GCIP
Global Cleantech
Innovation Programme

UNIDO

Global Cleantech Innovation Programme India 2013-2017

Stories and Lessons
A GCIP Journal

Disclaimer

This document is to provide insights into GCIP India's activities held over 2013-2017 on Cleantech innovations. We wish to share our learnings and lessons that emerged over the course of the programme. It also aims to give the reader a sense of Cleantech innovator journeys, the ecosystem, and the enablers. However, this document does not intend to provide any official data or information concerning any disputable issues. The views expressed in this publication are those of the contributors and do not necessarily reflect the views of UNIDO or GEF, or the member states or their secretariats. UNIDO or GEF, or the member states or their secretariats do not warrant or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information contained in this publication.

Global Cleantech Innovation Programme India 2013 - 2017

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March 2017

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List of Acronyms

BEE	Bureau of Energy Efficiency
CO_2	Carbon Dioxide
CSR	Corporate Social Responsibility
CTO	Cleantech Open
DSIR	Department of Scientific and Industrial Research
DST	Department of Science and Technology
DIPP	Department of Industrial Productivity and Promotion
GCIP	Global Cleantech Innovation Programme
GEF	Global Environment Facility
GHG	Greenhouse Gas
HRD	Human Resource Development
HVAC	Heating Ventilation and Air Cooling
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
MSME	Micro, Small and Medium Enterprises
PAT	Perform, Achieve and Trade
R&D	Research and Development
TDB	Technology Development Board
TIFAC	Technology Information Forecasting and Assessment Council
UNIDO	United Nations Industrial Development Organisation
VC	Venture Capital

Preface

As UNIDO promotes inclusive and sustainable industrial development among its member states, innovations in clean technologies assumes greater importance as low-cost solutions that can be utilized by the small and medium industries in developing countries. Over the past several years, the continued partnership between the Government of India and UNIDO has led to strengthening of the country's industrial, energy and environmental sectors. As India's economy continues to grow robustly, the focus shifts towards increasing the efficiency in industrial production and using energy more efficiently in an environment friendly way. UNIDO's activities in India are helping the government to explore and develop alternate and clean energy supply options for industrial applications.

In 2011, UNIDO, with the support of the Global Environmental Facility (GEF) successfully implemented the 'Greening the COP17' project. One of the four components of the project focused on the design and implementation of the Clean Technology Competition for green entrepreneurs and small and medium-size enterprises with innovative ideas and concepts in the areas of energy efficiency, renewable energy and green building practices. The success of the project in South Africa, which attracted a wide range of private-sector interest, identified 24 semi-finalist companies and 3 winners.

In May 2013, UNIDO launched the Global Clean Technology Innovation Programme (GCIP) in India with the Ministry of Micro, Small and Medium Enterprises (MSME) and with Cleantech Open, a non-profit based in Silicon Valley, as the knowledge partner. In these three years, the GCIP-India programme mentored 69 innovators for commercialising their technologies successfully. Each year, the winners went to compete in the Cleantech Open in the US. The UNIDO programme gave the innovators a unique opportunity to win accolades and recognition from enterprises worldwide.

This Journal is an attempt to capture the four-year learning by UNIDO's key stakeholders of the GCIP programme in India. It offers important insights and lessons about the Indian ecosystem primarily from the innovators and mentors experience and perspectives, which we wanted to share with the partner ministry. India ranks amongst the world's top five countries in terms of innovation thus creating a mature and thriving innovation eco-system for SMEs—keeping in mind their sensibilities—is the need of the hour.

UNIDO will continue to work with SMEs towards an efficient and commercially sustainable sector, and help the Government of India progress towards Sustainable Development Goal 9 to build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation. I congratulate the GCIP India team for this journal that beautifully encapsulates the learnings and nuances of their Cleantech journey.

We thank the Ministry of MSME for its proactive encouragement and support to the innovators and entrepreneurs as they continue to bring the innovations in the Indian market.

Philippe Scholtes
Managing Director
Programme Development and Technical Cooperation
UNIDO

From the PMU Desk

The Global Cleantech Innovation programme of the United Nations Industrial Development Organisation (UNIDO) was designed for small and medium size industries to leverage the power of entrepreneurship to address the most challenging energy and environmental problems with support provided by the Global Environment Facility (GEF). The Cleantech Open, USA is the knowledge partner of UNIDO in this programme. The programme is currently being implemented in eight countries namely India, Malaysia, Pakistan, South Africa, Thailand, Turkey, Morocco, and Ukraine.

GCIP India was launched in May 2013 in partnership and with the support of Ministry of Micro, Small & Medium Enterprises (MSME). Over the last four years, the programme attracted applications from over 534 entrepreneurs 69 were short-listed and exposed to around 100 subject specialists in the form of pure mentors, members of the screening committees, judges, jury, and investors. The semi-finalist innovators came from all over India, spread over 41 cities. Many of the teams were from tier 2 and tier 3 cities, which underpinned the success of the programme in terms of its outreach, as we had innovators participate from all over the country.

The idea was to select the best indigenous technologies in India through a competitive accelerator, bring the best learnings of commercialisation to them at par with the developed countries through the Cleantech Open platform and to get the government to participate and learn from this activity to effect positive policy change. I think we achieved all three objectives.

Firstly, the accelerator set in India was able to attract the best technologies in the four verticals – **energy efficiency, renewable energy, waste to energy and water efficiency** which is best validated by the fact that this year's winner of the Global Cleantech Innovation Award was India's national winner team Green India Building Systems and Services Private Limited (GIBSS). GIBSS has developed a geothermal heat exchange air-conditioning system that brings up to 60% energy savings and 100% water savings compared to conventional building cooling systems. India also got the award in the energy efficiency category, second year in a row, for an innovation in the DLC fan by team Atomberg Technologies this year and by Promethean Energy last year for a waste heat recovery solution.

Secondly, our teams could compete and win amongst the best in the programme, a fact validated by the 2016 GCIP accelerator cycle - conducted in seven countries received a total of 1,261 applicants, and 236 semi-finalist teams participated in the accelerators out of which the Indian teams came out with excellence.

Thirdly, the government has appreciated the initiative of the programme of creating a vibrant innovation ecosystem and has decided to consider carrying the initiative forward in one of its autonomous institute namely the Institute for Design of Electrical Measuring Instruments (IDEMI), Mumbai and designate it as the Cleantech Technology Centre.

It was an amazing journey and before ending the programme this year, we wanted to share our journey, the experiences, and the excitement besides the learnings - with all the stakeholders in the vibrant ecosystem, which this programme was able to reinforce. There were winners, there were

losers, there were dropouts but all had something to teach and we wanted to share that with all of you. I think the best takeaway of this programme was the friendships and the relationships that were forged among the participants and the various stakeholders who were all connected by this common, but novel experience of innovating something. They were all excited by the science of their innovation and wanted to share it with the world, wanted to make their mark in the system and we wanted to share that experience with you and that is how the idea of this journal came about.

We hope you will enjoy going through these pages as much as we enjoyed putting it together for you.

This programme was too short to make its mark in the Indian ecosystem but it definitely helped all associated with it to underline their own learnings. In some way GCIP helped each one of us to better ourselves in our understanding of the cleantech energy landscape.

We are thankful to the ministry of MSME and to the Development Commissioner's office for deciding to consider taking this agenda forward and we are sure it will be a leap forward in taking the Cleantech innovation to delivery for the millions of Small and Medium Enterprises in India!

We are grateful for the constant support and guidance from Sanjaya Shrestha, the Project Manager and Sunyoung Suh from UNIDO HQ at Vienna.

I would like to also thank the entire PMU team for the excellent team work and dedication.

Amrit Raj
National Project Coordinator
GCIP India, UNIDO

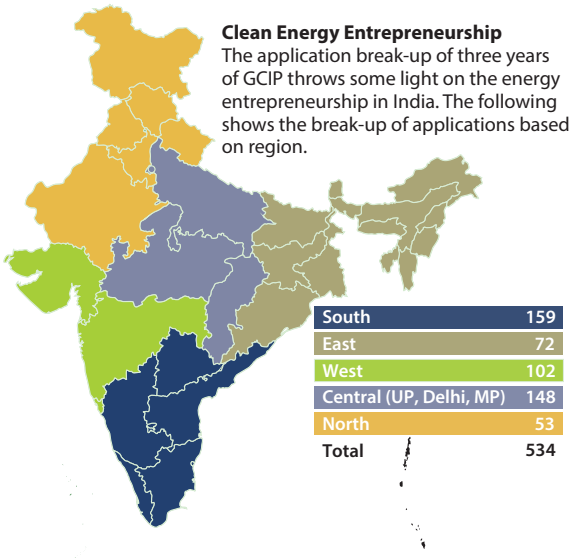
1 Introduction and Background

1. Towards Strengthening Cleantech Innovations and the Ecosystem

UNIDO for Sustainable Industrialisation

Over the last 50 years, UNIDO has been supporting Small and Medium Enterprises (SMEs) in developing countries and economies in transition. Recognising the need for industrial growth in these economies, UNIDO prioritised the strengthening of industrial SMEs for tapping into the opportunities and challenges of globalisation. It was clearly understood that clean-technology interventions in SMEs can aid in their sustainability and their competitive advantage. Further, as a specialised agency of the UN to promote industrial development for poverty reduction, inclusive globalisation, and environmental sustainability, UNIDO is entrusted to build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation - as highlighted in the Sustainable Development Goals 2030.

UNIDO's learnings so far indicate that entrepreneurship thrives in countries where there is minimal red tape, strong rule of law, ready access to venture capital, government funding and a vibrant support network for entrepreneurs. Further, almost all net new jobs are created by growing small businesses. Leveraging these learnings, the Global Cleantech Innovation Programme (GCIP) is designed to run an accelerator programme for Cleantech Innovators that drives home the idea of local innovation and builds on the entrepreneurial ecosystem. Funded by the Global Environmental Facility (GEF) and implemented in collaboration with local governments, UNIDO has rolled out the GCIP in eight developing countries, with the support of the Cleantech Open, a non-profit in the USA which runs one of the largest cleantech accelerators in the world.



Cleantech Innovator Interests in the GCIP programme across India

Global Cleantech Innovation Programme

GCIP works on enhancing emerging cleantech startups and the local entrepreneurial ecosystem and the policy framework in countries in transition. Through its accelerator programme for cleantech innovation startups with resources in developing countries, GCIP has an overarching agenda to deliver both environmental benefits and economic vitality by driving innovation. A competition-based approach is used to identify the most promising

> UNIDO objectives provide a key link to SE4ALL (Sustainable Energy for All) agenda of the UN and the SDGs (Sustainable Development Goals) - SDG 9 focuses on innovation, industry, and infrastructure, SDG 7 is on Sustainable Energy for All, and the overarching SDG 13 for climate action.

innovation teams across a country, supported by GCIP's local acceleration programme. Thus, the GCIP programme promotes and "de-risks" the participating companies and connects them to potential investors, customers, and partners. An integral part of GCIP is the development of the institutional capacity of local implementing partners, typically government agencies focused on SME development, clean technology, and innovation. A key local government agency responsible for SME development is the critical partner of the programme in each country.

With the cleantech agenda, GCIP focuses on innovators working on indigenous solutions for major challenges in energy efficiency and generation, distribution and storage, air and water pollution, waste management, new forms of transport and construction techniques. As the best cleantech startups progress through the GCIP platform, they are continuously trained, mentored and assessed. The very best startups from each country are brought together at a global competition in San Francisco, California, organised by the Cleantech Open, USA where they can compete with innovators from the GCIP programme run in other parts of the world, for the Global Cleantech Innovation Award. UNIDO, with support from the Global Environment Facility, is currently implementing the GCIP in India, Morocco, Malaysia, Pakistan, South Africa, Thailand, Ukraine and Turkey.

India's Cleantech Entrepreneurs and Innovation

MSMEs are the second largest employers in India, after the agriculture sector. While SMEs comprise 90% of the industrial units in India, they contribute to 45% of the total industrial output. Hence SMEs are critical to industrial sustainability in India, such that they are the potential absorbers of cleantech solutions and are also entrepreneur-innovators. Given India's ambitious economic growth agenda and clean energy objectives, bringing these SMEs into the fold of sustainable growth is highly critical for the nation.

India Cleantech Startup Stories and Lessons

The National Winner of GCIP India 2016 won the much coveted Global Cleantech Innovation Award in 2016 at GCIP's annual Cleantech Open Global Forum event held in Silicon Valley, California on 9th Feb 2017. Also, in 2015 and 2016 the programme won for the best innovation entry in the energy efficiency category, reflecting on the quality of the fast-growing startups in India. However, like any emerging space, the startup ecosystem in India is still evolving and the nuanced cleantech innovation space is riddled

with challenges. Yet the opportunities are large. The Global Cleantech Innovation Index points out that India is expected to spend almost USD 30 billion on renewables and USD 1.7 trillion on energy supply infrastructure by 2035 besides adding a grid interactive renewable capacity of about 30,000 MW. On the other hand, water-access and climate change challenges are immense and immediate.

With 10,000 startups in the country, India is the 3rd largest startup-hub in the world. However, the percentage of Cleantech startups is almost negligible. Thus, there is a critical need for these startups to vault in the cleantech scheme of things - what will help them get to the pole position, what does the ecosystem require to get India going? – while there are many questions and concerns, there are inspiring stories and market successes. So, this journal offers glimpses of GCIP's cleantech innovator stories from India, negotiating their challenges, the policy and market dynamics, and the pathways of the ecosystem.

The India winners of Cleantech Open Global Forum 2017 with the DC-MSME, UNIDO Project Manager India, GCIP Team and the mentors

GCIP India Success Story

At the finale of Cleantech Open Global Forum held in Silicon Valley on February 10, 2017, Bengaluru's Green India Building Systems and Services Private Limited (GIBSS) bagged the top Global Cleantech Innovation Award. The startup makes geothermal heat exchange AC system that cuts energy and water usage. Mumbai's Atomberg Technologies that makes DC fans that consume less electricity won the energy efficiency category.

The GCIP 2016 accelerator programme cycles conducted in the seven countries received 1,261 applicants and 236 semi-finalist teams participated in the accelerators. The competition and accelerator approach selected the best cleantech entrepreneurs across India, Malaysia, Morocco, Pakistan, South Africa, and Turkey and supported them in developing their innovative technologies into full-fledged market-ready products. Selected startups in each country participated in a rigorous and competitive national acceleration programme that trained, mentored, promoted, and connected them to potential investors, customers, and partners. The national winners competed in the Global Cleantech Forum and network with international investors and partners.

2. Government of India Perspective of GCIP - Interview with Shri Surendra Nath Tripathi, Additional Secretary & Development Commissioner, Ministry of MSME

The Government of India partnered with United Nations Industrial Development Organisation (UNIDO) to run the GCIP Programme in India. What was the thought process of the Government especially the ministry of MSME for conceptualising and executing this programme?

Conceptualising and Executing GCIP India Programme

S.N. Tripathi,
Additional Secretary & Development Commissioner, Ministry of MSME, Government of India

The government decided to partner with UNIDO for the Global Cleantech Innovation Programme because the programme focus was on mainstreaming clean technologies for SME sector, on developing commercially viable technologies, on promoting a competition based approach and to create a platform to showcase innovations for scaling-up indigenously developed solutions in both India and on the global stage. The GCIP programme focuses on linking innovators to advisors and investors with a vision which aligns with that of Ministry of MSME, "Making all SMEs in India energy efficient and environmentally sustainable through the adoption of clean technologies by 2025". Through the Cleantech Open, USA, the knowledge partner of UNIDO in this programme, we wanted to give the same learning to our SME innovators, which was being imparted to the best teams in the USA.

We wanted to see that whether this initiative of evolving an ecosystem based on volunteering approach as in the Silicon Valley, is workable and scalable in India and we are very happy with the results. We were able to rope in over 100 mentors in the programme in various capacities as pure mentors, judges, experts, screening committee members and investors who willingly came forward to give time from their busy schedule to make this programme work over the last four years. What better validation of the success of the programme than the fact that we have been able to bring back the award for the best innovation team in the Energy efficiency segment two years in a row (in 2015 and 2016) from the GCIP Global forum event organised in San Francisco, California by the Cleantech Open, the largest Cleantech accelerator in the world.

How does India's ambitious project like "Make in India", "Smart Cities Programme" and "Swachh Bharat" find synergy in the GCIP programme? What are your views on the role of Cleantech innovation in these programmes?

If you have a look at just the diversity of the global winners of the GCIP programme, you will find that GIBSS provides an alternative space cooling solution for Green Buildings, Atomberg Technologies provides an efficient ceiling fan for both households and SMEs and Cellzyme improves the efficiency of Pharma manufacturing. Renewable energy and solar is a very small part of the overall Cleantech spectrum. Cleantech touches all of these programmes and more – clean technology is about increasing the local productivity of resource – the GCIP programme is focused on the most underutilised resource of all in India when it comes to clean technology – human capital! Through mentorship and stewardship of startups and SMEs it has contributed to seeding an ecosystem around clean technologies that can now be further grown at regional levels as well as along any of the above specific focus areas – be it industrial efficiency, urban planning and development or water and sanitation. We are hoping that the success of GCIP would catalyse a community of entrepreneurs, mentors, and other stakeholders especially corporates and policy makers to lead some of these challenges

that the honourable Prime Minister has posed before us.

What are the biggest challenges in India's environment for innovation in Cleantech? Please comment on the ecosystem building blocks like R&D, finance, accelerators, new ideas, business models, and local/global markets etc.

A lot is happening in the Indian innovation ecosystem but we also have a long way to go. Firstly, we have critical needs in the masses that need to be addressed; we can't afford to only be focused on a audacious goal. Given the immediate needs and limited risk capital, we need to make more affordable mistakes. We need to take a safe and cautious approach to development and gradually build up credibility to invest more in research and development.

In India, we still have the need to sell the concept of Cleantech to the masses. For many enterprises, the question still revolves primarily around resource productivity, natural resource and human resources, and capital efficiency rather than lowering carbon emissions.

For the government, responsible manufacturing is a laudable goal but the priority is still to create more meaningful jobs. For that, we need to help our entrepreneurs develop the confidence to build manufacturing businesses, which can create employment. Today the cost of doing manufacturing is prohibitive. We need to change that. We need to replicate the success we have had in the domestic automobile sector and take it across to other industries.

India is a very big democracy, therefore despite the policy thrust given by this government to improve and strengthen the innovation ecosystem – a lot of coordination is required between different agencies of the government to make initiatives like "Make in India" really work. The changes are required in the banking sector, meaningful tax incentives, alternate funding mechanisms need to be developed in the private space along with changes in the investment fabric. Apart from these though the R&D efforts of the government for the ecosystem has been concentrated under the department of Science and Technology umbrella, many other government agencies like MSME, HRD, Skill Development, DIPP, etc.

also work in different aspects of R&D in the institutes under their aegis.

The Government of India has brought forward the ambitious 175 GW RE targets. Please comment about cost efficiency in indigenous energy efficiency and renewable energy technologies critically necessary to these goals.

The cost of any intervention is not just the price of the technology but also the cost of logistics and installation of the system and maintaining and operating these systems over the future. Indigenisation targets driving that overall cost down. In the process it also helps in creating the human talent pool required to further grow that business. My conversation with Mr. Danny Kennedy, MD of the California Clean Energy Fund, showed that we are not alone in this thinking. He mentioned how the move away from manufacturing capabilities is hurting the U.S. and California, while research shows that localised manufacturing of batteries (Li-Ion in this case) to be more cost effective, there is simply no experience or talent available in the U.S. to do so. They are now partnering with local universities to develop a 2-year training programme on battery technology to build the local capacity. We will be connecting with them to collaborate on bringing that programme to India – these are good long-term high quality SME and job creation opportunities. The honourable Prime Minister has set the ambitious target of 175 GW of generation from renewable energy as well as set a strong mandate for energy efficiency in all SMEs and consumer durable products by 2025, we now need to integrate that vision in the work that we do for the MSME ministry that means further improving our efforts to drive innovation in our existing clusters and potentially creating new clusters around RE systems and energy efficient appliances and creating a strong inclusive demand for clean energy from MSMEs across the country.

Is India's Cleantech innovation limited by the scope of SMEs? What kind of cleantech innovations is happening in the country?

Cleantech adoption in India faces its own unique challenges but for the best of entrepreneurs

each of these are opportunities to exploit. As I said earlier, the cleantech innovation happening in India is more about resource efficiency rather than being driven to reducing carbon footprints. MSMEs form the backbone of the economy but India faces both a capital investment and human capital problem. Less than 5% of the industry employs more than 5 persons and 70% of them don't use any modern source of power. So, yes, in some ways it is limited by the scope of SMEs. With the renewed focus of the government on distributed renewable energy, 24 x7 electricity for all, ease of doing business and skilling across all ministries there will be a more robust supportive platform for MSMEs to grow. Further, innovations in the energy efficiency space is something on which the government is focusing a lot as most SMEs are energy inefficient and need to make that quantum jump given the government vision of making all SMEs energy efficient by 2025.

What lessons can India learn from GCIP's innovation lessons worldwide? You have led the Indian delegation to the Silicon Valley, San Francisco for the Global Forum event for the last two year. Please share with us some key takeaways and experiences?

The GCIP Programme of UNIDO is running in seven countries namely South Africa, Malaysia, Thailand, Pakistan, India, Morocco, Turkey and earlier in Armenia. Ukraine is the latest country that will be joining the programme in the near feature. As you can see, the programme is spread out in developing countries and even though these countries are much smaller than India and have very different economic challenges, the entrepreneurial journey is the same in almost all the countries. To find funding at the seed stage and for series A from non-banking channels is a big challenge in all countries. SMEs are a big contributor in their economies too but most of them are looking for markets outside their countries whereas India can be that market for them. If India can develop the right investment ecosystem, it can become theregional market these countries will like to look at and explore. Apart from these countries, even USA is very keenly watching the cleantech and renewable space of India and China and we need to work on the same both on the policy as well as private initiative arena.

Hari Rao, National Winner India 2015 and DC-MSME S.N. Tripathi with Dave Lello, CEO of Khaya Power - Global Winner 2015 from South Africa

We must learn from the way the USA, especially the state of California, has taken initiatives in the cleantech space – the key learning for the government is that we need to build a collaborative eco-system where we are the moderators and mediators of a deep-rooted group of private stakeholders and consumers that are driving the agenda. Policies and subsidies don't solve problems, people willing to come to the table and collaborate do.

For the innovators, the key learning is that they need to be always selling. Showing what the Wow! Factor of their solution is. Pitching a business is a "skill" that our SMEs need to learn. When it comes to entrepreneurship, the ability to communicate an idea can be as important as the idea itself-not just to venture capitalists, but, also to employees, consumers, banks and policy makers.

The GCIP is ending, what happens next?

We are exploring options to build upon what the programme has achieved so far. The team at UNIDO Delhi and headquarters, Kevin Braithwaite and his team at Cleantech Open have done a good job here! I believe the MSME ministry given its multi-dimensional focus across industries including agri-based sectors is the right place for driving innovation and adoption of new clean technologies by the modern Indian SMEs. The key is to keep and maintain the collaboration and mentorship aspects of the programme intact. It is already in the works.

3. GCIP India Perspective - Interview with Dr. Pradeep Monga, Former Director, Energy and Climate Change, UNIDO

Dr. Pradeep Monga, Former Director, Energy and Climate Change, UNIDO, explains how Global Cleantech Innovation Programme fosters technological innovations, builds capacity and promotes entrepreneurship by connecting innovators to potential investors, in a conversation with Orchie of Energy Next.

Connecting innovators to potential investors

Dr. Pradeep Monga
Former Director, Energy and Climate Change, UNIDO

Q. How are innovations encouraged through the Global Cleantech Innovation Programme (GCIP) in India?

GCIP converges innovators and helps them for six months to a year through an accelerator programme. Innovators start with some knowledge and some ideas, but how to put it in a more scientific basis so that it can be replicated and at the same time its full market potential can be exploited, is important. From there, we verify their technologies and patents, and then we provide mentoring and guide them about how the innovation can be integrated into the global value chain. We bring everybody together so that the innovator can be recognised and be a part of the global value chain. Our innovators stimulate a lot of

interest from entrepreneurs and investors, and the IITs are roped in to provide them with scientific knowledge. GCIP runs in eight countries and we want to bring in global companies to work with these innovators in India and other developing countries and economies in transition.

Tell us more about how the participants attract investors.

The winners of GCIP India will be taken to Silicon Valley for the Global Clean Tech Programme meeting in February 2017. Along with winners from all the eight countries, the Indian innovators will be given 5-10 minutes each for making their pitches about their innovations so that participants, especially from the financial institutions, can gauge the innovations. There is a select jury to tell them how they feel about the innovation; what is the mass application of the innovation; and how do we go about it. So, these GCIP India winners along with UNIDO will pitch to a global audience where big companies like Tesla and Google will be present. Some investors may show interest to join hands with the innovators to have PPPs, special purpose vehicles, etc.

In Silicon Valley, we bring all winners together to learn from each other and to present their project ideas and innovations to everyone.

The companies provide us mentors and, many times, they are ready to invest in the innovations. We are very happy when a $1 million company is sold for $100 million.

How do you certify the winners?

During the six months of screening, there are experts to certify their innovations. The process begins with a screening committee of subject experts who conduct the first round to select the semi-finalist teams. The second and third round of judging is through a panel of judges and jury. For example, the jury includes former secretary of MNRE (Ministry of New and Renewable Energy), top scientists from IITs (Indian Institute of Technology), Ministry of Environment and private sector practitioners. They certify that the idea is innovative and not one taken from somewhere else. We have got NRDC (National Research Development Cooperation) to visit these teams and certify their claims.

So, when you bring in these global companies do they both mentor as well as invest?

The companies provide us mentors and, many times, they are ready to invest in the innovations. We are very happy when a $1 million company is

sold for $100 million. We also tell the company that for a $1 million company to become a $100 million one, you need to have patience, you must have the commitment, you must work on the knowledge, you must work on the IPR issues, and then scale up with the financial institutions.

Are investors ready to finance innovations?

Yes, absolutely, if it's a very interesting idea. Initially finance doesn't come from the programme, we take them to a stage, but then we do the matchmaking with the financial institutions. That's what we are looking at now, we have so many winners but remember, apart from winners every year, we have 25 semi finalists. So even if we have three winners, we have 22 entrepreneurs who are ready for scaling up. Now we are thinking about how to further motivate the semi finalists.

'Although India's target is very ambitious, it also shows that India has so much potential, a large market, a very large need and the RE programme is moving very fast in India'

In India, is it easy to get banks and FIs to finance such innovations?

