wissenschaftsplattform_
nachhaltigkeit
2030

Hintergrundstudie

# Assessment report: Recent initiatives in science and policy to promote sustainable consumption and recommendations to enhance the German Sustainable Development Strategy in, with and by Germany

Lena Domröse, Julia Olliges, adelphi
Manuel Bickel, Christa Liedtke, Jola Welfens, Wuppertal Insitut

adelphi

In Kooperation mit:

Wuppertal Institut

Im Auftrag der Wissenschaftsplattform Nachhaltigkeit 2030 2019

wissenschaftsplattform_
nachhaltigkeit
2030

## Zur Studie

**Hintergrund**

**Wie können Produktions- und Konsummuster nachaltiger gestaltet werden, insbesondere im Rahmen der Deutschen Nachhaltigkeitsstrategie:** Unter anderem diese Frage bearbeitet die Wissenschaftsplattform Nachhaltigkeit 2030 mit dem Ziel, wissenschaftlich basierte Handlungsempfehlungen für politische Akteure zu entwickeln. Zu diesem Zweck hat sich 2017 über die Plattform die Arbeitsgruppe „Nachhaltiger Konsum" formiert, geleitet von Prof. Joachim von Braun (Zentrum für Entwicklungsforschung). In diesem Rahmen wurden unter anderem zwei Hintergrundstudien von der Plattform in Auftrag gegeben. Das vorliegende Papier „Assessment report: Recent initiatives in science and policy to promote sustainable consumption and recommendations to enhance the German Sustainable Development Strategy in, with and by Germany" ist eine von ihnen. Maßgeblich für die weitere AG-Arbeit ist ein breiter interdisziplinärer Austausch mit der Wissenschaft sowie ein transdisziplinärer Austausch mit Politik, Wirtschaft und Zivilgesellschaft in mehreren Schritten.

**Zitierhinweis**

Domröse, L., Olliges, J., Bickel, M., Liedtke, C., Welfens, J. (2019): Assessment report: Impacts of the digital transformation on consumption and their impacts for implementing the German Sustainable Development Strategy in, with and by Germany. Report to the Science Platform Sustainability 2030. Berlin/Wuppertal: adelphi/Wuppertal Institut.

**DOI**

10.2312/iass.2019.043

## Suggested Citation:

Domröse, Lena; Olliges, Julia; Bickel, Manuel; Liedtke, Christa, Welfens, Jola 2019: Assessment report: Recent initiatives in science and policy to promote sustainable consumption and recommendations to enhance the German Sustainable Development Strategy in, with and by Germany. Berlin/Wuppertal: adelphi/Wuppertal Institute.

## Imprint


Publisher: adelphi research gemeinnützige GmbH
Alt-Moabit 91
10559 Berlin
+49 (030) 8900068-0
office@adelphi.de
www.adelphi.de

Authors: Lena Domröse, adelphi; Julia Olliges, adelphi; Manuel Bickel, Wuppertal Institut; Christa Liedtke, Wuppertal Institut, Jola Welfens, Wuppertal Institut; (with support from Ulrike Knörzer, adelphi and Franziska Stelzer, Wuppertal Institut)

Layout: adelphi research gemeinnützige GmbH

Photo credits: Title: Guus Baggermans via unsplash

Status: September 2019

# adelphi

**adelphi** is a leading independent think tank and public policy consultancy on climate, environment and development. Our mission is to improve global governance through research, dialogue and consultation. We offer demand-driven, tailor-made services for sustainable development, helping governments, international organizations, businesses and non-profits design strategies to address global challenges.

Our staff of more than 200 provides high-quality interdisciplinary research, strategic policy analysis and advice, and corporate consulting. We facilitate policy dialogue and provide training for public institutions and businesses worldwide, helping to build capacity for transformative change. Since 2001 we have successfully completed over 800 projects worldwide. Our work covers the following key areas: **Climate, Energy, Resources, Green Economy, Sustainable Business, Green Finance, Peace and Security, International Cooperation and Urban Transformation**.

Partnerships are key to the way we work at adelphi. By forging alliances with individuals and organizations, we help strengthen global governance and so promote transformative change, sustainable resources management and resilience. adelphi is a values-based organization with an informal culture based on excellence, trust and cooperation. Sustainability is the foundation of our internal and external conduct. Our activities are climate-neutral and we have a certified environmental-management system.

# Wuppertal Institute

The Wuppertal Institute for Climate, Environment and Energy GmbH has existed as an independent research institution since 1991. The sole shareholder is the state of North Rhine-Westphalia. The institute consists of the four research groups: **Sustainable Production and Consumption; Circular Economy; Future Energy and Industry Systems; and Energy, Transport and Climate Policy**. The institute has a total of 228 employees. 128 employees belong to the scientific staff, which is composed of different scientific disciplines, including: natural and environmental sciences, geography, systems sciences, engineering sciences, planning sciences, political science, law, economics and social sciences.

The Wuppertal Institute does research on and develops models, strategies and instruments for transitions to sustainable development at regional, national and international levels. It focuses on resource, climate and energy challenges and how they interact with business and society. The analysis and triggering of innovations to decouple the consumption of nature from the development of prosperity are a key focus of the research.

The research of the institute is based on classical, discipline-orientated science, which it combines it with interdisciplinary approaches for handling complex sustainability problems in order to find practice-relevant and stakeholder-related solutions. Problem areas, approaches to solutions and networks are equally global, national and regional/local. Particular importance is given to the target-group-specific preparation of research results.

The clients of the Wuppertal Institute range from municipalities and regions to the ministries of the state and the federal government, the European Commission, the United Nations and the Ministry of Economic Affairs of Japan; from small and medium-sized enterprises and large corporations to industry associations and federations; from churches and trade unions to environmental associations and foundations in civil society.

# Contents

# List of figures

# List of Tables

# List of Abbreviations

| | |
|---|---|
| **AI** | Artificial Intelligence |
| **AR** | Augmented Reality |
| **BAFA** | Bundesamt für Wirtschaft und Ausfuhrkontrolle (Federal Office for Economic Affairs and Export Control) |
| **BMAS** | Bundesministerium für Arbeit und Soziales (Federal Ministry of Labour and Social Affairs) |
| **BMBF** | Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research) |
| **BMEL** | Bundesministerium für Ernährung und Landwirtschaft (Federal Ministry of Food and Agriculture) |
| **BMI** | Bundesministerium des Innern, für Bau und Heimat (Federal Ministry of the Interior, Building and Community) |
| **BMU** | Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (Federal Ministry for the Environment, Nature Conversation and Nuclear Safety |
| **BMVI** | Bundesministerium für Verkehr und digitale Infrastruktur (Federal Ministry of Transport and Digital Infrastructure) |
| **BMWi** | Bundesministerium für Wirtschaft und Energie (Federal Ministry of Economics and Energy) |
| **BMZ** | Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (Federal Ministry of Economic Cooperation and Development) |
| **CE** | Circular Economy |
| **$CO_2$** | Carbon dioxide |
| **CORSIA** | Carbon Offsetting and Reduction System for International Aviation |
| **DENA** | Deutsche Energie-Agentur GmbH |
| **DNS** | Deutsche Nachhaltigkeitsstrategie (German Sustainable Development Strategy) |
| **DRS** | Digital Responsibility Strategy |
| **EEWärmeG** | Erneuerbare-Energien-Wärmegesetz (Renewable Energy Heat Act) |
| **ElekroG** | Elektro- und Elektronikgerätegesetz |
| **EnEV** | Energieeinsparverordnung (Energy Saving Ordinance) |
| **EnEG** | Energieeinsparungsgesetz (Energy Saving Act) |
| **EnoLL** | European Network of Living Labs |
| **EPC** | Energy Performance Certificate |
| **FONA** | Forschung für Nachhaltige Entwickung (research for sustainable development) |

| | |
|---|---|
| **GNH** | Gross National Happiness |
| **GHG** | Greenhouse gas |
| **ICAO** | International Civil Aviation Organization |
| **ICT** | Information and communications technology |
| **IMA** | Interministerieller Ausschuss (Interministerial Committee) |
| **KNK** | Kompetenzzentrum Nachhaltiger Konsum (Competence Centre for Sustainable Consumption) |
| **LCA** | Life cycle assessment |
| **LDA** | Latent Dirichlet Allocation |
| **LL** | Living lab |
| **MF** | Material Footprint |
| **NAP** | National Action Plan for Business and Human Rights |
| **NAPE** | National Action Plan on Energy Efficiency |
| **NaWI** | Nachhaltiges Wirtschaften (sustainable economy) |
| **NCI** | National Climate Initiative |
| **NGO** | Non-governmental organisation |
| **NPNK** | Nationales Programm nachhaltiger Konsum (National Programme for Sustainable Consumption) |
| **NRVP** | National Cycle Paths Plan |
| **NRW** | Northrhine Westphalia |
| **PBefG** | Personenbeförderungsgesetz (Passenger Transport Act) |
| **PSS** | Product service system |
| **RWL** | Real world laboratory |
| **SCP** | Sustainable consumption and production |
| **SDG** | Sustainable Development Goal |
| **SME** | Small-to-medium enterprise |
| **TF-IDF** | Term frequency – inverse document frequency |
| **TSC** | The Sustainability Consortium |
| **UBA** | Umweltbundesamt (German Environment Agency) |
| **UNEP** | United Nations Environment Programme |
| **VAT** | Value Added Tax |
| **VR** | Virtual Reality |
| **VZBV** | Verbraucherzentralen (consumer organisations) |
| **WBGU** | Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (German Advisory Council on Global Change) |

# Executive Summary

This assessment report identifies six key areas of sustainable consumption. Transforming those areas is associated with a significant, positive impact on sustainable development. In this way, those key areas lay the foundation to set clear priorities and formulate concrete policy measures and recommendations. The report describes recent developments and relevant actors in those six fields, outlines drivers and barriers to reach a shift towards more sustainability in those specific areas, and explores international good-practice examples. On top of this, overarching topics in the scientific discourse concerning sustainable consumption (e.g. collaborative economy, behavioural economics and nudging) are revealed by using innovative text-mining techniques. Subsequently, the report outlines the contributions of these research approaches to transforming the key areas of sustainable consumption. Finally, the report derives policy recommendations to improve the *German Sustainable Development Strategy (DNS)* in order to achieve a stronger stimulus effect for sustainable consumption.

Below, a selection of the most important (TOP 14) recommendations to foster sustainable consumption in the six key areas as well as for the scientific realm are presented. They were chosen because they possess a particularly high leverage for the field. The authors also endeavoured to propose a balanced mix of recommendations that address regulatory, market-based, information or education-based and research-related instruments. They can be clustered in three types of actions: (i) national strategic actions and policymaking, (ii) monitoring indicators and creating a decision-making basis, and (iii) supporting the operational level. The recommendations largely lie within the responsibility of the German Government or the National Ministries that can support the recommended actions by corresponding national programmes, supporting transdisciplinary research initiatives, or by providing funding in the respective fields.

In particular, policymakers should:

**National strategic actions and policymaking**

- Focus on the equity and balance between different modes of transport and achieve a **mobility transformation** by shifting the current subsidies for the private use of cars (e.g. energy tax, vehicle tax, commuter allowance, tax benefit of company cars) towards promoting sustainable modes of transport (e.g. reduction of VAT on long-distance train tickets, expansion of bicycle infrastructure, social balanced and partly free, citizen tickets for public transport, services and business models e.g. socially balanced car/bike sharing offers).
- Promote the **consumption of plant-based meat and dairy alternatives** by setting an example in public procurement policies (e.g. climate-friendly public canteens with sustainable menu management and communication) and by taxing meat and dairy products at the standard rate of 19%.
- Implement a dynamic and socially balanced **$CO_2$ tax** to trigger investments in renovations of buildings in combination with interventions, incentives and digital information to change energy use behaviour to reduce heating needs.
- Strengthen sustainability in the **textile sector** by moving the NAP from voluntary self-commitment to mandatory measures of **corporate oversight**.
- Shift short haul flights onto rail e.g. by a clear price signal (reducing VAT on train tickets and raising the air ticket tax *(Luftverkehrsabgabe)* on domestic flights and

foster the attempts to reach an effective global (or in a first step European) agreement **to reduce emissions in the aviation sector**.

- Formulate concrete policy goals for i**ncreasing reuse and repairing of electronic devices** and introduce low VAT-rates for repair services of and make the costs of repairing large household appliances tax deductible.
- Establish a National **Digital Responsibility Strategy (DRS)** that integrates global sustainability objectives and digitalisation and potentially encourages the introduction of an "SDG Digitalisation". A key issue should be avoiding rebound effects. This needs to be accompanied by a Consumer DRS addressing accessibility of digital innovations and safeguarding their interests (data protection) (SVRV BMJV 2017). In addition, DRSs are required for companies (SVRV BMJV 2017) and science.
- Integrate **behavioural insights / nudging experience** throughout policymaking process (from idea generation to design, implementation and evaluation); test nudges in different areas of consumption policy (see more Mont et. al. 2017, 69).

**Monitoring indicators and creating a decision-making basis**

- Create a set of **indicators in accordance with SDG12** that can actually map the targeted goals at sufficient level of detail. Further develop the German SDG12 indicator set in this direction. The indicators should be relevant for public institutions / policymakers, companies, and households/individuals. These stakeholders should further be able to use the data in order to operate and live more sustainably. The indicators must be socio-economic, spatial and for the areas of consumption differentiable in order to reflect rebound effects, problem shifts and socio-ecological situations.
- Monitoring of **central circularity indicators** (KRU 2017) is necessary and has to be connected to an integrated indicator set for dynamically monitoring and managing SDG12 (focus on SCP) – without a systemic integration the 1.5° lifestyles will not be achieved.
- Develop an **indicator "available time"** as an indicator of "quality of life" which should be integrated in the *German Sustainable Development Strategy* (Reisch and Bietz 2014, Buhl/Schipperkes/Liedtke 2017) and generate an empirical basis for evidence-based time policies as part of environmental and social policy in the most relevant areas of sustainable consumption.
- Initiate a **Lifestyle or Consumer Panel** in Germany (possible result: interactive, dynamic "Sustainable Lifestyle Atlas" with socio-economic and spatial differentiations and applications for research and consumer practice) as a contribution to the fulfilment of SDG 12 as well as a broad discussion about the related social-ecological situations of different social groups (e.g. energy poverty versus richness and related carbon footprints or digital divide between young and old, or poor and rich social groups etc.). Founding of a (new) Ministry of Good Living with focus on welfare of society and social-ecological justice.

**Supporting the operational level**

- Develop an accelerator mechanism: Establish a German **network of regional LivingLab centres** to push smart, sustainable products and services - implementing sustainable product service systems, e.g. bike or ride sharing services or assistance and feedback devices in the field of living, mobility and shopping (Erdmann et al. 2018).

- Develop new and **innovative sustainable services; temporary use of assets** should be encouraged, while ensuring adequate consumer and social protection, e.g. warranting fair working conditions, and tax compliance. Any approach has to be evaluated and monitored via sustainability indicators. The risk of rebound effects must also be considered and controlled.

# Zusammenfassung

In diesem Bericht wird untersucht, wie die Weiterentwicklung der Deutschen Nachhaltigkeitsstrategie (DNS) im Jahr 2020 genutzt werden kann, um eine noch stärkere Anschubwirkung für den nachhaltigen Konsum in Deutschland zu erzielen. Dafür werden sechs Schlüsselbereiche des nachhaltigen Konsums identifiziert, deren Transformation mit erheblichen positiven Auswirkungen auf die nachhaltige Entwicklung verbunden ist. Dies dient als die Grundlage, um Prioritäten zu setzen und konkrete politische Maßnahmen und Empfehlungen zu formulieren. Der Bericht beschreibt die jüngsten Entwicklungen in dem Zeitraum von 2016 bis 2019 und die relevanten Akteure in den sechs nachhaltigkeitskritischen Bereichen, skizziert die Treiber und Hemmnisse für einen Wandel in Richtung Nachhaltigkeit und untersucht internationale *Good-practice*-Beispiele. Darüber hinaus werden durch den Einsatz innovativer Text-Mining-Methoden übergreifende Themen im wissenschaftlichen Diskurs zu nachhaltigem Konsum (z.B. Kollaborative Ökonomie, Verhaltensökonomie und Nudging) aufgezeigt und die Beiträge dieser Forschungsansätze zur Transformation der Schlüsselbereiche skizziert. Anschließend werden politische Handlungsempfehlungen für die Fortschreibung der Deutschen Nachhaltigkeitsstrategie abgeleitet.

