CleanTech Sector

THE RISING SUN

Confederation of Indian Industry

TechSci Research
from NOW to NEXT

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FOREWORD

India is at an inflection point where the high growth roadmap meets the need for environmental sustainability. While India continues to be one of the fastest growing large economies, the incessant increase in urbanization and industrialization is resulting in high levels of pollution and environmental hazards.

There have been several debates and discussions on whether we want growth at the cost of health and environment. Definitely, not!

We need to strike a balance between the two, and CleanTech is the most potential solution. Be it renewable sources of energy, fuels, services or manufacturing, companies in India have CleanTech solutions at their disposal.

The regulatory framework in the country well supports the use of CleanTech in various industries and there was never a more suitable environment for those who are still thinking to deploy these technologies and processes into their businesses.

With innovations and new technologies prompting significant progress in this field, the role of leaders with engineering, business, finance, and policy backgrounds have come to the centerstage. There is a strong case to nurture an ecosystem that facilitates proliferation and promotion of CleanTech and we are proud to organize the third edition of CleanTech Summit to fulfill this purpose.

The Summit will also channelize deliberations to catalyze investments in clean technology, address pitfalls and put forth solutions for development of CleanTech industry.

The CII-TechSci Knowledge Report titled **"Cleantech Industry –The Rising Sun"** captures the current trends and emerging scenario of CleanTech in India with a snapshot of global best practices.

I am sure the Knowledge Report will be an important reference point for the industry stakeholders.

With best regards,

Rajesh Sikka
Conference Chairman &
Managing Director
Metaflex Doors India Pvt Ltd

FOREWORD

The Paris Climate Agreement of 2016 caused a fundamental shift in the way the industry and the government think about the environment. All of a sudden, the environment was not simply being seen through the prism of exploitation; companies realized that going green is the only way they can continue working. Sustainability, something that was read about in the news and taught in schoolbooks was soon either set to become a way of life or be the death of humanity, as we know it.

And all stakeholders, whether it be business leaders and thought leaders, the government or the average joe, responded with enthusiasm. Soon, startups started to spring up from the ground backed by conscientious investors and acquiescent governments. Renewables tariffs went down, distributive capacities shot up, visionary government schemes backed intellectual and financial forays and all culminating in one single long term goal - to reduce greenhouse gas emissions and at least stall global warming if not nullify it entirely.

Today, cleantech is not just on its way to profitability, but also a lightning rod for great ideas, something that our knowledge report "CleanTech Sector: The Rising Sun" which offers an overview of the CleanTech market in has tried to bring up. The report also covers emerging trends and global best practices. I sincerely thank to industry leaders, experts and all participants whose valuable inputs helped us to prepare this report. I welcome you to explore this report.

I look forward to your suggestions and feedback.

Best regards,

Karan Chechi

Research Director, TechSci Research

1.

