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Today, 20 leading economic media are sharing 50 business solutions for sustainable cities #Cities4Climate

EDITORIAL

Being the change

If there is one thing the world isn't short of, it is problems. The world today faces an unprecedented set of challenges — from an overcrowded planet to an overstressed environment, from the challenge of lifting millions out of abject poverty to tackling the growing disparity between the haves and the have-nots, from new and more virulent disease to terror and conflict — the list is as wide and varied as our world itself.

Problems also make for great journalism. Wars, epidemics and natural disasters are tailor-made for great story-telling. But that is not the only reason why the media is dominated by 'problems'. Bringing such issues into the public domain is one of the core responsibilities of a free media in any society. Highlighting a problem becomes the first step towards finding a solution.

But what of the solutions themselves? Who will take the responsibility to see a solution for a problem through to its logical conclusion? Is it just the government? Do we not owe a responsibility to our society to try and be part of solutions, and not just the problems?

A growing number of individuals and organisations around the world are beginning to think so. They are solving challenging issues using innovative ideas and frugal technologies. And we, at *BusinessLine*, are among the growing number of media organisations around the world that are convinced that our role does not end with simply reporting a problem.

That is the idea behind 'Impact Journalism'. Leading news organisations from around the world have collaborated in an innovative project to bring you stories from around the world about such solutions, in a bid to inspire action for change. *BusinessLine* is a part of this global initiative. This year, we join more than 20 leading global publications in bringing to you stories of sustainable business solutions for sustainable cities.

In this special issue (and many more online at **www.thehindubusinessline.com**), we bring to you a selection of such smart business ideas from around the world. From a simple idea developed in India — LC^3 concrete, which cuts costs, emissions and energy consumption — to 3D-printed houses in China; a start-up in Brazil that fuses technology with a waste-pickers' cooperative to recycle waste; and a company in Germany called ForestFinance, which sees trees as an asset class worthy of investments, you will find an amazing array of innovative solutions.

We invite you to read, share and get inspired by these stories. Together, we can be the change.

— Editor

DESTINATION | SUSTAINABLE CITIES

Cities and businesses are responding to the challenge of climate change with a variety of innovative solutions

For more features, articles and an e-book, visit http://www.thehindubusinessline.com/cities4climate/

With the support of TOTAL

How green is my city!

Lyon uses water and vegetation systems to reduce urban overheating

LÉA DELPONT

If you spread the leaves of a single plane tree on the ground, they would cover the same area as 10 football pitches. No wonder these trees make such good parasols, lined with a natural layer of moisture, thanks to the humidity kept up by the vegetation itself.

These natural attributes form the basis for why the city of Lyon has included in its Local Urban Planning, a 30 per cent greening quota, which applies to all new constructions and buildings. This is a first in France.

Around half of this will result in the planting and cultivation of large trees in open ground, creating a green canopy over the city.

"We need to make wooded areas in the same way that we think about making square metres of flooring," explained Alain Marguerit, the town landscape planner associated with many urban projects being rolled out across Lyon.

Rooftop gardens like these keep Lyon cool and green THIERRY FOURNIER

One of the aims of the initiative is to bring down the temperature of the city using a natural air conditioning system. Ensuring there are three levels of vegetation helps to create this effect: ground-level grasses, chest or eye-level shrubs, and then foliage cover. Air and water exchanges taking place between the three levels produce a cooling cycle.

"We can gain up to 10°C of perceptible comfort, without this necessarily registering on a thermometer," explained Karine Lapray, co-manager of the Tribu Research Office, an agency that advises Greater Lyon in recognising and diagnosing the 'urban heat island' effect.

The Metropolis of Lyon has also established a Climate Observatory and mapped the 'red zones' in the city with the aim of diagnosing spikes in temperature. New architectural models are being tried out in the Confluence area of Lyon — with better ventilation, 'cold' surfaces and greening solutions — to give us a window into the future of the ecological city.

Around 150 hectares of industrial brownfield is being restored and has become a laboratory for compact and well-managed systems that could enrich the whole of the surrounding urban area. One of the first techniques to be tested is the presence of porous soils that allow water to seep through channels and replenish the soil reserves.

Anti-waterproofing

The 'anti-waterproofing' policy now applies everywhere in the city. Rue Garibaldi has a recovery system for non-polluted water, which runs underneath walkways and cycle paths. The flow of water is driven into an old storage unit converted into a 30,000 m3 reservoir, where the staff of public gardens can come and fill up the water tanks of their trucks.

"But in an ideal situation," explained Alain Marguerit, "we'd be able to do without the need to water the green areas, thanks to new cultivation methods based around composting and the use of wood chips."

The incentive to create green roofs across the city has less to do with the 'spraying mist' or cooling effect, and more to do with improving the natural insulation of buildings. By reducing the need for air conditioning and by deflecting less heat on to public spaces, green roofs help to create a virtuous cycle.

For those rooting for a greener city, the ban on building new, detached underground parking lots in the Confluence area comes as another piece of good news.

Instead, the city is testing a shared parking lot system, where residents and businesses share around 800 parking spaces, using them at different times of the day or night.

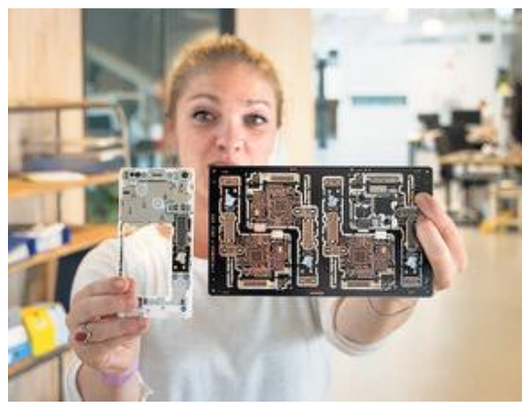
There is also talk of using the water from the mining of underground parking lots (pumped over a long period of time and unfit to return to the Rhône) to source ornamental ponds.

