Engineering Council of India

17th National Conference

on

'Role of Engineers in Achieving Sustainable Development Goals'

Friday, November 29, 2019

Souvenir

Partner Organisations :

AICTE

Network India

Patron Sponsor :

Oil and Natural Gas Corporation Ltd.

Supported by :

Member Associations of ECI

Venue :

Multipurpose Hall
India International Centre
40, Max Mueller Marg, New Delhi -110003

Engineering Council of India

17th National Conference
on
Role of Engineers in Achieving Sustainable Development Goals

November 29, 2019 • New Delhi

Souvenir

Engineering Council of India
1304, Hemkunt Chamber, 89, Nehru Place, New Delhi-110019
Tel. : +91-11-41783281, 41783282, 26283281
Telefax : +91-11-26283282, E-mail : eci@ecindia.org
Website : www.ecindia.org

Contents

**Keeping in view the environmental implication only soft version of the papers are available on demand : (eci@ecindia.org)*

प्रो. एम.पी. पूनीयाँ
उपाध्यक्ष
Prof. M.P. Poonia
Vice-Chairman

November 11, 2019

सत्यमेव जयते

अखिल भारतीय तकनीकी शिक्षा परिषद्
(भारत सरकार का एक सांविधिक निकाय)
(मानव संसाधन विकास मंत्रालय, भारत सरकार)
नेल्सन मंडेला मार्ग, वसंत कुंज, नई दिल्ली–110070
दूरभाष: 011–26131495
ई–मेल: vcm@aicte-india.org

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
(A STATUTORY BODY OF THE GOVT. OF INDIA)
(Ministry of Human Resource Development, Govt. of India)
Nelson Mandela Marg, Vasant Kunj, New Delhi-110070
Phone: 011-26131495
E-mail: vcm@aicte-india.org

Message

It gives me immense pleasure to learn that **Engineering Council of India (ECI)** is organizing its 17th National Conference on 29th November 2019 at New Delhi.

The theme *"Role of Engineers in achieving Sustainable Development Goals"* is significant and quite relevant in today's context. I am confident that the deliberations in this conference would result in knowledge sharing and wide awareness among engineers for the cost efficient use of natural resources, that support human and natural environment.

My best wishes for the success of this conference.

(Prof. M.P. Poonia)

Dr. Uddesh Kohli
Chairman

Chairman Emeritus : Construction Industry Development Council
Former : Chairman, Consultancy Development Centre
: CMD, Power Finance Corporation; Adviser, Planning Commission

Engineering Council of India

Message

Engineering Council of India, which was formed by coming together of a large number of professional associations/institutions of engineers, has been organizing a National Conference every year on a theme which is relevant to the engineering profession, society and country. The theme chosen for the 17th Conference, namely, "Role of Engineers in achieving Sustainable Development Goals" is very apt and timely. The engineering profession today needs to explore, develop, adopt use of new and emerging technologies whichare not only cost efficient but are also sustainable and support inclusive growth that integrates the poorest and at the same time maintains environmental balance for a better quality of life of people.

This is an opportunity for our engineers to discuss how to improve quality of development effortsand use technologies that are more affordable and cost efficient for achieving sustainable development.

I hope the deliberations at the Conference will be of great help conceptually and practically to pursue and develop cost efficient technologies. I wish the Conference all success.

(Uddesh Kohli)

Tel. : +91-11-41783281
Telefax : +91-11-26283282
E-mail : eci@ecindia.org
Website : www.ecindia.org

1304, Hemkunt Chamber
89, Nehru Place
New Delhi-110019

Dr. P R Swarup
Member Secretary

Engineering Council of India

Message

Engineering Council of India is organizing the 17th National Conference with the theme "Role of Engineers in achieving Sustainable Development Goals" with the support of All India Council for Technical Education(AICTE) and all Member Associations on November 29, 2019 at New Delhi.

Indian Engineers have taken a lead in sustainable development by developing simple cost effective technology to provide most desirable sanitation for the rural and urban poor. India has provided toilet facility for nearly 60 million families in just in 3 years. Engineering innovations have achieved energy security by harnessing solar energy in a cost efficient manner which affordable by common man and also are close to the target given to the world. It is also leading the world in solar energy development to fight climate change. Role of engineers in achieving sustainable development goals is a great opportunity to continuously innovate cost efficient technology to improve the quality of life of the people in India and World.

I am confident that the Conference will provide a forum for engineers, technologists, service providers, industry and other stakeholders to exchange knowledge and information which will benefit in employability of engineering innovations.

We at ECI are looking forward to compile and implement the recommendations arising out of this Conference and provide a road map for future economy and establishing India as global leader.

(Dr. P R Swarup)

Tel. : +91-11-26283281, 26283282
Fax : +91-11-26283283
E-mail : eci@ecindia.org, ecindia@vsnl.net
Website : www.ecindia.org

1304, Hemkunt Chamber
89, Nehru Place
New Delhi-110019

J. L. Narayan
Executive Director
Former Adviser, Ministry of Statistics and Programme Implementation, Govt. of India
Former Economic Advisor to Govt. of FIJI and St. Lucia Commonwealth
Former Management Expert to Govt. of Maldives, UNDP
International Consultant to Royal Govt. of Cambodia, ADB

Engineering Council of India

Message

I am delighted to share the information that Engineering Council of India (ECI), with AICTE and its member associations, is jointly organizing the 17th National Conference on the theme, "Role of Engineers in achieving Sustainable Development Goals" on November 29, 2019 at the Multipurpose Hall, India International Centre, 40, Max Mueller Marg, New Delhi.

Role of Engineers in achieving Sustainable Development Goals has a vast horizon as engineers have a role in every walk of life, may be it is agriculture, water harvesting and conservation, cost efficient sanitation, harvesting cost efficient natural resources and environment, solar energy production and distribution, safe digitization of services, cost efficient environment friendly infrastructure development, design and planning of projects that support inclusive sustainable development and economic growth. The conference would not only discuss these challenging role of engineers but also about role of academic/ engineering colleges and institutions together which can contribute towards achieving sustainable development goals 2030 at a faster pace.

The conference management team would record the proceedings andcompile the Salient recommendations which can be used as a guide for strengthening the role of engineers in achieving sustainable development goals.

I appreciate and feel proud to be a part of the Engineering Council of India that has always been proactive in making the engineering profession responsive to the needs of the Indian Society.

I also acknowledge the support from all Member Associations, AICTE, the Corporate Sponsors, Paper contributors and the ECI Team to make the event successful.

(J L Narayan)

Tel. : +91-11-26283281, 41783281
Telefax : +91-11-26283282
E-mail : ed@ecindia.org, eci@ecindia.org
Website : www.ecindia.org

1304, Hemkunt Chamber
89, Nehru Place
New Delhi-110019

BACKGROUND PAPER

Sustainable Development in India, a Brief Presentation as to how engineers can help in achieving SDG's 2030 and lead the economic growth

- Prof. Jawahar Lal Narayan*

Synopsis

Engineers can play an important role in sustainable development by planning and building projects that preserve natural resources, are cost-efficient and support human and natural environments. A closed-loop human ecosystem can be used to illustrate the many activities of engineers that support sustainable development.

The India's achievement of SDGs over the last five years is really laudable, the government has been ensuring that people at the "bottom of the pyramid" get the benefits that are due to them the benefits flow to them through the trinity of government initiatives - Jan Dhan bank account, Aadhaar unique identity number and mobile phone. The financial inclusion through 310 million accounts, 120 million gas stoves provided, the sanitation drive which built nearly 60 million of toilets across the country and the Ayushman yojana to cover health needs of the poor. According to 2019 global Multidimensional Poverty Index (MPI) of UNDP, India lifted 271 million people out of poverty between 2006 and 2016. India's health coverage has also helped reduce poverty and improve livelihood. That number alone is mind-boggling and it speaks to the success of targeted interventions at a level and scale of ambition that is without parallel in any other country in the world.

The result has been that, today, India is the fastest growing large economy in the world. It grew 7.9 percent during fiscal year 2015-16 and 7.1 per cent during 2016-17. Growth has brought increased volume of revenues, which have permitted the Government to sustain a high-level of social spending that directly targets poverty.

Role of Engineers is seen everywhere in the world. Indian Engineers have made India, an "epicentre" of innovative solutions towards the SDGs, both frugal innovations and the most advanced technological and digital-based solutions. The country is also the epicentre for achieving the SDGs globally with international partnerships and one can see already that "India is not shying away from that responsibility and is bearing that responsibility with great sense of seriousness and understanding of the implications for the world and achievement of SDGs."