Nachfolgend wird eine Auswahl der wichtigsten (TOP 14) Empfehlungen zur Förderung des nachhaltigen Konsums vorgestellt, die sich aus der Analyse der sechs Schlüsselbereiche sowie des wissenschaftlichen Diskurses ergeben und die eine besondere Hebelwirkung haben. Diese Empfehlungen können in drei Kategorien untergliedert werden: (i) nationale strategische Maßnahmen und Politikgestaltung, (ii) Überwachung von Indikatoren und Schaffung einer Entscheidungsgrundlage und (iii) Unterstützung der operativen Ebene. Die Empfehlungen fallen weitgehend in den Zuständigkeitsbereich der Bundesregierung oder der Bundesministerien, die die empfohlenen Maßnahmen durch entsprechende nationale Programme, die Unterstützung transdisziplinärer Forschungsinitiativen oder die Bereitstellung von Mitteln in den jeweiligen Bereichen unterstützen können.

Politischen Entscheidungsträger sollten insbesondere:

**Nationale strategische Maßnahmen und Politikgestaltung**

- Die Gerechtigkeit und Ausgewogenheit zwischen den verschiedenen Verkehrsteilnehmer*innen in den Blick nehmen und eine Mobilitätswende durch Verlagerung der derzeitigen Subventionen für die private Nutzung von Personenkraftwagen (z.B. Energiesteuer, Kfz-Steuer, Pendlerpauschale, Steuervorteil von Firmenwagen) hin zur Förderung nachhaltiger Verkehrsträger (z.B. Ermäßigung der Mehrwertsteuer auf Fernzüge, Ausbau der Fahrradinfrastruktur, sozial ausgewogene und teilweise kostenlose Bürgertickets für den öffentlichen Verkehr, Dienstleistungen und Geschäftsmodelle z.B. sozial ausgewogene Angebote von Fahrrad-/Car-sharing) initiieren.
- Den Konsums von pflanzlichen Fleisch- und Milchalternativen durch eine Vorbildfunktion in der öffentlichen Beschaffungspolitik (z.B. klimafreundliche öffentliche Kantinen) und durch die Besteuerung von Fleisch und Milchprodukten mit dem Standardsatz von 19% fördern.
- Eine dynamische und sozial ausgewogene $CO_2$-Steuer einführen, um Investitionen in die Renovierung von Gebäuden anzureizen, in Kombination mit Maßnahmen,

Anreizen und digitalen Informationen zur Änderung des Energieverbrauchsverhaltens und Reduzierung des Wärmebedarfs.
- Die Nachhaltigkeit im Textilsektor stärken durch die Umstellung des *NAP* von der freiwilligen Selbstverpflichtung auf verbindliche Maßnahmen für Unternehmen.
- Die Verlagerung von Kurzstreckenflügen auf die Schiene anreizen z.B. durch ein klares Preissignal (Ermäßigung der Mehrwertsteuer auf Bahnfahrkarten und Erhöhung der Luftverkehrsabgabe auf Inlandsflügen) und Bestrebungen hin zu einem wirksamen globalen (oder in einem ersten Schritt europäischen) Abkommen zur Reduktion der Emissionen im Luftverkehrssektor unterstützen.
- Konkrete politische Ziele zur Steigerung der Wiederverwendung und Reparatur von elektronischen Geräten formulieren und niedrigere Mehrwertsteuersätze für Reparaturdienstleistungen und steuerliche Absetzbarkeit der Kosten für die Reparatur von Haushaltsgroßgeräten einführen.
- Eine nationale *Digital Responsibility Strategy (DRS)* entwickeln, die globale Nachhaltigkeitsziele und Digitalisierung integriert und potentiell zur Einführung eines SDGs „Digitalisierung“ ermutigt. Ein zentrales Thema sollte die Vermeidung von Rebound-Effekten sein. Dazu muss eine DRS für Verbraucher hinzukommen, die sich mit der Zugänglichkeit digitaler Innovationen und der Wahrung von Verbraucherinteressen (Datenschutz) befasst (SVRV BMJV 2017). Darüber hinaus sind entsprechende Strategien für Unternehmen (SVRV BMJV 2017) und Wissenschaft erforderlich.
- Erkenntnisse der Verhaltensforschung/Erfahrungen mit Nudging im gesamten politischen Entscheidungsprozess einfließen lassen (von der Ideengenerierung über Design, bis zu Implementierung und Bewertung); Testen von Nudgingansätzen in verschiedenen Bereichen der Konsumpolitik (mehr hierzu siehe Mont et. al. 2017, 69).

**Überwachung von Indikatoren und Schaffung einer Entscheidungsgrundlage:**

- Ein Indikatorenset gemäß SDG12 erstellen, das die angestrebten Ziele tatsächlich und in ausreichendem Detaillierungsgrad abbilden kann. Weiterentwicklung des in diese Richtung gesetzten deutschen SDG12-Indikatorensets. Die Indikatoren sollten für öffentliche Einrichtungen/Entscheidungsträger, Unternehmen und Haushalte/Personen relevant sein. Diese Interessengruppen sollten ferner in der Lage sein, die Daten zu nutzen, um nachhaltiger zu wirtschaften und zu leben. Die Indikatoren müssen sozioökonomisch, räumlich und für die Konsumbereiche differenzierbar sein, um Rebound-Effekte, Problemveränderungen und sozial-ökologische Situationen widerzuspiegeln.
- Zentrale Indikatoren für Zirkularität (KRU 2017) überwachen. Das Monitoring muss an einen integrierten Indikatorensatz zur dynamischen Überwachung und Steuerung von SDG12 (Fokus auf SCP) angeschlossen werden - ohne eine systemische Integration werden die 1,5° Lebensstile nicht erreicht.
- Einen Indikator "verfügbare Zeit" entwickeln als Indikator für "Lebensqualität" und diesen in die Deutsche Nachhaltigkeitsstrategie integrieren (Reisch und Bietz 2014, Buhl/Schipperkes/Liedtke 2017). Generierung einer empirischen Grundlage für evidenzbasierte Zeitpolitik im Rahmen der Umwelt- und Sozialpolitik in den wichtigsten Bereichen des nachhaltigen Konsums.
- Ein Lifestyle- oder Verbraucherpanel in Deutschland initiieren (mögliches Ergebnis: interaktiver, dynamischer "Sustainable Lifestyle Atlas" mit sozioökonomischen und räumlichen Differenzierungen und Anwendungen für Forschung und Verbraucherpraxis) als Beitrag zur Erfüllung von SDG 12 sowie eine breite

Diskussion über die damit verbundenen sozial-ökologischen Situationen verschiedener sozialer Gruppen (z.B. Energiearmut versus Reichtum und damit verbundene $CO_2$-Fußabdrücke oder digitale Kluft zwischen Jung und Alt, armen und reichen sozialen Gruppen etc.). Gründung eines (neuen) Ministeriums für Gutes Leben mit Fokus auf das Wohlergehen der Gesellschaft und sozial-ökologische Gerechtigkeit.

**Unterstützung der operativen Ebene:**

- Ein deutsches Netzwerk von regionalen LivingLab-zentren zur Förderung intelligenter, nachhaltiger Produkte und Dienstleistungen entwickeln, Implementierung nachhaltiger Produktdienstleistungssysteme, z.B. Rad- oder Fahrgemeinschaftsdienste oder Assistenz- und Feedbackgeräte im Bereich Wohnen, Mobilität und Einkaufen (Erdmann et al. 2018).
- Neue und innovative nachhaltige Dienstleistungen und die vorübergehende Nutzung von Vermögenswerten fördern, wobei gleichzeitig ein angemessener Verbraucherschutz und soziale Sicherheit gewährleistet sein sollte, z.B. durch faire Arbeitsbedingungen und die Einhaltung der Steuervorschriften. Jeder Ansatz muss über Nachhaltigkeitsindikatoren bewertet und überwacht werden. Das Risiko von Rebound-Effekten muss ebenfalls berücksichtigt und kontrolliert werden.

# 1 Introduction

In order to achieve global sustainable development, there is an urgent need for fundamental change in today's consumption and production patterns. Since the Earth Summit in Rio de Janeiro in 1992, the topic of sustainable production and consumption has been increasingly represented in the international and national debate, but a "consumption transformation" via more sustainable products and services has not yet taken place. Consumption of resources and energy is stagnating at a high level, and rebound effects in particular reduce the potential of more efficient products. On an international level, the importance of responsible consumption and production has been confirmed in the Sustainable Development Goal 12 of the Agenda 2030 which calls on all countries to take immediate action. In Germany, the Agenda 2030 was translated into the *German Sustainable Development Strategy (DNS)* 2016 and substantiated by the *National Programme for Sustainable Consumption (NPNK)*. With the adoption of the *DNS* and the *NPNK* and the establishment of *the Competence Centre for Sustainable Consumption (Kompetenzzentrum Nachhaltiger Konsum - KNK)*, the Federal Government has set the course for a change in society as a whole towards more sustainable consumption. Federal ministries are meeting regularly in the *Interministerial Committee (IMA)* to elaborate cross-sectoral approaches to strengthen sustainable consumption. Civil society movements call for a change of the current production and consumption systems (e.g. *Fridays for Future*) and the recent elections results in Germany mirror the increasing interest of the public in green topics and a societal and economic transformation towards more sustainability.

The study provides a progress report on current policy initiatives and scientific developments in key areas of consumer policy in, with and by Germany in particular since the amendment of the *German Sustainable Development Strategy* in 2016. Building on this, it depicts how the enhancement of the *German Sustainable Development Strategy* in 2020 can be used to achieve an even stronger stimulus effect for sustainable consumption.

The challenge to achieve this transformation is immense and the means are limited. Thus it is important to set clear priorities and to identify the measures with a significant, positive impact on sustainable development. This assessment report defines key areas of sustainable consumption. A transformation of these areas towards more sustainability is associated with strong positive ecological and socio-economic effects (chapter 2). To this end, the key areas are identified by conducting a literature review and taking into account ecological and social criteria. As consumption and production are closely interlinked, parts of the study cover production processes as well, yet the focus is clearly on the consumption side. In chapter 3, the recent developments (since 2016) and relevant actors in the key areas are depicted, drivers and barriers to reach a shift towards a more sustainability in those fields are outlined and international good-practice examples are investigated. Each of those six sub-chapters will be concluded with policy recommendations. Chapter 4 can be seen as a complementary part: Whereas chapter 3 focuses on the societal level, Chapter 4 investigates overarching key topics from the scientific discourse based on text mining and a qualitative literature review (e.g. research on real-world labs and living labs, collaborative economy, or circular economy). It shows both the need for further research but also policy recommendations with regards to those overarching topics. Chapter 5 concludes with highlighting the contributions of these research approaches to transforming the key areas of sustainable consumption.

# 2 Key areas of sustainable consumption

The aim of this chapter is to identify key areas of sustainable consumption. Key areas are defined as follows: A transformation of this area towards more sustainability is associated with strong positive ecological and socio-economic effects. Within the framework of this study, recommendations for policy measures in the field of sustainable consumption should be made – focussing on those measures that make a major contribution to the achievement of the 2030 Sustainable Development Goals. Hence, the key areas identified here lay the basis to target those "big points" (Quack et al. 2017a; Bilharz 2009; Geiger et al. 2018). However, the formulation of priority lists does not yet contain any statements on the chances of their implementation (ibidem). The unit of analysis in this chapter are private household consumption activities, which on an aggregate level contribute to the majority of environmental impacts taking place (e.g. they are accountable for nearly three quarters of global greenhouse gas emissions) (Druckman and Jackson 2016).[1] At first, consumption activities causing significant environmental impacts will be derived from existing studies. To this end, ecological criteria (the global warming potential as well as the impact categories land-use, material-use and water-consumption) are taken into account. Subsequently, the social hotspot areas of consumption should be identified. There is still a great need for research in this area. In order to shed light on this, different sectors and product groups are investigated using the product database provided by the "The Sustainability Consortium" (TSC). This database is one of the most comprehensive references on research on sustainability issues of products covering more than 117 product categories. The database is based on a review of a range of scientific sources and goes through multiple stages of review itself hence it can be seen as a valid source.

## 2.1 Environmental impact categories

In the past decade, the life cycle environmental impacts of consumption activities have been investigated in a multitude of studies. However, many of them focus on a single ecological criterion, namely the global warming potential of consumption activities (Grießhammer et al. 2010b; UNEP 2010; Tukker et al. 2010; Kaenzig and Jolliet 2006; Di Donato et al. 2015; Druckman and Jackson 2016; Hertwich 2011; Neitzke et al. 2016). Few studies have addressed other impact categories than greenhouse gas emissions (Ivanova et al. 2016; Beylot et al. 2019). As far as possible, other environmental impact categories have been considered, too – such as the contribution of different consumption categories and activities to the land, material, and water footprint of households. For some impact categories, however, data are missing − for instance regarding the impact of consumption activities on biodiversity. This constitutes a true gap of research. There are some indications that the greenhouse gas emissions indicator can be used as a good approximation for a number of other indicators (Quack et al. 2017a). Nonetheless, target conflicts – for instance between the impact categories global warming potential and the impact on biodiversity might come into play.

[1] The environmental impact of public sector organizations are not covered in this chapter. However, recommendations addressing the public sector (e.g. public procurement) will be included in chapter 7.

### 2.1.1 Global warming potential

As described above, the impact of consumption activities on climate change has been investigated quite intensively (Grießhammer et al. 2010b; UNEP 2010; Tukker et al. 2010; Kaenzig and Jolliet 2006; Di Donato et al. 2015; Druckman and Jackson 2016; Hertwich 2011; Neitzke et al. 2016). The studies mentioned have in common that they take the whole life-cycle into account, including those emissions arising in other countries through upstream or downstream activities in the value chain. Yet, different functional units, system boundaries and data sources have been applied and consumption activities have been grouped differently (for instance, aviation emissions have been assigned to recreational activities or individual transport). Despite these variations and inevitable shortcomings, the main findings of this body of work are clear and consistent (Tukker et al. 2010). Mobility, food, and housing are responsible for the largest proportion of consumption-related environmental impacts: These domains, in aggregate, account for 70% to 80% of the life cycle environmental impacts in industrialized countries[23] (Tukker et al. 2010; UNEP 2010; Kaenzig and Jolliet 2006; Bilharz 2009; Quack et al. 2017a; Spangenberg and Lorek 2002; Neitzke et al. 2016; Druckman and Jackson 2016; Umweltbundesamt 2019a). Within each cluster, specific consumption activities can be identified that especially give rise to greenhouse gas emissions (Spangenberg and Lorek 2002). In the sector “mobility” travel by air and use of private cars can be identified as “key points” (Druckman and Jackson 2016; Grießhammer et al. 2010a; Hertwich 2011; Kaenzig and Jolliet 2006; Quack et al. 2017b; Spangenberg and Lorek 2002; Tukker et al. 2010). Within the sector of “food” the consumption of meat and dairy products is considered to be the main source of emissions (Druckman and Jackson 2016; Grießhammer et al. 2010a; Hertwich 2011; Ivanova et al. 2016; Kaenzig and Jolliet 2006; Neitzke et al. 2016; Quack et al. 2017b; Tukker et al. 2010; Wiedmann and Lenzen 2018). Other “key points“ are the use of domestic heating (influenced by the heating behaviour, the choice of insulation material and the size of living space) (Druckman and Jackson 2016; Grießhammer et al. 2010a; Hertwich 2011; Kaenzig and Jolliet 2006; Neitzke et al. 2016; Spangenberg and Lorek 2002; Tukker et al. 2010; UNEP 2010).