The future looks green for the Allée de Fontenay in the Gerland quarter of Lyon, where a leafy path will snake for 2 km alongside a small canal in the coming years. "It's a real passive cooling solution in the city," assured Bruno Charles, Vice-President of the Sustainable Development Department for Lyon. "Without pushing aside solutions offered by industry, for example the importance of ecological building standards and labels, Lyon is prioritising the use of natural systems to help the city cool off."

Les Echos

Dial F for FairPhone

With the world's first 'socially conscious' mobile phone, a Dutch start-up is inspiring others to take the right call on ethical sourcing



A smartphone contains about 30 mg of gold, 6-9 mg of which is found on the printed circuit board FAIRPHONE

NINA SIEGAL

In this day and age, a mobile phone is considered something of a necessity. And yet, those who are sensitive to business ethics will know that the supply chain that feeds the manufacture of handphones is fraught with many unethical practices.

A typical smartphone is made up of about 40 minerals, many of them sourced from poor countries where mining is conducted using exploitative practices, and where profits sometimes finance local conflicts. Phones are typically manufactured in factories where low-wage workers are employed under sub-optimal conditions. And because the average life cycle of a smartphone is one-two years, and the parts are difficult to replace, they generate a lot of electronic garbage.

Ringing in change

In a spacious former warehouse in Amsterdam's eastern docklands, about 50 young entrepreneurs are working to perfect the world's first socially conscious smartphone, the FairPhone.

Founder Bas van Abel and co-founders Miquel Ballester and Tessa Wernink had no prior experience in making phones, but they believed that the best way to have an impact on the industry is from within.

Bas van Abel and Ballester met in 2011 while researching the prospective market for fair electronics at the Open Design Lab at the nonprofit Waag Society. Wernink was a marketing and communications professional.

To understand the scope of the challenge, the team went on a fact-finding mission to eastern Democratic Republic of the Congo, where many minerals are mined, and to China, where most phones are manufactured. They conducted extensive research into smartphone technology. And together, they figured out how to improve practices along the entire value chain of the industry, from raw materials to recycling.

FairPhone 2 uses conflict-free tungsten

In 2013, FairPhone received an initial investment of €400K (about ₹3 crore) and mounted a crowd-funding campaign. The founders ended up surpassing their goal and 'selling' 25,000 phones before production had even begun. "All of a sudden, we had €3 million in our bank account," said Wernink, "and we hadn't even made a single phone."

The rollout

Partnering with a small fair-trade factory in China, FairPhone sold 60,000 of the first model. A more complex model, FairPhone 2, is modular, with parts that someone using a small screwdriver can replace if they break (and, in the future, with upgrades). More than 50,000 have sold since the beginning of 2016, at about €525 (about ₹39,000) per phone.

Wired magazine called FairPhone 2 "a decent phone with an exciting internal design and a boring exterior design." The company is looking to update the case design, and plans to let people customise the look.

Among the challenges that FairPhone faces are the need to set up distribution channels: it is somewhat complicated to sell outside of Europe for reasons that include varying technical specifications in different markets.

Also, it's not possible for the company to verify that the supply chain for every mineral is clean, although it promises that at least four of its components — tin, tantalum, tungsten and gold — are sourced from conflict-free, certified mines.

Work in progress

"It's important at this point to say there is no such thing as a fair phone yet, because no one can trace back exactly where each of the materials comes from," said Wernink. "But by making this phone, at least, we can start making that possible."

Right now, the company earns €9 in profit for each phone it sells. All of its income is fully accounted for on its website.

Beyond working with factories that promote fair working conditions, FairPhone puts aside funds for a worker welfare programme. It also addresses e-waste: €3 from the sale of each FairPhone is earmarked for recycling junk phones in Ghana, Rwanda, Cameroon and Uganda, through a partnership with the Dutch recycling organisation Closing the Loop.

In 2015, the company covered its costs, said spokesman Fabian Hühne; the aim this year is to sell 100,000 phones, which would make it profitable. Whether or not that happens, FairPhone's goal has been achieved. "It's not the aim to dominate the market," he said. "The aim is to inspire other companies and to cooperate with other companies to help them follow our lead."

Money does grow on trees

In Germany, a radical idea, which sees trees as an investment class, takes root

NINA SIEGAL

For years, the widely accepted consensus was that protecting forests was the job of charitable organisations. However, Harry Assemacher, a German environmentalist, believes that this is a flawed assumption. "To do good things for the environment, you have to change the economic system," he says.

When ecologists turned their focus to reforestation as a tool to reverse climate change, Assenmacher decided that any meaningful large-scale reforestation project would need to be financed by a company, not by charities.

Thus was sown the seed of ForestFinance, the firm he founded in Bonn. It sells "sustainable forest products" as an investment class, much like stocks and bonds.

The firm invites investors to buy shares (that is, trees) in forests that are ethically and sustainably managed.

A ForestFinance forest consists of up to seven different exotic tree species FORESTFINANCE

Branching out

In Panama, Colombia, Peru and Vietnam, the company's partners plant new forests on fallow grasslands that were once tropical rainforests. These are not mono-culture tree plantations that deplete the soil, but rather mixed-species forests, designed to provide habitats for wildlife and offset CO_2 emissions. ForestFinance also adds a mix of tree species to existing monoculture forests to provide greater biodiversity.

