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## Dear Friends

Energy is very important in today's world. And energy conservation is a must as we humans tend to use energy faster than it can be produced. As we go ahead nonrenewable energy and innovative energy management systems is the future. Quite a few innovations are happening across the globe and we focus on a few of them.

Solar thermal, geothermal, photovoltaic – what form of energy supply is most suitable for a particular municipality? Representatives of smaller communities are overwhelmed by a huge amount of information, which tends to exacerbate existing uncertainty. A new online tool from Fraunhofer is now helping to clarify this confusion. The tool calculates the optimal energy mix for each individual case, including funding possibilities available.

The amount of energy produced by renewable sources ebbs and flows. The Fraunhofer Institute for Industrial Mathematics ITWM has found a smart work-around for these fluctuations. Its scientists developed an innovative energy management system that connects photovoltaic systems, batteries, heat pumps and electric cars to power individual households or entire neighborhoods with locally produced renewable energy.

In our Innovation sector we have focused on embedded systems. Whether for the car or the drone: Developing image processing software for embedded systems takes a lot of time and is therefore very expensive. Now the Tulipp platform makes it possible to develop energy-efficient embedded image processing systems more quickly and less expensively, with a drastic reduction in time-to-market. The Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB is a member of the EU consortium which simplified the process.

As with every year HKTDC attracted lots of innovative companies. But surprised most of us was that despite social unrests, the event was able to attract more than 67,000 buyers from 141 countries including India that had a separate pavilion

The bilateral trade relations among Hong Kong and India have been quite robust. India is Hong Kong 7th largest trading partner. At the 39th Edition of Hong Kong Electronics Fair 2019 ASSOCHAM (The Associated Chambers of Commerce and Industry of India) one of the apex trade associations of India brought select Indian exhibitors and an Indian delegation. The organisation represents the interests of trade and commerce in India, and acts as an interface between issues and initiatives.

As 5G technology matures around the world, with Hong Kong's 5G network scheduled to launch next year, this year's Autumn Electronics Fair aligned with the latest market trend, inviting experts to share the latest 5G technology developments at the Symposium on Innovation & Technology, as well as launching the new Nanjing 5G Pavilion at the Tech Hall to showcase the latest 5G industrial and commercial applications.

As the race for becoming smart cities intensifies in India, 99 municipalities across the country get ready to attract consultants and implementers to make their city the best.

Initially cities across the country bid to be selected for the plan. Municipalities hired consultants to prepare their bids listing the array of activities and ideas they would implement. As of today 99 cities have been selected to be upgraded as part of the Smart Cities Mission. The top three cities were Bhubaneswar followed by Pune and Jaipur.

Smart City Features will include - Smart IT and Communications using Cloud / Open Data, IoT, Smart Transport, Smart Grid, Intelligent Street Lights, Home automation, Security Cameras, Video Intelligence / Data, Urban Planning, Geo-Spatial, Building Intelligence Monitoring (BIM), Green Building Solutions, Water monitoring and billing, Water ATMS, Solid Waste Management, Toilets, Pollution Monitoring, Clean Energy, Solar power garbage compactors, car recharging stations and energy saving lamps.



*Chandragupta Amritkar*  
Editor  
*chandraguptaa@hotmail.com*  
*editor@globalfeatures.info*

Editor - Chandragupta Amritkar, Managing Editor - Varsha, Design - Manoj Durgam  
Contact - Global Technologies, B-701, Customs Colony, Military Rd, Marol, Andheri(E), Mumbai-400 059, India.  
Phone - 91-22-29252569, Mobile - 9223419060 / 9969935878 e-mail: [editor@globalfeatures.info](mailto:editor@globalfeatures.info) / [globalfeatures@rediffmail.com](mailto:globalfeatures@rediffmail.com)  
Annual Subscription Rates - India: Rs. 600; Overseas: US\$ 60 (Rates include airmail charges).

Printed and Published by Chandragupta Amritkar on behalf of Global Features B-701, Customs Colony, Military Rd, Marol, Andheri(E), Mumbai-400 059 and Printed at Sumangal Press Pvt. Ltd. "Sumangal" G-8 Cross Road "A", Near Marol Bus Depot, MIDC, Andheri (East), Mumbai - 400 093.

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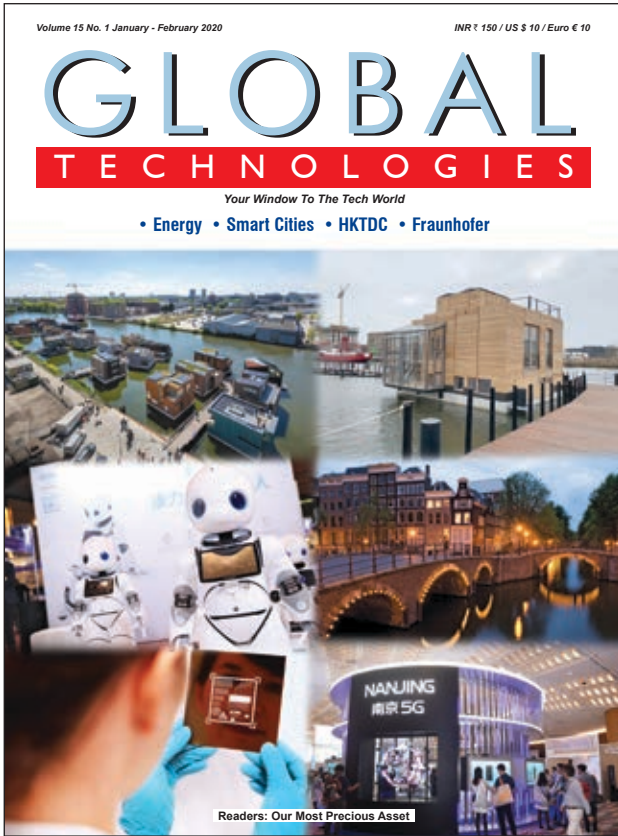
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# Innovations in the field of energy

Energy is very important in today's world. And energy conservation is a must as we humans tend to use energy faster than it can be produced. As we go ahead nonrenewable energy and innovative energy management systems is the future. Quite a few innovations are happening across the globe and we focus on a few of them

## A communal energy hub

The amount of energy produced by renewable sources ebbs and flows. The Fraunhofer Institute for Industrial Mathematics ITWM has found a smart work-around for these fluctuations. Its scientists developed an innovative energy management system that connects photovoltaic systems, batteries, heat pumps and electric cars to power individual households or entire neighborhoods with locally produced renewable energy.



One of the first houses to be anchored. © Fraunhofer

Houseboats have long been a fixture of cityscapes in the Netherlands. Many grace Amsterdam's waterways, but a new neighborhood in the city features a breed of floating home that is nothing like the traditional Dutch houseboat. Equipped with a sophisticated renewable power supply, these 30 waterborne homes are largely self-sufficient. The grid operator laid just a single shared power line to the quayside community. This narrow-band feed serves as a backup to furnish remote power on cloudy days.

## A management system for energy communities

The Fraunhofer Institute for Industrial Mathematics ITWM and its partners in an ERA Net Smart Grids Plus project called "Grid Friends" developed the energy management system that enables this kind of autonomy. "We built on our energy management system for individual houses to develop a system for entire energy communities," says project manager Matthias Klein. "It controls photovoltaic systems and heat pumps, and recharges home and electric car batteries, thereby also supporting sector coupling." Furnishing enough energy to everyone in the neighborhood – all the time, even on

dark days and without overtaxing the shared power line to the public grid – is no simple matter.

This energy management system's structure is modular – each module may be installed individually. Collectively, they serve as a communal energy hub. This hub is always analyzing the situation to determine where the energy needs to go. The 30 photovoltaic systems, heat pumps and batteries each installed in the Amsterdam neighborhood's individual houses work as one large system. A case in point: House A's residents are on vacation, so it draws very little electricity. Consumption in house B is spiking, perhaps because its residents are throwing a party.