OVERVIEW OF THE CLEANTECH SECTOR THE BIG PICTURE

THE BIG PICTURE
OVERVIEW OF THE CLEANTECH SECTOR

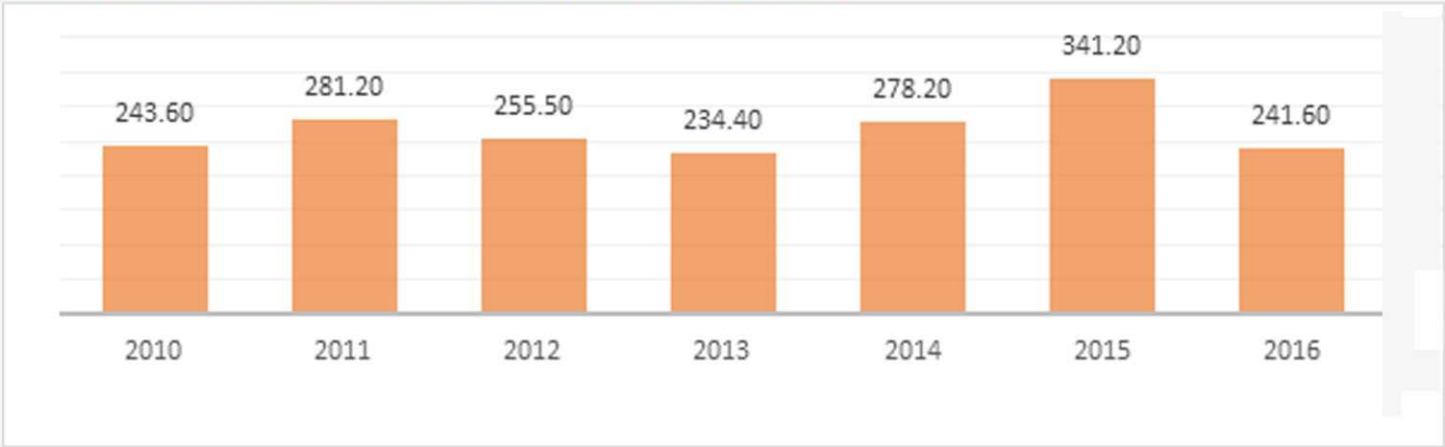
THE BIG PICTURE

The rapid pace of urbanization and industrialization across the globe is linked to the ways natural resources such as water and energy are being produced, supplied, stored, managed and consumed. Population explosion, rising power consumption, growing scarcity of natural resources, recovering commodity prices and altering business models due to climatic change are incessantly driving the transformation towards a decarbonized economy. This in turn is fostering the national economic development plans or strategies that encompass low-emission economic growth.

Economic operators in the cleantech industry come to the rescue as progressive agents utilizing a mixture of technology and innovative business models. These changes will eventually culminate in a shift to a resource-efficient, and a low carbon model that holds the potential to usher in a new era of industrial and technological revolution. All economic agents, from small-scale start-ups to large scale organizations and government bodies globally are adopting cleantech as a ladder for growth, improved work efficiency, sustainability and to attain competitive benefits worldwide. As a technology, it allows wide array of industries to innovate in term of their technology, business mechanisms, financing methods, cross-industry collaboration.

Onshore wind farms, solar thermal and biomass are a few fully commercialized technologies contributing to economic growth across the globe. With increase in technological innovation, a drop in the price of renewable energy equipment is being witnessed. There has been an upsurge in the investment in renewable energy over the last three years, a lot of which has gone towards purchasing additional renewable energy equipment given the sharp reduction in the capital costs in cleantech industries.

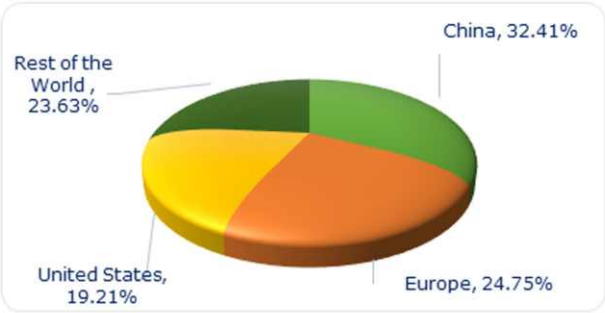
Figure 1: Global New Investment in Renewable Energy, 2010-2016, (USD Billion)



Source: UN Programme Statistics

GEOGRAPHIC ANALYSIS

Figure 2: Global New Investment in Renewable Energy, 2010-2016, (USD Billion)



Source: UN Programme Statistics

There are many countries that are taking a keen interest in the development of their respective renewable energy sectors:

China's steps to support solar energy: The country has been trying push on with its solar sector agenda by offering tax breaks to companies and, through merger and acquisition, to re-structure their operations and promote competition in the country's cleantech market.

European Union setting out strong example- The region is implementing energy efficiency measures via setting up of Energy Efficiency Obligation Schemes (EEOSs). For instance, member state Italy has White Certificates, tradable instruments that provide proof of end-use energy savings through energy efficiency improvement initiatives and projects. As per European Commission, 195 million electricity smart meters would be installed in 16 EU states by 2020 to alter consumer behavior towards energy saving. In 2016, the European Commission published a revised proposal on Renewable Energy Directive to ensure that EU's 2030 target is achieved and it becomes the global leader in renewable energy sector.

US Companies switching to renewable power source: Corporate sector in the country is focusing on reducing its greenhouse gas emissions and operating sustainably. For instance, companies such as Wells Fargo, a US based financial services company, has been working towards achieving its mission of operating 100% by renewable energy by the end of 2017. The Wells Fargo Foundation also said that it would offer additional environmental grants of USD65 million from 2016 through 2020 to boost country's cleantech market.

And the efforts continue….

As part of clean energy initiatives, nations are implementing renewable energy policies and regulations to leverage deployment of renewable energy. In 2014, 98 national and subnational governments had adopted Renewable Electricity Standards (RES). This in turn is also driving growth of the global renewable energy market.

