

# Germany and China: The Race to the Next Technological Frontier

24<sup>nd</sup> June 2021

- Introduction to Fraunhofer
- Sustainable Manufacturing
- Industry 4.0

Fraunhofer-Institute for Production Systems and Design Technology (IPK) Berlin

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# The Fraunhofer-Gesellschaft at a Glance

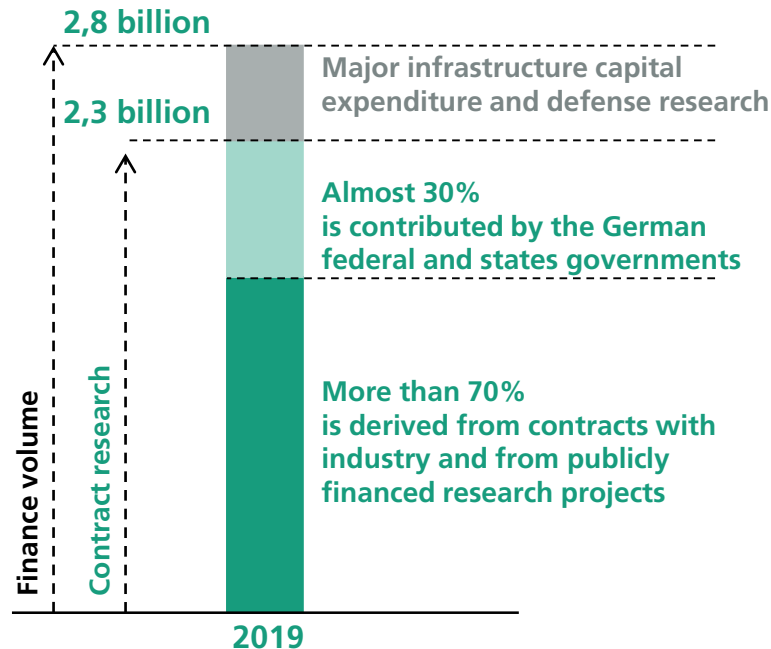
Applied research of direct utility to private and public enterprise and of wide benefit to society



28 000 staff



74 institutes and research units



# Intellectual Property Rights of Fraunhofer

	2013	2014	2015	2016	2017	2018
Active patent families at year end*	6407	6625	6573	6762	6695	6874
Invention disclosures reports per year	733	736	670	798	756	734
Patent applications per year	603	563	506	608	602	612
Brands (New registrations)	55	55	56	48	42	47

\* Portfolio of active rights (patents and utility models) and patent applications at year end.



2017: Fraunhofer

- **17th place** of the most active patent applicants and
- **8th place** among the most active trademark applicants at the DPMA



2018: Fraunhofer is one of the 100 largest applicants at the European Patent Office (rank 44)

2018: According to a study by the international group Clarivate Analytics, Fraunhofer is one of the »Top 100 Global Innovators«.

(3 other German companies: BASF, Bayer, Merck)



# International Network



- 8 independent Fraunhofer affiliates
- Active with partners in approximately 80 countries
- Representative Offices and Senior Advisors worldwide leverage networks abroad



# The Top 50 Technologies Driving Global Innovation and Commercial Growth



Source: Frost&Sullivan





# Sustainability – Selected Definitions



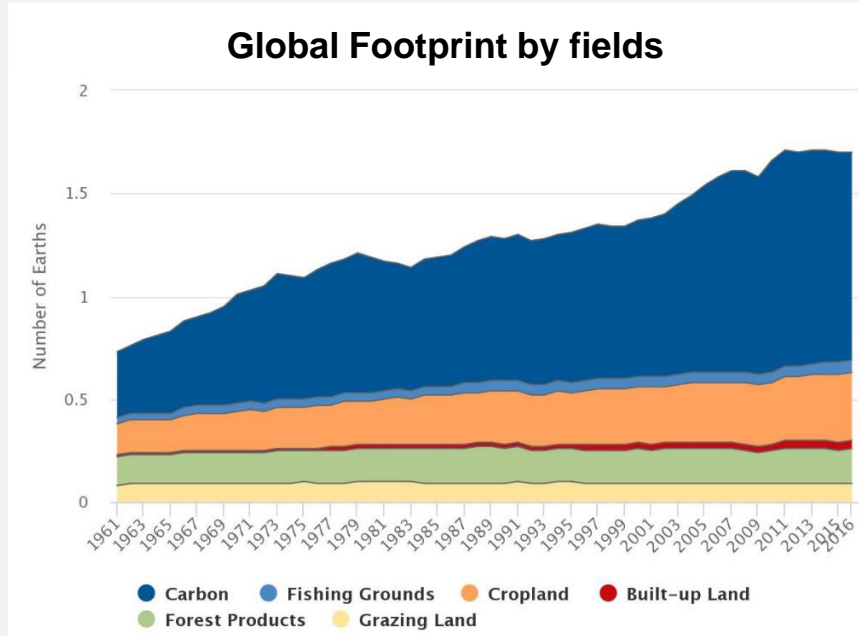
- "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

World Commission on Environment and Development. Our Common Future. (Oxford, Great Britain: Oxford University Press, 1987).  
(Frequently referred to as the Brundtland report after Gro Harlem Brundtland, Chairman of the Commission)

- "Sustainable development involves the simultaneous pursuit of **economic prosperity**, **environmental quality** and **social equity**. Companies aiming for sustainability need to perform not against a single, financial bottom line but against the **triple bottom line**."