The management system reroutes house A's solar power to cover house B's needs, the idea being to make the most of local power and sourcing the least possible amount of remote power from the public grid. The system taps the home battery when it is dark outside and the solar unit is not generating electricity. It can do this from home to home.

## The battery module

The management system endows every module with discrete intelligence. This has several benefits. One is that the home batteries' smart controllers enable the photovoltaic systems to operate to their full capacity. This is unusual. The law limits photovoltaic systems' infeed on very sunny days. Otherwise, the installed systems' output would overload the grid. This is

why standard PV units have to be throttled just when the sun is brightest and they could generate lots of electricity. The energy management system works around this problem by rerouting the



The water settlement in the north of Amsterdam is complete since September 2019. © Isabel Nabuurs



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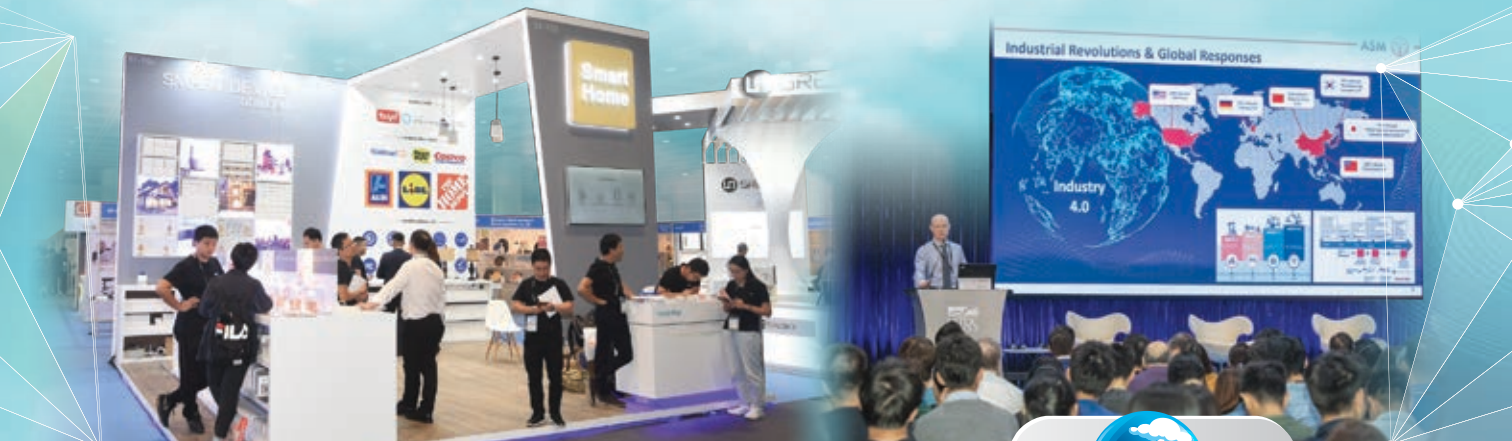
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surplus electricity that grid operators do not want to buy, and storing it in the home battery for later use.

A forecasting model boosts these batteries' efficiency. The model factors the weather forecast into its predictive equation. First, it determines how much energy the photovoltaic systems are expected to produce in the hours ahead, and how much heat is likely to be consumed. Then it applies the results of these calculations to regulate storage. For example, the PV systems run at less than full capacity when the morning sky is hazy. If the weather is expected to clear up by the afternoon so that the systems' output would have to be throttled, the energy management system will not start storing power in the morning, instead holding off until later to charge batteries. In other words, rather than following the standard practice of charging the batteries with the first kilowatt hour of electricity produced during the day, this system waits until more energy is on tap. The batteries will still be fully charged by evening, but without any solar power going to waste.

### The electromobility module

Electric cars' batteries also need charging, and the best time to do that is when PV systems are generating plenty of electricity.

However, an empty battery is not a welcome sight for drivers who need to run urgent errands. "Residents can determine the minimum charging levels for their cars simply by clicking in an app," says Klein. Fifty percent may be enough for someone who only needs the car for a quick grocery run. The system recharges the battery to the level specified by the owner when the car is plugged in. If necessary, it will fall back on electricity from the public grid. The system

will continue charging beyond this level if it is sunny outside. If not, it will wait until energy production picks up again to top off the battery. The benefits are twofold. For one, this solar 'self-consumption' brings down the electricity bill. For the other, every watt of surplus energy that is routed to local batteries rather than exported lightens the public grid's power load.

### An option not just for large communities

These modules may also be deployed individually and tailored to the given application. "There is already a permanently installed base of 60 to 70 of our systems ranging from private households and cafeterias to entire businesses and one sewage treatment plant.

While the Amsterdam system shifts peak power outputs of up to 250 kilowatts, the industry versions in place so far control 150 kilowatts," says Klein. Wendeware AG, a Fraunhofer ITWM spin-off, has been selling the system since early 2019.

## Fraunhofer connects energy production and storage

The good news is that renewables account for nearly 50 percent of electricity generated in Germany. The bad news is that they lack the flexibility to adapt to the day's fluctuating electricity demand. They only furnish electrical energy when the wind blows or the sun shines. In a perfect world, engineers would find a way to store the vast amounts of energy generated by renewables and coordinate power production and storage. And that is exactly what ES-FLEX-INFRA, a joint project led by the Fraunhofer Institute for Algorithms and Scientific Computing SCAI, aims to do.

Funded by the state of North Rhine-Westphalia, the ES-FLEX-INFRA project's express objective is to couple energy sectors in a bid to make their infrastructure more flexible. The software developed to this end aims to enable power utilities to analyze

and shift loads, and integrate storage facilities into the urban infrastructure. The TH Köln University of Applied Sciences, Werusys GmbH & Co. KG and Rheinische NETZGesellschaft mbH have joined Fraunhofer SCAI in this venture.

"What happens when demand for electricity is high but the sun is not shining? How do we use the surplus energy when the situation is reversed? If the share of renewable energies continues to grow, the individual

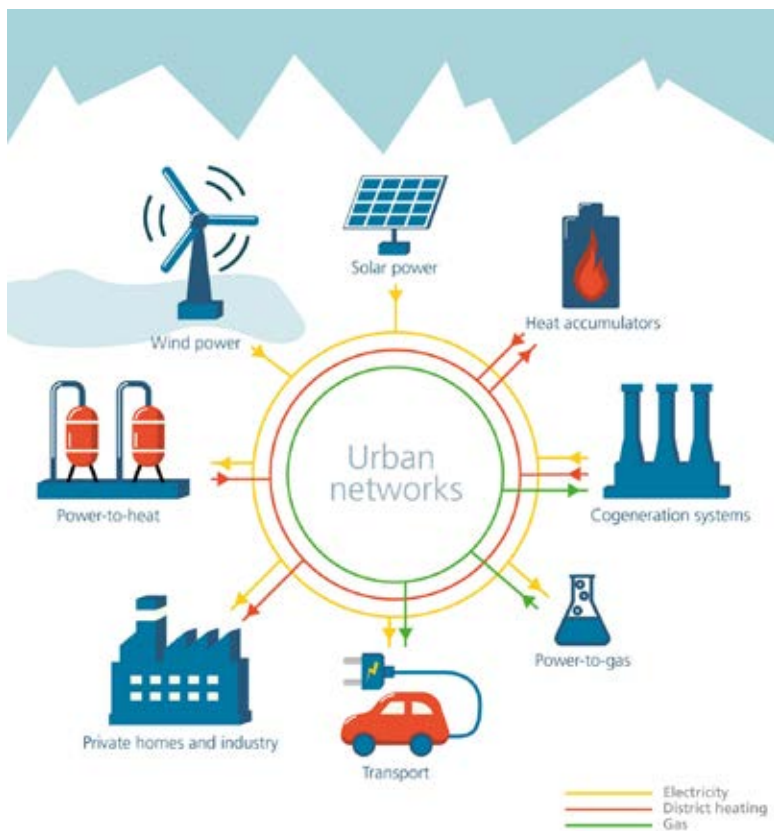
energy sectors' conventional efforts to optimize energy usage will no longer be enough. Instead, it will be necessary to link energy sectors such as electrical power, natural gas, district heating and transport," says Dr. Bernhard Klaassen, who is supporting the project at Fraunhofer SCAI. "For example, it is much more cost-effective and efficient to shift loads to balance out power generation and consumption, use industrial waste heat and store thermal energy than to store energy in the form of electricity."

