Fraunhofer

STATEMENT OF THE FRAUNHOFER SUSTAINABILITY NETWORK ON THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)

FRAUNHOFER SUSTAINABILITY NETWORK

The Fraunhofer Sustainability Network was founded in 2007 to help implement the guiding principle of sustainability within the Fraunhofer-Gesellschaft and its institutes. Through its continuous work on projects concerning sustainability strategies and sustainability reporting, the network has made a significant contribution to anchoring the concept of sustainability in the corporate policy and communication of the Fraunhofer-Gesellschaft. The network currently consists of 21 institutes and research entities. As an "agent of change", one of its goals is to analyze international developments in the field of sustainability and place them within the research context of the Fraunhofer-Gesellschaft.

INTENTION OF THE STATEMENT

In this paper, the Fraunhofer Sustainability Network discusses selected Sustainable Development Goals (SDGs) in relation to the scientific activities of the institutes as well as global trends and developments. It examines only those SDGs to which the institutes of the network can contribute. The aim is to inform the interested public and to document the network's position. This complements information already provided by the Fraunhofer-Gesellschaft in its most recent Sustainability Report, and represents a starting point for further discussion and for the implementation of the SDGs within the framework of research and development.

INTRODUCTION

The Sustainable Development Goals (SDGs) defined in the UN Agenda 2030 will play a decisive role in the future orientation of research at national, European and international level. In October 2017, the European Commission established a "High Level Stakeholder Platform" to accompany the implementation of the SDGs in Europe. The SDGs will serve as the guiding prin-ciple in the ninth Research Framework Programme (FP9) of the EU (from 2021). They will therefore significantly influence the orientation of research, development and innovation within the Fraunhofer-Gesellschaft. The Fraunhofer Sustainability Network has compiled approaches and ideas with which the SDGs can be addressed.

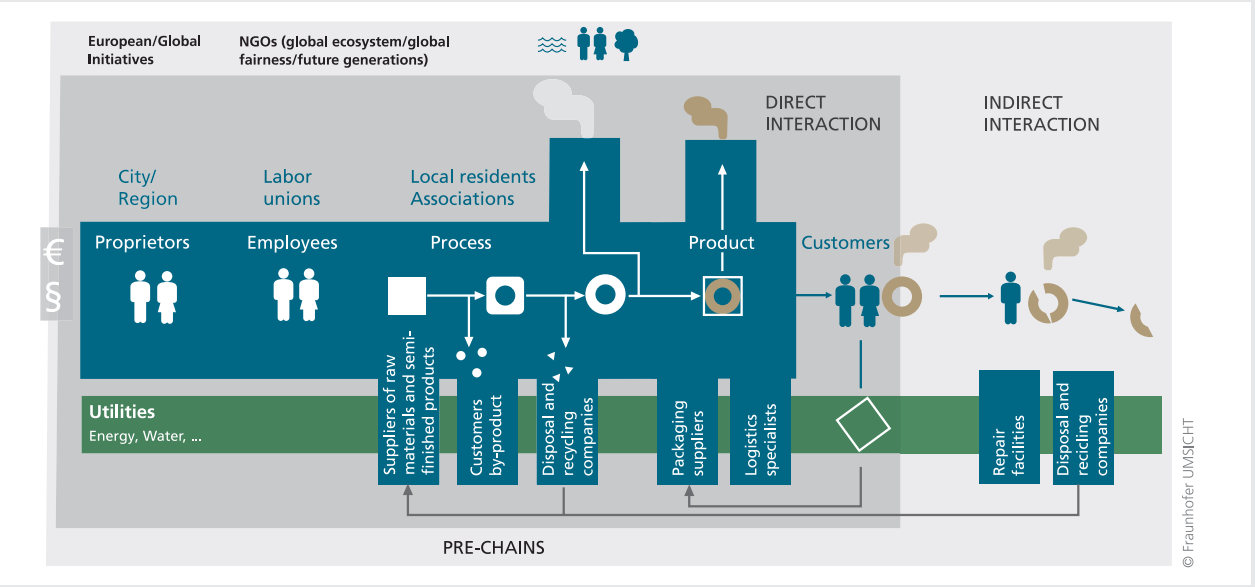
Various important agreements on sustainable development have been initiated in recent years. A key milestone is the Paris Climate Agreement to limit global warming to well below 2 °C, preferably 1.5 °C compared to pre-industrial levels. Global net greenhouse gas emissions must be reduced to zero by 2060 at the latest. This is leading to major changes in our economy and lifestyle. The vision of the Fraunhofer Sustainability Network is the active design of innovation spaces in Europe, taking into account a multitude of different climatic, economic, social and cultural conditions. The concept of sustainability is seen as a key to healthy, livable, safe and inclusive cities and regions and a knowledge-based economy. The Fraunhofer Sustainability Network focuses on people as the designers and users of these innovation spaces.