ForestFinance has competitors, but Assenmacher says they tend to do monoculture tree farming, which does not focus on biodiversity or the social impact. ForestFinance also guarantees fair wages and good working conditions for its employees, who are often drawn from indigenous communities. The company's projects have received certification from several bodies: the Forest Stewardship Council, the UTZ programme for sustainable farming and better workers' conditions, and the Gold Standard for carbon emission reductions.

The arboreal investment products are packaged as long-term and short-term plans. Under the TreeSavingsPlan, customers lease a parcel of land on which trees are planted.

Twenty-five years later the trees are selectively harvested, leaving the forest intact; investors earn money off the sale of timber.

The plan costs €396 (about ₹30,000) over one year, and anticipates annual returns of 6 per cent over 25 years, for revenues of €1,740 per share.

For those who prefer returns over a shorter term, there's PureCocoa, a one-time investment of €3,250 to lease 1,000 sq m of land in Peru, for sustainable, single-origin and fairly-produced cocoa. Payouts begin as early as five years.

Investing in forests is not without risk: there are risks of fire, drought and infestation by insects. ForestFinance offers insurance for the first five years after planting, when trees are most vulnerable.

The early days

But Assenmacher's bigger risk was in attempting to create a company of this kind back in the 1990s. At first, he tried it out as a private individual, investing a few thousand euros to buy and reforest land in Panama as a kind of personal pension fund. A "few very brave friends and family members" joined him, each investing a little bit.

Those early investors have received small payouts for harvested wood and carbon credits, though the bulk of their returns will come in five-seven years. Meanwhile, people who invested in GreenAcacia have earned approximately 6 per cent a year.

Satisfied that his experiment could work, Assenmacher officially founded ForestFinance in 2005.

It grew much faster than anticipated, collecting more than $100 million from 17,000 clients. More than 90 per cent of them are in Germany, with newer investors elsewhere in Europe.

(In 2013, ForestFinance created an offshoot in France.)

Assenmacher says the only criticism of his company has come from the conservative investment community (who point to ForestFinance profits as being lower than those of traditional stocks) or from environmental activists who say trees should not be used to earn money. To the latter, he responds: "If you want to save the environment, you have to find a way of sustainable production."

The Recycle of Life

In Brazil, a start-up fuses tech and a waste pickers' co-op to find a win-win solution

ANDREA VIALLI

Brazil produces rubbish as if it were a rich nation, but still disposes of it like an underdeveloped country. In large cities, such as São Paulo and Rio de Janeiro, each Brazilian produces an average of 1.2 kg of rubbish per day. About 41 per cent of urban waste is still disposed of without being treated, often in open-air landfills known as "lixões". This situation is common in the hinterland of the country, but even the federal capital, Brasília, known for the prized architecture of Oscar Niemeyer, continues to send its rubbish to landfill.

The National Solid Waste Law, passed in 2010, brought modern waste management concepts to the country, but its application has yet to make a significant difference. Among its objectives was to bring the lixões to an end by 2014. But many cash-strapped councils protested, and the deadline was extended to 2018.

Even though Brazil recycles large volumes of some materials — the country is the world leader in recycling aluminium cans, with 98 per cent returned to the industry — not all cities have implemented structured selective collection. Many depend on cooperatives of waste pickers, often working informally. Under the law, industry is required to take responsibility for ensuring the waste it generates is handled effectively — and this extends from a simple shampoo bottle to a computer, at the end of its working life.

Dawn of a new hope

Aiming to connect the two ends of the chain — industry and the waste picker cooperatives — a start-up, New Hope Ecotech, came into being just over a year ago, the brainchild of two young managers in São Paulo: Luciana Oliveira and Thiago Carvalho Pinto. After completing an MBA together at the Kellogg School of Management in Chicago, they looked for a business model with social impact. Oliveira, who had already worked at Google, had an affinity for technology. Their new company was born with the intention of uniting these two universes.

New Hope Ecotech's business plan is to use software solutions for data management so that companies producing consumer goods pay the pickers for the volume of waste that they remove from the environment and return to the production process. Everything is recorded in an online system, which provides real-time transparency to the process. The seed capital for the company came from a $70,000 prize from Kellogg itself, which has incentives for students who stand out in leadership and entrepreneurship.

The New Hope Ecotech team at a waste recycling centre

"The majority of the pickers have low incomes because the raw materials they recover are commodities and their market value varies greatly. Our business ensures the companies pay these workers directly for the waste they collect, without intermediaries," explained Oliveira.

The cloud software manages indicators such as the quantity of material that arrives at the cooperatives — classified by type of waste — details of who supplied it, and the date of entry. The quantity of material sold to the recycling industry is also stored in the software, and reports compiling this information are generated from the data. New Hope Ecotech has also developed a free management platform for the recyclers. According to Oliveira, the company's major differential lies in bringing technology and transparency to a sector that is still very informal.

A sustainable model

Currently, five companies that produce food and drink are using the services of the start-up; most of them are small and medium-sized. They include the beverage manufacturers Beba Rio, which makes natural juices and coconut water, and +MU. The ABC brand, which markets products such as soybean oil, olive oil and tomato extract and is part of the Algar Agro group, is the first large client of New Hope Ecotech.

Through these clients, the company has already been able to return 1 million tonnes of waste to the production chain and the first payments to the waste pickers was made in October — proof, according to Oliveira, of the viability of the system.

EDITORIAL

Concrete solutions

By 2050, 66 per cent of the world's population will live in cities: what concrete solutions can be implemented to meet urban climate challenges?

Cities are at the centre of climate change. They already represent 54 per cent of the global population and 70 per cent of greenhouse gas emissions. In 2050, the world's urban population will reach 66 per cent. Yet, cities also serve as hubs for business, innovation and strategies for resilience, capable of reinventing our modes of production, consumption and distribution, and shaping our relationship with urban mobility, energy and waste.

