



Webinar Proceedings

Technologies for NDC and their SDG linkages (India)

30 July, 2020 | 16:00 – 17:30 (IST)

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Webinar at glance

- Technologies for NDC and their SDG linkages (India)
- 30 July, 2020 | 16:00 - 17:30 (IST)
- Theme - Technology, Innovation, NDC & SDGs
- Organizer - TERI supported by Norwegian MFA
- Panelists - 5 | Attendees - 100+

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The Energy and Environment Institute

Technologies for NDC and their SDG linkages (India)

30 July, 2020 (Thursday) | 16:00 – 17:30 (IST)

Moderator
Mr R R Rashmi,
Former Sp. Secretary, MoEFCC & Distinguished Fellow, TERI

Panelists

Dr Akhilesh Gupta, Department of Science & Technology (DST)	Prof. Pradeep Srivastava, Technology Information Forecasting and Assessment Council (TIFAC)	Representative, Norwegian Ministry of Foreign Affairs
Mr J M Bhambure, Advisor - Technology, Bluestar & TEAP-UNEP Task Force Member		Dr Manish Shrivastava, Aast. Professor, TERI-SAS



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Team

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Background

The effectiveness of the Paris Agreement in achieving its goal rests in individual countries' capabilities to transform their production and consumption patterns into low-carbon development pathways over a long horizon. Mere achievement of current Nationally Determined Contribution (NDCs) will not be enough. The groundwork for low-carbon transition beyond current NDC timeframes has to begin now. A necessary component of groundwork for long-term national climate policy is to develop a detailed technology road map (TRM) compatible with the national developmental imperatives and the demands of progressive revision of NDCs. India has submitted an ambitious NDC to the UNFCCC. India's NDC also underscores the need for capacity building; technology development, diffusion and transfer; and mobilization of domestic and new and additional funds from developed countries to achieve these goals. The mainstay of India's NDC implementation is the transformation of the energy sector, as it accounts for over three-quarters of the country's total emissions. The webinar focuses on the broad theme of technology needs for India's NDC implementation and presented a user-friendly database of technologies developed, the on-line tool is available at <https://www.teriin.org/projects/nfa/techdatabase/>

Preliminary discussion

Dr. Manish Kr. Shrivastava, Assistant Professor – TERI School of Advanced Studies welcomed the distinguished panellists and the participants for the webinar 'Technologies for NDC & its linkages (India)'. He presented an overview of the research collaboration between TERI & NFA in developing the technology database and intended discussions pertaining to technology innovations with NDC and SDGs. He highlighted that the technology database exercise was developed with the generous support Royal Norwegian Embassy under 'The Framework Agreement between The Norwegian Ministry of Foreign Affairs (MFA) and The Energy and Resources Institute (TERI)'. The agreement focuses on broad spectrum of addressing India's policy and research pertaining to energy, climate change and sustainable development. Dr. Shrivastava informed the webinar intends to address the questions on the importance of technology; selection of technologies; financial & capacity building needs and international cooperation requirements in the context of NDCs.

In his special remarks, Mr. Vivek Kumar, Senior Advisor - Royal Norwegian Embassy highlighted the research study exercised was part of the partnership programme between Norwegian Embassy and TERI in the field of sustainable development and climate change. He stressed the three key thematic areas of research viz. (i) sustainability and clean energy; (ii) climate change; (iii) low carbon resource efficient growth. Eleven projects has been carried out under this partnership programme, resulting in strengthen the knowledge base and increased understanding of climate science, clean energy and resource efficiency. He highlighted that the studies has



also identified interventions and strategies addressing the adaptation, mitigation and aspects of climate change and supporting the policy landscapes at national & sub-national levels. He stressed that partnership programme has produced number of research papers, articles and web-based tools. He emphasized the other initiatives of Norwegian Government in strategizing the climate actions, NDC measures at national and international levels.

Introduction of technology database

Dr Manish Kr. Shrivastava, Asst. Professor – TERI School of Advanced Studies presented an overview of the research results on technology roadmap for achieving India's NDCs goals and technology database providing the list of 119 identified technology options across 13 sectors. A methodological approach was employed with preliminary steps on surveying of existing secondary resource and research papers, followed by detailed consultation meetings with various sectorial experts to comprehend their perspectives pertaining to (i) GHG mitigation potential; (ii) Relevant timeline; (iii) Technology development/deployment status; (iv) Barriers for implementation; (v) SDG interlinkages. The consolidated summary of identified 119 technology options is explicated below:



No.	Sectors	No. of technology options identified	Relative GHG emission reduction impact			Timeline	
			High	Medium	Low	Before 2030	Beyond 2030
1	Aluminum	4	4			4	
2	Buildings	24	13	7	4	20	4
3	Cement	13	6	7		6	7
4	Chlor-Alkali	2	2			2	
5	Fertilizer	12	9	3		8	1
6	Iron and Steel	7	5	2		7	1
7	Pulp and Paper	9	4	2	3	8	1
8	Refrigeration	10	5	4	1	6	2
9	Renewables	14	7	7		7	4
10	Textile	10	5	4	1	9	4
11	Thermal Power plant	5	3	2		4	3
12	Transmission	6		3	3		
13	Transport	3	3			3	6
	Sub-total 1	119	66	41	12	86	33

Dr. Shrivastava stressed that the financial barrier was considered as the greatest barrier amongst all other barriers – impeding the implementation of 91 out of 119 identified technology options. He also informed that the developed technology database is enabled with options for the sectorial experts and researchers to edit the existing identified options and to add new more technology options for firming more robust technology roadmap framework.