### Upping efficiency with cross-energy management

Once the various energy sectors are properly connected, this sector coupling can serve to regulate production and storage also



The Fraunhofer ITWM's energy management system goes by the name of Amperix®; myPowerGrid is a platform for microgrids and energy communities. © Fraunhofer ITWM



An schematic rendering of sector coupling across urban infrastructure © Fraunhofer SCAI

of heat. An inevitable side-effect of generating electrical power, heat can be so much more than just a waste product. At its best, this type of cross-energy management would be a perfect combination of electricity and heat generation paired with the optimum storage, distribution and use of this energy. This would make renewables-based power supply far more reliable and put it on the path to mainstream acceptance as a viable, long-term solution.

The researchers ran virtual trials in simulations to develop ES-FLEX-INFRA as a software-supported study, but they also investigated exemplary selected parts from the RNG grid under varying load conditions. Their assessment addressed the electrical power, gas and heating sectors.

Some of the options that could

make the infrastructure more flexible include:

- Using heat pumps, accumulators or grids to take advantage of waste heat and other heat flows that usually go unused
- Putting power-to-gas solutions into practice to generate methane with surplus electricity while tapping power-to-gas process heat for use in cogeneration systems
- Sourcing and feeding methane into gas grids and storage facilities, and using it in cogeneration systems
- Funneling surplus electricity to electric vehicles or, via power-to-gas, to vehicles running on natural gas

### Further steps for industrial applications

“Demand for storage and other flexible options will continue to grow. The exit from fossil fuels and nuclear power is only going to be efficient and an economic success if we manage to connect the electricity, heat, gas and transport sectors – for example, by way of electric mobility or vehicles powered by natural gas – and capitalize on load flow and storage synergies,” says Klaassen.

Industry is discovering the benefits of sector coupling. The project results are gradually included into Fraunhofer SCAI's simulation software to support planning efforts, for example, for hydrogen applications. Germany's leading gas pipeline operator, Essen-based Open Grid Europe GmbH (OGE), and others are already using Fraunhofer software in industrial applications.

### Suitable energy mix for smaller communities

Solar thermal, geothermal, photovoltaic – what form of energy supply is most suitable for a particular municipality? Representatives of smaller communities are overwhelmed by



Visualization of heating demand for the municipality of Neumark (486 inhabitants) in a 100 x 100 m grid. Dark colors indicate high energy demand. The results were estimated based on the building structures. © Open Data Thüringen | virtualcitySYSTEMS GmbH | Layout: Daniel Cebulla (JENA-GEOS®-Ingenieurbüro GmbH)

a huge amount of information, which tends to exacerbate existing uncertainty. A new online tool from Fraunhofer is now helping to clarify this confusion. The tool calculates the optimal energy mix for each individual case, including funding possibilities available.

The transition to a new energy economy is imminent. However, representatives of small communities are often unable

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to envision exactly what is the best solution for them due to missing resources and know-how. Solar power, photovoltaics or geothermal? What is suitable for a community and to which percentage could each technology contribute to the community's energy needs? Are there any funding opportunities available?

**Software tool analyzes needs and possibilities**

Researchers of the Advanced System Technology Branch of the Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB-AST have developed a software tool

which analyzes the needs and opportunities for a special community. The optimization tool is one of the major outcomes of the project "Technological and Economic Energy Modeling – modTRAIL". "With our project, mayors of smaller communities can learn about technical possibilities available for the transition into a new energy economy and corresponding opportunities for funding – and the information they receive is tailored specifically to their community," says Liane Rublack, scientist at Fraunhofer IOBS-AST. "The tool uses a mixture of conventional and renewable energy sources to calculate the optimized solution for the heat and electricity generation of the community."

In four model municipalities located in the German federal state of Thuringia with fewer than ten thousand inhabitants – namely, Kahla, Werther, Neumark and Großbröningen – the researchers are already testing the tool. The procedure for decision-makers in the communities is the following: At first they have to insert the name of their municipality, whereupon they receive details about the electricity and heating demand in their locality. Afterwards, they specify their preferences for future power and heating supply. What technologies would they like to use, and which ones would they prefer to rule out? There are numerous options to choose from, including solar and wind power, battery and thermal storage units, condensing oil and gas boilers, air heat pumps and geothermal heat pumps. The

tool also elicits the decision-makers' preferences regarding other factors. Is minimizing CO2 the top priority? Or are the costs of purchasing the energy more important? Based on this prioritization, the software tool determines the mixture of energy and power plants. For example, this might be a combination of photovoltaic plants, battery and thermal storage systems, and combined heat and power plants. The output also includes the costs for installation and operation, the energy procurement costs, the amount of CO2 emissions, and the funding possibilities available.

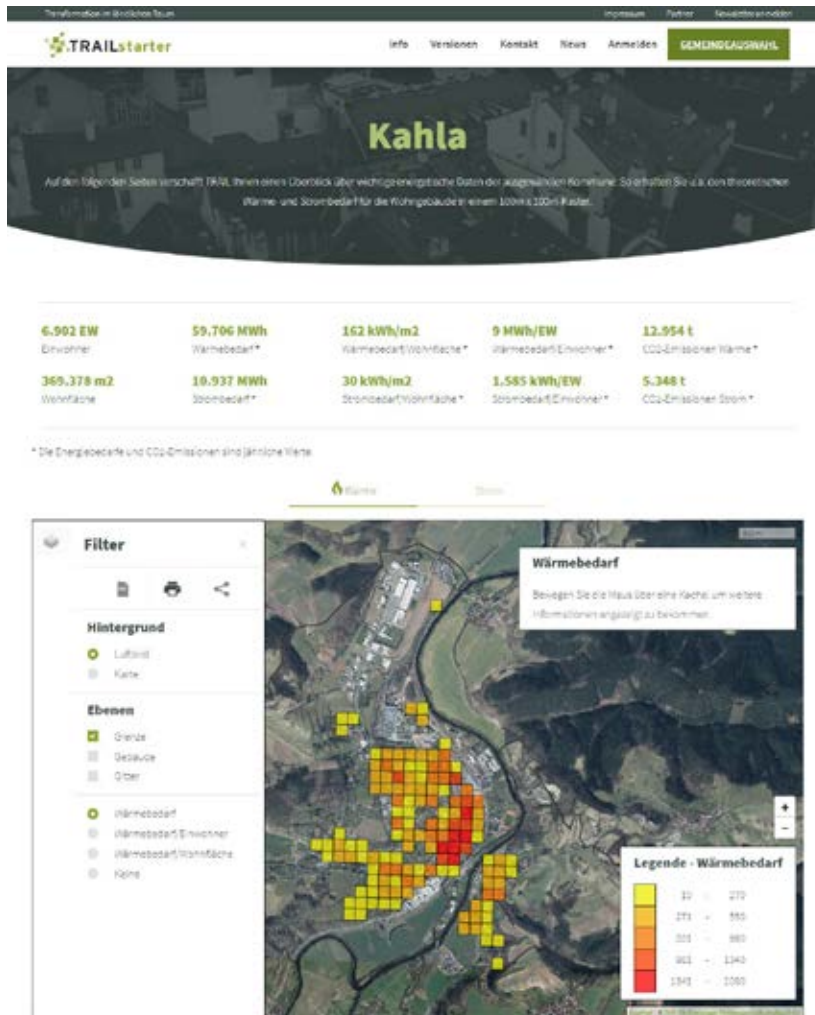
"With our optimization tool, we want to start the process and

show the mayors of small communities the potential offered by renewable energy sources for their municipalities," explains Rublack. The researchers from Fraunhofer IOSB-AST used standard load profiles for households as well as the time series for renewable energy sources recorded by the German Meteorological Service – in this case, by the Thuringia weather station at Erfurt-Weimar for their software tool. For communities in Thuringia with fewer than 10,000 inhabitants, the necessary data is already stored in the system. Nevertheless, the tool can also be used in other German states with the corresponding data.

