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LOOKING BACK ON A SUCCESSFUL YEAR AND AHEAD TO A PROMISING FUTURE

Fraunhofer Institute for Systems and Innovation Research ISI looks back on a successful year 2017: Around 220 highly motivated staff worked on roughly 400 projects in order to provide our clients from industry, politics and science with options and perspectives for important decisions. This generated an operating budget of almost 24 million euros.

At the beginning of 2018, we honored particularly innovative colleagues with the Fraunhofer ISI Prize. At this award ceremony, which took place for the first time, prize winners in the categories “Excellent Qualification”, “Outstanding Doctoral Thesis” and “Best Project” were honored for their outstanding work in the year 2017. We are already looking forward to more excellent work by our researchers in the coming year.

The end of the year 2017 also marked a change of personnel in the institute’s management: Dr. Harald Hiessl, who has held a number of positions at Fraunhofer ISI since the end of the 1980s, and who has made a valuable contribution to the institute as its deputy head over the past ten years, is leaving us for a well-earned retirement. A special thank you to him from the head of the institute and all the members of staff. From February 2018, Professor Mario Ragwitz will work alongside Professor Marion A. Weissenberger-Eibl as deputy director of the institute.

Once again this year, our six scientific Competence Centers did excellent work. We give you some examples of their projects in this annual report. These include decentralized energy networks made up of many small energy sources, support for the ASEAN network in implementing renewable energies and energy efficiency, the development of future strategies for responsible research, accompanying a stakeholder dialogue to reduce trace substances in water, identifying the innovation potential for industrial biotechnology, and evaluating the effect of equality measures in research and development.

As these projects can only give you an exemplary insight into our activities, you will find a list of all the projects we worked on in 2017 at the end of this report. The extensive annex also provides information about the teaching activities and lectures of our scientists, the doctoral theses completed in the past year and our visiting researchers.

We hope you enjoy reading this report and we would be delighted to receive your personal comments and feedback.

Prof. Marion A. Weissenberger-Eibl
Director of the Institute

Dr. Harald Hiessl
Deputy Head of the Institute
"WE SHOULD FOCUS MORE ON THE POSITIVE ASPECTS OF DIGITALIZATION"

Digitalization is often viewed critically in Germany. This is partly due to the fact that the country needs to do a lot of catching up with regard to digitalization and that a very gloomy picture is often painted of its effects. And yet digitalization offers countless opportunities for business and society that should be emphasized and exploited to a greater extent.

An interview with the institute’s director Professor Weissenberger-Eibl.

Ms. Weissenberger-Eibl, the topic of “digitalization” is currently the subject of intensive discussions in German industry as well as politics and science. Do you think this will be the big topic in the years ahead?

Weissenberger-Eibl: Yes, I think you could call this a “mega topic” and a huge challenge that will have large impacts on society in the next few decades. The majority of industrial sectors will experience changes due to digitalization in the near future. It can be assumed that the German technology sector will be the most strongly affected. But there are other fields like the media, telecommunications or finance, where data transfer already plays a pivotal role. This trend will accelerate rapidly, because so many sectors and businesses are integrated in large networks where data already contribute to digital value added. And this will continue to increase.

“DIGITALIZATION IS A MEGA TOPIC AND A HUGE CHALLENGE THAT WILL HAVE LARGE IMPACTS ON SOCIETY”

Does digitalization have the potential to alter the very foundations of our previous economic system?

Weissenberger-Eibl: Digitalization will certainly have a huge influence on how we do business and on the economic system as a whole. For instance, it could contribute to the emergence of many more microfirms in Germany, which would imply a major change to the country’s economic structure. Digital technologies, in particular, and an increased trend towards do-it-yourself are fostering these developments. Using digital 3D printing techniques, for example, such microfirms could make parts whose large-scale production does not pay off for large companies. In addition to this, digitalization could also establish a new culture of exchange, in which even industrial firms use online tools or portals to offer others their own machines, tools or even production lines for hire or for exchange. In this context, it is often said that Germany has a lot of catching up to do when it comes to digitalization – as the head of an internationally leading innovation research institute – what is your view of this?
GERMANY IS CURRENTLY NOT A WORLD LEADER
This is partly because Germany has invested too little in broadband connections. The penetration rate of fast fiber-optic Internet in Germany and other European countries is low. In Estonia, 73 percent of households can say the same; in rural regions, this figure can drop to less than two percent. In a comparison of OECD countries, therefore, Germany ranks 28 of 32 for the provision of fiber-optic Internet. Regardless of whether we look at the digital economy, education or digital research and technologies – the results are never very good.