Panel discussion

Moderator: Mr. R R Rashmi, Distinguished Fellow, TERI

Mr. R R Rashmi started with underlining the importance of technology in meeting NDC and SDGs, which are country specific and global specific targets respectively. He emphasized the fundamental difference between NDC focussing on predominantly in mitigating GHG emissions and energy centric and SDGs focussing on multi-dimensional developments like poverty alleviation, health improvement, infrastructure, energy, gender balance, climate action, water, etc. He also stressed that apart from GHG reduction, technology plays a crucial role by disrupting employment and livelihood. This directly influences the SDGs goal targets, particularly in developing countries like India. The industries and research institutes should come-up with technology solutions complementing the inclusive SDGs goal strategies. He highlighted that there are numerous factors influencing the deployment of low-carbon technology options like (i) high upfront cost; (ii) need for international coalition & co-operation; (iii) robust R&DD infrastructure; (iv) lack of awareness & capacity building

Mr. Rashmi introduced the distinguished panellists and opened the floor for expert discussion with the following questions:

- What are the solutions we have in terms of technology?
- What are the key barriers impeding the deployment of low-carbon technology options?
- How do we move from here in achieving both NDC & SDGs goals through the deployment of sustainable low-carbon technology options?

Panellist 1: Prof. Pradeep Srivastava, Executive Director - Technology Information Forecasting and Assessment Council (TIFAC)

- Prof. Srivastava informed that TIFAC, an Indian Government Thinktank working on the identification, mapping and assessment of technology, along with promotion of selection technology solutions across the country.
- He highlighted that TIFAC has recently produced a 'Technology Vision – 2035' document, encapsulating the key technology options & its pathways complementing both NDC & SDGs. The mapped technology options in the vision document directly support in achieving maximum SDGs goals and climate action targets.
- He emphasized TIFAC is persistently working on identification of clean energy technology options, advanced solar PV systems, bio-fuels and energy storage solutions to support the NDC target on mitigation of GHG emissions.
- He described that TIFAC is also working on technology prioritization exercise using MCDM (Multi Criteria Decision Making) techniques and analytical methods.



Panellist 2: Dr. Akhilesh Gupta, Advisor & Head, Climate Change Programme – Department of Science & Technology, Govt

- Dr. Gupta started with emphasizing the key elements of Paris Agreement – 2015, intending to limit increase in the global temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.
- He emphasized that at global level, it is imperative to achieve reduction of 40-70% in 2050 compared to 2010 and net or negative emissions by 2100 to achieve the intended Paris Agreement goals. In the current scenario, India with its climate action plans places itself in the '2 °C compatible zone' towards the Paris Agreement.
- He described that one of the 8 national missions under NAPCC - 'National Mission on Strategic Knowledge for Climate Change (NMSKCC)', has an institutional set-up 'Global Technology Watch Groups (GTWG)' for mapping, selection, assessment and prioritization of technology options for climate change mitigation and adaptation.
- He stressed that GTWG focusses on 8 technology sectors with individual team of 15 -20 sectorial experts working on identification of viable technology solutions. The GTWG progressed with the identification of 2,000 technology options and prioritization of 500 technology options across 75 sub-themes under the 8 technology sectors.

Panellist 3: Mr. JM Bhambure, Advisor - Technology, Bluestar & TEAP-UNEP, Task Force Member

- Mr. Bhambure highlighted that 'Innovation' plays a significant role in any technology deployment cycle. Intensive all-inclusive R&D infrastructure is required to catalyze the promotion of indigenous technology development.
- He emphasized that India has seen unprecedented success in transforming the household appliances sector under the Standards & Labelling programme. This has significantly benefitted India in reducing the massive electricity consumption and its associated GHG emissions.
- He underlined that the cooling segment with its cross-sectorial nature viz., residential thermal comfort, industrial applications, agriculture, plays a major role in country's energy share landscape. This resonates with the recent strategic document 'India Cooling Action Plan (ICAP)' released by Ministry of Environment Forest and Climate Change (MoEFCC) in 2019. The document elucidates country's strategic action plans for addressing the needs of cooling sector (demand, energy, and environment) over the next 20 years.
- He stressed that the future of technology development and deployment at consumer end & industry application will be completely integrated with the Internet of Things (IoT), Artificial Intelligence (AI) & Industrial Revolution 4.0.



This was followed Mr. RR Rashmi's concluding remarks, appreciating all three panelists for sharing their valuable insights from the perspectives of Government, Institutional and Industry. He highlighted that the sustainable pathways for low-carbon technology options in achieving NDC & SDGs goals are influenced with affordable costing, international coalition support and readiness to transform. He also stressed that there is a huge void in introducing the clean energy options with the unorganized MSME sector in India which shares significant GDP and caters employment opportunities to 30 crore people in India.

The discussion ended with a vote of thanks by Dr. Manish Kr. Shrivastava, thanking all distinguished panellists and participants. On behalf of TERI, he extended his gratitude to the Royal Norwegian Embassy for their generous support in conducting this research exercise of technology database development.

Webinar feedback form – response – summary

An online feedback form was shared with the participants during the discussion to perceive their views on the impact of research results and webinar consultation. The consolidated summary of 17 participants' views is explicated in the following table:

No.	Questions	Participant feedback
1	How likely are you to finding our technology database website?	85%
2	Prior to the event, how much of the information that you needed did you get?	70%
3	Date & time of the event	Very satisfied
4	Speakers & team	Extremely satisfied
5	How satisfied were you with the event?	Very satisfied
6	How likely are you to recommend this event to a friend or colleague?	85%

Participants testimony:

'The Events was giving me lots of knowledge about technology. Everything was wonderful experience.'