In India, the risk-taking ability is missing. In the Silicon Valley or in other countries, there are different financial institutions who want to invest immediately. In countries, where the innovation ecosystem is working very well, the funding follows immediately. When the idea is good and it's certified, a lot of funding comes in. In India, that funding is not that quick. So, you are right, and we want to close that gap so as to connect the dots. That's why we want to bring in angel investors, VCs, pension funds, financial institutions, etc. But, they also have a point: they don't want to take a risk unless they are sure about what kind of returns they can get. That's what we call a bankable project – a business model. And, that's how our programme will help these winners to go ahead.

Do you showcase your experience from other countries to encourage bankers and financiers here?

Yes, absolutely, and remember, these are very opportune times. In 2015, we had two major global agreements. One was the

Sustainable Development Goals (SDG), which was adopted in New York, and the second was the Climate Agreement in Paris. So, cleantech contributes to both: SDGs and the Climate Agreement because when you want to reduce greenhouse gas emissions, you want to adopt industries, you want to adopt agro-industries and others that is where the Climate Agreement becomes very important. So, cleantech, low carbon tech, low emission tech, renewables, and energy efficiency helps to address climate change. On the other hand, when you talk about the SDGs, the SDG7 is for sustainable energy for all, while SDG 9 is to build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation, SDG 11 is for sustainable cities and communities, and SDG 13 is for addressing climate change. The SDGs have a direct impact on cleantech. I do believe that cleantech and innovation programmes, while focusing on action on the ground, link up to SDGs at the global level as well as to the Climate Agreement, to address global climate change. Here we are looking at both mitigation and adaptation. These cleantech innovations will play an important part in moving to that agenda for sustainable development that we all want.

What's your outlook for the RE sector in India?

It is very positive, very encouraging. Indian Prime Minister Narendra Modi has taken a very ambitious initiative and we feel in the UN system that India is almost becoming a leading country to achieve 100,000 MW of solar power in the next five years. The UN Sustainable Energy for All aims to double the share of renewable energy in the global energy mix by 2030. Although India's target is very ambitious, it also shows that India has so much potential, a large market, a very large need and the RE programme is moving very fast in India. The cost of solar tech is dropping because of intense competition. We have newer technologies coming up every day in solar, wind, small hydro power, and second and third generation biofuel sector. When we talk about renewables, we talk of a mix of core technologies. Also, the decentralised approach is critical and important for a country like India. Each household can be a micro-grid. Villages can become micro-grids themselves and they can link up, provide energy security and supply at the village level and the surplus can be linked to the grid. I do believe that multiple micro-grids or decentralised energy grids themselves become a grid in that region. That's where you can take a hybrid approach, bring in solar and biomass together or solar and wind together. There are so many innovations taking place. I think it's a very positive outlook for RE in India and India has a huge potential which has not been harnessed. We need to bring in cutting-edge technologies and best practices, and I believe we are in a very strong, positive path.

Also, India was one of the first countries to have a ministry for renewable energy. MNRE has been a leader on the policy side. India was one of the first countries to set up a financial institution such as IREDA that only focused on RE funding. I think that shows the leadership but I still think that we need more private sector participation and financing. It has begun its journey in the right earnest. During the last two decades or so, India has done very well but now things need to take off very fast. What was done in the last 25 years, must be achieved in the next 5-10 years, given the thrust by the Government of India in terms of new policy instruments, RPOs, new laws and legislations. The critical point is to link everything to form a part of the venture to provide energy supply at affordable and sustainable basis. Renewables have a great future and India will become a very important country for other developing nations in

what is called the South-South cooperation exercise. If you want policies and technologies in place, you need some PPP model, such as an institution like IREDA. The rest of the space can be filled in by private sector banks and then the scaling up takes place. So, IREDA is a very good model for us in the UN system to quote and share its experience with other developing countries to scale up their efforts in the RE sector.

Besides investment and technology promotion, and development of Small and Medium Enterprises (SMEs), what are the other core elements of UNIDO's cooperation services in the Indian renewable energy sector?

When you talk about the renewable energy sector in India, one of the futuristic areas where we must focus on is the use of renewable energy for industrial heating and cooling applications. UNIDO is working together with other partner organisations under the leadership of the MNRE as we believe that the potential of renewable energy in industrial applications is immense. For example, solar energy for agri-businesses or process heat applications for dairy products. Renewables for industrial applications, both for process heat and refrigeration, need to be scaled up as renewables are equally cost-effective and result-oriented. Secondly, we need to link renewables to waste to energy programmes. I believe, there's a lot of scope there. Thirdly, another area, which is very critical for India, is how we make prosumers. We always take renewable energy as a sector for power generation, a very good business where many young entrepreneurs are working. But, how do we involve SMEs more into manufacturing as many of the technologies are still imported? The time has come to focus on manufacturing of RE equipment in India; make the country a manufacturing hub for solar and wind like other

'Renewables for industrial applications, both for process heat and refrigeration, need to be scaled up as renewables are equally costeffective and result-oriented'

countries. That's where I believe UN agencies like UNIDO will be very happy to contribute towards the Make in India campaign. Manufacturing of renewable technologies are part of that value chain in India. That'll be our endeavour for the future.

What about manpower requirements for the renewable energy sector?

Skilled manpower is required for manufacturing, operations and maintenance. The Skill India programme focuses on the skills needed for maintenance of solar power systems. When you have a target of 100,000 MW of solar power, you need a large skilled workforce to maintain those solar plants, and provide all other kinds of services. That's where the Skill India campaign comes in and we are very happy to be connected there. I'm not saying that only UNIDO is working, all our partners are working too. The Ministry is already working on developing a skilled workforce and we try to bring in global best practices and contribute to the sector.

Tell us about your sustainable city programme.

We have a very large sustainable city programme coming up. We have selected five cities now, namely Bhopal, Jaipur, Mysore, Guntur and Vijayawada, where we want to help in sustainable

urban planning and help these cities in developing sustainable waste-to-energy programmes. We are working with the Ministry of Environment, Forest and Climate Change on construction sector waste. India has a huge construction sector and everyday thousands of tonnes of waste are generated from the sector. Our work focuses on how to recycle that waste and how to reuse it. We are also working on a very important programme on Energy Efficiency where we're issuing ISO 50001 energy management systems because 20%-30% energy can be saved by our industries. So, I do believe that both EE and RE will have several innovative programmes for India. In closing, I'll say that in UNIDO we focus on three things: innovation in technology, financial instruments and capacity building. Wherever possible, we try to integrate these because that's where the challenge lies in a country like India as sometimes people and companies are working completely in isolation. We focus on how to bring them together and take a pragmatic approach and be more impactful, and, of course, build partnerships. In UNIDO, we strongly believe that partnerships are very important. That's why we have a strong partnership with MNRE, with IREDA CMD KS Popli and his wonderful team, with BEE and all other institutions like TERI, PCRA, National Productivity Council, CII, FICCI, etc. I do believe if you want to go fast, go alone but if you want to go far, go together.

Interview reproduced from Energy Next, Vol. 7, Issue 02, December 2016

II Innovator Viewpoints - Cleantech Innovation Ecosystem Challenges

GCIP approached its innovators for lessons and learnings from their cleantech innovation journey. They were asked to share their experiences in taking their innovation from product-phase to commercialisation; the key factors that facilitated their journey and the challenges they faced. Each of their input is hoped to inspire other innovators and provide an informed recommendation for strengthening the country's cleantech ecosystem. The following section showcases viewpoints of GCIP innovators reflecting personal experiences and observations.

1. Cleantech Policies Need Long-term Vision for India Opportunities

Ashwin K.P., Promethean Energy

Ashwin K.P. is a 2015 participant of the GCIP India programme who was mentored in the programme for his waste-heat recovery solution. He was the runner-up of the 2015 India programme and won the Energy Efficiency prize at the GCIP mega final, the Cleantech Open Global Forum Event held in Silicon Valley, California in 2015. He is an alumnus of IIT Bombay and IIM Ahmedabad. Ashwin is a cofounder of the Promethean Energy, a startup based out of Mumbai.

At Promethean Energy, we make a unique low-grade waste heat recovery solution for industrial applications helping industries to cut down their fuel usage by up to 70%. The key factors that will facilitate the success of our products (and companies like us) are a strong market access programme and access to early-stage development grants.

> "A market access programme would help a startup of our size to reach out to potential end-customers and generate awareness about our products."

This is a key challenge to our company as being a startup, we don't have sufficient resources to spend on business development, and reaching out to end-customers is critical for the growth of our company.

Most startups need access to early state product development grant. Though these are grants not potentially required at this phase of our venture as we have already received a few such grants, it is important in the early stages for a hardware startup, that there are sources of grants that could help us in building the prototypes and early-stage pilots. This ecosystem is very undeveloped in India, and is very important for ground-breaking hardware startups to come up.

What worked for us?

We wanted to be a bootstrapped model at any point of time, and hence the choice of products that we started out with ensured that we would survive despite less access to venture capital (VC). This turned out to be a good decision in hindsight, as capital in the cleantech space is relatively scarce. Also, we had a strong team of advisors who helped us reach out to end-customers, and refine our strategy. This included industry leaders, professors, and networks including GCIP, among others. Finally, we managed to target and acquire marquee clients early on which helped us in building our brand and reference-ability.

Today, cleantech innovators continue to face challenges.

> “In India, cleantech is a good-to-have, but not a must-have solution, unlike western countries, where there is very strong focus on clean sources of energy (for industrial and commercial use).”

This leads to most products being not top-of-the-mind for customers. In fact, the products that seem to have taken off are not sold on the “clean” tag, but on the economics/merits of the product itself. This might be a challenge, since most cleantech products/innovations tend to have slightly longer gestation periods/paybacks than their conventional alternatives. Access to capital is another challenge. Since cleantech is a more long-term game, most VCs in the country are averse to touching this sector, as the current trend in the country seems to be more along IT/digital-enabled products.

Interfacing with the Government

The government seems to be willing to help startups get off the ground and become successful. The Startup-India plan for example seems to be a good step in this direction. In addition, programmes like the GCIP have been very useful for clean energy companies, as they serve multiple purposes. For us, it has helped us in expanding our network, getting a “touch-point” with the government, as well as creating an ecosystem of cleantech entrepreneurs whom we can reach out to at any point of time.

On the financial assistance side, the government has channelled grant money via private bodies like Infuse Ventures, from whom we have received grants with zero bureaucracy. There are programmes like the SIDBI-TIFAC scheme, which we have qualified for and hope to receive capital from.

However, there are areas that require considerable improvement.

> “A startup works in hours and days, while the government works in months and years. For example, we received the technical approval for a government soft loan in January 2016, yet as of January 2017, we haven’t received the money.”

While all parties involved here have the right intentions, and are very pro-startups, the policy networks are not solid enough to enable seamless transmission of policy into execution.

What’s missing in the ecosystem?

The country does not have a demand push for clean energy. While the government is focused on solar power generation quite keenly, there are many more dimensions of a holistic clean energy system that need to be considered. Giving stronger directives for energy efficiency, more accountability for schemes like PAT[1], and targets being given to industries with deadlines on reducing their carbon footprint will help accelerate many clean energy solutions.

A network is required to help startups and relevant end-users identify each other. This is one major missing link in today's scenario. Large companies have extensive sales teams, which can reach out to end-users. However, startups can't afford such expensive systems, and moreover, they might not even know who the end-customers should be. Having a two-way system, which can act as a discovery platform, would be very useful for cleantech innovators.

Finally, a stronger product development ecosystem – including integrating academia, grants for R&D, and access to scientific manpower, would go a long way in accelerating early-stage product development.

2. Green Building Missions Can Catapult Space Cooling Innovations in India

Madhusudhan Rapole, Oorja Energy Engineering

Madhusudhan Rapole is a 2016 participant of the GCIP India programme, who was mentored for the radiant-cooling solutions. Madhusudhan is a winner of the WWF Climate Solver award for his radiant cooling technology. He is an alumnus of IIFT and TERI University. Madhusudhan is the MD & founder of Oorja Energy Engineering.

Oorja is a cleantech-based heating and cooling company focused on providing solutions to reduce energy consumption and CO2 emissions significantly by industrial and commercial sectors. We manufacture solar concentrators to provide heat (or steam) that help industries reduce their fossil fuel consumption, and radiant cooling systems for medium and large buildings to reduce energy consumption for their air conditioning by 30-50%.

We have had some initial success with our products and have installations across India. There were several factors that favoured us in our initial success. Early adopters who would benefit from replicating the technology adoption across their business chose to do pilots for technology validation.

[1] The Perform Achieve Trade (PAT) is market-based trading schemeunder the National Mission on Enhanced Energy Efficiency (NMEEE) for capping energy use and trading energy efficiency certificates

> "Also, green buildings rating programmes spurred the interest and demand for energy efficient space cooling technologies like radiant cooling."

We also spent a lot of time and effort creating awareness among influencers like architects, consultants, etc., which helped in greater acceptability of the technology. Our technology offered the highest savings, especially for buildings that were difficult to cool efficiently through conventional technologies.

Benefitting from the Green Building Policy

For an energy efficient technology like radiant cooling to become a mainstream solution it was a blessing to see energy efficiency becoming the central focus in building design. As the adoption of LED lights has gotten to be full-fledged, especially in most new buildings, we are confident that energy-efficient air-conditioning will soon follow suit. Implementation of the Energy Conservation Building Code (ECBC) nationwide, and capacity building through various industry platforms were other significant drivers.

Ongoing government programmes on energy efficiency are primarily driven by the Bureau of Energy Efficiency (BEE). BEE has taken a two-pronged approach – addressing the retail market through its labeling programme and tackling large energy consumers through its PAT scheme. Energy efficiency in buildings has been primarily left to rating agencies like Indian Green Building Council (IGBC), The Energy Research Institute (TERI), etc. The current awareness about energy efficiency can largely be attributed to these green building rating agencies that have created an initial market for products like Oorja's radiant cooling system.

An aggressive approach by BEE in pushing the implementation of the ECBC (Energy Conservation Building Code) across the country will go a long way in making energy efficiency a key criterion of building design and operation. Additionally, Demand Side Management (DSM) programmes by electricity distribution companies incentivising implementation of energy efficiency cooling systems would also stimulate the market. Energy efficiency cooling systems like radiant cooling can significantly lower peak electricity demand resulting from air-conditioning systems in peak summers. So a concerted effort by power generators and distribution companies can significantly reduce investments in unnecessary power plant capacities to serve the peak load and result in significant CO_2 reductions.

What can move the Radiant Cooling market?

Though many interventions through policies are possible, an ideal situation would be that the overarching philosophy of development policy will begin to acknowledge and work towards the future market that will be driven by green products whose entire value chain is green. Most countries with major manufacturing bases, including China, are pursuing this policy aggressively both as a response to the global climate change agreements and as a realisation to the fact that inefficient product markets will be soon obsolete.

> "If we do not create a large enough domestic market for green products Indian cleantech companies will not be able to scale up and continue to innovate."

This will force India to rely on importing of cleantech technologies.

> "A comprehensive national mission on enabling cleantech commercialisation is urgently needed."

This will yield an opportune criterion for Indian cleantech products aspiring to claim leadership position in the market and shall create large export potential for these technologies. Also, a large domestic market for cleantech will raise the bar for non-cleantech products manufactured in India to follow green standards, thus enhancing their value proposition to customers worldwide. For example, India's National Solar Mission has delivered great results on the ground, but has largely benefitted cleantech companies abroad, specifically China. This is because India did not have the ecosystem for rapid commercialisation of solar cells or solar panel manufacturing when the mission was announced. So, the mission should include creation of ecosystem as a prerequisite goal and not just power generation or savings targets.

Recommendations for India's Cleantech Ecosystem

The cleantech ecosystem should achieve closer ties with the industry-academia networks. The ecosystem needs to play a key role in supporting innovations by having a blueprint that includes related fields like materials, instrumentation/controls, manufacturing techniques, etc.

> "Further, a clear roadmap for commercialisation of cleantech innovation in the country, including validation and certification of the benefits of innovation through a single agency, is necessary."

Financing is a critical issue for many innovators, hence making early-stage risk capital available as grants, financial incentives to customers opting for validated innovations, and engaging cleantech accelerators to take the innovation towards rapid commercialisation is highly important.

Policy interventions that can bring wider stakeholder interactions and institutional support to cleantech innovators will create bigger impacts. A policy initiative mandating an industrial collaboration/ partnership for all cleantech-based research grants to ensure that research in these areas has a shorter path to market commercialisation, will be very effective. Active efforts are required to support multiple cleantech accelerator programmes that focus on mentoring and financing cleantech startups. Government financial assistance from the ministry of MSME or a similar agency to cleantech startups for the first three pilot installations is also necessary. Taking cues from the National Renewable Energy Laboratory (NREL) in the US, a nodal agency for stimulating, curating, validating and certifying cleantech products and solutions will create greater confidence in the early adopters of the technology and can help in its faster adoption.

Finally, policies that stimulate demand for cleantech has proven to play a critical role in the cleantech market transformation worldwide. Rebate in municipal taxes/electricity-use charges for investment in energy efficiency technologies in buildings can create large impacts. Mandatory energy efficiency norms for government and public sector unit buildings and mandatory energy audits for large commercial buildings above 200,000 sq. ft., like the existing mandatory energy audits in industries, can give a fillip to a robust market transformation.

3. The Startup Recognition Conundrum

Vijayaragavan Viswanathan is a 2015 participant of the GCIP India programme who was mentored for his innovation, SmartAgri – wireless sensor based precision agriculture, which is at the R&D stage. He is a scientist at CERN (EU nuclear research organisation). He is the founder and CEO of Tiino Techmations, based out of Coimbatore.

Dr. Vijayaragavan Viswanathan, Tiino Techmations

SmartAgri technology is for monitoring and controlling farm irrigation, for effective use of energy and other resources (water, fertilizer, pesticide, etc). Some of our learnings from R&D based innovation and entrepreneurship are shared here.

The never-ending challenges for getting a Startup recognised

Once a startup takes off the ground, it gets recognised as a "Startup" only if it fulfils several conditions. For example, one such condition prescribed is that the startup should be incubated in a government-recognised Technology Business Incubator(TBI) or Science and Technology Entrepreneurial Park (STEP) funded by the Ministry of Science & Technology or the Ministry of MSME (Micro Small and Medium Enterprises). But unfortunately, we found that neither TBI or STEP had the capacity or authority to process the applications. Further, there is no funding available to the incubators to process the application, and there is no prescribed structure or framework defined to carry out the application review.

If a startup has been granted a patent, it can be directly recognised as a startup. But unfortunately, getting a patent granted takes about 2 to 3 years. If the patent was filed initially as a provisional patent, then the period is still longer. But on the other hand, the startup recognition criteria say that a startup should have been up and running for 5 years or lesser. So, either the rule must be changed per the patent granting period or to the provisional patent status.

In addition, there is a missing connect between government agencies that advise and guide startups. Startup recognition criteria mainly look at innovative technology or first-of-its-kind technology. Technology Information Forecasting Assessment Council (TIFAC), under the Ministry of Science and Technology looks at scientific and commercial viability, and more importantly; they offer soft loans from SIDBI to startups. We have undergone this process and

obtained the approval from TIFAC. But now it looks like we must go through another almost-similar process with DIPP to get startup recognition. This seems like a complete waste of time and effort to run from pillar to pillar to get approvals.

> “When TIFAC has spent so much time visiting the manufacturing facility and customer site with a dedicated team of scientists, this process need not be repeated by another government agency or ministry.”

These processes should be integrated to shorten the application period and make life easier for the startup and government departments.

“Low-hanging” gaps of the Startup Ecosystem that can be easily fixed

Including startup representatives in all-important decision-making committees relevant to startups is necessary. These committees currently consist of experienced or administrative officers, etc. We would even suggest having representation from manufacturing, services, cleantech and social enterprise startups on various boards and committees. Officers at DIPP or any other department who deal with startups could be encouraged to work in startups for a three-month sabbatical to understand their problems. This will bring a great connect between startups and officers, and will help bring out on-the-ground realities faced by startups to the table.

Another issue we faced was tackling the Research and Development (R&D) expenses. As a startup, we have difficulty in obtaining customs clearance for even samples received from outside India. Perhaps the government could give a specific identification number to startups and a ceiling for any import of samples towards R&D, such that it reduces such hassles at the customs and the delay in getting electronic components. Also, there is no much clarity on how to get the R&D expenses reimbursed from the government. Perhaps the Department of Scientific and Industrial Research (DSIR) could consider a separate recognition procedure for startups and their R&D, to facilitate these solutions.

A dedicated website on relevant information for guiding startups is required. Most startups are equipped with skills and knowledge to innovate and build products and solutions, but do not know how to run the show. Specifically, startups are unaware of government norms and regulations. If there could be a dedicated website for startups which provides information on tax compliance, it will be of great use for the entire community.

On Mentoring and Acceleration Programmes

There are various incubation centres across India for startups. But these are not necessarily working on innovations, but those who need a prime location at a lower cost. So, the TBIs or STEPs tend to be treated as real estate rather than incubation centres. This scenario needs to change. For startups incubated in universities, i.e., student startups from the incubator (academic organisation) or from colleges in the same district could, for instance, have the space for 6 months free of cost, followed by a minimal cost. All other startups that take up the space must bear a cost that can be used to leverage the cost of housing student startups. Incubation centres should also have full-time mentors rather than only academic mentors. The mentors should have experiences in running their own startups, such that they have invested in at least 5 startups up to a sum of about INR 50 lakh and above, or who have mentored at least a minimum of 10 startups from different domains, etc. In addition, incubators should maintain an active roster of industrial advisors, mentors and academic advisors who can help create success stories.

4. The R&D Chicken-and-Egg Puzzle

Dhaval Thakkar, Sahastra Urja

Dhaval Thakkar is a postgraduate from the north Gujarat University and is the CEO & Principal Engineer at Sahastra Urja Pvt Ltd. He was a 2016 GCIP India participant, whose innovation is on solar stoves.

"DSIR has set a pre-requisite of 3 years' balance-sheet and an R&D track-record to grant a firm in-house R&D benefits (tax recovery of R&D expenses). Unlike IT or e-commerce, disruptive product R&D requires long years of research but these startups cannot recover their R&D investments without being certified by DSIR as an 'In-house R&D'. Besides the recognition struggle, in spite of open call for proposals most R&D funds go to academic or government research organisations. This leaves disruptive product startups stranded. Lack of disruptive R&D will create a big gap in the Government's ambitions for Startup India, Innovate India & Make-In-India agendas". Mr. Thakkar feels "there should be a significant representation of young innovators, angel investors and veteran 'technopreneurs' in cleantech R&D committees, who can appreciate the need and the commercial viability besides validations from scientists. There is an urgent need to appreciate market-oriented validation and commercialisation vision."

5. Some Other Policy Learnings...

Cleantech Castles in the Air

Hari Rao

Hari Rao was an income tax officer in the Government of India whose love for cooking drove him to develop highly efficient burners and his startup, Agnisumukh. He is the national winner of GCIP India programme, 2015.

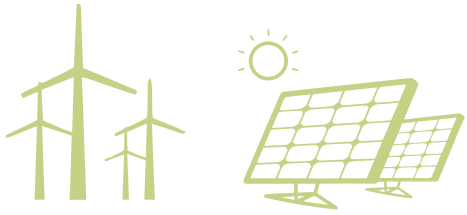
Innovation eco-system deals with an innovator who knows little about business. Contrarily, the success of innovation depends upon its commercialisation. The ecosystem's biggest challenge thus is how to narrow the gap of innovators' ignorance about business. There is always the danger that an innovator will build castles in air and would value the innovation more than what is actual worth."

The Lonely Cleantech Journey

Ramesh Kumar Nibhoria

Ramesh Kumar Nibhoria established India's first biomass pelletising company and founded Nishant Bioenergy that developed pellet cook stoves and burners for commercial kitchens and micro industries. Ramesh is a 2016 GCIP India participant.

"We feel the biggest challenge for small cleantech innovator is the lack of financial capital and there is almost no help from any agency in the R&D aspects. There is no risk-sharing support of any sorts for cleantech innovations. In our case, cleantech is business-as-usual; the entrepreneur's sheer will and determination are the key factors to success. Our business model succeeded as clients continue to save fuel, while our decentralised factory and supply chain models keeps it cost effective."



Tough Going for Social Ventures Despite Opportunities

Saket Kumar is the CEO of OáS water filters that removes arsenic and other harmful pollutants in drinking water. Saket, an alumnus of IIT Kharagpur is a serial social-entrepreneur and participated in GCIP India 2016.

"Government policies tend to make unrealistic announcements on the benefits to social entrepreneurs and innovations. Often agencies are not very concerned if our solution is environment friendly or not. Though products like ours have better profitability than normal ventures, investors are not easily enticed into social ventures."

Saket Kumar

Unfair Competition for Cleantech Products

A.V. Mohanrao is the founder and CEO of Spectrum Renewable Energy that processes 100 tons of sugarcane waste per day converting into biogas & organic manure (bio-slurry). He is a participant of GCIP India 2015.

"Besides creating local semi-skilled jobs, converting waste into bio-slurry safeguards the local environment from organic waste decomposing, water contamination and other potential hazards. However, to sustain the business, the company needs to sell the products at a remunerative price and eventually expand. But without benefits or tax relief, the sector has not been able to take off since 1950s, competing against LPG and urban compost (both enjoy subsidies). Market support instruments for commercialisation are thus necessary and "green-product" advantages in the form of subsidies, public procurement is critically necessary."

A.V. Mohanrao, Spectrum Renewable Energy

Arindam Paul

Things That Got Us Going

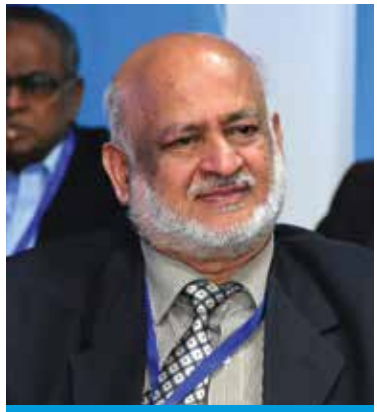
Arindam Paul is the Head of Marketing and Strategy, Atomberg Technologies, which won the energy efficiency award for high efficient DLC fans at the Cleantech Open Global Forum 2017. He is a participant of GCIP India 2016.

We have a strong core team of IIT and IIM graduates that worked on both end of the equation, that is, the technology aspects and on the business models. Further, our previous experiences on high-end technical products like Data Acquisition Systems have been very important in our learning curve. We were also very lucky to have the backing of strong institutional investors at the right time."

No Spoon-feeding the Innovators

Deepak Gadhia is a much sought after mentor of the GCIP India programme. He is the founder of Gadhia Solar Energy Systems Pvt. Ltd in Gujarat and has been awarded the "Solar Entrepreneur Award".

"Mentors can and should remain as facilitators. I feel it is not good to spoon-feed startups as it is a starting point for them to develop products/solution that are needed by the market and thus it should be their responsibility to identify and connect with potential customer/ future market demand. Yes, while mentoring we do try to connect them and help get information and point leads but it is up to them to convert these leads into business."

