

## THE FUTURE OF ELECTRONICS AT FRAUNHOFER GESELLSCHAFT YOUR TRUSTED INNOVATION PARTNER IN INDIA

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# FOREWORD



And of course while speaking of successful initiatives, how can we not mention the 4th Fraunhofer Innovation and Technology Platform on “Smart Technologies for a Smarter Planet”. The high powered event which was partnered by the Ministry of Heavy Industry and Public Enterprises, as well as Ministry of New and Renewable Energy and sponsored partly by the Indo German Science and Technology Centre, witnessed nearly 250 Delegates from the Industry, Government and Research. More than 20 top Fraunhofer Experts presented concrete initiatives from the fields of Smart Manufacturing, Smart Energy and Smart Cities. This issue has a dedicated report on this spectacular event.

Dear Friends,

It is quite amazing that we are already at the end of 2016! Time has flown by so fast!! However when we look back at the events that unfolded this year, we can surely underscore the fact, that quite a few exciting initiatives took root and shape in the course of 2016.

One of the most important and fulfilling activities in this year has been the cooperation with the **Department of Heavy Industries (DHI)**, Govt of India. The discussions that began with the visit of Prime Minister Shri. Narendra Modi to Hannover Messe in 2015, culminated in the signing of an MoU between Fraunhofer and DHI, making Fraunhofer the Technology Resource Partner for Manufacturing in India. The MoU was signed on October 2015 in the presence of Shri. Narendra Modi and Mrs. Angela Merkel in Bangalore. Since then several activities with public sectors in India such as **HMT, BHEL, RIEL** have been initiated, and taken forward. Also in the works is a strategic intervention with clusters in India, to help prepare a Road Map and facilitate the leapfrogging of technologies in the SMEs, thus working towards building a strong supply chain in India to augment the foreign investments in Manufacturing. In the **manufacturing sector**, several projects with Industry on a proprietary basis have been initiated, many of them aiming to create a major impact and technology thrust to these clients. In the automotive sector, a Lol has been signed with the **Indian Institute of Technology Madras**, Chennai to set up a Centre for Advanced Automotive Technologies, in an applied research mode, akin to the Fraunhofer Model of cooperation with Industry. This is certain to be one of our more exciting activities in India that will take shape over the course of 2017!

Fraunhofer has been deeply involved in the subject of **Smart cities** and **Urban Infrastructure**. In Germany and indeed in Europe we have been actively engaged in creating frameworks, as well as implementing Smart City Labs in various locations such as Tiflis, Stavanger, Manchester, Eindhoven, Berlin, Prague etc. In India, as a part of the Project funded by the Federal Ministry of Education and Research (BMBF), we will be organising many workshops over 2017 in New Delhi but also Coimbatore, Kochi, Bhubaneshwar and Bangalore to showcase our competencies, learnings and best practices.

**Renewable energy** is yet another area of major focus for Fraunhofer in India. Fraunhofer released a Study on PV Industry in India, and the potential to energise the manufacturing targets in the Solar Energy Industry. In this context Fraunhofer is working closely with the Ministry of New and Renewable Energy (MNRE), as well as IREDA, and will be the Technology Partner at the **Reinvest 2017**, bringing technologies, innovations and capabilities to this show. **Skill Building** is India's most pressing need, to ensure that our demographic strength is leveraged as a dividend does not turn into a demographic disaster. The **Fraunhofer Academy** has identified India as one of its key geographies of focus to implement training and advanced qualification courses in the field of automotive, engineering, electronics, energy and Industry 4.0. For sure, 2017 will see quite a few initiatives being implemented beginning with our cooperation with the **Brij Mohan Munjal University**.

So, here we go, take a read, and do revert with your Feedback. We gear ourselves to prepare for an exciting and action packed 2017, looking forward to stronger and impactful relationships. I also take this opportunity to thank our partners, client and well-wishers for the immense support and cooperation!!

Season's Greetings, and wish you a very happy and prosperous 2017!!

Anandi Iyer



# Emerging Electronic Scenario in India

**By: Aditya Fuke, Fraunhofer Office India**

The electronics market of India is one of the largest in the world and is anticipated to reach US\$ 400 billion in 2020 from US\$ 91.6 billion in 2015-16. The market is projected to grow at a compound annual growth rate (CAGR) of 24.4 per cent during 2016-2020.

Rapid growth in domestic manufacturing of electronic components is vital for supporting the growth in electronics manufacturing. The emerging high growth areas for domestic manufacturing are LED Lighting, Automotive electronics, energy meters, solar energy and medical electronics. These products are now driving the growth of electronic component manufacturing. These products are an addition to existing segments such as telecommunications, semiconductors and industrial electronics.

## **Thrust Areas of Investment:**

### **Industrial Electronics**

Industrial electronics sector is closely linked to the investment taking place in infrastructure and industry including power sector. Process Control Equipment, industrial control systems, Test & measurement devices, Power Electronics, Automated/automation equipment and Analytical Instruments are some of the key segments of this industry.

### **Automotive Electronics**

With the growth in the Automobile industry and the increasing digitization of automobile controls, Automotive Electronics has come to occupy an important segment of the industry. While data on Automotive Electronics for the current year is not available, the production of Automotive Electronics Sector (as per available data from Gartner) is estimated to be about INR 8278 crore in 2014-15 compared to INR 5629 crore in 2013-14 exhibiting a growth of about 29%.

### **Light Emitting Diode (LED)**

One of the driving forces for growth in electronics manufacturing and for growing component demand is the Indian Lighting market. The demand for energy efficiency has brought forward an immediate need for more energy efficient products and also has pushed market towards more efficient products such as Light Emitting Diode (LEDs). Over the years, opportunities for Light Emitting Diodes (LEDs) in Indian lighting markets have materialized in automotive, communications, signage, signaling, and architecture and entertainment sectors.

### **Semiconductor Industry**

India has a very fast growing electronics system design manufacturing (ESDM) industry. India

*The Government of India expects investment proposals in electronics manufacturing to increase two times in the two years to 2017-18, giving a push to the government's 'Make in India' initiative. The Government of India has allowed 100 per cent Foreign Direct Investment (FDI) under the automatic route in Electronics Systems Design & Manufacturing sector. According to the data released by the Department of Industrial Policy and Promotion (DIPP), the electronics sector attracted foreign direct investment (FDI) worth US\$ 1.53 billion between April 2000 and September 2015.*

Article Reference: [elcina.com](http://elcina.com)  
[ibef.org](http://ibef.org)  
[meity.gov.in](http://meity.gov.in)





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*The electronic system design and manufacturing (ESDM) industry will benefit from the Government of India's "Make in India" campaign and is projected to see investment proposals worth Rs 10,000 crore (US\$ 1.5 billion) over the next two years, according to the India Electronics and Semiconductor Association (IESA), an industry body.*

also has a strong design base with more than 120 units. According to the Department of Electronics and Information Technology (DeitY), nearly 2,000 chips are being designed every year in India and more than 20,000 engineers are working on various aspects of chip design and verification. The government has a strong focus in developing the ESDM ecosystem in India. Several subsidies and other incentives are on offer for setting up electronics manufacturing units in India. The semiconductor industry is estimated to grow from US\$ 15.02 billion in 2015-16 to US\$ 52.58 billion in 2020 at a Compound Annual Growth Rate (CAGR) of 26.72 per cent.

#### **Telecommunication Industry:**

Indian companies constituted 6.9 per cent of the global demand for telecommunication equipment in 2015-16. The industry spent Rs.137512 crores on buying gear, excluding handsets. The bulk of this money was spent on buying imported equipment, mainly from Europe and China. According to the Telecom Systems Design and Manufacturing Association (TSDMA), Indian firms that design and manufacture and also have intellectual property, had a three per cent share of the nearly Rs 50,000-crore telecom equipment market in 2014-15. Adding foreign companies that have factories in India raises the share to 10-12 per cent.

#### **Medical Electronics**

The medical electronics market is viewed as a sub-segment of the medical devices market. The product categories include-equipment, implants, flexible systems and disposables. Equipment accounts for the largest pie of the total market followed by medical implants and disposable segments, respectively. The medical electronics industry has witnessed double-digit growth in the past couple of years and this growth trajectory is expected to continue. According to a Deloitte FICCI report Indian Medical Electronics Industry Outlook 2020, the Indian medical electronics industry constituted sales of Rs. 13000 crore (USD 2.6 billion) in 2015 and is projected to reach Rs. 32,500 crore (USD 6.5 billion) by 2020, at a CAGR of 17 per cent.

#### **Investments with respect to "Make in India" campaign**

The Government of India expects investment proposals in electronics manufacturing to increase two times in the two years to 2017-18, giving a push to the government's 'Make in India' initiative. Of the 54 proposals received, the Centre has approved 30 requests entailing investments of Rs 6,000 crore (US\$ 900 million), while 24 are in an advanced stage. The Government of India has allowed 100 per cent Foreign Direct Investment (FDI) under the automatic route in Electronics Systems Design & Manufacturing sector. According to the data released by the Department of Industrial Policy and Promotion (DIPP), the electronics sector attracted foreign direct investment (FDI) worth US\$ 1.53 billion between April 2000 and September 2015.

A brief discourse on

# The future of Electronics in India

with **Dr. Ajay Kumar,**  
Additional Secretary, Ministry of Electronics  
and Information Technology,  
Govt of India.



## **Please share with us few Initiatives taken by the Ministry of Electronics and IT (MeitY) in strengthening the electronics sector in India?**

Promotion of electronics manufacturing is a priority area of the Government. Under Digital India and Make in India programmes of the Government.

Ministry of Electronics and IT (MeitY) has taken several initiatives for promotion of Electronics sector in India. These benefits are available to both foreign companies and Indian companies. The incentives/benefits are aimed at various stakeholders such as manufacturers, academia, research institutes, Students, start-ups etc.

**In manufacturing,** Modified Special Incentive Package Scheme (M-SIPS) provides financial incentives to offset disability and attract investments in the Electronics Systems Design and Manufacturing (ESDM) sector. For high technology and high capital investment units like Fabs, production subsidy @10% is also provided. Electronics Manufacturing Clusters (EMC) Scheme provides financial assistance for creating world-class infrastructure for electronics manufacturing units. For setting up of Brownfield Electronics Manufacturing Cluster, 75% of the cost of infrastructure, subject to a ceiling of Rs.50 Crore is provided. Special incentive package is available for setting up semiconductor wafer fab in the country. A High Level Empowered Committee has been set up to identify technologies and suggest incentives for attracting investments in the semiconductor wafer fabs in India. 100% Foreign Direct Investment (FDI) is permitted through automatic route for manufacturing most of electronic products.