- **Manoj Kumar Sahu**, Junior Research Fellow, Chhattisgarh Council of Science and Technology, Raipur, Chhattisgarh

'The Speakers' interventions, introduction to the database'

- **Nimita Pandey**, Post-Doctoral Fellow, DST-CPR, IISc Bangalore

'The information and knowledge shared by the experts'

- **Pragya Das**, Student, Banasthali University



'Sharing the information through ppts and question answer session. Please organize more such webinars so that there is more participation and awareness to conserve our planet will be increased.'

- **Apurva Upreti**, Executive, IMS

'All aspects are very informative and well explained. Keep sharing such platforms with us'

- **Deepa Chaudhary**, Assistant Professor, Lyallpur Khalsa College, Jalandhar

'Cross cutting issues addressed'

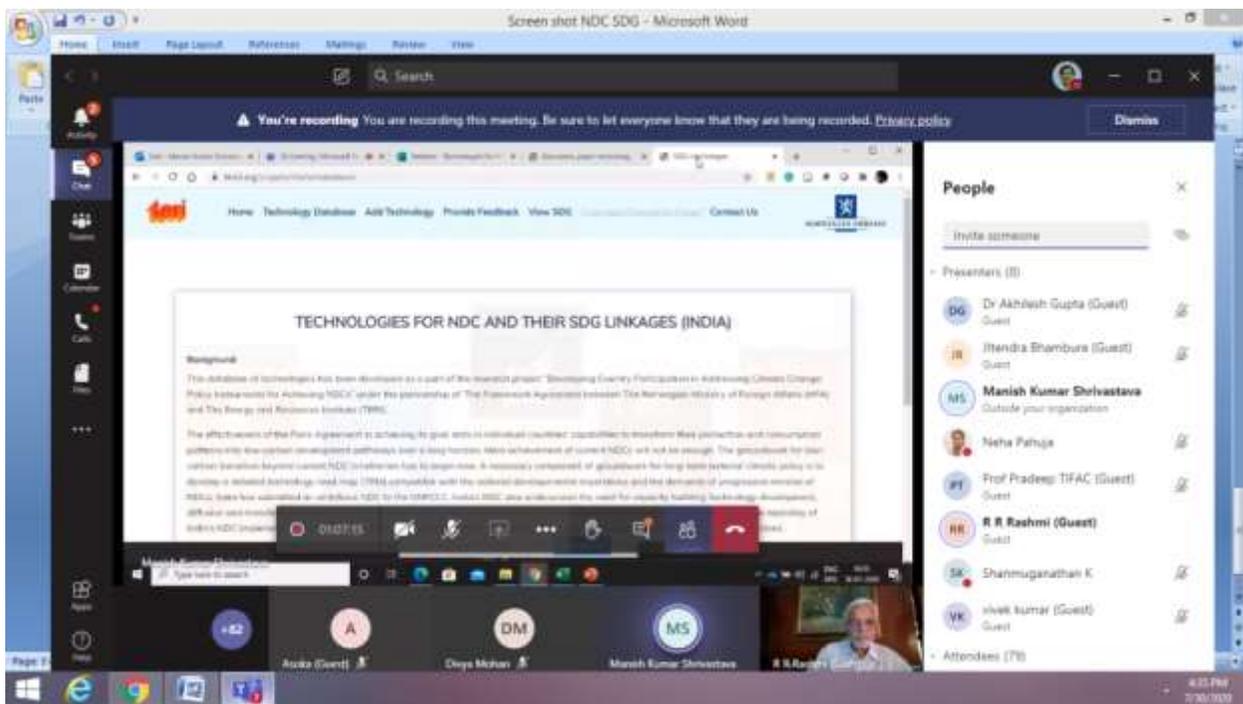
- **Bindu Aggrwal**, Faculty/ Special Adviser DM, Indian Red Cross Society



Webinar snapshots



Webinar Proceedings





Agenda

Tentative agenda

16:00 – 16:05	Opening remarks & setting-up the context	Mr. R R Rashmi, Distinguished Fellow, TERI
16:05- 16:15	About the NFA	Representative from the Norwegian Ministry of Foreign Affairs
16:15 – 16:25	Introduction of technology database & research findings	Dr. Manish Shrivastava, Asst. Professor, TERI-SAS
16:25 – 17:15	Panel discussion	Moderator – Mr R R Rashmi, Distinguished Fellow, TERI Dr. Akhilesh Gupta, Department of Science & Technology (DST) Prof. Pradeep Srivastava, Technology Information Forecasting and Assessment Council (TIFAC) Mr. J M Bhambure, Bluestar & TEAP-UNEP, Task Force Member
17:15 – 17:25	Q & A	
17:25 – 17:30	Sum-up & Concluding remarks	Mr. R R Rashmi, Distinguished Fellow, TERI



Webinar - presentations

PPT 1: Dr. Manish Kr. Shrivastava, Assistant Professor, TERI School of Advanced Studies