The following topics were selected by the Fraunhofer Sustainability Network as fields of action for achieving the SDGs, and are examined in more detail in this paper:

- Living spaces
- Energy
- Raw materials

The further development of cities and regions in terms of the supply of raw materials, clean water and air, safe and healthy food, energy from renewable sources, the protection of air, soil and water and the preservation of biodiversity requires a **holistic approach**. Regional and global challenges can no longer be met with individual solutions, but require trans- and **interdisciplinary networked system solutions and an integrated view that extends beyond individual sectors**.

Stakeholders throughout a product life cycle (© Fraunhofer UMSICHT).



For the successful implementation of innovations, stakeholders who play a decisive role in shaping the thematic field, or are influenced by the developments, must be involved proactively and at an early stage in the development of new technologies or business models (see figure). This is the responsibility of researchers who, among other tasks, conduct **stakeholder dialogs** in the context of sustainability, and thus build a bridge between implementation and innovation. The new digital possibilities for interaction and the resulting changes in the relationship between producers, consumers and prosumers must be taken into account.

National and international networks of research and industry ensure the **transfer of knowledge and technologies**. To this end, researchers must work together with partners from industry, science and society to develop solutions. It is essential that socio-cultural behavior patterns are understood and taken into account. The results of these approaches are incorpo-rated into further education at schools and universities, into chambers of trade and crafts, chambers of industry and commerce, and commercial enterprises.

In a two-day workshop, the Fraunhofer Sustainability Network identified the SDGs to which the institutes can contribute (see icons above). This paper shows the results of this workshop.

HEALTHY, CLIMATE-NEUTRAL AND FAIR LIVING SPACES

BACKGROUND

Urban and rural areas are strongly influenced by developments such as demographic change, individualization, rural exodus, digitalization, climate change and air quality degradation. These challenges have to be met accordingly and the necessary transformation processes must be coordinated and analyzed. Thus, the Fraunhofer Sustainability Network aims to create methods and knowledge to make cities and rural regions fit for the future. This means creating a fair and healthy, climate-neutral and climate-resilient living space in urban and rural regions for people in their private and working environment.

The built environment in particular has an enormous influence on the achievement of environmental and climate objectives. This applies both to existing (historical) buildings and to new buildings. Transport and mobility, and the consumption of products and services, are directly linked to this. The effects of these very resource-intensive areas on humans and nature can only be reduced to a minimum through the **intelligent recycling of material flows** (circular economy) (see also raw materials).

Urbanization leads to a change in rural and urban spaces and the associated patterns of production and consumption. This includes agricultural, industrial and new forms of production. Collaborative forms of production and consumption (such as the sharing economy, urban gardening, co-working and maker-spaces) are being established and are networking in diverse ways. Research is also stimulated by new forms of cooperation with stakeholders from civil society, e.g. within the framework of citizen science approaches. These processes of **networking buildings and infrastructure** must be further developed and established to ensure sustainable living spaces.