Choosing to centre the editorial line around cities for this second edition of *Solutions&Co* was an obvious choice for our business media partnership. Like last year, our media partners have reported on the most innovative companies responding to climate issues from their respective countries, and shared their work with the network of newspapers. Today, November 4, some 50 articles written by this group of prestigious media, including *BusinessLine*, are being published across the globe.

Christian de Boisredon, Sparknews founder

To go a step further, we have brought together insights from leading climate experts, like Mary Robinson and Dame Ellen MacArthur, in the form of a brand new e-book. Download it via **www.solutionsandco.org** and discover dozens of innovative companies, as well as inputs from experts and entrepreneurs, all working toward sustainable cities.

Several of the businesses featured last year have since been greeted with new opportunities; some were able to forge partnerships with major companies and organisations. These projects have also inspired the founding partner of *Solutions&Co*, Total, which is seeking out and developing responses to issues relating to the sustainable energy transition.

Sparknews has been working with leading media over the last five years to identify and publish the stories of a world that knows how to find solutions to its challenges. At the same time, we target actors in those fields that have the greatest potential impact: local governments, economic decision-makers and innovative entrepreneurs come together at our Positive Innovation Club events. Everyone has a role to play.

We invite you to nominate innovative companies for the next edition of *Solutions&Co* using **form.solutionsandco.org**

Enjoy your read! We hope you will be inspired and find on these pages the sustainable building blocks adapted to the transformation of your company or city.

— *Christian de Boisredon*, Sparknews Founder

SOLUTIONS &Co by sparknews

Cementing a revolution

A viable, sustainable alternative to cement lowers greenhouse gas emissions during the production process

PREETI MEHRA

A worker demoulding kerb-stones made with the revolutionary cement
DEVELOPMENT ALTERNATIVES

As a $2-trillion-plus economy growing at above 7 per cent a year, India has a gargantuan appetite for a variety of commodities. As borne out by the construction boom that is manifest across the country, it is also the world's second largest manufacturer and consumer of cement, next only to China.

The cement production process releases greenhouse gas emissions, both directly and indirectly. "A lot of carbon dioxide (CO_2) is emitted from burning fuel and the conversion of limestone to oxide during cement production," notes Ravindra Gettu, Professor of Civil Engineering and Associate Dean of Industrial Consultancy and Sponsored Research at IIT-Madras.

Building blocks

From a climate change perspective, this is a disaster waiting to happen. The search for alternatives has led to the pathbreaking technology for the development of Limestone Calcined Clay Cement (LC^3), an alternative building material that lowers CO_2 emissions and energy consumption.

It is cheaper to produce, requires low capital investment and has the potential to become the best sustainable substitute for Ordinary Portland Cement (OPC) or the fly ash-based Portland Pozzolana Cement (PPC).

In India, pilot production of LC^3 was completed in January 2015. Today, two buildings constructed with LC^3 and LC^3-based building materials bear testimony to the technology: the Swiss embassy in New Delhi, and TARAgram Orchha near Jhansi, which houses an office of Development Alternatives (DA), one of India's oldest social enterprises that focusses on sustainable development.

DA collaborated on an LC^3 technology development project with Switzerland-based École Polytechnique Fédérale de Lausanne (EPFL), which conducted the initial research.

"LC^3 is now about to be certified, standardised and produced commercially – in India and in countries across South America, Africa and Asia," says Vaibhav Rathi, Deputy Manager – Environmental Management, at DA.

But what exactly is LC^3, and why does it have anyone concerned about climate change excited?

The 'secret sauce'

LC^3's unique selling point is its composition: 50 per cent clinker; 30 per cent calcined clay, 15 per cent limestone and 5 per cent gypsum. The clinker content is about half as much as in OPC (which has 95 per cent clinker), but the 'secret sauce' is calcined clay, which is waste china clay abandoned by mine owners for its poor quality.

To produce LC^3 cement, this waste is calcined at 750-850°C; this process requires half the energy used for clinker production and can be carried out using existing rotary kilns.

The limestone used is again of low grade, and can be substituted by waste material from marble and kota stone, a fine-grained variety.

DA and IIT-Delhi are carrying out extensive research, which, if successful, will make productive use of the 7 million tonnes of marble sludge waste generated every year in Rajasthan alone.

Produced in a similar manner as commercial cement, LC^3 is stronger than both OPC and PPC. Its production process accounts for 30 percent less CO_2 emissions than OPC and 11 per cent less than PPC.