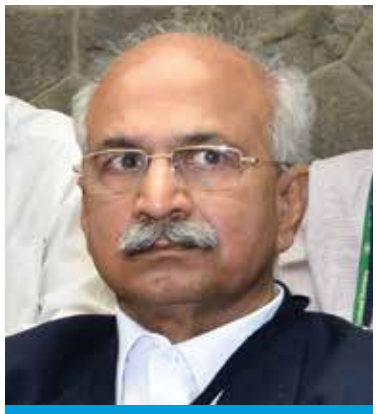


Deepak Gadhia

Underutilised Technology Transfer

Subbarao Aynampudi another mentor of the GCIP India programme, and is the President of Indian Innovators Association and also a former adviser to DST

"Converting patents into innovation calls for complementary competencies. Though there is a global pipeline of knowledge in the clean technology space, technology transfer provided in international agreements is underutilised. The way research projects are funded in the country needs to be reengineered with acquisition of core patents as a starting point and accept that patent acquisition for bundling with locally generated patents is in the public interest."



Subbarao Aynampudi

Need Core Technology Development Ecosystem

Ajee Kamath founded Gyatak that developed a patented multi-fuel efficient technology with high efficiency. He is a GCIP India 2014 participant.

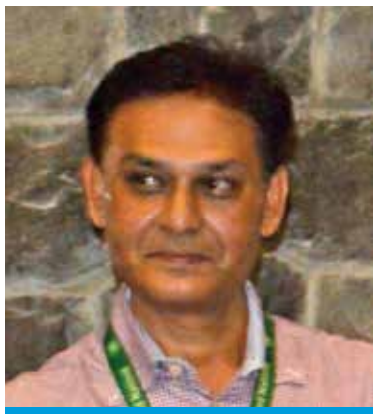
"There are no schemes tailored for core technological developments. The total innovation support is handled with tools for support trading. The Indian clean technology innovation space can consider the Horizon 2020 scheme in EU as a great reference."

Ajee Kamath

Boost needed for Boostrapped Innovators

Aninda Sircar's Green Cooling and Energy Regeneration offers sustainable cooling solutions for automobiles, through captive energy recovery. He participated in GCIP 2015.

"Cleantech innovators in India, like those of GCIP, have brought forward unique innovations with national and international patents – all of this achieved by 'bootstrapping' on our own. Hence all that is left for the Government to do is to assist us financially and help these technologies reach larger masses."



Aninda Sircar

III GCIP Innovator Stories - Innovations for Smarter and Safer Solutions

We present you 10 innovator stories showcasing the varied and diverse cleantech solutions that were mentored in the programme. The inspirations behind each of them are unique and exhilarating. Here is a collection of a few heterogeneous innovations, all leading to cleaner production or resource efficiency across water and energy. As an accelerator programme, the idea is take an innovation to the market, so we take a peek into these innovations, the opportunities, and markets for these solutions. These tales include inspiring innovations from a foodie who perfected burners for greater culinary results, a pharma scientist who engineered an enzyme to reduce the cooling demands of antibiotics production, a foundry that innovated their sector to make things safer and less energy consuming, and so on. There are stories equally exciting across different sectors like space conditioning, water-efficiency, and renewable energy resources, among others.

1 A Culinary Passion that Drove Innovation

Hari Rao
Agnisumukh, GCIP 2015

Hari has redefined the success recipe of startups by breaking the norm that knowledge and expertise of the technology is key to any technical innovation. His startup—Agnisumukh—manufactures clean and green energy efficient commercial gas burners, which emit no smoke, no flames, are carbon-free, leave no soot, are healthier, and cook food faster. Interestingly, Hari served in the Indian Revenue Services and holds a Master's Degree in Commerce and Business Administration, and has no experience or specialised knowledge of heat-transfer and thermodynamics, in general.

His startup recipe is one guided by passion and his interest in food. Those who belong to a generation where grandmothers cooked with charcoal, will share the reminiscence of a special taste of food. Unlike regular stoves in which heat tends to accumulate at the centre, Hari derives the idea of his cook stove from the three stone stoves that his grandmother used to cook in. The uniqueness of her stove was that the heat was evenly distributed around the vessel. Since the quality of heat is critical for the cooking process and defines the taste of food, Agnisumukh's startup journey was exactly to facilitate this.

Hari's innovation

Agnisumukh innovated a mechanism in gas burners that regulates this natural tendency and spreads the flame evenly as a thin layer, which produces flameless, smokeless, and noiseless radiant heat. Food is evenly cooked on this thin sheet of radiant heat without burning, and renders moisture retention in every molecule. The stove therefore mimics the three-stoned stove from the old days, but uses liquefied petroleum gas instead of charcoal.

Because ceramic heats up and starts radiating heat on its own, uniform heat is created, which leads to savings in fuel. Using these stoves, Hari shares that at least 30% savings in cooking gas can be achieve given that the thermal efficiency of the stove was 69%.

Breaking ice with niche markets

Hari says to access any market is to address a need

by a technology/innovation and particularly for niche market, competitive pricing with high quality can be a defining factor. Yet the innovator finds it hard to break the ice when it comes to replacing an existing product. The key reason is because a buyer who is not keen on "disturbing an existing system that is running fine". Another challenge is that while cleantech impact indicators highlight emission savings or fuel savings, it is often difficult for the innovator to find actual return on investment of the innovation/technology.So, Hari had to leave the samples of his burners with a few commercial kitchens for a long time. However, once these customers were satisfied, they started repeating the orders, and often for their other outlets and sister-concerns. His strategy was to tap into the niche segments that had wider corporate-owned chains. So, he targeted the head offices of large companies, which led to pan-India contracts, for example, with ITC Hotels and Infosys office canteens.

Hari feels it is the responsibility of each nation to handhold clean technology in terms of finance and marketing, which is the immediate need of any innovator, as they are starved for funds and market access. Since the government is the largest buyer in many cases, it can validate the innovation, and then apportion finance and also market the technology in its own sphere. In addition, there are many multinational companies that always give room for innovation to fulfil their Corporate Social Responsibility (CSR) obligations.

Hari has worked tirelessly and raised USD 1.2 million from angel investors. Hari's production facilities aim to generate revenues of around USD 30 million in near future. Things are looking great for Hari who is targeting a share of the domestic market of USD 100 billion and a commercial market size of around USD 35 billion.

Need of the hour and the way forward

Hari points out that India's spending on R&D is miniscule when compared to peer countries, while the nation is mired with various cleantech challenges that need urgent intervention. While markets try to serve the need, Hari urges that there is a huge gap between the technology that is needed and what actually exists. This divide puts the responsibility on the government to create an ecosystem for creating stronger products. Taking cues from the industrial development model of China, it clearly demonstrates that the government can proactively create an ecosystem for driving the cleantech businesses.

Finally, Hari's advice to future entrepreneurs is that since the business climate is tough and support systems are rather few, the test of any innovation is that the product should have a market appetite – this reduces the gap between an innovation idea and the actual challenges in implementing the solution.

Hari's innovation won him several awards like the IIGP Lockheed Martin Award 2015 and the GCIP Award in 2015 for his highly efficient innovation with a great understanding of his market. His passion for his innovation to better the culinary world, has been covered by various news articles.

2 Green Manufacturing Using Enzymes to Foster Healthcare

Rajkumar Rajagopal
Cellzyme Biotech, GCIP 2016

The Indian pharmaceuticals market is the largest provider of generic drugs globally, accounting for 20 per cent of global exports in terms of volume, while the antibiotics market in India alone is an estimated INR 350 crore industry.[2] By 2020, India is likely to be among the top three pharmaceutical markets by incremental growth (at a CAGR of 15.92 per cent) and the sixth largest market globally in absolute size.

The cost of production of Indian pharma companies is significantly lower than that of the US and almost half of that of Europe, giving it a substantial competitive edge. However, pharmaceutical manufacturers in India need to continuously improve their profit margins to maintain this edge. Thus, reduced production costs without compromising the quality of finished products becomes critical. Pharmaceutical manufacturing also involves energy-intensive processes at extremely low temperatures, some of which use large volumes of organic solvents and chemicals. Hence, these processes have significant negative impacts on energy usage, cost, regulatory policies, and the environment at large.

[2] Pharmaceuticals Sector Analysis Report, Equity Master, Feb 2016 https://www.equitymaster.com/research-it/sector-info/pharma/Pharmaceuticals-Sector-Analysis-Report.asp

The enzymatic innovation

Rajkumar Rajagopal, Ph.D, the founder and the Managing Director of Cellzyme Biotech, was driven by his passion, besides his wide international experiences working on biosensors and bioprocesses in pharmaceuticals. This paved the way to establishing Cellzyme Biotech for bioprocess development of recombinant enzymes. Cellzyme Biotech's award winning green manufacturing process uses an engineered enzyme, which reduces the cooling requirements in the production process.

What is exceptionally important about this enzymatic process is in the energy savings of drug manufacturing. Especially in the case of manufacturing of Cephalosporin antibiotics that is usually done at –60°, it can be carried now out at 26°C. Besides the immense energy savings, it eliminates the need for organic solvents and toxic chemicals. This process leads to huge savings in terms of cost of production and has lower environmental footprint.

The enzyme can potentially eliminate the use of organic solvents and alkali estimated at 6,000 tons and 450 tons per year respectively, thus making the discharges from the drug manufacturing processes less harmful. As these enzymes are biodegradable with some reusable components, inherently the process leads to increased plant and workers' safety.

Dr. Rajkumar anticipates Cephalosporin production facilities can achieve energy and chemical savings of around USD 4 million using the engineered enzyme. This means the pharma industry can achieve increased revenues in the tune of USD 12 million per year.

Rajkumar shares that besides pharmaceutical industries, cleaner manufacturing processes can yield high quality products in food and chemical industries.

The road ahead

Cellzyme Biotech is in the process of filing Intellectual Property Right of the engineered enzyme, where the product has been demonstrated, and third-party validation by pharmaceutical industry has been carried out. Reflecting upon the imminent impacts on the industry, Dr. Rajkumar shares that a few well-established pharma players may oppose any initiative that may increase the competition or dent their profitability. However, he feels confident that other big players may support the introduction of energy-efficient cleaner process with minimal waste streams, as part of environment friendly production initiatives. The opportunity for the application of the enzyme is large, across large-scale manufacturing in pharmaceutical industry, oral health care, textiles, chemical industry; the list is comprehensive. Cellzyme Biotech recognises its global opportunity and is establishing strategic partnerships with major players in the Indian subcontinent, besides developed nations, and large conglomerates.

Given that the enzyme technology has a wider impact across energy, waste and pharma manufacturing, Cellzyme Biotech acknowledges it is important to have greater cooperation with the Indian drug manufacturers' association and the Drug Controller General of India, central and state pollution control boards and the various ministries – Environment, Science and Technology, to name a few.

3 Driving Productivity and Efficiency in Foundries

Manish Kothari
Rhino Machines, GCIP 2015

India is the third largest casting manufacturer in the world, next only to China and USA. The Indian metal casting (foundry) industry is thus well established and produces an estimated 10.2 million metric tons of castings as per international standards. It caters to a wide set of industries across automobile parts, agricultural implements, machine tools, diesel engine components, manhole covers, sewing machine stands, pump-sets, decorative gates, and valves, to name a few. With a turnover of approximately USD 18 billion, the export value of India's casting industry is around USD 2.5 billion. Casting is a very energy-intensive activity in terms of power consumption. Table 1 gives a quick view of the energy use in the foundry sector.

Table 1: Distribution of Energy Consumption in Casting Industries[3]

Energy Consuming Sectors of the Industry	Energy Consumption Shares
Melting	70%
Moulding and Core making	10%
Sand plant	6%
Lighting	5%
Compressor	5%
Other	4%

Reports show that the energy intensity per unit of production in the foundry sector is much higher than that of the organised large-scale sector. Energy costs are often attributed to significant shares of the overall production cost of SMEs and hence the Bureau of Energy Efficiency, other government agencies and international development agencies have prioritised the energy use reduction in SMEs, especially the foundry sector. Energy use reduction would not only reduce production cost, but also potentially can improve the quality and productivity of SME products. Also, energy cost savings have been established to improve the sector's profit margins tremendously.

As Rhino moved into the Green Sand Process - Bentonite (Clay) bonded Silica Sand Process which was the most popular process catering to more than 70% of the casting production, it kept on finding its own solutions in the sand handling. Manish Kothari says, "The key to the success and growth of Rhino is our ability to understand the Indian context and needs, adapt the techno-economics and keep finding new technology solutions".

[3] Energy Consumption Studies in Cast Iron Foundries, PSG Polytechnic College, 2009 http://www.foundryinfo-india.org/tech_section/pdf/57ifctp12.pdf

Manish Kothari's international collaboration and technology exposure gave Manish and his team at Rhino the ability to absorb and adapt the process elevated the level of thinking and under the able guidance of the founder R.C. Kothari and mentor Renzo Cappelletto, Manish could experiment, and polish the design & innovation abilities.

The innovation journey

Necessity is the mother of invention (or innovation) holds true with Rhino. After some debacles and failures with adapting the technologies from Europe as it is, Rhino took a step back, and started using its own experience, knowledge and understanding of the Indian foundry industry.

In the year 2012, in order to resolve the issues of time, cost and space for Sand Handling Systems rEcoFlex was innovated. Rhino used belt conveyors instead of bucket elevators used by traditional plants (copied from MNCs) and not only created energy efficiency by 30% or more, but also a sustainable and clean foundry. Within a span of 3 years, Rhino could sell this concept and establish the product in the field in several regions. With the new government's initiatives and "Make in India" and "Made in India" push, the MSME-Technology Development Centre, Agra identified Rhino as one of the potential candidates for the GCIP 2015. The rEcoFlex™ got selected into the top 20 teams and then the top 6 of the Indian programme.

After the training and learnings of GCIP 2015, Rhino participated in the GCIP 2016 with its 2nd Innovation MultiflexFM. The journey of this innovation started in 2008, inspired from the need to find and replace Obsolete Compressed Air Operated Jolt Squeeze Moulding Machines which had only 30% power transmission efficiency with hydraulically operated High Pressure Moulding Machines. The machine was delivering 4 to 5 times higher squeezing force than the traditional machines, and yet consuming 30% to 50% lower energy. The machine, apart from energy saving, gave access to MSME foundries to inaccessible technology upgradation, and improves their process, saves in the weight and rejections – which have a huge impact on their competitiveness. Rhino's breakthrough innovation has now changed the entire paradigm in the Industry, and new players from India have been motivated to discard the old and obsolete technology and shift to affordable modern technologies.

Challenges of the innovation ecosystem

Manish shares that the challenge Rhino faces today is not of finance, but acceptance of the innovation. The acceptance at Tier 1 companies who are the ultimate buyers, do not approve foundries with Rhino's products, as there is no certification or validation. Unfortunately, the award or recognition does not validate the technology, and now we realise that in India, since nobody ever thought of innovation in the moulding process, there is no "definition" of high pressure moulding. The effort of Rhino goes into convincing that the process is

"real" and to educate the buyers of castings – like Tata, Eicher, Mahindra – that India also can produce internationally accepted process technologies.

Opportunities & future plans

Manish points out that the foundry sector continues to remain as a domain with very few innovations. Some of the examples that Rhino Machines are working to address the needs of the sector include: the MultiflexFMshall be integrated with Robot and the first plant goes into production in March 2017 first of its kind in the world with large energy saving and productivity.

Solar in foundries – inspired by Deepak Gadhia a mentor in the Programme, Rhino is working on integrating solar thermal solutions into the energy intensive foundry processes. Working on improving the 15% solar energy conversion from PV to direct heating applications in foundry will also be a first in the world. Similarly, aligning with Ecolibrium (another GCIP 2015 semi-finalist), Rhino has already launched the Data Acquisition from Machines to bring real-time data from the foundry shop floor, analysis, alerts, and performance monitoring. Rhino is also an example of how the programme has fostered collaboration and cross integration of technologies by bringing together the set of these innovators. Manish is one of our very pro-active participants who almost visited all our other teams spread across the country during his business trips to study and understand the technologies for collaboration, if any.

4 Snapping-Shrimp Technology for Process Reactors

Anjan Mukherjee
HyCator Reactor System, GCIP 2014

The HyCator reactor is inspired by biomimicry. Anjan Mukhjerjee uses the example of how a snapping shrimp attacks its prey by hydrodynamic cavitation – a shrimp shoots a jet of water snapping its claws, which creates cavitation bubbles.[4] These bubbles collapse as the pressure recovers with the decrease of fluid velocity. The high temperature, pressure and turbulence lead to the formation of free radicals that help in the water purification process.

Hydrodynamic cavitation for wider efficiency applications

HyCa mimics this 'snapping shrimp' phenomenon to create millions of precisely tailored bubbles. Thus, HyCa innovation harnesses the energy dissipated by collapsing cavitation bubbles to accelerate chemical reactions in water and effluent treatment processes.

Anjan Mukherjee and Dr. Aniruddha B. Pandit co-founded HyCa in 2006. HyCator Reactor System,

[4] This is Bernoulli principle - an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy.

offers highly efficient interventions wherever fluids need physical, chemical, or biological transformation. These applications range from effluent treatment, cooling tower water treatment, biogas generation enhancement to chemical processes. The application of innovation can potentially make any effluent treatment plant 15 to 30 percent more energy efficient. In biogas generation processes it increases the production of the gas upwards of 15 percent. With its ability to affect chemical compositions, it reduces chemicals usage in cooling tower water significantly while saving about 25 percent water usage. With such wide applicability, HyCator reactors are custom designed and retrofitted into existing plants with minor modifications.

Reaching out to customers across sectors

The HyCator process has greater impacts in effluent treatment plants, chemical processes, and cooling tower water disinfection. Today, its three market segments include Common Effluent Treatment Plant (CETPs) and other major polluting industries in that zone; bio-fouling prevention (BFP) and can be used in all major refineries, thermal power plants and fertiliser units, and biogas generation (BGG) in distilleries, breweries, and cattle-based units.

HyCa has applied for patents in many countries and boasts of a huge proprietary knowledge base. With its disruptive platform, HyCa's applications have a larger scope in diverse domains, and this is leveraged by a constantly expanding market opportunity. Also, since the systems are retrofits to an existing system, they can be fitted to legacy systems too.

The way forward

What makes HyCator an attractive option is that it influences legacy systems to improve efficiency, instead of increasing their capacity (renovations), HyCa's solution uses retrofit approaches to make the existing system more efficient, cost-effective, and environment-friendly. Ideally, an average customer is thus comfortable when renovations are not required in the application of innovative technology.

Reflecting upon his own experiences as an innovator, Anjan shares that it is very important

for innovators to find angel investors who are passionate about their product - unlike financial investors who are looking for a return of investment in a given timeframe. This is primarily important because pure science technology-based products take time to gain traction. HyCa benefited from raising funds from angel investors, corporates, a soft loan from the World Bank's SPREAD Programme and founders. HyCa is now looking for funds to build their team, for marketing and sales activities, set-up of manufacturing base, patent filing, various certifications, and for working capital.

5 Industrial Concentrating Solar Thermal Solutions

Geetanjali Patil Choori
Energy Guru SharperSun, GICP 2014

Concentrated Solar Thermal (CST) uses a combination of mirrors or lenses to concentrate a large amount of sunlight and harness solar energy to generate thermal energy. UNIDO's studies have already identified a total market potential of 6.45 GW for CST in industrial applications in India. Hence India's mission to achieve 100 GW solar power by 2022 finds CST technology to play an important role, especially in industrial processes. Industries thus can achieve large strides in reducing the use of LPG, diesel, and other fossil fuels in manufacturing process.

SharperSun for industrial thermal demand

Energy Guru ShaperSun founded in 2009 by the engineer-trio, Geetanjali Patil Choori, Umesh Choori and Rohit Chalvade, are leaders in technology collaborations and financing for utility-scale power plants.

SharperSun is an innovative CST based boiler for industrial process heating/cooling and hybrid power market. It aims to tap into the immense opportunity in catering to industrial thermal heat - over 50% of industrial energy, globally, is used for heating water or thermic fluid for steam or hot water generation. Through its innovation in CST technology, SharperSun has put its money and efforts to cater to a market for displacing industrial fossil fuels by producing steam for process applications and preheating feedwater in industries like food processing, paper pulp, textile etc. ShaperSun also offers hybrid solutions. SharperSun assures industrial customers a payback period of 2-4 years, payback particularly from reduction in consumption of fossil fuel.

Innovation to CST

Energy Guru SharperSun, awaiting its US Patent, is a high performance parabolic trough concentrating solar thermal collector. Geetanjali shares that major technical innovations were done in the product to suit to Indian factory conditions along with an energy efficient cradle like sun tracking system. Its innovative design improves performance and significantly reduces capital, installation, and operating costs of the standard utility-scale parabolic trough designs.

The SharperSun Space Frame was specially designed to reduce the assembly time on the ground and reduces auxiliary power consumption, besides being durable and corrosion-resistant. The SharperSun team is now working on an innovative single-axis tracking system that significantly reduces auxiliary power consumption required for tracking.

Great strides in fossil fuel replacement

Geetanjali shares an example of SharperSun implementation in a surgical cotton manufacturing factory where the client displaced 40% of LPG use by solar heat. With a 2-year payback to the customer, this 150KWth (Kilowatt Thermal) system can help to significantly reduce carbon dioxide emissions.

Reflecting up on the above experience, Geetanjali shares, "We are now focusing on project sizes of 150 kWthto enter the market. As the product is modular, it easier to scale up for larger-size projects. SMEs incur major energy costs in their product manufacturing - so after reviewing their plant data, land availability and willingness to implement a sizeable CST system, the 150-kW system is suitable for many small factories in a variety of industrial clusters."

Catering for CST solutions for india market

Energy Guru SharperSun empanelled[5] with Ministry of New and Renewable Energy (MNRE) is eligible for incentives up to 45% of the project cost. The incentive support has been vital, shares Geetanjali, such that 5 new projects will be soon commissioned for industries like packaging, effluent treatment plants and chemicals. Geetjanajli points out that while the market size is huge, Energy Guru is currently targeting the industrial process heat segment. The company will also pan-out its activities in the hybrid power plant market, and in enhanced oil recovery and desalination markets, that requires high intensity heat. The company professes to offer a very quick payment on displacement of fossil fuel.

Reflecting upon the road ahead, Geetanjali shares that a comfortable access to equity and debt funds are needed if developers are to cash in on the new opportunities. Though the ShaperSun projects have a fair credit access, the stringent requirements for

[5] Empanelled under the name Leverage Net Solutions

raising debt (roughly 6 months, with penalties for delays on financial closure) are party-spoilers. Banks are yet to get comfortable with some of the clauses in the model Power Purchase Agreements, and the yet-to-be released payment security mechanism. According to Geetanjali, Indian financial institutions are yet to gain experiences in the CST and are yet to become familiar with the project appraisal techniques. On the other side, debt seekers like her have little knowledge of the yardsticks the financial institutions deploy in financial sanctions.

Geetanjali has been awarded by MNRE in 2016 – Innovation in CST as Woman Entrepreneur. EnergyGuru ShaperSun has won various accolades including the Energy Globe National Award 2014.

6 Space Cooling Innovations

India's building sector is forecast to experience large expansion where the building stock is expected to increase rapidly such that by 2030, the commercial stock (office, retail, and hospitality) is going to see an increase by 5 times. The air-conditioning demand for this space will involve significant energy use, such that studies predict space cooling in commercial buildings will account for 60-70% of the total electricity consumed. Given this scenario, the need to optimise energy use by heating, ventilating, and air-conditioning (HVAC) systems, takes on added urgency.

The atmospheric temperature conditions contribute to the efficiencies of air-conditioning systems. If the atmospheric temperatures are higher, efficiency of the air-conditioning system is lower, and vice versa. Given that India is a tropical country, with consistently increasing temperatures around the year with longer summers, the cooling efficiencies of most prevalent air-conditioning technologies keep dropping. Hence it is invariable that more efficient and disruptive technologies are necessary to address both cooling and its energy-use efficiency.

Here we present two cooling solutions: **Radiant Cooling** and **Geothermal Cooling** innovations for Indian climate conditions and requirements.

a. Radiant Cooling for Energy Efficient Space Conditioning in India

Madhusudhan Rao
Oorja Energy Engineering, GCIP 2016

Oorja Energy Engineering provides sustainable solutions for industrial and commercial heating and cooling. One can witness radiant cooling examples in nature. Madhusudhan Rao, the founder of Oorja Energy Engineering gives the example of natural caves, where the inner walls of caves are at a lower temperature, as the heat from solar radiation does not percolate down to these walls. Additionally, these walls are cooled due to the water streams outside and, vegetation. Modern radiant cooling systems follow the same principle to cool a floor or ceiling (or even walls) by absorbing heat radiated by the rest of the room. A cooled ceiling or floor acts

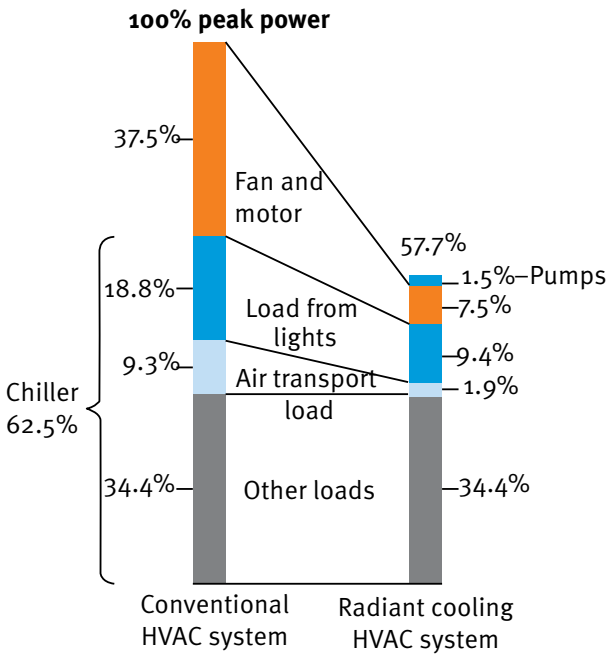
Radiant cooling technologies in history

Hollow walls in Agra Fort helped provide water-cooled air to inner room. The 11th century Agra Fort in India boasted some impressive design features and technologies. Water was elevated from the river below using Persian water wheels such that the water cooled the buildings by circulating water through the hollow of buildings. Also, air flow through vents carved into the walls ensured the cooler temperatures.

as a heat sink for all radiant heat sources in the room such as - human occupants, solar radiation, equipment, walls, or any object that radiates heat.