Export incentive of 2-3% of FOB value is available under the Merchandise Exports from India Scheme. Further, zero duty EPCG scheme allows import of capital goods at zero customs duty, subject to specified export obligation. Tariff benefits are available for manufacture of several electronic products including mobile handsets, Televisions, Set Top Boxes, LED Products, Medical Electronics, Solar PV Cells, Microwave Ovens etc.

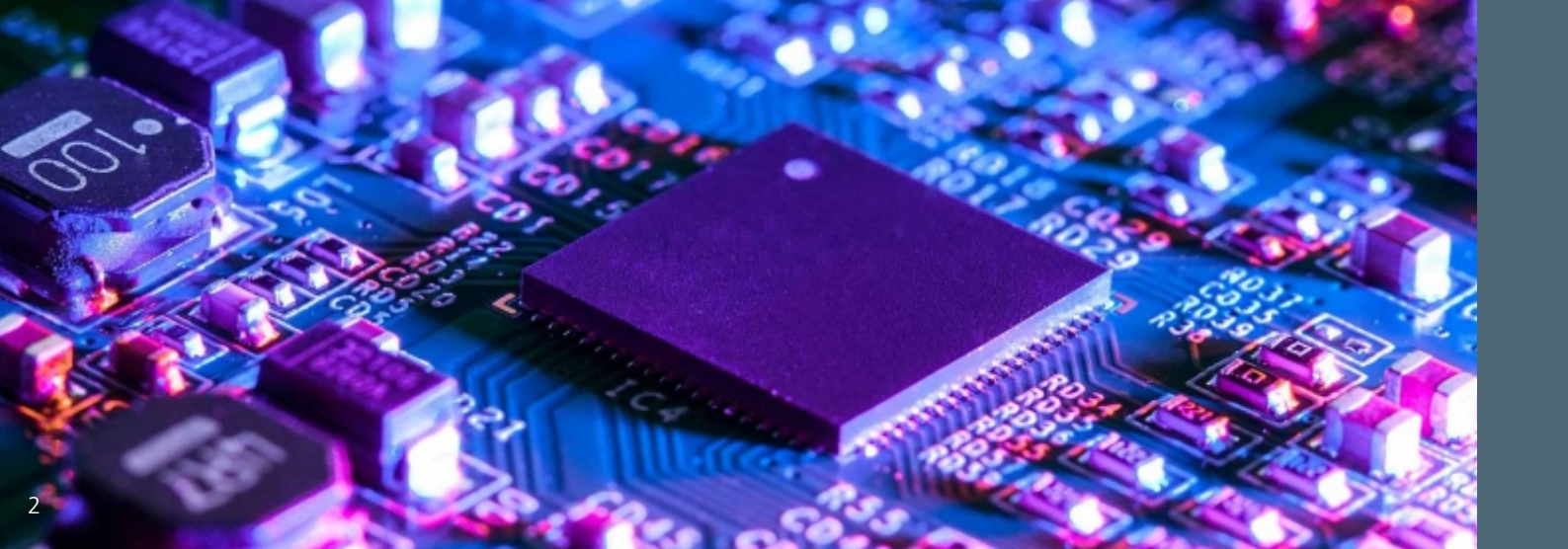
**For Skill Development:** Support from Government is available for specific skill requirement of electronics industry including foreign companies manufacturing in India. Council and Telecom Sector Skill Development Council. Government of India is supporting a quantum jump in the number of PhDs in electronics and IT in the country 3000 PhDs are fully supported by MeitY through top universities/engineering colleges including IITs/IISc/Private engineering colleges. Foreign students are also eligible to take advantage of the scheme. New Electronics and ICT Academies have been created to train faculty and professionals in emerging technologies/courseware. These Academies are collaborating with technology companies for supplying new courseware in areas like cloud, IoT, cyber security, chip design etc.

**For supporting infrastructure and new development:** Government has set up a Fund of Fund entitled "Electronic Development Fund (EDF)" which is managed by Canbank Venture

Dr. Ajay Kumar is a member of Indian Administrative Service (1985 batch). He was born on 2nd October, 1962. He has a PhD in Business Administration from the Carlson School of Management, University of Minnesota, USA and M.S. in Applied Economics from the University of Minnesota, USA and a B.Tech. in Electrical Engineering from the Indian Institute of Technology, Kanpur, India

### Key Experiences

- Additional Secretary, Department of Electronics and Information Technology, Ministry of Communications and IT, Government of India (July 2015-continuing)
- Joint Secretary, Department of Electronics and Information Technology, Government of India (Dec 2010 – July 2015)
- Principal Secretary/Secretary to the Government of Kerala, Information Technology Department, Trivandrum, Kerala (October 2007-December 2010)
- Secretary to the Government of Kerala, Industries Department, Trivandrum, Kerala (Nov. 1999 – Jan. 2003)
- Managing Director, Kerala State Electronic Development Corporation Ltd. (KELTRON), Trivandrum, Kerala (July 2000 – Jan 2003)



#### Key Experiences contd..

- Director/Deputy Secretary, NE Division, Ministry of Home Affairs, Government of India (May 1999- Nov 1999)
- Managing Director, Kerala State Agricultural and Rural Development Bank, Trivandrum, Kerala (Aug 1991-May 1992)
- Deputy Secretary, Finance, Govt of Kerala. (Oct 1989-May 1991)
- Sub – Divisional Magistrate and District Magistrate, Government of Kerala, Tellicherry and Palghat (Sep 1985- Sep 1989; May 1992 –Dec 1994)
- Instructor, Carlson School of Management, University of Minnesota, USA (Sep 2004 – May 2007)
- Taught courses on Management of Information Technology to the Undergraduate students and Executive MBA students.

Capital Fund Ltd. EDF supports Daughter Funds in the area of electronics, IT and nano-electronics. Government also supports setting up of Incubators in the country in electronics design and manufacturing. This initiative is implemented in partnership with industry and academia. “Electropreneur park”, an incubator for electronics has been set up in collaboration with Delhi University and India Electronics and Semiconductor Association. Similarly, another Incubator on consumer electronics has been set up at Kochi in collaboration with IITM Kerala and yet another on medical electronics at Patna in collaboration with IIT Patna.

A Centre for promotion of fabless chip design has been approved at IIT Hyderabad for promoting start-ups in the chip design activities. National Centre of Excellence in Large Area Flexible Electronics (NCFLEX) has been set up in IIT-Kanpur. The Centre promotes industry based R&D in the emerging area of flexible electronics. NCFLEX is looking for collaborations with similar initiatives world over. National Centre of Excellence for Technology on Internal Security (NCETIS) has been set up at IIT-Bombay with the objective to develop technologies for security needs in collaboration with industry. Centre for Excellence on Internet of Things (IoT) has been set up in Bengaluru jointly with NASSCOM with focus on promotion of “create and Use” IoT based technologies in various spheres of economy including Smart Cities, wearables, smart agriculture, smart security etc.

**For collaborative R&D:** MeitY provides support for collaborative research between an Indian company and foreign company. The assistance is operated through CII promoted organization called “Global Innovation and Technology Alliance” (GITA). MeitY also provides grant to industry for development of technology and IP in the area of medical electronics. This assistance is available through an organization called Biotechnology Industry Research Assistance Council (BIRAC).

In addition to support/incentives available from MeitY, support is also available from State Governments. Several States have come out with their own policies providing additional incentives for attracting investments in electronics design and manufacturing.

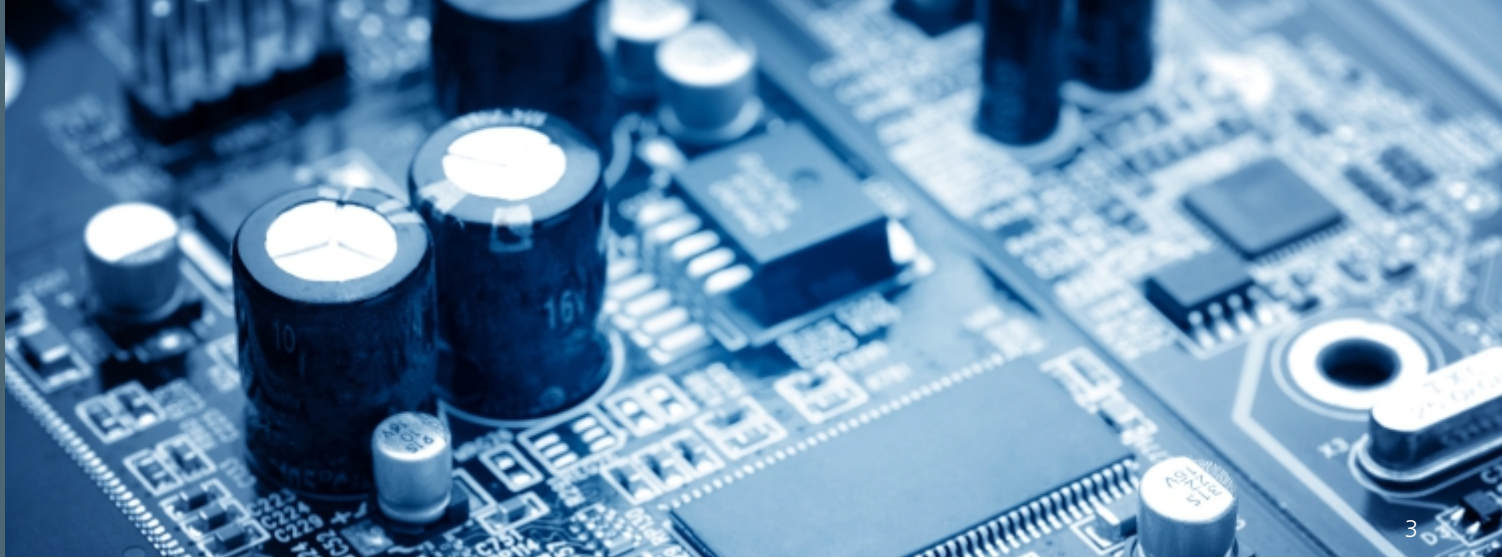
#### **What are the opportunities for public-private partnership?**

As indicated from description above, MeitY is supporting private-public partnership in electronics design and manufacturing sector. Most of the incentives are in nature of creating an enabling ecosystem which would allow private investment to flow in have a level playing field.