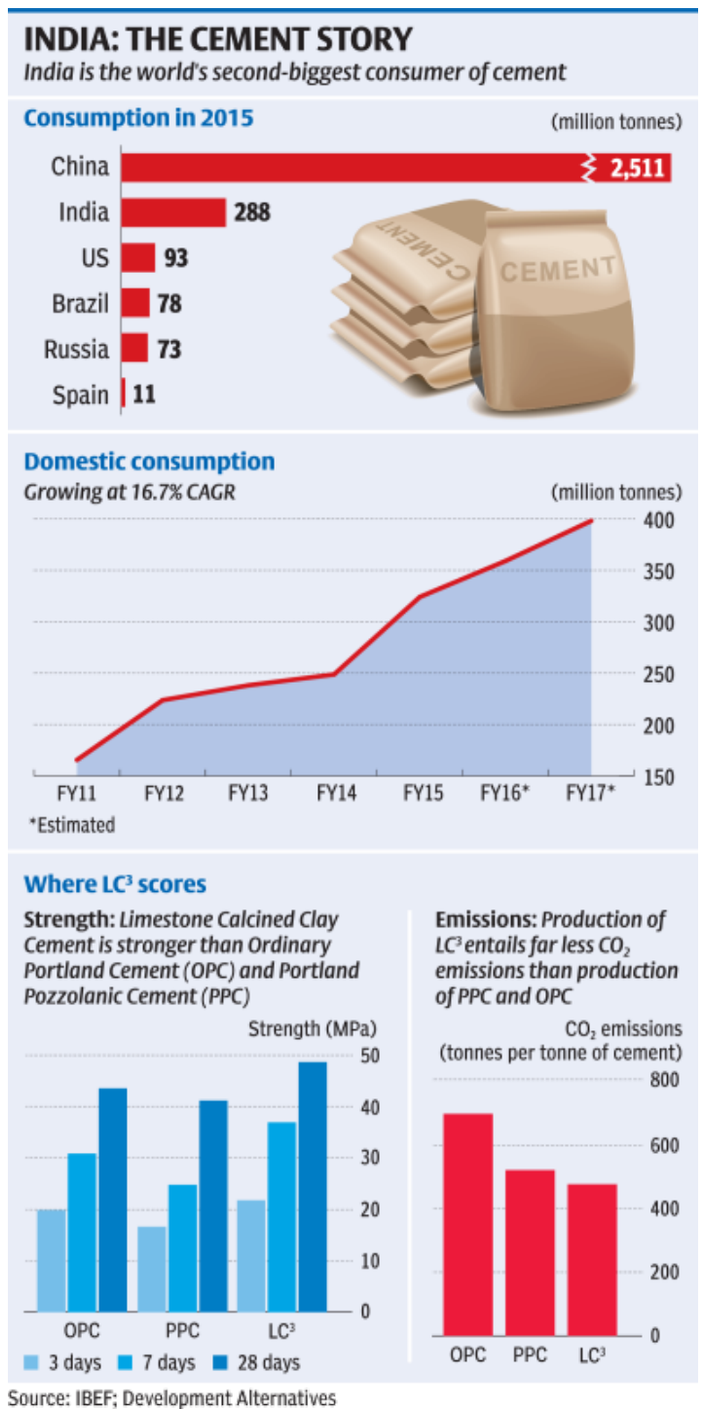
The research team has conducted LC^3 life-cycle analyses at two large cement plants. "We have moved from the lab stage to the pilot stage, and the feedback from companies is good," says Rathi.

"This is an important material, but it will take time to perfect," says Shashank Bishnoi, Assistant Professor at the Department of Civil Engineering, IIT-Delhi.

As part of its research, the LC^3 team has resource-mapped china clay availability in Rajasthan and Gujarat. An interactive GIS-based map provides details of the mine, its owner and the quality of raw material available.

This could provide crucial information for Indian cement firms looking to turn to cleaner technology.

As a sustainable, viable alternative to cement, LC^3 has enormous potential. "It can be easily replicated anywhere in the world, wherever china clay is available in abundance," notes Rathi.



Source: IBEF; Development Alternatives

Here comes the sun!

Spirited government intervention is recharging the rooftop solar plant movement across India

M RAMESH

India's ratification of the Paris Climate Change Agreeement commits it to sweeping cuts in emission of greenhouse gases, and one of the pivotal channels for achieving those punishing targets is the instrument of solar power plants. The country's experience in this space illustrates how even vexing problems can be fixed with innovative thinking backed by political will.

India has a good track record in solar power installations — 8 GW in six years, with a promise of another 8 GW in a year — but its record of rooftop solar plant installations is relatively poor. Against the target of 40 GW of rooftop installations by 2022 (which is part of the overall target of 100 GW fixed by the Centre), India today has just 1 GW of rooftop plants.

This is a serious failing. Since rooftop plants generate electricity right at the point of consumption, they do away with the need for transmission, which in turn cuts down on energy loss. Further, they give plant owners independence from utility companies and insulate them from tariff hikes.

Enormous potential

India's potential in this space is huge. Installing rooftop solar plants at educational institutions and factory buildings alone would help generate 40 GW. India's clean energy ministry estimates the 'market potential' at 124 GW, though it says the 'technical potential' is much higher, at 352 GW.

Electricity from rooftop plants will be cheaper than the power that educational institutions and factories procure from utility companies — and from the diesel-fired generators that come on during the frequent power outages. So why has rooftop solar not gained sufficient traction? The reason is the poor financial health of the utility companies.

Grid-tied solar power panels on the roof of the Sri Aurobindo International Centre of Education in Puducherry SS KUMAR

In India, most electricity utility companies are owned by State governments. Political and social imperatives have led governments to provide power cheap, or even free, to the poor and to farmers. These losses are cross-subsidised by higher tariffs on commercial and industrial establishments. Even so, most of the utilities are broke. To hold on to their paying customers, the utility companies effectively disincentivise these establishments from installing rooftop solar plants — by refusing to buy any surplus power from them.

In Tamil Nadu, for instance, the distribution company (discom) does not buy from rooftop solar plants of industries and educational institutions. Other States buy surplus power only up to a capacity cap, say, 1 MW.

Being stuck with unsellable surplus power skews the economics of rooftop solar plants for these colleges and factories.

But even if a rooftop plant owner 'gifts' the surplus power to the utility, the meter does not recognise the direction of flow of current, and treats the power exported as power consumed. The seller effectively gets billled for power he gave away for free!

"Discoms see rooftop solar plants as 'competition'," observes Ketan Mehta, CEO of Rays Power Infra, which owns solar power plants and builds plants for others.

'Storage' is an obvious answer, but it is still a costly proposition.