### 2.1.2 Land use

Land use reflects use of cropland, pasture land, and forest land. Ivanova et al. are one of the few authors conducting a comparative study on the impact of different consumer activities on land use (2016). They find that on a global scale the household demand for food and housing dominate the land footprint (46% of the land use and 26%, respectively). The significant impact of German and EU consumption of agricultural products on land use is also supported by a study conducted on behalf of the *German Environment Agency* (Umweltbundesamt 2017). Notably, the consumption of livestock products (meat), fats, and coffee have large land requirements (Gerbens-Leenes and Nonhebel 2005; IPCC 2019).

### 2.1.3 Material consumption

The material footprint (MF) is a consumption-based indicator of resource use including primary crops, crop residues, fodder crops, grazing, wood, aquatic animals, metal ores, non-

[2] The total impact of different consumption areas is determined by adding the individual life cycle assessments.

[3] also on the national level

metallic minerals, and fossil fuels and may be used to indicate the material input per service unit (Wiesen et al. 2014; Ivanova et al. 2016; Liedtke et al. 2014; Schmidt-Bleek 1998). According to Ivanova et. al, 36% of the material footprint arising from household activities can be attributed to food consumption, followed by services (23%) and manufactured products (17%) (2016). In a study on the material footprint of private households in Germany Buhl et al. (2019) find that besides food consumption, mobility and housing are the biggest components of the private households footprint.

### 2.1.4 Water consumption

The consumption of food is also considered to be the environmental hotspot with regard to the water footprint (Ivanova et al. 2016; UNEP 2010; Hoekstra 2015). A report published by *United Nations Environment Programme* (2010) shows that from a consumption perspective agricultural goods (including livestock products) dominate the water consumption of households whereas direct water consumption and consumption of industrial goods drive just a minor part of water consumption. Agricultural production accounts for 70% of the global freshwater consumption (Hoekstra 2015).

The production of textiles – a pair of jeans for example – including the growing of cotton and the diverse steps in the supply chain such as spinning, dying and weaving is another well-known example of a product with a remarkable water footprint (Hoekstra 2015) - a concept that accounts for the use of rain, ground and “grey” water to show what kind of water is used and how/if it is polluted within the production process.

## 2.2 Social impact categories

There is no literature focussing on the social impact of consumer activities in a comparative manner. However, the social sustainability of specific product groups and categories during their life-cycle has been analysed. Accordingly, a different unit of analysis is applied in this sub-chapter. The international non-profit organization The *Sustainability Consortium (TSC)* offers a brief evaluation of product groups’ social sustainability risk and points out social hotspots among product categories. As described above, the database is based on a review of a range of scientific sources and thus is used as primary reference here. In order to evaluate and compare consumer good’s social impact, *TSC* differentiates the following product groups:

- Clothing, footwear and textiles
- Electronics;
- Food, beverage and agriculture;
- General merchandise;
- Home and personal care;
- Packaging;
- Paper, pulp and forestry;
- Toys

After defining the specific boundaries of product categories, *TSC*, through a structured research process, allocates evidence for social risks and opportunities for each product category.

**The following indicators define a "social sustainability issue":**

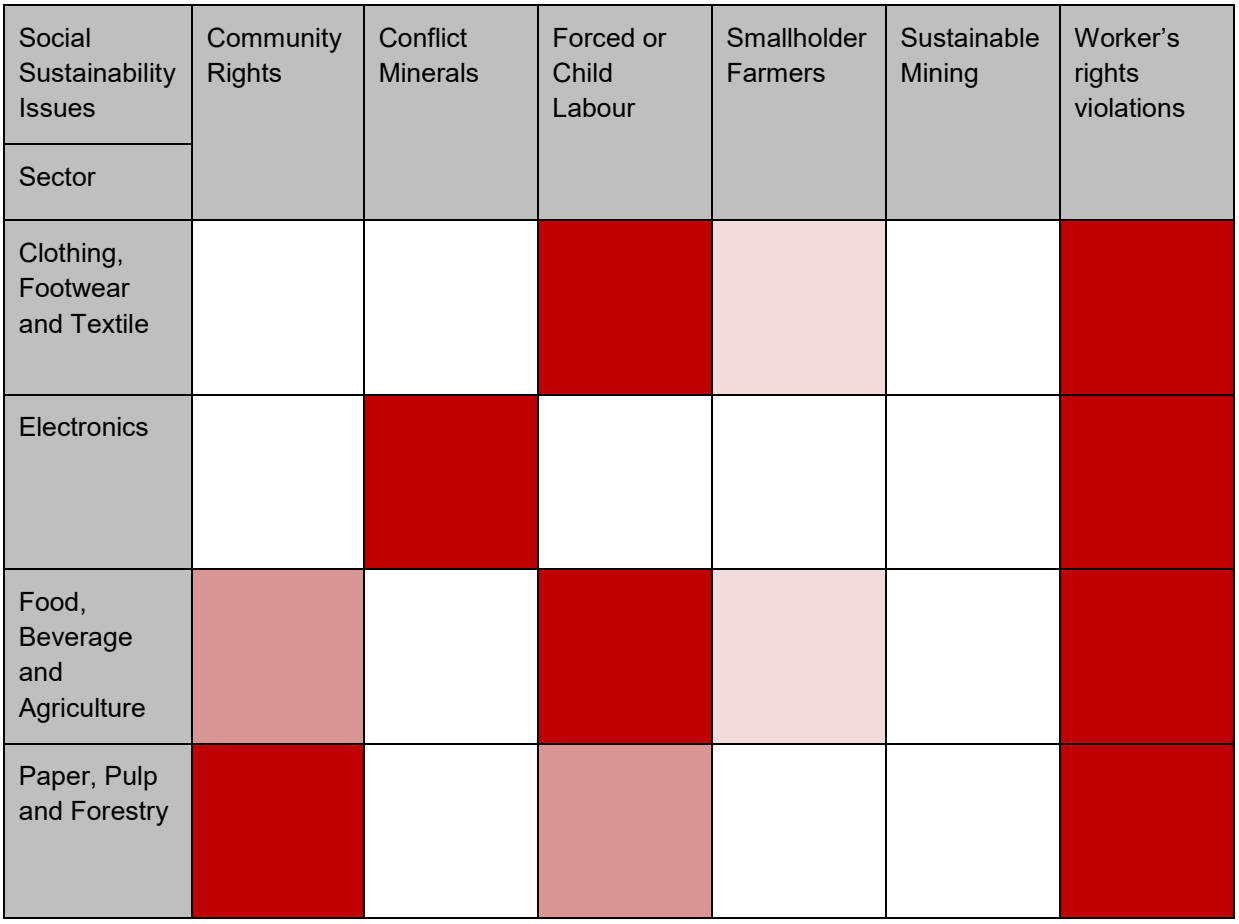
- **Community rights** pointing either to conflicts caused e.g. by farming, over access to land, water or harvesting ground; a diminution of access to land and resources of local communities; to the violation of rights of local or indigenous people through land grabbing or the exposure of surrounding communities to noise, dust or harmful chemicals and other industrial hazards by production sites.
- **Conflict minerals** suggesting that products contain "minerals, including gold and ores of tantalum, tin, and tungsten that may be mined in areas where groups responsible for human rights abuses control and profit from mining operations".
- **Forced or child labour** implying that during the production there is a risk of forced or child labor, "characterized by actions such as trafficking, withholding wages or documents, and restricting workers to the work site",
- **Smallholder farmers** pointing to a limited access of growers on small farms that supply bigger companies to information, technology and resources,
- **Sustainable mining** suggesting human rights abuses by groups which may control and profit from the mining of minerals like gold and ores of tantalum, tin, and tungsten,
- **Workers** implying the violation of worker's rights such as the protection from hazards at the workplace, the rights to freedom of association, equal opportunity and treatment as well as the denial of fair wages; which can be an issue particularly with women and migrant workers.

Evaluations made by *TSC*, based on the structured research of publications, are validated through a multi-stakeholder review, which integrates corporate, academic, government and non-government stakeholders. The final evaluation and oversight of social hotspots is accumulated in a Category Sustainability Profile (TSC Sustainability Insights). Through a qualitative analysis of each product category and their social impact evaluation the most critical consumer good categories can be identified:

- **Clothing, footwear and textiles,** depicting a high risk of forced and child labour, the violation of workers and smallholder farmers rights, especially among cotton products (cultivation) as well as apparel and home textiles (fabrication).
- **Electronics,** constituting social hotspots in the areas of Conflict minerals and the violation of employee rights for almost all of the assigned consumer goods.
- **Food, beverage and agriculture** with a high risk of forced or child labour, violation of workers' rights, community rights, and the rights of smallholder farmers, especially for the following products: sugar; apples and pears; cocoa; coffee; cucumbers, melons and squash; fish; shellfish; grains; nuts and seeds; palm and vegetable oil; root vegetables; soy; tea (non-herbal); tomatoes, peppers and eggplants
- **Paper, pulp and forestry** showed medium to high risk levels of workers' rights violations, community rights violations and forced or child labour for many of the product categories; especially for disposable food and drink containers and wooden furniture.)

Even though the TLC method and dataset allow for a superficial comparison of social sustainability risks in various product categories and help identify social hotspots among them, more research and theoretical work is necessary in order to develop a matrix which can help compare consumer goods and actions with regard to their impact on social sustainability issues. Furthermore, social criteria should not only take social issues in an international context into consideration, but also on national level (e.g. precarious employment) – which so far is a true research gap.

**Figure 1: Sustainability of specific product groups and categories**




**Source:** TLC product database. The colour highlighting is based on the qualitative analysis and depicts the frequency that one of the indicators has been assigned to the respective product group. The darker, the more often the indicator showed.

## 2.3 Preliminary conclusions

The literature review identified six key areas of consumption which have a high environmental and social impact and offer potential for improvement. It is therefore recommendable to set clear priorities in the *German Sustainable Development Strategy (DNS)* and address these issues. The key areas of consumption are clustered according to the fields of need of the *National Programme on Sustainable Consumption (NPNK)*. Within these fields specific focus points are discussed.

**Key areas**

- **Mobility:**
  - The use of private cars brings along environmental and social problems. Thus, a shift of motorised individual transport to public transport and foot and bicycle traffic is necessary for sustainable consumption in the field of mobility (relevance: global warming potential, material-consumption)
- **Clothing:**
  - Consumption of clothing, footwear and textiles brings along social and environmental problems, thus better working conditions along the textile supply chain need to be created (relevance: social hotspot, water-consumption)
- **Food:**
  - Environmental problems resulting from food consumption need to be tackled by reducing the overall consumption of meat and dairy products (relevance: global warming potential, land-use, material-consumption, water-consumption)
- **Home:**
  - Heating of private space has a high environmental impact, thus insulation of houses needs to be fostered and sustainable heat supply developed (relevance: global warming potential)
  - Size of living space is one important aspect, and a reduction of the size of living space per person is an important measure to lessen environmental impacts (relevance: land-use, global warming potential, material-consumption)
- **Leisure and tourism:**
  - Travel by air is increasingly becoming a main hotspot for environmental problems and needs to be addressed in the *German Sustainable Development Strategy* (relevance: global warming potential)
- **Workplace and office:**
  - The purchase and use of consumer electronic devices is increasingly leading to negative impacts. To support longer product life-cycles and repair and reuse systems is therefore vital for future actions (relevance: social hotspot, material-consumption)

# 3 Recent political initiatives that support sustainable consumption

This chapter presents a progress report on current political initiatives and relevant stakeholders in key areas of consumer policy of the past three years since the further amendment of the *German Sustainable Development Strategy (DNS)* in 2016. The assessed drivers and barriers are either of a regulatory, market-based, information based, structural, psychological, and/or technological nature. Due to the limited scope of the study, the key areas cannot be examined fully and in depth, limitations are mentioned in the respective chapter.

## 3.1 Key area: Use of private cars

Even though GHG emissions per car have decreased due to stricter fuel quality regulations and stricter exhaust emission regulations the overall emissions from motorised private transport remain high because car traffic increased by almost 18% between 1995 and 2017 (UBA 2019a). In Germany, about 57% of the journeys are made by car, in rural areas the figure is as high as 70% (Nobis and Kuhnimhof 2018). Therefore, technical improvements to the vehicle alone are not enough to achieve the climate targets. Research shows that in addition, other key elements for a successful transformation of the transport sector are essential, such as an increase in traffic efficiency, a decrease in overall passenger kilometres and a change in the choice of means of transport. Public transport, pedestrian and bicycle traffic offer many benefits for an environmentally-friendly mobility. A shift to these modes of transport is important not only because of the consequential reduction of GHG emissions and less material consumption but also due to the high potential to improve air quality, reduce noise pollution, and increase liveability in urban areas. Furthermore, the question of equity and a desired balance between all different uses of public streets calls for a just mobility transformation.

Although measures such as improved car efficiency standards, promotion of freight transport and use of alternative fuels are also vital to achieve the climate targets of the transport sector, these instruments are not elaborated further, as this study is about sustainable consumption. Therefore this chapter sets the focus on how to achieve a shift from motorised individual transport to public transport and non-motorized transport which has a high effectiveness and feasibility to achieve the climate targets of the transport sector.

### 3.1.1 Recent developments in the field/policy context

According to the *German Climate Action Plan*, greenhouse gas emissions from the transport sector must be reduced from 163 million tonnes to 95 to 98 million tonnes in 2030 (BMU 2016a). As the mileage of passenger car traffic is expected to increase by about ten per cent by 2030 compared to 2010, GHG emission reductions are planned to happen mostly through increased efficiency of the vehicles (BMU 2016a). The *National Programme on Sustainable Consumption (NPNK)* aims to improve public transport networks and providing support for pedestrian transport as well as for bicycle transport (for example through the *National Cycle*

*Paths Plan (NRVP)* (BMU 2016b). The *DNS* aims to decrease air pollution (SDG 3.2.a) and energy consumption in passenger transport (SDG 11.2) and to improve travel time connections in public transport (SDG 11.2.c)

The working group “transport and climate change” of the *National Platform Future of Mobility* developed a bundle of recommendations in March 2019 to achieve the transportation sector climate goals by 2030. With diverging interests of numerous stakeholders involved, the question of how to achieve a reduction of motorised private transport remained controversial. In contrast, there was unanimity regarding the strengthening of the rail transport, the public transport with buses and underground, tram and urban railways, as well as cycling and walking (NPM, Arbeitsgruppe 1 "Klimaschutz im Verkehr" 2019). The coalition agreement 2018 aims to double the amount of rail customers until 2030 (Die Bundesregierung 2018). As a consequence, the federal ministry of traffic and digital infrastructure announced to reduce the value-added tax for long-distance transport from 19% to 7%. It is still unclear when this is going to happen, but expected that this will lead to a higher passenger volume and tax revenues of around 500 million € per year as long as the price advantage is passed on to the customers (Die Bundesregierung 2019c).

The *German National Cycling Plan (NCP 2020)* aims to make cycling more attractive and safer. The follow-up plan is currently in development with the participation of civil society and other stakeholders and is to be published in 2021 (BMVI). A draft for a bicycle-friendly amendment to the road traffic regulations has been presented in June 2019 (BMVI 2019), critics see it as necessary step but also highlight the further need for improvement (adfc 2019). The *National Climate Initiative (NCI)* provides funding for bicycle projects in Germany, to support exemplary projects such as promoting load bicycles or investing in bicycle infrastructure (BMU 2019).