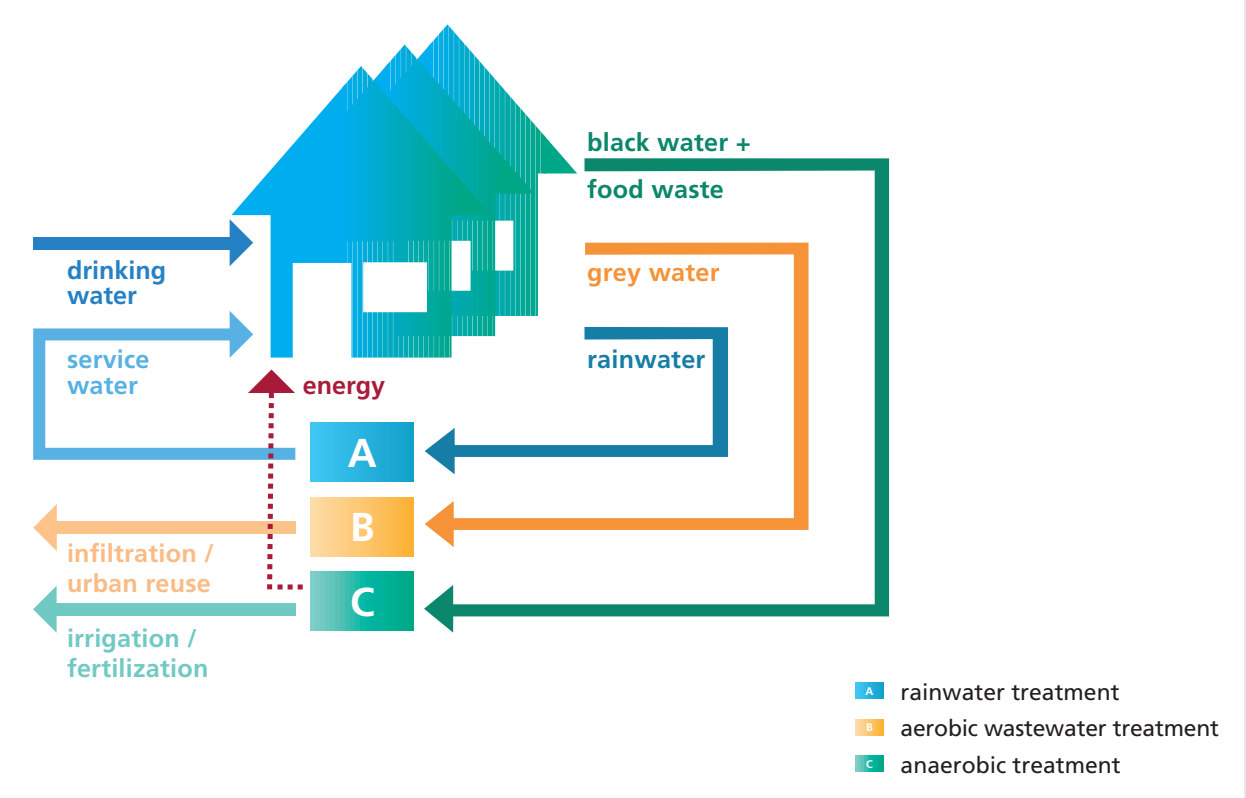
SOLUTIONS: DESIGN OF SUSTAINABLE RESIDENTIAL AND LIVING SPACES

In order to create a sustainable city or region it is necessary to develop and maintain **platforms and meeting spaces**. Here, different stakeholders can learn from each other how best to achieve the objectives in their respective regions. In order to meet the numerous challenges, technical and social innovations must be linked, adapted and further developed in the context of existing, historically evolved (geographical, cultural, climatic) conditions. With innovative developments, positive effects must be reinforced, such as a healthy indoor climate. Examples include Fraunhofer's comfort glass and the use of pollutant-absorbing insulating materials.

In order to obtain a holistic, individual solution for the different regional structures, the first step must be an exact analysis of the current infrastructure, e.g. with regard to the availability of resources, the technical status quo and the identification of local regulations and stakeholders. On this basis, concrete models and derived goals for the city or region can be defined as **sustainable circular roadmaps**.