World Business Council on Sustainable Development

# Overexploitation of Global Resources

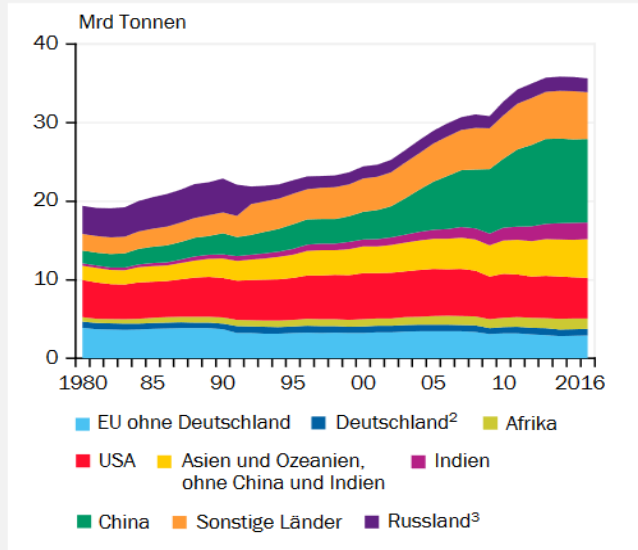


- Today's human lifestyle far exceeds the earth's biocapacity
- The ecological footprint of industrialized countries is well above the **global average of 1.75**
- By far the largest area is accounted to **carbon emissions**

Source: Global Footprint Network National Footprint Accounts 2019;  
URL: <https://www.footprintnetwork.org/resources/data/>

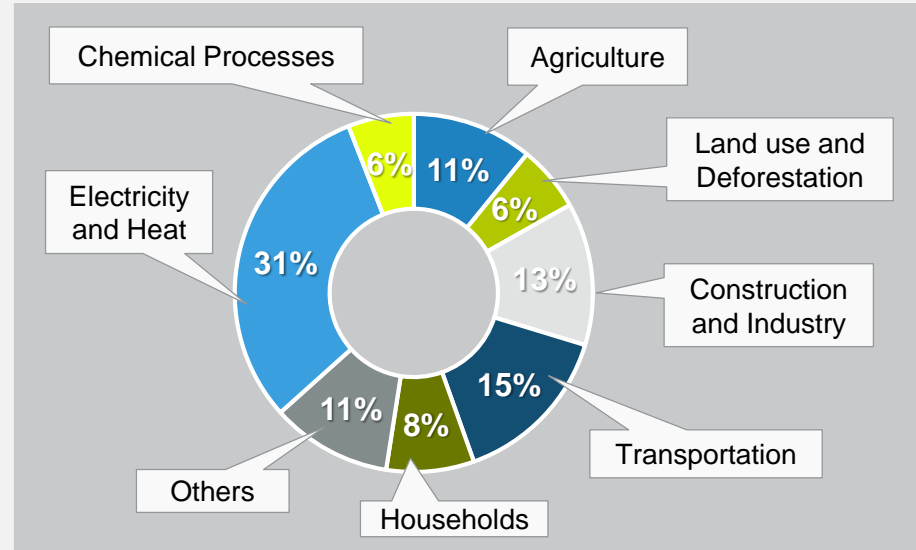
# Global CO<sub>2</sub> and Greenhouse Gas Emissions by Sectors

## CO<sub>2</sub> Emissions by selected countries and groups



Source: Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung. Aufbruch zu einer neuen Klimapolitik. Sondergutachten. 2019

## Sources of greenhouse gases broken down by economic sector



Source: Edenhofer, O; Jakob, M.: Klimapolitik. Ziele, Konflikte, Lösungen. 2. überarb. Auflage. C.H. Beck Verlag, 2019; Data: CAIT (2014) and CDIAC (2015)