Solutions in sight

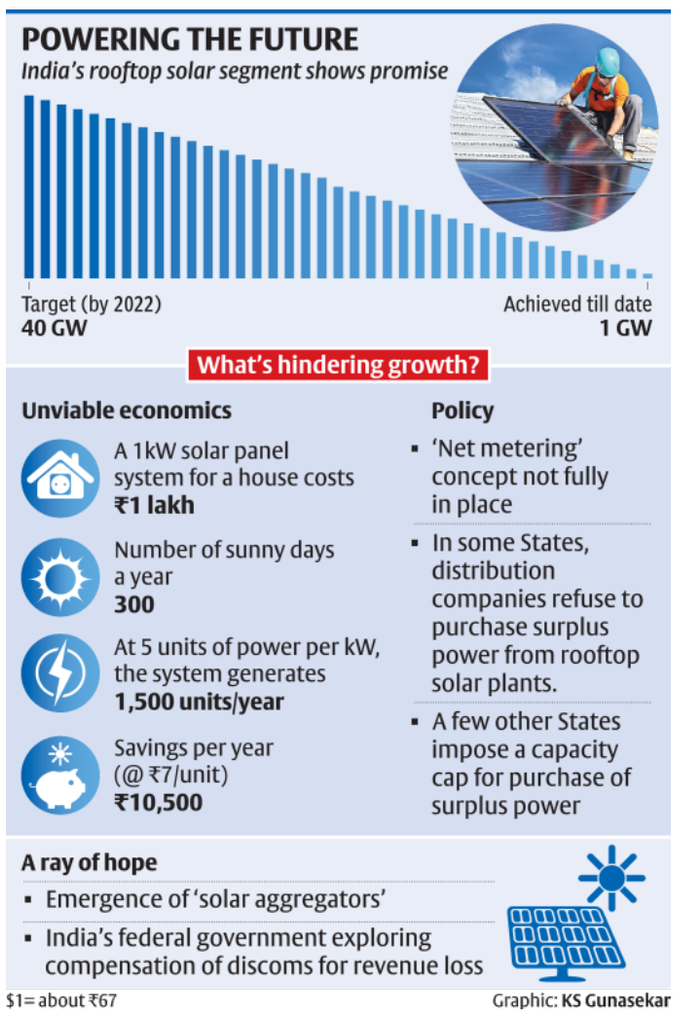
The Centre acknowledges that without 40 GW from rooftops, it would be impossible to meet the target of 100 GW of solar power by 2022. India has committed at the Paris Climate Change Conference to ensuring that by 2030, 40 per cent of energy consumed in the country will come from non-fossil fuel sources. This would require some 320 GW of renewable energy capacity, so rooftop solar has a key role, even beyond 2022.

Upendra Tripathy, Secretary in the Ministry of New and Renewable Energy, says the government has promised to compensate discoms for any revenue loss. The bureaucrat did not specify this, but the funds for such compensations could come from the National Clean Energy Fund, which has been formed by collecting a cess on every tonne of coal mined or imported. There are also suggestions from the industry that rooftop plant owners could be asked to pay the utilities a fee.

Alongside all this, the Centre is also looking to provide funds to State governments and cheaper loans for discoms.

Given the manifest seriousness in the government's intentions, hopes run high that the rooftop solar programme will see more dramatic growth.

The cloud cover over the industry, and over India's contribution to the climate change mitigation, is lifting, and a sliver of sunlight is streaming through.



'Honey, I 3D-printed our villa'

A construction firm in China is showcasing the future of eco-friendly homes

CHEN JUAN

China's construction market is, like all everything about China, mind-bendingly enormous. Given the scale of construction activity, the country is actively pushing for a low carbon footprint in its building projects, in keeping with domestic environmental protection laws that emphasise the ecological responsibilities of companies.

The work being done by Shanghai WinSun Decoration Design Engineering Co is an illustration of how Chinese companies are embracing sustainability. Recently, WinSun became the world's first high-tech company to build houses using 3D printing technology.

WinSun used 3D printing techniques and recovered waste materials to construct the buildings and interior decor of two showcase villas, among other projects. One of the villas was based on the design of the Classical Gardens of Suzhou, a distinctive representation of Chinese architecture.

Typically, it takes more than a dozen workers to build a traditional Chinese-style compound. But WinSun CEO Ma Yihe led a team of just three workers and finished printing all the components, assembly and interior decorations within a week.

Building from waste

The construction materials that WinSun uses, which serve as the 'ink' for the 3D printer, are primarily building and industrial waste from mills. The process of erecting the houses involved adding these materials layer by layer. Apart from helping to recycle massive construction waste, the use of these materials provides rigidity and strength to the new constructions.

"All the printing materials are from construction or industrial waste," Ma said. "Not only do we turn waste to our advantage, but the new technology does not generate any additional waste."

It makes money sense, too

3D-printed villas also make sound financial sense, The technology can help save 30-60 per cent on building materials and 50-80 per cent in labour costs.

Two years ago, WinSun printed out 10 single-storey houses in Shanghai's Hi-Tech Industrial Park in under a day, using giant printers (measuring 32 m x 10 m x 7 m). WinSun hopes that the technology will be used around the world to provide cheap and ecologically sustainable homes for low-income families.

The villas that WinSun built, which are on display at the Suzhou Industrial Park in Jiangsu province, are, however, targeted at the luxury housing market.

Each villa covers 1,100 sq m and cost just over 1 million yuan (about ₹1 crore) to print.

The Chinese government government has not yet introduced any standards for 3D-printed buildings, but the company voluntarily abides by the existing protocols. According to Ma, 3D-printed buildings are just as safe and secure as concrete buildings.

According to the UNEP Sustainable Buildings and Climate Initiative, the building sector worldwide currently accounts for 30 per cent of total global annual greenhouse gas emissions. With on-site 3D-printed houses, carbon emissions from transportation, construction dust and noise are reduced.

WinSun says it has established a joint venture with a US partner and plans to establish factories in Saudi Arabia, the UAE, Qatar, Morocco, Tunisia and the US in three years.