**Lowering the barriers**

The developed optimization model is an integral part of the online software of the "Transformation in Rural Areas" (TRAIL) joint research project. The specific goal of the project is to motivate a large number of smaller communities to engage

fully with the questions of efficient energy supply by the help of the easy-to-use optimization tool. In particular, it lowers the barriers for the communities to start, which are due to limited human and financial resources. An online software tool was developed which generates initial statements about electricity and heating consumption of the community chiefly based on publicly available GIS data and census data and further existing data-bases. Furthermore, the optimization part generates recommendations for the energy transition procedure of the specific community.



The innovative online tool TRAILstarter, can help to implement measures for the regional transition into a new energy economy. © Fraunhofer IOSB-AST/Martin Käfäler

## “We do have plans to tie-up with international universities”

One of the few Polytechnics in Maharashtra that has created a niche for itself is the Muchhala Polytechnic Thane. Approved by AICTE, Government of India, recognised by DTE, Govt. of Maharashtra and Affiliated to Maharashtra State Board of Technical Education, Mumbai Muchhala Polytechnic runs 6 engineering diploma courses i.e. Mechanical Engineering, Computer Engineering, Electronics & Tele-Com. Civil Engineering, Automobile Engineering and Information Technology. Reasonably priced, these courses provide knowledge and skills to meet the demands of a growing global economy to its students. Apart from this Muchhala Polytechnic Thane, Arun Muchhala Group has two more polytechnic colleges located in Gujarat - Suraj Muchhala Polytechnic (Gondal, Gujarat) and Arun Muchhala Engineering College (Dhari, Gujarat). All the colleges have up-to-date facilities including a state-of-the-art laboratory, sufficient computer labs along with an excellent library.

The first Muchhala Polytechnic was established way back in 1994 and over a span of two decades has been successfully churning out engineers. To get an insight into the success of Muchhala Polytechnic we spoke with **Aarav Muchhala who heads the education wing of the Muchhala Group**. Excerpts

### How did the idea of having Educational Institutions originate?

Opening an Educational Institute was my father's dream and I just carried forward his dream/ legacy. My father originated from a small background. He faced lots of hardships in his life. So during his struggling days, he understood the importance of education and he decided to open/ own an educational institute.

### What are the core strength of your college?

Strength of my college is my teachers, because I feel however good the college infrastructure or facilities will be, teachers are the backbone of any institute. Without their knowledge and skills, it would be practically impossible to generate quality education. Over the years we have been getting excellent teachers, quality guest lecturers, industry stalwarts to share their experiences etc. All this has helped in nurturing excellent engineers from our college.

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cede to the demands of our teachers as far as getting the latest equipment's is concerned. They use audio- visual aids like projectors, video links, to deliver lectures and practicals. We have our own website, Facebook page etc. from where we connect ourselves with the world.

### Any plans of international tie-ups?

Yes, we do have plans to tie-up with international universities and we are working on it.

### How do you view the Indian educational market and what role the government can play for the betterment of the industry?

Indian Education system needs a lot of revamping to be done. There is plenty of government interference in day to day working of the college, which creates hindrances in lot of activities and development of the institute. In foreign countries the colleges are having autonomy. They run their courses as per Industry requirements. Here, in India the industry is different and the teaching syllabus is different. The government should think about and act accordingly.

### Any CSR activity that you would like to highlight.

Being an educational institute, we completely believe in social responsibilities. We get students from all strata of society, hence we waive off fees of the needy students as well as students of high academic excellence. Being an Institute we do arrange blood donation camps, yoga sessions, meditation sessions. We also arrange quality development, teachers Refreshers training for our teachers.





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Looking at the Social need & business perspective, we are bound to support most effective energy saving Lighting products with latest trends & technology.

We plan to achieve this goal through our strength- The employees and seek their continuous involvement in achieving the company's objective. Our rapid & sustainable development rests a great deal on the prudent use of energy & curbing its wastage. Energy conservation has to be made a way of Life, hence we are targeting Indian Business and also emerging bigway globally too.

Today we are equipped with state of the art manufacturing setup along with knowledgeable staff. We have a strong background of more than 15 yrs. vast experience in the same field. ”



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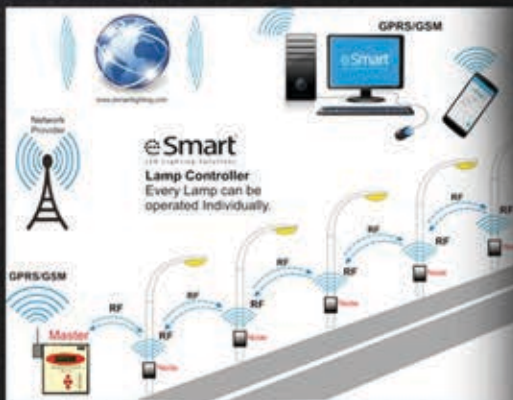
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### LED STREETLIGHT MANUFACTURING.

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- # Headquartered in Mumbai
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- # Undertakes energy saving in street lighting projects under

**PAY FROM SAVINGS MODEL**



### FEATURES/SPECIFICATIONS OF RF MODULE

- # Integrated RF for individual Streetlight control & monitoring.
- # Supports the Mesh networking protocol.
- # Six levels of step control through the RF nodes.
- # Works at SUB 1 GHz frequency band\* specific in 865Mhz-867Mhz
- # Controllable analog output voltage (0 to 10V) or 0 to 3.3V
- # Dedicated 2 Nos. inputs and 2 Nos. of outputs
- # Up to 255 nodes to be formed in the mesh network. (At least 150 numbers)
- # Operating voltage (3.3 to 5 volts)
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- # Encryption technique is AES-128.

## PRODUCTS



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## 5G and Beyond, Startup focus at HKTDC Electronics Fair and electronicAsia

As with every year HKTDC attracted lots of innovative companies. But surprised most of us was that despite social unrests, the event was able to attract more than 67,000 buyers from 141 countries including India that had a separate pavilion, says **Chandragupta Amritlar from Hong Kong**.

For the last 3 years that we have been covering global fairs like CES, CES Asia, IFA, GITEK etc we have noticed the thrust on startups is on the rise. The Hong Kong Electronics Fair was no different as the number of startups crossed a century. The 39th HKTDC Hong Kong Electronics Fair (Autumn Edition), organised by the Hong Kong Trade Development Council (HKTDC), and the 23rd electronicAsia, jointly organised by the HKTDC and MMI Asia Pte Ltd, tasted success again. Held concurrently over four days at the Hong Kong Convention and Exhibition Centre (HKCEC), the two fairs attracted more than 67,000 buyers from 141 countries and regions. More than 50,000 buyers visited the Autumn Electronics Fair while over 17,000 visitors attended electronicAsia.

“Despite the ongoing trade friction between the United States and Mainland China and the continued social unrest in Hong Kong, the twin electronics fairs and associated events ran without a hitch. The HKTDC will continue to strengthen its business-matching services and organise buying missions to create more opportunities for exhibitors and buyers through the Hong Kong platform,” said Benjamin Chau, HKTDC Acting Executive Director.

He added that the two electronics fairs saw an increase in buyer attendance from various markets, including Macao, the Czech Republic, the Netherlands, Romania, Russia, Turkey, Mexico and Iran. A wide range of renowned international electronic brands, retailers and distributors, including Brazil’s elg, Canada’s TDL Canada, the US’s Equity by La Crosse and Walmart, Korea’s Electromart (emart), Malaysia’s Ions Technologies, Indonesia’s depasar.com, Singapore’s Champ Electronics & Systems and Thailand’s Thai Habel Industrial, sourced at the fairs. Mr Chau said this demonstrates that global buyers continue to view Hong Kong as an important global trading platform for electronic products.

