Nijmegen, the Netherlands Photo Credit: The city of Nijmegen

Source: https://impakter.com/low-carbon-landscape/

Such landscapes primarily focus on carbon emissions produced through various activities including manufacturing, installation, extraction, and transportation. To overcome the high levels of carbon emissions the designers craft several innovative solutions at the ground level that are capable of limiting carbon emissions.

The world population is growing and further increasing the global energy demand. **To support that India set the target of achieving 500GW of energy from non-fossil fuel-based sources by 2030**. To achieve this, a low-carbon development strategy has been instrumentalized.



Source: https://www2.deloitte.com/us/en/insights/topics/strategy/low-carbon-future.html

Low-carbon Energy Landscape Highlights

Planners can make use of Lifecycle Assessment (LCA) to evaluate global warming potential of matter.

Assessment using LCA take control of emissions and energy from the matter used for construction, maufacturing etc.

Evaluation of the overall project using LCA covering energy and use of water from nearby infrastructure.

Particularly mention recyclable material, replacement of steel and concrete and viable options of wood source.

Environmental Product Declarations developed by manufacturers determine carbon generation from products.

The inclusion of special low-carbon matter along with the LCA will limit the high-emission energy requirement in the manufacturing sector. It will enable the designers to build an overall framework witnessing a clean and climate-friendly energy ecosystem.

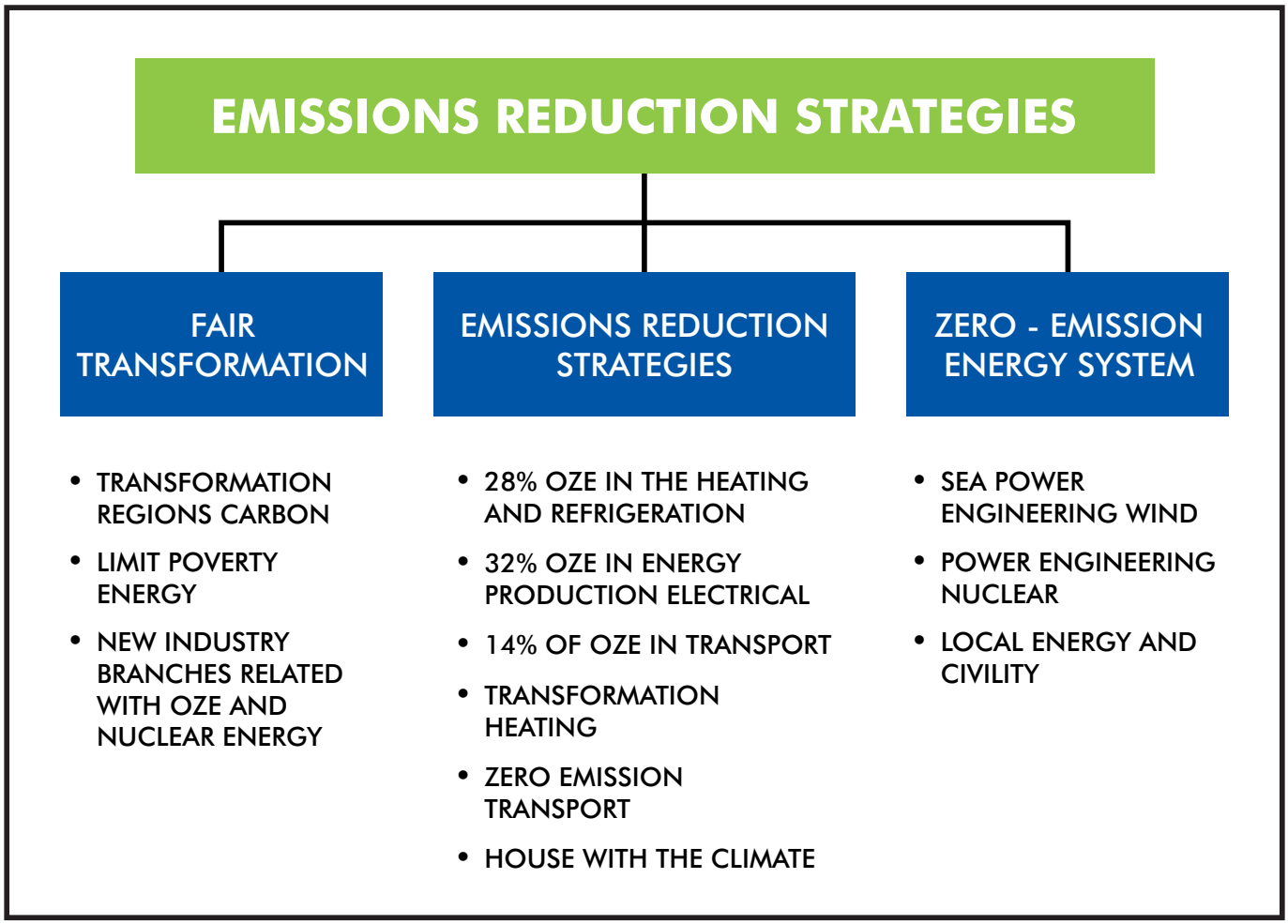
How You Can Tap the AG Group Expertise

To experience the expert service offerings to achieve low-carbon energy targets Click Here