Specifically, public private partnerships are welcome in the following areas:

1. Semiconductor wafer fabs
2. Electronics Manufacturing Clusters





3. Daughter Funds under EDF
4. Industry specific skilling in collaboration with Sector Skills Councils (Electronics and Telecom)
5. Joint collaborative research through GITA and BIRAC. Under GITA, collaborative research can be undertaken in any area. Under BIRAC, research should be in the area of medical electronics.
6. Collaboration with NCFLEX in the area of flexible electronics
7. Collaboration with NCETIS in the area of security devices
8. Collaboration with CoE on IoT
9. Collaboration in chip design with CoE at IIT Hyderabad
10. Collaboration with Electronics and ICT Academies for new technology courseware.

**As DeitY has a "Scheme for Skill Development in ESDM under Digital India", How will the training programme be initiated?**

To facilitate skill development in ESDM sector focusing on students/unemployed youth at 9-10th standard onwards, ITI, Diploma, Non-engineering graduates, etc. to increase their employability to work in 'Manufacturing' and 'Service support' functions, MeitY is supporting **Skill Development in Electronics System Design and Manufacturing (ESDM) sector**" These schemes support skilling in over 400,000 persons. The Government provides financial assistance of 100% to SC/ST/EWS category and 75% for other categories. As on date, under both the above Schemes, a total of 1,81,722 candidates have been enrolled, out of which 1,27,508 have been trained.

The training programmes are being imparted by Training Partners duly affiliated with the Electronics Sector Skill Council of India and Telecom Sector Skill Council (TSSC) and National Institute of Electronics & IT (NIELIT) More than 1350 Training Partners (TPs)/centres, affiliated with ESSCI, NIELIT, TSSC are conducting training programmes across the country. An Expert Committee set up by MeitY has approved 80 courses (49 Service and 31 Manufacturing Courses.) so far under the Schemes.

**What are your vision for the future of electronics in India?**

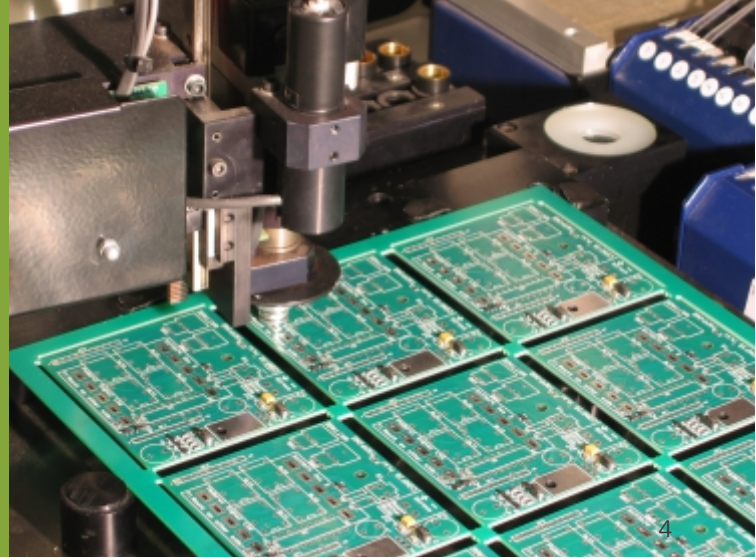
Electronics and IT Hardware manufacturing is one of the important pillar of Digital India programme and the Government has taken several steps towards promotion of the Electronics/ IT Hardware Industry. India already has many reasons to feel proud about the success of its IT-Electronics industry:

- **Internet user base:** ~500 million as on October 2016.
- **E-commerce:** USD 16.7 billion by FY 2015-16.
- **Smartphone penetration:** Second largest user of smartphone in the world. Currently, about 270 million smartphones in use.
- **e-Governance services:** Transactions - Count 65 crores per month.

Figures in US\$ Billion

	2013-14	2014-15	2015-16
Total FDI inflows in India	24.3	30.9	40.0
FDI in Computer SW & Hardware	1.13	2.30	5.90
YoY% growth (Computer SW & Hardware)	32.0%	39.0%	157.0%

**Tremendous growth in Computer SW & Hardware FDI inflow (2013-16)**



- **Aadhaar enrolment:** ~ 1.07 Billion as on October 2016.
- **Innovation and Start Ups:** Nearly 3-4 start ups every day.

According to recent studies, the demand for electronics hardware will grow rapidly. Thus, there is a big opportunity for stepping up production of electronics hardware in the country. India has the potential to become the new destination for electronics hardware manufacturing hub of the world.

The Government initiatives have resulted in spectacular growth of investments in electronics manufacturing. Investments of nearly USD 20 Billion from nearly 225 units have materialized. Several global majors have made India as their hub not only for the India or South Asia market but also for Middle East Asia, Africa and Europe. One example of success is the progress in mobile handset manufacturing in the country. 40 new manufacturing units have been established during past 18 months. It is estimated that mobile handset production in India would grow to 500 million nos. by the year 2019-2020 with total employment potential for 15 lakh persons. Considering the unprecedented growth witnessed in this sector during the past one year, it may only be a matter of time before India truly becomes the Global manufacturing HUB.

#### **As Fraunhofer is now supporting CDAC and SAMEER to become industry oriented R&D Centres in India, what is the vision for the collaboration according to you?**

"The core objectives of the project are to form the technological innovation and conversion capabilities. Main aim of the project is to build up and run SAMEER and CDAC in a self-sustaining way, i.e. to generate revenues from industry and project funding sources to cover costs and investments."

At the outset, Fraunhofer IPK would support these Institute's to structure the future business model, define the overall strategy and create a best-in-class business plan in order to deliver it to its stakeholders to ensure the profitability and operational performance. In the next stage, it is envisaged that Fraunhofer IPK will support SAMEER's and C-DAC's management to plan the operational implementation of the Institute and to develop an implementation roadmap as well as a monitoring system to strategically manage the implementation of the business model, as defined in the strategic business plan (Work Package 1).

We look forward to successful collaborations in these two projects so that it opens doors for further collaborations. Fraunhofer has been a model for the world in collaborative R&D between Government and industry. We look forward to associating with Fraunhofer and learning from their experience.



# The future of Micro Electronics

in conversation with

**Prof. Dr. rer. nat. Christoph Kutter,**  
Director, Fraunhofer EMFT



## **What are the emerging trends in the field of microelectronics globally?**

According to the recently published high tech strategy of the German federal government, the following trends will be shaping the future of microelectronics:

Multifunctional electronic systems („More than Moore“) and system integration technologies, Power electronics for energy efficiency, Innovative tools for chip and system design, Chip-based security technologies, Novel production technologies – precise, reliable and cost-efficient. Innovation and research activities in these areas are mandatory for tackling the grand challenges facing our society on a global scale today and in the future.

## **What are the prospects for Indo German collaboration in this field?**

The German R&D landscape has a strong background in most of these areas, especially in the fields of sensor, analog, opto and power technologies. India is very strong in software development and in integrated chip design. Bringing together these competences holds great potential for successful R&D collaboration between the two countries. Such activities could be supported by suitable bilateral research programs and targeted technology transfer undertakings.

**The Electronic market in India is expected to be a \$400 billion worth by 2020, which is currently stated at \$91 billion (source: India Brand Equity Foundation). The thrust areas of investment observed are semiconductor manufacturing i.e. ESDM (electronics system design manufacturing), telecommunication equipment manufacturing, medical electronics, automotive electronics & Solar energy. Can you please highlight some of Fraunhofer's competencies in the aforesaid areas?**

The 67 Fraunhofer institutes can flexibly combine their competences, depending on the individual requirements and goals of each collaborative undertaking. Institutes working in related subject areas also cooperate in Fraunhofer Groups and foster a joint presence on the R&D market. The Fraunhofer Groups include: Information and Communication Technologies, Life Sciences, Microelectronics, Light & Surfaces, Production, Defense and Security and Materials and Components.

Whereas all the Fraunhofer Groups can certainly contribute to the observed thrust areas of investments in India to a certain degree, one of the most relevant ones is probably the Fraunhofer Group for Microelectronics with its combined core competences: semiconductor-based technologies, sensors and sensor systems, power electronics and system technologies for energy supply, design for smart systems, RF and communication technologies, quality and reliability, and system integration technologies. Bundling the core competences of the member institutes allows sector-specific, holistic and tailor-made system developments for the industry partners.

Christoph Kutter is the director of the Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT since 2012. Additionally, he holds the professorship with focus on Solid State Technologies at the Universität der Bundeswehr München. His focus areas at Fraunhofer EMFT are research and development of sensors and actuators for the internet of things, utilizing new sensor materials, silicon technologies, flexible electronics and microdosing systems. From 1995 to 2012 Christoph Kutter held various executive positions at Infineon Technologies AG and Siemens AG, such as heading the development of communication products, the chip card and central research. Christoph Kutter was responsible for several central improvement projects aiming at increasing efficiency in research and development, as well as leading the enterprise-wide innovation initiative. From 1990 to 1995 Christoph Kutter worked as a research scientist in the High Magnetic Field Laboratory (Max-Planck Institute for Solid State Physics) in Grenoble, France. He received his Dipl. Phys. degree from the Technical University Munich and his Dr. rer. nat. degree in 1995 from the University of Constance.



The research work at Fraunhofer EMFT is based on the core competences of the institution, combining silicon technology with flexible electronics and chemical sensor materials in order to create new kinds of sensor and actuator systems. The real strength of Fraunhofer EMFT lies in the interaction between these competence areas: after all, innovations often emerge when several disciplines are combined. Due to its long history in microelectronics, the background and experience of Fraunhofer EMFT staff is very broad, allowing the employees an excellent knowledge of the world of microsystem technologies. Their high level of motivation results in exceptional commitment and dedication, ultimately producing outstanding results. When defining its research fields, Fraunhofer EMFT always attaches priority to practical application, assessing the market importance and feasibility in dialogue with its partners and customers. This allows the researchers to optimize their contribution for the ultimate benefit of the customers.