"GERMANY IS CURRENTLY NOT A WORLD LEADER FOR DIGITALIZATION AND INDUSTRY 4.0 AND MUST CATCH UP QUICKLY."

What about the digital infrastructure that businesses need to use advanced Industry 4.0 applications, for example?

Weissenberger-Eibl: The digitalization indicator I mentioned was also used to see how Germany’s digital infrastructure measures up. Here, the country is only in 19th place in an international context. This is partly because Germany has invested too little in broadband rollout in recent years. This picture is confirmed by another study of Fraunhofer ISI, in which we analyzed the penetration rate of fast fiber-optic Internet in Germany and other European countries. We discovered that 73 percent of households in Estonia already have high-speed fiber-optic Internet connections, 56 percent in Sweden and 53 percent in Spain. In Germany, only 6.6 percent of households can say the same; in rural regions, this figure can drop to less than two percent. In a comparison of OECD countries, therefore, Germany ranks 28 of 32 for the provision of fiber-optic connections. This is a cause for concern because powerful Internet connections form the basis for the Internet of Things, in which companies interconnect their digital applications and devices.

What has to be done to put Germany in a better position concerning digitalization in the future?

Weissenberger-Eibl: First and foremost, we need more ambitious national targets for broadband expansion and better coordination of the deployment activities. In Estonia and Sweden, for example, municipal utilities are responsible for providing households with fast Internet connections along the lines of a public service; they are constructing new networks following the Open Access network principle that different providers can then utilize for a fee. In addition to this, small and medium-sized enterprises must be better integrated and their needs and requirements considered to a greater extent; education and further training has to be expanded more intensively in the direction of digitalization; and IT security must be future-oriented and guaranteed. However, a positive aspect is that people in Germany are using digital technologies intensively and there is strong awareness of the importance of digitalization.

"PEOPLE IN GERMANY ARE USING DIGITAL TECHNOLOGIES INTENSIVELY AND THERE IS A STRONG AWARENESS OF THE IMPORTANCE OF DIGITALIZATION."

What insights are there at Fraunhofer ISI concerning the question of how digitalization will affect the world of work as we know it today?

Weissenberger-Eibl: Based on our studies, we assume there will be major changes to how work is designed and a significant transformation of today’s work environment. So-called “atypical work models” such as flexible part-time employment could increase considerably and create the basis for new working forms: For example, there is likely to be a clear increase in the number of firms in which “creative digital crowd workers” work together in frequently changing teams and projects as well as partially on a self-employed basis. The employment relationships in 2030 could be much more heterogeneous than they are at present, and the share of “ad-hoc click workers” performing standard tasks from any location via computers and the Internet will increase dramatically. This would affect highly qualified as well as low-skilled workers.

"WE SHOULD FOCUS MORE ON THE POSITIVE ASPECTS OF DIGITALIZATION AND ACTIVELY EXPLOIT ITS POTENTIALS."

In this context, it is often said that automation and digitalization will replace human labor and could lead to a massive loss of jobs. What do your studies conclude?

Weissenberger-Eibl: When it comes to jobs, there is all too often a one-sided view of the risks posed by digitalization and too rarely of the opportunities offered. Of course, there could be a strong increase in the use of robots, not to replace people, but rather to help them, to ease their workload and to improve their productivity. Robots could perform repetitive tasks, for example. One of our studies further shows that companies with robotic systems do not invest less in human capital in order to amortize high technology costs, for instance. In fact, the use of industrial robots in companies leads to greater efficiency and productivity in work and production processes and can improve their competitiveness. And this is what companies need in order to be well-positioned when facing fierce competition.

You mentioned the opportunities resulting from digitalization for Germany. Can you give us an example?