  <p style="text-align: center;">Technologies for NDC and their SDG linkages (India)</p> <p style="text-align: center;">Towards a Technology Roadmap for achieving India's NDC goals</p> <p style="text-align: center;">Manish Kumar Shrivastava Assistant Professor, TERI School of Advanced Studies, New Delhi Shanmuganathan K Associate Fellow, Earth Science and Climate Change Division, TERI, New Delhi</p> <p style="text-align: center;">30 July 2020, New Delhi</p>	<p>Context of study</p> <ul style="list-style-type: none"> Global Stocktake and progressive revision of NDCs <ul style="list-style-type: none"> Chasing a moving target The groundwork for low-carbon transition beyond current NDC timeframes has to begin now. Arguably, the progressive revision of NDCs implies that by the time of NDC revision, countries would have already done, fully or partially, the necessary groundwork to move upwards in their national climate policy. 																																																																																																																													
<p>Technology Roadmaps</p> <ul style="list-style-type: none"> A necessary planning exercise for long-term structural transition <ul style="list-style-type: none"> Balance between NDC and National Socio-Economic Development priorities (including concerns of just transition) Identify international cooperation needs for developing countries TIC guidelines It is important for developing countries to have an assessment of immediate, current NDC relevant technological options, their appropriateness in national context, and their cost implications. How do we prioritize technologies? 	<p>Before TRM:</p> <ul style="list-style-type: none"> Identify technologies that contribute to both, addressing climate change and SDGs. <ul style="list-style-type: none"> Possible tradeoffs between climate change and the SDGs implications Ideally, those technologies which show strong synergies for climate change and SDGs should be prioritized. A structured scenario of how various competing technologies may play out in the future <ul style="list-style-type: none"> What should be the governance structures? Roles of different stakeholders in regulating the interplay of competing technologies Removal of barriers in greater diffusion Understand sectoral dynamics of actors involved in determining the demand and supply of specific technologies, and accordingly <ul style="list-style-type: none"> Coincidence of changes required in the governance structures to promote diffusion of new and futuristic technology substitutes. Possible governance is ideal: a governance structure for current technologies should also be suitable for future technology substitutes when they become available. For example, the experience with diffusion of CFLs has been really useful for the diffusion of LEDs. A description of interventions, including international cooperation, at different temporal or diffusion milestone intervals at national and international levels 																																																																																																																													
<p>This study:</p> <ul style="list-style-type: none"> Aims to inform on technologies Survey of government documents identifying technologies Consultations with industry experts/on job experience <ul style="list-style-type: none"> GHG Mitigation potential Relevant timeline and development/deployment status SDG linkages Barriers 	<p>Database of technologies</p> <p>https://www.teriin.org/projects/nfa/techdatabase/tool.php</p> <table border="1"> <thead> <tr> <th rowspan="2">No.</th> <th rowspan="2">Sector</th> <th rowspan="2">No. of technology options identified</th> <th colspan="3">Relative GHG emission reduction impact</th> <th colspan="2">Timeline</th> </tr> <tr> <th>High</th> <th>Medium</th> <th>Low</th> <th>Before 2030</th> <th>Beyond 2030</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Aluminium</td> <td>4</td> <td>4</td> <td></td> <td></td> <td>4</td> <td></td> </tr> <tr> <td>2</td> <td>Buildings</td> <td>24</td> <td>23</td> <td>7</td> <td>4</td> <td>20</td> <td>4</td> </tr> <tr> <td>3</td> <td>Cement</td> <td>13</td> <td>8</td> <td>7</td> <td></td> <td>6</td> <td>7</td> </tr> <tr> <td>4</td> <td>Chemicals</td> <td>2</td> <td>1</td> <td></td> <td></td> <td>2</td> <td></td> </tr> <tr> <td>5</td> <td>Fertiliser</td> <td>12</td> <td>8</td> <td>3</td> <td></td> <td>8</td> <td>1</td> </tr> <tr> <td>6</td> <td>Iron and Steel</td> <td>7</td> <td>3</td> <td>2</td> <td></td> <td>7</td> <td>1</td> </tr> <tr> <td>7</td> <td>Pulp and Paper</td> <td>9</td> <td>4</td> <td>2</td> <td>3</td> <td>8</td> <td>1</td> </tr> <tr> <td>8</td> <td>Refrigeration</td> <td>10</td> <td>5</td> <td>3</td> <td>1</td> <td>8</td> <td>2</td> </tr> <tr> <td>9</td> <td>Renewables</td> <td>18</td> <td>7</td> <td>7</td> <td></td> <td>7</td> <td>4</td> </tr> <tr> <td>10</td> <td>Textile</td> <td>10</td> <td>5</td> <td>4</td> <td>1</td> <td>9</td> <td>4</td> </tr> <tr> <td>11</td> <td>Thermal Power plant</td> <td>5</td> <td>3</td> <td>2</td> <td></td> <td>4</td> <td>3</td> </tr> <tr> <td>12</td> <td>Transmission</td> <td>6</td> <td></td> <td>3</td> <td>3</td> <td>2</td> <td></td> </tr> <tr> <td>13</td> <td>Transport</td> <td>3</td> <td>3</td> <td></td> <td></td> <td>3</td> <td>3</td> </tr> <tr> <td></td> <td>Sub-total 1</td> <td>128</td> <td>66</td> <td>21</td> <td>12</td> <td>85</td> <td>22</td> </tr> </tbody> </table>	No.	Sector	No. of technology options identified	Relative GHG emission reduction impact			Timeline		High	Medium	Low	Before 2030	Beyond 2030	1	Aluminium	4	4			4		2	Buildings	24	23	7	4	20	4	3	Cement	13	8	7		6	7	4	Chemicals	2	1			2		5	Fertiliser	12	8	3		8	1	6	Iron and Steel	7	3	2		7	1	7	Pulp and Paper	9	4	2	3	8	1	8	Refrigeration	10	5	3	1	8	2	9	Renewables	18	7	7		7	4	10	Textile	10	5	4	1	9	4	11	Thermal Power plant	5	3	2		4	3	12	Transmission	6		3	3	2		13	Transport	3	3			3	3		Sub-total 1	128	66	21	12	85	22
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Key observations: Technology landscape

- Progressive revision faces technological uncertainty
 - Of the 119 technologies, 56 technologies are relevant before 2030 and 53 technologies would be important post-2030.
 - The respective numbers of ready-to-deployable technologies are 51 and 2.
- Aggressive R&D is a precondition for ambition
 - It is intuitive to recognize the importance of R&D for transformative action post-2030, also reflected in the dominant number of technologies (25 of the 33) needing significant R&D attention.
 - The period up to 2030 too would need significant emphasis on R&D as only 41 out of 56 technologies that will have high mitigation impact are ready-to-deployable. 13 high-impact technologies would need open-ended R&D efforts while 4 high-impact technologies would require targeted R&D.
- Weak understanding of SDG implications of these technologies with few exceptions

Key observations: Barriers



Key observations: Barriers

No.	Barriers	No. of targeted technologies (out of 119)
1	Technological barriers	48
2	Financial barriers	81
3	Policy barriers	57
4	Capacity barriers	77

Source: perception analysis with industry etc.