[www.emft.fraunhofer.de](http://www.emft.fraunhofer.de)

**With the Prime Minister Shri, Narendra Modi's initiative of Make In India the foreign direct investment inflow in India has leapfrogged in the past few years to \$17.29 US Dollar today (source: Department of Electronics & Information Technology, Govt. of India (DeiTY)). Do you see Fraunhofer EMFT collaborating with OEM's in India as a technology resource partner?**

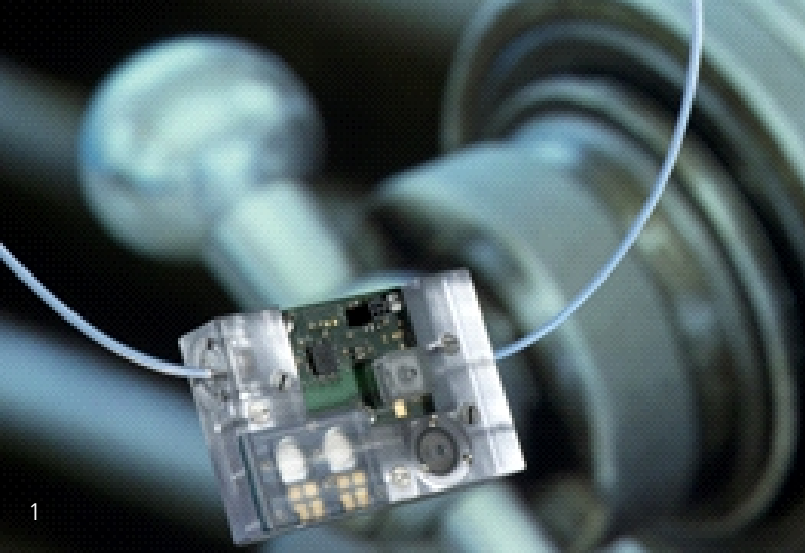
Fraunhofer in general is already pursuing several activities outside Germany as a technology resource partner to industry today. Important is to achieve a win-win situation for both parties, i.e. lasting, successful business relationships are only possible, if both partners benefit from the cooperation. For Fraunhofer EMFT it would be important to build trustful, long-term relationships to industrial partners in India. Cooperation with Indian industry could also be established via a German company having operations, OEM's or strategic industry partners in India, since supporting the German industry abroad is of particular interest to Fraunhofer.

**One of the factors hampering the growth of electronics in India is lack of targeted & proactive R&D in collaboration with industry. What scope do you see for Fraunhofer EMFT in India.**

Fraunhofer EMFT could envision delivering innovative technology to OEM's in India e.g. in the field of semiconductor manufacturing, MEMS, flexible electronics or sensor and actuator systems. The technology transfer could include common R&D activities with the industry, technology consulting by Fraunhofer EMFT or staff exchange agreements. Such activities could be financed via R&D contracts directly with the industry, or via targeted research projects funded mutually by the Indian and German government. Fraunhofer EMFT could also support the Indian research infrastructure by helping to install "Fraunhofer-like" operation models for collaborative R&D in India.

**Could you please highlight some of your recent technology inventions/innovations at Fraunhofer EMFT?**

One example of the innovative developments of Fraunhofer EMFT is the smallest micropump in the world. Reliable, nanoliter-exact micro dosing systems are essential for several applications in the medical technology, such as drug delivery or wound therapy. In the manufacturing environment, the micropump can help saving material and reducing waste, e.g. by exact dosing of lubricants for the production machinery. Another interesting recent technology project is the lab-on-foil system for point-of-care diagnosis of infectious diseases. The system is based on electronics printed on plastic foils, which enables low production costs, thus making the system suitable for disposable use in environments with no access to expensive laboratory infrastructure.



# Micro dosing system for lubricants

**Fraunhofer EMFT and an industrial partner have developed a new micro dosing system for precision ball bearings which reduces lubricant consumption by 95%.**

Precise dosing of lubricants is crucial to ensure smooth-running production - especially in the case of fully automated processes: it guarantees a long equipment service life, prevents premature wear and tear and extends the maintenance intervals required. Scientists at Fraunhofer EMFT have developed a new type of micro-quantity lubricant system in cooperation with an industrial partner. It enables controlled release of minute quantities of lubricant into precision ball bearings in high-power spindles. The self-contained dosing systems with integrated oil reservoir for an anticipated operational service life of approx. 20,000 hours are designed to be mounted decentrally on machine spindles. Piezo electrically powered silicon micro membrane pumps are at the heart of the system, developed at Fraunhofer EMFT and with a chip size of just 7 x 7 mm<sup>2</sup>. A new method of dosage monitoring was also integrated in order to ensure reproducible oil transport. This is based on a sensor principle for minute conveyance volumes, likewise developed at Fraunhofer EMFT: capacitive runtime monitoring of phase boundaries between oil and air. Another particular area of focus was that of solutions to avoid free-flow. The industrial partner supports development work by means of extensive testing on real machine tool spindles so as to assess the optimum oil quantity for stable, efficient bearing lubrication. The newly developed solution based on classic oil/air lubrication offers several advantages as compared to commercially available lubricant systems. For example, with dosage units of far less than 25 µg per second in some cases, only a fraction of the lubricant is used. In addition to making economic sense, there is also an ecological bonus. It is also worth mentioning the health benefit here: after all, it leads to a reduction in oil contamination of the air in production halls. Less oil in the bearing also means a lower coefficient of friction, which in turn increases the efficiency of high-speed spindles.

All Fraunhofer EMFT micropumps fulfil the highest requirements on security and reliability, which is essential for products in the area of medical technology, e.g.:

- High back pressure resistance with liquids and gases, making purging of clogged catheters possible
- Self-blocking free flow protection for preventing false dosing in case of excess pressure on the drug reservoir
- Methods for dosage monitoring and for detecting malfunctions • Integrated bubble monitoring and bubble separator
- The metal micropump is autoclavable several times, without negative influence on the functionality

1. Source: Pirjo Larima-Bellinghoven, Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT  
Photo Credit: Fraunhofer EMFT/Bernd Müller





# Software adapts speech to ambient noise level

*Researchers from the Oldenburg-based Project Group Hearing, Speech and Audio Technology of the Fraunhofer Institute for Digital Media Technology IDMT have developed a software that significantly improves the intelligibility of speech – even for the voices of speakers at conferences or conversations on mobile phones.*

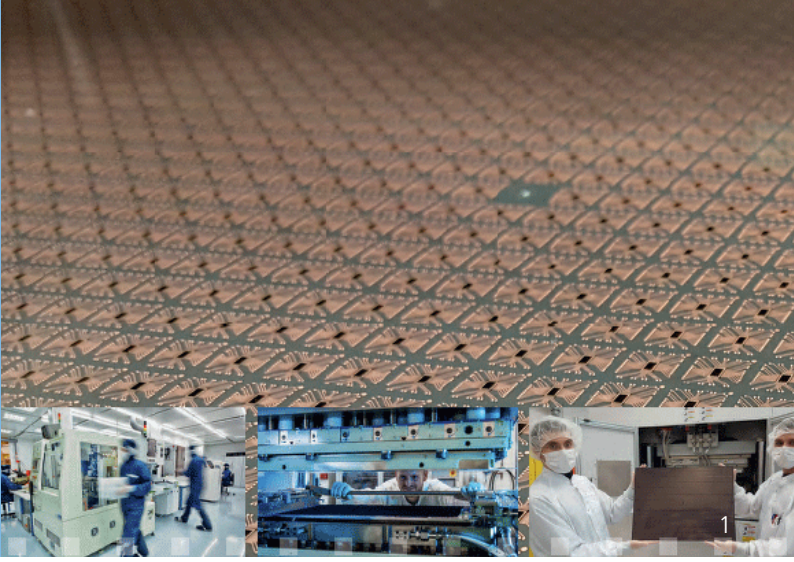
Loudspeaker announcements at railway stations are often incomprehensible, since the surroundings are noisy. With new software, the clarity of such announcements can be considerably improved. A microphone picks up ambient noise and adjusts the spoken messages perfectly to the noise level. Even calls over mobile phones will be understood more easily with the help of this technology.

## Microphone analyzes noise levels

The trick of the ADAPT DRC software is that the ambient noise is continually analyzed via a microphone, and the speech is adjusted to it in real time. "It is not enough to simply make the voice louder over the loudspeaker or mobile phone to drown out the noise," says project manager Dr. Jan Rennies-Hochmuth. Such technologies are already used today in car radios, making the voice louder, but not necessarily more easily understood, because, at high volumes, the speakers reach their limits and start to rattle. "Speech is much more complex," says Rennies-Hochmuth. Firstly, it is important to reinforce certain pitches, the frequencies, in a targeted fashion. Vowels are relatively deep, long-drawn-out word components that are easy to understand. Consonants like "p", "t" and "k", however, are very short and have higher frequencies. Even though they are very important for understanding what is said, it is generally not easy to understand them as well in noisy environments. For example, the consonants influence whether a recipient who is listening to an announcement in German thinks he has heard the word "Kasse" or "Tasse" (in English, "checkout" or "cup"). "Our algorithms are able to prioritize certain frequencies and to reinforce, at the right time, precisely those which are particularly disturbed by the ambient noise," adds Rennies-Hochmuth.

## Amplifying quiet speech components

Secondly, the software takes into account the parts of the speech signal which are of different volumes. Since spoken language is composed of loud and quiet parts, experts use the term "voice dynamics". Speech intelligibility increases particularly when loud parts are systematically subdued and quiet parts are specifically amplified. This technique is called Dynamic Range Compression (DRC). This is also of interest if, for example, you make a call using a mobile phone when you are on a noisy street. The ADAPT DRC software has already been developed to the point of application maturity and is available to industrial partners. Since modern conference equipment or mobile phones already have built-in microphones, the devices already possess the technology which is necessary to be able to record the ambient noise. For speaker systems at railway stations or airports, additional microphones would first have to be installed.



# Panel Level Packaging as new technology for cost-efficient manufacturing

## A milestone in manufacturing technology

Each new generation of smartphone by leading brands like Apple and Samsung is manufactured in the hundreds of thousands each day. Most of the necessary components, such as memory chips and microprocessors are purchased separately and then assembled into units in assembly plants. This means that when suppliers change the size of components, the processing flow is thrown into disarray. "If a memory chip is suddenly smaller, everything in the assembly process has to be changed," explains Dr. Michael Töpper, Fraunhofer IZM scientist. But high-pressure manufacturing environments do not allow for constantly reconfiguring an assembly process.

So what to do if a component suddenly doesn't fit anymore, because the chip is now smaller? Well, the component can be artificially enlarged and cut to size anew. Fan-out wafer level packaging is one means of accomplishing this. Here the individual chips are mounted on a temporary carrier and integrated into a new, reconfigured wafer using a molding process. Once the newly molded wafer with the embedded chips has been detached for the substrate, interconnection can be performed. Here, several chips can be interconnected or the electrical terminal pads can simply be routed to the chip surface that has been enlarged using the molding compound. In this way, extremely flexible yet miniaturized packages and components can be produced. However, the number of components that can be simultaneously processed on the reconfigured wafer is restricted by the latter's traditional maximum size of 300 mm.

A new technology is now set to do away with this limitation. Fan-out panel level packaging will be the next milestone in packaging technology and a new standard in heterogeneous 3D integration. Instead of round wafers, rectangular panels sized 610 X 457 mm<sup>2</sup> will be used, allowing the mounting of many more components simultaneously on one substrate. The switch from wafer- to panel-level technology therefore also promises a much higher production volume. The new technology will particularly shape consumer electronics, with its tablets and smartphones, and the market value for this type of packaging is estimated at 170 million USD (Yole 2016).