Weissenberger-Eibl: By focusing more on the positive aspects of digitalization, remaining curious, interested and open to new developments and actively exploiting the potentials offered by digitalization to develop solutions to the Grand Challenges of our time. As well as economic and social innovations, digitalization can also contribute to ecological and sustainable innovations. For instance, it can make an important contribution to the recycling and reuse of materials and energy – equipped with this knowledge about material and energy flows, companies can optimize entire production chains. A study by Fraunhofer ISI shows that the use of energy management systems in companies quadrupled to 21 percent between 2012 and 2015. According to the study, companies that use digital tools to find out more about their energy consumption are also much more likely to implement saving measures like technologies to recover energy. Without digitalization, they would know nothing about this potential for optimization.

Thank you very much for the interview Ms. Weissenberger-Eibl!

The interview was conducted by Anne-Catherine Jung.
**FACTS AND FIGURES**

**OPERATING BUDGET 2017**

<table>
<thead>
<tr>
<th>Total</th>
<th>23.9 million euros</th>
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<tbody>
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<td>Basic funding</td>
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</table>

**Development of Turnover in million euros**

<table>
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<tr>
<th>Year</th>
<th>Total</th>
<th>Earnings</th>
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<tr>
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<td>2017</td>
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**Number of Staff**

<table>
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<th>Year</th>
<th>Total</th>
<th>Scientists</th>
<th>Non-scientists</th>
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<tr>
<td>2017</td>
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**Earnings**

- Total: 20.2 million euros
- Public sector national: 10.7 million euros
- Industry: 3.8 million euros
- EU: 3.9 million euros
- Other R&D: 0.3 million euros
- Other earnings: 1.5 million euros

- Total: 224
- Scientists: 161
- Non-scientists: 63
DEVELOPMENT OF THE ASEAN ENERGY OUTLOOK 2017

A population increase by 24 percent by 2040, a tripling of the gross domestic product, and stable economic growth by 5 percent annually— the countries that make up ASEAN (Association of Southeast Asian Nations) constitute one of the fastest growing regions in the world. The energy demand of its member states is increasing at the same time. The “5th ASEAN Energy Outlook (AEO5)”, which was co-developed by Fraunhofer ISI, shows how countries can react to the associated challenges.

A major finding of the AEO5: Renewable technologies should cover a large share of the ASEAN region’s energy demand in the future. In the past, the ASEAN states relied heavily on fossil fuels. However, because the costs of renewable technologies have recently dropped significantly—as demonstrated by auctions in Germany and Dubai—it is now worth investing more in renewable technologies such as photovoltaic power stations or electricity storage. This trend is set to continue over the next decade.

This offers the ASEAN countries new opportunities. Transforming the energy system from fossil energy to renewable sources creates jobs, strengthens local industries and helps combat poverty. Examples of this include countries like Malaysia, Vietnam and the Philippines that have begun to construct their own production lines for photovoltaics. In addition, the deployment of solar, wind, biomass and geothermal enables ASEAN member states to become more independent of energy imports from abroad, which eases the burden on the states’ budgets. However, to start with, fossil and renewable energies should be used in tandem in order to ensure a reliable supply of energy able to meet current demand. The plan is to then rapidly increase the share of renewables and, in addition, improve the efficiency of supply and use of fossil technologies.

Three scenarios of energy demand and supply in the ASEAN region

A main objective of the AEOs was to analyze the implementation of ASEAN’s Plan of Action for Energy Cooperation (APAEC). This Action Plan aims to raise the share of renewables in the region’s primary energy mix to 23 percent by 2025. At the same time, energy intensity should be lowered by 20 percent (by 2020) and then 30 percent (by 2025) compared to 2016.

The AEOs analysis focused on three scenarios of energy demand and supply for the ASEAN countries up to 2040:

- “Business as usual”: continuation of past trends
- “ASEAN Member States Targets Scenario (ATS)”: Each of the ten ASEAN member states meets the national targets for energy efficiency and renewable energies.
- “ASEAN Progressive Scenario (APS)”: The entire region meets the community targets for EE and RE defined in the APAEC. The region’s targets are much more ambitious than the national ones. However, the targets set for energy efficiency are less ambitious than those for renewable energies are.

The analysis showed that the ASEAN countries are on the right track to achieving the region’s targets for energy efficiency. However, the energy efficiency targets could be formulated much more strictly. This would also help to achieve the targets for renewable energies that still require greater efforts. To advance the deployment of renewable energies, the AEOs recommends a joint, harmonized energy policy along the lines of that practiced in the European Union.