WinSun has additionally established partnerships with a number of building contracting companies and real estate developers in China. "3D printing technology is a revolution in the real estate industry," said Chen Sheng, President of the China Real Estate Data Academy. "In the future, furniture and houses can be custom-built to suit people's requirements."

New territories

WinSun is also spreading its wings into other areas. Recently, it signed a cooperation agreement with Hyperloop Transportation Technologies, a high-speed rail company, to 3D print high-strength, high-precision pipelines, stations and platforms for their 'super-speed' rail project.

This is an innovative mode of transportation that allows passengers to travel at a maximum speed of 1,200 kmph.

Prospective buyers eye an exhibit at the showcase 3D-printed villa

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A cool solution for farmers

In Nigeria, ColdHubs' solar-powered walk-in fridges are helping to reduce farm produce waste

ColdHubs has installed solar-powered walk-in refrigeration units like these near farms and markets COLDHUBS

DAVID THOMAS

For millions of Nigerians in rural Kaduna state, a trip to an outdoor food market provides cheap and ready access to the staples of a traditional diet. In a normal week, dozens of wicker baskets overflow with ripe tomatoes, an essential ingredient in the rich stews favoured by locals.

Yet, over the summer, market-goers were dismayed by the spiralling costs of a fruit that has come to be seen as a national necessity. After a moth epidemic ravaged some 80 per cent of the region's tomato farms in May, sending the price of a basket zooming from $1.20 to more than $40, Kaduna's authorities were forced to declare a state of emergency.

Kaduna's 'tomato emergency' was triggered in part by a national dip in food production that has Nigeria's food security experts very concerned. In the north-east, production in large parts has been all but abandoned in the face of continued attacks by Boko Haram militants, putting millions at risk of famine.

Yet, even in areas where food production remains strong, poor handling, storage and delivery methods mean that much of Nigeria's food is spoiled before reaching those in need. In a bid to minimise post-harvest losses — which the government estimates could be higher than 50 pre cent for some fruits and vegetables — businesses are beginning to develop new technologies to assist farmers.

Enter ColdHubs

For one entrepreneur, the causes of post-harvest losses are obvious. "Most of the spoilage starts on the farms because delivery trucks don't visit farmers every day," said Nnaemeka Ikegwuonu, Chief Executive of ColdHubs, a cold storage company.

"Sometimes it takes three or four days for trucks to get to the farm. So, these farmers keep the food in a shed or try and cover it, but by the time the truck comes in, the food is already spoiled. The trucks take a long trip to the market, and the spoilage accelerates."

That's a problem common to farms across the continent. In 2011, the UN World Food Programme estimated that annual food losses in Sub-Saharan Africa exceeded 30 per cent of the total crop production and cost farmers some $4 billion in value every year.

ColdHubs offers a simple solution. It installs walk-in refrigeration units near farms and markets in an effort to preserve valuable crops in the crucial period before they reach consumers. Tomatoes, which would have rotted near the vine, are swiftly dispatched to a nearby unit, where farmers are charged around 50¢ per crate per day to cool the produce.

ColdHubs abides by a pay-as-you-go model, which allows farmers to dodge pricey storage agreements that tie them to excessive payments regardless of production.

Expanding the network

What's more striking is that in a country where 95 million people are estimated to have no access to electricity, ColdHub refrigeration units are entirely solar-powered. Whether the units are installed in remote rural villages or bustling urban markets, the power of the sun can be harvested to save, rather than spoil, produce.

It's an affordable and eco-friendly model that does not need expensive infrastructure; it's a model that the company believes can be quickly rolled out across the continent, beginning with further expansion in Nigeria and a potential franchising scheme in Kenya.

"In five years, we want to have 1,000 units installed in Nigeria, and in the future, there could be 1 million units all over Africa," said Ikegwuonu.

"We're very ambitious because there's lots of market opportunity. You can use them in schools, hospitals, airports — anywhere you need to store food."

For hawkers and worried consumers in Kaduna, it may be the first step towards ensuring that 2016's tomato emergency remains little more than an unpleasant memory.

Farmers and vendors pay for only as much of the ColdHubs facilities that they use COLDHUBS

African BUSINESS

Paving the path to conservation

In Mexico, an innovative solution to rainwater runoff that leaves cities flooded

ANGÉLICA PINEDA

Cities around the world are prone to flooding during periods of excessive rain, and Mexico City too has had more than its fair share of troubles. According to the Municipal Water System of Mexico City, the city receives an average of 750 mm of water in just 45 days during the June-October period.

That's the equivalent of 1,100 million cu m of water, a volume that exceeds the total capacity of the Cutzamala System, which provides drinking water to the Valley of Mexico's metropolitan area. As a result, about 20 per cent of the rainfall runs off and ends up clogging the city's drains, causing flooding and a build-up of debris.

The floods are a serious problem for the city of nearly 20 million people. There is, of course, an ongoing effort by the authorities to expand and improve the drainage system. But alongside that, innovative initiatives by entrepreneurs are helping to address the problem with smart solutions.

Permeable pavements

One such company, Gravalock, has come up with permeable floor grids made from recycled plastic, which are increasingly replacing cemented walkways, since they allow rainwater to percolate into the ground, thereby recharging the water table — and averting flooding of the city.

Gerardo Dominguez, co-founder and Commercial Director of Gravalock, says the plastic grids have replaced cement in over 40,000 sq m of industrial parks, housing complexes, sidewalks, pedestrian walkways and parking lots in at least five states. Their clients come from the government and private sectors.

"The main application is for parking lots, the idea being that the rainwater filters into the ground, rather than going into the drains," explained the entrepreneur. The plastic grids are sturdy: they can take a weight of up to 60 tonnes per sq m, and can last up to 25 years.