1. Source & Photo Credit: Fraunhofer Institute for Reliability and Microintegration IZM



Over the last three years, more than 40 million euros have already been invested into the development of wafer- and panel-level systems at Fraunhofer IZM. “We’re equally at home in both worlds. This makes us unique in terms of the equipment we offer and the techniques we can develop,” explains Dr. Tanja Braun, who is spearheading the technology reemphasis together with Michael Töpper. “We now want to work with leading industry players to develop this process further,” explains the scientist. “A networked processing chain such as here can only be advanced collaboratively.” For this reason, Fraunhofer IZM is currently bringing together a new research initiative, which already includes renowned US, Chinese, Japanese and European companies. The industry and research partners met for the first time on June 28 and 29 for an opening symposium at Fraunhofer IZM in Berlin to discuss the next steps in the collaboration.

Developing demands and the market show two main trends helping to shape the ongoing development of system integration technologies. First of all is an ongoing increase in the number of functions directly included in a system - such as electrical, optical, mechanical, biological and chemical processes - combined with the demand for higher reliability and longer system lifetime. Second is the increasingly seamless merging of products and electronics, which necessitates adapting electronics to predefined materials, forms and application environments. Only by these means systems sensors - which are often installed in extremely harsh environments - and signal processing can be implemented near to the point where signals are occurring. Large area mold embedding technologies and embedding of active components into printed circuit boards (Chip-in-Polymer) are two major packaging trends in this area.





# “Our diagnostic test combines high information content with fast analysis and low cost”

**Anna Ohlander and Ronnie Bose, a young research team at Fraunhofer EMFT, are currently busy setting up a spin-off to market a rapid diagnostic test for infectious diseases they developed themselves.**

Can you describe your rapid test system in a few words?

**Anna Ohlander:** Our point-of-care diagnosis system for infectious disease detection consists of a disposable test card and a portable reading device. The test card is a microfluidic chip fabricated in plastic foil in which we have additionally integrated various functionalities. In this tiny chip it will be possible to carry out a high-quality DNA analysis of a sample material as was previously only possible in a lab. The result will be available within one hour and minimal training and hands-on time of the user will be required. The system is designed to be portable and low power consuming in order to enable usage in low resource settings without access to a high-tech centralized lab.

What are the advantages of your product or what technological innovation does it embody?

**Anna Ohlander:** Generally, the current DNA-based infectious disease tests on the market can only show whether the pathogen is present or not. Our test allows us to identify the specific pathogen subtype. This has two very significant benefits. Firstly, each strain responds to different antibiotics. If the subtype is not known, the standard procedure is to treat the patient with a broad-spectrum antibiotic – but it is precisely this mass-scale usage that is increasingly leading to the formation of dangerous resistance. Our test enables a very specific therapy to be applied.

**Ronnie Bose:** Further, the subtype provides valuable information as to potential infection sources and transmission routes. This is helpful in terms of hygiene management in a hospital or for health authorities to prevent outbreaks. Of course, methods already exist which allow the pathogen subtype to be defined – but this involves laboratory infrastructure and takes time. The key USP of our test is that it combines high information content with speed. At the same time, it is inexpensive to manufacture and simple to use.

Currently you are setting up a spin-off to put your research activities on the market.

1. Anna Ohlander and Ronnie Bose.

2. Foil based lab-on-chip for infectious disease diagnostics.  
© Fraunhofer EMFT



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**What are the main challenges along the way from being a researcher to becoming an entrepreneur?**

**Ronnie Bose:** We had to learn to adopt an entirely new perspective and view the whole thing from the point of view of the market. When we started our business activities, we had a technological platform but we hadn't envisaged a specific application. It has been an important learning process for us: ultimately, users are not interested in how our test works from the technological aspect - it simply has to do the job and offer additional benefits as compared to competing products. We found this rather disconcerting at first - in fact we took it as something of an insult to our sense of pride as researchers (laughs).

**Anna Ohlander:** Also when looking at the current competition, the technology is not the main differentiator: the five leading providers all use technologies derived from the same family of patents, for instance. The main differences between them lie in aspects such as time of analysis, sensitivity, cost etc. Our product on the other hand is based on a different technology which will deliver a completely new level of information delivered by a DNA-based PoC test. We believe this will make a ground breaking impact on global health in the battle against multiresistance and infectious diseases.

**What are the next steps you'll be taking towards setting up your own company?**

**Ronnie Bose:** Our aim is to refine our test card within the next two years to create a complete sample-to-answer system. This would then be a good time for another round of funding talks with interested investors. If that goes well we could officially register the spin-off and start business operations. In terms of our premises we'd very much like to stay at Fraunhofer EMFT.



# Fraunhofer Innovation and Technology (FIT) Platform 2016

The Fraunhofer Innovation and Technology (FIT) Platform is the biennial flagship event of Fraunhofer in India and this year was held on 1st and 2nd of September in Hotel Taj Palace, New Delhi. The 4th Fraunhofer Innovation and Technology (FIT) Platform 2016 featured 'Smart Technologies for a Smarter Planet' encompassing the thematic areas of Smart Manufacturing, Smart Energy and Smart Cities. 4th FIT 2016 was supported by Ministry of Heavy Industries & Public Enterprises, Govt. of India and Indo German Science and Technology Centre (IGSTC). The preparation for the FIT event was initiated as early as February 2016. A deliberated database of area relevant organisations was created and four invitation mailers with the updated programme and participation registration form at different timelines were sent to nearly 2000 representatives.

## September 1st: Exclusive Networking Dinner

An exclusive pre-event networking dinner was arranged on September 1st for a blue-ribbon audience which witnessed the conflux of CEOs, bureaucrats, major stakeholders, decision makers, industry pioneers, policy makers and innovation experts from Government, Industry and Research. The exclusive pre-event networking dinner was preceded by impulse presentations by renowned experts from Fraunhofer to showcase the global scenario in the areas of Smart Manufacturing, Smart Energy and Smart Cities and suggestions to map the road for India-Fraunhofer cooperation.

**Ms. Anandi Iyer**, Director, Fraunhofer Office India evoked the session followed by the Introductory Address delivered by **Prof. Frank Treppe**, Director, Corporate Strategy and International Relations, Fraunhofer Gesellschaft, Germany.

The session progressed with the Fraunhofer Impulse Presentations by:

- **Prof. Dr. Boris Otto**, Director, Information Management & Engineering, Fraunhofer IML and Head of the Fraunhofer Innovation Centre for Logistics and IT (FILIT) who presented on Manufacturing and the global trends in Industry 4.0.,
- **Prof. Dr. Eicke Weber**, Director Fraunhofer ISE presented on Renewable Energies and leadership in the global context.
- **Dr. Jennifer Dungs**, Director, Mobility and Urban Systems Engineering, Fraunhofer IAO presented on Smart Cities and Urbanisation.
- **Prof. Dr.-Ing. Holger Kohl**, Head of the Corporate Management division, Fraunhofer Institute for Production Systems and Design Technology IPK presented on Applied Research Ecosystem.

The session culminated by a Special Address delivered by the Guest of Honour, Shri Dr. V. K. Saraswat, Former Secretary, Defence R&D and Member, NITI Aayog who also released a study prepared by Fraunhofer Institute for Solar Energy Systems ISE on **Solar Energy PV Plant**.

1. Source & Photo Credit: Fraunhofer Office India





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## September 2nd: 4th Fraunhofer Innovation and Technology Platform 2016, New Delhi

More than 25 Fraunhofer experts from various institutes participated and portrayed technology solutions for the Smart Technology situation in India. Prof. Dr. Boris Otto was the chairperson of this event. The event was a huge success and attended by almost 220 participants from Industry, Government and Research institutes from India and abroad. The event was held in New Delhi as the thematic focus will warrant participation from senior policy makers & bureaucrats who are major stakeholders & decision makers in the implementation of various government programs.

Participants' Profiles (including Indian speakers) the participating delegates were mostly of top and middle level management. Among these, 55% were mainly the CEOs, Managing Directors, Vice-Presidents, Ministry Secretaries, Advisors to the Govt. of India, etc i.e. the top level management while 41% were of middle level management. The remaining 4% were mainly junior level executives (refer figure 1.0)

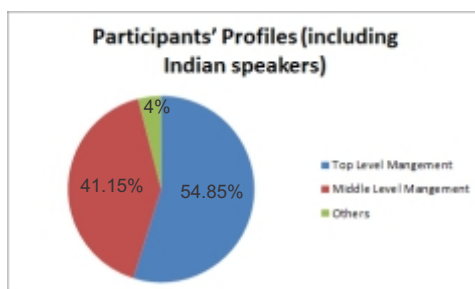


Figure 1.0

**Inaugural Plenary Session:** The event began with an Inaugural Plenary Session, 'Smart Technologies - The Key Differentiator'. Prof. Frank Treppe followed by opening statements by speakers like Mr. Graf von Schulenburg, Counsellor, German Embassy, Dr. Arabinda Mitra, Advisor & Head, International Bilateral

Coop, IGSTC & the Guest of Honour Shri. Anant Geete, Hon'ble Minister for Heavy Industries & Public Enterprises commended the session by sharing his valuable extrapolations with the gathering.

## The three parallel technical sessions of 4th Fraunhofer Innovation and Technology Platform (FIT)

: There were three parallel technical sessions on Smart Manufacturing, Smart Cities & Smart Energy, and all the participants were requested to identify their sessions of interest based on their email registrations. (refer figure 1.1) 41% of the participants expressed

interest in Smart Manufacturing, 28% in Smart Energy and 31% in Smart Cities.