This compilation covers, quite in detail about Indian efforts in localising SDGs, developing 150 SDG Index and taking up well laid out action plans within the national policy framework which are fully synchronised with our national development goals and with possible linkages and international partnership to bridge any gaps.

Sustainable Development

The concept of sustainable development is continuously changing from nature's closed cycle to closed -loop human ecosystem to National and International Development.

The American Society of Civil Engineers (ASCE) defines sustainability as a set of economic, environmental and social conditions ("The Triple Bottom Line") in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality or the availability of economic, environmental and social resources. Sustainable development is the application of these resources to enhance the safety, welfare, and quality of life for all of society.

This is the concept which has been used for economic appraisal of projects in India, ever since independence to achieve sustainable development objectives which are based on three pillars of social development (social inclusion), environment and financial sustainability using life cycle assessment from planning to reuse. Sustainable development in the national context is the inclusive economic growth that integrates the poorest lot in development and at the same time maintains environmental conditions for a better quality of life of its people.

*Executive Director, Engineering Council of India

According to World Commission on environment and development 1987,'Humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.' This is an important tag to proceed.

Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030 poverty

In September 2015, the General Assembly adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). Building on the principle of "leaving no one behind", the new Agenda emphasizes a holistic approach to achieving sustainable development for all.

The proposal contained 17 goals with 169 targets covering a broad range of sustainable development issues. These included ending poverty and hunger, improving health and education, making cities more sustainable, combating climate change, and protecting oceans and forests.

Status of Sustainable Development Goal in India

India is part of the Voluntary 2020 High Level Political Forum (HLPF) on sustainable development

In its pursuit to achieve sustainable development goals, India localised the SDGs in national development goals well in time and assured commitments to achieve them. India has also released 150 SDGs Index in December 2018. A report submitted by the government for voluntary review of SDGs for HLPF is submitted here:

The expression "Sabka Saath Sabka Vikas," which translates as "Collective Effort, Inclusive Growth" and has been popularized by Prime Minister Narendra Modi, forms the cornerstone of India's national development agenda. To fast track this agenda, the Government of India has just released a draft Three-Year Action Agenda covering years 2017-18 to 2019-20. In parallel, work is in advance stages on a 15-Year Vision, which will also include a 7-year Strategy. Reflecting the country's long-standing federal tradition, these documents are being prepared with active participation of the States (sub-national Governments).

Reflecting the country's commitment to the SDG agenda at the highest levels of Government, the Indian Parliament organized several forums including the South Asian Speakers' Summit in February 2017. These forums have focused on the elimination of poverty, gender equality, climate change and resource mobilization for SDGs. Additionally, the Speaker's Research Initiative has been launched for providing SDG-related insights to Members of Parliament.

For implementing the SDG agenda, the Government of India has launched several ambitious programmes, some of which are highlighted below. A noteworthy example of a crosscutting initiative is the Pradhan Mantri Jan Dhan Yojana (PMJDY) which is the world's largest financial inclusion programme. By leveraging PMJDY, Aadhaar (biometric identity system) and mobile telephony, the Government has disbursed a cumulative amount of INR 1.62 trillion (USD 25 billion) to 329 million beneficiaries through Direct Benefit Transfers.1 This has helped to significantly enhance the efficiency of Government programmes.

Further, special efforts have been made to invigorate the federal governance structure of the country through cooperative and competitive federalism. State Governments are playing a prominent role in advancing the national development agenda. The recommendations made by three sub-groups of Chief Ministers of States on various themes including the Swachh Bharat Abhiyan (Clean India Movement) and skill development have contributed towards shaping relevant policy decisions at the national-level.

India's bold Nationally Determined Contributions (NDC), communicated to the Conference of the Parties (COP) of the UN Framework Convention on Climate Change, form a significant part of its SDG strategy. These include substantially reducing the emission intensity of GDP, tapping non-fossil fuel energy sources and creating additional carbon sink.

The responsibility for overseeing SDG implementation has been assigned to the National Institution for Transforming India (NITI Aayog), which is the premier policy think tank of the Government and is chaired by the Prime Minister of India. NITI Aayog has mapped the goals and targets to various nodal ministries as well as flagship programmes. State Governments are also engaged in developing roadmaps for achieving the SDGs with several of them having already published

their plans. Draft indicators for tracking the SDGs have been developed and placed in the public domain by the Ministry of Statistics and Programme Implementation for wider consultation.

The main messages for India's Voluntary National Review of SDG implementation encapsulate the progress made with respect to Goals 1, 2, 3, 5, 9, 14 and 17. This is not to suggest that progress has not been made with respect to other goals. Interconnections across the 17 SDGs are so strong that the pursuit of the goals explicitly discussed below necessarily involves the promotion of other goals as well.

Important observations are:

India is focused on good governance, sustainable livelihood and cleaner environment in achieving SDGs 2030 is of great significance:

- The India's achievement of SDGs over the last four years is really laudable, the government has been ensuring that people at the "bottom of the pyramid" get the benefits that are due to them the benefits flow to them through the trinity of government initiatives.
- The Government's agenda of Sabka Sath Sabka Vikas well-conceived in the Flagship Programs like:
  - Aadhaar unique identity number and mobile phone.
  - Swach Bharat Mission
  - Beti Bachao, Beti Padhao
  - Pradhan Mantri AwasYoojna
  - Pradhan Mantri JandhanYojna
  - Pradhan Mantri UjjwalaYojna
  - Deen Dayal Upadhyay Gram Jyoti Yojna
  - Ayusman Yojana
- The financial inclusion through 310 million accounts, 120 million gas stoves provided, the sanitation drive which built nearly 60 million toilets across the country and the Ayushman yojana to cover health needs of the poor are some laudable achievements

SDG 6- Clean Water and Sanitation (8 Targets)

The Wikipedia compilation of water sanitation statistics reveals that a lot has yet be done to achieve a desirable level of potable water availability for personal consumption. India has made tremendous progress in providing basic sanitation. The present status of Water and Sanitation is as follows:

Access to at least basic water	88% (2017)
Access to at least basic sanitation	98.9% (2019)[2]
Average urban water use (liter/capita/day)	126 (2006)[3]
Average urban water and ewer bill for $20m^3$	US$2 (2007)[4]
Share of household metering	55 percent in urban areas (1999)[5]
Share of collected waste water treated	27% (2003)[6]
Annual investment in water supply and sanitation	US$5 / capita[7]
Institutions	
Decentralization to municipalities	Partial
National water and sanitation company	No
Water and sanitation regulator	No
Responsibility for policy setting	State Governments; Ministry of Housing and Urban Poverty Alleviation, Ministry of Urban Development and Ministry of Drinking Water and Sanitation at the Federal Level
Sector law	No
Number of urban service providers	3,255 (1991)
Number of rural service providers	about 100,000

SDG 4: Quality Education (10 Targets)

Ensure that all girls and boys complete free, equitable and quality primary and secondary education by 2030.

A quality education is the foundation of sustainable development, and therefore of the Sustainable Development Goals. As a policy intervention, education is a force multiplier which enables self-reliance, boosts economic growth by enhancing skills, and improves people's lives by opening up opportunities for better livelihoods.

In India, significant progress had been made in universalising primary education, with improvement in the enrolment and completion rates of girls in both primary and elementary school. The net enrolment ratio in primary education for boys and girls was at 100%, while at the national level, the youth literacy rate was 94% for males and 92% for females. India has the largest youth population of 423 million. However, the gross enrolment in higher education is only25.8%. About 55% of the people with disability are literate. India's adult literacy is 74.04% and in rural areas it is 68.91%. International average shows global literacy rate 86.2% but 63.67 million children out of school.

The new national Education Policy and Sustainable Development Goal 4 share the goals of universal quality education and lifelong learning. The flagship government scheme, Sarva Shiksha Abhiyan, is aimed at achieving universal quality education for all Indians, and is complemented in this effort by targeted schemes on nutritional support, higher education, and teacher training.

SDG 7: Affordable and Clean Energy (5 Targets)

Ensure access to affordable, reliable, sustainable and modern energy for all by 2030.

There is no development without fueling the engine of growth. Energy is critical and people with no sustainable access to energy are deprived of the opportunity to become part of national and global progress. And yet, one billion people around the world live without access to energy. More than 781 million people in 2016, or 39% of the world's population, do not have access to clean fuels and technologies for cooking.