India opportunity for radiant cooling

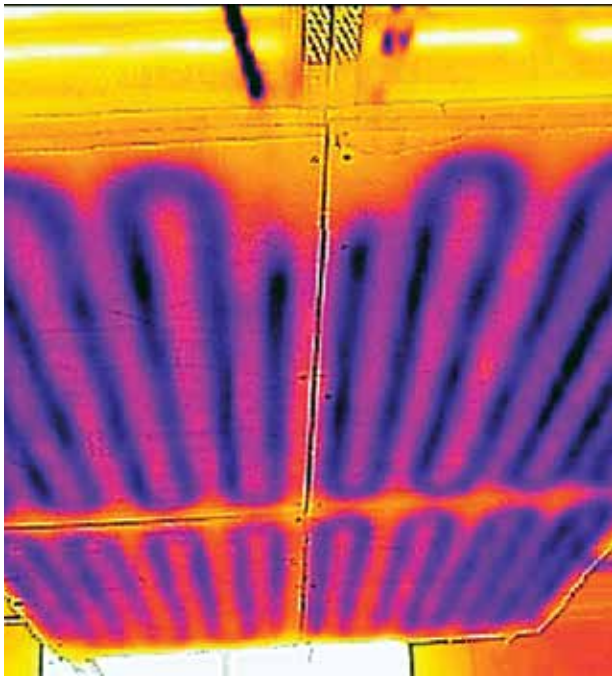
Oorja understood the viability of radiant cooling technology in India; in hot-dry climates, the technology has "the largest proportion of cooling by way of removing sensible heat". A key aspect of the cooling solution that Oorja has focused on is the cooling distribution. Madhusudhan points out that



Power consumption comparison between Conventional and Radiant Cooling HVAC systems

there arevarious efforts to increase the efficiency of cooling, while much efforts focus on efficient 'generation of cooling.' However, the use of air ducts for 'cooling distribution' has remained unchanged.

Madhusudan with Chairman NRDC Dr. H. Purushottam in his shopfloor

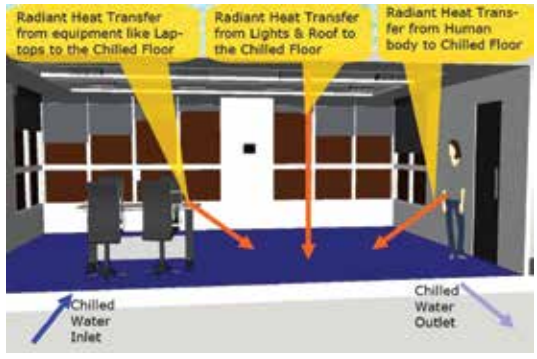


Oorja took up the challenge of changing the cooling distribution by using pipes embedded in the floor, or panels in the ceiling instead of air ducts. This reduces inefficiencies in cooling distribution and consequently cooling generation too. Oorja's radiant panels and pipes provide 30-50% reduction in electricity consumption by the chiller units, thus eliminating the need for fan motors in air handling units (AHUs). By circulating chilled water through pipes embedded in the ceiling or floor, of commercial or residential spaces, radiant cooling eliminates the need for fan motors. In addition, conventional (air-based) cooling requires chilled water supply at a temperature of 7°C, whereas radiant cooling requires water chilled only to 16-18°C. This leads to additional electricity and commercial savings as the compressor in the chiller consumes less electricity by operating at higher temperature.

The market and the road ahead

With four patents filed in radiant cooling technologies, Madhusudhan is aspirational. The potential market size for radiant cooling technology is INR 20,000 crore[6]/year across IT services firms, hospitals, educational institutions, industrial shop floors, aircraft hangars, etc., in India. These spaces need year-round air conditioning and hence energy efficient cooling interventions have great opportunities. He points out that radiant cooling also has lower first costs and lifecycle costs are also lower, compared to conventional systems. Much of the first costs are largely attributed to integration with structure and design elements but lower lifecycle costs make it very attractive for longer term investments. India is already leading the Green Buildings agenda in the world with the largest built areas. Thus, Green Buildings rating systems have spurred interest and demand for energy efficient space cooling technologies and Oorja's technology offered the highest savings. Oorja now has 15 customer installations in India under its belt, and was conferred with the Skoch Smart Technology Award in 2015, WWF-India's Climate Solver award in 2016 under the GHG Reduction and Energy Access category, and was a semi-finalist in the GCIP 2016 awards.

The company is now working on making the technology more viable in the country by addressing challenges from potential condensate formation on the cold radiant surface (resulting in mould and the like), due to which radiant cooling systems have not been widely applied. Though dehumidifiers could limit humidity and allow for increased cooling capacity of the technology.



[6] 1 crore INR = 100,00,000 INR

Going forward, Madhusudhan stresses that policy making agencies in the country, the BEE, addresses the retail market through its labelling programme and large energy consumers through the PAT scheme, and rating agencies like the Indian Green Building Council (IGBC), and others need more induction into radiant cooling system concepts for their success and market viability. Right now, Oorja is actively involved in supporting research activities and projects in this technology area at IIT Chennai, National Institute of Technology (NIT) Trichy and Malaviya National Institute of Technology (MNIT) Jaipur. Oorja is also the Industry Partner for Advanced HVAC at US-Indo Joint Centres for Building Energy R&D.

b. A Passion for Geothermal Cooling Technology

Mandar Karprekar

GIBSS, GCIP 2016

Arun Shenoy and Mandar Karprekar launched their startup, the Green India Building Systems and Services (GIBSS) in April 2010 from one of their homes. Incubated in the Indian School of Business, Hyderabad, GIBSS is an outcome of their varied experiences in working on geothermal systems and crossing each other's paths by sheer coincidence. Their technology background helped them study the geothermal cooling viability extensively for India and also enabled them to gather enough data on geothermal temperatures across the country, before they launched GIBSS. The founders were thus able to identify the opportunity for energy efficient geothermal cooling in India, where annual cooling demands in the country continue to grow very rapidly.

> The National Geothermal Mission by the Ministry of New and Renewable Energy, targets to reduce national electricity demand by 35%, national industrial water demand by 30%, and greenhouse gas emissions by 22 million metric tons by 2022. This agenda is also upheld by the Smart Cities Mission that aims to use geothermal district cooling systems.

"If you go 10 meters below the earth's surface, it has a constant temperature round the year, connecting the air-conditioning systems to that temperature makes the system think it is winter outside and uses less energy for cooling", shared Mandar. Thus geothermal cooling uses earth as a heat sink instead of

the outside atmosphere as in conventional systems. The earth remains at a constant, moderate temperature just below its surface around the year, in contrast to the ambient temperature that varies with seasons. The geothermal cooling system takes advantage of this stable temperature underground. A piping system that goes underground is used here, through which water is circulated and the cool water that emerges out of the pipes is used in centralised chiller systems, thereby improving the efficiencies of the chiller systems. Thus, by reducing the cooling load of the chiller systems, these geothermal air-conditioning systems bring about 60% energy savings, besides 100% water savings and reduced carbon emissions. These systems have a payback potential of 2 and 3 years.

Cooling for large spaces - commercial and industrial buildings

GIBSS has achieved various installations in different regions of India. Their copyrighted ground thermal and hydrological data for 29 cities in India forms the basis for standardisation of designs for different regions.

Arun Thomas
GIBSS, GCIP 2016

Thus, all buildings that use centralised air-conditioning chiller plants are potential customers. These include commercial buildings, industrial buildings, and infrastructural buildings – both existing building retrofits and new construction.

This huge market segment thus includes IT parks and SEZs, super specialty hospitals, data centres, airports, sustainable buildings (campuses of large MNCs), manufacturing segments with heavy cooling requirements such as FMCG plants, etc.

Currently, GIBSS is executing one of the world's largest geothermal air-conditioning projects at Hewlett Packard Enterprise in Bengaluru. With a 1200 TR system, it is expected to save 1.3 million units of electrical units every year and 61 million litres of water every year.

Making the pricing right for customers

GIBSS geothermal cooling systems are priced about 40-50% higher than the traditional alternatives, but the team shares that with a 2-3 year payback period, the cost is easily recovered. With an economic life of over 30 years and operating costs reduced by 50-60%, the team feels that geothermal cooling should be ideally attracting more clients. Yet GIBSS soon found that limited capital budgets challenged most potential clients to pursue energy efficiency projects in their buildings. This encouraged GIBSS to develop a financing model like that of energy services companies where the client pays from the savings. In this zero-initial investment model, the client pays for the project from the operating budget rather than the capital budget. GIBSS uses the stream of income from the cost savings to pay the costs of the project, including the costs of the investment. The remuneration is clearly based on demonstrated performance. GIBSS retains an ongoing operational role in measuring and verifying the savings over the financing term. By utilising the energy savings, the client becomes able to put the funds once used to pay for energy, now towards the capital improvement.

The road ahead

In 2015, GIBSS raised VC funds and is now targeting revenues of INR 600 crore in the next five years. As one of the GCIP mentor-investor pointed out, the confidence with which a young startup like GIBSS makes itself audibly heard for large equity makes it easier for a VC. Mandar shares how GIBSS grew from a small founding team which bootstrapped without salaries for over 2 years, into a fully developed 90-member strong participative organisation. Today, GIBSS has more than 75 large corporate clients, such that their work is spread across 500+ building facilities across India. The company has four patent filings in the Geo-Exchange space and it is evident that GIBSS is holding the mantle for market leadership in the geothermal exchange space in India.

GIBSS has won many innovation awards in the past years for its geothermal air-conditioning innovation, including the first prize at the Vibrant Gujarat's Startup Grand Innovation Challenge in October 2016, the Climate solver award by WWF India, India Innovation Award by the Ministry of Science and Technology, among others. GIBSS was the national winner for GCIP India 2016. GIBSS then went on to win the much-coveted GCIP global prize - the Global Cleantech Innovation Award at the Cleantech Open Global Forum held in Silicon Valley, California 2017.

7 Critical Innovations for Affordable Drinking Water

Of the 783 million people, worldwide without improved drinking water, 97 million live in India, says UNICEF.[7] Further, almost 90 per cent of child deaths from diarrhoeal diseases are directly linked to contaminated water, lack of sanitation, or inadequate hygiene. Microbial contamination (bacteria, viruses and amoeba) in water is often are the cause for diarrhoea in children. Further, the level of chemical contamination in water ensuring water quality at the source is crucial. In India, there is a widespread natural occurrence of arsenic and fluoride in the groundwater.

With the constantly increasing number of arsenic occurrences, especially in the South Asian region, it is now recognised as a major public health concern affecting many people around the world. Arsenic contamination in groundwater has been found in the Ganga-Brahmaputra fluvial plains in India and Padma-Meghna fluvial plains in Bangladesh. Arsenic pollution has a huge impact on human health, and its consequences have been reported as one of the world's biggest natural groundwater calamities. In India, West Bengal, Jharkhand, Bihar and Uttar Pradesh in the flood plains of the Ganga; Assam and Manipur in the flood plains of the Brahmaputra and Imphal rivers; and Rajnandgaon village in Chhattisgarh state have been reported to be affected by arsenic contamination in groundwater. Groundwater contamination of arsenic is so severe that the toxicity in drinking water has reached alarming levels, especially with the decrease in ground water levels.

Regions affected from arsenic water contamination in India

a. Arsenic Removal from Drinking Water

Saket Kumar
OáS Media Technology, GCIP 2016

Saket Kumar, the CEO of VAS Bros. Enterprises Private Limited, shares that OáS Media technology addresses almost all heavy metals, bacteria, and other pollutants in drinking water. However, arsenic has been a key focus area given its role of being a silent killer and increasingly robbing away young life.

The overwhelming arsenic contamination is a result of, what he calls, "the molestation of earth". Arsenic

[7] https://www.unicef.org/media/media_68359.html

levels in areas where it naturally occurred went up from 110-120 ppb (part per billion) until about 2009 in areas like Malda in West Bengal, such that in the last 8 years it has gone up to 800 ppb. Saket points out that in India, arsenic poisoning was endemic more so only to 2-3 human habitats, but now at least 11% of habitats are arsenic contaminated. One of the key reasons for this is the fast depletion of groundwater levels. Arsenic occurs naturally in the inner crust of the earth. While submerged in water, arsenic stays oxidised as the iron molecules keep them bound to the soil. However, with water-depletion, the inner crust dries up, exposing it to disintegration and thus weakening the oxidised bonds.

The genesis of OáS Media technology is the discovery of no arsenic poisoning in the district of Midnapur in West Bengal, while various other places had severe occurrences. IIT-Kharagpur, Saket's alma mater, is also situated at Midnapur. Under Prof. Sirshendu De, the researchers at IIT-Kharagpur discovered that the laterite soil endemic to Midnapur region was the key reason for safeguarding the region from arsenic poisoning. Their research showed that the adsorption characteristics of arsenic on laterite soil kept it held in the soil, instead of percolating into the ground water. However, Prof. De's team soon figured out that it took almost one truckload of laterite to filter one glass of water. The research team then extensively worked to increase the adsorption efficiency of laterite. The indigenous approach was to subject laterite of 200-micron size to intensive thermo-chemical processes over a 12-hour duration for increasing their surface area. This creates nanometre porosity in the laterite material, thus enabling arsenic and other heavy metal filtration. With this nanometre-porous laterite, a 200 gm can do the job of what a truck of raw laterite was to achieve. After 8 years' research, this indigenous material is capable of adsorbing arsenic to the extent of 32 mg per gram and has led to 2 patents in the

An OaS Media Water Filter

OáS (Organic ársenic Sorber) Media technology. Prof. Sirshendu De was honoured with the 'Bhatnagar Award' for his invention.

An important aspect of OáS Media is it fulfils the 'Toxic Characteristic Leaching Protocol', which means the filter system does not leave behind a toxic sludge/waste from which arsenic can leach back into the environment. OáS Media is manufactured and marketed by Vas Bros. Enterprises Private Limited. Vas Bros. is a startup-company, incubated and manufactured at Gopali, the STEP of IIT Kharagpur. Saket shared that Government of India's Water Mission Project of DST provided support in the research and development of OáS Media.

Reaching out to homes and people

There appears to be substantial market potential for the OáS media technology given the huge number of habitats affected by water contamination, across the country - 735 habitats in 63 districts, in 13 states affected by arsenic, while contamination from heavy metals like lead, chromium, cadmium, uranium, mercury, etc., across 232 habitats in 23 districts, in 6 states. Saket Kumar estimates a market opportunity of USD 500 million annually in India alone. Given that much of these regions are economically poor, Saket points out that OáS Media supersedes other competing technologies in terms of capital and operation expenditure at water filtration cost of approx. 2p/litre (partly because it does not need electricity). Besides filtering out almost all impurities OáS Media technology, the average life of the filters is five years with very low operation and maintenance.

The USP of their success so far has been the low cost, less maintenance, and long life, however Saket feels the key factors that will facilitate the scaling up and market mobilisation, along with government support to demonstrate the right model to address the problem. Saket appreciates the initiatives by the Government of India, under the Niti Aayog that sanctioned USD 200 million to address the arsenic menace in the country while the World Bank has sanctioned USD 600 million for rural drinking water in five low-income states (Uttar Pradesh, Bihar, West Bengal, Assam and Odisha). The OáS media technology has scored work orders worth more than USD 1 million. As of March 2017, the company is planning to roll out the retailing of filters in communities facing acute drinking water problems.

The road ahead

Community based interventions to safeguard against arsenic contamination of drinking water has been met with difficulties. Bringing behaviour changes among the members of the community is not easy particularly if none of the villagers have any immediate signs of arsenic poisoning/ Arsenicosis.[8] Thus, painting a well red to warn arsenic contamination, does not

[8] Disease from long-term exposure to arsenic, often has severe but non-fatal outcomes and sometimes death

necessarily help, especially when water is clear without any visible contamination.

Thus, local NGOs and government need to play a key role in changing the awareness of rural communities in bringing clean water interventions. Affordable interventions like OáS media can change the situation and hence, public procurement agencies need more exposure to local innovations for specific issues. With such knowledge, the local government agencies that manage the funds can play an important role in being a catalyst in addressing the arsenic menace. Saket feels that a 'green product' advantage in the form of subsidy is critically required, especially to subsidise his products, given that his target customers live in poorest parts of the country.

The team has already achieved strategic partnerships with local NGOs like Empower Jharkhand, Doctors For You, VARDAN, etc., and is now aiming to tap commercial sectors such as cinema halls, government institutes, and the export market in Bangladesh, Malaysia, Pakistan, Morocco, and over 50 other countries.

Reflecting upon some of their learnings as startup-innovators, Saket shares that the mentoring they received through the UNIDO-MSME GCIP programme played a key role in his business transformation. "Timing is the most important factor for any venture, especially for startups. After six years of research and development we managed to fabricate our first reactor just before GCIP 2016 started. This programme helped us to shape up our business in such a way that we already have work orders for more than a million dollars in the last six months." As an innovator, Saket shares that access to product development ecosystem is essential. Once a product prototype is ready, he stresses that there should be a clear procedure to get the innovation selected/ identified. Or else innovators are left in blind alleys.

b. WATSAN Nano-Clay Based Filters

Chandrasekaran J.
WATSAN Envirotech Private Limited, GCIP 2016

WATSAN emerged in its current avatar in 2013, evolving from Custom Parts Online founded in 2009. The company provides water and sanitary solutions to the rural population by manufacturing and distributing low-cost, electricity-free water filters to urban slums and rural families. Chandrasekaran J., the founder, shares that the name of the company was coined by blending the words 'Water' and 'Sanitation', which are its two main working areas.

WATSAN Projects Undertaken	Households Impacted
Government Project	50,000
Child Care Centres	5,000
CSR Initiatives	1000
Flood Rehabilitation	2000
Old Age Homes and Orphanages	2000
Sales to Urban and Rural Homes	34,000
With Arsenic Removal Add-Ons	5,000

WATSAN deploys nano-clay-based water purifiers. These micro-filters made of clay, filter out pathogens, turbid materials or heavy metals from passing through, thus ensuring clean drinking water. The technology was patented by IMMT–CSIR[9] Bhubaneswar and made available to almost 140 licensees in 2012, but it was WATSAN that scaled up the model and made changes in the formula as well, besides its manufacturing process with a few innovative measures.

WATSAN holds the flag position as the first company in India to provide these electricity-free arsenic and iron removal purifiers. The product requires very little maintenance and no water is wasted, unlike RO systems. The success of the product was shown when WATSAN had impacted more than 100,000 households in rural India, within three years of its inception.

Playing with clay

WATSAN filters are made from clay and sand sintered to form patented Terafil water filters. These filters retrofitted in high quality plastic water containers (which are guaranteed virgin, toxic free, food grade containers).

Nano clay particles form the crux of the Terafil candle. The pores in the candles are smaller than the nano-sized microbes like bacteria and virus, thus enabling the candles to filter the pathogens in the top layer itself. The capillary holes formed within the candle structure are highly complex it filters away turbid materials, other waste solids, minerals, and

[9] Institute of Minerals and Materials Technology (IMMT), under the aegis of the Council of Scientific and Industrial Research (CSIR), New Delhi.

metal complexes from flowing outside its structure. Clean water flows down due to gravitational pull and gets collected in the bottom container. An Arsenic removal cartridge can be separately attached to filters.

Tapping into its market via self help groups

WATSAN is trying to build a pricing mechanism for rural clients whose willingness to pay is low. The cost of a WATSAN filter unit is arrived at by focusing on basic features like removal of turbidity and pathogens, besides the customers' willingness to pay miniscule amounts based on the benefits offered. For areas with specific problems with arsenic and fluoride contamination, WATSAN offers add-ons like arsenic removal and fluoride removal filters.

Chandrasekaran acknowledges the heavy competition from conglomerates with "large pockets", but is still optimistic about WATSAN. While his price-offer for WATSAN units is very attractive, he points out that if he can reach out to 1% of India's villages in the next 5 years, at a cost of USD 16 per standalone filter, he foresees USD 19.2 million worth of revenue!

The company is seeking to engage 10,000 women self-help groups to help market these purifiers throughout villages, thus aiming to create an important social impact. WATSAN thus hopes to make potable water reach 4,200,000 rural families by the year 2022. Chandrasekaran foresees water savings of 21 billion liters (from wastage) besides approx. 480,000 kW of power saved, when compared to RO systems.

WATSAN has formed strategic partnerships with DST, CSIT (IMMT), CIPET (for licensing, approval, and accreditation), and IIT Madras for arsenic removal technology and PSG College of Technology for removal of fluoride, besides the Open University, UK for removal of dye chemicals from potable water. WATSAN is a recipient of various national awards from Ministry of Petrochemicals in 2012 and 2015, and Business World India's Hottest Young Entrepreneur award, while Force-Park shared the Value Award for Innovation for BOP in memory of CK Prahlad, 2014. They also got a grant from the Millennium Alliance Round 3 in 2016 for automation and capacity building.

The road ahead for rural drinking water solutions

Since clean drinking water is critical in reducing mortality among children due to water-borne diseases, WATSAN is hoping to tie up with government-sponsored initiatives to spread awareness of their affordable clean water solution, to effect changes in policy, and penetrate the rural water market through government projects, public buildings, schools, hospitals, etc., old age homes/ orphanages, flood rehabilitation programmes, and so on. It is also approaching companies to form partnerships through CSR initiatives in rural/urban areas.

Despite facing stiff competition from conventional and modern high cost water filters, ROs and water

purifier systems, promoted by well-established players in the market and a host of other smaller/ local players, Chandrasekaran is confident that WATSAN's products have great market potential given its lead on all counts of water preservation and energy saving, and therefore affordability. However, if agencies like the Ministry of Drinking Water and Sanitation identify WATSAN as one of the necessary interventions during the planning, funding and coordination of programme of drinking water and sanitation in the country, he feels it will leapfrog his efforts to create a wider impact.

8 Small Wind-Turbines Gaining Ground in India

Arun George
Avant Garde, GCIP 2015

India has abundant wind energy resources and now ranks fifth amongst the world's top ten wind energy producers. The growth of this market is mainly attributed to the rise in demand for renewable sources for energy generation. The potential for wind energy at the 80m level in India is around 102,788 MW (103 GW), while the World Institute of Sustainable Energy (WISE) estimates micro-generation potential from small wind turbines in India at about 83 GW. Various studies suggest the estimated potential at about 80-100 GW. This means, about 50 million small wind turbines of sizes ranging from 500W to 10 kW capacities are needed to be installed, to tap into the opportunity.

Affordable windmills

What makes Avant Garde Innovations particularly noticeable is the small-sized wind turbines. As one magazine puts it, "It's around the size of a ceiling fan and costs about the same price as a new Apple iPhone". Despite its size, this wind turbine can generate 3-5 kWh, which is what needed to power a home. This patent pending Small Wind Turbine is for residential and commercial use, expected to be sold for about INR 50,000 per kilowatt. The founders feel that their wind turbines cost only one-fifth of the market costs of a standard 1 kilowatt wind-turbine. Arun George, the CEO and founder of Avant Garde Innovations points out that given the low initial investment, it will be literally free electricity for the user for the next twenty years.

Degree of innovation

Brothers Arun and Anoop George, founded Avant Garde Innovations in January 2015. Their innovation has already attracted large traction worldwide even before it is formally commercialised. Reports show that most of the existing small wind turbines are prohibitively costly and are prone to failure. The winning part of the Avant Grade Innovation is their motor innovations. This is particularly important as motors do the mechanical work with the energy generated by the turbines. The compact design enables the system to run for a long period without incurring costs on frequent maintenance and enables it to produce the most optimal power

efficiency. The patent-pending Gyroscopic Axial Flux Turbine (GAFT) is designed for low-cost electrification applications. This helps in reducing the wind turbine manufacturing cost, hence is targeted to be being available at an attractive price.

The brothers feel that GAFT design can be applied for all smaller systems used for energy production. So GAFT could be applied to small wind turbines, hydro turbines, and tidal turbines also.

Wind-machine gone viral

A study by 'Research and Markets' in 2015 shares that the global Small Wind Power market was valued at USD 776.8 million in 2014 is projected to grow at a CAGR of 19.5% and reach a market size of USD 1,895 million by 2020. With affordable, small wind turbines, these numbers are bound to go up further. Hence it is no wonder that Avant Garde founders share that they have product bookings from over 100 countries and from every continent, except Antarctica, as of now! The company is targeting segments consisting of houses and apartments, offices, SMEs, commercial/non-commercial institutions, corporate enterprises and industries, agricultural sector, street lighting, mobile towers, rural electrification, government power projects. The startup has received over 6,000 residential product bookings and over 1,500 commercial product bookings. Further, the company today has also received over 2,600 distribution/franchise applications from across the world.

Avant Garde Innovations was also honoured to be one of the select few companies from across the world, and the only clean energy Indian company, invited to be presented at the prestigious 7th Clean Energy Ministerial (CEM7) held at Silicon Valley, San Francisco in 2016. They were also chosen amongst the Top 100 Global Startups of the world at the NEWENERGY Global Startup Fest, held in Astana in Kazakhstan. The company also says that it is the world's 1st Startup, and the 1st Indian energy company, which has committed for 100% clean energy usage for its operations.

Reflecting on his experiences, Arun extends his advice to entrepreneurs, "Whenever you are thinking of making a new product or solution, instead of focusing on the quickest profit with the least effort, think of what could sustainably solve some of the most pressing challenges in our society that demand our attention and support. As a developing economy, cleantech enterprises can contribute much more to the nation than any other sector, to solve its decade-long challenges with electricity, water, waste management, mobility, pollution, housing, etc. In these challenges lie our biggest opportunities too."

IV Glimpses into India's Cleantech Policy Space

Reshmi Vasudevan and Sandeep Tandon

1. Building Blocks of Cleantech Ecosystem

Climate change presents a formidable challenge to developing countries. It has also presented an opportunity to develop solutions that help mitigate the factors that are understood as causes of global warming. As a result of Oil Shock in the 1970s clean technology evolved from a niche aspiration of energy efficiency into a competitive force motivating many of the world's most progressive business planners and boardroom strategists. It has also caught the attention of governments and covers the full range of technologies that reduce the utilisation of fossil fuels, reduce wastage of energy in production and utilisation and provide environmental benefits. Global efforts have promoted resource-efficient and low carbon technologies during the past 40 years, while growing worldwide attention towards climate change has helped to bring efficient technologies in everyday products and services demanded by consumers.

While governments built a policy environment that encourages research and development in efficient, lower carbon technologies, investors became interested in this nascent sector because of the opportunities created by evolving energy and environmental policies, high energy and resource costs that made resource efficiency more economically attractive. Together, these public and private sector shifts allowed a clean technology market to emerge, which encompassed an array of products, services and processes that shared a common set of characteristics: they all delivered value using fewer resources and producing less pollution (carbon, waste or otherwise) than conventional solutions.

Though the clean technology sector has unique characteristics that, for instance, limit private risk capital investments and suggest a greater role for public finance in supporting early stage companies, the sector compares favourably to other sectors on innovation output. Countries that successfully build local cleantech industries can capture this economic value while simultaneously building climate resilience.