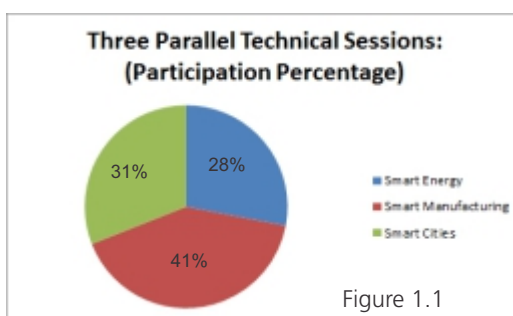


Figure 1.1

A special session was arranged for Fraunhofer Academy. Ms. Clara Tu, Fraunhofer Academy and Ms. Telsche Nielsen-Lange, Fraunhofer IWES presented the generative measures for

## 2. Inaugural Plenary Session

L-R: Ms. Anandi Iyer, Director Fraunhofer Office India, Prof. Dr. Boris Otto, Director, Information Management & Engineering, Fraunhofer IML and Head of the Fraunhofer Innovation Centre for Logistics and IT (FILIT), Prof. Frank Treppe, Director, Corporate Strategy and International Relations, Fraunhofer Gesellschaft, Guest of Honour Shri. Anant Geete, Hon'ble Minister for Heavy Industries & Public Enterprises, Mr. Graf von Schulenburg, Counsellor, German Embassy and Dr Arabinda Mitra, Advisor & Head, International Bilateral Coop, IGSTC  
Photo Credit: Fraunhofer Office India

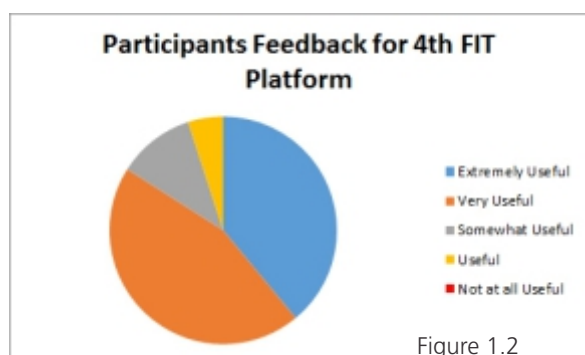


skill development through advance training by Fraunhofer. Dr. Clemens Pollerberg presented on the Ready to Market Technologies for India in a session for Fraunhofer Spin Offs.

**Concluding Session:** Shri. Amitabh Kant, CEO, NITI Aayog (National Institution for Transforming India), Govt. of India was the guest of honour for this session. He laid down his inferences for subsequent developments in India through Smart Manufacturing, Smart Energy and Smart Cities and vaticinated the role of India-Fraunhofer cooperation for a paradigm shift in transforming India to an economically and technologically progressive nation.

#### Participants Feedback:

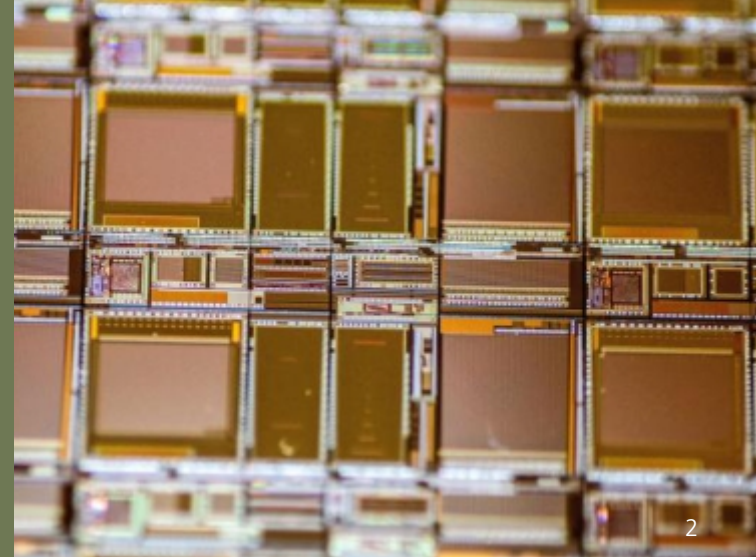
The 4th FIT also showcased the exclusive Fraunhofer exhibits juxtaposed at strategic positions. Literature tables displayed participating Institutes' flyers and Conference docket consisted of the programme, speakers' profiles, relevant Fraunhofer brochures and feedback forms. Through these forms, the participants' views about the event were collected and the same is outlined in the figure 1.2 where 84% of the total participants found the event very useful. The presentations of the Fraunhofer experts will be published on Fraunhofer India website and the link will be shared with all the participants of FIT Platform as per their request.



#### 3. Concluding Session L - R:

Dr. Jennifer Dungs, Director, Mobility and Urban Systems Engineering, Fraunhofer IAO presented on Smart Cities and Urbanisation, Prof. Frank Treppe, Director, Corporate Strategy and International Relations, Fraunhofer Gesellschaft Guest of Honour, Shri. Amitabh Kant, CEO, NITI Aayog (National Institution for Transforming India), Govt. of India, Prof. Dr. Boris Otto, Director, Information Management & Engineering, Fraunhofer IML and Head of the Fraunhofer Innovation Centre for Logistics and IT (FILIT) Prof. Dr.-Ing. Matthias Busse, Director, Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM and CEO, Fraunhofer Electromobility Forum highlighted Electromobility, Ms. Anandi Iyer, Director Fraunhofer Office India  
Photo Credit: Fraunhofer Office India

**4. Pre-event Press Conference: Media spokesperson representing Fraunhofer (R to L):** Prof Dr. Eicke Weber, Director Fraunhofer Institute for Solar Energy ISE, Prof Matthias Busse, Director Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM & CEO Fraunhofer Electromobility Forum, Dr. Jennifer Dungs, Director Mobility and Urban Systems Engineering, Fraunhofer IAO, Prof Frank Treppe, Director Corporate Strategy and International Relations Fraunhofer Gesellschaft, Prof Dr Boris Otto, Head of the Fraunhofer Innovation Center for Logistics and IT (FILIT), Ms Anandi Iyer, Director Fraunhofer Office India  
Photo Credit: Fraunhofer Office India



# Recent Research News @ Fraunhofer

## German Industry Innovation Award for Flexible Ultra-Thin Glass

Glass, thinner than a human hair, that bends and flexes? What sounds like science fiction has now become reality with the aid of the **Fraunhofer IZM**. Schott AG, one of the world's leading producers of technical glass and long-standing research partner of the Fraunhofer IZM, has won the coveted German Industry Innovation Award in the large company category for its new ultra-thin glass.

On receiving the award in Darmstadt on April 16th, Dr Frank Heinrich, Chairman of the Management Board of Schott AG, paid tribute to the close partnerships with national institutes and companies in his acceptance speech – also in recognition of the value of these partnerships for maintaining Germany's position as a leading research and technology nation.

The unique material – half as thick as a human hair at only 25  $\mu\text{m}$  – combines stability with flexibility and promises a wide range of applications: Pliant and malleable touchscreens that are near-shatterproof, or improved fingerprint recognition for smartphone encryption with much thinner scanner glass. On top of these visible and touchable applications, the new material paves the way for new technology under the surface, as ultra-thin glass has great potential for traditional semiconductor technology or novel battery solutions.

## Highly sensitive lidar sensor has no mechanical parts.

The Fraunhofer Institute for Microelectronic Systems (IMS) now has developed an innovative lidar sensor that combines an all-electronic approach with high sensitivity, enabling more cost-effective systems in the future.

Advanced driver assistance systems and autopilot systems depend greatly on the quality of their sensors. A meaningful complement to existing radar-camera combination is Lidar, but in practice, lidar sensors are regarded as too expensive for the extremely cost-conscious market of volume cars. Cameras have proved unreliable under difficult lighting situations – we remember the infamous fatal accident earlier this year when a vehicle in autopilot mode crashed into a crossing truck. “A lidar sensor probably would have identified the obstacle correctly and thus the system could avoid the crash”, comments Werner Brockherde who oversees Fraunhofer IMS' CMOS Image Sensor department. According to the researcher, lidar in combination with other components sets out the conditions for future self-learning systems that can brake and steer automatically. In automated vehicles, lidar therefore will have at least a complementing function besides radar and camera and help the systems to properly identify the surroundings of the vehicle.

1. German Industry Innovation Award for Flexible Ultra-Thin Glass

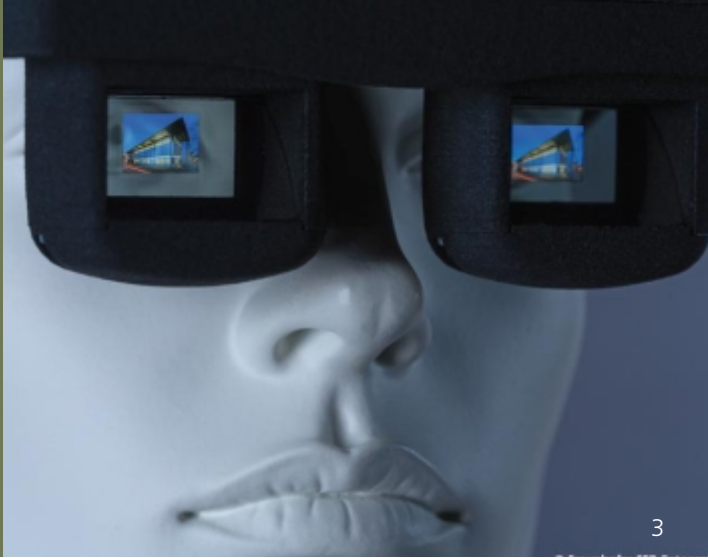
Photo Credit: Fraunhofer IZM

2. Highly sensitive lidar sensor has no mechanical parts\_

Photo Credit: EE Times Europe

In traditional lidar systems, a single laser beam is deflected to a rotating mirror. Through the rotation of this mirror, the system can capture data from the surroundings in a 360-degree angle around the sensor. Such sensors however are clumsy and, due to its high degree of mechanic parts, failure-prone. Brockherde and his colleagues at Fraunhofer IMS therefore use highly sensitive lidar sensors that do not require any a rotating mirror, and, actually no moving parts at all. The “Flash Lidar” developed by IMS transmits a single laser flash to acquire all the reflexes from the surroundings. The scientists utilize so-called Single-Photon Avalanche Diodes (SPADs) also developed at the Duisburg, Germany based Fraunhofer institute. “We do not illuminate just a point but a rectangular measurement field”, explains Brockherde.





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### **OLED Microdisplays in Data Glasses for Improved Human-Machine Interaction**

The Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP has been developing various applications for OLED microdisplays based on organic semiconductors. By integrating the capabilities of an image sensor directly into the microdisplay, eye movements can be recorded by the smart glasses and utilized for guidance and control functions, as one example. The new design was debuted at Augmented World Expo Europe (AWE) in Berlin at Booth B29, October 18th – 19th.

“Augmented-reality” and “wearables” have become terms we encounter almost daily. Both can make daily life a little simpler and provide valuable assistance for patients, athletes, and in manufacturing. With the help of the so-called bi-directional OLED microdisplays, which are developed by Fraunhofer FEP, the function of “wearable displays” and hands-free eye controlled systems are joined together in a unique way.

The advanced bi-directional OLED microdisplays of Fraunhofer FEP open up a whole world of possibilities and opportunities. The displays can be acquired in various evaluation kits for industry partners to test out their own ideas. This facilitates the integration of the displays in client-specific applications, and our scientists look forward to new research and development projects.