Based on the target definition and the various tailored basic technologies, holistic concepts can be developed, for example for water supply. An urban integrated water management concept (see figure) has already been partially implemented in the DEUS 21 research and demonstration project. Taking into account problems of raw water quality and water scarcity in some regions, the diagram shows a concept for separate drinking and process water cycles and the responsible use of water for households, industry and agriculture (green arrow "fertilizer").

Urban integrated Water management concept.



The Fraunhofer Sustainability Network suggests the introduction of a "sustainability level" to measure the degree of sustainability for rural regions and urban areas. For this purpose, sustainability indicators must be developed. The evaluation scale, which has not yet been fully developed, must take account of aspects such as:

- Disciplines: Logistics, infrastructure, production systems, etc.
- Key performance indicators (KPIs): Resource and energy efficiency, environment, health care and disease prevention, etc.
- Framework conditions: Consumption patterns, regional development, adjustment of programs to SDGs, etc.

These proposals contribute to the achievement of the SDGs 2, 3 ,6, 11, 12, 13 and 15.

SUSTAINABLE ENERGY SYSTEMS – FUTURE-ORIENTED CONCEPTS

BACKGROUND

Improved energy efficiency and the increased use of renewable energies will be the main pillars of a sustainable energy system in the future. The technologies required have made significant progress in recent years – especially in the photovoltaic and wind industries. These basic technologies for energy system transformation must be manufactured in a holistically optimized production process from material to product. Successes in the field of energy include Fraunhofer's work on the development and optimization of individual buildings (e.g. Energy Autarkic Solar House, 1992 or the project WaveSave, 2015-2018), energy solutions for neighborhoods and smart cities (e.g. the project Triangulum, 2015-2020), and studies on intersectoral system development for Germany.

The Fraunhofer Sustainability Network considers that, in addition to the further development of components and systems, the topic of "**networking**" must also be taken into account (e.g. the project WindNoDe, 2017-2020). Besides the network infrastructure for electricity, heating/cooling and liquid and gaseous energy sources, the following connections apply in relation to

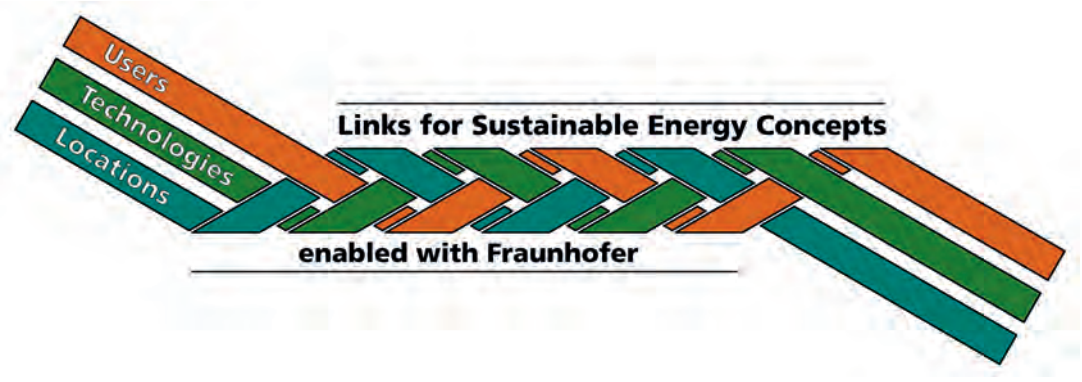
- **Users**: Lifestyle and economy
- **Technologies**: Heating, cooling, logistics/mobility, and Information, Communication Technology ICT
- **Locations**: Building, quarters, city, and region

The generation of renewable energies naturally fluctuates, which is why the balance of supply and demand requires very good networking between producers and consumers, intelligent energy management with the use of flexibility options on the consumer side and storage concepts. The electricity market therefore needs:

- Electricity storage concepts (especially batteries) and other energy storage solutions such as power-to-gas, power-to-liquid and power-to-heat.
- The large-scale balancing of decentralized generation through new grid concepts, e.g. HVDC (high-voltage direct current transmission).

In the heating market, solutions for both sensitive (e.g. water) and latent (e.g. phase change materials, PCM) storage exist, as well as local/regional heating and cooling networks and mobile storage concepts.