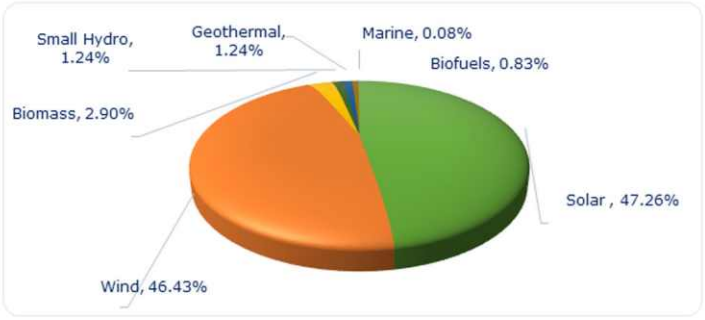
Table 1: Partial List of Installed RSEs, By Country, 2016

State, Country	Renewable Energy Generation
California, United States	33% by 2020 and 50% by 2030
India	17% by 2017
Nova Scotia, Canada	25% by 2017
Republic of Korea	10% by 2020
Romania	20% by 2020

Source: National Renewable Energy Laboratory

SECTOR ANALYSIS

Figure 3: Global New Investment Market Share in Renewable Energy, By Sector, 2016



Source: UN Programme Statistics

Globally, the renewable energy industry is dominated by two sectors- solar and wind. The focus is heavily on lowering the cost of renewable energy from solar photovoltaics, wind farms and on installing hybrid energy decentralized systems. Cheap financing of solar PV and wind projects in many countries has resulted in increased competitiveness between the two sectors. Further, not only are countries focusing on improving efficiency of solar and wind energy generation equipment, but their location of installation and maintenance as well.

Onshore wind has been taken up a notch due to increase in the capacity factors (the amount of electricity a power plant produces in a year). Additionally, growing adoption of crystalline silicon photovoltaic mono cells across the globe is augmenting the solar energy sector share in renewable energy sector.

2.
EMERGING TRENDS IN MAJOR INDUSTRIES

EMERGING TRENDS IN MAJOR INDUSTRIES

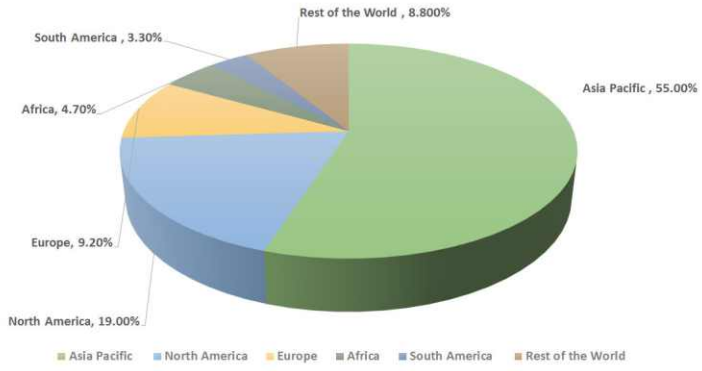
Solar Energy Industry: Improved progression in photovoltaic industry along with shift from high subsidies to low subsidies is occurring at a rapid pace. Lower subsidies would force PV companies to boost research and development efforts in order to survive. In solar PV, over-supply of silicon wafers and solar modules has coaxed manufacturers to reduce the prices within the supply chain.

Wind Energy Industry: Wind power is on the verge of entering the optimization phase with expansion in subsidiary markets. Wind energy operations are being optimized and with implementation and application of 'Internet of Things' and Big Data.

Waste Management Industry: Progressive growth in the industry is mainly witnessed due to foray of Internet of Things that helps resolve bottlenecks including high costs associated with waste management.

Water Industry: Various developing countries are facing water shortage issue. With traditional water and wastewater treatment system such as sewage treatment require improvement, the innovative water treatment methods such as water reclamation are slowly gaining acceptance across the globe.

Figure 4: Global Ground Water Abstraction Share, By Volume, By Region, 2014



Source: Future of Science

3.
BEST PRACTICES

BEST PRACTICES

In 2016, US-India Clean Energy Finance (USICEF) initiative was launched. It is a fund to support the Promoting Energy Access Through Clean Energy (PEACE) track of the US-India Partnership to Advance Clean Energy (PACE). The objective of this initiative is to leverage set up of off-grid clean energy in commercial sector by through funding grants for development and testing of innovative products, system and business methods.