India's Clean Energy Initiative (as per UN2016)

- Nearly 85% of the people have access to electricity
- 100% villages electrified
- 30 million households still lack access to electricity (about 300 million people)
- National Solar Mission has set up a target of Renewable Energy of 175GW by 2022

Which include 100GW of Solar Energy, 60GW energy from Biomass and 5 GW energy from micro hydro projects.

India can achieve this target only by decentralised renewable energy (DRE) but scale needed to deliver this goal.It has a thriving innovation and start-up economy. It is building infrastructure and supply chains for needed capacity. And it has access to money for R&D and deployment - not just for rural household power, but for so-called "productive uses" such as agro-processing and manufacturing. It also has the desire and ability to leverage its international stature and market size to partner in Africa and other low energy access countries. These are all ingredients for further cost reductions and global scale.

DRE is a perfect policy solution but private power companies and the state-owned power companies in debt developed cold feet. However, Bihar and Uttar Pradesh, the two states with the highest number of energy poor, are taking steps to increase the role for DRE. After Uttar Pradesh promulgated the first state-level mini-grid policy, it has quickly become the leader in number of mini-grid deployments, reinforcing the strong link between policy certainty, sector growth and investment. Other states like Odisha, West Bengal and Assam are also planning and integrated approach to implement DRE.

Whether it's electricians, loan officers, sales force, manufacturing, standards and quality assurance, hardware design or IoT and software, India has the pieces in place to scale DRE and create significant job opportunities. The Skill India campaign, with a goal of training 500 million youth by 2020, including those in villages, will help. Renewable energy is one focus of that training, although more is needed specifically on electricity access. At the same time, civil society and

social enterprises are working to build capacity in other areas, such as banking, women's entrepreneurship and micro-enterprises. Moreover, the recent introduction of a Goods and Services Tax (GST) is expected to discourage imports of DRE products and increase domestic manufacturing and assembly, potentially adding greater scale and capacity.

Energy access is a massive economic opportunity in India - some estimates put it at $48 billion a year by 2030.Yet despite that prize, the sector is smaller than its potential. A new report from India's DRE industry body Clean Energy Access Network (CLEAN), based on partial data for Fiscal Year 2016-17, showed that India's DRE sector deployed 3.6 million solar lanterns, 92,000 solar home systems, 206 mini-grids and 144 productive use projects during the period. It could be growing more rapidly with more supportive policy, and the finance that such policy would unlock.

India- China Partnership

In a recent study, a budget gap of US405 million is estimated in achieving SDG 7 target by India. India - China are working on together to harness business solutions in alignment with sustainable infrastructure development, such as, renewable energy technology, amongst others.

Goal 8: Decent Work and Economic Growth

Promote sustained, inclusive and sustainable economic growth.

Economic growth is one of the central tenets of SDG 8. India has been growing at the rate of 7.5% per annum. However, the aim is to grow at the rate of 9-10% per annum. India's growth story has been driven by the services sector which constitutes 62% of India's GDP. Dependence on the services sector alone for growth is possible in countries with high per capita income and less population. However, if one takes the example of China, Japan, South Korea, process of manufacturing is essential to growth and in turn for creation of jobs. India needs to focus on the same. NitiAyog has prepared a roadmap to attain the underlined goals, India needs to focus on two aspects: Urbanization and Manufacturing. Also, key to all of it is innovation - especially innovation in our education system. There is also a need to understand that SDG's are interlinked. To attain the indicators of one SDG, several other SDG's and their indicators also need to be evaluated and achieved. The attainment of SDG 8 will also help in moving further towards attainment of various other goals and their indicators, for example - for instance goal 1 to 5, and then again to 9, 10, 11 and 12.

Goal 9: (8 Targets)

Industry, Innovation and Infrastructure

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by 2030.

Industrialization: As mentioned before, manufacturing sector is vital for the economic growth and process of industrialization of the country. It is also essential for job creation. Unfortunately, in India, even among the Asia Pacific countries, lowest share of GDP comes from manufacturing sector. Many factors led to decline of manufacturing sector in the country. To accelerate the growth of manufacturing sector to at least 9%, strategic intervention is required. Revival of industrial policy is required and exampled need to be taken from East Asian countries like Thailand.

Other interventions include in the form of public procurement policies and India is also now using it in defense procurement. Soft intellectual property rights have been used in East Asian countries very extensively. Managed exchange rates, keeping the exchange rates competitive to give a spur or competitive edge to the local goods have been the standard mechanism used by different East Asian countries starting from Japan. Infrastructure support, innovation, skill formation are other interventions much required in India. India can also use the potential of FDI to crowd in more of domestic investments can be enhanced by pushing it in either export orientation or in import substitution so that then it would only be crowding in rather than crowding out. Proactive targeting is another way to attract the right kind of investment. Thus, revival of industrial policy for strategic import substitution using these initiatives can be useful for India and realizing the vision of SDG's in the country.

Agriculture: Agriculture is an important area which needs focus for the economic growth of the country.

Although 13% of GDP comes from agriculture, around 50% population still depends on it. The goal of inclusive growth can be achieved through the growth of agriculture. A study by World Bank shows that while poverty reducing impact of growth in manufacturing sector was almost zero, but poverty reducing impact of agriculture growth was quite high. Another facet which needs to be in focus is that growth of agriculture does not lead to over exploitation and depletion of natural resources as has been seen in case of states like Haryana, Tamil Nadu or Punjab. Thus, agricultural growth has to be inclusive and sustainable.

Small and Medium Enterprises (SME's): SME is really important for the Indian economic growth as it constitutes about 95% of all industrial units in the country, contributes more than 40% to the domestic industrial output. It generates about 45% of the industrial employment and constitutes about 50% of the total manufactured exports, direct and indirect. They produce a diverse range of products, more than about 8000 consumer items, capital goods and intermediates. There are many issues with the SME's like financial gaps, adequate, timely and cost-effective credit availability, access to equity, risk capital and financing innovation. In the non-financing sector, issues pertain to infrastructure, marketing, procuring raw materials, designing the products and also quality services. SME's and Global Value Chain East in 1998 defined what value chain is and how it is relevant for the SME's - where internationalization of manufacturing processes and which is to be conducted in several countries in different stages and production is located in different countries based on the low cost or the cost efficiency in different countries as a result of which individual countries get independence in terms of having their specialization in very specific segments of a particular commodity. Global Value Chain has become very important for all sectors, especially textiles, electronics and auto components. Government intervention in the form of strong infrastructure, strong science and technology, strong innovations is important to promote India's performance in GVC exports.

Informal Sector In Indian economy, almost 92% of the population is employed in the informal sector. However, informal economy is larger than the informal sector, as it comprises of unincorporated enterprises, and also those working in formal sector but on contractual basis. Thus, they do not get the desired social security and these two together combine as informal economy.

Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all based investment under these ministries Estimated investment in Road, Railways, Civil Aviation, Ports and Shipping Infrastructure is INR 119 lakh crores USD 1900 billion (2015-20) has a gap of INR 59.5 lakh crore or USD 950 billion (at 2014-15 Prices).

Goal 10: (10 Targets)

Reduced Inequality

Reduce inequality within and among countries by 2030.

The Gini coefficient of income inequality for India fell from 36.8% in 2010 to 33.6% in 2015. The Government of India's emphasis on the three-pronged Jan Dhan-Aadhaar-Mobile programmes are aimed at a comprehensive strategy of inclusion, financial empowerment and social security.

Inequality is multi-faceted in nature. There is inequality in income; but there is also inequality in educational attainment, health status, employment, access to food, access to water, access to social security and in general access to opportunities and choices. These different aspects of inequality are interlinked; improved access to water and sanitation may help reduce inequality in health outcomes, improved educational attainment may help people find better jobs and reduce the inequality in employment and incomes, and so on. Therefore, the achievement of Goal 10 will be closely linked to the achievement of all other goals.

Goal 11: (7+3 Targets) Goals 6, 7 14 and 16 are assessed together

Sustainable Cities and Communities

Make cities and human settlements inclusive, safe, resilient and sustainable.

Goal 11 calls for the sustainable development of cities and human settlements. Urbanisation in India has been on the rise. Population residing in urban areas in India, according to 1901 census, was 11.4 percent. This count increased to 28.53 percent according to 2001 census, and crossing 30 per cent as per 2011 census, standing at 31.16 percent. People migrate to cities in the hopes of finding better economic opportunities, access to a larger range of public amenities and services, and prospects of a better life than in rural areas. Unfortunately, a large section of the population is marginalised, resorting to dwelling in slums without access to basic amenities such as clean water, sanitation and proper housing. Congestion in Indian cities is clearly visible, particularly in metropolitan cities such as Mumbai and Delhi. This necessitates proper urban planning with provisions for necessary urban infrastructure and services, including urban water supply, urban transport, sewage, solid waste management, roads, traffic control, maintenance of public spaces etc.