04

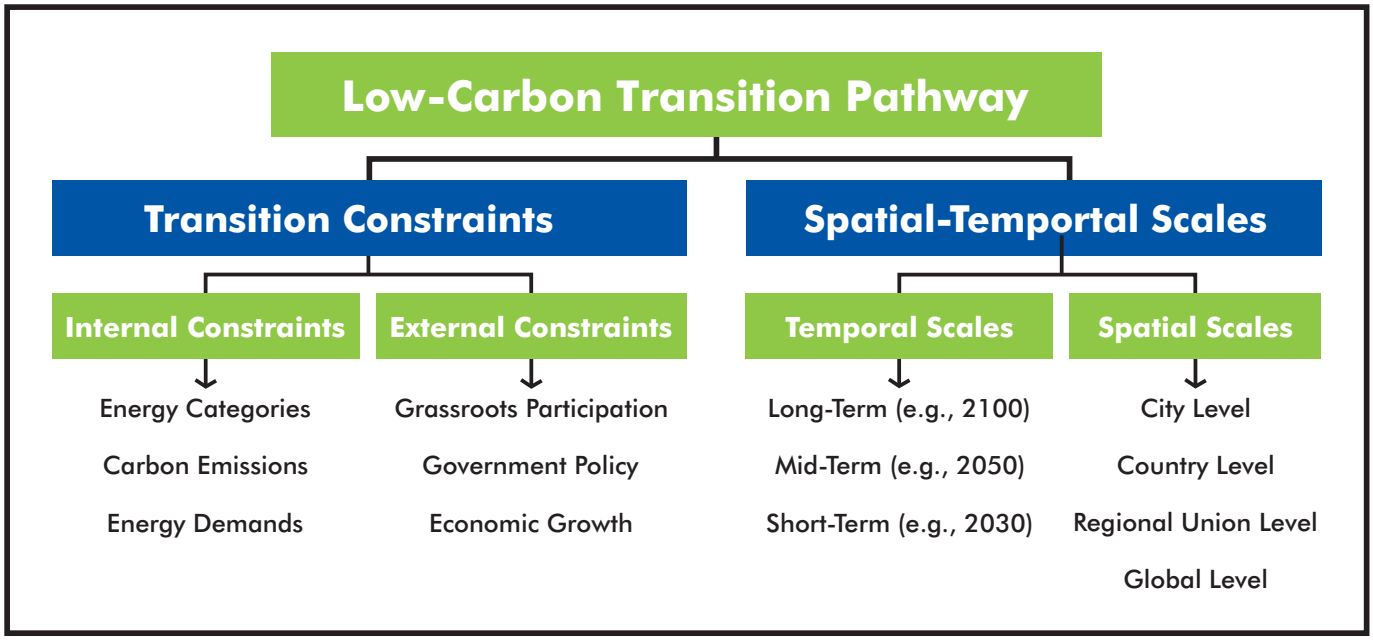
Strategies to Support Low-carbon Energy Transition

Worldwide the development was achieved at the cost of unrestricted carbon emissions. To overcome this serious concern the world needs to implement several strategies that will bring a positive impact and support low-carbon energy transition.



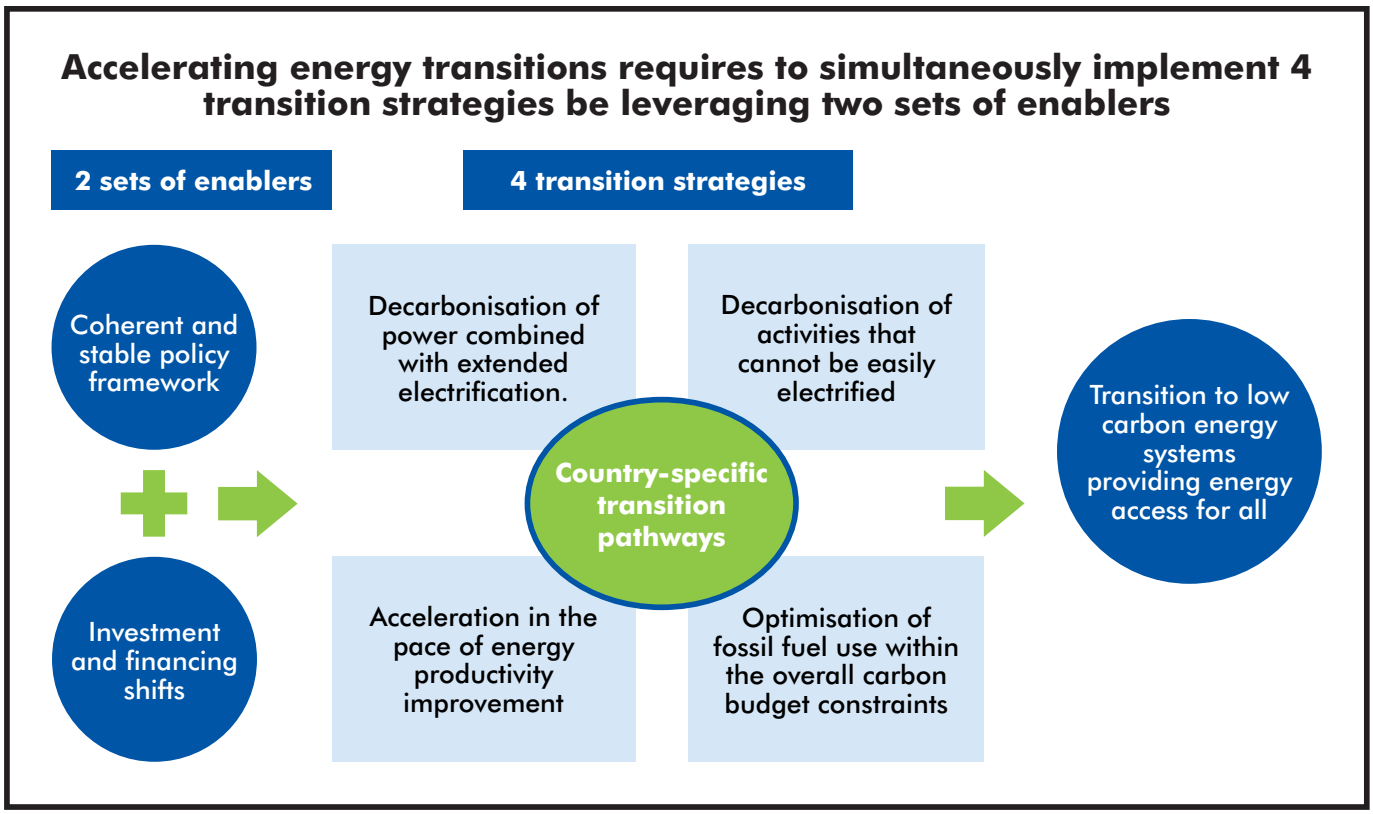
Source: https://www.mdpi.com/1996-1073/15/7/2351

Developing the right mix of renewable sources of energy will develop the low-carbon energy transition pathway with the help of technological advancement.



Source: https://www.sciencedirect.com/science/article/pii/S2095809923001625

Strengthening India's electricity grid by investing more in increasing its flexibility is paramount. The Research and Development to invent future technologies, especially in the areas of green hydrogen, biofuels, and fuel cells is going to ensure a robust energy security system in India.