- Of 119 options, 44 technological options are ready-to-deployable but face financial as well as capacity barriers
- 22 options at R&D stage face all four barriers

NEXT STEPS Towards TRM

- Develop sector specific SDG impact assessments
- Identify and address technology specific barriers to ready-to-deploy technologies
- Develop innovative market-mechanisms to address financial barriers
- Targeted R&D strategy of technologies in R&D stage
- Ensure easy access to information on latest technologies
- Strategic use of technology and finance mechanism under the Paris Agreement

The Technology Database

<https://www.teriin.org/projects/nfa/techdatabase/>

Relevance for Just Transition

- Consider SDGs as a measure of just transition
 - NDC-SDG trade-offs are important to understand
- The sectors where in-situ upgradation of technology can deliver efficiency without much work-force transition should be prioritized
- Wherever capacity gaps are identified, filling those gaps could be linked with the reskilling of workforce where work-force transition poses a challenge



PPT 2: Dr. Akhilesh Gupta, Adviser & Head – Climate Change Programme, DST, GoI

<p>DST's Initiatives on Global Technology Watch Groups <i>Climate Technology Mapping, Assessments, Selection, and Prioritization</i></p> <p>Akhilesh Gupta Adviser & Head Climate Change Programme Department of Science & Technology Government of India Email: akhilesh.g@nic.in</p>	<p>Key Climate Elements of "Paris Accord -2015"</p> <ul style="list-style-type: none"> ◆ Limiting increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels ◆ Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, ◆ Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.
<p>Global Surface temp CHANGE DURING PAST 138 YEARS (1880-2018) Global Mean Estimates based on Land and Ocean Data</p> <p>Relative to the 1951-1980 mean 2018: 1.09°C 2016: 0.99°C 2015: 0.97°C 2014: 0.94°C</p> <p>Annual Mean 5-year Mean</p> <p>NASA GISS</p>	<p>Atmospheric CO₂ is now well above 400 ppm : 120 ppm above the pre-industrial level</p> <p>Atmospheric CO₂ at Mauna Loa Observatory</p> <p>~100 ppm increase in last 60 years</p> <p>Unprecedented in the last 1 million years and possibly in the last 20 M years.</p>
<p>Limiting Temperature Rise to 2^o C What does it entail?</p> <ul style="list-style-type: none"> ◆ Global GHG emissions reduction of 40-70 % in 2050 compared to 2010 ◆ Net zero or negative GHG emissions in 2100 ◆ Global emissions must peak and start declining within next 5-15 years ◆ However, with the current commitments (Paris Agreement) temperature rise is most likely to exceed 2.7 °C falling well short of 2°C target. ◆ With US quitting the agreement, the 2°C target is now even more difficult to achieve. ◆ To achieve 2^o C target and aspiration of 1.5^o C, much more additional contributions and other measures need to be taken by all countries more so by developed ones. 	<p>Where do we Stand? - India's Climate Action Tracker</p> <p>India's Present Climate Actions (initiated under NAPCC and NDC)</p>
<p>Eight National Missions under NAPCC</p> <ul style="list-style-type: none"> ◆ National Solar Mission ◆ National Mission for Enhanced Energy Efficiency ◆ National Mission on Sustainable Habitat ◆ National Water Mission ◆ National Mission for Sustaining the Himalayan Ecosystem (NMSHE) ◆ National Mission for a Green India ◆ National Mission for Sustainable Agriculture ◆ National Mission on Strategic Knowledge for Climate Change (NMSKCC) <p>Both NMSHE and NMSKCC coordinated by DST were launched with broad objectives of building S&T Capacity for sustenance of Himalayan ecosystem and for developing strategic knowledge system</p>	<p>One of deliverables of NMSKCC is to set up "Global Technology Watch Groups" for Mapping, Selection, Assessment and Prioritization of Technologies for CC Adaptation and Mitigation</p>



Why do we need GTWG?

- ◆ GTWGs needed to be set up for **technology mapping, selection, assessment, evaluation, prioritization, risk assessment and foresight** in the areas of climate change adaptation and mitigation.
- ◆ GTWG is **an independent, standing think tank mechanism** that performs a number of critical functions including alerting, assessment, evaluation, prioritization, etc.
- ◆ Technology being dynamic which evolves continuously, GTWG need to be institutionalized within some well identified and established institutions.
- ◆ GTWG was set up as a **network of experts** that tap into the global pool of scientific expertise available in the open scientific community.

GTWG linkage with Technology Needs Assessment (TNA)

- ◆ As part of International negotiations for climate change, the 21st Conference of Parties (Cop 21) held in Paris in 2016, have desired developing countries to come up with their country specific **Technology Needs Assessments (TNAs)**.
- ◆ The **GTWG outcomes are targeted to meet the requirements of TNAs**.