The estimated estimates of Investment by 2030 for some important targets are:

To ensure access for all to adequate, safe and affordable housing and basic services, and upgrade slums Assessed independently, an investment of INR 63 lakh crores USD 994 billion (2015-22) is required but there is a huge gap of INR 60 lakh crores USD 942 billion.

To enhance inclusive and sustainable urbanization and capacities for participatory, integrated and sustainable human settlement planning and management in all countries, estimated investment is INR 68 lakh crores USD 1073 billion (2015-30) which has a gap of INR 16 lakh crores USD 260 billion.

Goal 12: (6 Targets) and Goal 13 Responsible Consumption and Production

Ensure sustainable consumption and production patterns.

Climate Action

Take urgent action to combat climate change and its impacts.

With rising greenhouse gas emissions, climate change is occurring at rates much faster than anticipated and its effects are clearly felt worldwide. While there are positive steps in terms of the climate finance flows and the development of nationally determined contributions, far more ambitious plans and accelerated action are needed on mitigation and adaptation. Access to finance and strengthened capacities need to be scaled up at a much faster rate, particularly for least developed countries and small island developing States.

Without action, the world's average surface temperature is projected to rise over the 21st century and is likely to surpass 3 degrees Celsius this century - with some areas of the world expected to warm even more. The poorest and most vulnerable people are being affected the most. Climate change also exacerbates disasters and combating it is absolutely vital to guaranteeing our survival and the wellbeing of future generations.

India's Climate Change Challenge

- Nearly 300 million rural population depend on forests for a part of their subsistence and livelihood
- 3rd largest green house emitter-6.9 of the global emissions
- 60% land is used for agriculture and 24.1% is under forest cover

Climate Change Targets

- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- Integrate climate change measures into national policies, strategies and planning.
- Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
- Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilising jointly USD 100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful

mitigation actions and transparency on implementation and fully operationalise the Green Climate Fund through its capitalisation as soon as possible.

- Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing states, including focusing on women, youth and local and marginalised communities.
- Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.

India's Climate Challenge Action

India's emissions intensity of India's GDP reduced by 12% between 2005 and 2010. In October 2015, India made a commitment to reduce the emissions intensity of its GDP by 20-25% from its 2005 levels by 2020 and by 33-35% by 2030. On 2 October 2016 India formally ratified the historic Paris Agreement. The Government of India has also adopted a National Action Plan on Climate Change to address this issue directly, as well as a National Mission for Green India. These national schemes are complemented by a host of specific programmes on solar energy, enhanced energy efficiency, sustainable habitats, water, sustaining the Himalayan ecosystem, and to encourage strategic knowledge for climate change.

- Committed to reduce emissions intensity by 33-35% by 2030
- Highest ever green energy of 175GW by 2030

India achieved Solar Energy of 6550 MW capacity and Wind Energy capacity of 1772 MW in 2018

- Committed to reduce emissions intensity to its GDP by 33-35% by 2030.

Role of Engineers in achieving sustainable development

Role of Engineers

The most sophisticated closed loop Sustainable Development Model "SD Prod Consum Model" is more relevant today, Engineers contribute to all the steps in this systems model:

o By developing, processing and transporting natural resources in closed-loop systems, we can reduce waste and increase the efficient use of resources.

o Harvesting renewable resources such as water, fish and trees within the limits allowed by nature will ensure a continuing supply of resources for humans and natural ecosystems. Minimizing our use of non-renewable resources, such as petroleum and scarce minerals, and replacing them with environmentally friendly substitutes will also help extend the supply of natural resources.

o Processing natural resources efficiently and with little or no waste helps to preserve the earth's finite natural resources. We can further preserve resources by designing products and packaging for reuse and recycling, and we can protect resources through industrial processes and facilities that have minimal adverse environmental impacts throughout their full life-cycles.

o Transporting goods contributes heavily to pollution; to minimize these effects, we can transport resources and manufactured goods efficiently to consumers by pipelines, rivers, railways, roads, ships. For instance, we can supply washed coal to our thermal plans with reduced ash content and we can save environment from dust, reduce transport cost, also use the ash in manufacturing bricks at lower costs, use electrostatic precipitators to check pollution and thus reduce environment management cost. This has happened in India after decades of innovations.

It is a vast canvas to discuss the role engineers as far as sustainable development is concerned. Achieving sustainable development goals is a collective responsibility of Engineers of all disciplines, Economists, Demographists, geologists, scientists, management experts, commerce and trade experts, educationists, health and family welfare, sports and youth, financial experts, the last but not the least the community: institutions (all types including religious), NGOs, associations, leaders and social workers. I have therefore, tried to summarise the role of engineers ina matrix as given below.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
1.	No Poverty	By 2030, eradicate extreme poverty for all people everywhere.	By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day 1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions 1.3 Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable 1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance 1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters 1.a Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions 1.b Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions	The intricate nature of poverty with various social, economic and environmental components makes an independent assessment of this goal difficult. Many issues relating to poverty are covered under various goals like food security (Goal 2), access to healthcare (Goal 3), education (Goal 4), water (Goal 6), and energy (Goal 7) for all. Additionally, Goals 9 and 11 aim for infrastructure development that can enable capital formation and generate job opportunities. Goal 8 aims for inclusive economic growth models that can enable income opportunities which will contribute towards poverty reduction. Scientific literature (ICSU, ISSC, 2015) on the relations among climate, sustainability and poverty suggests that the targets of Goal 1 need to be at the centre of all other targets, in order to avoid an inequitable transformation to a low carbon future. Apart from the basic needs fulfilment schemes, attention to national and international processes of wealth creation, redistribution and regulatory regimes will be instrumental in poverty eradication.	- Agriculture engineers can help to mechanise the farm sector at an affordable cost, this will provide opportunity to local skilled and semiskilled labour and thus prevent migration and reduce poverty. -Engineers to develop cost efficient solar energy for rural areas can reduce cost of energy to poor in rural areas. -Engineers can develop cost efficient means for water management for multiple cropping using solar energy. -Engineers can develop agriculture products chain with inclusive participation of the small and poor farmers. These activities are happening but what is needed is innovations for cost effective use natural, and agriculture produce and inclusion of the poor in the entire chain. There is endless scope along achievement of other SDGs 2,6,7, and 8
2.	Zero Hunger	End hunger, achieve food security and improved nutrition by 2030.	2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round 2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	The financial requirement for India to meet its costs for food security is around INR 46 lakh crores (USD 729 billion) from 2015-24. Food subsidies are the mandate of the government. The sector-specific study that was used to derive investment needs in	Food security is influenced by a number of factors, including those that determine food availability-domestic food production and the capacity to import food-as well as determinants of food access, including the distribution of food

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment 2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality 2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and ensure access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed 2.a Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries 2.b Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round 2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility	sustainable agricultural techniques considers only public expenditures. Of the finances required for ensuring food security, the financial gap that India is estimated to face is of the order of INR 18.5 lakh crores (USD 293 billion) for access and distribution costs of food and for financing sustainable agricultural production systems.	among various segments of the population. India has enough food production, but agriculture engineers can develop more diversified crop pattern to meet all type food requirement. Creation of enough capacity, for storage and improved distribution network remains a challenge for engineers to solve.
3.	Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages by 2030.	3.1 By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	For India to achieve this goal, it will have to reach the value of around 0.9 for its Health Index, which includes health	Engineer role is enormous: such as develop indigenous medical equipment to