### India Pavillion

The bilateral trade relations among Hong Kong and India have been quite robust. India is Hong Kong 7th largest trading partner. At the 39th Edition of Hong Kong Electronics Fair 2019



ASSOCHAM (The Associated Chambers of Commerce and Industry of India) one of the apex trade associations of India brought select Indian exhibitors and an Indian delegation. The organisation represents the interests of trade and commerce in India, and acts as an interface between issues and initiatives.

### Survey: Majority hold conservative view on market outlook

The HKTDC commissioned an independent survey during the fair period, interviewing a total of 1,055 exhibitors and buyers. The survey showed that the majority of them hold a conservative view on the outlook for the electronics industry. Fifty-five per cent of respondents expect overall sales will remain steady next year, while 25% expect sales to increase and 17% expect a decrease.

The survey respondents view Korea (62%) as the most promising traditional market with the strongest growth potential, followed by Taiwan (55%). For emerging markets, the Middle East (80%) and Association of Southeast Asian Nations (ASEAN) countries (69%) are expected to show the most promise.



### Augmented and virtual reality devices show great potential

In terms of product trends, the survey revealed that three-quarters (75%) of industry players have a positive view towards augmented reality (AR) and virtual reality (VR) devices in the coming two years, of which mobile or online games have the greatest market potential.

Respondents are most optimistic regarding electronic or electrical accessories (18%), followed by audio visual products (16%) as well as computers and peripherals (12%), which are all seen as significantly more promising compared to last year.

### Buyers place on-the-spot orders

As 5G technology matures around the world, with Hong Kong’s 5G network scheduled to launch next year, this year’s Autumn Electronics Fair aligned with the latest market trend, inviting experts to share the latest 5G technology developments at the Symposium on Innovation & Technology, as well as launching the new Nanjing 5G Pavilion at the Tech Hall to showcase the latest 5G industrial and commercial applications.

Dedicated to developing innovative medical and healthcare



products through the deployment of North European technologies, MiNiSV Holding participated in the Nanjing 5G Pavilion for the first time. The company's President, Kevin Liu, said it received more than 10 orders on the first day of the fair, comprising some 5,000 product units. "These buyers are from Ireland, Spain, India and Mainland China. The biggest order came from an Irish buyer who bought 3,000 of our baby monitors. We are happy with the results so far and we'll set up a booth next year," he said.

Tuncay Gülcü, a first-time buyer from Turkey's Gulcu Security Systems, also placed on-the-spot orders at the Autumn Electronics Fair. Looking for adapters, cables and professional outdoor cameras, he was able to find four reliable suppliers and placed onsite orders worth US\$50,000 with them. He added that the recent situation in Hong Kong did not affect his decision to visit the Autumn Electronics Fair. "I believe that Hong Kong is still a safe place to do business," he said.

VIISA, a venture capital company from Vietnam, found new investment opportunities in the Startup zone at the fair. Phuc Nguyen, the company's Senior Program Manager, said: "The Startup zone has brought together some really interesting start-ups from different places to showcase interesting and attractive products and solutions. We have found four start-ups from Hong Kong and the United Kingdom. Our average investment amount is around US\$200,000 for each venture."

### The Startup zone

The Startup zone at the Autumn Electronics Fair showcased 100+ start-ups from Hong Kong, the Chinese mainland, Denmark, Japan, Korea, Taiwan and the United States that are looking to expand into international markets. A series of start-up-themed events are organised during the fair period, including the Investment Pitching Competition, Media Pitch Day, Startup Smart Launch, Meet the Mentors and sharing sessions.

### Experts discuss prospects for 5G adoption in Hong Kong

Industry experts gathered at a symposium titled "Intelligent Connectivity: 5G and Beyond", held as part of the HKTDC Hong Kong Electronics Fair (Autumn Edition) to discuss the boundless opportunities presented by 5G commercialisation.

### Changing how cities work

Peter Lemmens, Director of imec Innovation Services, provided a compelling example of how 5G was used to help an entire region of Belgium with nearly 6.5 million inhabitants revolutionise their water system. "[Our] solution in Belgium was a massive deployment of very tiny sensors that can measure pH and

chlorides in water, that you connect to an app on a mobile phone to monitor water quality in real-time," said Lemmens, explaining that the large-scale wireless sensor network pushed by 5G now maps water reserves covering 13,522 square kilometres across the whole of Belgium.

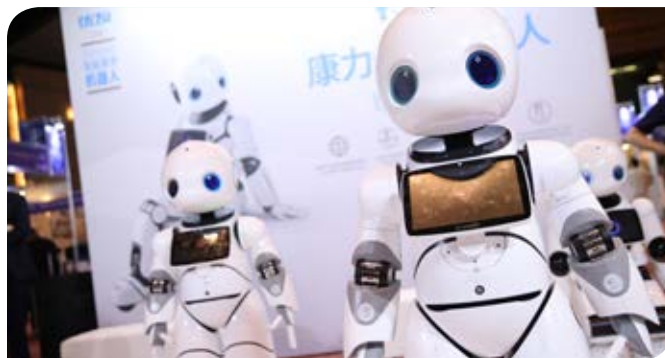
He said the design and development of innovative sensor systems has garnered lots of attention in the scientific community because of the scope and speed capabilities enabled by 5G technologies. He believed it would inspire more Internet of Things (IoT) applications and enable innovative product development with a realistic time-to-market.

### Safer drivers, safer roads

Another much lauded use of 5G is its application in smarter transport systems and for autonomous driving, providing the extremely high processing speed that can match a human operator, as well as the low latency and connectivity that can enable a new generation of applications that have not been seen before.

Ho Kai-leung, Strategic Wireless Technology and Project Officer at Hong Kong Telecommunications (HKT), said although he did not expect self-driving cars to hit Hong Kong's roads for at least another five years, they are unlocking the potential of 5G by developing intelligent transport systems that can keep drivers alert to enable a safer driving experience.

Mr Ho added that this is good news for the industry locally as the Hong Kong Science and Technology Research Institute received approval earlier this year from the Transport Department of the Hong Kong Special Administrative Region to hold autonomous driving vehicle trials for 5G research purposes – making it a more tangible possibility than ever before.



### What will 5G bring?

In 2019, the 5G rollout is happening in several leading markets and the global momentum is beginning to build. Michael Chang, CTO, Customer Operations, Greater China at Nokia Networks, said he expected that more overwhelming capabilities will exist over the horizon, and explored possibilities of what a 6G network might look like.

"We've digitised the physical world; we connect machine things together," he said. "But there's one element we have not digitised: it's the biological world. How about our feelings, our emotions? Our emotions can be digitised and uploaded to the cloud."

Mr Cheng cited the example of technology entrepreneur Elon Musk, whose company Neuralink has been quietly working on a brain-machine interface with the ultimate goal of implanting devices in paralysed humans to enable them to control phones or computers.

# Indian Smart Cities Mission

As the race for becoming smart cities intensifies in India, 99 municipalities across the country get ready to attract consultants and implementers to make their city the best. **Global Technologies** analyses the concept of smart cities.

Soon after becoming the Prime Minister Narendra Modi's one of the first initiatives was establishing smart cities - his vision to set up 100 smart cities across the country with an aim to "provide core infrastructure, a decent quality of life to its



citizens, clean and sustainable environment and application of Smart Solutions”.

Initially cities across the country bid to be selected for the plan. Municipalities hired consultants to prepare their bids listing the array of activities and ideas they would implement. As of today 99 cities have been selected to be upgraded as part of the Smart Cities Mission. The first round winners were declared in January 2016. There were 20 cities and the top three cities were Bhubaneswar followed by Pune and Jaipur. The second round winners included 13 cities of which Kolkata from West Bengal has withdrawn itself from Smart Cities Mission. The third round winners included 27 cities while the fourth round winners included 30 cities. The final round winners included 8 cities.