The involvement of the states and municipalities is crucial for the transformation of the transport sector. In 2017, the Federal Government and the participating states and municipalities launched an “*Immediate Clean Air Programme 2017-2020*” to improve air quality in cities. Municipalities can apply for funding for measures that aim at key areas such as electrification of urban transport, charging infrastructure, traffic management, logistics and digitalisation (Die Bundesregierung 2019a).

### 3.1.2 Governmental and non-governmental stakeholders

The organisations listed here are a selection of stakeholders active in this key area. The list does not claim to be exhaustive.

**Governmental**

- Federal Ministry of Transport and Digital Infrastructure (BMVI)
- Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU)
- Federal Ministry of Economics and Energy (BMWi)
- German Environment Agency (UBA)
- ...

**Business**

- Allgemeiner Deutscher Automobil-Club (ADAC)
- Allgemeiner Deutscher Fahrrad-Club (ADFC)
- Allianz pro Schiene
- Bundesverband der deutschen Industrie (BDI)
- Bundesverband der Energie- und Wasserwirtschaft (BDEW)
- Bundesverband Güterkraftverkehr Logistik und Entsorgung (BGL)
- Deutsche Bahn AG
- Deutscher Städtetag
- Deutsches Verkehrsforum e.V.
- Mineralölwirtschaftsverband e.V.
- Verband der Automobilindustrie (VDA) e.V.
- Verband Deutscher Verkehrsunternehmen (VDV)
- Ingenieursgesellschaft Auto und Verkehr (IAV)
- ZF Friedrichshafen AG
- PTV Planung Transport Verkehr AG
- M-Five GmbH
- e-mobil BW GmbH - Landesagentur für neue Mobilitätslösungen und Automotive Baden-Württemberg
- ...

**Civil society**

- Environmental NGOs (Bund für Umwelt und Naturschutz Deutschland (BUND), Deutsche Umwelthilfe (DUH), Greenpeace, Naturschutzbund Deutschland (NABU))
- Transport & Environment
- ...

**Science and think tanks**

- Research institutes (Fraunhofer-Institut für System- und Innovationsforschung (ISI), Öko-Institut e.V., Wuppertal Institut für Klima, Umwelt, Energie)
- Agora Verkehrswende
- Deutsches Zentrum für Luft- und Raumfahrt (DLR)
- infas 360
- IVT
- ...

### 3.1.3 Drivers and barriers

**Drivers***:*

Numerous studies have been published in recent years about the impact of motorized private transport on the environment and health and how to increase the share of public and non-motorized transport (Agora Verkehrswende 2018b; Petersen and Reinert 2018; SRU 2017; UBA 2017; SRU 2012; BMUB, UBA 2017). Thus, the information base and data quality is quite high and suitable for policy recommendations.

In large German cities, the car only uses 40% of the modal split and the use of train, and pedestrian and bicycle traffic is slightly increasing because the infrastructure has expanded (Agora Verkehrswende 2017; TU Dresden 2015). The younger generation in urban areas has a large proportion of multi-modal people, using various modes of transport (Nobis and Kuhnimhof 2018; Schönduwe and Lanzendorf 2014). Furthermore, the usage of digital technologies enables more efficient mobility concepts (NPM, Arbeitsgruppe 1 "Klimaschutz im Verkehr" 2019). The number of stationless and station-bound bicycle rentals has increased in recent years and can serve as an alternative to the use of a private car (Agora Verkehrswende 2018a). Digital technologies also improve transitions between modes of transport and facilitate the use of public transport by providing timetable information, ticket booking etc. Load bicycles are getting increasingly popular especially in urban areas for private and commercial users at the same time. A trend that is increasingly being promoted by municipalities through funding programmes, such as in Berlin (Senatsverwaltung für Umwelt, Verkehr und Klimaschutz 2019). Additionally, the increasing number of electric bicycles provides alternative ways of transport.

**Barriers:**

Economic interests from automobile manufacturers are especially prominent in Germany as the automotive industry is Germany's most important industrial sector, with a contribution to gross value added of 4.7% in 2016 (Destatis 4/9/2019). 880,000 people were employed in the automotive industry in 2016, taking into account the suppliers this number amounts to 1.75 million employees (Destatis 4/9/2019). Expected change of propulsion systems and decreases in added value through mobility services should be met with socially acceptable reforms (Jannsen et al. 2019; NPM, Arbeitsgruppe 1 "Klimaschutz im Verkehr" 2019). Today, cars are still the preferred means of transport in Germany, on average 1.1 cars are owned per household (Nobis and Kuhnimhof 2018). Rural areas and urban areas differ considerably in terms of the modal split, in rural areas approximately 70% of the journeys are made by car (Nobis and Kuhnimhof 2018; TU Dresden 2015). Lower mobility density in rural areas leads to higher expenditures for public transport infrastructure and a decreasing offer of public transport which in turn makes the car indispensable (Riesner 2014).

A shift from cars to public transport to a significant extent will only be achieved if the attractiveness of the motorised individual transport decreases. Several national regulatory instruments however favour the use of private cars, either by subsidies or tax advantages. The most known are the energy tax (*Energiesteuer*), the tax benefit of company cars (*Dienstwagenbesteuerung*), and the commuter allowance (*Entfernungspauschale*), these three subsidies alone amount to 15.6 billion €/year (Köder and Burger 2016). The energy tax for diesel fuel is 18.41 cent/l lower than for petrol, though diesel cars emit more harmful emissions, thus the level of the tax does not relate sufficiently to the energy content or greenhouse gas emissions of fuels (Agora Verkehrswende 2018b). The tax benefit of

company cars promotes the use of cars and does not incentivize to drive less nor buy less fuel-intensive cars (Agora Verkehrswende 2018b). As the tax benefit increases with rising income tax rate and with increasing price of the car, the social justice of this tax privilege may be called into question (Diekmann et al. 2011). Those who commute long distance by car daily benefit especially from the commuter allowance, which does not promote behavioural change (Köder and Burger 2016). In addition, it is important to mention that the design of the motor vehicle tax (*Kfz-Steuer*) does not yet fully take into account the environmental harm of the vehicles, as the $CO_2$ emissions influence only partially the level of the tax (Agora Verkehrswende 2018b).

Whereas in many European countries a route-based toll is in place, in Germany an annual infrastructure charge is being paid by all car owners to maintain infrastructural services. Accordingly, the current annual infrastructure charge does not allow for a just-cost allocation and financial incentives to shift to rail transport, as it does not take into account the kilometres driven (Agora Verkehrswende 2018b). In contrast to other European countries, the tax on long-distance train tickets is currently 19% (Förster et al. 2018). Critics also state that the *Bundesverkehrswegeplan 2030 (BVWP 2030)* should undergo a reform and allow more rail projects to be financed and realized. Due to the "*Standardisierte Bewertung*", road construction projects are often more eligible than investment projects in the area of public transport and thus the assessment procedure should be redefined (Klima-Allianz Deutschland 2018).

Spatial and settlement structures are an important element for promoting climate-friendly mobility. Road traffic regulations and infrastructure in many German cities are suited for automobiles, and there is room for improvement regarding the rights of pedestrian and bicyclists (SRU 2017). For example, the parking spaces in urban areas cover a lot of the area, this is especially crucial as on average one car is being used less than one hour/day, thus removing the space for other residents of the city and impairing public spaces in their quality, attractiveness and functionality (Nobis and Kuhnimhof 2018). Additionally, the parking fees also do not reflect the true societal costs (Klima-Allianz Deutschland 2018).

### 3.1.4 Practice-Examples

A promotion of train transport can be achieved through several measures. A regulatory measure is e.g. the VAT level. The VAT for long-distance train tickets in other European countries is lower than in Germany. In France the VAT amounts to 7%, in Denmark it is 0%. In Switzerland integrated timetables with half-hourly frequencies make the use of railways more attractive.

Denmark established a national bicycle strategy promoting the use of bicycles by providing funding for bicycle lanes, bicycle parking and educational programmes. Between 2009 and 2014 around 150 million € were granted (The Danish Road Directorate 2016). In a recent study by Wuppertal Institute several cities were evaluated regarding the modal share, air quality, public transport, road safety mobility management and active mobility. Copenhagen ranks first especially due to the high performance in the category mobility management and road safety and a high combined modal share of 48% for walking (19%) and cycling (29%) (Kodukula et al. 2018). Measures include high cost of parking, a low-emission zone for heavy duty vehicles, bicycle infrastructure and integrating urban planning and bicycle planning (Kodukula et al. 2018).

In Great Britain the taxation of company cars was reformed in 2002, making the level of the tax dependent on $CO_2$-emissions (Agora Verkehrswende 2018b).

### 3.1.5 Recommendations

Focusing on the balance between different modes of transport is vital for an enhanced equity between all mobility participants and brings along many benefits such as better air quality, road safety and liveability in cities and municipalities. Therefore, the attractiveness of environmentally friendly forms of mobility should be increased to facilitate a switch. Access to more environmentally friendly mobility should also be socially balanced - so far, sharing models have usually been affordable for higher-income households. Infrastructure and train services need to be improved. Measures include a reduction in track prices and a reduction of the VAT on long-distance train tickets leading to a reduction of the train tickets for consumers and thus increasing train transport. States and municipalities need appropriate financing and scope for action to expand local public transport which is socially fair and safe compared to private car traffic.

Cycling and foot traffic needs to be encouraged by an increase in funding for municipalities, for example via the *National Climate Initiative (NCI)*, to expand vital infrastructure such as bike lanes, parking spaces for bicycles, bike rental stations and walking lanes. Furthermore road traffic regulations should be revised to limit the current preference of car traffic.

It is recommendable to use push and pull-factors equally. Currently state subsidies promote the use of private cars, thus a reform of these subsidies would be beneficial in order to achieve a just mobility transformation. As shown above, these subsidies include the energy tax (*Energiesteuer*), the tax benefit of company cars (*Dienstwagenbesteuerung*), the commuter allowance (*Entfernungspauschale*), and the motor vehicle tax (*Kfz-Steuer*). Higher costs for $CO_2$-intensive vehicles as well as mobility lifestyles and tax advantages for low-$CO_2$ vehicles as well as mobility lifestyles should be the guideline for these reforms and would cause a steering effect towards climate protection. Besides, route-based tolls would allow for a just cost allocation and financial incentives to shift to rail transport (Agora Verkehrswende 2018b).

Urban and rural areas have different requirements. Facilitating climate-friendly mobility in urban areas requires improvements in active mobility, local orientation, public transport, sharing services, and parking management (Agora Verkehrswende 2018b). A socially acceptable reform of the *Passenger Transport Act (PBefG)* is necessary for rural areas to further promote public transport, facilitate on-demand mobility services, and integrate car sharing into the local transport plans (SRU 2017). Age-appropriate and inclusive mobility options for children, adolescents and seniors must be integrated into socio-ecologically oriented business models.

## 3.2 Key area: Consumption of clothes, footwear and textiles

Clothing and associated textile supply chains are among the most crucial areas of sustainable consumption with respect to their environmental and social impact, in particular due to the social risks emerging in the sector as well as the high consumption of water and

chemicals. Clothing accounts for between 2% and 10% of the environmental impact of overall EU consumption (Šajn 2019). This trend can largely be traced back to drastically falling prices for textile and apparel garments in recent years and the rise of fast fashion (Šajn 2019).

### 3.2.1 Recent developments in the field/policy context

Since the tragic collapse of the Rana Plaza textile factory in Bangladesh in 2013, the poor labour conditions in many textile and garment producing and processing countries have been receiving strong public attention and numerous political initiatives have been launched. These initiatives have continued since 2016 and have been reinforced by increasing pressure from civil society and corporate self-regulation initiatives.

In response to the fatal collapse, the *Partnership for Sustainable Textiles* was formed in 2014. The multi-actor partnership is made up of 122 members from industry, non-governmental organisations, trade unions, standard organisations and the Federal Government (Bündnis für nachhaltige Textilien 2019b). The alliance has set itself the goal of improving conditions in global textile production – from raw material production to disposal. This is to be achieved through joint local projects and voluntary self-declarations. Although many civil society organisations have criticised the alliance for not being effective, it is one of the most important multi-stakeholder platforms in Germany on the subject of sustainable textiles (CorA et al. 2018).

In 2018 the introduction of a new government seal for fair and sustainable clothes, the "*Meta label Grüner Knopf*", was announced. The medium-term goal is to ensure compliance with ecological and social minimum standards throughout the entire textile production chain. Partly due to harsh criticism and scepticism of the effectiveness and necessity of a new seal on the part of civil society, the further configuration of the seal has passed in relative silence since its announcement (CCC Germany 2018).

Another major governmental initiative launched in 2016 was the *National Action Plan for Business and Human Rights (NAP)*. The *NAP* describes a wide catalogue of measures by the German Government to do more to uphold the state's duty to protect human rights, particularly in the business context. At the same time, the *NAP* lays down German companies' responsibility to respect human rights in a fixed framework for the first time. One of the central focus areas are textile supply chains and human rights diligence by companies producing in countries in which the rule of law is insufficiently enforced (BMAS 2019). The Federal Government reserves the right to examine further steps, including legal measures, if 50 % of the companies located in Germany with more than 500 employees fail to implement certain processes by 2020 (BMAS 2019).

The multilateral *Vision Zero Fund* was established at the meeting of the G7 ministers for employment and development in Elmau from 7 to 8 July 2015. It is intended to provide financial resources from 2016 to 2020 to make international supply chains more sustainable. On 17 June 2016, the fund was launched in Myanmar, where specific projects are being promoted to set up labour inspections, public structures for occupational safety and health, accident insurance and sustainable initiatives at company level. The fund also specifically targets improved working conditions in the garment production sector. For the start-up phase, it has been endowed with eight million US dollars provided by the German Federal Government, the United States Government and the European Commission. (ILO 2019)

Furthermore, when the *Deutsche Nachhaltigkeitsstrategie (DNS)* was updated by the Federal Government on November 7th 2018 (addition to the version of January 2017), a reference to the NAP and the importance of sustainable global supply chains has been included (Presse- und Informationsamt der Bundesregierung 2018)[4]. The *NPNK* also includes concrete measures in the field of sustainable textile production, such as supporting the *Alliance for Sustainable Textiles* in achieving the goal of 75% of the German retail market and linking the Alliance internationally. In addition, the programme aims to increase the market share of clothing from certified organic cotton standards such as the *Global Organic Textile Standards (GOTS)* and the *Blue Angel* (BMUB 2018).

In addition to political initiatives, civil society has also been increasingly committed to sustainable textiles. Non-governmental organizations such as *Misereor, Care, FEMNET e.V., Inkota-netzwerk e.V., Future Fashion Forward e.V.* and the *Campaign for Clean Clothing - Germany* have joined the *Alliance for Sustainable Textiles* (Bündnis für nachhaltige Textilien 2019a). Since 2016 the association *Future Fashion Forward e.V.* aims to establish a long-term platform to inform citizens about abuses in the clothing industry and thus make a positive contribution to change in the producing countries. The association brings together designers, consultants and communication scientists from the fashion industry (future fashion foward).

[4] In public procurement, there have also been attempts since 2016 to orient textile procurement towards sustainability aspects. At the end of 2018, for example, a guideline for sustainable textile procurement was put to the vote by the Federal Administration. The first dialogue formats with those responsible for procurement and standard-setting organisations (e.g. Fairtrade, Fair Wear Foundation, Global Organic Textile Standard - GOTS etc.) have already been implemented. Should it become apparent that the goal of the sustainability programme of measures to procure 50 per cent of textiles at federal level on a sustainable basis by 2020 cannot be achieved with the help of the voluntary guideline, the federal government will evaluate the implementation steps and challenges to date in order to achieve the goal. Within the framework of this review, further options for action would be discussed, including the possible introduction of a General Administrative Regulation (AVV) for textiles. Deutscher Bundestag 2019.