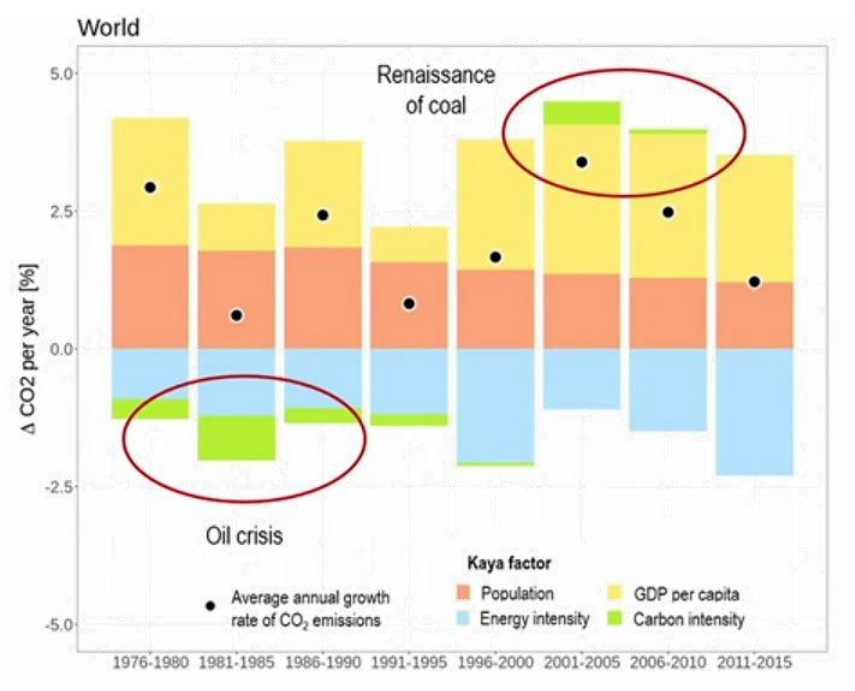


# Reasons for the Change of Co2-Emissions

- Increase in **energy efficiency** more than compensated by **economic growth**
- The **oil crisis** has reduced the carbon intensity, the **coal renaissance** has increased it again

## Kaya Factors

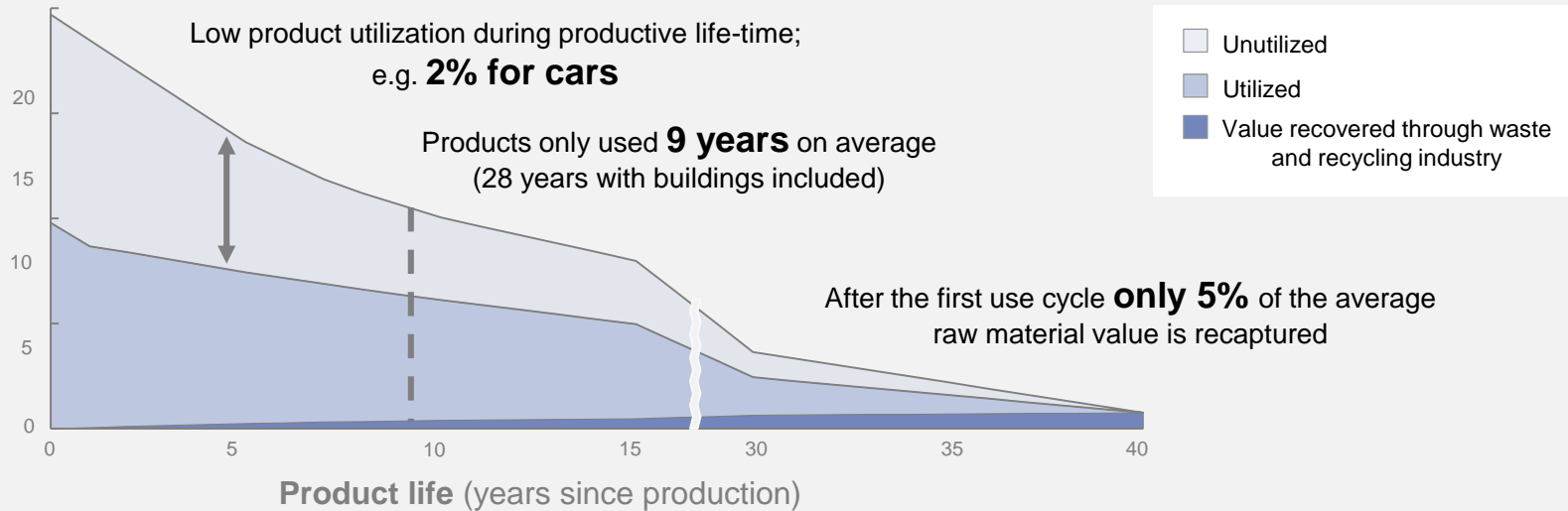
- Human population
- GDP per capita
- energy **intensity** (per unit of GDP)
- carbon **intensity** (emissions per unit of energy consumed)



Source: Hilaire, Steckel based on IEA (2017) Data

# Utilization of Processed Products

Value of manufactured goods, % of GDP (EU, 2012)