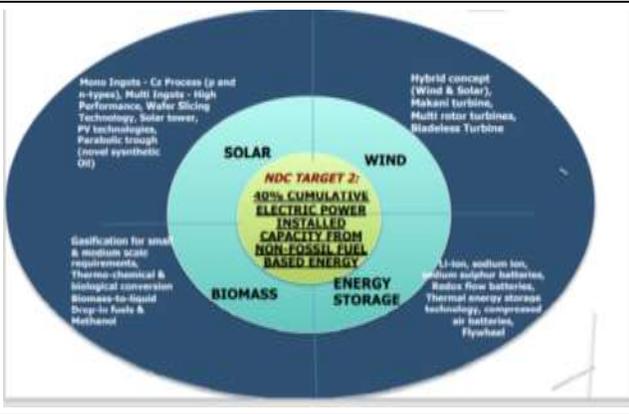
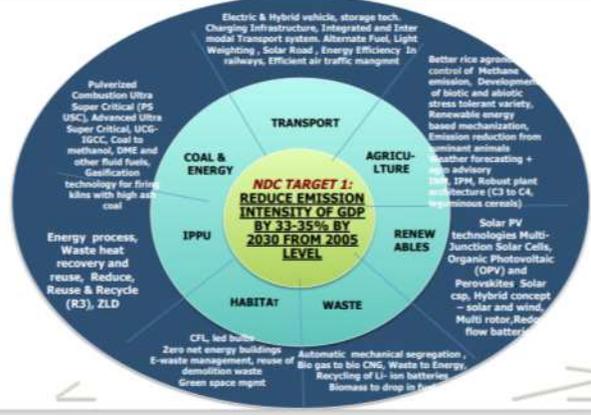
DST's Global Technology Watch Groups (GTWGs)

SNo	GTWG sector	Lead Institution
1.	Renewable Energy Technology	NIAS, Bangalore
2	Advanced Coal Technology	IIT Madras
3	Water Resources	TIFAC, Delhi
4	Sustainable Agriculture	
5	Sustainable habitat	
6	Energy Efficiency	
7	Green Forest	
8	Manufacturing	

GTWG Consultations

- ◆ For all the 8 Technology Sectors, GTWG teams were set up. Each team comprised of 15-20 experts
- ◆ National and regional level Stakeholder workshops including consultation with industry leaders
- ◆ 3-4 rounds of discussions for each GTWG sector
- ◆ A total of 300 experts across the country were involved
- ◆ A National Steering Committee chaired by Dr Anil Kakodkar, Former Chairman Atomic Energy Commission, Secretary, DST and all the Mission Directors of National CC Missions as members to monitor the programme

Technology Mapping and Alignment with NDCs





Sector-wise Sub-Themes Identified

Energy Efficiency

- ◆ Industry - Power Sector, Steel, Cement, Pulp & paper, Fertilizer and Metal Processing
- ◆ Transport - Road, Rail, Air and Waterways
- ◆ Small & Medium Scale Enterprises (SME)
- ◆ Building
- ◆ Agriculture
- ◆ Municipal
- ◆ Electronic uses by public
- ◆ Motors & Drivers
- ◆ Home appliances
- ◆ Telecom Infra, Data Centers, Hospitals

Forestry

- ◆ Forest Productivity
- ◆ Climate Change Impacts
- ◆ Forest Protection
- ◆ Biodiversity Conservation
- ◆ Carbon Service
- ◆ Forest Measurements
- ◆ Livelihood Improvement

Sector-wise Sub-Themes Identified

Sustainable Habitat

- ◆ **Urban Infrastructure & services**
 - Mobility
 - Water
 - Energy
 - Waste
 - Health
 - Education
 - Communication
- ◆ **Buildings**
 - Housing (Materials, building etc.)
 - Green spaces
 - Others
- ◆ **Habitat Management & Services**
- ◆ **Safety & Security**

Sustainable Agriculture

- ◆ **Crop (Crop Improvement and Natural Resource)**
- ◆ Land and Water management
- ◆ Soil and Nutrient management
- ◆ Microbial Technology
- ◆ Geo-ICT
- ◆ Crop Protection
- ◆ Mechanization
- ◆ Horticulture and post harvest technology
- ◆ Agro-forestry
- ◆ Protected cultivation, vertical Farming, Hydroponics etc.
- ◆ Animal Husbandry and Livestock
- ◆ Fisheries

Sector-wise Sub-Themes Identified

Manufacturing

- ◆ Petrochemical & Pharmaceutical, Agro-Chemicals
- ◆ Electronics
- ◆ Textile and Leather
- ◆ Food Processing
- ◆ Transportation
- ◆ Metal/Material processing
- ◆ Precision Machine tools
- ◆ Energy Manufacturing
- ◆ Aerospace
- ◆ Defense

Water

- ◆ Waste water
- ◆ Water Conservation (Domestic/Municipal and Buildings)
- ◆ Water Augmentation/availability (Flood water recharge, Control of evaporation /evapotranspiration, Desalination and Water recycling)
- ◆ Irrigation (Increase water use efficiency)
- ◆ Health of aquatic system (River flow/discharge)

GTWGs for Climate Technologies Outcome At a Glance

- ◇ 8 Sectors
- ◇ About 75 Sub-sectors/Sub-themes
- ◇ Nearly 2000 technologies scouted and mapped
- ◇ Nearly 500 technologies selected and prioritized – Average 8 technologies per sub-theme