In the developed world, SMEs are important players in driving clean technology innovation and services, and evidence suggests SMEs in emerging economies can follow suit if supported by appropriate government policies and support structures to help them take advantage of the opportunities.

There are three building blocks that are particularly relevant to developing countries like India, and SMEs—investment, innovation, and jobs—which further highlight the relevance of clean technology and the potential it has to drive employment, innovation, and economic growth.

Investments

Clean technology ventures have raised significant risk capital investment in developed countries, although the overall amounts are much lower than other sectors such as biotech or ICT. Moreover, the fraction of risk capital and R&D expenditure is modest as a proportion of overall deployment spending.

As of 2015, about 147 GW new renewable energy capacities were added globally, such that clean energy investment increased to USD 286 billion worldwide; about 58% in Solar and 38% in wind power[10]. The trends in the investments show that investments were largely asset finance (for instance, investing in building a wind farm), while about 5 percent was risk capital (1 percent from Venture capitals and about 4 percent from private or

[10] Renewables 2016 - Global Status Report, REN21, 2016

government R&D). The relatively small VC investment highlights one of the challenges of investing in clean technology because of the particularly high CAPEX, long timeframes, less differentiated product, and regulation-dependent innovations. An MIT study showed that over 2008-13, VC investors globally had poured USD 25 billion into the cleantech sector but lost over half of it. While 2008 saw VC cleantech investments over USD 5 billion, by 2013 it dropped to USD 2 billion. This was reflected in the sector, such that only 24 cleantech companies were founded in 2013, compared with 75 companies in 2007[11]. Thus, clean technology VC is now more likely to be invested in software and services that augment some existing cleantech, at the expense of newer technologies that continue to rely on government finance for early stage development.

The investment experience also highlights the unique characteristics of clean technology, which has greater difficulty attracting VC, and requires more public investment than traditional sectors. This investment obstacle is even more pronounced in conservative industrial sectors in the developing countries. India and many key developing nations who have an active cleantech interest on the rise, face increased investment risk, besides less developed debt, and equity markets for cleantech. Hence various studies point out that public finance needs to play a key role as a catalyst for private funds in the form of credit guarantees and subsidised equity or debt financing.

Dr. Satish B. Agnihotri
Former Secretary Co-ordination, Cabinet Secretariat, Faculty IIT-Bombay

"The Government's involvement should help startups to leverage public funds to reduce the high-risk factor in the innovation and startup businesses. Due diligence by Government and FIs should be done on the SME companies to increase their chance of success. Also, the Government has a vital role to play in giving consistent and steady market support. This would be significant in bringing down the costs, as well as to nurture the business of startups."

Workshop on Innovative Ecosystems, MSME-UNIDO, Feb 2016

Innovation

Clean technology is a particularly nascent area for innovation since it promotes a product or process application for increasing resource efficiency - using fewer resources and reducing emissions and waste compared to conventional solutions. Essentially, any innovative improvement that results in a more efficient of use resources fall under the clean technology umbrella. Innovation is the lifeblood of this sector, but illustrating that intrinsic connection with hard data can be challenging. Nevertheless, some indicators like patents are helpful.

[11] Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation, MIT Energy Initiative, 2016

Environmental technologies account for a significant proportion of patent applications globally. There were 10,286 Patent Cooperation Treaty (PCT) applications filed in 2010, representing 6 percent of total PCT filings globally in 2010 (the latest data available from OECD). Environmental technology patents grew at a compound annual rate of 9 percent from 1999 to 2010 (based on PCT filings), which is second only to the mining sector in terms of growth rate (10 percent) but for a significantly higher number of patents.[12]

In India, over the past two years, about 70 percent of surveyed firms introduced new or significantly improved clean technology products or services, methods of manufacturing their clean technology products, and process-based activities to enhance clean technology product delivery. Such innovation across such a broad spectrum of indicators suggests that firms are quietly responding to ever increasing discussion on climate change.

Jobs

Looked at through the lens of job creation, clean technology is impressive in the developed world. U.S. employment in clean technology represents 2.6 percent of the total workforce, supporting over 2.5 million private sector and 886,000 public sector jobs[13]. Germany has about 2 million people employed in the clean technology sector, almost 5 percent of its total workforce. In the United Kingdom, about 940,000 people are employed in clean technology.

These benchmarks indicate that clean technology is a major employer. Clean technology jobs also compare favourably to jobs in other sectors: green jobs tend to be more skilled, safer, and better paid than jobs in similar sectors. Indeed, the move towards a lower carbon, more resource-efficient economy is expected to yield a double-dividend in terms of employment and environmental improvement. The International Labour Organisation (ILO) estimates that transitioning to a greener economy could yield a net gain of 60 million jobs[14].

The Role of SMEs and the India Cleantech Scenario

In India, the SME sector contributes to 45 percent of the manufacturing output and 40 percent of the exports. Hence, the sector plays a critical role to drive entrepreneurship and innovation in the country. As SMEs often can be both a cleantech innovator and an absorber of these technologies, opportunities for clean technology development and deployment are large across industries and value chains. Drawing parallels from other parts of the world, cleantech SMEs in India need consistent support to overcome the challenges which are characteristic of clean technology firms, including higher upfront capital requirements, longer payback periods for investors and a heavier reliance on government policy than other technology sectors. Some of the key areas that require careful nurturing to leapfrog into an enabling ecosystem for cleantech innovations are: entrepreneurship and business acceleration, innovation finance, market development, technology development, legal and regulatory framework – with key support from public and private sector players.

SME entrepreneurship and business acceleration in clean technology sectors have benefited from direct technical assistance and the linking of foreign investors with local clean technology SMEs

[12] OECD Report, 2011

[13] U.S. Bureau of Labor Statistics, 2013

[14] ILO, 2012 http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_181795/lang--de/index.htm

for technology development and/or production capacities. Hands-on and in-country business incubation is critical to the ecosystem.

Diverse financial instruments to support early stage financing and risk capital for clean technology SMEs are necessary to complement traditional financing sources. These include providing soft loans and loan guarantees and stimulating seed and venture capital investment. On the demand side, establishing technology-specific consumer credit facilities, can aid higher up-front investments such as renewable energy systems.

Market development is a critical challenge, given the need to increase demand for products and services of local SMEs, and facilitate the overall growth of the clean technology market. Clean technology markets can benefit from strong procurement policies which can create the necessary initial momentum for market transformation. For instance, Government of India is a major procurer of goods and services where a significant spending is on energy consuming products that use least cost methods for procurement. This method of decision making in the procurement provides a major boost for the cleantech products in the markets and also benefit from the operating costs of various agencies could be brought down by 20-30 per cent from resource savings. This could aid the non-plan expenditure of the government, which is a significant part of the annual budgets.[15]

Incentivising technology development through tax credits, research grants, publicly funded competitive research collaborations, competitions, public investment in R&D, public or private agreements on technology cooperation, demonstration projects and applied research networks have proven to be effective. This must be translated with a cleantech agenda for the country. Similarly, an overall enabling framework for clean technology SMEs can be strengthened by implementing a number of legal and regulatory policies and emission reduction credits.

Conclusion

Given the various developments in the sector, clean technology markets are projected to be worth close to trillions of dollars in India in the coming years. India has already ventured out to offer a healthy startup ecosystem for entities in the clean tech area. While many academic institutions offer incubation support, the Government of India through its many departments including the Department of Science and Technology (DST), the National Science and Technology Entrepreneurship Development Board (NSTEDB) and the Ministry of Small and Medium Enterprises (MSME) offer various forms of startup capital to specific ventures. The Ministry of New and Renewable Energy (MNRE) too offers support in the form of startup capital to select ventures. Among others, the Startup India initiative was launched by the MSME ministry for creating a conducive environment for startups in India. Similarly, the Zero Effect Zero Defect (ZED) Certification Scheme for MSMEs encourages Indian manufacturers to produce global quality products with minimal adverse impact on the environment. Further, between 2012 and 2015, the number of incubators and accelerators that support early stage entrepreneurs has grown exponentially. Despite the advantages and opportunities for ventures seeking to enter the cleantech sector in India, several challenges remain. While access to finances remains a widely debated chasm in the ecosystem, investment returns from the cleantech sector are also mired with various issues.

Private equity investors share that they prefer backing companies seeking growth capital. They are familiar with technology adoption models implemented locally, but for many cleantech startups

[15] http://www.thehindubusinessline.com/opinion/energy-savings-in-public-procurement/article3336442.ece

in India are of the first kind. Investing in companies that have positive earnings before interest, taxes, depreciation, and amortisation offering growth capital has been the usual trend. Investors point out that while debt support can be offered to cleantech startups, often the exit options are unclear and untested as the sector is relatively new. Further, an initial public offering is not an option for many entities, given their small size. Drawing parallels from developed country experiences, many of these investors view cleantech as a high-risk area which demands high capital investments and unguaranteed returns. A few of those who have ventured out to work with cleantech startups were faced with poor payment practices that tend to create cash flow crunches and dampen investor enthusiasm.

Aligning and coordinating the ecosystem components for cleantech innovation thus become highly critical. India's ability to learn and leapfrog the paths traversed by the forerunners in the cleantech space will be put to test. This requires closer collaboration of stakeholders, ensuring a sustainable ecosystem for the country's cleantech market transformation.

2. How are Accelerator-Incubator Programmes Helping Cleantech Startups in India?

Reshmi Vasudevan

Startup accelerator and incubator programmes aid the entrepreneur looking to start off on the right foot by playing a critical role in mentoring and strengthening the startup. Accelerator programmes like GCIP are a great way to attract talent and entrepreneurial interest and seed ecosystems. In the cleantech sector in the country, there is a dire need for innovations targeted specifically at the Indian consumer and the MSME market. The GCIP programme is such an accelerator programme for cleantech startups, aimed to boost the local small and medium entrepreneurial community's role in cleantech innovations and strengthen the essential ecosystem.

Both accelerators and incubators offer entrepreneur mentorship, networks, and other support to startups for quickly growing their business. Some of them might even provide seed investment. They often improve a startup's chances of attracting a top VC firm to invest. However, accelerators and incubators are not the same. Accelerators are time-bound programmes that "accelerate" scale-up of an existing business, ideally a startup. They have a set timeframe in which a cohort of startups is chosen through a competitive process to get the opportunity to spend anywhere from a few weeks or sometimes a few months working with a group of mentors to

A startup is a young entrepreneurial company that is

- in the early stages of operation, usually financed by an individual or small group of individuals
- building a new product to disrupt one or more existing technologies
- innovating a product or service to meet an unmet demand
- in search for a repeatable and scalable business model
- building a new business model to disrupt existing markets

–various sources define "Startup"

help them move up with their business. Incubators physically host or "incubate" disruptive ideas with the hope of building a business model and company. Incubators often provide a co-working environment, for a longer period, and enable a strong connection to the local startup community.

A critical component to both is the mentor network, typically composed of senior executives, seasoned entrepreneurs and angel and venture capital investors – this is often the biggest value for prospective startups. Mentors often play a critical role in vetting their business plans and finally these startups are enabled to pitch to investors, mentors, and other partners who can further their business.

Incubators often are academic institutions and government entities besides a few private ones linked to major corporations. Accelerators and incubators can also provide equity. Some incubators might receive key financing from a corporate or a funding agency and this tend to influence the focus areas of the incubator. This could be specific market or vertical, for instance an agriculture focused corporate may prioritise incubating various agri-business solutions. A typical accelerator takes 5-10 percent pre-seed equity in the startup. Besides empowering the startup's access to finances, equity can create immediate positive impacts on the valuation of early stage startups, thus increasing the value of their equity. On the other hand, accelerators tend to offer prize monies for the winning team of their acceleration programme, i.e., the team that has built a great business case for an exciting innovation.

India Scenario

India is the third largest startup hub in the world, with 10,000+ startups. Almost 57% are non-IT based (mostly engineering) startups that work on agri-products, textiles, printing, and others, besides a significant percentage in construction. Cleantech startups are largely engineering enterprises or product companies, but some of them could be ICT-based solution providers to enhance these engineering solutions.

Venture Centres by National Science & Technology Entrepreneurship Development Board (NSTEDB)

The "Seed Support System for Startups in Incubators" is an initiative the National Science & Technology Entrepreneurship Development Board (NSTEDB), under DST for setting up 'Venture Centre' with a seed fund with a corpus of INR 1 - 2 crores. One of the best examples of Venture Centres is the National Chemical Laboratory's Venture Centre, at Pune. With 42 startups physically operating from the Venture Centre, it has eight associated incubates and 100 pre-incubating programmes with a greater focus on cleantech. As an incubator, the Venture Centre offers office spaces, technology support, investors, information on grants, funding, filing for patents and IP rights, etc.

The number of accelerators, incubators and startup co-working spaces in the country has dramatically increased to 140+, which is up by 40% YoY as per NASSCOM[16], with many new programmes appearing in large metropolitan areas like Bangalore, Delhi etc., with rich startup presence. At the same time, the competition for participation in these accelerators has increased, as evidenced by the growing number of applications from startups clamoring for a coveted spot in the accelerator's next cohort. This is visible

[16] Indian Startup Ecosystem Maturing, NASCCOM, 2016

in the cleantech space as well, the GCIP India programme saw more than 500 applications (for about 60 spots) over its 3-year programme held between 2014-16.

The Department of Science and Technology (DST), under the Government of India, has setup more than 100 "Technology Business Incubators" (TBI) in academic and R&D institutions including Indian Institute of Technology (IITs), the Indian Institutes of Management (IIMs), National Institutes of Technology and others. There are about 2,000 startups currently incubated under DST's initiatives. The Technology Development Board (TDB) and DST have been spearheading the deployment of various innovation missions in the country. The Department of Industrial Policy and Promotion (DIPP) and NITI Aayog, among others, are actively engaged in the startup policy and development space in the country.

Some of the most thriving incubators in the country include the IIT Madras Incubation Cell (IITM-IC), IIT Mumbai's Innovation and Entrepreneurship (SINE) and IIT Delhi's Technology Business Incubator. Similarly, the IIM Bangalore's N.S. Raghavan Centre for Entrepreneurial Learning (NSRCEL) and IIM Ahmedabad's Centre for Innovation Incubation and Entrepreneurship (CIIE). These are also among the few with a focus on cleantech given the prevalence for IT-based startups in most incubators. Many of these institutions fund their incubation spaces using sponsorships besides funding from the state governments and the HRD Ministry. Some incubators like the NSRCEL acquire equity in exchange for offering rental space.

Various academic institutes have been offering startup incubation for more than a decade. There is a prevalent idea that incubators in IITs tend to have an edge in the aspects of technology and engineering, while IIMs and others score better on business models. Interestingly many startup founders are students and alumni of IITs and IIMs, among other established academic spaces. A recent global survey found IITs among the top 4 academic organisations that produced some of the largest unicorns (billion-dollar startups); i.e., out of 189 unicorn founders globally, 12 went to one of India's 23 IITs[17]. Hence it is no wonder that some of India's best incubators are housed in these places. However, the cleantech incubators and startups are rather few.

Increasingly a slew of non-academic cleantech incubator spaces have opened in the country and many state governments have yielded support to these initiatives. Some of them include the Startup Village run by Government of Kerala with an earmarked fund of INR 100 crore, the Centre for Incubation and Business Acceleration, Goa, the Centre for Science, the Technology and Innovation (CSTI), and the Goa Information Technology Innovation Centre, among others.

The Cleantech Ecosystem Enablers

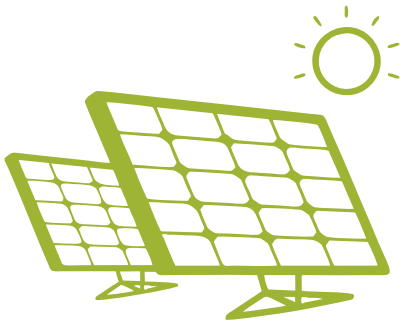
When an investor examines a startup-business hinged on an innovation, ideally the startup's performance, its ability to manage risk and its offerings' differentiated value proposition for competing in the dynamic business environment (locally or globally) - are scrutinised. Investors, depending on the nature of their fund, would support a startup depending on the stage where the startup is in its growth cycle. During the early stages, startups primarily rely on family and friends, besides one's own savings for the

[17] Which universities did these Unicorn founders go to?, SAGE, 2016http://www.sage.co.uk/c/v/unicorn-league/#founder|founder-universities

The Centre for Innovation, Incubation, and Entrepreneurship (CIIE), is one of the most successful incubators in the country that has a large cleantech agenda. A joint initiative of the Gujarat government, DST and IIM-Ahmedabad, the CIIE launched the Indian Fund for Sustainable Energy (Infuse), a USD 25-million fund for investing in cleantech startups. CIIE's venture capital branch, Infuse Ventures offers incubation for cleantech and is backed by Ministry of New and Renewable Energy, TDB, IFC, BP, Godrej Industries, ICICI Bank, SIDBI, Bank of India and Union Bank. CIIE has also been receiving international VC funds. So far CIIE has invested about INR 14-15 crore in startups, taking up to 10% equity in these startups, while the Asian Development Bank backs its clean-tech boot camp, the German development agency GIZ supports CIIE to run its MentorEdge, that engages local NGOs and government departments, to train entrepreneurs.

seed capital. Sometimes angel investors step-in for seed funding. In India, the Indian Angel Network (IAN), a group of individual equity providers, has been providing holistic support through incubation and financing for innovators. A VC often comes into the picture only when the company is ready to scale up. VCs thus bring larger institutional funds that can be very useful in helping the company to tap the market (building sales force, widening into global market etc.). At a stage when the startup is ready to aggressively expand, banks and other public market may provide necessary working capital essential for growth. An accelerator or incubator programme helps the startups in traversing this ecosystem.

National missions like the "Make in India", "Startup India", "Digital India" and "Standup India" initiatives spread across various agenda for promoting startups and entrepreneurship in SMEs and manufacturing spaces, offering funding, attractive FDI schemes, strengthening IPR rules and infrastructure support. The Standup India campaign launched in 2016 aims to help startups with bank funding and encourage entrepreneurship among the young Indians. The Startup India with INR 10,000 crore earmarked is one of the key campaigns to fund VCs in India to invest in startups. These programmes are driven primarily by DST, TDB and DIPP in key positions with key collaborations from the private sector, bilateral agencies and industry associations and others towards development and commercialisation of indigenous technologies, besides adaptation of imported technology.



Deepak Gadhia is the founder of Gadhia Solar Energy Systems Pvt. Ltd.,in Gujarat, which offers services in the Energy sector. His pioneering work includes bringing to India the Seifert Parabolic Solar Concentrator technology in co-operation with the developers and successfully commercialising it. Gadhia has won numerous awards including Blue-sky in Shenzhen, Solar Entrepreneur Award (Solar Thermal Field) among others. He is a Board member of Solar Cooker International (SCI) in USA.

Deepak Gadhia
GCIP Mentor

"Mentoring cleantech innovators has been one of the most fulfilling experiences to me. Having been an entrepreneur myself I understand the value of right advice and, also, given at the right time. While mentoring the startups, I realise and have witnessed this 'value' applies to all and it is heartening to see how well the advice is received. My experience of GCIP mentoring has gotten me so involved that I decided to join the startup I was mentoring to go with them to San Francisco for their pitching at the Global Cleantech Forum, where they competed with the rest of the cleantech innovators from other parts of the world. It was very heartening to see them win. For me as a mentor it is important that the startup learns from our experiences and mistakes that we made. These lessons from our experience will help them benefit. They also benefit from our networks and the goodwill that we built over last 30 years working in the Clean-tech sector starting with Solar thermal to Solar PV and biogas. I feel that a accelerator programme like GCIP should continue in one form or other".

Some of the well-received accelerator programmes include, Indian Innovation Growth Programme (IIGP), for accelerating Indian technologies to global market, by the DST, Lockheed Martin Corporation, Indo-US Science and Technology Forum and FICCI. The second round of IIGP will now see Tata Trusts' Foundation for Innovation and Social Entrepreneurship (FISE) joining the initiative to foster sustainable social and industrial innovations. Similarly, the Global Innovation & Technology Alliance (GITA) was initiated by CII and the DST, for stimulating private sector's investment in R&D and innovation. The Economic Times "Power of Ideas" was launched to strengthen the startup participation in the CIIE programme of IIM Ahmedabad, a joint initiative of DST and Jio. WWF jointly with TDB launched the ClimateSolvers to speedup cleantech innovation for reducing GHG emissions and improve clean energy access. Under the India-US bilateral umbrella, the Millennium Alliance was initiated by the Technology Development Board and the USAID, supported by FICCI, and the Pacesetter Fund for early-stage grant funding for accelerating the commercialisation of innovative off-grid clean energy access solutions - the USAID and the Ministry of New and Renewable Energy (MNRE). GIZ India and Social Impact Lab (a German social innovation incubator), along with SAP, Bosch and Intellecap, held a boot camp in Berlin for energy sector startups.

Evolving Pathways of Cleantech Innovations in the Country

Despite an impressive list of incubating facilities for startups in the country, most of them are inside universities and government research institutions. This is further narrower for cleantech startups. Though there are multiple academic institutions that house incubators, one of the critical issues

for cleantech incubators to flourish is the lack of universities with programmes and research across multiple domains – engineering, sciences, and business. Very few of the above work towards developing an eco-system or community of entrepreneurs or startups towards longevity of the programme beyond the programme cycle. Most focus on diligence and judging the startup but have no incentive to involve providing fit for purpose mentoring and assistance to startups. While this poses a great damper for the innovation agenda in the country, IITs are recognising this gap and are working towards widening their incubation centres to drive incubation and R&D of technologies. IIT Madras has now opened a research park and is planning to host some 75 research and development centres. Similarly, IIT Delhi is working towards setting up facilities worth over INR 450 crore which will house many R&D centres and about 100 startups [18]. These facilities will incubate both for IIT alumni and non-alumni startups. The centres also provide the opportunity to deepen connect with the industry R&D ecosystem by co-locating industry R&D labs in the same space. However, it is yet to be understood if these facilities will also critically asses the business models required for each startup. Some experts feel, funding is what venture capital funds and angel funds do best, not academic institutions.

Business incubators are still rather few in the country such that experts point out that of the 4,000 odd business schools, only a handful work with entrepreneurs. One of the key issues that impedes the cleantech spaces is how most corporates and private acceleration programmes are driven towards the latest developments in AI (Artificial Intelligence), Data Analytics, and Fintech (payment and credit solutions). The VCs, thus, continue to bet on consumer internet startups as it is easy to follow on funding from their peers. Hence it is critical to bring in cleantech investments into incubators as well and in enabling the institutional linkages while upholding on accountability of the incubator. A 2015 report[19] by NITI Aayog points out the urgent need for strengthening the scale, scope, and efficiency of business incubators in the country. Startups tremendously benefit from networks through associations and incubators need to provide the platform to cooperate with the government and access to global markets. However, the report raised concerns as to how most of these incubators work in isolation. Despite many being housed in universities, academic and R&D facilities the report finds very few of them have built on the linkages with the research climate in the universities. Therefore, neither the incubator nor the startup benefit from the research or contribute to it. On the other side, these incubators are not sufficiently connected to established corporates. Thus, both, incubators and their startups tend to lack exposure to 'real world' problems, and fail to generate productive solutions for current needs.

The Way Forward

NITI Aayog report draws lessons on entrepreneurship from Israel where the country witnessed unemployment rate decline from 9% to 5.5% and new businesses grew by 23% over the period 2000-2011. On the other hand, Japan was stalled for two decades due to stagnation in entrepreneurial activity. Taking cues from these experiences, India needs to ramp up its tactics in addressing "low-hanging" gaps in the innovation ecosystem, by driving efficiency of business incubators, and provisions for easy access to finance. Globally, competitions and prizes as tools have been proven to encourage innovation. Also, encouraging corporates to fund research and development at the university level, and improving the efficiency of business incubators can bring down the burden on the state.

[18] IITs look to nurture start-ups, host companies' R&D centres, Feb 2016, Live Mint http://www.livemint.com/Politics/CnutyXqAGBjbYLrYNWr8oI/IITs-look-to-nurture-startups-host-companies-RD-centres.html

[19] Report of the Expert Committee on Innovation and Entrepreneurship August 2015, NITI Aayog, New Delhi

Thus, fostering a national entrepreneurship and innovation movement will be critical. To this end, India should diligently work towards achieving the goals of 'Make in India' and enrich its 'Startup Policy' deployment. India is also a signee of UN's Mission Innovation Challenge for doubling its clean energy sources and ramping-up R&D spending, with a critical role for the private sector in mobilising finances. Further embracing technology advancements will cross-pollinate the innovation space in the country. For instance, FICCI jointly with Google has launched the Digital Unlocked programme to help small businesses and startups to grow their businesses digitally. Finally, reforming the educational system to encourage innovation and upskilling workers and strengthening IPR will attract more entrepreneurs in the country.

Accelerator Lessons from GCIP India Programme

Karthik Chandrashekar shares his mentor experiences working with the GCIP programme over 2015-16.

Discipline matters - as getting entrepreneurs with limited time to go through the workshops and workbooks was bitter medicine – not very enjoyable but valuable and appreciated in the end. The Startup Community is the next critical thing - the support and learning from peers and continued camaraderie among the participants of the various budding entrepreneurs in clean tech space has been invaluable for shared value creation and moral support. A pro-active leadership and supportive enthusiastic mentor group is key to entrepreneurs feeling valued in the programme. Despite constant effort the programme avidly felt the lack of industry participation as customers or investors. This makes it disconnected from the overall ecosystem leaving open stewardship opportunities for participants beyond the Programme. On the brighter side, the programme received strong government participation. This was one of the attractive aspects of the programme with connects to SIDBI, EESL, BEE and MNRE but to make the programme meaningful, structured outcomes with government agencies within their existing schemes and bounds of engagement with the private sector is critical. Finally, as entrepreneurs and MSMEs that need support are a varied group, young first time entrepreneurs to mature serial entrepreneurs, startups in high growth markets to SMEs in niche markets. They have very diverse needs. To promote innovation to drive productivity in the MSME sector all of them need to be supported."

(Karthik is the Founder & CEO of Sangam Ventures, a VC based out of Delhi)

3. India's Climate Commitments and Cleantech Innovation

India accounts for about 4.5% of global greenhouse gas emissions, which threaten to exacerbate the climate impacts, adversely affecting the country's agriculture, water resources, cities, and its large coastal ecosystems, among others. Studies by the Intergovernmental Panel on Climate Change (IPCC) have shown low-carbon technologies (cleantech) and services reduce and help to stabilise greenhouse gas (GHG) emissions cost efficiently. IPCC and other studies suggest three broad areas for cleantech interventions: (i) Generic largescale technologies consisting of end-use efficiency, alternative energy resources, carbon capturing, clean carbon technologies, (ii) Sector-specific large scale technologies that include energy efficient

manufacturing, forestry, agriculture, and (iii) Micro-level mitigation technologies such as methane digesters, fuel efficient stove that promote efficient utilisation of resources to reduce emissions.[20] Interestingly, small-scale technologies and services and newer production processes are found to have the greatest potential to create about 50% of emission reduction. This highlights the need for many cleantech innovations that can be easily deployed.