### 3.2.2 Governmental and non-governmental stakeholders

The organisations listed here are a selection of stakeholders active in this key area. The list does not claim to be exhaustive.

**Governmental**

- Federal Ministry of Economic Cooperation and Development (BMZ)
- Federal Ministry of Labour and Social Affairs (BMAS)
- Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU)
- Federal Ministry of Economics and Energy (BMWi)
- International institutions (e.g. EU)
- ...

**Business**

- Sports apparel companies (e.g. Adidas) and fashion brands (e.g. H&M, C&A)
- Small innovative fashion brands/Start-ups, like SyncFab
- Fast fashion brands
- Trade associations
- Gesamtverband textil + mode

**Civil society**

- ACT (Action, Collaboration, Transformation)
- CARE
- CRI-Christliche Initiative Romero
- Environmental NGOs (e.g. Greenpeace, NABU, INKOTA-netzwerk e.V. )
- Clean Clothes Campaign
- Ethical Trading Initiative (ETI)
- Fair Labour Association (FLA)
- Fair Wear Foundation (FWF)
- Fashion blogger/influencers
- FEMNET e.V.
- Future Fashion Forward e.V.
- Global Organic Textile Standard (GOTS)
- Misereor
- Organic Content Standard (OCS)
- Öko-Tex
- Platforms (e.g. Kleiderkreisel.de)
- Südwind e.V.
- Transparency International Deutschland e.V.
- Consumer organisations (Verbraucherzentrale Bundesverband)
- ...

**Science and think tanks**

- Research institutes (e.g. adelphi,
- Transparency One
- SyncFab

### 3.2.3 Drivers and barriers

**Drivers:**

As pioneers who see sustainability as the basis of their business strategy and implement it comprehensively, numerous start-ups and sustainable fashion brands have emerged that offer sustainable products and thus counteract the fast-fashion trend.

Some companies have launched their own sustainability seals or recycling campaigns in addition to the legally agreed adjustments, e.g. *C&A* or *H&M*. Lehmann (2018) and also the 2018 report of the *Clean Clothes Campaign* identify major sportswear brands as well as major fashion brands in general as the drivers of corporate change, as the *2018 Pulse of Fashion Industry report* shows, some large sports apparel brands, e.g. *Adidas* and big fashion brands like i.e. *H&M* have started to invest in new technologies and apply their own risk prevention systems (Šajn 2019). Furthermore, small and innovative start-ups have been experimenting with new business models, such as clothing rental, designing products that are more easy to recycle and ways to efficiently re-use textiles ("circular economy") (Šajn 2019).

Technical improvements promise to drive the sustainable transformation through innovation and optimization. Already today AI (Artificial Intelligence) systems can help optimize supply chain management and increase transparency; Computer Assisted Design (CAD) can determine the optimal use of different materials and dyes as well as resource-saving manufacturing methods. Databases enable a faster overview of resource-saving materials, such as alternatives to natural cotton, and webinar-based training for supervisors in supplier companies or audits can take place cost-effectively and regularly worldwide (Kompetenzzentrum Textil & Bekleidung Niederrhein 2018). Start -ups such as Laborlink are working on apps that allow for workers in producing companies to anonymously report breaches against working standards and therefore empower the labour force (CorA et al. 2018). The use of blockchain technology to make supply chains up to the cotton producer visible and traceable for consumers is also being discussed publicly. In reality, there are still some special reservations in SMEs about the use of technologies, and blockchain is associated with very high energy consumption due to the high computing power required (Donaldson 2017). Other visions point to smart and instant fashion that could be equipped with smart technology, thus enabling consumers to adjust the colour or fit or a clothing item at the touch of a button, reducing the need to produce multiple versions of the same garment (Šajn 2019). The further development of industry 4.0 can also fundamentally change the textile industry. If production is made cheaper by the use of smart robots, textile and clothing production could be relocated back to Europe and social sustainability aspects in the direct production process could be omitted (Šajn 2019). Until the future scenarios come true, however, it is crucial to sensitize people to the topic of sustainable clothing, as digitalisation currently tends to accelerate consumption and lead to large numbers of returns (Greenpeace 2018).

**Barriers**:

Various structural characteristics of the textile and clothing industry make sustainable development of the sector difficult and slow: the sector has one of the most complex global value chains (Šajn 2019), leading to numerous difficulties in regulation and auditing. For the *Fashion Transparency Index 2018*, 68 out of 100 surveyed brands did at least reveal a list of suppliers, but most only mentioned the factories where the clothes are sewn, no further steps down in the supply chain (Fashion revolution CIC 2019, p. 3). With not even all companies, subsidiaries, contractors, suppliers and joint ventures in the production line known to producers, tracing the origins of violations of human rights and ecological standards becomes difficult to impossible. This development is driven by globalisation and the associated growing market and price pressure (Niebank 2018). The high proportion of women in the textile supply chain along with the strong suppression of women's rights in the main textile-producing countries may be reasons for the lack of political action regarding the

improvement of working conditions. Globally, estimates put the share of female workers in the garment industry at over 75% while in some countries such as Bangladesh and Cambodia women account for an estimated 80% and 90% respectively (Business & Human Rights Resource Centre 2018). Systematic discrimination, gender-based violence and stereotypes against women lead to weak distinctive capability to organize collectively as well as "job segregation and disparities in wages and benefits" (Niebank 2018).

Regulatory shortcomings in production countries that still do not adequately comply often with their duty to protect human rights and enforce the compliance with minimum standards also stem from a variety of structural and market-based reasons: many countries simply lack the necessary governance structures and administrations do not work efficiently due to corruption. Often, political and economic actors overlap and it is not uncommon that members of governments and parliaments are factory owners themselves (Niebank 2018). Production countries also compete with each other to "keep business operations in the country" (Niebank 2018). Developments in the past have shown that companies move their production sites around the region once a state tries to implement minimum working conditions that bring along small increases in production costs.[5]

Such regulatory restraints do not only occur in producing countries, but also in countries where fashion and textile brands originate and are legally notified. The *NAP* only asks for a voluntary self-commitment from German companies. Several commentators, especially NGOs, have described such initiatives as inefficient and call for mandatory regulation for textile companies at least throughout Europe (Niebank 2018; CCC Germany 2018; Brot für die Welt).

In particular, the constantly rising demand for fast fashion has a negative impact on the sustainability of the textile sector: six to nine collections per year are today the standard for many fashion houses. Short and frequently changing product cycles generally lead to higher consumption of materials and resources during the manufacturing process, which also drastically increases $CO_2$ emissions and water consumption. Also, changing collections demand short-term and faster work in manufacturing factories, which increases the risk of inhumane work and the risk of exploitation. Ever-changing suppliers also make it difficult to carry out detailed audits and checks on working conditions, which can be ensured only through regular exchanges and training in the case of long-term relationships (Niebank 2018).

Several product labels try to provide transparency and information to consumers about the origin of the cotton and the working conditions at the production sites of several brands or individual product lines. However, the sheer number of labels and different approaches make it difficult for consumers to find their way around them (Kompetenzzentrum Textil & Bekleidung Niederrhein 2018; BMUB 2018) and labels can be misused by brands for greenwashing purposes. Besides, products that fulfil high standard in both spheres of sustainability, social and environmental, up to date are rarely available and the share of organic cotton in the overall cotton market remains below 1% (BMUB 2018).

When considering consumer impact, not only information- and market-related issues represent a barrier to a sustainable transformation, but also individual psychological effects. A survey in 2018 showed that, while the environmental awareness in Germany is growing

[5]Aa Niebank points out that such business decisions do not always lead to the highest return rates and that in fact not all companies prefer the lowest possible degree of state regulation Niebank 2018, p. 16

steadily, the actual consumer actions of most people are lagging far behind, as price still is the most decisive argument for consumer decisions (BMU and UBA 2019). Consumers are, besides brands and producers, the most important stakeholder group in the quest for more sustainable clothing: consumption is the life cycle phase of clothes that was estimated as having the largest environmental footprint, "owing to the water, energy and chemicals (primarily detergents) used in washing, tumble drying and ironing and the microplastics shedding into water" (Šajn 2019). Regulatory measures and demands on producers alone cannot solve the problem, which requires a comprehensive change in consumer behaviour.

### 3.2.4 Practice-Examples

At the policy level, the French duty of vigilance law can be cited as an international practice. The law requires French companies to develop and implement a comprehensive due diligence plan to identify and prevent environmental and human rights risks along the entire value chain worldwide. In the event of a breach of the duty of care, liability can be claimed from those affected (European Coalition of Corporate Justice 2017). Fines of up to 30 million euros, originally planned, were cancelled by the Constitutional Council before the law was passed (Brot für die Welt). Numerous NGOs such as *Amnesty International, Brot für die Welt, Germanwatch* and *Oxfam* have welcomed the passing of the law and call for a similar regulation to be implemented throughout Europe, i.e. also for German companies .

Similar to the German foundation of the Partnership for Sustainable Textiles, the Dutch government set up the *Agreement on Sustainable Garments*. It is a coalition of industry organizations, trade unions, civil-society organizations and the Dutch government that aims at a transition towards a sustainable and responsible garment and textile industry. In January 2018, the *Alliance for Sustainable Textiles* and the Dutch government signed a cooperation agreement to further support textile companies in implementing due diligence and harmonising the sustainability requirements of both agreements. The *Business & Human Rights Resource Centre* assesses the cooperation as an improvement and a model for the gradual adaptation of international standards towards binding rules. However, the NGO also points to the need of the establishment of a "Common European Framework on human rights due diligence and transparency in order to achieve real sustainable improvement in working conditions in the textile supply chain" (Business & Human Rights Resource Centre 2018).

Furthermore, the Dutch government is in the process of adopting a Child Labour Due Diligence Law, which, if approved by the Senate, will enter into force in 2020 and would oblige companies to determine the risk of child labour violations along their supply chain (Niebank 2018).

The UK introduced the *Modern Slavery Act* in 2015. The legislation "requires certain large businesses to produce a slavery and human trafficking statement for each financial year" and also steps to remove any risks (Niebank 2018).

### 3.2.5 Recommendations

Overall, the German government has recognised the problem of unsustainable textile production and included it in central sustainability programmes. For a comprehensive programme of measures that contributes to real change, however, greater involvement of the

BMWi and a decision by the entire Federal Government in favour of a binding law would be necessary.

The *NAP* must move from voluntary self-commitment to mandatory measures of corporate oversight. These must be as practicable as possible and their impact measurable using indicators based on European best practices.

It is essential to think beyond the national level and to create at least EU-wide social and ecological minimum standards for companies (better still, international ones) in order to remove price pressure from compliance with minimum standards and achieve a level playing field between the signatories of both due diligence agreements and companies that are not part of it across the EU.

It is recommended to introduce an extended producer responsibility (EP) scheme and in-store collection, making producers and importers legally responsible for ensuring that used clothes are reused and recycled. Companies can either develop their own system – like *H&M* – or contribute financially to an accredited collectively responsible organisation, like in France (Šajn 2019). Furthermore an independent and credible corporate reporting and transparency should be promoted e.g. through a central database of corporate data with access rights for NGOs and consumers. Another idea is the introduction of a “second price tag”, i.e. a price that takes into account the environmental impact of the production of textiles.

## 3.3 Key area: Consumption of meat and dairy products

Consumption of meat and dairy products is especially crucial with regards to the environmental and social impacts. Along the value-chain, meat and dairy products have a high global warming potential, high land-use requirements, as well as high material and water consumption. Many scientific studies demonstrate the advantages from an environmental and health point of view of reduced livestock husbandry and reduced meat and dairy consumption and call for a food transformation (Poore and Nemecek 2018; Boland et al. 2013; Hedenus et al. 2014; Popp et al. 2010; Röös et al. 2017; Schader et al. 2015; Springmann et al. 2016; Stehfest et al. 2009; IPCC 2019; Schneidewind 2018).

Yet, in 2018, consumption of meat increased slightly in Germany to 60.1kg per capita (BLE 2019b), the per capita consumption of dairy products in Germany was 88kg (BLE 2019a). It is predicted that the world population’s demand for animal protein will increase by about 80-100% by 2050 (predominantly in the so-called emerging and developing countries) and that global meat production will double in parallel if agricultural food production continues to develop as it does today (Boland et al. 2013). Hence, the question of how to achieve a transformation of the food systems and how to meet nutritional requirements of a growing world population is essential. Insects, in-vitro meat and especially plant-based meat and dairy substitutes (e.g. soy, oat, wheat, peas, lupin beans, etc.) offer great potential for providing a vital source of proteins and are becoming increasingly popular (Jetztke et al. forthcoming 2019).

### 3.3.1 Recent developments in the field/policy context

Whereas introducing policy measures that intend to reduce meat and dairy consumption is currently not on the political agenda, the *Federal Ministry of Food and Agriculture (BMEL)* focuses on animal welfare and ecological agriculture. The national label of animal welfare, called "*Initiative Tierwohl*" was founded in 2015 to ensure more animal-friendly and sustainable meat production. Companies and associations from agriculture, the meat industry and food retail provide funding for which farmers can apply to implement measures for higher animal welfare (Gesellschaft zur Förderung des Tierwohls in der Nutztierhaltung mbH 2019). BMEL also aims to increase ecological agriculture up to 20% of the total agricultural area until 2030, by providing funding possibilities to farmers. Currently the proportion of organically farmed land is 9.1% (Ökolandbau.de 2018).

The *DNS* addresses the food sector under SDG 2, but only aims to reduce the nitrogen excess, increase the share of ecological agriculture and increase funding for food security worldwide. The *Climate Action Plan 2050 (Klimaschutzplan 2050)* also acknowledges that a high share of greenhouse gas emissions from agriculture is due to the production of animal food. It aims to cut greenhouse gas emissions from livestock farming by developing more climate-friendly animal husbandry, for example in the areas of feeding, breeding and farm management (BMU 2016a). Yet, a general reduction of the consumption of meat and dairy products is not mentioned. In the *National Programme on Sustainable Consumption (NPNK)* several measures are shown to produce food along the value chain in an environmentally-sound manner, such as reducing the use of pesticides, the diversification of crops, and the appropriate use of fertilizers. Though the lower environment impact of plant-based food is recognized (BMU 2016b), a reduction of meat and dairy products is not elaborated in detail and not backed with policies supporting this change of consumption pattern.

Civil society organisations have been more precise in their demands. The *Climate-Alliance Germany* published a comprehensive demands paper in 2018 in which the necessary measures in all fields of climate policy action are described so that Germany can achieve its climate target by 2030. One of the central demands is to reduce the livestock numbers and to reduce the consumption of animal products (Klima-Allianz Deutschland 2018).

### 3.3.2 Governmental and non-governmental stakeholders

The organisations listed here are a selection of stakeholders active in this key area in the past years. The list does not claim to be exhaustive.

**Governmental**

- Federal Ministry of Food and Agriculture (BMEL)
- Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU)
- Federal Office for Agriculture and Food (BLE)
- German Environment Agency (UBA)
- International institutions (EU)
- ...

**Business**

- Farmers' association (Deutscher Bauernverband (DBV)
- Meat and dairy industry associations (Verband der Fleischwirtschaft e.V. Deutscher Fleischer-Verband e.V., MIV Milchindustrie-Verband e.V.)
- Food retailing
- Slaughter industry
- Farmers
- ...

**Civil society**

- Environmental NGOs (Bund für Umwelt und Naturschutz Deutschland (BUND), Germanwatch, Greenpeace, Naturschutzbund Deutschland (NABU), WWF)
- Animal welfare organisations (Deutscher Tierschutzbund e.V., PETA)
- Vegetarian and vegan lobby (European Vegetarian Union, Proveg e.V.)
- Germany's Civil Society Alliance for Climate Protection
- Food blogger/influencers
- ...