The AEOs was presented to two important groups on 28 September 2017: first to the energy ministers of the ASEAN countries at the 35th ASEAN Ministers on Energy Meeting (AMEM). Subsequently, to stakeholders in the energy industry at the ASEAN Energy Business Forum. Both meetings took place in Manila, the Philippine capital. Further information is available on the project’s website.

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BUSINESS UNITS

- Renewable energies
- Energy policy
- Climate policy
- Electricity markets and infrastructures

Renewable energy sources provide chances for companies, which means that worldwide investments are increasing. The Business Unit Renewable energies evaluates the contribution of renewable energies to climate protection, security of supply as well as competitiveness, draws up scenarios for future development and studies the design of energy policy instruments.

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Other projects of the Competence Center
An important result of the energy transition is the decentralization of electricity production. Designing a decentralized, intelligent energy system (smart grid) that is as robust and efficient as centralized networks with large power stations is a huge challenge. In the “C/sells” project, scientists from Fraunhofer ISI together with 60 partners are exploring how decentralized energy systems made up of many small energy sources can work reliably and efficiently. Fraunhofer ISI is helping to shape the guiding principle, among other things, and evaluating the solutions developed.

The C/sells project is based on the vision that, in the future, a large number of power plants will produce energy from different renewable sources and feed this into a shared grid. In order to design a reliable energy grid for the whole of Germany from the interaction of these numerous local renewable energy sources, C/sells is planning to connect the individual plants with each other in cells.

Such a decentralized cellular energy system is currently being tested in southern Germany. In a model region, the project’s participants are testing the interaction of decentralized electricity production and consumption in 35 demonstration cells. The cell is the key component of this energy system. One cell comprises one or several units that generate, consume or store electricity. The individual systems within one cell are connected with each other, as are the cells themselves.

Cellularity as the key component of the energy system

Cells can be geographical, such as the residential district Franklin in Mannheim, but also comprise single objects like Stuttgart airport. The aim is to develop a decentrally controlled cost-effective energy system by exchanging data and energy within cells as well as between them.

The scientists are evaluating solutions to improve the coordination of consumption, production and grid loads within and outside cells. They are also investigating the willingness of the public, enterprises and organizations to actively participate in a cellular energy system.

The energy system of the future: participative, diverse and cellular

Fraunhofer ISI is designing important parts of C/sells, including the guiding principle, which describes how the energy transition is implemented in C/sells. Apart from cellularity, the guiding principle describes two further properties of such an energy system. First, participation: C/sells wants to motivate the public and enterprises to realize the energy transition themselves, for example by selling self-generated electricity on the market or by adapting their own consumption to the availability of renewable energies. Innovative solutions are also being tested, such as blockchain technology, which makes direct transactions possible without an intermediary. This is linked to the hope that citizens who actively participate in the energy system will support and shape the energy transition as a whole. To what extent and under which conditions this is successful is one of the questions in the project. Second, diversity: C/sells unites a number of actors, technical solutions and needs. Not only the cells and the systems are closely interconnected, so is the project structure and organization of C/sells. The sum of the individual solutions creates a big, functioning whole.

Fraunhofer ISI is responsible for evaluating the results of C/sells. The team is developing a quantitative and qualitative evaluation instrument to assess the concepts developed within C/sells. This can evaluate not only the various technical solutions, but also the business models and incentives that aim to guarantee, for example, that the power trading among owners of private energy facilities complies with the regulations.

Further information is available on the project’s website.

Other projects of the Competence Center

Energy efficiency
Energy economy
Demand analyses and projections
Demand responses and smart grids
RESPONSIBLE RESEARCH – FUTURE STRATEGIES FOR SCIENCE

Artificial intelligence in our cars, cancer treatments based on our DNA – huge advances in research also raise serious ethical concerns. How can researchers adequately consider social values in an increasingly innovation-driven society? This is the question addressed by the EU project JERRI (Joining Efforts for Responsible Research and Innovation).

Together with its partner, the Netherlands Organisation for Applied Scientific Research (TNO), Fraunhofer is developing new practices for responsible research and innovation (RRI).