Source: https://images.app.goo.gl/ob19XhcQanjJYqu26

Strategies Adopted to Promote Low Carbon Energy Transition

- Global approach should be appreciated by all the countries to implement plans promoting transition towards renewable energy sources.
- The plan should efficiently manage energy stats, technology used and infrastructure
- Government working with other significant groups is vital to promote knowledge sharing, advance support and successfully running green energy initiatives.
- All-inclusive approach to be practiced towards energy transition by syncing with policies across various domains including healthcare, agriculture, education etc.
- Installation of technologically advanced equipments like smart grids, energy-efficient devices and infrastructure designs to advance energy saving practices.
- Strategies should be designed to promote financial investment on latest technologies including RE technologies, power plants and smart grid infrastructure.
- Blueprint should be prepared for replacing RE fuels against the legacy fossil ones.
- Governments of different countries should come forward to advance the R&D setup for energy transition.
- Low-carbon energy setup can be advanced by pioneering RE technology, grid management and storage solutions.
- Public involvement equally plays vital role by encouraging them to consume energy wisely.
- Global policies, their regulation, international exposure and carbon pricing would play crucial role towards energy transition.

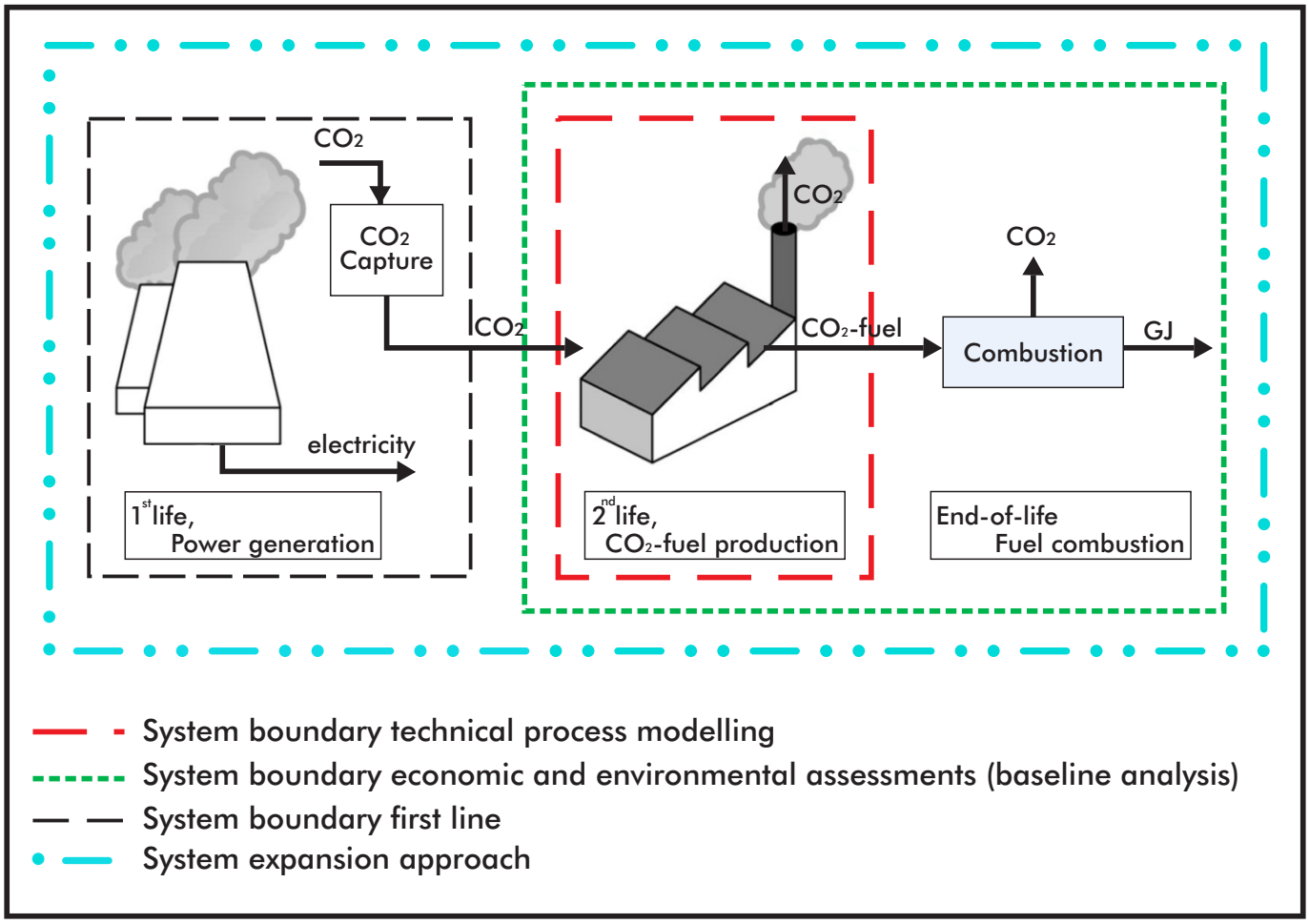
Sincere efforts to implement strategies for developing a low-carbon energy mix are different for various sectors. Therefore, an agile, capable, and responsive institutional mechanism should be developed to achieve effective results.

05

Potential Benefits and Associated Challenges

Energy is the prime source of global development. The transformational shift from dependence on legacy fossil fuels to a low-carbon energy ecosystem is very crucial to sustaining future growth.

Low-carbon Energy System



Source: https://www.sciencedirect.com/science/article/pii/S0306261918317616

Currently, the world demands mutual benefits between Climate Sustainability and energy security. Thus identifying low-carbon energy pathways is required to develop efficient low-carbon energy systems.

Benefits of Low-Carbon Energy System

01 Keep a check on climate change.

02 Enhanced quality of water, land fertility and air leading to the conservation of flora and fauna in the system.

03 Innovation opening doors for varied energy sources like RE will reduced the dependence on fossil fuels and leading to independence including energy security.

04 With renewable energy innovation the locals are self-sufficient to generate their own energy requirement attaining energy independence too.

05 Improved Human Health.

06 Working conditions in RE ecosystem are improved.

07 The transition will open doors for green jobs creation in the RE segment across the domain.

08 Transformation to low-carbon technologies advance economic growth and welcomes additional financial investment.

However, these developments are prone to several challenges and India falls short of achieving its fair share of the carbon budget due to multiple reasons.