BOOMING INVESTMENT SCENARIO: Government organizations, policy formulators and investors are acquainted with the benefits of implementing clean technology startups. Be it in deciding the greenhouse gas emissions target roadmap, improving labor force participation rates, finding methods for preserving biodiversity, raising profit margins, or setting up new technology sectors, the investment scenario for clean technology companies has been decidedly rosy so far. According to clean tech group data there has been more than USD55 billion equity investments in cleantech startups during 2010-2016 across the globe.

CREATING AN IMPACT

In 2016, 21st session of the UNFCCC Conference of the Parties (COP21 Paris), also termed as Breakthrough Energy Coalition was launched. It comprised of a team of more than 25 investors from 10 countries with the aim of addressing issues related to climate change. The new initiative revolves around clean energy with the aim of offering investment for start-ups involved in cleantech innovation, beginning with USD 2 billion value that is expected to reach to USD20 billion by 2025, globally. Such efforts by global authorities would drive the innovation in renewable energy sector, majorly in solar and wind energy.

FORAY OF CLEAN ENERGY SOLUTIONS FROM SMALL SCALE COMPANIES (STARTUPS)

Table 2: Partial List of Innovative New Renewable Energy Companies, 2016

Startup Name	Location	Objective
1366 Tech	Massachusetts	Working towards making solar wafers cheaper to reduce the cost of photovoltaic panels
Aemetis	California	Develop advanced biochemicals and renewable fuels to reduce dependency on petroleum products
Airlight Energy	Switzerland	To develop sustainable renewable technology using solar technology
Azuri	United Kingdom	Launched PayGo solar system that offers electricity to people living off the grid.
Ensyn	Ontario	Production of renewable liquid fuels and chemicals using wood biomass.

Source: Global Cleantech Innovation Index Report

Table 3: Top 10 Global Clean Tech Innovation Index Companies, 2017

2017 Rank	Countries
1	Denmark
2	Finland
3	Sweden
4	Canada
5	United States
6	Israel
7	United Kingdom
8	Germany
9	Norway
10	Switzerland

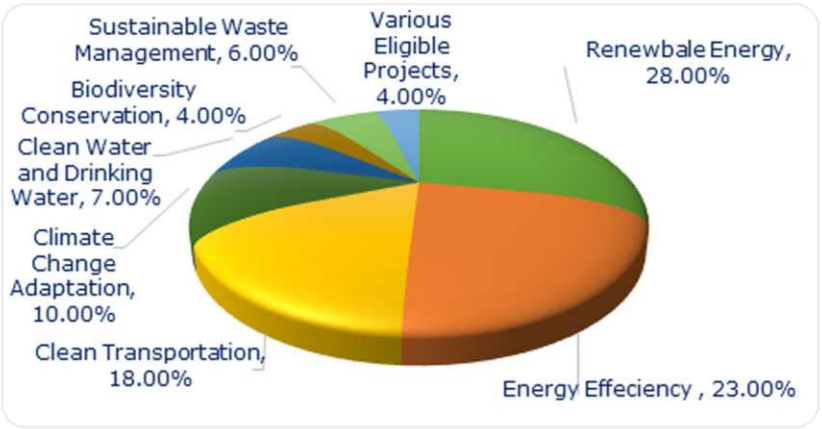
Source: Global Cleantech Innovation Index Report

Denmark topped the 2017 index due to increased funding for clean tech and number of cleantech companies in the country. The country also demonstrates highest number of employment in renewable energy sector showcasing strong growth of commercialized cleantech.

GREEN BONDS – A support to Cleantech

Green bonds are turning out to be a rage across countries driving the cleantech and renewable energy investment. According to Global Cleantech Innovation Report, the global Green Bonds market was worth USD95 billion in 2016. Energy efficiency, transportation and renewable energy sectors captured 70% of the market share in 2016. These are the three key priority sectors for future investments to enable development of a completely decarbonised global economy across the global.

Figure 5: Global Green Bonds Issuance Market Share, By Sector, 2016



Source: Global Cleantech Innovation Index Report

4.

CLEANTECH THE KEY APPLICATION PLATFORMS

INTELLIGENT BUILDING AND RAW MATERIAL MANAGEMENT

Architects, construction firms, photovoltaic manufacturers, green building material producers, building management systems, among others are focusing on promoting innovation in construction through the concept of intelligent building. Such construction efforts employ clean technologies to offer cost effective, eco-friendly and well-constructed building projects.