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			3.2 By 2030, end preventable deaths of newborns and children under 5 years of age 3.3 By 2030, end the epidemics of aids, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases 3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well being 3.5 Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol 3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents 3.7 By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes 3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all 3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination 3.a Strengthen the implementation of the world health organization framework convention on tobacco control in all countries, as appropriate 3.b Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha declaration on the trips agreement and public health, which affirms the right of developing countries to use to the full the provisions in the agreement on trade-related aspects of intellectual property rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all	status of population, quality of healthcare institutions and financial instruments for access to healthcare (insurance, etc.). India will require around INR 55 lakh crores (USD 880 billion) till 2030 to achieve this value of the Index. A gap of around INR 19 lakh crores (USD 305 billion) is projected with respect to availability of finances for public health in India. Public expenditure on health in India has hovered around 1 per cent of the country's GDP, and accounts for less than one third (33 per cent) of total health expenditure. Only a few countries have such low ratios of public to total expenditure on health. The world's average is 63 per cent and even the average of Sub-Saharan Africa is 45 per cent (Drèze& Sen, 2013). The total gap of INR 19 lakh crores (USD 305 billion). It will be relevant to note that the preliminary estimates for the incremental annual investment needs in developing countries till 2030, related to achieving the outcomes for health goal alone range from USD 51-80 billion (as in 2010) (Sachs, J. D. & Schmidt-Traub, G., 2014).	meet lab requirements, modern vital parts , denture, limbs, for heart patients, urinary disorders, and operation aids to minimise cost. India Scientists / Technocrats still have develop new vaccines and treatment for killing disease, diabetes, arthritis etc.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			3.c Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing states 3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks		
4.	Quality Education	Ensure that all girls and boys complete free, equitable and quality primary and secondary education by 2030.	4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes 4.2 By 2030 ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education 4.3 by 2030 ensure equal access for all women and men to affordable quality technical, vocational and tertiary education, including university 4.4 By 2030, increase by x% the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship 4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples, and children in vulnerable situations 4.6 By 2030 ensure that all youth and at least x% of adults, both men and women, achieve literacy and numeracy 4.7 By 2030 ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development 4.a Build and upgrade education facilities that are child, disability and gender sensitive and	In order to achieve all the targets of Goal 4; the total financial requirement for India is of the order of INR 142 lakhs crores (USD 2258 billion). While there is no financial gap identified in case of primary and secondary schooling due to provisions and finance allocations under Right to Education Act, there are significant gaps in case of early childhood development and tertiary and higher education. There is a gap of INR 27 lakh crores (USD 429 billion) out of the total of INR 35 lakh crores (USD 555 billion) required for ensuring access to quality early childhood development, care and pre-primary education. Further, India will require an additional INR 19 lakh crores (USD 301 billion) for ensuring quality technical, vocational and tertiary education. To enhance the standards of Indian higher education to match world standards, additional finance may be required over and above what is estimated here. India is estimated to require a sum of INR 9 lakh crores (USD 145 billion) to skill India's workforce. Estimates indicate that only about 2 per cent of the existing workforce has undergone formal skill training and about 15 per cent of the existing workforce has	Engineers can bring revolution to multiply human efforts by providing cost efficient teaching aids (software). Engineers can develop Model cost efficient school building for the future expansion with environment friendly class rooms, toilet and sports facilities, Develop cheaper mode of travel which is safe and cheaper. Develop better way for assessment of children's capacity and preferences for focussed education and training. Large scale skill development is the need for the India to meet its requirement to new tech industry , service sector, and manufacturing.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			provide safe, non-violent, inclusive and effective learning environments for all 4.b By 2020 expand by x% globally the number of scholarships for developing countries in particular LDCs, SIDS and African countries to enrol in higher education, including vocational training, ICT, technical, engineering and scientific programmes in developed countries and other developing countries 4.c By 2030 increase by x% the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially LDCs and SIDS	marketable skills, whereas 90 per cent of jobs in India are skill based and require vocational training (Simon M. , 2014). The Government of India has announced a target of skilling 500 million individuals by 2022. The gap in finance under this component is not assessed due to the scattered nature of government and private sector investments in skill building. However, India's current skilling capacity is only 7 million people per annum, which necessitates substantial involvement of the private sector in skilling workforce as well as a substantial expansion of the government's skilling capacities.	
5.	Gender Equality	To achieve gender equality and empower all women and girls.	5.1 End all forms of discrimination against all women and girls everywhere 5.2 Eliminate all forms of violence against all women and girls in public and private spheres, including trafficking and sexual and other types of exploitation 5.3 Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilations 5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies, and the promotion of shared responsibility within the household and the family as nationally appropriate 5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life 5.6 Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the ICPD and the Beijing Platform for Action and the outcome documents of their review conference	The Gender Gap Index of India is comparable to countries like Bangladesh, Cambodia, Ghana, Uganda and Tanzania. This index includes indicator for economic participation and opportunity, educational attainment, health and survival and political empowerment of women. Comparing to the per capita spending requirement of these countries to ensure gender equality, India requires a sum of INR 89 lakh crores (USD 1408 billion) to ensure gender equality by 2030. The current trend in gender budgets of the country shows a gap of INR 69 lakh crores (USD 1091 billion) under this component. The cross-cutting Goal 5 on gender equality with an estimated gap of INR 69 lakh crore (USD 1091 billion) over the fifteen-year period needs to be looked at with a view to improve our Gender Equality	The society's attitude need a change. Engineers can play a role in the community with their scientific and positive approach.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			5.a Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance, and natural resources in accordance with national laws 5.b Enhance the use of enabling technologies, in particular ICT, to promote women's empowerment 5.c Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels provide safe, non-violent, inclusive and effective learning environments for all 4.b By 2020 expand by x% globally the number of scholarships for developing countries in particular LDCs, SIDS and African countries to enrol in higher education, including vocational training, ICT, technical, engineering and scientific programmes in developed countries and other developing countries 4.c By 2030 increase by x% the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially LDCs and SIDS	Index that continues to be extremely low. The index tracks the strong correlation between a country's gender gap and its national competitiveness. Because women account for one-half of a country's potential talent base, a nation's competitiveness in the long-term depends significantly on whether and how it educates and utilises its women. marketable skills, whereas 90 per cent of jobs in India are skill based and require vocational training (Simon M. , 2014). The Government of India has announced a target of skilling 500 million individuals by 2022. The gap in finance under this component is not assessed due to the scattered nature of government and private sector investments in skill building. However, India's current skilling capacity is only 7 million people per annum, which necessitates substantial involvement of the private sector in skilling workforce as well as a substantial expansion of the government's skilling capacities.	
6.	Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all by 2030.	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and increasing recycling and safe reuse by x% globally 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure	For access to and availability of water and sanitation for all, India is estimated to require a sum of INR 13 lakh crores (USD 199 billion) till 2030. While no additional finances are required for access to drinking water for all, an additional sum of INR 8 lakh crores (USD 123 billion) is needed for universal sanitation coverage in the country and cleaning of the Ganga River. Increasing water quality of other natural and artificial resources will require more such planning and finance.	Engineers role is enormous. Water being a scares resource to a number of approaches to cost effective utilisation, and management of water resources are required: - rain water Harvesting (at all levels) - used water treatment - distribution of water for basic sanitation both in rural areas and small to big cities for sanitation drinking