## What are smart cities?

Due to the breadth of technologies that have been implemented under the smart city label, it is difficult to distill a precise definition of a smart city. As per Wikipedia 'A smart city is an urban area that uses different types of electronic data collection sensors to supply information which is used to manage assets and resources efficiently. This includes data collected from citizens, devices, and assets that is processed and analyzed to monitor and manage traffic and transportation systems, power plants, water supply networks, waste management, law enforcement, information systems, schools, libraries, hospitals, and other community services. The smart city concept integrates information and communication technology (ICT), and various physical devices connected to the network (the Internet of things or IoT) to optimize the efficiency of city operations and services and connect to citizens. Smart city technology allows city officials to interact direct-

ly with both community and city infrastructure and to monitor what is happening in the city and how the city is evolving.'

Major technological, economic and environmental changes have generated interest in smart cities, including climate change, economic restructuring, the move to online retail and entertainment, ageing populations, urban population growth and pressures on public finances. While many countries across the globe are already in the process of making their cities smart. India jumped into the bandwagon in 2015.

## Smart City Features

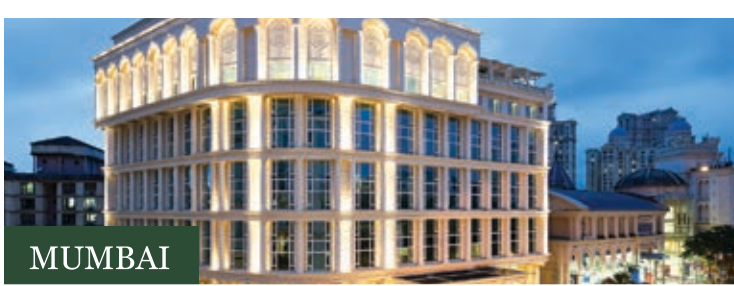
Several concepts of the Smart city rely heavily on the use of technology; a technological Smart City is not just one concept but there are different combinations of technological infrastructure that build a concept of smart city - Digital city, Virtual city, Intelligent city, Ubiquitous city (U-city), Cognitive Smart City.

Some typical features of comprehensive development in Smart Cities are described below.

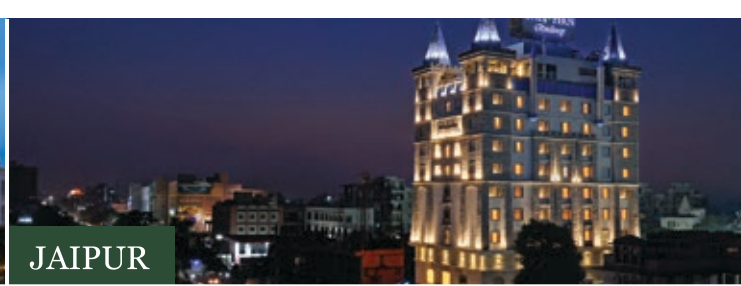
- Promoting mixed land use in area based developments—planning for 'unplanned areas' containing a range of compatible activities and land uses close to one another in order to make land use more efficient. The States will enable some flexibili-



- ty in land use and building bye-laws to adapt to change;
- Housing and inclusiveness - expand housing opportunities for all;
- Creating walkable localities –reduce congestion, air pollution and resource depletion, boost local economy, promote interactions and ensure security. The road network is created or refurbished not only for vehicles and public transport, but also for pedestrians and cyclists, and necessary administrative services are offered within walking or cycling distance;
- Preserving and developing open spaces - parks, playgrounds, and recreational spaces in order to enhance the quality of life of citizens, reduce the urban heat effects in Areas and generally promote eco-balance;
- Promoting a variety of transport options - Transit Oriented



MUMBAI



JAIPUR



BHIMTAL (NAINITAL)



GOA



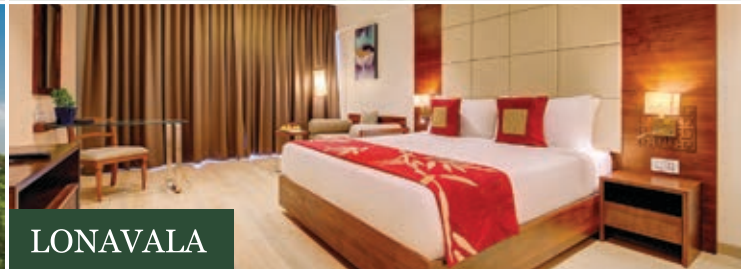
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- Making governance citizen-friendly and cost effective - increasingly rely on online services to bring about accountability and transparency, especially using mobiles to reduce cost of services and providing services without having to go to municipal offices. Forming e-groups to listen to people and obtain feedback and use online monitoring of programs and activities with the aid of cyber tour of worksites;
- Giving an identity to the city - based on its main economic activity, such as local cuisine, health, education, arts and craft, culture, sports goods, furniture, hosiery, textile, dairy, etc;
- Applying Smart Solutions to infrastructure and services in area-based development in order to make them better. For example, making Areas less vulnerable to disasters, using fewer resources, and providing cheaper services.

Smart City Features will include - Smart IT and Communications using Cloud / Open Data, IoT, Smart Transport, Smart Grid, Intelligent Street Lights, Home automation, Security Cameras, Video Intelligence / Data, Urban Planning, Geo-Spatial, Building Intelligence Monitoring (BIM), Green Building Solutions, Water monitoring and billing, Water ATMS, Solid Waste Management, Toilets, Pollution Monitoring, Clean Energy, Solar power garbage compactors, car recharging stations and energy saving lamps.

### Global Scenario

London, Singapore and Seoul make up the top three smart cities worldwide. Eden Strategy Institute recently unveiled the rankings of the Top 50 Smart City Governments globally, from a study conducted in partnership with OXD (ONG&ONG Experience Design) that analyses the diverse approaches towards developing smart cities around the world.

"Smart Cities are taking centerstage in securing an adaptable, inclusive, productive, sustainable, and resilient future for humanity. Leading the development and re-invigoration of high-performing and loveable cities is one of the grandest challenges of our time," says Mr. Calvin Chu Yee Ming, Partner at Eden Strategy Institute.

This 2018/19 rankings studied 140 smart cities, from which the Top 50 Smart City Governments were ranked across ten vectors: Clarity of Vision; Leadership; Budget; Provision of financial incentives; Support programmes; Talent-Readiness; People-centric approach; Development of an Innovation Ecosystem; Implementation of "Smart" Policies; and Track Record of previous ini-

tiatives and projects.

Six Indian cities emerged among the Top 50 Smart City Governments with smart city plans co-created with citizens, and supported by systematically-planned and mobilized budgets from the central government since 2015. **These included New Delhi, Surat, Ahmedabad & Bhubaneswar (Tie), Jaipur and Pune.**

Large IT, telecommunication and energy management companies such as Cisco, Schneider Electric, IBM and Microsoft market initiatives for intelligent cities. Cisco, launched the Global Intelligent Urbanization initiative to help cities using the network as the fourth utility for integrated city management, better quality of life for citizens, and economic development. IBM announced its Smarter Cities to stimulate economic growth and quality of life in cities and metropolitan areas with the activation of new approaches of thinking and acting in the urban ecosystem. Sensor developers and startup companies are continually developing new smart city applications.



### A Brief Report on Indian Smart Cities Mission

- A total of **99 cities** have been added to Indian Smart Cities Mission
- Top Three Cities are Bhubaneswar followed by Pune and Jaipur.
- An investment of **Rs 57,393 crore** has been proposed under smart city plans.
- Under the Smart City Mission, the Centre provides **Rs 500 crore to each city over a period of 5 years** for implementing various projects.
- The progress on smart cities has been slow as the mission is facing several implementation challenges but is expected to pick up this year.
- Each city selected will create a company **with a CEO to implement the mission.** The State and Central government will each provide the city with Rs 500 crore for the mission. So this means a total of Rs 1,000 crores in funding from both.
- The cities propose to take up various projects, including "smart" roads, rejuvenation of water bodies, cycle tracks, walking paths, smart classrooms, skill development centres, upgradation of health facilities, and pan city projects like integrated command and control centre.