**Science and think tanks**

- DGE e.V.
- Öko-Institut
- Universities
- ...

### 3.3.3 Drivers and barriers

**Drivers:**

Numerous reports from relevant scientific institutions have shown the importance of reducing meat and dairy consumption to achieve climate targets (Poore and Nemecek 2018; Boland et al. 2013; Hedenus et al. 2014; Popp et al. 2010; Röös et al. 2017; Schader et al. 2015; Springmann et al. 2016; Stehfest et al. 2009; IPCC 2019). Furthermore, recent studies have been published that highlight the health implications of excessive meat consumption. Red meat and processed meat in particular are the focus of many studies that establish a connection between high consumption and intestinal cancer, obesity, cardiovascular diseases, hypertension or diabetes type 2 (Stewart and Wild 2014; Godfray et al. 2018; Bouvard et al. 2015). Research findings indicate that the high use of antibiotics in animal breeding leads to antibiotic resistance in humans and animals, which makes antibiotic treatment of diseases increasingly difficult (Landers et al. 2012; UMID 2017). Air quality in areas around intensive livestock farms is often affected by coarse and fine dust particles,

gases and endotoxins and can cause health problems in humans (Greenpeace International 2018). The effects on the environment and human health are thus well elaborated and known.

These information based drivers favour the change of dietary behaviour happening in many western European countries. Flexitarian, vegetarian and vegan diets have become trendy and are part of a conscious lifestyle. According to a recent study, 37% of German households call themselves flexitarians, meaning they reduce their meat consumption to a minimum, which is mostly due to health reasons (GfK 2016).

New meat and dairy alternatives are entering the food market, making a plant-based diet easier, with a large product range to choose from. The market for plant-based dairy products recorded a turnover of 167 million euros in 2018 (Statista GmbH 2018b). Sales of meat substitute products in the German retail sector are equally on the increase, having a turnover of 155 million euros in 2018 (Statista GmbH 2017, 2019c). Overall, meat substitutes account for a share of 6% of the total meat industry's market volume (Lebensmittelzeitung 2019).

**Barriers:**

Still, the habit of eating meat and dairy products is deeply ingrained and part of German food culture (BMEL 2017b). Individual preferences vary and change in behaviour cannot be forced (Ploeger et al. 2011). The sensitivity of that subject was shown in 2013, when the Green party's election program included a proposition to introduce a Veggie Day in public canteens which caused a public uproar (Zeit Online 2013). Education campaigns could be used to nudge consumers towards choosing plant-based products. Recent research findings explore the awareness-gap on the relationship between meat/dairy consumption and climate change, indicating that the perceived contribution of the livestock sector is low despite the actual large share of the sector (Bailey et al. 2014). Yet, the majority of education campaigns about the environmental impact of meat and dairy products are launched by non-governmental organizations and not by national governments.

As shown above, regulatory measures reducing meat and dairy consumption are scarce. Regulatory measures that intend to influence behaviour towards a plant-based diet are deemed to be unpopular and too invasive in the individual sphere of decision making.

Providing and facilitating access to plant-based alternatives can be one way to reduce consumption of meat and dairy products. Yet some regulatory measures make the selling of these products more difficult, such as the Sales Denominations of Vegetarian Alternatives: The *German Food Code Commission (DLMBK)* published complex guidelines for food labelling of vegan and vegetarian products and alternatives to animal products. Several producers have already asked for an adjustment of these guidelines as they see them as a disadvantage (ProVeg e.V. et al. 2019). Furthermore, the tax on plant-based meat and dairy alternatives is currently 19%, whereas meat and other animal products benefit from the reduced tax of 7%.

Plant-based alternatives are seldom part of dietary plans. The *EU School fruit, vegetables and milk scheme* grants money to the EU Member States to provide healthy food to children. Yet it does not include plant-based milk alternatives (European Commission 2019b).

Animal husbandry is an important branch of German agriculture; animal products accounted for around 61% of sales revenue in 2016 (BMEL 2017a). New production methods allow more animals to be supplied with fewer workers which led to a decrease of employee numbers – in 2016 less than 2% of the German workforce worked in agriculture, fishery and

forestry (BMEL 2017a). Meat and milk processing employs an estimated 120,000 people (Statista GmbH 2019a, 2019b). Especially the meat industry is being criticized due to the use of contracts for work and labour/temporary labour and harsh working conditions (John et al. 2017). Exports to other EU Member States and third countries are of enormous importance for the dairy and meat industry as a whole, from producers and dairy companies to traders. The export surplus in trade with meat, meat products and canned goods amounted to around 1.38 million tonnes slaughter weight (BLE 2019b). In 2018 a total of 2.4 million tonnes of selected important milk products (cheese, drinking milk, skimmed milk powder, butter) were exported by Germany, which amounts to an export surplus of 1.2 million tonnes (BLE 2019a).

Even if food consumption patterns in Germany change, it would need to go hand in hand with a decrease in production of animal products in order to avoid an externalisation of the negative effects on the environment to other countries.

### 3.3.4 Practice-Examples

Rather than at the policy level, international practices in this key area are fostered by civil society and grassroots movements.

*Meatless Monday* is a global initiative, present in 40 countries and cities, promoting to eat vegetarian food on Mondays. The city of New York even expanded *Meatless Monday* to all New York City public schools starting 2019/2020 (Meatless Monday 2019). The City of Ghent has initiated a Thursday Veggie Day (*Donderdag Veggiedag*), with public schools, hospitals and restaurants participating (Thomas 2012). In the United Kingdom *Veganuary* has been organized for the second time now. It challenges the people to avoid meat consumption for one month in January.

Information campaigns by two large Swedish supermarkets, *Coop* and *ICA*, are encouraging consumers to lower their intake of meat by increasing their awareness of the environmental impact of meat (FCRN 2019). Sweden has also introduced labels indicating $CO_2$ emissions of food, highlighting the high environmental costs of meat and dairy products (Sigill Kvalitetssystem AB).

The provision of food outside the home is becoming increasingly important for many people, and every year around 11.7 billion meals are consumed “outside the home” in Germany (BVE – Bundesvereinigung der Deutschen Ernährungsindustrie 2016). This is why the out-of-home catering sector plays a key role in shaping nutritional structures and eating culture. Case studies highlight the importance of municipalities in their role of ensuring a reduction of meat in the public canteens, e.g. Malmö, Sweden, Copenhagen, Denmark or Vienna, Austria (Smith et al. 2016). This could be further enhanced by national sustainable public procurement plans fostering alternatives to meat and dairy products.

### 3.3.5 Recommendations

Promoting the consumption of plant-based meat and dairy alternatives will require a bundle of measures. Currently, meat and milk products benefit from a reduced tax level of 7% as they are regarded as staple food. This leads to a distortion and externalisation of costs and an increase to the regular tax level of 19% is regularly cited as one economic instrument to reduce meat consumption (Buschmann et al. 2013; Förster et al. 2018).

Additionally, plant-based meat and dairy alternatives have a tax rate of 19%, even though they fulfil the same nutritional requirements with less environmental impact. Hence, the tax for plant-based meat and dairy alternatives should be lowered in order to facilitate the access to people with lower income. It should be further analysed whether a lower tax level could be applied to organic products, as they have a lower impact on the environment (Hirschfeld et al. 2008).

Since out-of-home catering is showing high growth rates, a guiding principle "sustainable out-of-home catering" must be developed, which political and entrepreneurial measures can use as a guideline. Procurement policy for public canteens should follow such guidelines to be healthy and climate-friendly, thus reducing the share of meat in meals and offering more plant-based alternatives to meat and dairy products. Corresponding online tools (e.g. *https://www.nahgast.de/rechner/)* for sustainable menus offers and kitchen management already exist – these should be made mandatory for public canteens and linked to communication of climate protection contributions and biodiversity per meal and kitchen – overall for the public sector and also at the counter itself.

Information-based instruments should be equally used, as research shows a big awareness-gap among consumers regarding the impact of the animal husbandry (Bailey et al. 2014) and global/regional products. Long-term political information campaigns on the climate impact of our diet are therefore essential and should be initiated by the Germany. The *German Nutrition Society (DGE)* publishes nationally recommended diets; a stronger focus on sustainability criteria in these diets, which are also taken into account in the named online calculator, would have an educational effect on consumers (Behrens et al. 2017).

## 3.4 Key area: Heating of private space

Human beings live or work in homes and these homes need heating, at least in our latitudes. Germany has 18.8 million residential buildings (and roughly 2.7 million non-residential buildings) which are responsible for 40% of the national energy consumption and for more than 1/3 of Germanys GHG emissions (Deutsche Energie-Agentur GmbH 2018). 12 million residential buildings were built before the first Heat Insulation Ordinance was passed in 1978 (*Wärmeschutzverordnung*) (ibid.). They require energetic refurbishment of some sort to meet national $CO_2$ emissions goals and to reduce the energy consumption for heating in the building sector by 20% until 2020[6] and attain a climate-neutral building stock by 2050. However the refurbishment rate has been stagnating for years under 1% (ibid.). Hence, the building sector with its contribution to $CO_2$ and its heating needs plays a crucial role for sustainable energy consumption in homes.

Furthermore, the living space per capita has been increasing steadily from 2011 till 2017 from 46.1 $m^2$ to 46.5 $m^2$, due to e.g. the increasing share of single households (Umweltbundesamt 2018b)[7]. Every inhabited square metre of surface area in buildings leads

[6] The reference year is 2008.

[7] Other factors driving this phenomenon are remanence and cohort effects. The first means that older people stay in big apartments after the children have moved out as the rents are cheaper than in newly rented smaller apartments, the second describes the trend that from generation to generation more living space is demanded per person (due, among others, to rising prosperity).

to higher energy and material consumption because the space has to be heated, equipped with furniture etc. Moreover, household members occupy not only living space within buildings, but also (part of) the area on which the residential buildings stand, as well as access roads or other parts of infrastructure (ibid.).

Attempts and developments to actively decrease the living space per inhabitant have been limited in the past years and few developments have taken place. Therefore, this chapter focuses on heating in private homes and efforts or developments to decrease the consumption. Due to space constraints, social aspects connected to this discussion, although important as well, were touched upon only to a limited extend.

### 3.4.1 Recent developments in the field/policy context

In order to address the problems in the building sector, numerous strategies, legislations and other political or society-driven initiatives have been undertaken since 2016, but with limited impact concerning the goals mentioned above.

Most prominently for the building sector, the May 2019 draft of the *Gebäudeenergiegesetz (GEG)* from BMWi and BMI needs to be mentioned. It responds to long-lasting demands from civil society and business to merge *EnEV*, *EnEG* and *EEWärmeG* with the aim of eliminating the juxtaposition of different regulations and to improve coordinating energy efficiency and renewable energies in buildings (BMWI 2019a). Until the end of June 2018, the “Länder”, as well as business and environmental associations and organisations were invited to comment on the legislative text. While merging the different regulations was appreciated, criticism was voiced that the draft is not ambitious enough and misses the opportunity to create a sustainable framework for an almost climate-neutral building stock and does not grant the needed security for long-term planning in the construction and renovation sector (DENEFF and VfW 2019).

In 2014, the German government laid out the details of its efficiency strategy in the *National Action Plan on Energy Efficiency (NAPE)*. This action plan brings together energy efficiency goals, tools and responsibilities and identifies measures that can make a contribution to energy efficiency including the building sector) (BfEE 2019b). The latest monitoring report on Germany’s energy transition[8], which included an evaluation of *NAPE* measures, came to the conclusion that many of the efficiency goals for the building sector were unlikely to be met in 2020 (BMWI 2019b). Hence, there are plans to launch new measures under “NAPE 2.0” covering the period between 2021 and 2030 with the aim of achieving the German energy efficiency target for 2030 (Die Bundesregierung 2019b).

The building-specific renovation roadmap (*iSPF*) was initiated by the BMWi in May 2017 and is a measure of the building efficiency strategy from 2015. It is a software-supported tool which addresses home owners and provides them with an overview of the renovations that should be scheduled in their building in the long term. In addition to energy saving potentials and possibilities to implement renewable energy sources, the monetary investments are estimated and savings for heating cost and $CO_2$ are shown (BMWI 2017).

In May 2016, the BMWi launched the nationwide awareness raising and information campaign “*Deutschland macht’s effizient*”. It addresses households, businesses and

[8] I.e. the „Zweiter Fortschrittsbericht der Energiewende”.

municipalities and wants to motivate different stakeholders to use energy for heating and electricity more wisely while delivering the message that energy efficiency is not a sacrifice, but rather adds value (BfEE 2019a).

Various funding programmes have been launched since 2016 including, for example, non-repayable subsidies to trigger the replacement of heat pumps by highly efficient pumps as well as funds to ensure heating systems are hydraulically balanced, i.e. distribute heat in a building more efficiently. The aim of these programmes is to motivate citizens to invest in energy efficient products or processes (BAFA 2019).

With its 38 areas, the *DNS* addresses topics connected to the building or heating sector indirectly under SDG 7,11, and 13, which relate to the sustainable use of energy, sustainable settlements and the reduction of GHG (Presse- und Informationsamt der Bundesregierung 2018). Therefore, sub-goals refer to indicators such as: the share of renewable energies in the energy mix, energy efficiency goals related to decreasing primary energy use and the reduction of $CO_2$ emissions and finally the reduction of land used by settlements and traffic infrastructure (ibid.). SDG 12 directly mentions heating as one source of $CO_2$ caused by consumption through households, and the DNS refers to some of the earlier mentioned strategies to foster energy efficiency in buildings as well as energetic refurbishment.The *NPNK* covers topics related to energy efficiency and dedicates a few paragraphs to the increase of living space needed per capita and its potential remedies. As counter measures it mentions shared housing projects or co-housing to counterbalance demographic change and suggests a helpdesk to serve as contact and information point for innovative housing projects. Actions laid out in the *NPNK* to address the high consumption of energy for heating at home mostly focus on education of the younger generation, providing free advice on heating behaviour for low-income households, as well as the reference to funding efficiency measures (cf. the paragraph above). A noteworthy aspect mentioned in the *NPNK* is the support for promoting environmentally friendly building products (BMU 2016b). However, concrete regulatory measures or concrete numeric goals are absent from the programme.

The final paper of the housing summit (*Wohnungsgipfel*), underlines and re-manifests efforts to meet the 2030 $CO_2$ and energy consumption reduction goals for the building sector while stressing that renting or building flats should remain affordable thus addressing social issues and concerns (BMi 2018).

The new *Mietrechtsanpassungsgesetz* which entered into force in January 2019 equally focused on social issues triggered by costly energetic refurbishments. Hence modernisation costs are only to be passed on to the tenant at an annual rate of 8% (previously 11%) to protect tenants from a rent increase after (energetic) refurbishment (MietAnpG). Next to the above-mentioned political initiatives, there are two impulses from civil society worth mentioning: Firstly, the *Caritas' Stromspar-Check Plus* Programme, which started long before 2016, but was prolonged in 2016 until 2019 due to its big success (NKI 2019). It targets low-income households by providing energy saving advice and emergency aid packages including energy-saving or LED lamps etc. Secondly, the open letter of 41 environmental organisations, representatives of the real estate industry, energy consultant networks, consumer and business associations that requested the government to become active and introduce tax incentives for energetic refurbishment (BundesBauBlatt 2019).

No active political measures were undertaken since 2016 against the trend of increasing living space per capita. The *DNS* under SDG 11 touch on this subject vaguely mentioning

that population-related loss of open space should be reduced (Presse- und Informationsamt der Bundesregierung 2018).

Stakeholders that have influenced recent developments and have a stake in the key area are listed below.

### 3.4.2 Governmental and non-governmental stakeholders

The organisations listed here are a selection of stakeholders active in this key area in the past years. The list does not claim to be exhaustive.