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity 6.5 By 2030 implement integrated water resources management at all levels, including through trans boundary cooperation as appropriate 6.6 By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes 6.a By 2030, expand international cooperation and capacity-building support to developing countries in water and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies 6.b Support and strengthen the participation of local communities for improving water and sanitation management	Ensuring water security (Goal 6) for domestic, agriculture and industry applications and sustainable management of our rivers and water bodies in order to retain the ecological flows is another huge task. The NamamiGange Plan has an outlay for INR 20,000 crore (USD 3 billion) only for the next five-year period; the operational management for the next 10 years are also to be funded by the government and the amounts for that are not yet known. On the other hand, the Ganga River Basin Management Plan (2015) (NDTV India, 2015) estimates that nearly INR 6-7 lakh crores is required to address the pollution problem in the Ganga. All of this is expected to be funded by the government.	- river water diversion/ storage Availability of water is the success criteria in achieving total sanitation target, This is big challenge for engineers in given time horizon and available resoureces.
7.	Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all by 2030.	7.1 By 2030, ensure universal access to affordable, reliable and modern energy services 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix 7.3 By 2030, double the global rate of improvement in energy efficiency 7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology 7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries and small island developing State.	In order to address the energy security (Goal 7) needs of the country, along with mitigating carbon emissions India has upped its targets for renewable energy considerably. The total renewable energy installed capacity in India at the end of financial year 2014-15 stood at 35.77 GW. The Indian government plans to increase this capacity to 175 GW by end of 2022. Under existing policies, in today's values, the cost of supporting 20 GW of utility scale solar energy by 2022 is INR 46.97 billion (INR 2.71/W) (Gireesh, Srinivasan, Goel, Trivedi, & Nelson, 2015). The current study estimates a total finance requirement of INR 54 lakh crores (USD 854 billion) from 2015-30 to increase generation capacity with a high share of renewable energy, install transmission and distribution infrastructure and provide	This is the most challenging goal to achieve in the given time frame. India can achieve this target only by decentralised renewable energy (DRE) but scale needed to deliver this goal. Engineers have to innovate new cost efficient technology, manufacture indigenously with international support. Engineers also have to prepare large backup technical manpower to serve not only India but other developing countries as a leader.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
				access to clean cooking fuel. A shortfall of INR 26 lakh crores (USD 406 billion) is estimated.	
8.	Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth.	8.1 Sustain per capita economic growth in accordance with national circumstances, and in particular at least 7% per annum GDP growth in the least-developed countries 8.2 Achieve higher levels of productivity of economies through diversification, technological upgrading and innovation, including through a focus on high value added and labour-intensive sectors 8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage formalization and growth of micro-, small- and medium-sized enterprises including through access to financial services 8.4 Improve progressively through 2030 global resource efficiency in consumption and production, and endeavour to decouple economic growth from environmental degradation in accordance with the 10-year framework of programmes on sustainable consumption and production with developed countries taking the lead 8.5 By 2030 achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value 8.6 By 2020 substantially reduce the proportion of youth not in employment, education or training 8.7 Take immediate and effective measures to secure the prohibition and elimination of the worst forms of child labour, eradicate forced labour, and by 2025 end child labour in all its forms including recruitment and use of child soldiers 8.8 Protect labour rights and promote safe and secure working environments of all workers, including migrant workers, particularly women migrants, and those in precarious employment	MSMEs are contributing 12-13 per cent to GDP of India. The projected desirable contribution to India's GDP from MSMEs is ranging from 20-25 per cent. The finances required by MSMEs for such contribution is about INR 148 lakh crores (USD 2360 billion). Of this INR 148 lakh crores (USD 2360 billion), India is yet to find financial source for INR 105 lakh crores (USD 1672 billion).	Engineers role is enormous in helping India to grow at 9-10 % to meet all is SDG goals - This possible by increasing production in agriculture technology and agriculture diversification, -cheap solar energy, efficient water management, and public distribution system - more focussed digitisation of the service sector and - increase in manufacturing needs of India and the world. For a sustained, inclusive and sustainable economic growth, India will require to enhance its MSME sector and other labour intensive sectors. It would require growth strategies that generate employment opportunities for its youth. In addition to this, for India to ensure sustainable economic growth it needs to look at costs of resource efficiency and promoting sustainable production systems.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			8.9 By 2030 devise and implement policies to promote sustainable tourism which creates jobs, promotes local culture and products 8.10 Strengthen the capacity of domestic financial institutions to encourage and to expand access to banking, insurance and financial services for all 8.a Increase Aid for Trade support for developing countries, particularly LDCs, including through the Enhanced Integrated Framework for LDCs 8.b By 2020 develop and operationalize a global strategy for youth employment and implement the ILO Global Jobs Pact.		
9.	Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by 2030.	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries 9.3 Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including fordable credit, and their integration into value chains and markets 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and increasing the number of research and development workers per 1 million people by [x] per cent and public and private research and development spending 9.a Facilitate sustainable and resilient infrastructure development in developing	Based on projections provided in the Mid-Term Appraisal of the Eleventh Five Year Plan, in order to attain a 9 per cent real GDP growth rate, infrastructure investment should be on average almost 10 per cent of GDP during the XII Five Year Plan (2012-2017). The present study estimates a financial requirement of INR 119 lakh crores (USD 1900 billion). Assuming 50 per cent of the investment will be met by budgetary resources, INR 59.5 lakh crores (USD 950 billion) would need to be met through debt and equity. The Delhi-Mumbai Industrial Freight Corridor initiative of the Government of India, initiated in 2006, is an ambitious plan that requires an investment of about USD 90 – 100 billion projected over a thirty-year period. India and Japan have agreed on a USD 9 billion fund with equal contribution from both sides as initial investment; the rest is expected to be raised through private investments. Public private partnerships have been initiated through bids for about INR 5000 crores (USD 0.8 billion). In addition, four more proposed corridors — Amritsar-Kolkata,	Engineers have done it to a great extent but still far from developed countries level. Engineers role is in cost effective development in: - In all forms of transportation and transportation network - Expansion and diversification of MSME for more employment - Increase capacity of Manufacturing sector (for competitive manufacturing and employment) - enhance and innovate digital sector for best served and transparent, secure commerce , business and services - start-ups – a new challenge to engineers to bring in innovation and manufacturing at low cost - develop new packaging technology and environment

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States 9.b Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities 9.c Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020.	Visakhapatnam-Chennai, Chennai-Bengaluru and Bengaluru-Mumbai — are to be initiated with secured initial investments (Arun, 2015). At the global scale, the UNCTAD has estimated that the total investment in economic infrastructure in developing countries – power, transport (roads, rails and ports), telecommunications and water and sanitation – is currently USD 1 trillion per year for all sectors, but will need to rise to between USD 1.6 and USD 2.5 trillion annually over the period 2015-2030 (UNCTAD, 2014).	friendly material to replace plastics.
10.	Reduced Inequality	Reduce inequality within and among countries by 2030.	10.1 By 2030 progressively achieve and sustain income growth of the bottom 40% of the population at a rate higher than the national average 10.2 By 2030 empower and promote the social, economic and political inclusion of all irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status 10.3 Ensure equal opportunity and reduce inequalities of outcome, including through eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and actions in this regard 10.4 AAdopt policies especially fiscal, wage, and social protection policies and progressively achieve greater equality 10.5 Improve regulation and monitoring of global financial markets and institutions and strengthen implementation of such regulations 10.6 Ensure enhanced representation and voice of developing countries in decision making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions 10.7 Facilitate orderly, safe, regular and responsible migration and mobility of people, including through implementation of planned and well-managed migration policies	Inequality is multi-faceted in nature. There is inequality in income; but there is also inequality in educational attainment, health status, employment, access to food, access to water, access to social security and in general access to opportunities and choices. These different aspects of inequality are interlinked; improved access to water and sanitation may help reduce inequality in health outcomes, improved educational attainment may help people find better jobs and reduce the inequality in employment and incomes, and so on. Therefore, the achievement of Goal 10 will be closely linked to the achievement of all other goals.	Engineers role is assed here as the SDG targets under this goal have close link of the targets with other goals.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			10.a Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with WTO agreements 10.b Encourage ODA and financial flows, including foreign direct investment, to states where the need is greatest, in particular LDCs, African countries, SIDS, and LDCs, in accordance with their national plans and programmes 10.c By 2030, reduce to less than 3% the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5%.		
11.	Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable.	11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services, and upgrade slums 11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons 11.3 By 2030 enhance inclusive and sustainable urbanization and capacities for participatory, integrated and sustainable human settlement planning and management in all countries 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage 11.5 By 2030 significantly reduce the number of deaths and the number of affected people and decrease by y% the economic losses relative to GDP caused by disasters, including water-related disasters, with the focus on protecting the poor and people in vulnerable situations 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management 11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities	For making cities inclusive, safe, resilient and sustainable, India will require a sum of INR 131 lakh crores (USD 2067 billion). This includes housing for all, development and planning of cities, efficient transport systems, public spaces and other components of urban infrastructure costs. Of the INR 131 lakh crores required for such urban development, India at present faces a financial gap of INR 76 lakh crore (USD 1202 billion). The costs for disaster management are not included in this estimate at present. The government of India has already rolled out ambitious plans for sustainable urban development (Goal 11). The AMRUT (initial 500 cities) and 100 smart cities programmes have a Central allocation of INR 98,000 crore (USD 15.6 billion) for a period of five years, while the Housing for all (urban) by 2022 has a Central allocation of INR 5625 crore (USD 893 million). This accounts for a small fragment of finances required for sustainable urbanisation as it does not cover the finance that will come from the States for the same and additional cities in the AMRUT programme. In addition the 'Rurbanisation	This goal puts an enormous responsibility on engineers as there is no unique solution for all cities and communities as it will require lot of effort in planning infrastructure, and services in an integrated way. Cost is a high consideration along with the selection of material and technology.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning 11.b By 2020, increase by x% the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, develop and implement in line with the forthcoming Hyogo Framework holistic disaster risk management at all levels 11.c Support least developed countries, including through financial and technical assistance, for sustainable and resilient buildings utilizing local materials.	Initiative' has an estimated cost of INR 43033 crore (USD 6.8 billion) which includes budgetary support of INR 33453 crore from Government of India for the entire implementation period.	
12.	Responsible Consumption and Production	Ensure sustainable consumption and production patterns.	12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries 12.2 By 2030, achieve the sustainable management and efficient use of natural resources 12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse 12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	The methodology for the calculation of this goal has considered the financial gaps for 'low carbon strategies' as detailed out in April 2014 by the Planning Commission, with projections up to 2030 (Planning Commission, GoI, 2014). The cumulative costs of low carbon strategies have been estimated to be around INR 62.5 lakh crores (USD 992 billion), between 2011 and 2030. If these costs were borne entirely by domestic resources, the cumulative loss in output (GDP) between 2011 and 2030 would be USD 1,344 billion, at 2011 prices. The estimates do not yet take into consideration costs for waste management in a comprehensive manner or for financial requirements for new technology development and research and development for cleaner resource efficient production systems.	- The engineer role is to minimise wastes in the use of natural resources. - Develop and design low carbon technology to take advantage of funds and at the same time reduce size carbon foot print - alternative material and technology to replace plastics - avoid environment risk and manage disaster - develop echo tourism for social inclusion - development markets and procurement system for social inclusion