## 1st Round winners

No.	Cities	State/UT
1	Bhubaneswar	Odisha
2	Pune	Maharashtra
3	Jaipur	Rajasthan
4	Surat	Gujarat
5	Kochi	Kerala
6	Ahmedabad	Gujarat
7	Jabalpur	Madhya Pradesh
8	Visakhapatnam	Andhra Pradesh
9	Solapur	Maharashtra
10	Davangere	Karnataka
11	Indore	Madhya Pradesh
12	New Delhi	New Delhi
13	Coimbatore	Tamil Nadu
14	Kakinada	Andhra Pradesh
15	Belgaum	Karnataka
16	Udaipur	Rajasthan
17	Guwahati	Assam
18	Chennai	Tamil Nadu
19	Ludhiana	Punjab
20	Bhopal	Madhya Pradesh

## 3rd round winners

No.	Cities	State/UT
1	Amritsar	Punjab
2	Kalyan	Maharashtra
3	Ujjain	Madhya Pradesh
4	Tirupati	Andhra Pradesh
5	Nagpur	Maharashtra
6	Mangalore	Karnataka
7	Vellore	Tamil Nadu
8	Thane	Maharashtra
9	Gwalior	Madhya Pradesh
10	Agra	Uttar Pradesh
11	Nashik	Maharashtra
12	Raurkela	Odisha
13	Kanpur	Uttar Pradesh
14	Madurai	Tamil Nadu
15	Tumakuru	Karnataka
16	Kota	Rajasthan
17	Thanjavur	Tamil Nadu
18	Namchi	Sikkim
19	Jalandhar	Punjab
20	Shimoga	Karnataka
21	Salem	Tamil Nadu
22	Ajmer	Rajasthan
23	Varanasi	Uttar Pradesh
24	Kohima	Nagaland
25	Hubli-Dharwad	Karnataka
26	Aurangabad	Maharashtra
27	Vadodara	Gujarat

## 5th round winners

No.	Cities	State/UT
1	Erode	Tamilnadu
2	Saharanpur	Uttar Pradesh
3	Moradabad	Uttar Pradesh
4	Bareilly	Uttar Pradesh

## 2nd Round winners

No.	Cities	State/UT
1	Lucknow	Uttar Pradesh
2	Bhagalpur	Bihar
3	Faridabad	Haryana
4	Chandigarh	Chandigarh
5	Raipur	Chhattisgarh
6	Ranchi	Jharkhand
7	Dharamasala	Himachal Pradesh
8	Warangal	Telangana
9	Panaji	Goa
10	Agartala	Tripura
11	Imphal	Manipur
12	Port Blair	Andaman & Nicobar
13	Kolkata*	West Bengal

\*(withdrawn by CM West Bengal from Smart Cities Mission)

## 4th round winners

No.	Cities	State/UT
1	Thiruvananthapuram	Kerala
2	Naya Raipur	Chhattisgarh
3	Rajkot	Gujarat
4	Amravati	Maharashtra
5	Patna	Bihar
6	Karimnagar	Telangana
7	Muzaffarpur	Bihar
8	Puducherry	Pondicherry
9	Gandhinagar	Gujarat
10	Srinagar	Jammu and Kashmir
11	Sagar	Madhya Pradesh
12	Karnal	Haryana
13	Satna	Madhya Pradesh
14	Bangalore	Karnataka
15	Shimla	Himachal Pradesh
16	Dehradun	Uttarakhand
17	Tiruppur	Tamil Nadu
18	Pimpri Chinchwad	Maharashtra
19	Bilaspur	Chhattisgarh
20	Pasighat	Arunachal Pradesh
21	Jammu	Jammu and Kashmir
22	Dahod	Gujarat
23	Tirunelveli	Tamil Nadu
24	Thoothukudi	Tamil Nadu
25	Tiruchirappalli	Tamil Nadu
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27	Aizawl	Mizoram
28	Allahabad	Uttar Pradesh
29	Aligarh	Uttar Pradesh
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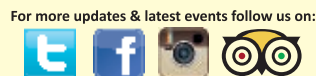
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## Photostructurable pastes for 5G applications

For many years now, miniaturization has been the main driver of the electronics industry. This is particularly true for ceramic-based circuit boards, which have properties that make them especially suitable for high-frequency circuits. Increasingly demanding technical requirements have exposed the limits of the classic thick-film technologies used for the production of circuit-board conductors. Now, however, a new generation of thick-film pastes and their photolithographic structuring enable the manufacturing of extremely high-resolution thick-film structures necessary for 5G applications. Moreover, this process is suitable for mass production and industrial applications while maintaining low investment costs and only minimally extending production times.

The next generation of mobile internet and mobile telephony is about to arrive: the fifth generation – or 5G, for short. South Korea, Switzerland and a number of U.S. cities are already using 5G. In Germany, the licenses for this standard were auctioned in June 2019. The new technology also means that the electronics used for transmitting and receiving signals will have to be much more finely structured than is currently the case. This applies equally to antennas, which will initially operate at a frequency of 3.6 GHz, before moving to higher frequencies. In terms of miniaturization, the thick-film technology currently used to produce this circuitry has now reached its limits.

As far as industrial applications are concerned, a resolution of around 50 micrometers is the absolute limit for this method. In plain terms, this means that the single electrical structures, such as conductors, are minimum 50 micrometers wide. The 5G standard, however, requires circuitry as fine as 20 micrometers and less.

### Structures with a resolution no thicker than 20 micrometers

Researchers from the Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden, in cooperation with the UK-based company MOZAIK, have now been able to solve this problem. A corresponding license agreement was signed in June 2019. “We can produce conductors with a resolution of 20 micrometers or less,” explains Dr. Kathrin Reinhardt, research associate at Fraunhofer IKTS. “The process is suitable for mass production and industrial applications, and the investment costs are low.” The process is based on screen-printing technology, the standard industry method, so companies will be able to

continue using their current equipment. Screen printing works as follows: a screen with the desired printing pattern is placed on a substrate, and a thick-film paste is pressed through the openings in the screen, thereby applying the pattern to the substrate. In the next step, the layer on the substrate is dried and then sintered at high temperatures, which creates the functional characteristics. However, the stainless-steel wires used to create the screen cannot be produced any thinner than to a certain minimal thickness. So screen printing can only be used to create structures with a minimum resolution of 50 micrometers.

Photoimaging pastes – an additional 15–30 seconds at the most

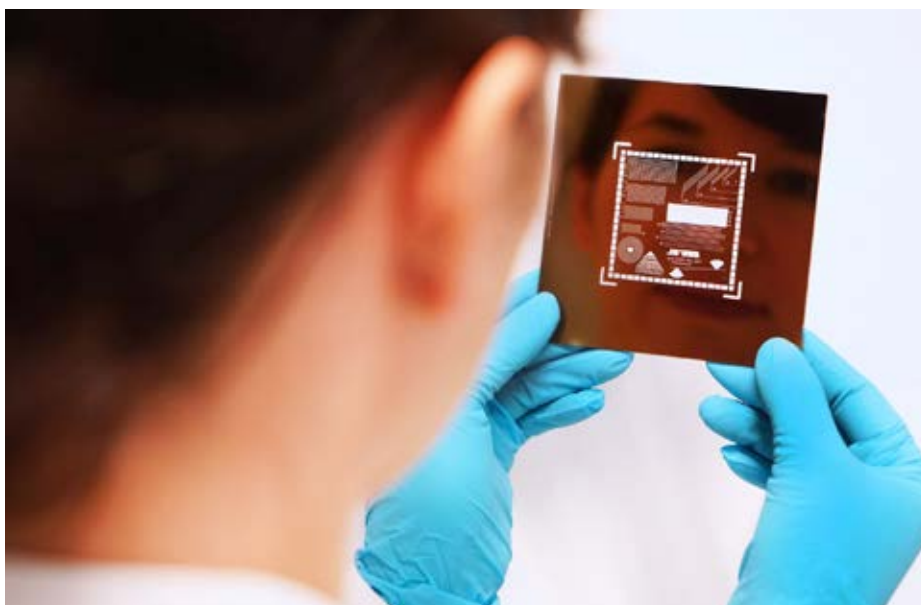
So-called photoimaging (PI) technology adds two extra steps to the standard process. “Once the thick-film structures have dried on the substrate, we then position a photomask with the final structure above the substrate,” Reinhardt explains. The entire substrate is then illuminated with UV light. A pattern of openings in the photomask allows UV light to pass through to the thick-