Key Challenges

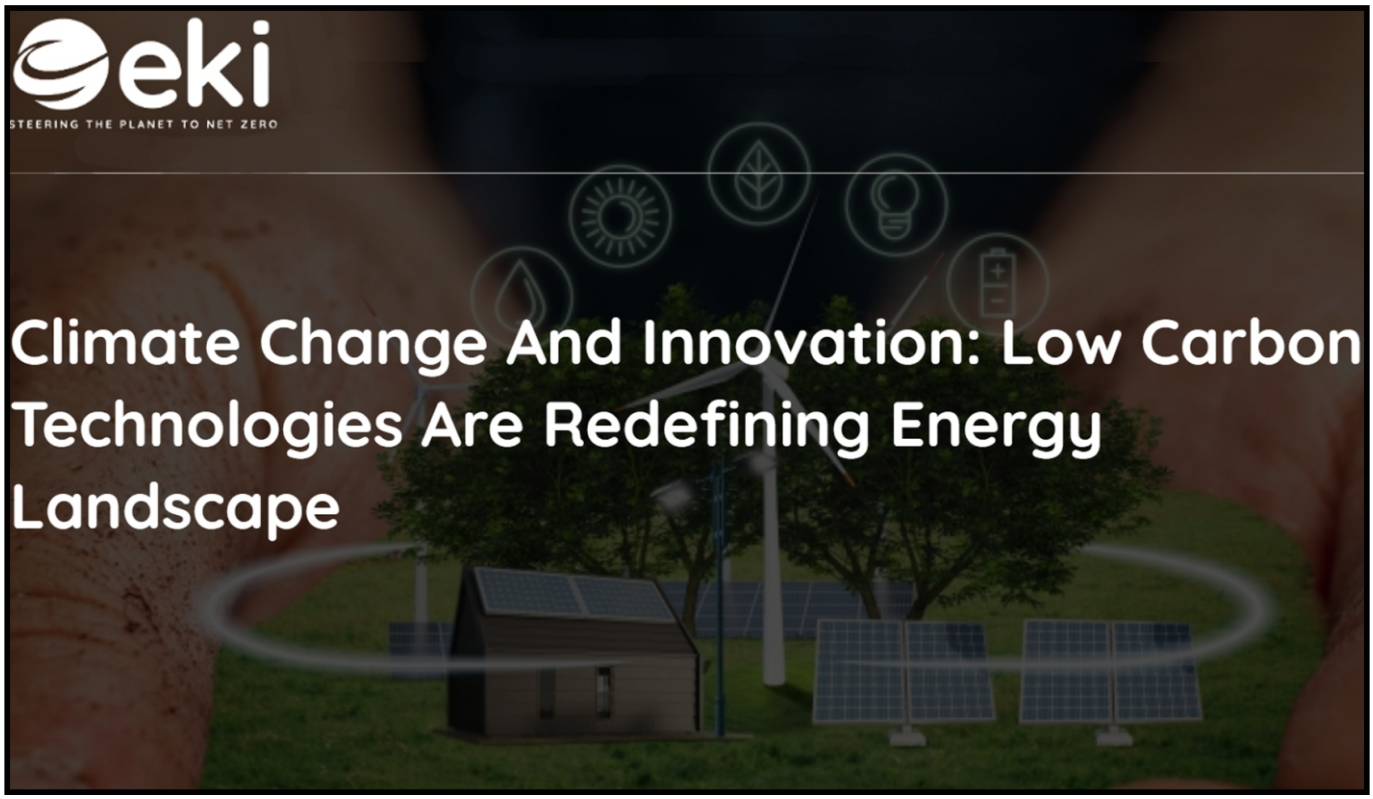
- The production of energy from renewable sources like air, water and others are irregular in nature. Therefore, we need innovative ways for energy storage solutions.
- Integration of existing grids to overcome decentralization of energy production but its complex process.
- Shift in transition demands huge financial investments impacting country's economy.
- Global transformation from traditional fuels to new innovative energy solutions would cause great losses to fossil fuel industries.
- Governments should come with various policies to promote investments for low-carbon projects.
- The transformation phase might face employment concerns for the community associated with fossil fuel or coal industry.

Thus, continuous government hand holding will be required to smoothly transit towards achieving a sustainable energy system. It will help India to decouple economic and industrial growth with increasing emission levels.

06

Low-Carbon Energy Innovation and Research

Advancement in the low-carbon energy production system is an innovation that is redefining the future of clean energy in developing countries. Setting up a low-carbon solution depends on diverse attributes including cultural, political, workforce, availability of technology and natural resources including social acceptability. Thus, just having technology and its distribution will not ensure effective ground for low-carbon development.

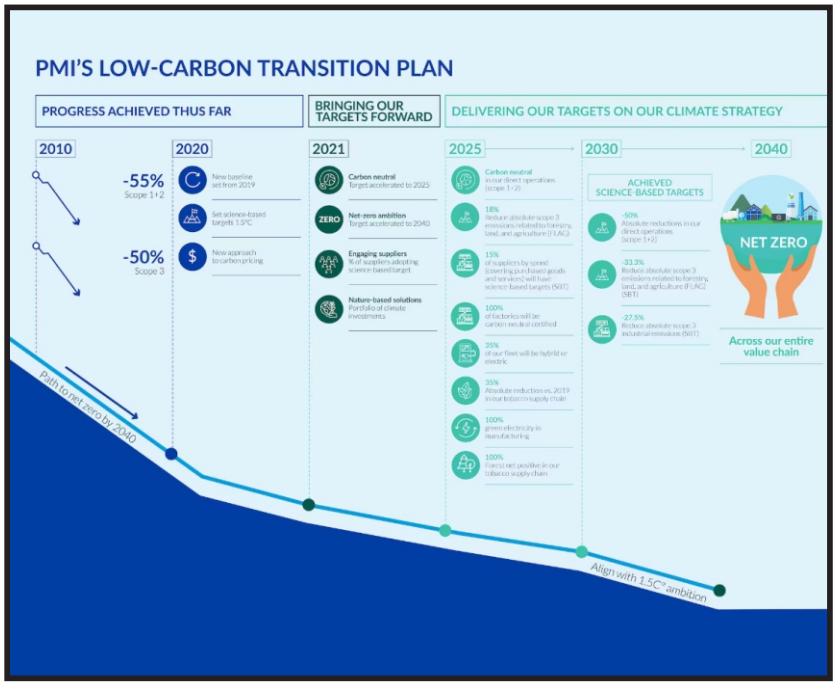


Source: https://enkingint.org/climate-change-and-innovation-low-carbon-technologies-are-redefining-energy-landscape/#:~:text=Renewable%20energy%20sources%2C%20including%20solar,electricity%20without%20emitting%20greenhouse%20gases.