**Governmental**

- Federal Ministry of Economics and Energy (BMWi)
- Federal Ministry of the Interior, Building and Community (BMi)
- Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU)
- Funding institutions such as the Federal Office for Economic Affairs and Export Control (BAFA) and the KfW
- Funding institutions at state, district and municipal level
- State authorities
- International institutions (e.g. EU, EEA, IEA)
- Energy Efficiency Platform (also including non-governmental stakeholders)
- ...

**Business**

- Associations representing renewable energies (e.g. Bundesverband Wäremepumpe, Bundesverband Bioenergie, Bundesverband EE)
- Energy consultants and their asssociations (e.g. GIH e.V.)
- Associations of building technology (e.g. Gesamtverband Gebäudetechnik e. V.)
- Construction industry and their associations (e.g. ZDB, architects, crafts)
- Overarching associations for energy efficiency in the building sector (e.g. GEEA, DENEFF)
- Association of the insulation industry (BUVEG)
- Owners' association (e.g. Haus und Grund).
- Housing and real estate companies and their association (GdW)
- ...

**Civil society**

- #effizienzwende
- Gebäudeallianz
- Environmental NGOs (e.g. DUH, NABU, BUND)
- Tenants and tenant associations
- Association of energy consumers (Bund der Energieverbraucher)
- Caritas
- Consumer organisations (e.g. VZBV)

**Science and think tanks**

- Research institutes (e.g. adelphi, DIW, FÖS, Ifeu, Thünen Institute, Wuppertal Institute...)
- Universities
- ...

### 3.4.3 Drivers and barriers

**Drivers:**

The pending GEG could become an important regulatory driver for improving energetic refurbishment in the housing sector, as it aims to simplify and harmonise current legislation such as *EnEV*, *EnEG* and *EEWärmeG* and includes promising approaches such as the "*Quartiersansatz"* (Die Bundesregierung Bearbeitungsstand: 2019). A prerequisite for meeting its expectation is that the draft takes the comments from the stakeholder consultation into account (cf.3.4.1) to enhance the ambitious character it set off with.

Digitisation is a driver for energy efficiency and reduction of heating in homes, as numerous applications can help visualise energy use for heating in homes and thus raise consumer awareness on energy use and its financial implications. Smart thermostats and smart home systems can help control and adjust the heating system, taking into account absences of inhabitants. Chat-bot technology, such as that trialled in the on-going European Research Project "*Eco-Bot*", can be used to provide personalised energy saving recommendations and trigger behaviour change (eco-bot 2019). Simple tools, such as "$CO_2$ traffic lights" that display air composition can be used to trigger behavior change towards a more energy efficient aeration.

An "analogue" driver to contribute to reduce heating of private space is personal energy consulting as, for example, offered by several local and federal consumer organisations (*Verbraucherzentralen*) in Germany. Consulting services of *VZBV* cover topics such as insulation, heating systems and the use of renewable energy in private homes; its information-based service assists 120 000 consumers per year in decision-making and changing their behaviour (VZBV 2019). Increasing consumer information by offering targeted information on refurbishment with alternative and sutainable measures were tested in pilot projects successfully, as well (Stieß und Kresse 2017).

Market-based drivers for achieving energetic refurbishment and reduce heating usage include funding opportunities of *BAFA* and *KfW* that provide financial aid and attractive loans for energetic home improvement. It is important that access to state funding is simplified and the administrative burden for the applicant remains reasonable in order to be an attractive offer. Furthermore, refurbishment programmes or incentives for households with small incomes need to be developed as well (Stieß und Kresse 2017).

**Barriers:**

Barriers for improvement in this field are manifold; a selection of them is included below. One of the most important market-based factors for stagnating renovation rates is the fact that prices for fossil fuel are relatively low which prevents investments into insulation measures or the replacement of fossil fuel based heating sources in the building stock with renewable energy sources. At the same time, prices for construction and planning services in the building sector are constantly rising (Weitz 2019). Existing regulations such as *EnEV* and *EEWärmeG* (soon to be incorporated into the GEG) are hardly enforced by state authorities, for example, when it comes to the existence or validity of energy performance certificates of buildings or the obligatory exchange of certain old and out-dated heating system (Deutsche Umwelthilfe e.V. 2016).

Additionally, households are not aware of the costs and the saving potential of improved heating habits as the heating bill is not transparent and therefore difficult to understand

(ibid.). This can partly be overcome by digitalisation and specific apps, as mentioned above, but would require a wider roll-out of these solutions. Furthermore, the two different energy performance certificates of building that exist in Germany in parallel prevent uniform records of energy consumption and comparability of buildings and therefore miss their potential to promote energy efficiency and influence the purchasing or renting decision of potential buyers or tenants (Tappeser and Chichowitz 2017).

Additionally, numerous structural problems are accountable for lack of progress in the field of energetic refurbishment. For instance, Germany's high proportion of rental properties causes an investor-user dilemma, which, despite cost-sharing possibilities, is not entirely resolved (ibid.). The structural heterogeneity of stakeholders that own houses, e.g. real estate companies, cooperatives, private home owners, homeowner associations etc. make it difficult to find rules and regulations or incentives that do not favour or disadvantage certain groups (ibid.). In addition, the incoherent funding policy of recent years represented a risk for investors or owners and made it more difficult to plan long-term refurbishment measures. Furthermore, experience has shown that architects, craftsmen and energy consultants often lack expertise and experience in dealing with energy refurbishment projects, thus hampering the full exploitation of energetic refurbishment potential within a renovation activity (ibid.). On top of that, demographic change also causes shortage of skilled workers in the construction/refurbishment sector.

Last but not least, financial efforts, time expenditure and nuisances associated with the implementation of insulation measures outweigh the concrete benefits of energetic refurbishment (e.g. higher comfort level). This, paired with a generally bad image of energetic refurbishment through divers scandals in the past (e.g. facade fires or mould incidents scandalised by the media), leads to significant hesitation on the part of home owners towards energetic refurbishment (Tappeser and Chichowitz 2017; Deutsche Umwelthilfe e.V. 2016).

### 3.4.4 Practice-Examples

Numerous examples of good practices for reducing energy consumption in the building sector via different instruments exist in Europe and beyond.

The *French Energy Transition Tax Credit (CITE)* provides an income tax credit of 30 % for expenditures related to certain building renovation work to improve the energy efficiency of private dwellings or the modernisation of heating installations including the building-integration of renewable electricity generation technologies such as wind and solar (Schneller and Hennig 2018). Impacts, although to be considered with caution[9], indicate that the implementation of *CITE* led to a reduction of the annual final energy consumption by 0.93 million tonnes of oil equivalent (Mtoe) in 2016 and was projected to amount to 1.08 Mtoe in 2020. The reduction of GHG emissions of the residential sector through this scheme was estimated 7.5 % for the years between 2008 and 2010 (ibid.).

Denmark serves as a good-practice example for the implementation and maintenance of its Energy Performance Certificate Database and for maximising its impact and contribution to realising energy efficiency goals. The high quality and easy to access database (as

[9] To calculate the impacts the exact "content" of renovations measures was based to some extent on estimations.

compared to e.g. the German EPC database approach), allows stakeholders to obtain the relevant energy-related information and make informed purchasing and renting decisions, because they understand a building's energy consumption and the saving potential as compared to other buildings. Measurable impacts of the Danish EPC database is, for example, the increase of sales prices of single-family houses in correlation with improved EPC classes of the buildings (Brand et al. 2018).

In the Dutch *Energiesprong* example, the local housing company "*BAM Wonen*" achieved a massive renovation of terraced houses dating from the 1960s through prefabricated thermal insulation modules while remaining affordable for its tenants (Franken and Drewes 2019). The goal was that a) houses would become zero-energy homes and b) the total rent (including heating) remains the same after the renovation activities since renovation costs would be refinanced by energy savings. Until now, more than 4500 houses have been renovated in the Netherlands under the *Energiesprong* project. Due to its success, the project is being duplicated in Germany (to a certain extend) by the *Dena* in a three year project that started in 2018.

Different programmes in US cities such as the "*NYC Retrofit Accelerator*" in New York City, or the "*Green Home Choice*" programme in Arlington offer home owners of small or big residential buildings guidance and step-by-step support throughout the entire renovation process including aid in selecting the appropriate implementation companies. The service is offered by specialists and free of charge (City of New York 2018).

Other good-practice examples include the so called "white certificates" in the UK, which oblige electricity and gas suppliers to achieve energy savings through costumer education and support. On the legislative spectrum, countries such as Denmark or the Netherlands have adopted legislation which prohibit fossil heating systems in new buildings entirely.

### 3.4.5 Recommendations

In order to increase the renovation rate of existing buildings, Germany should implement a dynamic and socially balanced $CO_2$ tax to trigger investments in renovations of buildings in combination with interventions, incentives and digital information to change energy use behaviour to reduce heating needs.

The government must strengthen the instrument of the energy building certificate to become a relevant information tool. This can be accomplished by eliminating the two different co-existing energy performance certificates that do not allow buildings to be compared properly concerning their energy efficiency properties (for tenants or buyers) and by funding an efficient and well-maintained energy certificate database (cf. Danish best practice example) that allows for comparison of buildings and serves as a decision-making tool.

Policymakers must finally activate federal funds to enforce a quick implementation of tax deductibility or incentives for energetic renovation measures which had been agreed in the coalition agreement, but are still pending. Low-income households and house-owners with liquidity constraints should receive special attention to be eligible for such a scheme while mechanisms to exclude potential free riders should be implemented.

Germany should consider undertaking mass renovation projects using prefabricated modules following the Dutch *Energiesprong* example. For this, a high-quality evaluation of the corresponding *Dena* trial and the provision of sufficient funds are necessary.

Finally, the shortage of skilled labour for a sustainable building sector needs to be addressed. Promoting and educating the next generation of craftsmen and architects for innovative heating/cooling systems, insolation and other climate related technologies is essential because for higher renovation rates and a more sustainable building stock more well qualified craftsmen are needed.

## 3.5 Key area: Travel by air

Air travel is the most carbon-intensive means of transportation per kilometre (UBA 2019b). Critics state that aviation only accounts for 2.69 % of global carbon dioxide emissions (BDL 2018). However, it has to be taken into account that the non-$CO_2$ effects – e.g. nitrogen oxides (NOx) and cirrus cloud formation that trap radiation from the Earth − increase the damage caused by air traffic to the atmosphere by a factor of two to four − as calculated by the organisation *atmosfair* on the basis of the *IPCC* report (atmosfair 2016). Furthermore it is estimated that 80-90% of the world's population has never taken a flight but there are millions of new passengers traveling by air every year (IATA 2018; Heinrich-Böll-Stiftung and Airbus Group 2016). A report published by the *European Environmental Agency* indicates that $CO_2$ emissions from the aviation sector continue to increase and it is estimated that they will account for 22% of global emissions by 2050 if no further action is taken (EEA 2017). Also in Germany passenger numbers are rising: Whereas in 2004 134 million passengers boarded an aircraft in Germany, today the figure is 222 million a year (Statista GmbH 2019d). Travelling by air symbolizes urbaneness and a cosmopolitan lifestyle. Reducing air travel demand is challenging and constraining demand is viewed as politically unpopular (EEA 2017). In the following section some light should be shed on recent attempts to regulate the aviation sector und recommendations to strengthen those approaches should be derived.

### 3.5.1 Recent developments in the field/policy context

So far, there are many tax exemptions when it comes to air travel (SRU 2017). Value Added Tax (VAT) is only raised on domestic German flights, however intra and extra EU flights are not subject to VAT: Article 15 of the Chicago Convention from 1944 prohibits states to levy charges "in respect solely of the right of transit over or entry into or exit from its territory" (ICAO). Train tickets (also cross-border rail-tickets), however, are subject to 19% VAT in Germany[10] (SRU 2017). The *1944 Convention on International Civil Aviation* ('Chicago Convention') is the main regulatory framework for international civil aviation. Introduced at the end of World War II, it was established to promote cooperation and "create and preserve friendship and understanding among the nations and peoples of the world" (ICAO) − when climate change was not yet an issue. In addition to the VAT-exemptions, the Chicago Convention stipulates that there is no tax on fuel (kerosene) in the international aviation sector.

Within the EU, intra-continental flights are covered by the EU emissions trading system (ETS) since 2012 (European Commission 2019a). However, over 80% of ETS emissions

[10] VAT is only reduced on journeys of up to 50km to 7per cent,

allowances are allocated for free to the aviation sector and carbon prices under the EU ETS have been low − which means that the inclusion of air travel in the ETS has not yet resulted in a significant carbon price signal for air travel (Sonnenschein and Smedby 2019). Flights into and out of the European Union are not included in the ETS (ibidem).

At the UN level, *the International Civil Aviation Organization (ICAO)* has adopted the global, market-based $C0_2$ compensation system *CORSIA* (Carbon Offsetting and Reduction System for International Aviation) in 2016 which will be implemented in 2021 (ICAO 2019). However, the scheme only aims at freezing growth-related $CO_2$ emissions at the 2020 level by offsetting. To this end, airlines acquire emission certificates, for example credits from projects that save $CO_2$ emissions elsewhere (e.g. sponsor thermal heating systems that use solar energy to generate). In the pilot phase (2021-2023) and in the first phase (2024-2026) participation is voluntary. Participation will be compulsory from 2027 onwards. However, critics state that further measures and an actual reduction of greenhouse gas emissions in aviation itself are necessary to achieve the objectives of the Paris Convention (Heinrich-Böll-Stiftung 2018).

As charging VAT on international flights or taxing kerosene would require renegotiations of international agreements, the most common way to create incentives to travel less is air ticket taxation (Sonnenschein and Smedby 2019). Germany introduced the "*Luftverkehrsabgabe*" in 2011 which amounts for 7 up to 40 euro, depending on the distance flown (Bundesministerium der Finanzen 2011). An evaluation of this ticket tax conducted on behalf of the Federal Ministry of Finance indicates that the levy resulted in a loss of two million passengers per year (minus 1.0 %) (Infras 2012). In 2017 the Federal Ministry of Transport and Digital Infrastructure presented an air traffic concept ("*Luftverkehrskonzept*") with measures to strengthen and secure Germany as an air traffic location – including the announcement that consideration will be given to reduce the "*Luftverkehrsabgabe*" (Bundesministeriums für Verkehr und digitale Infrastruktur 2017). When it comes to the federal government itself and its business trips, the "Sustainability Programme" (*Maßnahmenprogramm Nachhaltigkeit*) stipulates that the Federal Government and its subordinate authorities have to offset the emissions caused by business trips (Staatssekretärsausschuss für nachhaltige Entwicklung 2017).

### 3.5.2 Governmental and non-governmental stakeholders

The organisations listed here are a selection of stakeholders active in this key area in the past years. The list does not claim to be exhaustive.

**Governmental**

- Federal Ministry of Transport and Digital Infrastructure (BMVI)
- Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU)
- Federal state ministries (responsible for regional airports)
- International Civil Aviation Organization (ICAO) - a specialized agency of the United Nations (UN)
- International institutions (e.g. EU)
- ...

**Business**

- Bundesverband der Deutschen Luftverkehrswirtschaft (BDL)
- Bundesverband der Deutschen Luft- und Raumfahrtindustrie (BDLI)
- Unternehmen der Luft- und Raumfahrtindustrie: Airbus, Boeing, ...
- International Air Transport Association (IATA)
- Flughafenverband ADV
- Aviation Initiative for Renewable Energy in Germany aireg e.V.
- DFS Deutsche Flugsicherung GmBH
- ...

**Civil Society**

- “Stay Grounded”
- Carbon Offset-Companies or NGOs (atomsfair, ...)
- Environmental NGOs (BUND, Greenpeace, Klimaallianz ..)
- Bundesvereinigung gegen Fluglärm e.V.
- VCD
- ...