Participant confirmation list

No	First name	Last name	Designation	Organization	Sector
1	Imandi	Manga Raju	Research Scholar	Andhra University	Academia
2	PRAGYA	DAS	Student	BANASTHALI UNIVERSITY	Academia
3	Arshpreet	Kalsi	Program Associate	EPIC India	Academia
4	Isabella	alloisio	Prof	EUI	Academia
5	N.Kayalvizhi	Nadimuthu	Principal	Govt Law College	Academia
6	Ashok G.	Matani	Professor	Govt. College of Engg, Amravati	Academia
7	Jimmy	Kumar	Research Scholar	IIM Lucknow	Academia
8	Saritha	Vishwanathan	Research Fellow	IIMA	Academia
9	Apurva	Upreti	Executive	IMS	Academia
10	SADANAND	.	Student	INDIRA NATIONAL UNIVERSITY GANDHI OPEN	Academia
11	Samikchhya	Kafle	Researcher	International Center for Integrated Mountain Development	Academia
12	Raina	Dua	Research Scholar	Jawaharlal Nehru University	Academia
13	Sudhir	Verma	PhD candidate in International Law	Jawaharlal Nehru University New Delhi	Academia
14	Rishi	Rana	Assistant professor senior grade	Jaypee University of information technology wakhnaghat Solan Himachal Pradesh	Academia
15	Trishla	Dubey	Assistant Professor	Maharashtra National Law University, Nagpur	Academia
16	Abi	Irwin	Self-employed	NA	Academia
17	Shyandeep	Haldar	Library and Information Assistant	Natesan Institute of Cooperative Management Chennai	Academia
18	Ashutosh	Pande	Assistant professor	Raksha Shakti University	Academia
19	Pramod	Anand	Visiting Fellow	RIS	Academia
20	Roderick	Wijunamai	Lecturer	Royal Thimphu College, Bhutan	Academia
21	Arsh	Saluja	Student	School of Planning and Architecture, Bhopal	Academia
22	Varun	Pandey	TTL	TERI	Academia
23	Anita	Yadav	Student	TERI SAS	Academia

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26	S	Paragnee	Research Scholar	TERI School of Advanced Studies, New Delhi	Academia
27	Arvind	Jasrotia	Professor, Department of Law, University of Jammu	University of Jammu	Academia
28	Asilata	Karandikar	PhD Candidate	University of Mumbai	Academia
29	Kavita	Singh	PhD Scholar	University School of Law and Legal Studies Guru Gobind Singh Indraprastha University Delhi	Academia
30	Vani	Prakash	Assistant professor	USLLS, GGSIPU	Academia
31	aakriti	mathur	Ph.D. scholar	USLLS, Guru Gobind Singh Indraprastha University	Academia
32	Swati	Arora	Phd researcher	Waseda university	Academia
33	Rima	Ghosh	Research Assistant	WBNUJS	Academia
34	Vivek	Kumar	Sr Advisor	Norwegian Embassy	Bilateral organisation
35	Mihir	Bhatt	Director	All India Disaster Mitifigation Institute	Civil Society
36	Mohd. Sahil	Ali	Associate Felllow	Brookings India	Civil Society
37	Vedant	Ballal	Consultant	Clean Air Asia	Civil Society
38	Sheetal	Antil	Program Manager	Climate Reality India	Civil Society
39	Amit	Babu	Programme Associate	CUTS International	Civil Society
40	Bindu	Aggarwal	Faculty/Special Adviser DM	Indian Red Cross Society	Civil Society
41	Vivek	Adhia	Country Director	Institute for Sustainable Communities	Civil Society
42	Prima	Madan	Lead- Energy Efficiency and Cooling	NRDC	Civil Society
43	Aprup	Adawadkar	Founder President	Paryavaran Pratham	Civil Society
44	Shweta	Prajapati	Scholar	TERI School of Advanced Studies	Civil Society

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46	Indrajit	Bose	Sr Researcher	TWN	Civil Society
47	Faraz	Alam	Manager- Energy & Power	Vasudha Foundation	Civil Society
48	Rabindra nath	Sen	Chairman rtd	WBERC	Civil Society
49	Chirag	Gajjar	Head - Subnational Climate Action	WRI India	Civil Society
50	RAJESH	AGRAWAL	Architect	AAKAR	Corporate
51	Sunny	Sankneniwar	Executive	Adani Power Ltd.	Corporate
52	Sanjay	Singh	GM Environment	Ambuja Cement	Corporate
53	Saurabh	Allen	Manager - Corporate Environment & Sustainability	Ambuja Cements Limited	Corporate
54	Abhishek	Ranjan	AVP and Head Renewables	Brpl	Corporate
55	Sayan	Koley	Senior Engineer, Planning	CESC Limited,Kolkata	Corporate
56	Rajmohan	Rangaraj	CEO	DESL	Corporate
57	Vatsal	Khandelwal	Environmental Engineer	Eco Mitra Solutions	Corporate
58	Gagan	Nigam	Sr. Manager	IL&FS Environment	Corporate
59	Himanshu	Arora	Manager (Sustainable Development)	IndianOil	Corporate
60	Abhishek	Pattanaik	Specialist	Karo Sambhav Pvt. Ltd.	Corporate
61	Reetika	Arora	Associate Consultant	KPMG	Corporate
62	Amani	Gupta	Consultant	KPMG	Corporate
63	ANKUR	BHARDWAJ	AM	Create	Corporate
64	Nikhil	Mall	Analyst	Meghraj Capital Advisors Private Limited	Corporate
65	Arihant	Jain	Consultant	Meghraj Capital Advisors Pvt. Ltd.	Corporate
66	Satendra K	Jain	AGM Env Mgmt	NTPC	Corporate
67	Bgvperunaidu	Pentakota	Managing director	PENTAKOTA ALLIANCE PVT LIMITED	Corporate
68	Pankaj	Satija	Chief Regulatory Affairs	Tata Steel	Corporate
69	Mansi	Deshmukh	Senior Architect	Tatva Architects	Corporate
70	Pradeep	Mishra	Head	UPL Limited	Corporate