Incorporating technological advancement to achieve energy efficiency is the key. **Technology and knowledge transfer along with ongoing research and innovation are important to achieve energy security**. It will enhance the performance of the indigenously developed solutions at par with global standards.

Research & Development in the Domain

01	Dedicated analysis revealed around 10,442 traditional energy patents and 10,603 renewable energy patents.
02	The selection of the above patents were done on the guidelines of patent citations, technical and commercial usage and global presence in the world of internet.
03	Diverse energy technology invented showcased vital innovation shifts.
04	Research revealed that the nature of the patents are driven on the grounds of geographical, institutional and social factors at large.
05	To assess the profit-oriented importance of the patents the stats for the web hits were studied.
06	The evaluation suggests that the acquired findings should be wisely used to make noble use of research funding to quickly adopt green energy innovations.



Source: https://images.app.goo.gl/m54F36aoJGDx9yEe8

Since 1975, researchers have analysed the vast spectrum of low-carbon energy landscape in the USA. They assessed the potential patented data related to energy systems to identify the contributions made in the field of clean and green energy.

India is also developing strategies to achieve innovation in the low-carbon energy landscape. To this, it has identified the key technological areas where urgent advancement in technology and innovation is required to keep a check on rapid climate change scenarios.

How AG Group Can Be a Help

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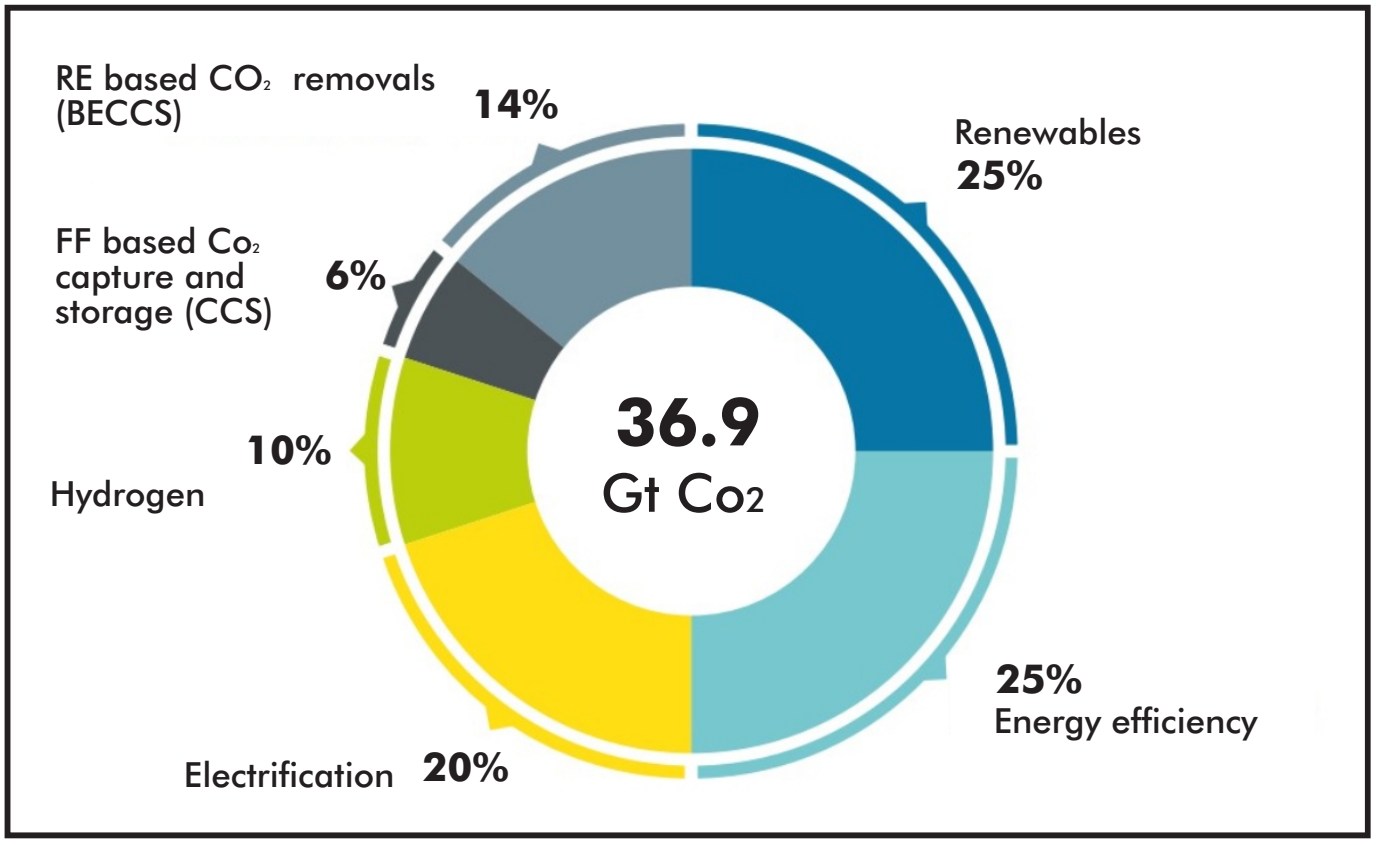
07

Investment Scenario and Global Cooperation

To support innovation and technological advancement in the low-carbon energy sector, financial support in the form of investment and incentives is needed by 2030. This may vary in low-emission, renewable, and nuclear energy among others. It will help in developing the best sustainable alternatives in the low-carbon energy segment.