The Indian government is, understandably, giving high priority to economic development of the country. In this context, India has taken a cautious approach towards the negotiations on climate change, to safeguard India's development goals. Simultaneously, India is keenly pursing the path to lower its greenhouse gas emissions trajectory by putting a lot of stress on renewable energy and encouraging energy efficiency in end-use. Thus, clean technology options are an important element to fulfil the country's need for energy in an environmentally benign manner.

Of the 194 countries that submitted their Intended Nationally Determined Contributions (INDCs) under the International Climate Agreement, 75% indicated technology as key criteria to reduce emissions. Almost half of the non-developing countries indicated technology research and development or innovation in their Intended INDCs, [21] for limiting the increase in global average temperature to well below 2°C while pursuing efforts to limit the increase to 1.5°C. Thus, the patterns and pace at which technology development and investments will take place is important. India and many other developing countries have stressed on the climate technology needs for achieving the commitments under the Climate Agreement and indicated the need for augmenting their innovation capacities. To this end, one of the key outcomes of the Paris Agenda was the launch of Mission Innovation, where 20 major economies including India will work to fast-track clean energy transition by doubling clean energy research and development investments in the next five years. It is thus imperative that innovations in cleantechare made an important tool to the climate change mitigation measures.

Cleantech Transitioning and the Road Ahead

The core of a low-carbon economy transition lies in the efforts needed in mobilising the required scale of technology, knowledge, and finance and an enabling market framework. A strong national innovation system assumes significance as low-carbon green growth models are emphasised to drive resource efficiency strengthening energy security while mitigating climate change, thereby generating jobs, and ensuring environmental welfare and thus sustaining economic growth.

The Global Cleantech Innovation Index points out that India is expected to spend almost USD 30 billion on renewables and USD 1.7 trillion on energy supply infrastructure by 2035 besides adding a grid interactive renewable capacity of about 30,000 MW. India's attractive investment policies for environmental equipment and services companies is making the country a supply chain hub for both local and international manufacturers of RE technology. This has also given way to a sizeable number of private equity deals in the country including the Goldman Sachs' USD40 billion commitment to ReNew Windpower for wind energy projects [22]. While, mitigating greenhouse gases is a global commitment, climate adaptation

[20] Investing in Low-Carbon Energy Systems, 2016, Venkatachalam Anbumozhi et al

[21] INDCS and technology, UNFCCC, April 2016 http://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/HOME_infobox_2/a61f9f4b94704dd78f06b2bc7cd0b547/f7bbe982812a469db476fd4917714813.pdf

[22] The Global Cleantech Innovation Index 2014

solutions are particularly important to climate sensitive economies like India. Hence the scope of Cleantech innovations range from tailoring clean technologies and processes for adoption by people to developing indigenous clean technologies for specific requirements.

National Agenda for Transitioning Towards Climate Friendly Regime: Prime Minister has expressed government's intentions to drive a paradigm-shift in the international community's policies, and moving on from "carbon credits" to "green credits". India's National Action Plan for Climate Change of 2008 was one of the most comprehensible step towards addressing climate change, with its eight Core National Missions: The objectives of these missions further strengthened India's INDCs to the Paris Agreement where the country intends to lower the emissions intensity of GDP by 33% to 35% by 2030 (below 2005 levels) and achieve about 40% of installed electric power generation capacity from non-fossil fuel resources. To this end, India targets deployment of 175 GW renewable energy capacity by 2022 which includes 100 GW of solar, 60 GW wind, 10 GW from Biomass and 5 GW from small hydro power. Besides, India's 100 Smart Cities mission has extensive agenda for the use of renewables and energy efficient technology in building habitats.

India is witnessing a fast-paced emergence of innovations driven by disruptive innovations. With rapid increase in the awareness about climate change and contribution of efficiency to company's profit margins, the corporates are giving serious consideration to deploying efficient systems and processes.

As governments and organisations around the world are proceeding on the path of climate mitigation, the cleantech innovation will get serious attention as well as greater recognition for bringing in disruptive change in the way energy is utilised. The clean technology innovation would also get benefitted by the development of information communication technology and expand its reach to other important sectors of the economy which consume natural resource such as water, which has a strong nexus with energy. The GCIP initiative and the cleantech innovations nurtured Programme jointly implemented by UNIDO and Ministry of MSME, require greater recognition as important contributors to the country's effort to lower its greenhouse emissions and improving energy security.The role of SMEs here is significant and need a larger thrust for the cleantech pathways in the country. AninfoDev study shows that the climate change regimesare creating opportunities for cleantech SMEs in developing countries to reap from USD 1.6 trillion investments that will be made before 2025.[23] However, the report cautions that the challenges to smaller entrepreneursin accessing early and growth stage financing could impede SMEs from tapping into the opportunities. Hence viable policies and financing is critical for the transitions to happen.

While the share of cleantech startups in the country is small, India remains an important player for commercialising cleantech innovation given the strong market potential which exist to address clean energy demands, rapid urbanisation, high levels of pollution and waste, which are common to many countries. Thus, ifIndia play its cards well; the cleantech sector offers a viable space for fast-trackinginnovations to address various climate change and environmental problems in India and various other developing countries and economies in transition - thereby the cleantech sector contributing toeconomic growth.

[23] Building Competitive Green Industries: The Climate and Clean Technology Opportunity for Developing Countries, InfoDev, 2014

4. Financing for Cleantech Innovations

Sandeep Tandon

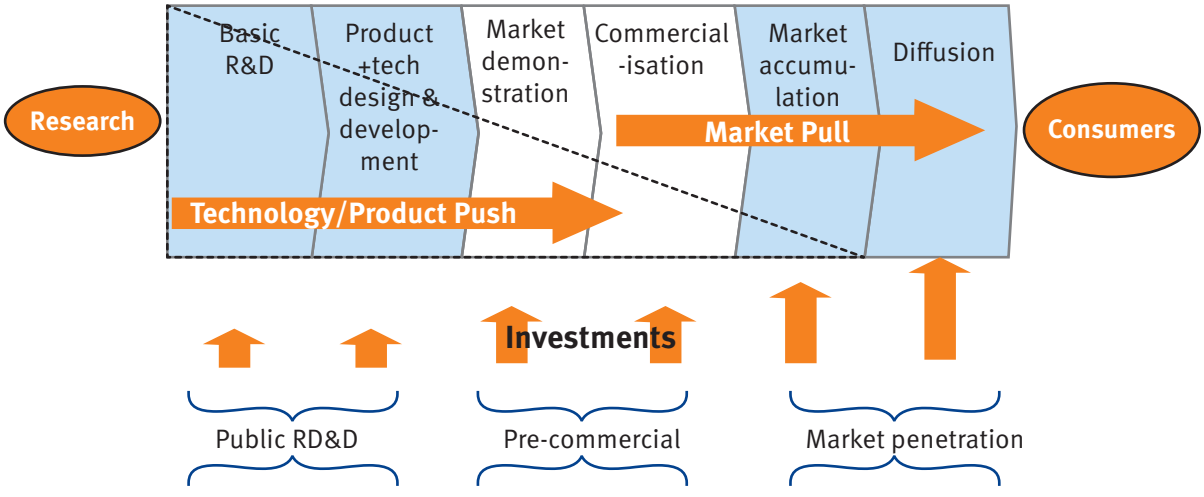
Clean technology innovation involves development of solutions and based on research and products development, and eventually introduction in the market as specific products or business solutions. These innovations solve specific issue of energy consumption in different situations and offer tangible financial benefits which results from reduced energy usage, without compromising the comfort or productivity.

Start-ups that work in developing innovative 'Clean Technology Solutions' are therefore, often 'product oriented' and serve select market as opposed to 'service oriented' start-ups that serve a large market based on the service offering. The main steps in the cleantech innovation cycles are product development and demonstration which requires technology push supported by investments as shown below.[24]

While the cleantech innovation is driven by the need for prudent use of energy and natural resources, the factors that create market demand for such solutions vary by geography. Cost is often the dominant factor to deploy new technologies in markets that are disaggregated. Any Cleantech innovation to sell in large quantities have to compete with an established technology and procurement processes in 'cost terms' and not in terms of 'efficacy'. The cost of any innovative technology is higher in the early stages of production, which deters potential users, thus severely limiting the ability of the technology to make an entry in the market and gain acceptance.

"Majority of manufacturing innovations are capital intensive. More importantly it is difficult for the innovator to convince the investor on the new market creation (which is actually the driver). Investor looks for existing competitor to see if market is ready but someone taking that risk is something that needs to be looked at"

– Vijayaragavan Viswanathan, Tiino Techmations.



[24] Technology innovation and climate change policy: an overview of issues and options, Keio Economic Studies,2004

The product cost typically reduces with economies of scale and until then the start-up needs funds to sustain itself and steadily grow to overcome a critical phase in its life which is referred to as the 'valley of death'. This refers to the stage between the Research, Development and Deployment phase, when a technology is advanced enough that its application can be demonstrated, and the stage when the deployment of the technology/ product takes place at a sufficiently large scale to make it viable in the market.

Although start-ups in India manage to get funding from various informal channels including corporate, angel/seed or VC funding, the cleantech start-ups can be more capital intensive. Generally, in the initial phase, cleantech start-ups get going with funds from friends and family and only after sustaining in the market for 3 years, they get the attention of Angel or Seed Funds and after completing 5 years in business and based on the growth, they receive attention from Private Equity firms.

Challenges

One of the biggest challenge that remains for start-up is Financial Management, since most start-ups are self/family funded with limited workforce which makes it difficult to maintain records both financial and operational. Excessive technology focus of the innovators, flawed business models and lack of innovative revenue strategies have led to the failure of many start-ups.

"Each EE innovation should have a validation done. Each Cleantech innovation should be connected to its domain agency for validation. This I think is one major missing link for innovation ecosystem. Once validated and found substantial as claimed, with due diligence, there has to be a mechanism to publish the results in the domain they belong. The innovation should be evaluated commercially for feasibility by investment experts -once again validation of the claims"

–Manish Kothari, Rhino Machines

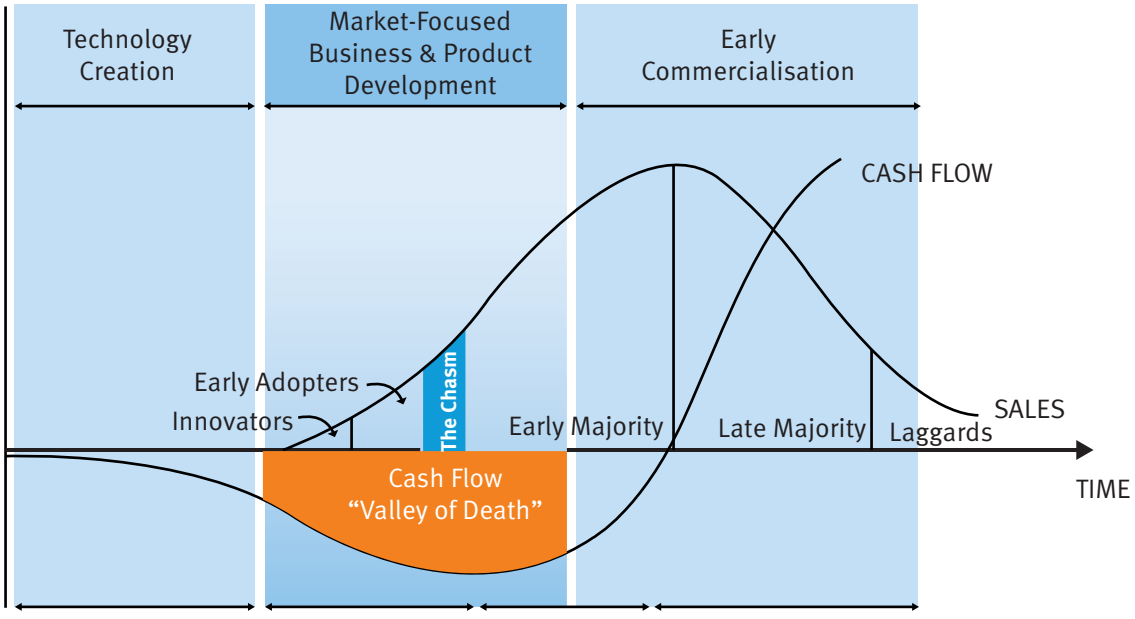


Figure 3: The 'valley of death' in the innovation process

Source: Adapted from http://www1.eere.energy.gov/commercialization/images/valleyofdeath_sm.jpg

Capital and access to capital has been a perennial problem for start-ups'. Although, at various occasions, government and private sector investors have set aside funds through investment channels but they are not available for all forms of business. One of the biggest problem for innovation startups is to attract investors and gain their trust about their mode of Operations.

In the initial phase of operations, start-ups do not get funding from banks given no credit history of the firm. In addition, there is limited number of credit rating firms for small and medium sized enterprises. If the start-ups' are not developing channels to bring their innovation in the market, despite having raised good investments, several start-ups are unable to mitigate the gap between expenditure and revenue, thus struggle to survive the competition.

Regulatory issues are another formidable barrier which the start-ups have to confront. Requirement of multiple clearances puts onerous demand on budding entrepreneurs who must make multiple trips to government offices to register and seek clearances. Also, it has been found that taxes VAT, excise create problems for entrepreneurs while starting up a business. Taxation is a barrier for technology adoption and proves to be an immense hurdle for budding entrepreneurs. Start-ups will be able to stem the cash outflow, if they are accorded tax-exempt status for initial period of 3 years or 5 years. The self-explanatory table below provides a comparison of tax rate, number of tax payments by business and bank lending rates amongst three large economies.[25]

	India	China	Israel	Singapore	Japan	US
Total no. of startups (-)	10,000	10,000	4,750	N.A.	N.A.	83,000
Tech-based startups	4,300	3,400	4,000	N.A.	N.A.	48,500
Non-tech based startups	5,700	6,600	750	N.A.	N.A.	34,500
Set up a new business (Days)	30-60	30	13	2	10	4
Corporate tax rate	34%	25%	26%	17% (100% tax exemption for startups)	34%	39%
No. of Tax payments by businesses (p.a.)	33	9	TBD	TBD	TBD	11
Bank lending rate	10.3%	5.6%	3.9%	5.4%	1.2%	3.3%
R&D spending % of GDP (Est. 2014)	0.85%	1.90%	4.20%	n/a	3.40	2.80%

[25] Startups Indian – An Overview: Joint Study by Grant Thornton and Assocham, 2016

Since energy is a commodity business, receiving funds for developing cleantech solutions is relatively challenging. Also, as new ways of producing energy (or saving it) has to compete primarily by being cheaper than incumbent technologies, the rewards to innovation are thus intrinsically smaller in markets which are driven by product pricing.

"Lack of a precedent example based on which the investor / lender could feel comfortable. Most innovations are the first of its kind. One or two working models are not sufficient to dispel the discomfort of the investor/ lender in making a large investment"

– Philip Ittyerah, Sevat

There is a need to accelerate the development and deployment of GHG-mitigation and adaptation technologies to meet the climate challenge in developing countries. To bring such technologies into widespread use successfully, there is a need to provide both push and pull mechanisms and create local capacity that provides financial incentives to deploy clean technology at large scale.

5. Energy Efficiency Innovations Open New Avenues for India

India remains strongly dependent on the import of fossil fuel. The strong growth of the country's economy between 2003 and 2016 drove up the demand for energy by 60%. Increased dependence on fossil fuels has led to a dramatic rise in India's greenhouse gas (GHG) emissions, making India the third largest contributor to global emissions.

To address the increase in GHG emissions and energy consumption—projected to steadily increase from 1,033 Mtoe in 2020 to 2,097 Mtoe in 2030—India embarked on an ambitious renewable energy generation agenda. Demand-side interventions for saving end-use of energy through improved processes and the use of efficient equipment, appliances, and services are critical across several sectors of the economy.

The need and opportunities for energy efficiency (EE) interventions in the country are several across building, appliances, small and medium enterprise (SME), industrial and agricultural sectors, among others. Over the last decade, the Bureau of Energy Efficiency (BEE) and other public and private sector agencies are addressing the end-user energy demand or the 'Demand Side Management (DSM)' market. For instance, the BEE has brought 21 appliances under its standards and labeling programme. In addition, the government, through its UJALA scheme for LED lights, targeted large-scale penetration of these energy-efficient lights by creating a pool of investment funding for on-bill financing.

Innovation and EE Entrepreneurship

The spirit of frugal innovation caught industry's attention and saw a new cadre of young entrepreneurs with innovative business models and technologies coming to market. Most of these innovators are part of India's SME sector and play a critical role in increasing the penetration of energy efficiency across various sectors through innovative products and business models that recognise the market opportunities beyond the immediate linkages of climate issues.

Due to the increasing availability of efficient technologies and solutions that provide cost-efficient results, India is now witnessing a steady emergence of cleantech innovators with broader emphasis on clean energy, water, waste and transport, and their overlapping linkages. Many of these innovators are first-generation entrepreneurs, with a passion for the cause and a keen sense of technology, often backed with advanced technical training.

The diversity of these energy efficiency innovations were presented by the UNIDO-managed "Global Cleantech Innovations Programme". Some of the innovations are path-breaking and disruptive. For instance, nano materials from herbal extracts, via a single-step process that Aarshadhaatu Green Nanotechnologies uses, replaces wastage in extraction of metals from their respective ores. This decreases the enormous amounts of energy spent, and reduces air and water pollution. Similarly, Aquvio is another invention that imparts a cost-efficient reverse osmosis-based water purification solution. The purifier converts unsafe water to potable water with the highest efficiency, at a recovery rate of more than 70%. The emphasis of these technologies in resource efficiency presents the overarching trends in energy efficiency innovations and their critical need to an economy.

McKinsey Global Institute estimates that by improving energy efficiency in buildings alone in India (new construction and retrofits in existing ones) can create savings of 2,988 MW, estimated at USD 42 billion per annum. To this end, the BEE is working aggressively to address the efficiency of air-conditioners (AC). The AC market is expected to reach 10 million units by 2020 from the current market of about 3.75 million units. In light of this, it is critical to assess other technologies that are providing greater paybacks and resource efficiency.

Another GCIP innovation, the Airtron AC energy-saver is an easy retrofit to existing AC systems that cuts electricity bills by up to 35%, yet assures precision control of room temperature by reducing the compressor run-time. It is a dual-sensor driven, programmable AC power saver as opposed to the "blind plug `n' play" timers currently available. Geothermal air-conditioning offered by GIBSS, also a GCIP innovator, provides up to 60% energy savings and 100% water savings for commercial and industrial buildings. Another cooling solution offered by Oorja, provides radiant cooling panels and pipes for energy-efficient air-conditioning with innovative gypsum board-based panels, providing 30-50% reduction in electricity consumption by the chiller units. Besides the energy savings, it also eliminates the need for fan motors in air handling units (AHU) thus saving additional costs. On the cooling side, where fans are largely used in India, Atomberg's 28W ceiling fan is 65% more energy-efficient than similar ceiling fans that are available in the market.

The costs of these energy efficiency improvements will range fromUSD 5 to 10 billion, with payback periods of five to ten years. These costs need to be compared to the funds required for building new power plants or operate existing ones to meet the future energy requirements of the economy, and the logical conclusion lies in providing further impetus to the energy efficiency sector.

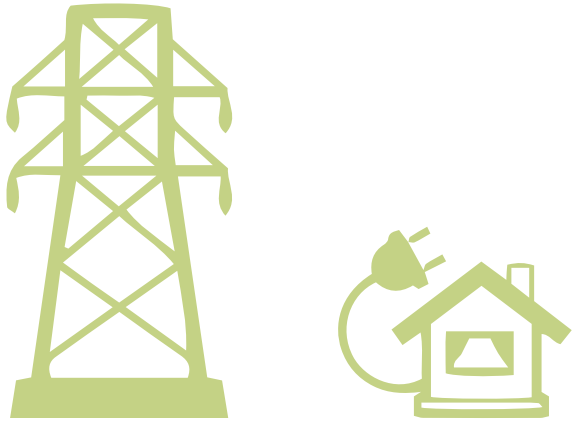
"When we innovated the first Sponge Iron cum scrap preheater for the Induction Furnace charge, and despite the availability of the first working model and a proven energy saving of 44% besides 55% increase in production, which were unheard of in the industry - there were no takers. Once a few more units were set up the idea spread like wildfire and the Industry was inundated with their process" – Philip Ittyerah, GCIP 2015

Future Action

The above-mentioned innovations are practical and implementable in the immediate term. However, what will it take for these technologies to replicate the success of LED lighting? They do require technical expertise, political will and persistent follow-up to increase their penetration through creative financing mechanisms. These ideas are also multi-disciplinary — they cut across and provide solutions to prohibitive perceptions of risk in investing and financing energy efficiency, the lack of reliable baselines, and poor policy incidence.

Globally, the innovation trend in energy efficiency is becoming information-driven. As one study shows, if we consider the trends of energy intelligence the energy efficiency is moving from a static, reactive process into a dynamic, proactive market strategy. For instance, the availability of cheaper sensors enabling granular monitoring of every appliance in a building has resulted in various energy monitoring appliances. Web-based monitoring platforms are making energy consumption predictable and paving the way for customised solutions.

Given the availability of data indicating critical gaps, in the immediate term, the products that promote energy-efficiency need a platform to create public awareness, along with a financing mechanism to help the product increase its market penetration and develop into a sustainable business. This would encourage more innovators to enter in this space. Besides a well-informed debate, the energy efficiency sector requires the formulation of reliable baselines and protocols to kick-start bankable industry and design the necessary incentives to reward first movers.

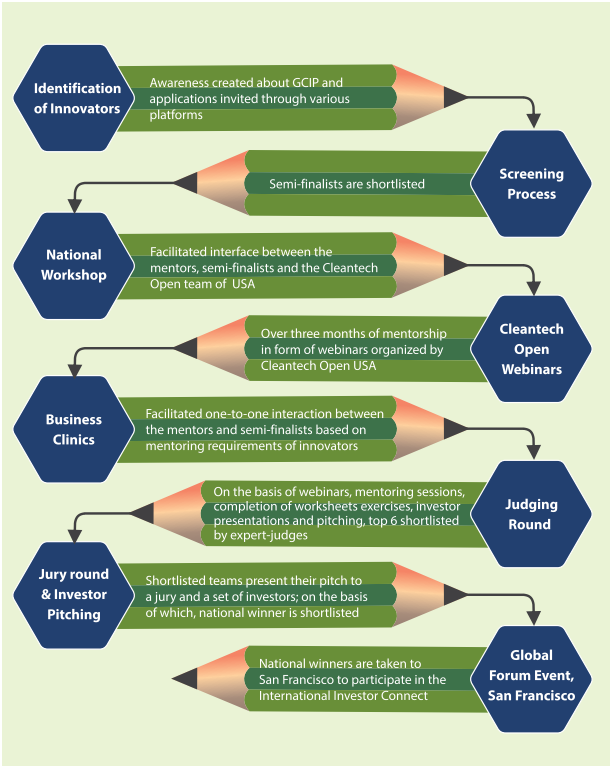


V Cleantech Mentoring Enablers

The GCIP India programme launched in May 2013 gathered various learnings and experiences over the course of the programme that conducted 3 acceleration rounds, where each lasted almost a year. To this end, the programme convened eminent experts from various Cleantech spaces towards enabling the ecosystem to ensure that the accelerator programme benefited from the technology and business aspects of cleantech innovations.

The Accelerator programme was structured to deliver its key milestones as indicated in the image, over the course of a year. The semi-finalists were shortlisted based on the validity and viability of their innovations. These cleantech innovators, over the course of the accelerator programme year attended: (i) National Workshop, (ii) Cleantech Open Webinars, (iii) Business Clinics, (iv) Judging Round, (v) the Jury Round and (vi) an Investor pitching, and (vii) the finale, the Global Cleantech Forum at Silicon Valley, California. Thus, the semi-finalists were mapped to their mentors, attended one-one mentoring, mandatorily attend CTO webinars, and grudgingly completed their elaborate and tedious worksheet exercises. Failure to finish the worksheet activity often got them, rarely but ousted from the programme. Finally, these market-ready innovators pitched their technology viability and business models to an enterprising set of judges – where the scoring exercise also considered their ratings from mandatory activities prescribed by the GCIP. The 6 top scorers competed at the jury round facing an esteemed panel, where their mettle as innovators and future businessmen were tested and apprised. The winners thus got to go to Silicon Valley to pitch for the Global Cleantech Innovation Award. GCIP India also provided networking opportunities with the investors.

Central to GCIP programme is the extensive mentoring provided such that the programme had put its efforts to maximise every participant's chances of being a prize winner, and enhancing their product positioning for better chances in raising investment capital and of achieving sustainable commercial success. In the following sections of this chapter, we have tried to capture the reflections of the enablers of the GCIP India programme.



GCIP Accelerator Programme Milestones

1. Mentoring - Gurus who were buddies too!

Ashok Toshniwal is the CEO of Universal Instruments Manufacturing Pvt Ltd a small family owned ISO 9001-2008 certified company that manufactures battery chargers for power plants & substations, specifically tailored Solar charge controllers since 1986 for special applications. As a mentor, he was very popular among the semi-finalists and was voted the Mentor of the year for 2015.

Ashok Toshniwal,
GCIP Mentor 2015, 2016

"I accidentally stumbled across the GCIP website, got curious about the volunteering part and wrote to them offering Mentor services to the programme. I had all but forgotten about the programme, so when I got a call from Rishabh, 7 months later, asking me if I could be a mentor in the programme, for a moment I went blank; then after a short pause gave a blind YES, to his call. That was the starting point of my journey in GCIP.

In the 2015 edition, I was given two mentees and got to mentor the third one too. Amit Kumar of Carbon continuum dropped out of programme, Manoj Kumar of Jyoti Cero worked hard specifically on his communication and presentation skills. He, along with his wife, developed rollers for use in conveyor belts, specifically in mining industry. These rollers need replacement only once in 11 months as compared to convention rollers – resulting in great energy saving and improved productivity. My additional mentee that year, Hari Rao of Agnisumukh, developed a gas stove, for cooking which went to become a Global Game Changer! The efficiency of his stove operating on conventional LPG is 35% higher than the available stoves and is approved by concerned statutory authorities. Hari was (continues to be) very passionate about his innovation. Guiding both Manoj and Hari on positioning their technologies and strategising their product pitches were a very satisfying experience. More so that Hari became the GCIP India national winner. In the process, I too learnt a lot.