Each grid is 4 cm high and weighs 940 grams. Nine pieces form a section of 1.44 sq m. The material is 100 per cent recycled polypropylene and ultraviolet resistant. Due to the weight of the gravel used to fill it, there is no need to anchor it to the ground.

Dominguez stresses the importance of reducing the use of cement. According to reports cited by the UNEP, cement manufacture is responsible for around 5 per cent of global greenhouse gas emissions. Cement is manufactured at temperatures of 1,500°C, and produces 0.8 tonnes of carbon-dioxide for each unit of cement.

In addition to the emission of pollutants, given the ability of concrete to retain high temperatures, it contributes to the "heat island" phenomenon, which has been felt in Mexico City since 2010. Under its influence, the local government has reported an increase in temperature of 3 degrees.

Business opportunity

Gravalock's expertise lies in permeable pavements, which holds significant business opportunities for the company. In Mexico City, some 40,000 parking spaces will be built in the next few years. Parking spaces also make up 42 per cent of the area occupied by real estate projects built between 2009 and 2013, a total of 16 million sq m, as reported by the Mexican Institute for Competitiveness.

Gravalock grids have been used in 40,000 sq m of industrial parks and housing complexes

For all their good looks, Gravalock grids are sturdy and can last up to 25 years

Framed against a Gravalock grid, the company's co-founder Gerardo Domínguez EL ECONOMISTA

Gravalock is the brainchild of the Dominguez brothers, who earlier made plastic parts for other companies. When that market began to decline, they developed and patented the grid system. They currently have 30 employees and are working on complementary products.

In 2015, Gravalock participated in Cleantech Challenge Mexico, and came in third. The exposure they received opened the doors to new markets in Costa Rica and Colombia.

To produce its grids, Gravalock uses waste plastic from the automotive and domestic appliance industries, which is collected by other companies. Gerardo Dominguez explains that once they have purchased this material, it gets crushed and manufactured into the grids at their plant in Iztapalapa. One of the greatest challenges for Gerardo as he looks to drive his product is the cost of inputs, which is compounded by the rising dollar. However, "having exports helps us, because we receive revenue in dollars. Our current business strategy is to achieve more exports," he said.

EL ECONOMISTA

Next stop: the solar, wind-powered Metro system

Taking a giant leap for conservation, Santiago looks to power its underground rail entirely on renewables

DANIEL FAJARDO CABELLO

In mid-June, Chilean President Michelle Bachelet signed the Paris Agreement, which promises a 30 per cent reduction in Chile's greenhouse gas (GHG) emissions by 2020.

To achieve this, the public sector has initiated several projects, one of which was announced by Bachelet in May. Santiago Metro has signed an agreement with both the solar plant El Pelícano and wind farm San Juan, which will be fully operational by 2018.

The agreement will meet all the energy requirements for Santiago Metro through the Central Interconnected System. The two projects combined involve a state investment of more than $500 million.

The issue is key in several respects. While the commitments of the Paris Agreement are currently in focus, the Chilean capital is midway through constructing two new subway lines, which will be ready in 2017 and 2018. In addition, one of the election pledges of the current administration is decongestion and reducing pollution in the city.

The solar potential

In recent years, Chile has become one of the countries with the greatest potential for solar energy. Wind power also seems to be an increasingly strong option. Several multinational players in the solar industry have established operations in the Atacama desert due to the high levels of solar radiation (over 1,200 w/m2).

It is estimated that Chile has 1.3 GW of electrical capacity in solar panels on a large scale (mostly in the north), generating a boom in the use of this technology. According to the National Energy Commission, in January this year, plans for the construction of solar power plants in the Northern Interconnected System accounted for 37 per cent of all power plant initiatives, followed by carbon (33 per cent) and natural gas (20 per cent).

"Both the government and the private sector were excited by the initial goal of generating 25 per cent of energy from NCRE (non-conventional renewable energy) sources by 2025 and we are working towards this quota very quickly," said Peter Horn, CEO of Heliplast, a Chilean-German solar solutions company with more than three decades in the field.

In this context, El Pelícano (run by SunPower), located between the regions of Coquimbo and Atacama, will have a capacity of 110 MWp, which is equivalent to the electricity generation required to supply an average of 100,000 Chilean households. All of the energy generated by this plant will go to Santiago Metro.

"In association with Total, SunPower is committed to the continual growth of the local solar industry, especially with the demand for solar renewable energy at a competitive cost," said Manuel Tagle, General Manager of SunPower Chile.

Santiago Metro has set itself an ambitious target in terms of renewable energy usage; (*right*) by 2018, about 42 per cent of the Metro's energy matrix will come from solar power

San Juan de Aceituno (owned by Latin American Power), the wind farm to be built in the Freirina district of the Atacama region, will have a capacity of 185 MWp, and will allocate 15 per cent of the energy it generates to the subway.

As a result, from 2018, the energy matrix of Santiago Metro will consist of 40 per cent conventional energy (Chilectra), around 42 per cent solar energy (El Pelícano) and 18 per cent wind energy (San Juan Wind Farm).

"While international experience has shown that several metro systems in the world have incorporated NCREs into their production process, Santiago Metro is a pioneer in incorporating such a magnitude of clean energy in its consumption matrix," explained the state-owned metro.

Furthermore, in terms of actual impact, it is estimated that, from 2018, the two new contracts will provide a countrywide emissions reduction of 130,000 tonnes of carbon-dioxide per year, the equivalent of planting 7.8 million trees.

"Together, these contracts will enhance the sustainable development of the company from an environmental perspective. This will allow Santiago Metro to provide a stable and competitive price, which on average, considering 100 per cent of the energy matrix, will remain below $100/MWh," added Santiago Metro.

PULSO