### **3D-integration: More performance on less space**

Heterogeneous 3D integration is a key technology for the development of miniaturized, multifunctional, high-performance devices and sensor systems. Fraunhofer EMFT has a long-standing experience in vertical integration of subsystems, especially in the field of inter-chip interconnections. This allows for highly integrated devices and systems for diverse applications. In order to expand its world-class MEMS manufacturing capabilities with the most advanced 3D integration technologies available, Fraunhofer EMFT just signed a license agreement with InvenSense Corporation, a wholly owned subsidiary of Tesser Technologies, Inc., to incorporate ZIBOND® and Direct Bond Interconnect (DBI®) technologies into their portfolio of foundry services. ZIBOND and DBI technologies are cost-effective, versatile 2.5D and 3D semiconductor integration solutions that enable leading edge functionality and accelerate time to market for MEMS and multiple other semiconductor products. ZIBOND and DBI bonding can be performed at room temperature without requiring bond pressure. Bonding is typically completed in less than a minute for an entire wafer, substantially reducing manufacturing cost. “These are truly enabling bonding and 3D integration technologies for next generation electronic products,” says Dr. Peter Ramm, department head, Heterogeneous System Integration at Fraunhofer EMFT.

### **Use Case:**

Miniaturized sensor systems for medical applications are a significant example how 3D integration technologies can be a crucial innovation motor: At present, Fraunhofer EMFT scientists are developing a highly miniaturized, self-powered pacemaker in cooperation with the partners Tyndall National Institute, University College Cork, Cork Institute of Technology, TU Eindhoven, KU Leuven, Paris University South, 3D-Plus and SORIN CRM within the EU funded Manpower-project. The main attraction is an energy harvesting system that operates at extremely low frequencies within the range of just a few Hertz. Thus, the beating heart itself powers the pacemaker – battery replacement becomes redundant. Fraunhofer EMFT contributes with its competences in the area of „Silicon Processes, Devices and 3D Integration“, deploying the Solid Liquid Interdiffusion (SLID) bonding and the Fraunhofer EMFT TSV technology for vertical integration of extremely thin (< 50 µm) chip components.

3. OLED Microdisplays in Data Glasses for Improved Human-Machine Interaction\_pic  
source Fraunhofer Institute for Organic Electronics, Electron  
Photo Credit: Fraunhofer website  
[www.fraunhofer.de](http://www.fraunhofer.de)

4. 3D integration More performance on less space  
Photo Credit: Fraunhofer website  
[www.fraunhofer.de](http://www.fraunhofer.de)



# Recent Events @ Fraunhofer Office India

## Fraunhofer Office India at Hannover Messe 2016

24th April, 2016 Hannover

This year the Department of Heavy Industry, Embassy of India in Berlin and Engineering Export Promotion Council of India (EEPC) India participated in a workshop on **"Indo-German Innovation Partnership through Industry 4.0"** during Hannover Messe 2016. As the leader in Germany's Industry 4.0/ "Smart Manufacturing" and the largest application-oriented research organization in Europe, Fraunhofer is guiding the Indian Manufacturing sector into the next level. Mr. Jan Cirullies, from Fraunhofer Institute for Material Flow and Logistics, moderated the session at the innovation workshop. He also provided the opening statement at the event & Fraunhofer office India coordinated the event. The Indian Government delegation were accompanied by Fraunhofer office India.

## Visit of German Ambassador Dr. Martin Ney & Ms. Anandi Iyer, Director Fraunhofer Office India to Chennai, Coimbatore and Kochi for 'Smart City' collaboration

19th July, 2016 India

The main objective of the visit was to initiate 'Smart City' collaboration. Fraunhofer, represented by Ms. Iyer was a part of the delegation along with Ambassador Dr. Martin Ney in all the cities. Ambassador Dr Martin Ney met with the Chief Minister of Tamil Nadu, Jayaram Jayalalithaa, in Chennai on 19th July. He reiterated Germany's commitment to contribute to Coimbatore's Smart City Project. CM Jayalalithaa assured Dr Ney full support for the German engagement in Coimbatore. They also discussed the current economic and political situation in India. Germany contributes INR 630 cr. to Integrated Water Transport System for Kochi City: In the presence of His Excellency, the German Ambassador Dr. Martin Ney, the German Development Bank KfW, mandated by the German Government, has signed the Separate Agreement to the Loan Agreement for EUR 85 million (INR 630 cr.) with Kochi Metro Rail Limited (KMRL). Kochi is one of the three smart cities chosen by the German Government for its support. Ambassador Dr. Ney remarked that "this is the first project to be signed under the climate friendly urban mobility framework of Indo-German cooperation and is a way forward for a smart Kochi".

1. Department of Heavy Industry, Government of India along with its PSUs, Embassy officials & EEPC India team at Department of Heavy Industry booth at Hannover Messe.  
Photo Credit: DHI

2. German Ambassador Dr. Martin Ney visit to Chennai for 'Smart City' collaboration addressing the media at a press conference.  
Photo Credit: German Consulate

## The European Climate Action Day: Challenges and Innovative Solutions 21st September, 2016 Bangalore

European diplomatic missions in Bangalore – representing the United Kingdom, Germany, Switzerland, and France – together with Fraunhofer as the knowledge partner organised



'The European Climate Action Day: Challenges and Innovative Solutions', on Wednesday, 21st September in Bangalore. The event brought together sectoral technology experts, researchers and decision-makers, who discussed innovative solutions to limit climate change impact with main focus on Karnataka. The event included two very topical panel discussions on 'Energy and Water: Critical Factors in Climate Change' and 'Innovative Solutions to Mitigate Climate Change'. Ms. Anandi Iyer was the moderator for the 1st panel discussion. The panellists are renowned industry experts, who were invited to shed light on the global and local scenario in the core area of "Climate Control" and suggest measures for the road ahead for international cooperation. The experts also highlighted specific technology solutions, as well as existing projects and activities for mitigating such challenges.

#### **India Innovation Study Launch 22nd September 2016, New Delhi**

Bertelsmann Stiftung concluded a study on innovation in India (executed by Roland Berger) which analyses recent developments and future trends on innovation in India and its implications for Germany and Europe. The report was launched on 22nd Sept 2016 at the Taj Mahal hotel in Delhi. Ms. Anandi Iyer, representing Fraunhofer Office India was a part of the panel discussion where she presented and shared her decades of experience in the scientific cooperation between India and Germany

#### **Cityscapes**

##### **29th September - 1st October 2016, New Delhi**

The German House for Research and Innovation Deutsches Wissenschafts- und -InnovationsHaus DWIH New Delhi organised INDO-GERMAN conference. The conference on "CityScapes" was held at India Habitat Centre, New Delhi from 29th September 2016 to 1st October 2016. The concept of CityScapes Conference was to address the various harmonious solutions to tackle the global challenges of migration and sustainable urbanization. Ms. Anandi Iyer coordinated a session on Smart Cities: Industry Perspective.

#### **IIT Madras partners with Fraunhofer Gesellschaft, Germany to establish a Centre for Advanced Automotive Research**

##### **19th October 2016, Chennai**

Indian Institute of Technology Madras (IIT Madras), Chennai signed a Letter of Intent (LoI) with Fraunhofer Institute IWU Germany on October 19, 2016, to establish an Applied Centre for Advanced Automotive Research (CAAR). CAAR is envisaged to be a Centre of Excellence focusing on providing research solutions to the automotive industries through focused R&D in association with the talent and capabilities at IIT Madras and the experience and delivery mechanisms developed at the Fraunhofer Institutes in Germany. Some of the areas of interest for CAAR will include frontiers in Light-weighting, Advanced

3. Panel discussions on 'Energy and Water: Critical Factors in Climate Change', Ms. Anandi Iyer moderating the discussion.

Photo Credit: Fraunhofer Office India

4. IIT Madras partners with Fraunhofer Gesellschaft, Germany to establish a Centre for Advanced Automotive Research. L to R: Ms. Anandi Iyer, Director Fraunhofer Office India, Mr. Achim Fabig, Consul General of Germany, Dr.-Ing. Dirk Landgrebe, Head of Fraunhofer Institute, Germany, Prof. Bhaskar Ramamurthi, Director, IIT Madras and Prof. Krishnan Balasubramanian, Dean, ICSR, IIT Madras at the LoI signing ceremony to establish a Centre for Excellence in Advanced Automotive Research

Photo Credit: IIT Madras





Manufacturing, Emission, NVH, Engineering Design and Novel Materials of interest to the automotive sector. CAAR will be developed in collaboration with Government of India organizations such as the Department of Heavy Industries as well as Industry partners including OEMs, Tier I and Tier II companies as well as associations representing automobiles as well as manufacturing sectors.

### **Workshop on Solar Energy in India: Technology, Manufacturing and Quality Standards**

**20th October 2016, Mumbai**

Fraunhofer Institute for Solar Energy Systems ISE, Germany together with Confederation of Indian Industry (CII) and Indian Renewable Energy Development Agency (IREDA) organised a Workshop on Solar Energy in India: Technology, Manufacturing and Quality Standards at Intersolar India, Mumbai. The objective of this joint workshop was to analyse and address the challenges facing the Indian solar industry. This session was an extension of the initiative to develop standards for Indian solar Industry. The workshop was coordinated by Fraunhofer Office India and began with a welcome address by Ms. Anandi Iyer, Director, Fraunhofer Office India. The speakers at the session included Mr. Ivan Saha, President and Chief Technology Officer, Vikram Solar Pvt. Ltd, India, Dr. Jochen Rentsch, Head of Department - Wet & Plasma Technologies/ Cell Process Transfer, Fraunhofer ISE, Germany, Mr. Sandeep Koppikar, CTO, Waare Energies Limited, India, and Dr. Sudhir Kapur, Chair, CII Core Group on Standards (Renewable Energy) and Managing Director, Country Strategy Consultants Pvt. Ltd, India.

5. Ms. Anandi Iyer, representing Fraunhofer Office India was a part of the panel discussion at the 'India Innovation Study Launch' where she presented and shared her decades of experience in the scientific cooperation between India and Germany.

Photo Credit: Bertelsmann Stiftung

6. Workshop on Solar Energy in India: Technology, Manufacturing and Quality Standards at the Intersolar 2016 in Mumbai L TO R: Mr. Ivan Saha, President and Chief Technology Officer, Vikram Solar Pvt. Ltd, India, Dr. Jochen Rentsch, Head of Department - Wet & Plasma Technologies/ Cell Process Transfer, Fraunhofer ISE, Germany, Ms. Anandi Iyer, Director Fraunhofer Office India, Mr. Sandeep Koppikar, CTO, Waare Energies Limited, India, Dr. Sudhir Kapur, Chair, CII Core Group on Standards (Renewable Energy) and Managing Director, Country Strategy Consultants Pvt. Ltd, India

Photo Credit: Inter Solar

### **Erfinderland Deutschland Exhibition on Land of Inventors – Research in Germany 04th to 17th Nov 2016 - Bangalore**

The Goethe-Institut dedicated this interactive exhibition to Germany, the Land of Inventors – Research in Germany, in cooperation with the Fraunhofer Institute and the Max Planck Society. Fraunhofer Office India participated in the exhibition and contributed as speakers in the inauguration and closing ceremony.