JERRI’s objective is to foster a long-term and sustainable change in both organizations towards innovative and responsible research. More specifically, the researchers analyzed five aspects of RRI:

- Ethics
- Gender equality/gender in research content
- Open access
- Public engagement
- Science education

The results were used by researchers from both organizations to define guidelines and measures for orienting responsible research in the future, and to launch concrete pilot activities.

The JERRI roadmaps point the way to responsible research

The project team organized workshops with external stakeholders on all five aspects and developed visions of the future. These define the orientation of Fraunhofer-Gesellschaft and TNO with regard to the respective aspect. For example, in JERRI’s vision of “Ethics”, the Fraunhofer-Gesellschaft is described as a “recognized advisory body for ethical aspects of research” in fields in which it plays a leading role in research. Fraunhofer’s vision of “Gender” in JERRI specifies that the provision of equal opportunities for all should be deeply engrained in the organizational culture.

For each vision, workshop participants defined specific pilot actions to promote its realization. Examples include:

- Setting up an ethical advisory service for researchers.
- A café-type meeting place, where citizens can talk to researchers and ask questions.
- An infrastructure for open access to research data.
- A gender toolbox with practical examples of how to improve equality between men and women in a research organization.

Following the intensive work in 2017 on developing the long-term visions of the future, the plan is to further develop and implement the measures in 2018 and 2019. The team from Fraunhofer ISI can contribute an additional foresight competence here. The development of transition roadmaps that illustrate which activities should take place at which time, which obstacles have to be overcome, and which opportunities can be exploited. JERRI’s unique contribution is, that, in close interaction with TNO, a new understanding of responsible research is formed, not only for individual research institutes but also for the Fraunhofer-Gesellschaft as a whole.

The Fraunhofer-Gesellschaft and TNO are the biggest organizations for applied research in Europe. Alongside the Fraunhofer ISI (project coordination), the Fraunhofer-Gesellschaft’s headquarters and the Fraunhofer institutes UMSICHT, IAO, IRB are also involved in JERRI. Other project partners include the Manchester Metropolitan University and the Institute for Advanced Studies in Vienna. Further information is available on the project’s website.
STAKEHOLDER DIALOGUE TO REDUCE TRACE SUBSTANCE CONTAMINATION IN WATERS

One of environmental policy’s main aims is to protect our water. All over the world, rivers, lakes and oceans are being contaminated by chemicals that are harmful even in very low concentrations. Such trace substances enter water bodies from medication, building products or household chemicals. In 2017, Fraunhofer ISI conducted a dialogue process within which the participating stakeholders agreed on 14 recommendations for action to reduce the discharge of trace substances into water bodies.

The resulting policy paper “Recommendations from the multi-stakeholder dialogue on the Trace Substance Strategy of the German federal government to policy-makers on options to reduce trace substance inputs to the aquatic environment” was presented to the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) in June 2017. It contains strategies for the following stages in the life cycle of trace substances:

- Mitigation strategies at source (e.g. concretization of manufacturers’ product responsibility, improved assessment of substances and transparent communication of the results).
- Mitigation strategies on the user side (e.g. information campaigns and educational programs, labelling, technical and organizational measures).
- Mitigation strategies based on end-of-pipe measures (such as additional wastewater treatment and proper disposal).

The paper also addresses the question of how to finance the strategy’s implementation. The paper and the strategy it describes are the most important result of the sometimes very controversial stakeholder dialogue on the German government’s “Federal Trace Substance Strategy”. Together with the IKU GmbH, Fraunhofer ISI organized and conducted the stakeholder dialogue on behalf of the BMUB and the Federal Environment Agency. The aim was to listen to and bring together the needs of stakeholders from industry, municipalities and the health system and to develop a joint strategy for dealing with these substances on this basis.

Fraunhofer ISI provides technical input for specialist workshops

Within the framework of the stakeholder dialogue, Fraunhofer ISI provided input papers that formed the basis for three specialist workshops where the key points of the strategy were developed. The focus was on the entire life cycle of trace substances. IKU GmbH moderated the workshops. Different stakeholders were involved as well as representatives of federal ministries, authorities and federal states. The basic principle was to seek stakeholder consensus. Minority votes were documented.