High quality raw material, from the time of procurement to the time of their disposal, has associated long-term costs. The high costs involved are managed by introducing the life cycle design concept consisting of cost-benefit analysis at each stage of the construction process including procurement of raw materials, manufacturing, distribution, and installation, and final reuse or disposal during pre-building and post-building phases.

SMART CITY CONCEPT

The combination of integrated and systemic solutions in construction sector has led to increased adoption of clean technology. Implementation of green roofs and walls in new construction helps improve energy efficiency of buildings as well as the retention of the biodiversity of such locales.

ENHANCING ENERGY EFFICIENCY

Most of the energy produced and consumed is mainly wasted during transmission, heat loss. Counties are focusing on reducing energy consumption by implementing energy efficiency framework consisting of smart grids. This technology utilizes computer-based control and automation systems to improve energy efficiency on the electricity grids.

5.

WORLDWIDE NOTABLE CLEANTECH FUNDINGS

WORLDWIDE NOTABLE CLEANTECH FUNDINGS

- In **2016**, Ottawa's Business Development Bank of Canada approved USD406 million financing to Energy/Cleantech Fund (ECF), which would invest it in well-established Canadian companies that boost energy efficiency and productivity.
- Horizon **2020-** European Union's Research and Innovation Programme gives USD6.90 billion as funding for projects in energy sector for a duration from 2014- 2020. The energy projects help in enhancing implementation of clean energy technologies including energy storage, energy networks, tidal power in the region.
- European Structural and Investment Funds (ESIF) has funded USD20.94 billion to energy efficiency and USD6.98 billion to renewable energy projects for buildings and district heating and cooling along with approximately USD1.16 billion to smart distribution grids for a period of 2014-2020 across EU.
- In **2017**, International Finance Corporation announced its investment plans in Tata Cleantech Capital Ltd., which would further offer financing services for projects pertaining to renewable energy, waste management, water management, energy efficiency among others in India.
- In **2015,** New York Green Bank funded USD100 million to Renew Financial, a US financing company, for aiding in expansion of its clean energy and energy efficiency finance products across United States.

6.

INDIA CLEANTECH SCENARIO

INDIA CLEANTECH SCENARIO

Coal and gas are the prominent sources of energy in India and held approximately 58% and 9% share respectively in the total energy consumption basket of the country in 2016. Robust economic growth coupled with rapid urbanization rate, increasing per capita energy consumption, and a burgeoning middle-class population is likely to propel energy demand in the country.

In 2016, India's renewable energy market stood at USD17 billion. There is certain untapped potential in generating energy. So far, only 19.97 Giga Watt out of total estimated potential of 200 GW have been utilized. As per the Governments' estimation, the country requires 150 GW of power capacity in coming 5 years, which would encompass a USD200 billion investment the will help bridge the supply/demand gap.

Clean tech in the country covers all the possible domains starting from renewable energy, water and waste water management, electronic waste (e-waste) disposal and recycling. Clean Tech is a culmination of services, processes and products that make use of renewable materials and energy resources to reduce the dependency on natural resources and at the same time cut and eliminate.

WATER

Table 4: Water Sector Issues and Cleantech Opportunities in India

Issue	Driven By	Opportunity for Cleantech
High energy cost	Waste water treatment process are energy incentives with high operating costs.	Implementation of energy efficiency technologies
Water shortage	Population explosion, industrial expansion	Water conservation and reuse technologies, off gird water systems
Deteriorating infrastructure	Ageing water infrastructure resulting in water loss/leakage	Implementation of decentralized system

Source: TechSci Research

7.

REGULATORY ENVIRONMENT

REGULATORY ENVIRONMENT

Already deeming as a water stressed nation, various cities in India are reeling under severe water crisis. To recover from such scenario, India has been formulating, implementing and adopting various government policies that have been acting as a driver for cleantech in water sector of the country.

» **March 2016** - Announcement of USD2.46 billion funding by central government for a National Hydrology Project (NHP). The objective is to establish a system for authentic water resource data acquisition, storage and management. The project is aimed at bringing a definitive approach for water management by addressing the issue at a national level.

» **2015** - Launch of Smart Cities Mission in India plans to eliminate urban water challenges by inculcating water reuse technologies. Advanced sewage digestion process results in increased amount of biogas – a byproduct, which can be used as a fuel for heat and power generation to bring in the concept of smart cities sustainability goals.