Sustainable energy supply must take account of interactions with other sectors (water, food, transport, etc.). Conflicts of use can arise both in the management of dams and in the cooling of power plants. Waste water and waste streams can be used to produce biogas and heat, and waste heat from waste water can be recovered locally.



SOLUTIONS: DEVELOPING A SUSTAINABLE ENERGY SUPPLY

In the development of new energy concepts, stocks of residential buildings and industrial enterprises must be taken into account, which vary significantly from region to region. Industrial complexes must be networked with residential areas and heat, electricity, transport and mobility concepts must be considered together and optimized through **sector coupling**. This is achieved, for example, by operating heat pumps or storing electricity in heat accumulators or batteries in electric vehicles (e.g. the project WindNoDe, 2017-2020).

This requires a detailed consideration of industrial processes to record the internal potentials for heat recovery (pinch analysis) or the possibility of supplying waste heat or solar process heat to external users. Thermally driven processes such as gas heat pumps or sorption chillers can also be integrated into overall concepts.

Future energy systems require a significantly improved networking of components and subsystems, as well as the development of **intelligent energy management solutions** based on innovative ICT solutions. New business models must be developed for this purpose. For example, an energy-intensive company with a high peak power requirement (e.g. a glassworks) could install an electricity and/or heat accumulator for its own use and additionally provide a range of services to third parties. It is also conceivable that future government framework conditions will support new business models for sustainable energy concepts in order to achieve climate targets, for example in the form of public-private partnerships (PPP), e.g. through subsidized contracting models.

The development and successful implementation of sustainable energy systems at local and regional level also requires the provision and further development of support measures:

- Planning and modeling tools that help local stakeholders to develop optimized solutions for local conditions.
- Monitoring tools that regularly evaluate the implementation of the long-term transformation process and indicate when the planned measures need to be adjusted.
- Modeling and monitoring tools must be linked to ICT platforms to ensure efficient and consistent data collection.

The planned infrastructure measures will lead to better security of supply and greater energy efficiency, which will significantly enhance the attractiveness of the cities and regions concerned, especially rural regions, as industrial and residential locations.

The above proposals contribute to the achievement of the SDGs 7, 9, 11 and 12.

RAW MATERIALS AND SUSTAINABLE VALUE CHAINS

BACKGROUND

The needs of the population must be reconciled with changing material flows and future requirements. Challenges include: Resource scarcity and availability, environmental impacts of consumption, logistics and mobility and production, regional differences in waste and recycling management, and the development of sustainable products ("circular design"). Through a **circular economy**, a substantial contribution must be made to the high-quality use of products and materials in Europe. Circular use enhances value creation and enables a more effective use of resources. Waste volumes are minimized and products are used for longer in high-quality applications.

The expected economic effects are as follows:

- Contribution to waste avoidance, to avoidance of littering (e.g. plastics) and to environ-mental and climate protection
- Measurable reduction in resource dependency (raw materials, water, energy)
- Higher recycling rates and higher proportions of recycled materials in new products
- Higher proportion of renewable materials in production
- Greater security of supply and reduced environmental impact through reuse of water and other resources/products