One research group in the Business Unit Water Management has focused for years on the impacts of trace substances on the aquatic environment. As these substances enter water bodies in many different ways, there are also many possibilities to reduce or stop their discharge. The team not only investigates emission patterns and discharge paths for different groups of substances. It also tests concrete countermeasures in pilot projects. One project was conducted in cooperation with healthcare facilities to retain x-ray contrast agents that have so far been discharged into our waters in large quantities. The results clearly demonstrate that the measures required have to go well beyond traditional water management in order to reduce water pollution efficiently and sufficiently.

In the second phase of the dialogue process, which was officially launched with a kick-off event on 21 February 2018, Fraunhofer ISI will support and accompany the concretization and implementation of the strategy and the derived measures.

Further information is available on the project’s website and in our Policy Paper.

♭ Other projects of the Competence Center

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BUSINESS UNITS

- Water resources management
- Sustainability innovation and policy
- Systemic risks
- Mobility

Water supply and wastewater disposal must be adapted to the challenges such as new pollutants or demographic and climate change. The Business Unit Water resources management analyzes the developments and works out measures that contribute to the sustainability of infrastructure systems.

Dr. Thomas Hillenbrand

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Microorganisms and fungi can help to make industrial products cleaner and more sustainable. These types of methods are called “Industrial biotechnology” (IB) and are already being used in many production chains, for example in textiles, the food sector or pharmaceuticals. Biotechnology helps to reduce the CO₂ emissions of industry and protect the environment. A research team in the Competence Center Emerging Technologies has developed methods to identify innovation potentials in the field of IB.

In a simple form, biotechnological processes have been used since the Middle Ages, when brewing beer or making cheese, for example. In modern knowledge-based industries that are characterized by a division of labor, increasingly refined application possibilities are emerging. Today, for example, wood-based fuel or biotechnological fragrances and flavors can be produced with the help of microbes, fungi or components obtained from them. The advantages compared to production processes based on fossil fuels: The final products are less contaminated with environmentally harmful substances and some are even biodegradable. This makes industrial biotechnology a key technology on the road to a resource-efficient circular economy.

Industrial biotechnology has enormous innovation potential. The market for bioplastics alone could quadruple in the next few years – not solely, but also due to innovations. The European Commission wants to exploit this innovation potential. To do so, it needs appropriate policy, technology and economic measures. A research team from the Competence Center Emerging Technologies has explored what these measures could look like in the EU project PROGRESS (Priorities for Addressing Opportunities and Gaps of Industrial Biotechnology for an Efficient Use of Funding Resources).

The team analyzed six value chains: Alongside lignocellulosic-ethanol, these included bio-based plastics and enzymes, biopharmaceuticals, biotech flavors and fragrances and microorganisms for a healthy diet. The scientists analyzed how the technology was developing in these fields, which patents and markets could emerge in the future, and which framework conditions can be expected for these value chains. This resulted in six future scenarios that describe the possible market developments of the next ten years for each of the six value chains.

Technical progress not the only decisive factor
The scenarios show that the question of how intensively companies and industry apply biotech processes depends on various factors. Significant factors of success for all value chains include upscaling to industrial production, for example, supportive regulatory framework conditions (standards, labelling), and a positive environment that is open to new processes. Model simulations conducted for lignocellulosic-ethanol and bio-based plastics also identified the key role played by targeted public spending on research and development, and demand-side measures.

An important finding of PROGRESS: Technical progress is not the only decisive factor for establishing biotech processes in European industry. A coherent overall concept of technologies, processes, applications and policy support is more important. This includes the expansion of supranational cooperation to improve the access to knowledge about industrial biotechnology. There are large differences within the EU Member States, for example concerning the availability of biotechnological capacities and resources. Further information is available on the project’s website.

Technical progress is not the only decisive factor
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THE EFFECT OF EQUALITY ON RESEARCH AND DEVELOPMENT

What do politics, companies, universities and research facilities in the European Union do for the equality of male and female employees – and how successful are these measures? An evaluation system from the EU project “EFFORTI”, coordinated by Fraunhofer ISI, measures the effect of equality measures in Research and Development (R&D). The reports on gender equality in seven European countries have been published recently.