# Fraunhofer India: Recent Media Coverage

### The European Climate Action Day: Challenges and Innovative Solutions Discussions for Limiting Climate Change Impact in Karnataka Bangalore, 21st September 2016

The European Climate Action Day: Challenges and Innovative Solutions Discussions for Limiting Climate Change Impact in Karnataka Bangalore, 21st September 2016

The event will bring together sectoral technology experts, researchers and decision makers, who will discuss innovative solutions to limit climate change impact with real focus on Karnataka. The event will include new and hybrid panel discussions on Energy and Water Critical Factors in Climate Change and Sustainable Solutions to Mitigate Climate Change.

### Business Standard

**India most secured destination for overseas investment: Geete**

New Delhi, Sep 21 (PTI) Given the current global scenario, India is the most secure destination for overseas investors to pour in funds, Union Minister Asant Geete said today.

### Fraunhofer Innovation and Technology (FIT) Platform: powering smart technologies for a smarter planet

**Fraunhofer should now consider to establish their 68th Fraunhofer institute in INDIA - Minister Hi&PE Shri Asant Geete**

### भारत विदेशी निवेशों के लिए सबसे सुरक्षित गंतव्य: जीतें

नई दिल्ली, नौद्वय वैश्विक परिप्रेक्ष्य को देखते हुए भारत विदेशी निवेशकों के लिए सबसे सुरक्षित गंतव्य है। केन्द्रीय मंत्री असांत गेते ने यह ज्ञापन देते हैं। उन्होंने फिट प्लैटफॉर्म विदेशी निवेशकों से परास्वी में मुंबई में आयोजित मेक इन इंडिया सम्मेलन के दौरान संसदाध्यक्ष व पीएम मोदी की अध्यक्षता में सत्र 3 सांख्यिक वर्ष के समीक्षा बैठक में भाग लेने का अवसर भी इस अवसर पर उल्लेख किया।

### A European climate change solution for Karnataka

Rashwan Kappa, September 17, 2016, Bengaluru, CHES

Feeling under a recurring water and energy crisis, as Karnataka learns from Europe's innovative solutions to limit the impact of climate change? Engaged in a low-carbon transition to collectively face the climate challenge, Europe is now ready for a partnership with the state to share its resources, experiences and knowledge.

The first step: A European Climate Action Day on September 21, jointly organised by the Bangalore-based expatriate missions of the UK, Germany, Switzerland and France besides the Fraunhofer Institute. Sectoral technology experts, researchers and decision makers will converge for the event to shed light on 'Climate Control' linked to both global and local scenarios.

The event is a follow-up of the Paris Agreement on Climate Change that aims at capping the rise of temperature below 2 degrees Celsius by the turn of this century. To reduce carbon emissions to 40% by 2030, European Union member-states had committed to providing assistance in finance, technology and capacity-building to developing countries. India has a target of generating 100 GW of solar energy before 2022 and sourcing 40% of its electricity mix from non-fossil fuels by 2020.

The process is two-way: German Consul General in Bengaluru, Margit Hellwig-Gottke, explained, "Changing weather patterns and unexpected floods threaten Germany like any other country. Climate change is a global phenomenon and thus needs to be addressed by all of us in a joint effort."

She articulated the German approach to mitigate the effects of climate change: minimise greenhouse gases, promote use of sustainable resources and increase energy efficiency. "We are looking forward to partnering with India's highly skilled R&D experts to work together for a better future and to find innovative and comprehensive solutions to deal with the consequences of climate change."

The UK, said the British Deputy High Commissioner Dominic McAllister, is already active in India in areas of energy access, energy storage, renewables and smart grids. Climate finance and climate smart urban development he elaborated. "The event in Bengaluru will help identify the challenges we face, local innovative solutions, and ways we can work together to tackle climate change."

### indiatoday NEWS TV

**India most secured destination for overseas investment: Geete**

New Delhi, Sep 21 (PTI) Given the current global scenario, India is the most secure destination for overseas investors to pour in funds, Union Minister Asant Geete said today.

He recalled that overseas investors signed agreements worth a whopping Rs 3 lakh crore with the Government and domestic private firms during the Make in India Week in Feb in Mumbai.

"A few months ago the Make in India and Make in Maharashtra week were celebrated. During that period foreign investors signed MoUs worth Rs 3 lakh crore with the Government as well as the private sector," the Heavy Industries Minister said at a conference here.

### BusinessLine

**Fraunhofer Innovation and Technology (FIT) Platform: powering smart technologies for a smarter planet**

August 31, 2016: Business Wire India

Fraunhofer Innovation and Technology (FIT) Platforms is scheduled for Friday 2nd Sept in Delhi where international technology experts will be getting big on the prospects of International Collaboration in Smart Manufacturing, Smart Energy & Smart Cities in the near future.

### IIT-Madras partners with Fraunhofer Gesellschaft to set up Automotive research centre

The Indian Institute of Technology (IIT) - Madras will set up an Applied Centre for Advanced Automotive Research Centre in partnership with Fraunhofer Gesellschaft of Germany on its campus here, the premier institute said on Thursday.

MADRAS | October 21, 2016, 15:18 IST

Chennai: The Indian Institute of Technology (IIT) - Madras will set up an Applied Centre for Advanced Automotive Research Centre in partnership with Fraunhofer Gesellschaft of Germany on its campus here, the premier institute said on Thursday.

### India likely to source vehicle scrappage and flex-fuel tech from Germany

By ANURAG PRADEEP DESAI OCT 27, 2016

Germany delegation led by the Federal Minister of Transport and Digital Infrastructure of the Federal Republic of Germany, Alexander Dobrindt, met with the Union Minister for Heavy Industries and Public Enterprises, Asant Geete, in New Delhi on October 14, 2016, a high-powered delegation from Germany held talks with the Indian government to collaborate within the Indo-German Automobile Working Group.

### New Automotive research centre at IIT-M

By Vigneshwar Gopal THE HANS INDIAN Oct 21 2016, 08:34 AM IST

At IIT Madras, the new Automotive research centre will be established in partnership with Fraunhofer Gesellschaft of Germany. The centre will focus on developing advanced automotive technologies and promoting innovation in the automotive sector.

### Fraunhofer Innovation and Technology (FIT) Platform: Powering Smart Technologies for a Smarter Planet

October 21, 2016  
New Delhi, Delhi, India

The 4th Fraunhofer Innovation and Technology (FIT) Platform is scheduled for Friday 2nd Sept in Delhi where international technology experts will be getting big on the prospects of International collaboration in Smart Manufacturing, Smart Energy & Smart Cities in the near future.

The event is hosted in co-operation with the Ministry of Heavy Industries & Public Enterprises, Government of India & Ministry of New & Renewable Energy, Power and Mines, Government of India and supported by Indo-German Science & Technology Centre (IGSTC). It will be inaugurated by Shri. Asant Geete, Hon'ble Minister, Ministry of Heavy Industries & Public Enterprises (Hi&PE), Govt. of India.

### Intersolar India 2016: India, one of the fastest growing solar markets in the world

India InfoNews News Service | Mumbai | October 14, 2016 09:32 IST

The Intersolar India Conference and exhibition informs attendees about innovations in the battery storage industry concurrent with Intersolar India for the second year in a row.

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# UPCOMING EVENTS

## **Visit of Fraunhofer experts to India on Cluster Road Mapping in Manufacturing.**

**Date:** 20th to 29th January 2017

Workshops to develop the strategy for improving India's manufacturing value chain  
Participating institutes: Fraunhofer ISI, Fraunhofer IPT, Fraunhofer IFAM.

## **High level delegation visit from State of Baden-Wuerttemberg**

**Date:** 22nd to 29th January 2017

## **International Seminar on Machining Technologies coinciding with IMTEX 2017**

**Date:** January 26 to February 1, 2017, **Venue:** BIEC, Bangalore

## **IMTEX Forming 2017**

**Date:** January 26 to February 1, 2017, **Venue:** BIEC, Bangalore

## **Visit of Prof Karlheinz Brandeburg, Inventor of MP3 Software and Director Fraunhofer EMFT**

**Date:** 3rd to 5th February 2017

Prof Karlheinz Brandeburg will be addressing at the 'Annual International Science and Technology Festival of BITS Pilani in Goa. Fraunhofer Office India to schedule meetings Prof Karlheinz Brandeburg.

## **Global Re invest 2017**

**Date:** 15th to 17th February 2017, **Venue:** Gandhinagar, Gujrat

Fraunhofer to participate as a Technology Knowledge Partner for Ireda.

## **Indian Electromobility Delegation visit to Fraunhofer, Germany**

**Date:** Mid-February

## **ChemTECH World Expo**

**Date:** February, 14th to 17th, 2017, **Venue:** Bombay Convention & Exhibition Centre

Fraunhofer-Institut für Keramische Technologien und Systeme IKTS is participating at the exhibition to showcase developments for the chemical industry such as catalytic and chemical reaction concepts, membranes and membrane reactors.

## **WINDERGY INDIA 2017 International Conference & Exhibition**

**Date:** 25th to 27th April, 2017, **Venue:** The Ashok, New Delhi



# PROFILE: FRAUNHOFER

## **Fraunhofer-Gesellschaft**

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 67 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of 24,000, who work with an annual research budget totaling more than 2.1 billion euros. Of this sum, more than 1.8 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

## **Fraunhofer Office India**

Fraunhofer has been active in India for a long time through its individual institutes. However, the brand Fraunhofer came to India in the middle of 2008 with a concerted efforts to understand the Indian market and engage with Industry, Government and Academia. It inaugurated its representative office in Bangalore, India on October 30, 2012, housing an experience theatre which showcases some of the latest technologies and the Fraunhofer Innovation and Technology (FIT) Academy which conducts workshops, bringing Fraunhofer experts from various Institutes to connect with our clients and partners in India. The Fraunhofer Innovation and Technology (FIT) platform is another exciting initiative and annual flagship event which focuses on different thematic fields and showcases cutting edge technologies, innovation and solutions like never before. Fraunhofer works with 30 of the 50 leading companies in India and in the last few years, contracts worth nearly 10 Million Euros were signed.

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