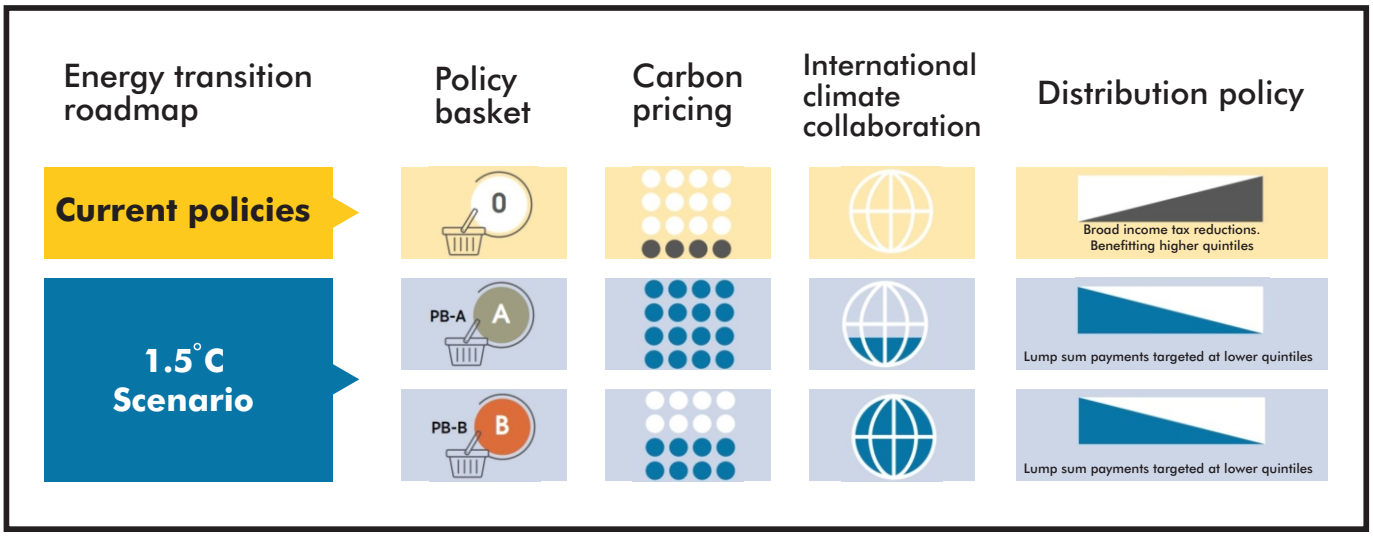
Various Technology Avenues for Emission Reduction by 2050



Source: https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022

The cumulative policy decision with required financial support can help the countries to attain net zero emissions by 2050. The energy sector will require significant financial investments and a dedicated and determined international alliance to materialize all these set priorities.

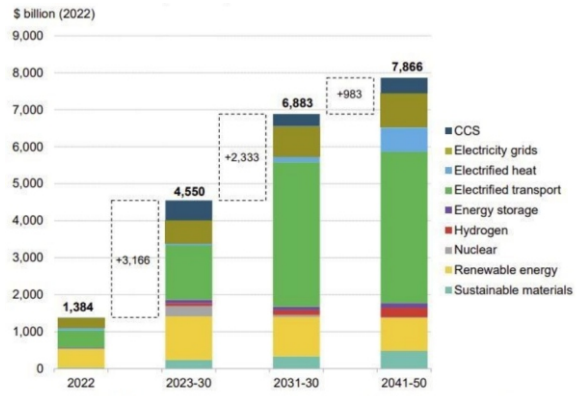
Conceptual Difference Among Various Policy Scenarios Globally



Source: https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022

The International Renewable Energy Agency (IRENA) highlights the significance of holding back global warming to 1.5 degrees Celsius. However, **to achieve this goal, the reduction of around 37 Gigatonnes of carbon emissions from the 2022 level will be required globally**.

Comparison: 2022 energy transition and grid investment versus required annual investment in 2023-30,2031-40, and 2041-50 in NEO 2022 Net Zero Scenario



Source: *BloombergNEF*. Note: *future values are from the New Energy Outlook 2022, except electrified transport, which is from the Electric Vehicle Outlook 2021 Net Zero Scenario.* The *Net Zero Scenario* target global net zero by 2050 in line with 1.77 degrees Celsius of warming. Investment includes electricity grids.

Source: https://images.app.goo.gl/igWdSytsJbjz3U4B6

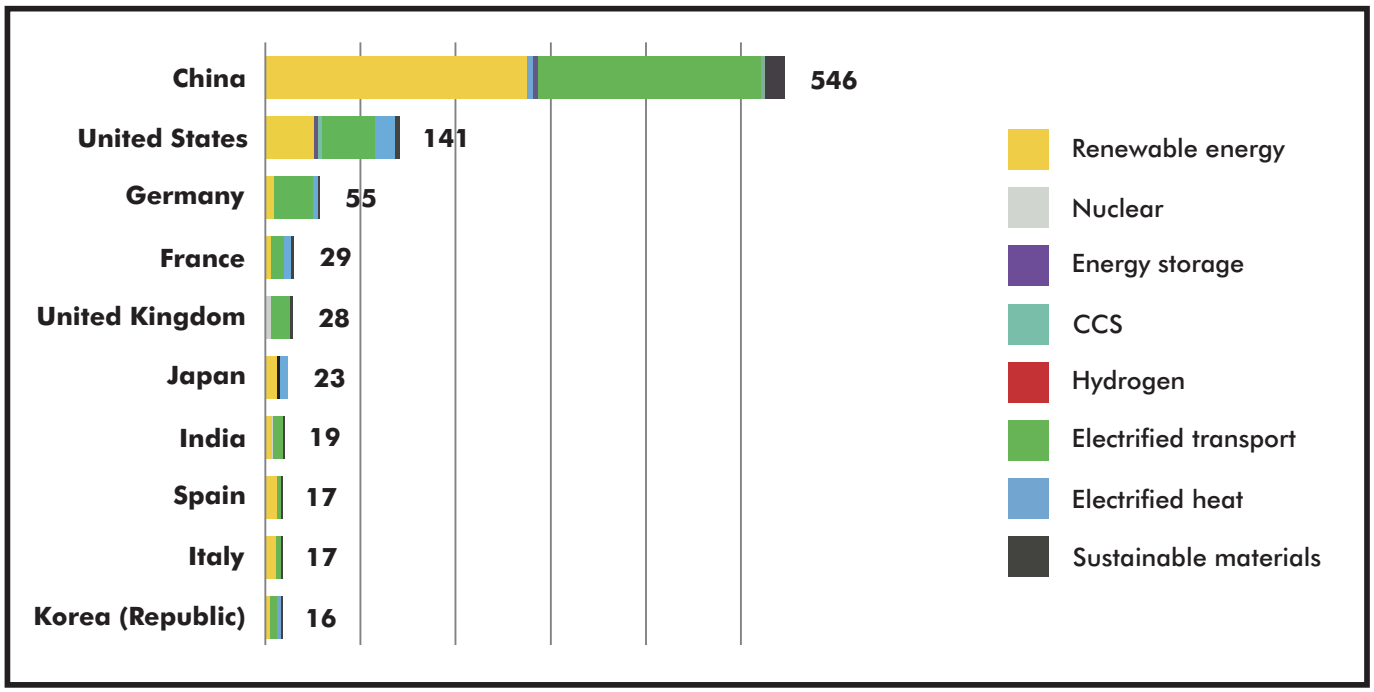
Investment comparison: energy transition versus fossil fuels