In recent years, Germany has caught up enormously on the subject of equality in Research and Development. This emerges from a comparative report, which the participants in the project EFFORTI published in 2017. Nevertheless, women are still under-represented in decision-making bodies and top positions. Germany has also only recently become increasingly active in monitoring equality measures in R&D. The results are based on seven country reports, which investigate the framework conditions of equality in seven EU states. In addition to Germany, these also include Austria, Denmark, Spain, Hungary, France and Sweden. The studies focused on the gender specific participation and segregation in the research and innovation system, on gender equality strategies and their influence on research, technology, development and innovation in the individual countries as well as country-specific evaluation practices.

All over Europe, women are subject to precarious work situations in the higher education sector far more often than men. This situation is particularly pronounced in Hungary. At the same time, however, the number of female scientists has generally increased all over Europe in recent years. Spain remains number one in the number of women in research and development. The study also showed that women still do far more unpaid work than men. The differences here are least prominent in the Scandinavian countries Sweden and Denmark.

High strategic importance for the European Commission

Within the context of EFFORTI, the research team of Fraunhofer ISI together with its project partners has developed indicators which measure the effect of equality measures on the quality and performance in R&D. In addition to the classic indicators such as the number of patents and publications, the scientists also used new concepts from the area “Responsible Research and Innovation”, in which Fraunhofer ISI has already realized several projects. As a next step, an online toolbox has been planned. The users from ministries, companies and research institutions can measure the various effects of different equality measures and adapt the support instruments if necessary. As of May 2019, access to the toolbox will be free of charge.

In addition to Fraunhofer ISI and the Fraunhofer Institute for Industrial Engineering (IAO), the University of Aarhus (Denmark), the Universitat Oberta de Catalunya (Spain), Joanneum Research (Austria), the Hungarian non-governmental organization NaTE (Association of Hungarian Women in Science) as well as Intrasoft Ltd. are represented in EFFORTI. The European Commission supports the project within the Horizon 2020 program where it experiences high strategic importance.

Further information is available on the project’s website.

Other projects of the Competence Center

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BUSINESS UNITS

- Policy design and evaluation
- Industrial innovation
- Regional innovation systems
- Innovation indicators

The main focus of research in the Business Unit Policy design and evaluation is on the analysis and evaluation of research, technology and innovation policy measures. We advise the German and foreign governments, ministries, the European Commission and funding agencies.

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BUSINESS UNITS

- Policy design and evaluation
- Industrial innovation
- Regional innovation systems
- Innovation indicators

The main focus of research in the Business Unit Policy design and evaluation is on the analysis and evaluation of research, technology and innovation policy measures. We advise the German and foreign governments, ministries, the European Commission and funding agencies.

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<td>Jumana Al-Sibai</td>
<td>Dieter Schweer</td>
<td>Engelbert Beyer</td>
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<td>Robert Bosch GmbH, Heilbronn, curator since November 2017</td>
<td>Former member of the central management of the Federation of German Industries e.V. (until August 2016), Berlin, curator until November 2017</td>
<td>Head of Department 11 &quot;Innovation strategies&quot; in the Federal Ministry of Education and Research, Berlin</td>
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<td>Professor Thomas Hirth</td>
<td>Professor Andreas Barner</td>
<td>Dr. Toni S. Seethaler</td>
<td>Daniel Caspary</td>
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<tr>
<td>Vice president for Innovation and International Affairs, Karlsruhe Institute of Technology Karlsruhe</td>
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<td>Member of the European Parliament, Strasbourg</td>
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<td>Professor Wilfried Juling</td>
<td>Dr. Andrea Frenzel</td>
<td>Professor Wiltrud Treffenfeld</td>
<td>Dr. Caroline Liepert</td>
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<td>Former Head of Department II “Informatics, Economics and Society” at the Karlsruhe Institute of Technology KIT, Karlsruhe</td>
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<td>Ministry of Science, Research and the Arts, Baden-Wuerttemberg, Stuttgart</td>
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<td>Professor Doris Schmitt-Flansied</td>
<td>Dr. Heike Hanagarth</td>
<td>Dr. E. h. Manfred Wittenstein</td>
<td>Dr. Peter Mendler</td>
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<tr>
<td>Chair of Technical Elektrotechnik at the Technical University Munich, Department of Electrical Engineering and Information Technology, Munich, curator until November 2017</td>
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PRESENTATIONS