In 2016, I was again invited to mentor Rajkumar Rajagopal of Cellzyme and Arindam/Shibrata of Atomberg. Rajkumar is a biotech professional, a PhD and Post Doc from Fraunhaufer Institute and Max Planck, Germany. Despite such credentials, he is the kind who feels there is much to learn! He developed an enzyme which makes it possible for a chemical reaction to do the work in 20+ oC instead of below zero temperatures. The huge cost saving from energy savings promised immense reduction in antibiotic manufacturing. Rajkumar spent hours discussing his presentation, on the phone and in person, especially to make it very concise. In his case, it was a little tricky to explain energy saving in manufacturing process, that too in a short span of time (allotted for product/tech pitching).

Arindam and Shibrata took turns to represent Atomberg owing to some health issues that came in their way. Atomberg founders and techies are mostly young graduates from IITs, a bunch of breezy guys, eager to listen and improve. They developed the most energy efficient ceiling fans in the country. Shibrata speaks fast and at times it is difficult to comprehend him. But his hunger to do better prevailed upon his habit and within a short span

he delivered his presentation, almost completely, within the time. I was pleasantly surprised too! He kept discussing on his way to SFO, even after doing security clearance at airport, on way to SFO for the Global Finals and finished as winners in the Energy efficiency category - we all are very proud! Rajakumar, despite the complicated task of communicating his enzyme technology, was the first runner up at the nationals.

Before one of the Delhi finals, a mock session was planned for the previous evening but got cancelled owing to logistic reasons. By evening my room at the hotel was converted into a seminar room with most of the semi-finalists and a few mentors. Presentations were made and feedbacks and extensive discussions were held. The result of this hard work, that lasted past midnight, was visible the next day, in the finals.

In both editions of GCIP, I guided the mentees, not only on the content of their investor presentation but also on the content, delivery and how to answer various questions, that might come up from the Jury. The art of defending in front of the jury was fine tuned. Interestingly, I found that most of them had to learn the difference between speaking concisely on the presentation rather than delivering a story. A common problem with all of them, hardcore technocrats, presumably, was that it is difficult NOT to explain the WHOLE technology!

An interesting aspect of all these entrepreneurs were that they were careful listeners and engaged in critical discussions – this made things easy. Further, we had numerous discussions over phone calls and emails and eventually all my mentees were highly focused and made excellent presentations in the stipulated time. So, I was extremely happy, but not really surprised to see most of them win the top awards or go on to do well."

Chandan Gadgil has been an entrepreneur throughout his career, with more than 25 years' experience in the biogas sector. He founded the erstwhile Innovative Environmental Technologies that worked on large-scale biogas projects and is the founder president of Sankalp Trust, for promoting cleantech innovations in social enterprises. He is an honorary advisor (Renewable Energy) in BAIF Development Research Foundation in Pune for setting up of family size biogas plants and the use of slurry for developing value added organic fertiliser.

Chandan Gadgil
GCIP Mentor 2016

"India is a country of entrepreneurs. The potential for startups is huge. In this context, the GCIP programme is a successful accelerator platform, and its mentor component, which I thought, has played a substantial role. My experience as a mentor has been immensely satisfying. I was given two startups to mentor: Arshadhatu and GIBSS. The objective of the mentoring was at multiple levels. Many of the startups are typically first generation entrepreneurs and generally technical. They are at ease to talk about their technology and its advantages. Moreover, they are emotionally attached to their technology. But where it concerns commercial issues and marketing pitch they desperately fall short. In addition to this all entrepreneurs need additional funds to expand their project and therefore have to make a commercial pitch at some point to potential investors. There exist various challenges in this area. This is exactly where the rich and wide experience of mentors can play a vital role in helping and guiding the mentee.

I observed that my mentee Mr. Arun Thomas, of GIBSS, unlike many other mentees, was very keen to engage with most of the mentors, not just me. He was picking up a lot of key points from all of them for continuously improving his presentation.

For discussions, here, I will take Arshadhatu's example - which had come up with an outstanding and game changing herbal process to produce nanoparticles. So, when I first started discussing with my mentee, Mr. Karthik, he was very sound and confident on the technical side. Having heard him, I asked him some basic commercial questions about the viability of the project, he realised that he had to think differently. He then went back and reworked on other possibilities and their application. This changed the whole direction of his approach as well as his presentation. It then became a viable commercial marketable pitch.

However, there are some key limitations to mentoring: I observed that several mentees do not want to disclose their technology and their company's commercial interest and were reluctant to share information. Understandably so. I suggest that any mentor who wants to engage in such a programme must understand and accept this challenge and then provide guidance to the start up."

2. Investors who mentored too!

Three investors who were also mentors to GCIP India programme are profiled here. These investors brought key insights into the funding space of cleantech from their own work experiences and advised the innovators on the business positioning of their technologies. A few GCIP innovators are now incubated by some of these VCs. In this section, the mentor-investors share their experiences about the cleantech investing and also their lessons and learnings.

Karthik Chandrasekar is the founder & CEO of Sangam Ventures, a venture capital fund (backed by the Shell Foundation, USAID and DOEN Foundation).

Karthik Chandrasekar
Sangam Ventures

Karthik says that he founded Sangam with the belief that cleantech venture capital globally is broken – access to capital seems to be the truant panacea at all stages. Sangam invests in early stage enterprises that improve access to sustainable energy and increase resource productivity leading to inclusive development and creation of communities that are resilient to climate change. Karthik points out, "Cleantech is not sexy, but, it has a secular growth opportunity if innovators are focused on meeting an unmet market need. Unfortunately, investor focus on riding government infrastructure schemes has left the sector littered with a graveyard of failures, keeping even the bravest of investors at bay". Unlike, developed markets it has a high potential for returns in developing markets given the inefficiencies in resource utilisation. Products and services developed for these markets can have global impact by shifting price – performance matrix. As clean tech investments represent fundamental technology shifts, they have a significant opportunity to drive inclusive access and have a multiplier effect of enabling all other sectors as energy is the bedrock for creating access to almost all modern services.

"The Sangam team and portfolio are designed to focus on the above market opportunity by driving empathy for consumers (purpose) and strong emphasis on cash management (survival)", shared Karthik. Over the last 3 years Sangam has tested and evolved its engagement model to ensure that investment decisions are purely based on a startups potential to achieve a product – market fit while disregarding any government or carbon mitigation incentives or programmes to create financial sustainability. By trying to fill critical talent gaps as the investor, Sangam tries to keep the startups extremely capital efficient while not forcing them to be asset light. To this end, Karthik emphasises that Sangam has understood the critical need for building a nurturing eco-system, which listens to the entrepreneur's pain points.

The above approach has also led Karthik to actively engage in the GCIP mentorship and take up stewardship roles; mostly behind the scenes but more impactful in developing a sense of community. Karthik spends a lot of his time within the clean technology ecosystem in India to help entrepreneurs get the right partners – customers, financiers, and policy makers to ensure success. Sangam is now an investor in two GCIP start-ups, Promethean Energy (GCIP 2015 global runner up) and Inficold, Inc. (GCIP 2016).

Karthik is also a co-founder of LexStart, a legal advisory services start-up and has in the past worked with Acumen Fund and TVS Capital where he supported Prof. C.K. Prahalad in developing vision for India@75. Karthik holds an MBA from the University of Chicago Booth School of Business, Masters in Public Policy & Management from Carnegie Mellon University and a B. Tech from the Indian Institute of Technology, Bombay.

Mahesh is the Managing Director & Founder of Arivali Partners where he provides investment and advisory services to for-profit social enterprises that has the potential to become USD 1 billion in value and impacts at least a million lives.

Mahesh Kanumury
Arivali Partners

Mahesh prefers to invest and work with companies that have disruptive technologies. He believes that innovation led models are key to creating large scale impact and financial success. Hence, he closely works with the entrepreneurs to help them scale and grow. He has been playing a variety of roles to start-ups including: early investor, co-founder, board member and advisor.

Clean technology is one of the major focus areas for Mahesh. On the solar front, he is investing and working with companies in concentrated solar power (e.g., path-breaking thermal storage technologies, distributed solar thermal power). Other renewable and clean technology that are of interest include: bio-fuel plantations in arid lands, distributed on-demand hydrogen, nano-technology based bio-remediation of large water bodies, waste-oil processing, "clean" diesel, to name a few. He is also on the board and investment committees of other debt and equity funds focused on social enterprises. These funds actively look at and have invested in solar roof-top/pumps, solar EPC, community clean-water and waste management companies. Mahesh brought these learnings to the GCIP programme.

Some of the other social enterprises he has been involved with include: nano-nutrients for agricultural productivity, financial inclusion for the rural poor, micro-finance and livelihood promotion, pre-cast housing for rural markets and low cost health care.

Mahesh was a General Partner at Gabriel Venture Partners, a US based VC fund. He has also worked at McKinsey in the US where he led several high-impact initiatives at the CXO level, identifying new product areas, leading more sales, driving innovative capabilities of a R&D and developing a global strategy for a Fortune 50 firm, creating a global manufacturing strategy with >USD200M/ year savings. Prior to McKinsey, Mahesh worked at Schlumberger Technologies and Research. Mahesh has an MBA from Harvard Business School, an MS in Engineering from Purdue University and BS in Engineering from Indian Institute of Technology, Chennai. Mahesh has widely travelled in North America, Europe, and Asia. He enjoys running, music and meditation. He is also an instructor at the Art of Living Foundation.

Atul Bhatia is passionate about building and supporting an eco-system for Small and Medium companies that focuses on B2B markets for technology driven products.

Atul Bhatia
Angel Investor

This passion brought Atul Bhatia to reach out to the GCIP PMU and work with the programme where he has played a key role in working with the innovators as a mentor and Angel Investor. Mr. Bhatia is currently mentoring about a dozen companies from TLab, TiE-Delhi and works with several companies from his own network. He has set for himself a target of helping 100 start-ups cross a million dollar in revenue. In the past, he founded nSys Design Systems, a software product company that he bootstrapped from start to exit. nSys became a world leader in Verification IPs and was acquired by Synopsys, the leader in Electronic Design Automation. He has strong Engineering experience having worked as VP Engineering at DCM Data Systems and IBM, Austin. Mr. Bhatia holds a BE from the Indian Institute of Science, Bangalore and an MBA from FMS, Delhi.

"The GCIP cleantech entrepreneurs that were shortlisted had one key thing in common: they were all very passionate about the technology they were working on. As a mentor, the challenge was to bring home the point that for people to benefit from the work they have done, it was necessary to market the product professionally. Another key learning was that we need to calculate the payback period of the product. The importance of payback period became so obvious when a product had to be dropped, as its estimated payback was over 10 years. Luckily another product in the same family had payback period of 6-7 months, that got the innovator following his passion."

3. Judging was pivotal in mentoring

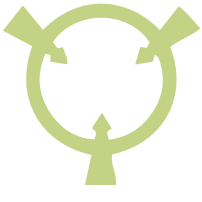
The GCIP Programme had built in three round of judging to make sure that the best innovations were selected, and mentored and would compete for the final selection of the National winner. The first round of Judging was by a Screening Committee comprising of Energy Experts who went through each application in the programme to select the best twenty innovations who would be mentored in the programme each year. The second round of Judging was by the subject experts who evaluated the teams on the subject specific worksheets. The third round of judging was by the experts who would judge the teams on the investor pitching. In GCIP India, we introduced an additional round of judging in the form of a jury which comprised of some very eminent subject experts of the Innovation ecosystem in the cleantech space with the intent to showcase the best teams of the programme to these people who could bring the much-needed validation to the Programme and the teams by selecting them after a close scrutiny. We bring you the profile of a few of these people to give you a flavour of the richness of the expertise of the members who helped us deliver this programme successfully. All these experts who helped us in various judging activities had a common underlining agenda of mentoring too.

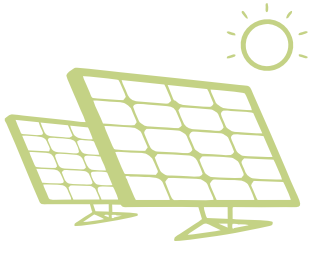
a. The Screening Committee who sought the best

Dr. Bibek Bandyopadhyay is the former director of the Solar Energy Centre, the solar institute of the Ministry of New and Renewable Energy, Government of India.

He started his career in solar energy at the Indian Institute of Technology, Delhi. He served at the Department of Science and Technology and Ministry of New and Renewable Energy (MNRE), Government of India in various capacities for more than 31 years. As a science administrator, he handled a number of national and international programmes related to new and renewable energy. As one of the senior most Advisers of the Ministry, Dr. Bandyopadhyay was associated in the formulation and implementation of the Jawaharlal Nehru National Solar Mission. So when the PMU had to select a chair for the screening committee in 2015, the credibility of Dr. Bandhopadhyay was real strong and brought immediate acceptability of the selection by the experts!

Bibek Bandyopadhyay
Screening Committee Chair 2015





Mr. Anil Dhussa is the former advisor of Ministry of New and Renewable Energy, Government of India who was the Screening Committee Chair of 2016.

Anil Dhussa
Screening Committee Chair 2016

He headed the Government of India programmes on Biogas, Biofuels, Waste-to-Energy and Hydrogen energy, besides coordinating R&D in various renewable energy domains. Earlier he worked as Director for National Programmes on Biogas, Biofuels and energy from urban, agricultural and industrial wastes. He also worked as National Project Coordinator of the UNDP/GEF assisted project on Development of High Rate Biomethanation Processes as means of reducing Green House Gases Emissions. He holds a Bachelor of Engineering (Chemical) from Indian Institute of Technology, Roorkee (formerly University of Roorkee) in the year 1977. He chaired the Expert Committee on R&D on biogas programme of the Netherlands Development Organisation and was a Co-chair of the Agriculture Sub-Committee of the Global Methane Initiative of the US DoE for about five years.

Dr. T.S. Panwar is the Director, Climate Change and Energy programme at WWF, New Delhi since November 2010.

Dr. T.S. Panwar
Screening Committee 2015, 2016

He has research experience of 29 years on energy-environment. He was the former Director of energy environment policy division at TERI where he supervised multi-disciplinary team of researchers. His key areas of work include Energy-environment policy, Environmental impact assessment/environmental management plans, Air pollution and Climate change. He also supervises the WWF Climate Solver programme that is a global initiative to strengthen the development and widespread use of innovative low carbon technologies. He Holds a Ph.D in Air Pollution Modelling from IIT, Delhi.

An innovative programme that provides an ideal platform to small-scale entrepreneurs to show-case their inventions and find an opportunity to interact with the potential investors. The hand-holding support provided under the programme facilitates development of an entrepreneurship ecosystem that helps the entrepreneurs in streamlining their energy in the right direction.

Sachin Kumar, Sr. Fellow, TERI Screening Committee Member

GCIP is a unique platform that provides valuable mentoring support to startups and innovators. I sincerely hope such initiatives should continue in the area of clean technologies. It has been very useful and informative for me to be associated with this programme as one of the panelists in the preliminary round of shortlisting for the last two years.

P.R. Basak, PhD, Scientist-F, TIFAC Screening Committee Member

b. The Judges who cared too!

Poonam is the General Manager at IFCI Venture Capital Funds Limited, a premier venture capital organisation and a subsidiary of IFCI Limited.

Poonam Garg
Judge 2015, 2016

She brings more than 20 years of experience in the Private Equity/Venture Capital industry. She is presently the Fund Officer of Green India Venture Fund, India Enterprises Development Fund and Venture Capital Fund for Scheduled Castes with a total corpus of about Rs. 568 crores. GCIP was very keen to have her in the programme because she has successfully deployed the corpus raised from about 39 investors in various companies. Over the years, she has analysed more than 400 companies working in the SME sector. She could successfully manage to exit from portfolio ventures with returns of more than 20% IRR through OFS in the IPO, through induction of strategic investor etc. We thought that if she was part of the programme she will bring and share this vast domain experience which included fund management from commencing to closing of fund, lead the team doing investor relation management, project appraisal, monitoring, value addition, scanning environment for new developments in different sectors, and valuation of portfolio with the teams – an area which is most critical to a SME. She for two consecutive years helped the GCIP PMU on evaluation of the worksheets of the team and also evaluating their pitches.

Unni is an Assistant Professor at the Public Policy and Management Group, Indian Institute of Management Calcutta prior to which he was Assistant Professor - Intellectual Property Law, NALSAR University of Law, Hyderabad.

V.K.Unni
Judge 2015, 2016

His areas of research interests are Intellectual Property Law/Intellectual Property Rights (IPR), Legal & Regulatory Framework of Business Transactions, Capital Market Regulations including Takeover Code, IPO Regulations-ICDR, Delisting of Securities, Legal and Regulatory Aspects of Private Equity/ Venture Capital Funds, Contract Management, FEMA Regulations/ Law, Law dealing with Mergers and Acquisitions, Joint Ventures etc. He has coordinated /consulted on various programmes dealing with Intellectual Property Law, Banking & Finance Law sponsored by Microsoft Corporation, Reserve Bank of India, Herbert Smith LLP, Munich Intellectual Property Law Center, National Academy of Agricultural Research Management (ICAR). He has been awarded Max Planck India Fellowship for the term 2008-11 by Max Planck Society, Germany (first and only awardee outside the stream of natural sciences) where he did research on Indian position dealing with Protection of Know-how cited by the European Commission. GCIP was very keen to have an IPR expert and what better credentials than of Mr. Unni! Unfortunately Mr.Unni could not join us for the events but very enthusiastically did the worksheet evaluation of the teams and provided mentoring comments to the teams individually.

Shyam is an Investment Director at Infuse Ventures, Bengaluru, Karnataka and has been an entrepreneur, climate policy analyst and venture capitalist in the space since 2001.

Shyam Menon
Judge 2015, 2016

His experience in the energy sector included investment management roles at Conduit Ventures, a corporate backed early stage energy venture capital fund in London and Nadathur Holdings, a family investment office in Singapore. At Conduit Ventures, Shyam evaluated and invested in startups operating in the areas of energy efficiency, energy storage and emissions control across Europe. As part of the Energy Sector Management Assistance Programme (ESMAP) at the World Bank (2005-2007) in Washington DC, he worked on Carbon Finance methodology development and techno-economic analysis of energy use in India and China and as a member of the China Energy Group at Lawrence Berkeley National Laboratory in California (2004-2005) and addressed topics around low carbon technology penetration in the transportation sector in China. Shyam holds a Masters in Materials Engineering from the University of Missouri, Bachelors in Metallurgical Engineering from National Institute of Technology (NIT) Nagpur, India and advanced energy policy studies from the University of California. As Investment Director/ Co-founder at Infuse Ventures, the first Cleantech focused early stage venture capital fund in India he actively works with entrepreneurs focused on building scalable businesses in the areas of energy, water, waste management, sustainable agriculture, and transportation. So the PMU thought he was the best resource to evaluate the investor pitches of the teams in the programme but what was surprising was the ease with which we were able to rope in Shyam despite his busy schedule. It was the experience of working with Shyam that dispelled many of the fears of the PMU to approach investors in many other events in the following years. So we owe a big thanks to Shyam for all the support!!

c. The eminent Jury who blessed too!

When the GCIP programme was launched in India, we were looking for a person of such depth and stature on the subject such that his very presence will lend credibility to the new programme and get it necessary traction.

Dr. Prodipto Ghosh, a Distinguished Fellow and Director at TERI presently, was our first choice as he has been involved in research and teaching the interface of science, economics, philosophy, and public policy.

Dr. Prodipto Ghosh

Dr. Ghosh was gracious enough to give his patronage to the programme and agreed to chair our first jury selecting the National winner. He has vast experience as a member of the Scientific Advisory Council of the Cabinet, and Governing Council of the Indian Council of Social Science Research, member of the National Security Advisory Board, PMs Council on Climate Change, G 20 Advisory Group of the Ministry of Finance, and the CAGs Audit Advisory Committee and retired as Secretary, Ministry of Environment and Forests in 2007. He has also held the positions of Senior Environment Specialist at the Asian Development Bank, Manila. He was a member of India's negotiating team at the UNFCCC climate change negotiations from 2001 to 2012. He has a Ph.D. and M.Phil in Economics and Policy Analysis from the Carnegie-Mellon University, Pittsburgh, and a B.Tech in Chemical Engineering from IIT Delhi. He is also the recipient of the BP Pal Centenary Memorial Award.

Mr. Anil Razdan was one of our esteemed jury members in the programme.

Mr. Anil Razdan

He is presently the Chairman of the Energy and Environment Foundation (E2 Foundation), which is a not-for-profit, non-political, neutral and independent, non-governmental organisation (NGO), focused towards helping billions of poor people world over who presently have little or no access to electricity and other basic energy sources. Mr. Razdan brings the rich experience of policy making as a member of the prestigious Indian Administrative Services to the field for effective planning and execution in the private domain. His tenure as Secretary Power (2007-08) saw many path breaking initiatives and activities heralding a paradigm shift in the scale and width of energy planning and operations. There was capacity addition of nearly 60,000 MW as against previous capacity addition aggregates of just 20,000 MW over five-year plan periods. He piloted the new Hydro Power Policy 2008, the Revised Rajiv Gandhi Grameen Vidyutikaran Yojna 2008 and many such new initiatives in the year. He has also led various delegations at international fora, including International Energy Agency and World Energy Council on energy and climate change issues. He has worked as government nominee on may power sector PSUs and is still working as Independent Non-Executive Director on many public sector undertakings like MMTC Ltd, Hindustan Petroleum Corp. Ltd., ONGC, Gail India Ltd., and Indian Oil Corporation etc. Mr. Razdan is an alumnus of St. Stephen's College, Delhi with a B.Sc. in Physics and has a law degree from the Faculty of Law, Delhi University.

Dr. Saurabh Srivastava is one of India's leading entrepreneurs and institution builders.

Saurabh Srivastava

He is widely acknowledged in India and globally, as one of the architects of the Indian IT Industry and for leading the creation of a vibrant entrepreneurial ecosystem in India. He is a cofounder and past Chairman of NASSCOM, NASSCOM Foundation and the Indian Venture Capital Association, Chairman Emeritus of TIE Delhi-NCR (was on the global board of TiE) and as member on the National Executive Committees of FICCI (was also on CII Executive Committee). He worked in the US and India for IBM and headed the Tata Unisys software operations before becoming an entrepreneur, founding several successful IT companies. He has since founded/invested in over 50 startup ventures and serves in a non-executive capacity on boards of both private and publicly listed companies in the UK, Singapore, and India such as YES Bank, Naukri.com, etc. He co-founded India's first and extremely successful Venture Capital fund in the private sector, Infinity, which created companies such as India Bulls and Avendus. He also founded the Indian Angel Network (IAN), India's first and possibly the world's largest business angel group with over 350 members, comprising the who's who of successful Indian entrepreneurs and CEOs, with operations in 7 cities, including London. He launched the London Chapter jointly with PM David Cameron at 10 Downing Street. IAN has invested in over 100 startups. He has a Masters from Harvard University and a B.Tech from the Indian Institute of Technology (IIT), Kanpur. Getting Dr. Srivastava onto the programme was one of the achievements of the GCIP PMU because he represented the space of the entrepreneurial ecosystem which is most difficult to navigate i.e., the funding. Not only did he grace the programme but also validated the quality of the participation in the programme by offering a term sheet to all the six finalist whom he saw pitching in the jury round.

VI Running the GCIP Programme - PMU Experiences

1. Mentor Connect

Amrit Raj

The Mentoring Programme is a key component of the Cleantech Open Programme of USA which was adopted as it is in the GCIP. The mission of the mentor programme is to associate each team with a Mentor who can take ownership of the team and handhold them in understanding the innovation ecosystem better contextually. The mentors because of their vast experience help the teams understand and maximise their chances of being prize winners, of raising investment capital, securing customers and of achieving sustainable commercial success. Mentors and teams are matched based on their skills, industries, technologies, and regions viz-a-viz the team profiles. Every year applications are invited for the best innovations as well as mentors online through the Cleantech Open website. In India our experience of the online applications was not very satisfactory so the key players/stakeholders of the industry were also approached by the PMU to nominate suitable people who could commit and devote time as mentors since in India mentoring was purely a voluntarily exercise.

There were broadly two categories of mentors – Specialist Mentors and Generalist Mentors and their experience ranged from being experienced Start-ups, consultants, Venture Capitalists, legal experts, Scientists, Government officials and Service providers in the sector. Generalist Mentors were experienced professionals with proven records of success in leading early stage businesses. They become an integral part of the team providing

coaching and feedback for final deliverables such as the investor pitches, financial models, and summaries. Specialist Mentors were subject matter experts in the technical area who acted as resources for one or more teams in the Accelerator. In 2016 a new category of mentors known as "Scalability Mentors" were introduced who were brought into the programme to get the companies the right scalable connects. In addition, a Mentor Chair was designated this year in form of a highly-experienced expert, Dr. N.P. Singh, ex Senior Advisor MNRE, Government of India and presently Senior Technical Advisor to UNIDO, who was able to get many experienced mentors enrolled into the programme.

The list of shortlisted mentors specifying their specialisation and achievements was circulated to the semi-finalists and vice-versa. The first cut of mentor matching was done based on the choices of the teams and mentors but the final matching was done after the national workshop where all the people who enrolled in the programme had a face-to-face interaction. In the national workshop, the teams got to meet all the mentors and both were given an overview of their detailed role and expectations. A mentor coaches teams through all important deliverables, provides feedback on all aspects of the business to ensure that the assigned teams meet all deadlines, provide expertise in key functional areas which may include but are not limited to Finance (finance modelling, P&L development, financial performance benchmarking), Marketing (positioning statement, pricing, value proposition development, Engineering (product development, architecture, innovative designs, design for manufacturing), early stage fund-raising, Intellectual property, Human resources, Digital and online presence and Interaction with university and national labs (technical validation).

In India, mentoring was a very interesting exercise. The mentors were very enthusiastic and greatly appreciated the effort of the programme to fill in the mentoring gap as they had had no such support in their days but we had a very busy set of teams who were finding it very hard to connect with the mentors due to paucity of time. The mentors showed tremendous patience and indulged the teams at their pace but as expected in the end the inputs and

"Innovations mostly bloom in small budget companies and not in big corporates, therefore, programmes like GCIP are very relevant in all big industrial economies."

N. P. Singh
Mentor Chair, 2016

Dr. Nand Pal Singh is a Senior Technical Adviser at the UNIDO Regional Office for South Asia, New Delhi. He has 33 years of experience in policy making as officer in the Department of Non-Conventional Energy Sources, now Ministry of New and Renewable Energy, Government of India. He was Group Head of Small Hydro Power, Biomass Power Cogeneration, Waste-to-Energy Group, Information and Public Awareness Group and Energy Parks. He was also Director General of National Institute of Solar Energy and Director of National Institute of Bio Energy. He has contributed in over 50 research papers on solar energy and bio-energy in leading national and international journals/conferences. He has written three Books/Reports on Solar Energy and Biomass Energy. Dr. Singh was awarded an honour of Senior Adviser by UNIDO International Centre for Solar Technologies, Hangzhou, China.

the support given by the mentors were valued by all. There were in all over 100 people who filled in the role of mentors at different times like the screening committee members, the exclusive mentors, the judges and the jury members who all gave mentoring comments and feedbacks to the teams, which were promptly shared with the teams, at every stage.