Source: *BloombergNEF, IEA. Note: ETI stands for Energy transition investment. FF stands for Fossil fuels. 2018-21 FF values were derived from the IEA World Energy Investment 2022 report. 2022 Fossil fuel investments are BNEF estimates, and include upstream, midstream, downstream sectors and unabated fossil power generation.*

Source: https://images.app.goo.gl/P9QThtvtiZjZq7nP6

Furthermore, implementing energy transition in reality needs huge investments. The majority of this investment will be earmarked for renewable energy projects. The investment will also focus on the seamless operationalization of low-carbon emission projects and grid infrastructure setup.

Top 10 countries for energy transition investment, 2022



Source: https://images.app.goo.gl/3r666UUNgbJu2Wsd6

Stakeholders especially the developed countries are required to come forward with a rigid financial framework to support the clean energy initiatives in the developing and emerging economies.

Global Investment Outlook

The Organization for Economic Co-operation and Development (OECD) including both OECD and non-OECD G20 nations have successfully transitioned to low-carbon energy.

The green energy technologies and framework have witnessed triple-fold increase in the investment going beyond 3 trillion USD globally.

The OECD on the noble grounds syncs with the agenda of net zero emissions by 2050.

Around 2 trillion USD is allocated for the advent of green energy projects.

Globally the investment need in the areas of energy storage, renewables, electric mobility, etc has been highlighted. India is also trying to develop a resilient investment ecosystem of public and private investment for its energy demands with global cooperation and policy support.

08

Supportive Government Policy Structure

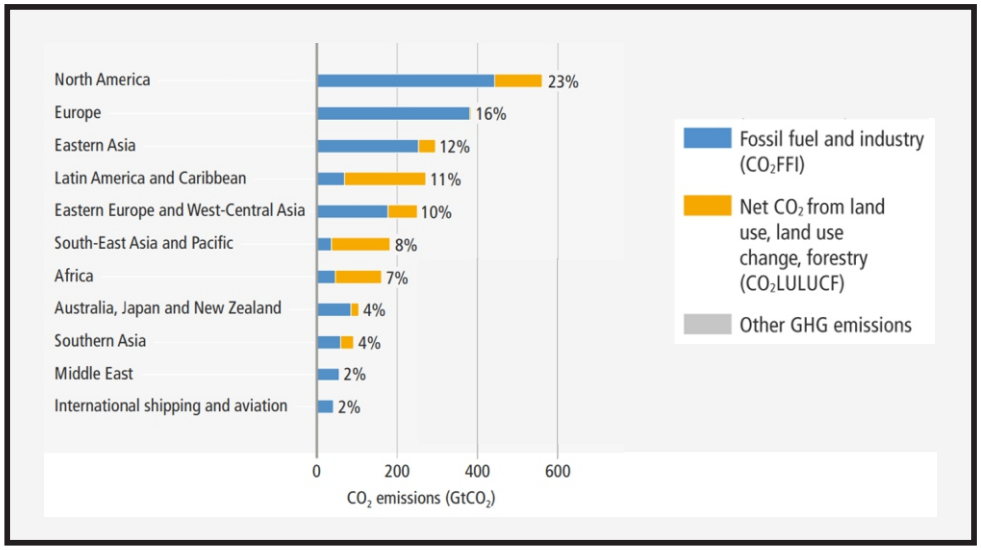
The global transformation towards a low-carbon energy ecosystem is challenging and policy reforms across the globe are taking place. The strong political will with progressive government policy reforms in the energy sector can play an effective role in the smooth transition towards a sustainable low-carbon energy system.

Global Policy Outline for Low-Carbon Energy Scenario

- Make flexible Policies to boost low-carbon financial inclusion and the new investment in the energy infrastructure capable to counter climate change
- The government should study the prevailing rules of the financial sector that could open doors for investments in the low-carbon infrastructure and reduce GHG emissions.
- Reforms should be introduced to scale-up the low-carbon energy innovations and technological advancements against the prevalent use of fossil fuels support by various subsidies.
- The government should focus on the innovation and skills for the low-carbon transition and support potential startups, innovators and business prototypes
- Government should come forward and promote policies that enables ease of doing business by overcoming all sorts of barriers such as import tariffs etc.
- Policy reforms would be needed to innovate efficient energy system and a low-carbon mobility in the transport sector
- Government should rethink on investing and incentivising the electricity domain to ensure a long-term agreement and the regulated system by encouraging the new setup.
- Government should reform policies to witness viable land-use through crucial initiatives like restoring degraded land, controlling deforestation, and low-carbon agricultural practices.

India has always taken a firm stand on common but differentiated responsibility as its contribution to global historical CO_2 emission was minuscule. Thus it fights for its growing energy needs on the global platform to meet aspirations of 'Viksit Bharat' with low-carbon energy solutions.