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities 12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature 12.a Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production 12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products 12.c Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.		
13.	Climate Action	Take urgent action to combat climate change and its impacts.	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries 13.2 Integrate climate change measures into national policies, strategies and planning 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning 13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	The total finance required for climate adaptation alone from 2015 to 2030 is INR 17 lakh crores or USD 267 billion. The costs of mitigation and resilience have been calculated under other targets and goals. The Planning Commission of India has estimated the total costs of implementing the National Action Plan for Climate Change (NAPCC) and State Action Plan for Climate Change (SAPCC) at INR 17 lakh crores (USD 270 billion) from 2015- 17.The estimated costs are for all programmes and activities envisaged in each of the eight identified missions.	Preparing for climate resilience is the area where engineers can play role in deigning structure, buildings that enable to fight disasters. This goal also served with other linked goals: Goals 2, 3, 4, 6,7,8, 9,11, 12, 1514, &15

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries, including focusing on women, youth and local and marginalized communities		
14.	Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.	14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration, to achieve healthy and productive oceans 14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels 14.4 By 2020, effectively regulate harvesting, and end overfishing, illegal, unreported and unregulated (IUU) fishing and destructive fishing practices and implement science-based management plans, to restore fish stocks in the shortest time feasible at least to levels that can produce maximum sustainable yield as determined by their biological characteristics 14.5 By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on best available scientific information 14.6 By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation 14.7 By 2030 increase the economic benefits to SIDS and LDCs from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism 14.a Increase scientific knowledge, develop research capacities and transfer marine technology taking into account the	The cost estimated is for 14 &15 together. For India to achieve this target as well as corresponding SDG goals, there are 2 kinds of costs: direct administrative costs and opportunity costs of protection. The total finance required is estimated at INR 31 lakh crores (USD 489 billion), while the finance gap is around INR 30 lakh crores (USD 481 billion).	Mechanisation of marine pollution control and cleaning on continuous basis is the only answer. This goal has linkages with

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular SIDS and LDCs 14.b Provide access of small-scale artisanal fishers to marine resources and markets 14.c Ensure the full implementation of international law, as reflected in UNCLOS for states parties to it, including, where applicable, existing regional and international regimes for the conservation and sustainable use of oceans and their resources by their parties		
15.	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, combat desertification and halt biodiversity loss.	15.1 By 2020 ensure conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements 15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and increase afforestation and reforestation by x% globally 15.3 By 2020, combat desertification, and restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land-degradation neutral world 15.4 By 2030 ensure the conservation of mountain ecosystems, including their biodiversity, to enhance their capacity to provide benefits which are essential for sustainable development 15.5 Take urgent and significant action to reduce degradation of natural habitat, halt the loss of biodiversity, and by 2020 protect and prevent the extinction of threatened species 15.6 Ensure fair and equitable sharing of the benefits arising from the utilization of genetic resources, and promote appropriate access to genetic resources 15.7 Take urgent action to end poaching and trafficking of protected species of flora and fauna, and address both demand and supply of illegal wildlife products	India has an existing network of 700 protected areas (ENVIS Centre on Wildlife & Protected Areas, 2015). However, since the average size of the protected areas in India is small, the percentage of the country's land area covered through this through network is only 5.06 per cent. This is well below Target 11 of the Aichi Targets for Biodiversity Conservation that states, "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (CBD, 2010). The Indian National Biodiversity Support and Action Plan states that "Ecologically representative areas on land and in inland waters, as well as coastal and marine zones, especially those of particular	It is combined responsibility of engineers along with the marine engineers. It is quite complex process. It has been more developed along with international cooperation.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			15.8 By 2020 introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems, and control or eradicate the priority species 15.9 By 2020, integrate ecosystems and biodiversity values into national and local planning, development processes and poverty reduction strategies, and accounts 15.a Mobilize and significantly increase from all sources financial resources to conserve and sustainably use biodiversity and ecosystems Achieving SDGs in India: A study of India's financial requirements and gaps 15.b Mobilize significantly resources from all sources and at all levels to finance sustainable forest management, and provide adequate incentives to developing countries to advance sustainable forest management, including for conservation and reforestation 15.c Enhance global support to efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities.	importance for species, biodiversity and ecosystem services, are conserved effectively and equitably, on the basis of protected area designation and management and other area-based conservation measures and are integrated into the wider landscapes and seascapes, covering over 20 per cent of the geographic area of the country, by 2020"[31].	
16.	Peace and Justice Strong Institutions	Promote peaceful and inclusive societies for sustainable development; provide access to justice for all.	16.1 Significantly reduce all forms of violence and related death rates everywhere 16.2 End abuse, exploitation, trafficking and all forms of violence and torture against children 16.3 Promote the rule of law at the national and international levels, and ensure equal access to justice for all 16.4 By 2030 significantly reduce illicit financial and arms flows, strengthen recovery and return of stolen assets, and combat all forms of organized crime 16.5 Substantially reduce corruption and bribery in all its forms 16.6 Develop effective, accountable and transparent institutions at all levels 16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels	Not assessed as these are linked to many other goals 3 (Health); 4,5,8, 10 and 11	Engineers role is limited to linked Goals. It is mostly dealt along with UN other international forums.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			16.8 Broaden and strengthen the participation of developing countries in the institutions of global governance 16.9 By 2030 provide legal identity for all including birth registration 16.10 Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements 16.a Strengthen relevant national institutions, including through international cooperation, for building capacities at all levels, in particular in developing countries, for preventing violence and combating terrorism and crime 16.b Promote and enforce non-discriminatory laws and policies for sustainable development.		
17.	Partnerships to achieve the Goal	Strengthen the means of implementation and revitalize the global partnership for sustainable development.	**Finance** 17.1 Strengthen domestic resource mobilization, including through international support to developing countries to improve domestic capacity for tax and other revenue collection 17.2 Developed countries to implement fully their ODA commitments, including to provide 0.7% of GNI in ODA to developing countries of which 0.15-0.20% to least-developed countries 17.3 Mobilize additional financial resources for developing countries from multiple sources 17.4 Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries (HIPC) to reduce debt distress 17.5 Adopt and implement investment promotion regimes for LDCs **Technology** 17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation, and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, particularly at UN level, and through a global technology facilitation mechanism when agreed	Not directly assessed as it has linkages withal other goals.	Engineers role is limited to linked Goals. It is mostly dealt along with UN other international forums.

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			17.7 Promote development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed 17.8 Fully operationalize the Technology Bank and STI (Science, Technology and Innovation) capacity building mechanism for LDCs by 2017, and enhance the use of enabling technologies in particular ICT **Capacity building** 17.9 Enhance international support for implementing effective and targeted capacity building in developing countries to support national plans to implement all sustainable development goals, including through North-South, South-South, and triangular cooperation **Trade** 17.10 promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the WTO including through the conclusion of negotiations within its Doha Development Agenda 17.11 increase significantly the exports of developing countries, in particular with a view to doubling the LDC share of global exports by 2020 17.12 realize timely implementation of duty-free, quota-free market access on a lasting basis for all least developed countries consistent with WTO decisions, including through ensuring that preferential rules of origin applicable to imports from LDCs are transparent and simple, and contribute to facilitating market access **Systemic issues** ***Policy and institutional coherence*** 17.13 enhance global macroeconomic stability including through policy coordination and policy coherence 17.14 enhance policy coherence for sustainable development 17.15 respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development		

S.No.	Goal	Description	169 Targets	Estimated Cost	Role of Engineers
			Multi-stakeholder partnerships 17.16 enhance the global partnership for sustainable development complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technologies and financial resources to support the achievement of sustainable development goals in all countries, particularly developing countries 17.17 encourage and promote effective public, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships **Data, monitoring and accountability** 17.18 by 2020, enhance capacity building support to developing countries, including for LDCs and SIDS, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts 17.19 by 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement GDP, and support statistical capacity building in developing countries.		