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• Fokus: Zukunft. Unser Leben 2050, Trend- und Forschungsdruck, Baden-Baden, Germany
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Jörg Zahn
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• Energy Efficiency Template: Überprüfen und Aktualisieren der Energy Efficiency Template der IEA für Deutschland

Barbara Schlomann

• BMWi Folgeabschätzungen 2030: Energiemärkte für Klimaschutz: Potenziale für Selective European Innovation Projects

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• Gebäudeleute 2030: Gutachten zu Maßnahmen zur Zukunftserhebung 2030 im Gebäuderektor

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· SET-Net: Navigating the Roadmap for Clean, Secure and Efficient Energy Innovation

Frank Sensfuß

· ESPON: Territories and low-carbon economies

Frank Sensfuß

· Leitstudie Strommarkt 2: Leitstudie in einer zukünftigen Energiesysteme (FiS) des BMWi

Barbara Schlomann

· EE-Ausschreibungsdesign: Unterstützung im Projekt NoEnergyWaste@Production!

Ali Aydemir

· DG Glaw-Energy Support: Effective use and application of alternative energies in the building sector

Jan Steinbach

· ESPON: Territories and low-carbon economies

Jan Steinbach

· BMWi Folgeabschätzungen 2030: Energiemärkte für Klimaschutz: Potenziale für Selective European Innovation Projects

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· BMWi Digitalisierungs- und Gebäude- 
  Digitalisierung in das Gebäudebereich

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· BMWi Monitoring Alwärme: Monitierung Förderprogramm Alwärme

Clemens Rohde

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Julia Michels

· EnergiestiftungBW Lastversch.:

Martin Wietschel

· EnergiestiftungBW Lastversch.:

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· BMWi Markthochlauf 2030: Aktualisierung der Klimaschutzpläne

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VISITING RESEARCHERS

Marianne Kulicke
BioÖkonomie 2030
• BioÖkonomie2030-CCP: Evaluationen aus der Wissenschaft (EXIST)
  • EXIST V Verlängerung: Modernisierungsprozess
  • Green Finance-CC-Ü: Green Modernisierungsprozess

Henning Kroll
• Frugal Innovations − CCP: Study of a fast growing priority domain
  • Frugal Innovations − CCP: Strategic analysis of international competitiveness
  • Smart specialisation in Serbia − analytical Innovationsprofile in China:
  • Innovationsprofile China: Regionalanalyse: Gliederung der Innovationsprozesse in China
  • Innovationsprofile China: Regi-

Christian Lerch
• EFI PAT 2016: Ergebnisse von öffentlicher und privater Forschung: Patente
  • Evaluation of the Robert Bosch Stiftung Förderprogramm
  • Innovation-Course 2017: Innova
tion Course at Fraunhofer ISI 2017

Peter Neuhäusler
• EFI PAT 2017: Ergebnisse von öffentlicher und privater Forschung: Patente

Niclas Meyer
• LSH EvA: Evaluation LGB Career Center

Sarah Seus
• Eval RBS: Evaluation der Robert Bosch Juniorprofessur

Torben Schubert
• BMUB Klimawandel: Beglei-
tung und Weiterentwicklung des BMUB-Förderprogramms Maßnah-
men zur Anpassung an den Klima-

Thomas Stahlecker
• High End Society: High End – im Vergleich und Perspektiven des Wirt-

Sophie Schacht
• BIJAST VII: The Implementation of Partnership in Germany and the

Sarah Seus
• CECM CC P: Centre for New Technologies and Personalised Therapy

Thomas Stahlecker
• CECCM CC P: Centre for New Technologies and Personalised Therapy

Andrea Zenker
• Clusters and Industrial Change

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Fanny Seus
• Innovation-Course 2017: Innovation-Course 2017: Innovation-Course 2017: Innovation

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Katharina Karnes
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Na Li
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Uppsala, Sweden
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The Fraunhofer Institute for Systems and Innovation Research ISI analyzes the origins and impacts of innovations. We research the short- and long-term developments of innovation processes and the impacts of new technologies and services on society. On this basis, we are able to provide our clients from industry, politics and science with recommendations for action and perspectives for key decisions. Our expertise lies in a broad scientific competence as well as an interdisciplinary and systemic research approach.