The mentors also helped the PMU at all stages to make the programme a success by suggesting the right resources, by giving the right connect to the teams, by encouraging the teams and by showing full support to the programme just by being around. This programme would not have been complete and successful without the rich experience of the mentors who added so much meat to all the discussions in the entrepreneurial and technical space.

2. Cleantech Open Webinars

Rishabh Goel

Today, where competition is both unknown and immense, start-ups need guidance that is global yet targeted. This has been the approach of Cleantech Open USA (CTO), which has been GCIP's knowledge partner for the past 3 years. CTO, through its highly informative and interesting set of webinars has left a substantive impact on the innovators and the mentors. These webinars, as the name suggests are a web-based integration of ideas and people, which is meant to bring together expertise, experiences, and problems of cleantech start-ups, thus, creating a virtual ecosystem of the important stakeholders.

Rishabh Goel

The yearly-drill was started by the Cleantech Open and the PMU structure to plan the competition, the timelines for the programme and strategies were adopted, besides sharing of experiences among participating GCIP countries of the previous years' experience etc. This helped the PMU devise the execution of the programme in more creative and competent ways. A series of webinars were conducted twice a week for the semi-finalists, where the local mentors were also encouraged to participate. These 20-25 webinars were spread over a period of three months. A Natioal Workshop was conducted each year to introduce all the teams and mentors to the programme contours, especially the webinars and the worksheets. We, as PMU, made sure that the semi-finalists attended these webinars by taking a headcount on WhatsApp groups and sending e-reminders. The webinar attendance also had a weightage of 10% in the final evaluation. The programme also expected the teams to work on eight to ten worksheets that were also evaluated for selection of the national winner. These worksheets were discussed in detail in these webinars.

The semi-finalists while interacting with us on a personal level had expressed some dissatisfaction with this weekly exercise. Most of this discontent was because of regimentation that was necessary, something like the college years. At the end of the programme, we, the PMU received some great feedback from the innovators on the quality and the practical learnings from these webinars. As these webinars are linked to the worksheets that the semi-finalists had to submit as a part of evaluation process, the webinars made the work easier and more comprehensible.

The webinars and worksheets were structured around the analysis of business models and the validation of these business models on various aspects such as legal, financial, technical, commercial, etc. Starting from revisiting the pain-point or problem that the semi-finalists were addressing through their technologies or products, to revamping their go-to market strategy, the webinars forced the semi-finalists to restructure their business models. The business model validation exercise proved helpful to the start-ups as most of them were students of engineering who had not been trained much on the social and commercial aspects of taking an innovation to the market.

The webinars also provided an opportunity for interaction with GCIP alumnus and mentors from all

Kevin Braithwaite
VP of Global Programmes, CTO, USA

Kevin leads the Cleantech Open's partnership with UNIDO to launch the GCIP cleantech accelerators around the world, including Armenia, India, Malaysia, Pakistan, South Africa, Thailand, Morcco, and Turkey. Kevin works with a wide stakeholder group across the world to run the CTO, the largest accelerator programme for cleantech entrepreneurs.

Kevin has founded and built several companies, encompassing both service and product based ventures in multiple technology sectors. He has been a valued advisor to early stage technology investors, startups, corporations and universities around the world. For many years, he worked with the venture incubator at the University of Cambridge, where he mentored, trained, and supported young entrepreneurs. Kevin holds an MBA from London Business School.

the GCIP countries. This enabled not just exchange of ideas but also contacts and networking which is a crucial component of any successful business. Some comments and feedback we received from semi-finalists, which were shared with the CTO. The success and the relevance of the webinars is evident from the fact that in 2016 programme there was over 80% attendance in general while some teams had 100% attendance.

3. Business Clinics for Semi-finalists

Ananya Pandey

The PMU held the 'Business Clinics' to identify the pain/problem points faced by the shortlisted semi-finalists of GCIP such that the mentors could be brought in to address the issue. While saying this, the attempt is not to sound self-congratulatory; instead it is to show that in the process of interacting with such bright and enthusiastic entrepreneurs, the PMU and the mentors also learned a thing or two.

The logic of business clinics was that many of the semi-finalists expressed certain concerns and shortcomings that hindered their ability to optimise on their previous interaction with the mentors. The reason for such shortcomings ranged from inhibitions on their end; lack of clarity on expertise of mentors; inability to structure queries; inability to understand the exact problem area; long distance format of mentor interaction etc. The mentors also raised concern about the lack of communication from certain semi-finalists. For this reason, the Business Clinic was organised as an effort to streamline the mentoring requirements and queries of semi-finalists in the form of one-to-one discussions with mentors.


Ananya Pandey

The PMU organised two business clinics at two important cleantech hubs of the country- Delhi and Bangalore. Owing to the geographical spread of our innovators ranging from Mohali in the North of India

to Kozhikode down South, we divided the semi-finalists based on northern and southern regions.

The Business Clinics were preceded by a month of spadework on the part of PMU in executing a "requirements capture" exercise based on the requirements and expectations of innovators and profiling of their products/technologies. The information was collated in the format of business model validation provided by Cleantech Open USA, the knowledge partner of GCIP. These were circulated to the select mentors before the sessions were held so that they could refer to it while discussing specific issues of the innovators. The set-up of the business clinic was such that mentors were grouped into 7-8 groups of one to two mentors in each group. Each semi-finalist had at least five one-to-one sessions, each lasting an hour, with the mentor groups allocated to him or her. The requirements capture exercise was utilised in these sessions to give appropriate shape and direction to the content of the mentor-semi-finalist interaction. The motive was to fill in the gaps in the innovators' mentoring needs by resolving or atleast touching upon issues that are crucial for the progress of the semi-finalists.

While the PMU was apprehensive in the beginning, the sessions saw intensive and engaging hour long discussions take place between the semi-finalists and mentors. Often the enthusiasm on the part of mentors were so contagious that many of them did not budge even during tea-breaks, as they were so engrossed in the discussions with semi-finalists (assigned to them).

Apart from the knowledge that the semi-finalists garnered from their interactions in the one-to-one session, the mentors were also requested to share feedbacks which were shared with the semi-finalists later so that they could refer to it in future and indulge in correctives as well. At the end of the session, PMU also received several feedbacks from mentors and semi-finalists that boosted our confidence but also helped us identify the scope of improvement and improvisation for future events or programmes.

Mentors reflections on the Business Clinic

Niranjan Kathri: "Enjoyable. I am learning too"

Vibha Tripathi: "People might need support for specific area. Maybe more intense handholding can help."

4. The Investor Connect

Ananya Pandey and Rishabh Goel

Investor Connect, in a way, marked the climax of GCIP as investor pitching is one of the crucial components of the programme- so much so that the semi-finalists were trained and evaluated on their investor pitch. The PMU organised the first round of investor connect in 2015 programme, wherein it was incorporated as a part of the National Selection Round. The investors were invited alongside the judges to hear out and provide feedback on pitches of our innovators. Further, based on the experience and feedbacks, the PMU held a separate Investor Connect event for the 2016 programme, which consisted of one-to-one interactions based on choice-list of investors.

The investor-connect unfolded with initial round of introductions by the investors, GCIP innovators and the rest of the team. After this, the innovator-investor dialogues were held in 15-minutes slots for each interface. About 11 investor organisations participated and around 60 one-on-one interactions were conducted. Most investors were mainly from pure venture capitalist investments, primarily interested in good patents and viable technologies. Others included those who were handling debt and equity; YES Bank offered debt-cum-venture funding; while others like TIFAC offered soft loans (at 5% interest) promoted by the government.

The feedbacks provided by investors for the semi-finalists showed that almost all GCIP innovators were well-prepared with their pitches. Many investors found the winning pitches very crisp, but wanted specifics of the technology. Almost all investors indicated their interest in following up with most innovators. The semi-finalists were also appreciative of the event as it not only helped them connect to the investors but also served as a real assessment of their pitch and product.

The investor connect exercise highlighted that it was necessary for the PMU to understand beforehand the kind of funding provided by each investor vis-a-vis the kind of funding that each innovator was looking for (debt, equity etc.). Even if equity was available, not necessarily all cleantech VCs supported startups in a similar way. The ticket size of the investment that a VC firm/angel offered made an impact as the investment requirement among the participants fluctuated from USD 50,000 to USD 10 Million. Also, the VC investments varied from pre-series to series B, depending on whether the company had a proven business model or a commercialised product. The interest in the cleantech areas for a firm or a bank also had crucial role to play as some were restricted to sustainable technologies or simply solar based, while others were open to automotive, water purification, healthcare etc., where cleantech interventions were developed. So, the PMU learnt that if such a mapping is done prior to the investor connect it would have been more effective and result oriented. They integrated these experiences and learnings in the final investor connect for the programme.

5. GCIP India Partners

The Federation of Indian Chambers of Commerce and Industry (FICCI) was the initial implementing partner in 2014, given their diverse innovation programmes and collaboration with the Government of India and various national and international agencies. Besides being the implementing partner, FICCI also supported the GCIP in mobilising diverse stakeholders, mentors, cleantech investors and others.

The Alliance for an Energy Efficient Economy (AEEE) is an industry association of energy efficiency companies. In 2015, GCIP brought AEEE collaboration for engaging the SME clusters. The objective of reaching out to the SMEs and their associations was to bring their participation in the GCIP programme as innovators and mentors. Also, GCIP was promoting these cleantech innovations such that they find takers among the SMEs.

National Research Development Corporation (NRDC) does technology transfer in India and undertakes number of activities for advancement of research and promotion of inventions and innovations such as meritorious inventions awards, techno-commercial support, and technical and financial assistance for IPR Protection. In 2016, NRDC was brought in by GCIP for technology and physical verification of the shortlisted semi-finalists selected by the programme.

6. GCIP India Collaterals

GCIP India brought a **compendium** on Innovators in 2015 and in 2016. The Cleanovators 2014-15, on GCIP innovators from 2014 and 2015, is an e-book that demonstrates how Indian MSMEs are buzzing with cleantech ideas and innovations, and showcases that the GCIP has had considerable impact in creating a sustainable innovation ecosystem to nurture ideas and prototypes. The Ministry of MSME and the UNIDO has hosted the e-book at their websites. Similarly, a UNIDO movie is available on GCIP activities in India at the UNIDO India website.

In 2016, the PMU brought a more detailed compendium of GCIP Innovators of 2016 and an e-book that showcases the innovator, the technology and the key business and technology pitches.

The GCIP PMU also got nine semi-finalists' stories made into short films. As advised by the DC-MSME, these 2-3 minute videos try to capture the innovation, inspirations, and the impact besides the ecosystem challenges they endured. The idea behind the short films was to highlight interesting cases, where innovators despite their struggles and challenges have managed to bring forward their innovations. The innovator's drive and zeal to make a cleantech impact is what the videos are about. The PMU promoted the GCIP events and innovators actively on Twitter and Facebook.

7. Musings from GCIP India

GCIP Team 2015

"GCIP is an excellent programme for budding entrepreneurs like me. It has helped me in developing holistic approach towards business development. The programme has brought together various experts onto a common platform which helped us significantly. The best part is the mentoring activity."

- **Karthik R.B. Aamanchi**
Aarshadhatu, GCIP 2016

"It is critical to have complete clarity on the product or service which is central to your business – why is it required, its functionality and its architecture. The product or service must either solve a customer's pain-point or meet an unmet need. In addition, a concept or idea is not enough – the investor needs to understand how the product or service works, what is its architecture and application. It therefore becomes imperative for an entrepreneur to have a good understanding of the target customer, why they need it, and how the need is being met currently."

- **Padmaja Ruparel**
President, Indian Angel Network

"Real disruptions happen in most unexpected places by unknown people who dare to follow their dreams. The beauty of the GCIP programme is to identify those dreamers and give them an international platform to show their talent and ideas that have potential to disrupt the business as usual ways."

- **Sudhir Kumar Singh**
Energy Expert, UNIDO, Mentor 2015

"Before the last date of submission of worksheets, its feeling like back to college days...last couple of days to submit the assignments so mug all the night."

- **Tanmay Pandya**
Bridgedots

"The best thing what I have seen in GCIP is that it has been 3 years still there is wonderful interaction between GCIP team and contestants. It always feels good talking to them and getting updates for upcoming events and programme. The whatsapp group created has given a full-time communication with our fellow contestants. They are the one who are still holding us as a team."

- **Brijesh Maurya**
Bhavin Mehta & Shashikant Maurya

"Thanks Hari bhai for your help, you can be a mentor in this programme and very soon you can run for elections. We all are winners..... NO one can take that away from us."

- **Ankur Narula**
Jet Group

"The only way is to swim ourselves. During the 1st workshop in July 2015, Rex asked about my expectations and I bluntly told nothing."

- **Gurinder Jeet Singh**
DEN Energy Efficiency Team

"One cannot do fishing without wetting his hands. "Nice to see all the web interactions, some are going great lengths. We all will make it up to end"

- **Noby Joseph**
Team Millennium

"Tender participation for MSMEs is the most important part also the ability to match L1 and get 10% of tender business ensured."

- **Amit Soni**
WR600

"Thank you so much everyone!! I see GCIP as more of a collaborative platform rather than a competitive platform. And due to this there is a lot of opportunities that I will be sharing with all of you once I return. Actually I see all of your teams have more possibility to reach the finals than mine as your teams are all much established unlike my few months old startup. All our GCIP teams working collectively can bring more impact in India, rather than individually. Wish you all the best and look forward to our next meeting"

- **Arun George**
Avant Garde

"I would love to help you to take the bull by the horn...breaking monopoly and biased practices... I don't know how. I have been facing stiff challenges in growing my own business in the private sector, but always kept going and going...if we do our best always, ways will open. Being at GCIP is a result of that, and firms my belief to believe in ourselves and continue to do what we do best. Only time taught to become more "street smart" and find the way around."

- **Manish Kothari**
Multiflex

"GCIP is a very powerful platform for SME innovators. It made us understand the SME sector much better and paved a smoother way to collaborate with other innovators. The UNIDO team has been extremely professional, efficient and helpful. I wish the team all the best and looking forward to more interaction."

- **Chintan Soni**
Ecolibrium Energy

"We thank GCIP programme for boosting our confidence through conducting webinar training and two days workshop at Delhi. Recently, my daughter- Shravani Ladkat, received the prestigious Young Scientist (Junior) Award for her project 'Study of Grain stored at Hot and Cold Storage' and has been sanctioned INR 30 Lakh Millennium Alliances Grant. Through this grant, we are developing a Hot and Cold Storage model for farmers, government and private sector. Our Technology transfer for bakery, sweet mart and snack centre segment is in progress. At this stage, we are confident to take this clean-technology global within two years."

- **Rajendra Ladkat**
Freezcool

GCIP Team 2016

"I truly appreciate the endeavour of GCIP & UNIDO. It's very commendable the way topics have been covered in details through series of webinars and didactic interactions with the learned speakers as well as mentors. GCIP's views on developing an efficient marketing strategy and its execution have really broadened our horizon."

- **Amit Mitra**
DNV

"Technology validation would really help to raise funds from VCs or Banks. We are also trying to get independent and 3rd party test data from universities and government organisation for better chances."

- **Nitin Goel**
Inficold

"Greenvironment Innovation & Marketing India (P) Ltd., is profoundly grateful to UNIDO for giving us an opportunity to be part of their GCIP 2016 – India by getting our innovation selected in the 'Water Efficiency' space. The five month long most captivating workshops, webinars and video presentations immensely helped us to understand our product and business model in depth through the process of validation at every stage. We were able to redefine our business strategy and learn the art of fundraising to move forward and are now very optimistic about the success of our venture. Thanks again UNIDO and all those associated with GCIP 2016 India."

- **Latha Kannan**
Greenvironment Innovation

"Nested interest with deep pockets does not want to give away their interests. Fight for your technology – you will win. Super coordination between all of you. Could not be a part of this but reading all the exchanges was an eye opener – lot of innovation."

- **Mohan Rao**
GCIP 2015

Hard-up startups come up with unique energy efficient products

By Sourabh Gupta - Excerpts from Economic Times Magazine Special Report on the GCIP India Programme, published on 20-November-2016

Manoj Meena

Founder, Atomberg Technologies
Mumbai, 2012

INNOVATION:

Claims to have made India's most **energy-efficient ceiling fan,** reducing power consumption by 65% compared with ordinary fans; over 10,000 units have already been sold, says the startup.

Funding Needed: ₹4.3 crore for working capital

Karthik R.B. Aamanchi from Guntur, Andhra Pradesh, is looking for an investor. At a five¬star hotel in Delhi, the young engineer moves from table to table, explaining to 12 investors why he needs to urgently raise Rs. 20 crore to test and execute his startup's first order from Krishnapatnam Port. His venture Aarshadhaatu makes nanocopper using a secret herbal mix, a patented process that investors exclaim could be "magical".

His presentation, honed by months of mentorship at an accelerator, is detailed and smooth, listing long¬term revenue projections and competitive advantage: the organic coating can prevent ships from corrosion and fouling. The pitch's effect on the manager of a private equity fund run by a conglomerate is immediate. After a 10-minute chat, he asks for the startup's valuation. "The product (nanocopper) is disruptive. It is something you wouldn't have heard of," the fund manager tells ET Magazine later, asking not to be named.

Manish Kothari

Founder, Multiflex
Anand, 1996

INNOVATION:

This SME **users hydraulics instead of compressed air in high-pressure moulding machines.** The standalone machine, claims the company, reduces energy consumption by 30-50%, cuts noise pollution, improves quality and saves energy.

Funding Needed: ₹50 lakh to increase production

Like Aamanchi's nano¬copper, there are 15 such award¬ winning innovations, most of them first of their kind globally, vying for investor attention. The clean technology products either use less electricity or turn waste into energy, or run on the sun. Each innovator takes turns speaking to investors, including Yes Bank, Tata Capital Innovations Fund, Indian Angel Network, Villgro Innovations Foundation and Blume Ventures, all of which are looking for their next bet among these early stage ventures.

What brought these innovators together in Delhi in the third week of October was an exhaustive selection process that began several months ago by the United Nations Industrial Development

Varun Sridharan

Cofounder, Greenvironment Innovation and Marketing, Chennai, 2012

INNOVATION:

Uses Internet of things based **real-time monitoring and reporting system for treatment plants** for water security and safety.

Funding Needed: ₹1 Crore to cover expenses and increase sales.

Organisation, the Ministry of Micro Small and Medium Enterprises and FICCI, with funds from Global Environment Facility to find India's finest clean technology innovations. Sixteen were picked from nearly 200 applicants and given four months of intensive mentorship under the Global Cleantech Innovation Programme (GCIP).

These 16 startups and small enterprises were grilled by a panel of judges that included investors and green tech experts. Eight were shortlisted, and eventually a jury chose two winners who will compete in the Global Cleantech Open in Silicon Valley early next year. Aamanchi, the nano¬copper maker, did not make the final cut.

Karthik R.B. Amanchi

Co-founder, Aarshadhaatu, Guntur, 2011

INNOVATION:

Nano-copper for developing anti-fouling and anti-corrosive coating for ships; and anti-bacterial fabrics; replaces conventional process of producing nanoparticles with economic, energy-efficient and eco-friendly process with technology validated by IIT-Madras, IIT-Bombay, NCL-Pune and BHEL.

Funding Needed: ₹20 crore to scale up

Nitin Goel

Founder
Inficold India, 2015

INNOVATION:

Plug-and-play solution for conventional AC and refrigeration systems to store electricity in low-cost materials such as ice; technology is now being integrated for cooling milk and cold storages; claims to have 10 times less capex and higher life cycle than lithium ion batteries.

Funding Needed: ₹16.6 crore to scale up the technology

The chance to shine globally went to Green India Building Systems and Services (GIBSS), a Mumbai startup that sells a unique geothermal heat sink to make air conditioners power¬ efficient; and to Cellzyme Biotech from Coimbatore that uses an engineered enzyme to make antibiotics at room temperature without any toxic materials.

Where are the Funds? These cleantech startups are a far cry from the internet¬ or mobile app-based ventures that pull in millions of dollars in equity funding. What these ventures ask for in funding are modest amounts so that they can start mass-producing the products while also serving the larger goal of reducing carbon emissions and fighting climate change. Unlike the online marketplaces or aggregators that have Indianised successful foreign models, most of these innovations are India specific,

patented and validated at labs in the country's top universities and tech institutions, including IITs. Taking a break between investor meetings, Nitin Goel, cofounder of Inficold, which claims to be the world's first refrigeration system where electrical energy is stored as ice, calls the preference of investors for e-commerce startups, ride hailing apps and social networks over real inventions as "the capital light era". "Facebook made tonnes of money without capital."

Sunish Issac

Founder
Timers N Saver, Kozhikode

INNOVATION:

Timers N Saver is a **Sunrise and sunset timings are pre-programmed in device** to turn on and off streetlights.

Funding Needed: ₹1 crore

That is the new terminology among startups — be capital light. VCs want startups to be feather¬light so that capital investment is not required," says Goel, an IITian with a PhD from the University of Florida, who developed the refrigeration product with US based Himanshu Pokharna.

Patented in the US, Inficold, however, has not had a bad run so far, with many AC manufacturers showing interest in its unique refrigeration system. Meanwhile, Dhaval Thakkar from Vadodara is pitching to a lender from Mumbai about his invention: the world's first portable cooking solution that captures solar energy in a high density portable, thermal storage system and becomes a hotplate for cooking. The founder of UNesar tells the investor that his solar stove has received an R&D grant from the ministry of new and renewable energy and about his plans to scale. They agreed to meet again.

Thakkar, who left his job in GE, used up his savings and borrowed money from family to develop the solar cooker, says: "This is a dis-ruptive solar techno-logy suitable for remote and rural areas with energy supply challenges. It can provide 24x7 indoor cooking." Cleantech startups need investor support, says Karthik

Dhaval Thakkar

Founder,
Unesar

INNOVATION:

Dhaval Thakkar's product is world's first **solar-based indoor and portable cooking and heating system;** it can be used by army and rural urban homes.

Ramesh Kumar Nibhoria

Founder, Nishant Bioenergy
Zirakpur near Chandigarh

INNOVATION:

The biomass pellet-run cooking stoves & burners for commerical kitchens and micro industries save fuel cost and replace fossil fuels.

Funding Needed: ₹10 crore for 10 biomass pallet plants.

Naveen Kumar

Founder, Aquivio
from Varanashi

INNOVATION:
The product is a **semi-permeable membrane (reverse osmosis) to make water portable.**

Funding Needed: ₹2.3 crore

Chandrasekar, CEO of Sangam Ventures, who mentored some startups. "A lot of them are working on significant pain points faced by Indian consumers and industries. These have a great long¬ term, secular growth story where the opportunity does not go away like in e-commerce, as soon as the top player emerges or gets acquired." He says these ventures can provide great returns and exits to investors and become high¬ growth SMEs. Sangam Ventures is among the few funds in India that support clean energy innovations. But raising funds for an early stage, cleantech product startup is not easy. "One thing that goes against cleantech companies is the long gestation period. It takes six months to one year for a B2B (business to business) startup to secure an order, where they test it out for some time. Then it will go to procurement. So from the investor point of view, you know that the product will take a long time to adopt," says a PE fund manager, who did not want to be named. "But once the innovation is adopted, it will grow very fast," he adds. "The same thing then works in the investor's favour. So when the firms have reached a certain stage and a bigger scale, that is when investors would be interested. For initial stages, they will need to look for other sources of funding. This is the dilemma." "Sadly, it is a very competitive market for investor capital and few investors are interested in cleantech startups," says Chandrasekar. "Fortunately, some investors will recognise a good team and growth opportunity when they see one. This is where programmes like GCIP come in.

Arun Thomas

Founder, GIBSS,
Mumbai 2010

INNOVATION:
Making **AC systems become more energy-and water-efficiency and reducing the carbon footprint.**

Funding Needed: ₹65-70 crore for scaling up

(Extracted from Economic Times, 20th November 2016).

VII The Way Forward

MSME sector is among the largest employer and a dominant player in country's industrial sector and in trade and commerce. In a competitive environment, commercial sustainability of MSME establishments requires due consideration. Use of energy efficient technologies and production processes are important steps in that direction. Hence the sector is identified to play a key role in climate change mitigation strategies for the country. The Cleantech Innovation programme has stimulated and brought to forefront various home-grown innovations, which are amongst the best in the world and can provide cost effective solutions to the MSME sector.

Considering the Sustainable Development Goals to which Government of India is signatory, Goal 9 allows to build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation. This requires a long-term work plan to promote use of clean and sustainable technologies, and create an ecosystem in the country that promotes innovation.

Learnings from GCIP programme provide the following way forward:

1. **Reaching out to the innovators** remains a great challenge. The project's experience of utilising over 500 industry associations as channels for communication with their respective members was not very encouraging which raised doubts about the vibrancy of the industry associations to promote innovations. Common IT based mobile applications proved to be effective medium to bring together innovators and to reach out to them. The government should encourage use of such common platforms to promote new initiatives.
2. **Research and Development (R&D)** is the first step to innovation and therefore easy access to R&D facility for real innovators is a must. Retaining some successful innovators and experienced entrepreneurs in all such government committees which handle the R&D funds will bring in the understanding of the real ground realities. Scrutiny and streamlining of R&D funding at one level with participation of all ministries will go a long way in making it easier for the innovators to access the funds. A single portal of the government with minimum government and maximum governance, clearly defined timelines and criteria for selecting proposals will help to keep the process transparent and avoid duplication of efforts.
3. **Validation of innovative technologies** by the concerned line ministry through their website after detailed scrutiny will go a long way in their acceptance by various stakeholders like the funding institutions, end users and customers. The Ministry of Drinking Water and Sanitation does such centralised technology validation so that the state governments (which are much leaner) do not have to individually get such validation done again for adopting these new technologies. This model can be replicated by other ministries.

4. **A single window advisory** by a nodal ministry like DIPP or MSME for promoting deployment of innovations in MSME, through a standard notification to all concerned departments will help in improving the ecosystem. Such advisory is necessary since, most of the innovative products are new technologies and it is not possible for them to compete with established products at par. Taking ownership of the initiative of promoting innovations should be centered in one nodal ministry so that the associated feedbacks can be given to the nodal ministries by the relevant players.

5. **Enforcing Cleantech** by incentivisation is necessary to accelerate its deployment. This mandate should be given to the Public Sector Enterprises to try atleast ten cleantech innovations approved by accredited organisations or R&D institutes by relaxing the existing procurement procedures through their board level approval. The public sector companies can utilise the innovations to meet climate and social obligations, and help to create market for them.

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