On the basis of the above estimates, India needs Rs 909 lakh crore (USD 14427 billion) with fund gap.

References:

1. Achieving the Sustainable Development Goals in India A Study of Financial Requirements and Gaps, a Study sponsored by Ministry of environment and Forests: By Technology and Action for Rural Advancement A Social Enterprise of Development Alternatives Group.
2. SDG Baseline Index 2018, NitiAyog
3. UNESCAP 2019: Annual Report
4. Engineers and Sustainable Development

   Prepared by the World Federation of Engineering Organizations' Committee on Technology, August 2002.
5. Voluntary National Review Report on the Implementation of Sustainable Development Goals by Government of India.
6. Achieving SDG 4 in India discussion paper: Moving from Quantity to Quality Education for All Dr. Beena Pandey.

About Engineering Council of India

Engineering Council of India (ECI) was established on April 4, 2002 as a Federation, by coming together of a large number of Professional Organizations/Institutions of Engineers to work for the advancement of engineering profession in various disciplines and for enhancing the image of engineers in society, by focusing on quality and accountability of engineers. Today there are 32 Indian Engineering Professional Organizations/ Institutions as members representing practically all engineering streams.

For more details, please visit www.ecindia.org

Aims and Objectives

- To promote the science and practice of Engineering for national development, collectively along with constituent members;
- To encourage engineers to serve the needs of the society;
- To promote advancement of engineering education in the country;
- To promote the practice of continuing education and training to upgrade the quality of engineering professionals;
- To identify and undertake activities of Common interest to the engineering profession;
- To encourage inventions, investigations and research; and promote their application for development of the national economy;
- To identify and undertake activities directed to enhance prestige of engineers in the country, and to secure for them their rightful place at various levels of planning , administration etc.
- To promote steps to attract bright persons of the younger generation to the engineering profession;
- To assist associations and professional societies in adopting standard criteria for membership so as to make these national equitable and internationally acceptable;
- To establish a common "Code of Ethics" for professional and consulting engineers adoption by Associations / Professional Societies and to evolve the strategy for its enforcement;
- To interact with the Government at the State and Central Levels and help adoption of policies for betterment of engineering profession;
- To represent engineers and engineering professionals of all disciplines at national and international levels;
- To maintain a national register of 'Professionals Engineers' and a national register of "Consulting Engineers";
- To act as a Nodal Body , representing India, for bilateral/multilateral recognitional of "Professional Engineers" and "Consulting Engineers" on mutual and reciprocal basis;
- To identify and encourage the implementation of best practices for the development and assessment of engineers intending to practice as professionals in domestic as well as foreign markets;
- To standardize criteria to be adopted for according status of "Professional Engineer" and "Consulting Engineer" and to accord licence/accreditation to practice Engineering in India;
- To identify major engineering disciplines in which substantial cross-border mobility is expected and to cater to those disciplines in ECI' policies, practices and their registers/ sub-registers.

- To identify barriers to professional engineers mobility and to develop and promote strategies, to advice and if required, assist Central and State Government Departments, in managing those barriers in an effective manner;
- To develop mutually acceptable Standards and Criteria for facilitating cross- border mobility of experienced Professional Engineers and Consulting Engineers among WTO and other related Agreements.

National Register of Engineers

National Register maintains the credentials of Professional Engineers (PE) in following Categories:

No. of PEs/Consultants

Sr Professional Engineers/ Consultants:

- Professional Engineer:
- Associate PE:
- Student PE:

Advantage of Being Registered Professional Engineer

For Employer

- Due to the higher technical competence levels of these Professional Engineers, better Indian products shall be available, thus enhancing the Indian Industrial might in the world arena. Better products mean more orders, implying expansion of the Indian manufacturing base, resulting in more business opportunities.
- Due to higher skills, lower rejections, higher outputs, implying higher profit margins, increased profitability.

Advantage to nation

- Due to the higher technical competence levels of these Professional Engineers, better Indian products shall be available, thus enhancing the Indian Industrial might in the world arena. Better products mean more orders, implying expansion of the Indian manufacturing base, resulting in more business opportunities.
- Due to higher skills, lower rejections, higher outputs, implying higher profit margins, increased profitability.

Advantage to Individual

- Increased Confidence due to recognition,
- Better chances for premium placement,
- Recognition by international companies for better placement,
- Due to registration, no difficulties in justifying relevant competencies

Board of Governors

Chairman
Dr. Uddesh Kohli

Vice Chairman

Shri Mahendra Raj	Indian Association of Structural Engineers

Member Secretary

Dr. P. R. Swarup	Construction Industry Development Council

Treasurer

Shri Sanna Ratnavel	Association of Consulting Civil Engineers (India)

Members

Prof. G. L. Sivakumar Babu	Indian Geotechnical Society
Shri Bhupinder S. Bhalla	Department of Commerce, Ministry of Commerce & Industry
Shri Vinay Gupta	Indian Concrete Institute
Shri Arun Kumar Kothari	Mining Engineers' Association of India
Prof. Prem Krishna	Indian National Academy of Engineers
Dr. Shuchita Kumar	International Council of Consultants
Shri D. D. Maheshwari	Indian Institute of Chemical Engineers
Shri S. C. Mehrotra	Consulting Engineers Association of India
Prof. Indra Mani Mishra	Indian Society of Agricultural Engineers
Shri Sanjay Mohapatra	Computer Society of India
Shri Dileep K. Nair	The Automobile Society (India)
Prof. M. P. Poonia	All India Council for Technical Education
Dr. P. S. Rana	Institute of Urban Transport (India)
Prof. (Dr.) K. T. V. Reddy	The Institution of Electronics and Telecommunications Engineers
Shri Uday Purohit	The Institute of Marine Engineers (India)
Shri Ranganathan Chandrashekar	Indian Institution of Plant Engineers
Dr. Santosh Kapuria	Council of Scientific & Industrial Research
Lt. Gen. Harpal Singh, AVSM, VSM	Indian Institution of Bridge Engineers (DSC)
Dr. S. L. Swamy	The Institution of Civil Engineers (India)
Dr. Niranjan Swarup	Indian Society for Trenchless Technology
Shri J. L. Narayan	Executive Director

ECI Member Associations

1. Association of Consulting Civil Engineers (India)
2. Broadcast Engineering Society (India)
3. Computer Society of India
4. Construction Industry Development Council
5. Construction Chemicals Manufacturers Association
6. Consultancy Development Centre
7. Consulting Engineers Association of India
8. Indian Association of Structural Engineers
9. Indian Buildings Congress
10. Indian Concrete Institute
11. Indian Geotechnical Society
12. Indian Institute of Chemical Engineers
13. Indian Institution of Bridge Engineers (DSC)
14. Indian Institution of Industrial Engineering
15. Indian Institution of Plant Engineers
16. Indian National Group of IABSE
17. Indian Society for Non Destructive Testing
18. Indian Society for Technical Education
19. Indian Society for Trenchless Technology
20. Indian Society of Agricultural Engineers
21. Institute of Urban Transport (India)
22. Institution of Mechanical Engineers (India)
23. International Council of Consultants
24. Mining Engineers' Association of India
25. The Aeronautical Society of India
26. The Automobile Society of India
27. The Council of Engineering & Technology (India)
28. The Indian Institute of Metals
29. The Institute of Electrical and Electronics Engineers. Inc.
30. The Institute of Marine Engineers (India)
31. The Institution of Civil Engineers (India)
32. The Institution of Electronics and Telecommunication Engineers
33. The Institution of Surveyors

SPONSORS

Patron Sponsor

Oil and Natural Gas Corporation Limited

Main Sponsors

Power Finance Corporation Ltd.

Bharat Petroleum Corporation Ltd.

Delhi Metro Rail Corporation Ltd.

GAIL (India) Limited

Indian Oil Corporation Limited

JMC Projects (India) Ltd.

KENT RO Systems Ltd.

L&T Construction

NMDC Limited

NTPC Limited

Oil India Limited

Petronet LNG Limited

Power Grid Corporation of India Ltd.

Rural Electrification Corporation Ltd.

Sponsors

Airport Authority of India

BEML Limited

Hindustan Petroleum Corporation Ltd.

NHPC Limited

IRCON International Ltd.

SJVN Limited

Co-Sponsors

Bharat Electronics Limited

RITES Limited