» **2015** - India and the USA signed a Memorandum of Cooperation(MoU) to set up PACESetter Fund, which would support Promoting Energy Access Through Clean Energy (PEACE) to promote flagship initiative the promoting energy access through clean energy track of the US-India partnership.

ENERGY

Government's National Mission on Enhanced Energy Efficiency (NMEEE) launched in 2010 has targeted four initiatives for pacing up the implementation of energy efficiency efforts in the country

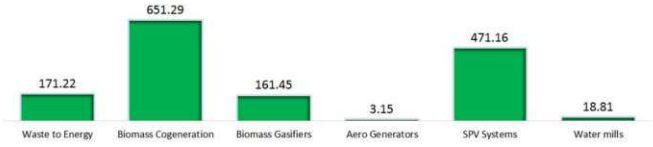
» **Perform, Achieve and Trade (PAT)** - It is a market-based mechanism that helps implement energy efficiency improvements in energy intensive industries in cost-controlled manner. It covers eight industry sectors thermal power, cement, iron & steel, fertilizer, textile, pulp & paper, aluminum and chlor-alkali.

» **Market Transformation for Energy Efficiency (MTEE)** - Promotes shift to energy-efficient appliances by making products more affordable to the masses

» **Energy Efficiency Financing Platform (EEFP)** - platform covering demand side management plan to reduce electricity use through activities.

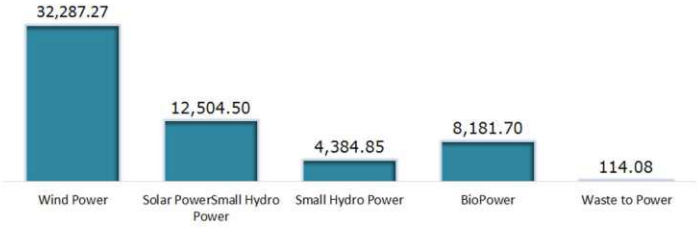
» **Framework for Energy Efficient Economic Development (FEEED)** - Aimed at developing the fiscal policies involving taxation and budgeting to promote energy efficiency.

Figure 6: India Grid Interactive Power Capacity Achieved, By Power Type, Mega Watt, as on 30-4-2017



Source: Ministry of New and Renewable Energy

Figure 7: India Off-Grid Interactive Power Capacity Achieved, By Power Type, Mega Watt, as on 30-4-2017



Source: Ministry of New and Renewable Energy

India suffered approximately 25% electricity loss in transmission and distribution (T&D) in 2016. Owing to robust growth in country's electricity markets, the country needs to focus on modernizing its grid infrastructure so as to be able to handle its current and future energy demands. Thus, smart grids are a rage in the country; some key examples include:

1. Launch of a pilot smart grid project for industrial consumers in Kerala by Central Ministry of Power at a sanctioned value of USD4.35 million for the project including 40% funding as a grant.

2. In 2012, announcement of USD25 million smart grid program by Maharashtra government including electricity distribution in eight nearby cities.

3. Implementation of a pilot project on smart grid upon successful collaboration of Puducherry Electricity Department with the Power Grid Corporation of India. The project is expected to cost USD11.8 million and includes installation of smart meters in 87,000 houses in Puducherry.

8.

WAY FORWARD

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WAY FORWARD

The focus towards Cleantech has been growing at a tremendous pace resulting in increased number of innovations, drop in prices and formulation of new policies frameworks. With the aim of eliminating the problem of environmental issues caused by non-renewable sources of energy, clean technologies have slowly gained global recognition and acceptance.

Sufficient energy demand-supply gap on account of robust industrial growth, population growth and urbanization, huge availability of untapped renewable energy resources, rising number of associated environmental and social issues are driving the cleantech market across the globe, especially the emerging economies.

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ABOUT CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, playing a proactive role in India's development process. Founded in 1895, India's premier business association has over 8,300 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 200,000 enterprises from around 250 national and regional sectoral industry bodies.

CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water, to name a few.

With 67 offices, including 9 Centres of Excellence, in India, and 10 overseas offices in Australia, Bahrain, China, Egypt, France, Germany, Singapore, South Africa, UK, and USA, as well as institutional partnerships with 344 counterpart organizations in 129 countries, CII serves as a reference point for Indian industry and the international business community.

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