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73	Akanksha	Krishan	Sector expert	BEE	Government
74	P	Kawishwar	Scientist	CCOST, Raipur	Government
75	Ravi	Shah	Project Associate	Centre for Climate Change & Sustainable Development	Government
76	Tapesh	Jha	APCCF	CG Forest	Government
77	Susheela	Negi	Scientist E	Department of Science & Technology	Government
78	Rabindra	Panigrahy	Scientist D	Department of Science and Technology	Government
79	NAGENDRAPJ	Kumar			Government
80	Nisha	Mendiratta	Adviser & Scientist G	DST	Government
81	J K MONY	ANGELUS	ASSISTANT PROFESSOR OF ENVIRONMENTAL LAW	GOVERNMENT LAW COLLEGE CHENGALPATTU TAMILNADU	Government
82	Surya Prakash	Sethi	Retired	Government of India	Government
83	SD	ATTRI	Dy Director General	IMD	Government
84	Gopi Krishna	Das	Professor & Head, Dept. Of Agro-Meteorology.	Indira Gandhi Krishi Vishwa Vidyalaya, Raipur, Chhattisgarh.	Government
85	Ajay	Raghava	Jt. Director	MoEFCC, Govt of India	Government
86	PRADIP KUMAR	PATAJOSHI	MANAGER	NALCO	Government
87	A M	Siddiqui	Representative	NEDO	Government
88	Srinivas	Shroff Nagesha Rao	CHIEF EXECUTIVE OFFICER	REC Foundation	Government
89	Gautam	Goswami	Sc F	TIFAC	Government
90	Hemant	Mallya	Sr. Programme Lead	CEEW	Institution
91	Sachin	Zachariah	Research Analyst	CEEW	Institution
92	Nimita	Pandey	Post Doctoral fellow	DST-CPR-IISc	Institution
93	Prerona	Kaushik	Project Officer	GRIHA Council	Institution
94	Srikanta K.	Panigrahi	Director General	Indian Institute Of Sustainable Development (IISD), New Delhi	Institution
95	Madhuri	Nigam	Assistant Professor	Lady Irwin College	Institution
96	MD	ADIL	Asst.Professor	MSS Law College/Osmania	Institution

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98	Chandra	Kumar	Expert Operations	SIDBI	Institution
99	Arpo	Mukherjee	Associate Fellow	TERI	Institution
100	Aditya	Raghwa	Associate	TERI	Institution
101	Vijay Vikram Singh	Parihar	Associate Fellow	TERI	Institution
102	Snehlata	Tigala	Research Associate	TERI	Institution
103	Ashriti	Gupta	Developer	TERI	Institution
104	Shivangi	Seth	Master's Student	TERI School of Advanced Studies	Institution
105	Rajendra	Ninganuri	Consultant	Development Environenergy Services Limited	Multilateral organisation
106	SK. Gulam Shafi	Ahmed	Founder Chairman of GWPPF Trust	Global Warming Protocol Protection Force Trust - GWPPF	Multilateral organisation
107	Pradyumna	Rana	Climate Change Adaptation and Governance Analyst	ICIMOD	Multilateral organisation
108	Takahiro	Oki	TO	IEA	Multilateral organisation
109	Pier Roberto	Remitti	Lead Expert Climate Action	IUC Asia	Multilateral organisation
110	Ravi	Aggarwal	Proprietor	Maman Chand Ramji Das	Multilateral organisation
111	Divya	Mohan	Coordinator	UnESCAP	Multilateral organisation
112	Rashi	Mehta	Manager and marketer	Vnv advisory services	Multilateral organisation
113	Kanhaiya	Kumar	Student	Central University of South Bihar	Student
114	Farha	Naaz	Student	Delhi University	Student
115	Komal	Pabri	Student	Delhi University	Student
116	Manisha	N/A	Master's	Guru Gobind Singh Indraprastha University	Student
117	SHIVANI	SHARMA	PG Student	Guru Gobind Singh Indraprastha University Delhi	Student
118	Kalp	Das	Student	IGKVV, Raipur	Student
119	Prashantkumar	Sathvara	Student	ISTAR	Student
120	Manish	Mirchandani	Student	KC Law College, University of Mumbai	Student
121	Chanchal	Singh	Masters	Lady Irwin Collge	Student

Webinar Proceedings



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123	Athokpam	Lanjingba	Student	None	Student
124	Abishek	S	Student	PSG	Student
125	Monika		Master student in Environmental Planning	School of Planning and Architecture, Bhopal	Student
126	Wahengbam	Nikhil	Bsc. 4th semester	Student	Student
127	Sujata	Gautam	Student	Tata Institute of Social Sciences	Student
128	Saurabh	Shukla	Master's Student	Tata Institute of social sciences	Student
129	Garima	Sharma	Msc	TERI	Student
130	Akshat	Shrivastava	Student	TERI	Student
131	Diti	Mathew	Student	TERI SAS	Student
132	Vinni	Munjal	student	teri sas	Student
133	SRISHTI	MINOCHA	PhD scholar	Teri SAS	Student
134	Veena	C P	Student	Teri school of advanced studies	Student
135	Denver Magdol	Nogueiro	Post Graduate	TERI School of Advanced Studies	Student
136	Nisarg	Bhatt	Student	The Maharaja Sayajirao University of Baroda	Student
137	Riddhi	Joshi	Student	The Maharaja Sayajirao University of Baroda	Student
138	Khyati	Arya	Student	The Maharaja Sayajirao University of Baroda	Student
139	Darjin	G.D	LLM	TNDALU	Student