SOLUTIONS: TRANSITION TOWARD SUSTAINABLE PRODUCTION AND CHANGED PATTERNS OF CONSUMPTION

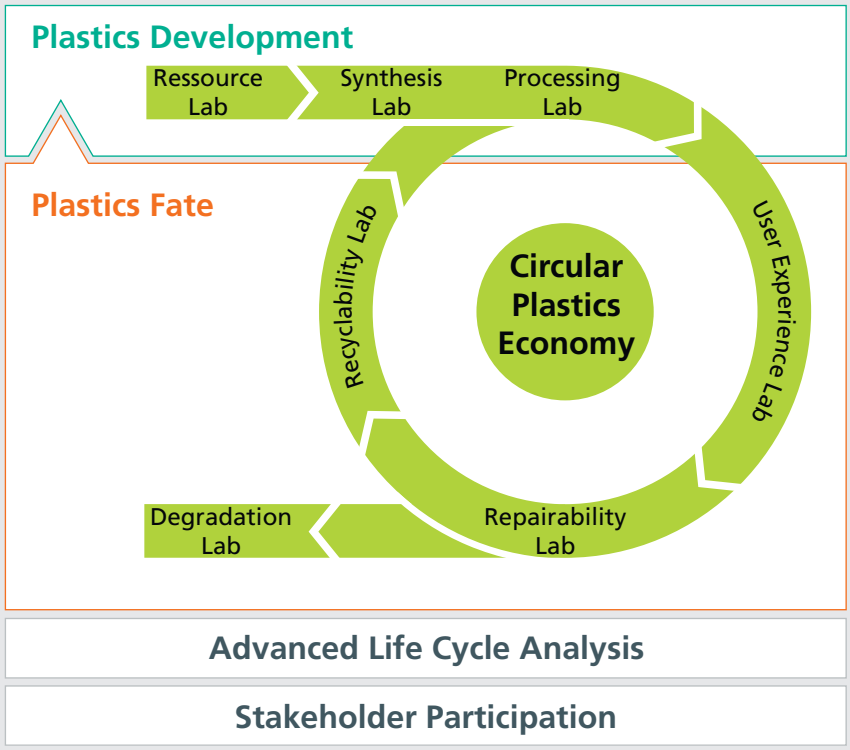
The Fraunhofer-Gesellschaft uses its expertise in the biological transformation of production and consumption (e.g. bionics, biologization, biotechnology) to design products using environmentally friendly raw materials. This includes, for example:

- The development of recyclable products that are durable, upgradeable/repairable and, depending on the application, degradable or easily dismantled
- The development of new (biogenic) basic raw materials

For the implementation of the circular economy, **digitalization** and the creation of ICT architectures are essential. These help to track and network information on new materials and anthropogenic storage (sum of buildings, infrastructures and other durable goods). An increased proportion of labeled products (e.g. digital passports, traceability by track and trace) enables the material to be fed back into the material cycle.

Through cooperation with partners from industry, research and education, Fraunhofer supports the transfer of knowledge and technology with (civil) society (e.g. via the Weizenbaum Institute for the Networked Society, the German Internet Institute, 2017-2020). Through concepts for the acceptance of durable and recyclable products, market entry barriers are reduced and product image is improved. The transfer to other areas in Europe must also be taken into account. Successful examples of the circular economy will consolidate Europe's pioneering role.

In addition to technological innovations, the circular economy requires new business models and a rethinking of current production and consumption patterns. Digitalization and biological transformation can contribute to this. Fraunhofer helps to develop these business models e.g. in the areas of new utilization concepts, citizen science, open workshops (e.g. repair cafés), urban production, and smart homes. Fraunhofer then evaluates the business models systemically and ensures transparency concerning rebound effects and socio-ecological and socio-economic impacts for the regions of Europe. For example, knowledge about changes in economic segments can provide a basis for decision-making on the effects of the circular economy. Conflicting objectives



Circular plastics economy.

between functional and performance requirements, safety, cost-effectiveness and recyclability must be openly addressed and resolved. At the same time, in a circular economy the accumulation of pollutants in the circuits must be ruled out and the protection of people and the environment must be a priority.

Due to significant anthropogenic storage, with often non-circulating materials, thermal recycling will supplement the circular economy. The steps needed to achieve a circular economy are the following:

- Development of "circular materials" and a measurement system for evaluation
- Reduction of the quantities of undesirable substances (microplastics) introduced into water bodies
- Development of business models for closing cycles with the high-quality reuse and further use of products

The Fraunhofer-Gesellschaft has launched a Cluster of Excellence "Circular Plastics Economy" as a focal point for the transformation toward a circular plastics economy (see figure). One aim is to develop prototypes for new circular plastics, additives and compounds. A second aim is to strengthen high value material recycling.

These proposals contribute to the achievement of SDGs 8, 9, 11, 12, 13.

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Fraunhofer Sustainability Network

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