film layer on the substrate, where it cures polymers contained in the paste. Those parts of the substrate below the areas of the photomask without any openings are untouched by UV light, meaning that the polymers there remain uncured. The next additional step involves a wet chemical development process using water. This step removes those parts of the layer in which the polymers are uncured – i.e., those areas that were

covered by the photomask – leaving all the other parts attached to the substrate. Therefore, the previously 50 micrometer wide structures can be reduced to the desired 20 micrometers by this process, the final structure being determined by the photomask. The process now rejoins the normal procedure, whereby the substrate is sintered. Although all this sounds quite elaborate, the whole process is very simple. “In all, the two steps take only between 15 and 30 seconds each,” says Reinhardt. “And they can be easily integrated in the production process.”

### PI pastes already available for users

PI technology involves the use of customized thick-film pastes that cure reliably when exposed to UV light but remain unaffected by daylight. In other words, a costly yellow room is not required. The PI know-how comprises the precise tuning of the paste composition. For example, metallizing pastes are made up of metals in powder form (silver, gold or alloys), which will form



UV light penetrates through a patterned photomask onto a substrate, where it cures a polymer incorporated in the thick film. This technique is used to create fine structures with a resolution of as low as 20 micrometers. © Fraunhofer IKTS



# Muchhala Polytechnic



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the structures, along with a UV-cured polymer and various other additives. If there is too much metal in the paste, the layer exposed to UV light will be insufficiently cured, with the result that it will get washed off the substrate during the development process. If, on the contrary, there is too much polymer, the metal structures become porous and can no longer fulfill their function. “We had to take into account two additional parameters while developing the pastes: not just functionality but also the steps of illumination and development,” says Reinhardt. Fraunhofer IKTS researchers have already achieved this with pastes containing silver or gold. Now they are working on platinum and resistor pastes. This research is to be unveiled for the first time at the Productronica trade fair in Munich from November 12–15 (Hall B2, Booth 228).

The Italian company Aurel is developing suitable production plants exactly tailored to the new PI pastes from Fraunhofer IKTS. These will also be on show at Productronica (Hall A2, Booth 481). “This extremely promising technology is easily integrated in standard thick-film processes – a field in which Aurel has over 50 years of experience,” explains Fabio Pagnotta, sales and marketing manager at Aurel. “We have therefore opted to launch a high-performance unit, featuring LED illumination and spray jet systems, for use in both small-scale and mass production. The Aurel systems can be used as a standalone unit or as a module incorporated in a fully automated production line, where it will keep pace with the typical cycle times of a standard thick-film production line. Fine lines and combined structures represent a cost-effective alternative to thin-film and solid-state designs for applications such as HF and microwave modules, sensors, chip components, 3D stack interposers and fan-out substrates.”

### Developing embedded systems faster

Whether for the car or the drone: Developing image processing software for embedded systems takes a lot of time and is therefore very expensive. Now the Tulipp platform makes it possible to develop energy-efficient embedded image processing systems more quickly and less expensively, with a drastic reduction in time-to-market. The Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB is a member of the EU consortium which simplified the process.

At first glance drones, driver assistance systems and mobile medical diagnostic equipment don't appear to have much in common. But in reality they do: they all make increasing use of image processing components, for

example for detecting obstacles and pedestrians. Image processing can also be used with mobile X-ray equipment to ensure adequate image quality at reduced radiation levels, thus considerably reducing radioactive exposure.

In contrast to a workstation computer, where dimensions and energy consumption are not particularly critical factors, applications like these require for small, lightweight, energy-efficient image processing components that are nevertheless real-time capable. Hardware platforms based on conventional computer architectures and processors can't properly meet these requirements. This is why embedded systems using field-programmable gate arrays (FPGAs) are often used.

Field-programmable gate arrays are logic components whose circuit structure can be freely configured using a special type of programming, usually involving the low-level language VHDL. There's a problem, however: The majority of image processing applications are written in higher-level programming languages such as C/C++, and their migration to the embedded systems is highly complicated. Not only does VHDL differ greatly from other programming languages, but the code must also be adapted to the specific hardware. This means even existing VHDL programs can't be transferred to other hardware. Software developers have to start virtually from scratch with every new system.

### Starter kit for rapidly implementing especially energy-efficient embedded systems

A consortium of eight partners from six countries, including the Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB in Karlsruhe, has now considerably simplified this procedure in the Tulipp project. “The result is a development platform consisting of design guidelines, a configurable hardware platform and a real-time-capable operating system that supports multicore processors, as well as a programming tool chain,” says Dr.-Ing. Igor Tchouchenkov, group manager at Fraunhofer IOSB.

“A starter kit put on the market by one of our partners in Tulipp provides additional support. The starter kit makes developing such applications much faster and easier. Porting C++ programs to FPGA, which frequently means several months of work for the developer, can be handled within only a few weeks using the Tulipp starter kit.”

The same image with overlaid depth information from the stereo image analysis, highlighting close obstacles in red. The arrow indicates the resulting recommended evasive path.

This means the



Drone with stereo camera. The small white box holds the embedded system, which evaluates the slightly offset images from the two cameras in real time in order to detect obstacles. © Fraunhofer IOSB



Drone with stereo camera. The small white box holds the embedded system, which evaluates the slightly offset images from the two cameras in real time in order to detect obstacles. © Fraunhofer IOSB

developer first has to consider, based on the software programmed in C++, which code elements should be distributed to which hardware components and which program steps could be optimized or parallelized. The formulated design guidelines provide help with this task. Then the starter kit comes into play. It contains the configurable hardware to which the necessary sensors and output devices can be connected, the multiprocessor-capable real-time operating system, and what is called the S<sub>T</sub>H<sub>E</sub>M toolchain. The applications in the toolchain make it possible to optimize the C++ program in such a way that it can be ported to the FPGA as easily and quickly as possible. “One special focus of the toolchain is on energy optimization: after all, the aim is to design image

processing systems that can be powered by a small battery whenever possible,” says Tchouchenkov. “The toolchain makes it possible to individually display and optimize energy consumption for each code function.”

### A hundred times faster than a high-end PC

The consortium worked through three specific use cases in order to develop and test the Tulipp platform: The Fraunhofer IOSB research team addressed stereo camera based obstacle detection for drones, while other project partners worked on pedestrian detection in the vicinity of a car and on live quality enhancement of X-ray images taken by mobile C-Arms during surgical operations. In Tulipp they ported the corresponding image processing software from C++ to FPGA.

The results are impressive: The processing, which originally took several seconds to analyze a single image on a high-end PC, can now run on the drone in real time, i.e. now approximately 30 images are analyzed per second. “The speed of pedestrian detection algorithm could be increased by a factor of 100: Now the system can analyze 14 images per second compared to one image every seven seconds. Enhancement of X-ray image quality by applying noise-removing image filters allowed reducing the intensity of radiation during surgical operations to one fourth of the previous level. At the same time energy consumption could be significantly reduced for all three applications.

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A photograph of a businessman in a dark suit and tie, with his hand reaching out to touch a glowing white cloud. The cloud is surrounded by various digital icons: a desktop monitor, a laptop, a smartphone, and a globe. Arrows indicate a flow of data or interaction between these devices and the cloud. The URL "https://batoi.com" is overlaid in white text across the bottom of the image.

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