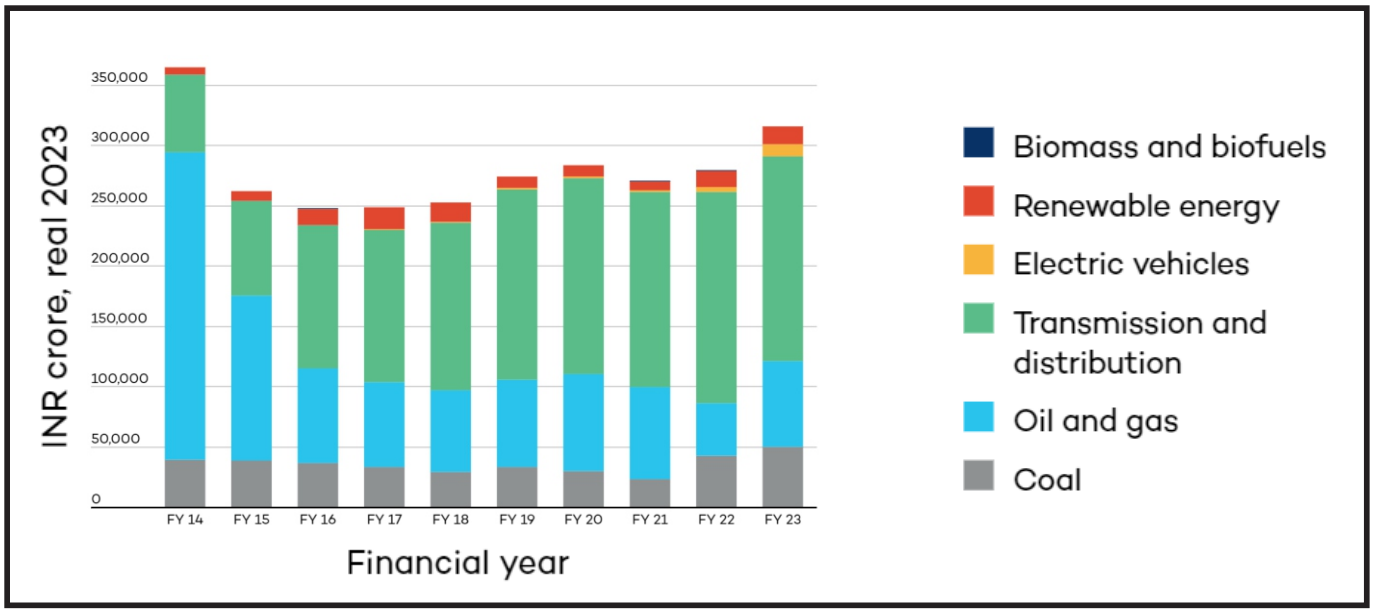
Region-wise Historical Cumulative net Co_2 Emission (Anthropogenic)



Source: https://moef.gov.in/wp-content/uploads/2022/11/Indias-LT-LEDS.pdf

Reforms or the introduction of new policies by various governments are trying to address the challenges of climate change. But with innovation in hydrogen and fuel cell technology, the government is targeting to take benefit of different low-carbon energy alternatives to transition from fossil fuels over time.

India's Public Finance Support to Low-Carbon Energy Solutions



Source: https://www.iisd.org/story/mapping-india-energy-policy-2023/

These policy-level reforms and financial support in the form of incentives for Low-carbon energy transition ensure a sustainable future for India.

09
Way Forward

India is aiming towards achieving sustainable energy solutions to combat climate change. It has adopted several key strategies at policy levels to attain its commitment towards net zero emission. The continuous focus on clean energy solutions is imperatively contributing the India's low-carbon development aspirations along with the promotion of a sustainable lifestyle at the core.

Besides this, India is committed to garnering cooperation in areas such as climate finance, technology & knowledge transfer through collaborative projects, and the joint development of technological standards. It will help the country to progress towards achieving its long-term decarbonization commitments while advancing towards an inclusive and more equitable world order in the 21st century.

10

Expert's Insight

> “Taking India to a developed country status while realizing the clean energy transition is a critical challenge. We should recognize that India can meet it leveraging a time-targeted implementation strategy informed and guided by comprehensive energy studies and technological insights as well as a well-thought through domestic development effort carefully supplemented by well-designed international cooperation.”

Dr Anil Kakodkar
Chancellor,
Homi Bhabha National Institute, Mumbai

RESOURCES

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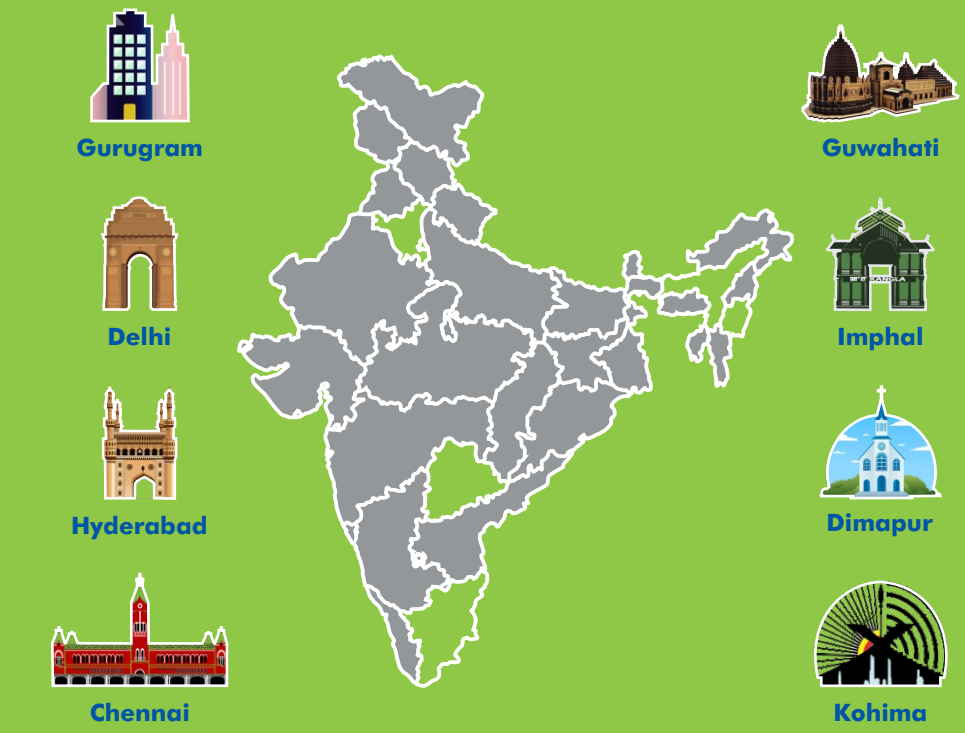

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