=> **Effective Technologies for fostering Circular Economy are necessary**



# The Demand regarding Complexity

## Order Specific Processes for Mass Production

### Combination of Variants



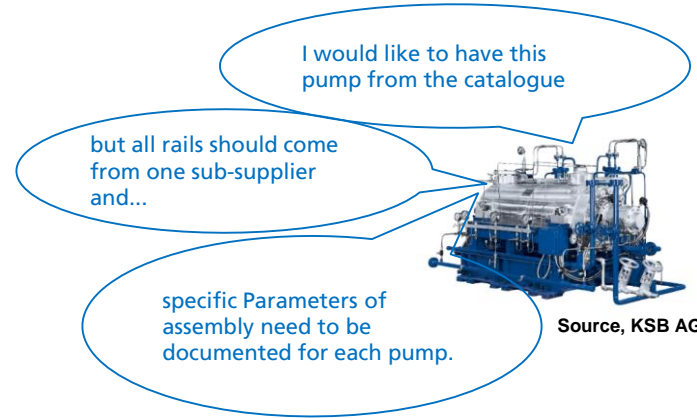
Source, Audi

“Conveyer Belt Less” Production at Quattro GmbH for Audi

110.338.690.475.432.439.829.762.481.848.320.000.000

**Theoretical Variants to produce Audi A3**  
No Car has a twin in a time frame of a year

### One of a Kind Production in Serial

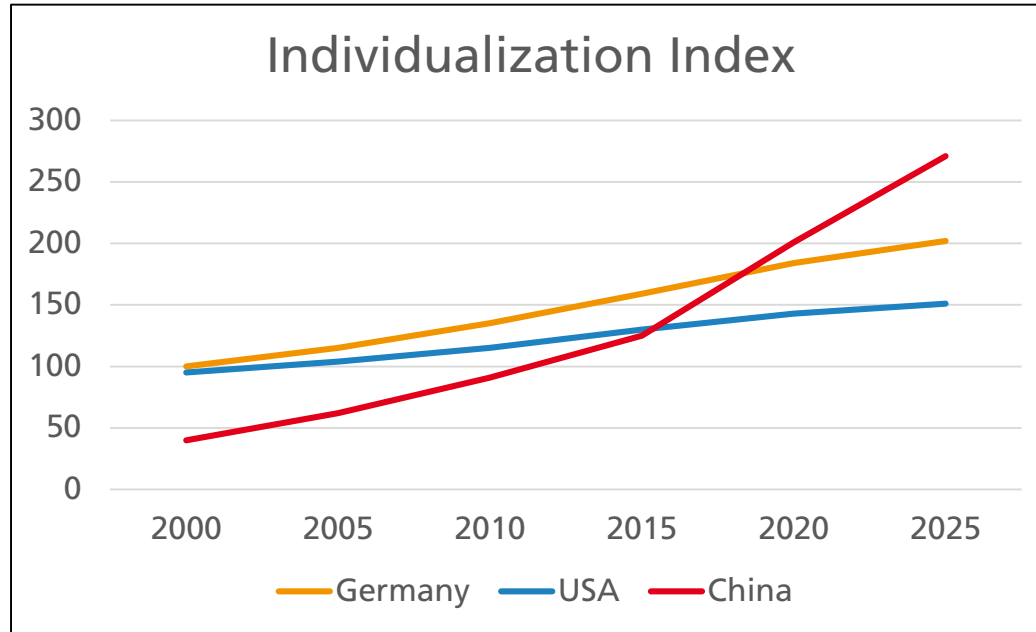


Source, KSB AG

**60.000 Pumps annually**

**Repetition Rate: 1,4**

**Individualization Index** – In particular in China the number of variants is increasing intensively, combined with expectations regarding realization time



2000 Germany 100%, Estimation of Fraunhofer IPK based on Experiences in Order Management

Example:

Truck Producer estimated for  
Chinese new Plant

Max: 60 Variants of Trucks

Today there are over 800  
Variants and each Year there  
is an increase of 65 new  
variants

# Industrie 4.0

## Challenges and Opportunities

### The 4th industrial revolution leads to...



Grafik © Anna Salari, designed by freepik

# Strategic Cooperation



**Meeting between German Chancellor Angela Merkel and Chinese Premier Li Keqiang 13.06.2016 in Beijing**



# Sino-German Intelligent Manufacturing Research Institute - SGIMRI

## German Engineering Excellence meets Chinese Speed

### Demonstration Center



- Demonstration of possibilities in the field of industry 4.0
- Possibilities for strategical partners, to exhibit self created technologies and integrate those

### Training Center



- Change Management Training for the top und middle-management
- Interactive training in a industry 4.0 learning factory for operational staff

### Application Center



- Prototype development of industry 4.0 – solutions for production
- Fast integration of German technologies in Chinese applications





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