**Science and think tanks**

- DLR
- FÖS
- Heinrich-Böll-Stiftung
- ...

### 3.5.3 Drivers and barriers

**Drivers**

Technical developments in the telecommunications sector helps to some extent to reduce the need for business-related air travel (Denstadli et al. 2013). Improved online technologies have facilitated the use and accessibility of videoconference and remote online meetings for many organisations (ibidem).

**Barriers**

As indicated above an internalization of external costs in the field of aviation can only be implemented by international cooperation. This is perfectly illustrated when it comes to taxing

fuel (kerosene)[11]: Without any international agreement on taxing fuel, it is highly likely that moves to impose it at a domestic level would encourage airlines to refuel abroad to avoid paying taxes − which might even be counterproductive from an environmental point of view (Seely 2012). However, amending the Chicago Convention, which still prohibits states from placing a levy on flights, would require the agreement of the 193 signatory states.

There are also technical barriers that jeopardize a more sustainable future in the aviation sector: Technological innovations that may reduce the environmental effect of aircraft are slow (Lee and Mo 2011). The so called power-to-liquid (PtL) (power-to-kerosene) technology which can supply green, climate-neutral jet fuel by using solar and wind energy is a promising development (UBA 2016b). However, the PtL-technology still is quite cost-intensive and highly energy-demanding (ibidem). Even if it reaches market maturity, development and certification procedures for commercial aircraft take a long time. On top of this, aircrafts remain in service for an average of 30 years: Even if innovative, more sustainable machines enter the market, the older machines would still remain within global fleetmix for a long time due to the long life spans of those machines (Heinrich-Böll-Stiftung and Airbus Group 2016). Moreover, the rebound-effect has to be taken into account: Fuel efficiency gains and fleet modernisation might not keep pace with the rising emissions resulting from the increase in air passenger travel (ibidem).

### 3.5.4 Practice-Examples

There are no best-practice examples yet for an effective global approach to reduce emission resulting from the aviation sector. Recently, more countries have implemented ticket taxes (CE Delft 2019). For instance, France recently has established a per-passenger tax on all commercial flights departing from an airport situated on French territory (Deutsche Welle 2019). The amount of the tax is generally lower than the German "*Luftverkehrsabgabe*". In France, however, the revenue will be explicitly invested in greener transport infrastructure, notably rail infrastructure. In Germany, the "*Luftverkehrsabgabe*" it is not explicitly labelled as environmental tax.

The recently established high-speed railway between Berlin and Munich can be listed as one domestic good-practice-example to reduce domestic flights. The new line reduced travel time by train between Berlin and Munich from 6 hours to 4 hours. Since then, the number of flight passengers on the route is steadily declining and it is becoming increasingly unprofitable for airlines (Deutsche Bahn 2018).

When it comes to bottom-up approaches, Sweden has seen the development of a movement called "*Flygskam*" ("flight shaming") (Deutschlandfunk 2018). The idea is that people encourage each other to travel by train instead of plane by posting pictures from their rail trips online, using the hashtags #flygskam or #tagskryt on social media and making it a social media trend. The movement had spillover effects (e.g. Flight Free UK 2020).

[11] which currently can only be implemented on domestic flights or by additional bilateral agreements on international flights to circumvent the Chicago Convention

### 3.5.5 Recommendations

The international *CORSIA* scheme (as described above) is a start, but further measures are needed to achieve an actual reduction of greenhouse gas emissions in aviation itself to meet the objectives of the Paris Convention.

Germany should foster the attempts to reach a global (or in a first step European), effective agreement to reduce emissions. According to a study conducted on behalf of the European Commission, taxing aviation kerosene sold in Europe would cut aviation emissions by 16.4 million metric tons of $CO_2$ a year (CE Delft 2019). The modelling shows that applying a tax of 330 euro per 1000 liters of kerosene would result in a ticket price increase of 10% and an 11% decrease in passenger numbers (ibidem). It would also lead to an 11% fall in carbon emissions and would not have a net impact on jobs and the economy as a whole (ibidem). In contrast to air ticket taxation, a fuel tax increases the incentive for airlines to use particularly economical aircraft and to encourage pilots to fly fuel-efficiently (Sonnenschein and Smedby 2019). Introducing a tax on fuel is one option – different policy measures, including emission trading, carbon pricing, offsets, fuel and aircraft standards and operational improvements are discussed. As described above there already is a mixture of policy instruments in force – there needs to be an in-depth analysis of the interaction of those different economic and regulatory instruments (which is beyond of the scope of the study). Research indicates that the frequency of air travel is determined by the family income (Valdes 2015). The tax exemptions in place so far (see above) thus amount to subsidies primarily in favour of wealthier people. There are innovative approaches that take into account the accessibility of air travel. Mobility researcher Andreas Knie suggests to tax people according to how often they fly: Each person has a fixed budget of three flight pairs per year that they can buy normally (Knie 2018). If they want to fly more, flights have to be bought from others who don't use their budget (ibidem). However, this is a relatively cumbersome policy instrument to administer.

To shift short haul flights, both domestic and to destinations within Europe, onto rail, the VAT on train tickets should be lowered, whereas the "*Luftverkehrsabgabe*" air ticket tax on domestic flights (currently 7.38 euro) should be raised. The revenue of the tax should be explicitly invested into rail infrastructure. There should be more high-speed rails connecting the big European cities.

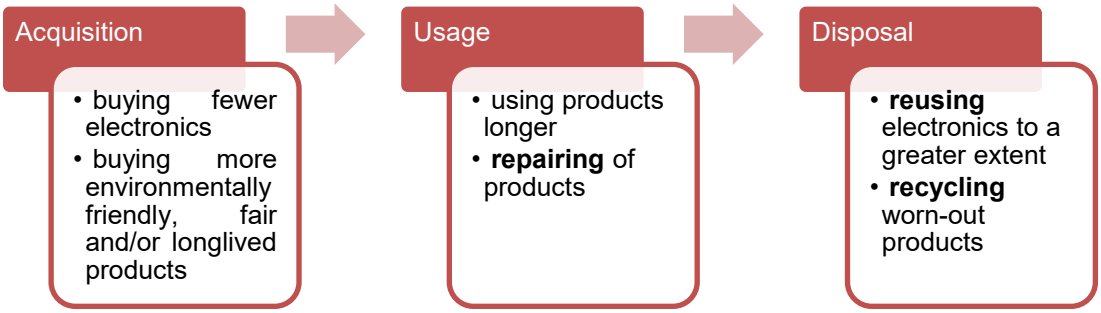
In addition, soft policy instruments such as communication, education or awareness-raising should be implemented (e.g. a roadshow on the impact of air travel and climate change similar to the "*DBU Wanderausstellungen*" for schools).

## 3.6 Key area: Consumption of electronic devices

A study conducted on behalf on the German Federal Environment Agency finds that, in Germany, the number of electronic devices per household is increasing whereas the lifetime of those appliances is becoming shorter and shorter (Umweltbundesamt 2016). The reason is on the one hand that many appliances (both "white goods" and consumer electronics) have too short a durability – but on the other hand many appliances are being replaced though they are still in good working order (ibidem). As described in chapter 2 with regard to

the "*TSC database*" there are many environmental problems and social issues associated with the extraction of materials used in electronic devices. Policy measures in this field need to target the supply side (producers) (e.g. by implementing and monitoring working standards along the supply chain, regulatory measures against built-in obsolescence and the sustainable management of E-Waste) − but also the demand side (consumers). Due to limited space within this report this chapter focuses on the consumer perspective. When analysing sustainable consumption of electronic devices the following aspects are taken into account:

**Figure 2: Sustainable consumption of electronic devices (along the consumption phases)**




### 3.6.1 Recent developments in the field/policy context

Policy instruments as of yet first and foremost address the recycling of worn-out products. Here, the Electrical and Electronic Equipment Act ("*Elektro- und Elektronikgerätegesetzes" (ElektroG*)) is the main regulatory framework in the field. Since 2015 – after a revision of the ElekroG − the take-back obligation of retailers (including online-retailers) has entered into force. In this way, and in addition to the collection of electronic waste from municipal sites, retailers with a sales area of over 400 square meters have to take back used electrical equipment and recycle it. From 1 May 2019 on, even more items are included in the obligation. With respect to the acquisition of more environmentally friendly and long-lived products and the extended use of products, the German Federal Environment Agency launched an information campaign providing information material at the point of sale to raise consumers awareness about the life-span of products (Umweltbundesamt 2018). On top of this, the "Sustainability Programme" (*Maßnahmenprogramm Nachhaltigkeit*) stipulates that the federal government as public procurer take sustainability aspects into consideration when purchasing electronic devices (environmental criteria and – as far as possible – social criteria) (Staatssekretärsausschuss für nachhaltige Entwicklung 2017). To this end, several guidelines have been developed by state and non-state actors to specify those criteria, e.g. "Leitfaden zur Operationalisierung der Reparatur von Produkten in der öffentlichen Beschaffung" which focuses on the possibilities of taking repairability into account in public procurement (Runder Tisch Reparatur 2019). Furthermore, several educational projects for schools e.g. pilot project "G2 Schulkoffer" (launched in 2017) and information material for pupils e.g. "Umwelt im Unterricht – Rohstoffe für unseren Lebensstil" (BMU 2018) and "Die Rohstoff-Expedition" (Nordmann et al. 2015) have been developed to raise awareness of the

sustainable consumption of resources with regard to electronic appliances. Reusing and repairing of products so far are less covered by policy instruments.

### 3.6.2 Governmental and non-governmental stakeholders

The organisations listed here are a selection of stakeholders active in this key area in the past years. The list does not claim to be exhaustive.

**Governmental**

- Das Beschaffungsamt
- Federal Ministry of Education and Research (BMBF)
- Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU)
- Federal Ministry of Economics and Energy (BMWi)
- International institutions (e.g. EU)
- Kompetenzstelle für nachhaltige Beschaffung (KNB)
- Kaufhaus des Bundes
- ...

**Business**

- Associations representing companies of the digital economy and electronic industries (bitkom, ZVEI, Bundesverband Technik des Einzelhandels eV: BVT …)
- Associations representing retail (stationary and online) (bevh, HDE, ...)
- Resellers (e.g. “reBuy”, ebay-kleinanzeigen, ....)
- Social businesses (e.g. “Arbeit für Menschen mit Behinderung” (AfB))
- Stiftung elektro-altgeräte register (stiftung ear)
- Municipal enterprises Verband Kommunaler Unternehmen e.V.
- ...

**Civil society**

- Consumer Organisations („Verbraucherzentrale Bundesverband”)
- Monitoring organizations (Electronics Watch, …)
- Environmental NGOs (Greenpeace, BUND, Nabu, Deutsche Umwelthilfe)
- NGOs in the field international development (Germanwatch, Power Shift,… )
- “Runder Tisch Reperatur”
- “Murks, nein danke”
- “ReUse”
- Sustainability platfoms (e.g. “Rank a brand”)
- iFixit
- Repair Cafés
- www.kaputt.de
- Verschenknetzwerk „Alles und Umsonst”
- ...

**Science and Think Tanks**

- Research institutes (e.g. adelphi, Institute for Advanced Sustainability Studies in Potsdam (IASS), Öko-Institut e.V., Wuppertal Institut für Klima, Umwelt, Energie)
- Stiftung Warentest
- anstiftung
- ...

### 3.6.3 Drivers and barriers

**Drivers**

Digital platforms (both commercial and non-commercial) have facilitated the b2c (business-to-consumer) or c2c (consumer-to-consumer) exchange of refurbished electronic devices (especially smartphones) (Deloitte 2016). Thus, the growing recommerce-market can be seen as a driver towards more sustainability.

Another driver towards more sustainability is the growing number of repair cafés: To date, around 600 repair cafés exist in Germany (Mundt and Göll 2018). However, only 12% of the newly founded repair cafés can be based on start-up financing from the governmental or the public side (ibidem).

**Barriers**

When it comes to the purchase of electronic devices, there is little information on the sustainability of products (e.g. via labelling), which can be seen as a barrier to make the consumption of electronic devices more sustainable. There are few ecolabels that take into account environmental aspects such as a low energy consumption, durable and recyclable construction, avoidance of materials harmful to the environment and health (e.g. for *Energy Star*, the German Blue Angel ["*Blauer Engel*"], the *EU-Ecolabel*, *TCO-Label*). However, those labels are not (yet) established in the market (currently, no laptops or desktop PCs with the Blue Angel label are available on the market and only few with the EU-Ecolabel) (Umweltbundesamt 2019b). Furthermore, they mostly do not take social criteria into consideration (except the TCO label and the EU-Ecolabel), such as working conditions – as these are not as easy to measure as environmental standards.

As described above, the lifetime of electronic appliances is becoming shorter due to both technical reasons (such as built-in obsolescence), but also behavioural aspects as many appliances are replaced even though they are still functioning (Umweltbundesamt 2016). There are many different reasons for a premature purchase of a new appliance: In consumer electronics, technological innovation cycles are short and thus the desire for a new device – supported by marketing campaigns – is stimulated (ibidem). On top of this, many products do not allow repairs (ibidem) (here, eco-design approaches come into play – which are not addressed within this chapter).

When it comes to the recycling-phase, studies have revealed that consumers tend to store outdated-appliances at home rather than discard them in a proper manner (e.g., mobile phones, laptops, and entertainment electronics) (Shevchenko et al. 2019). Even if the devices are no longer in active use, they are still kept at home as a reserve or for sentimental reasons and therefore consumers are unwilling to deliver them to reuse or recycling (ibidem). In Germany, around 124 million old or broken cell phones are currently stored in private households (Statista GmbH 2018a).

### 3.6.4 Practice-Examples

The following section explores several tools that ensure the extension of a product's lifespan through reuse and repair. In Sweden, for instance, 50% of the labour costs for repairs of large household appliances ("white goods" such as fridges, ovens, dishwashers and washing machines) are tax deductible up to a maximum of 25.000 Swedish crowns per year (around

2300 euro) or 50.000 Swedish crowns per year for persons over the age of 65 (around 4600 euro) (Swedish Tax Agency 2019). The law has been in force since January 2017 and aims to make the repair of goods into more rational, economic behaviour. Initial figures reveal an increasing number of repairs for “white goods” − however, reliable surveys have not yet been conducted (Swedish Tax Agency 2017). On top of the possibility to claim back half of the labour costs on repairs from income tax, the VAT on repairing costs has been lowered from 25 % to 12 % in Sweden. Naturally, an increase of repairs does not only depend on the consumer willingness to repair goods, but also on the reparability of products – more precisely the availability of spare parts and the replaceability of individual components. Therefore, as described above, policy instruments addressing the supply side and the demand side need to be interlinked. Having a reduced VAT on repair services would encourage not only environmental improvement but also local job creation (rreuse 2017). It would generate employment and qualification opportunities especially for those people who are currently excluded from the regular labour market (ibidem). As for the reuse of worn-out products: In France, the collection and sales of used goods carried out by social enterprises are exempt from VAT because their activities are linked to the employment of disadvantaged and disabled persons (Eco-systèmes 2019).

As quality assurance is indispensable for reuse, many companies and networks involved in the preparation for reuse and repair have established and have developed quality seals that guarantee that the goods are inspected and that they are well-functioning in compliance with all safety criteria (RepaNet 2019). In some cases, the quality seals also provide information about the duration of the warranty and guarantee granted. Examples include the “Revisie”-seal of approval, the French “envie”-label or the Austrian Revital-Label. There are also other communication-oriented instruments in place. The Spanish government helped develop an online-tool that shows consumers the amount of $CO_2$ emissions saved through reuse of various products (e.g. furniture, electronic appliances and clothes) (Spanish Ministry of Agriculture, Fisheries and Food).

### 3.6.5 Recommendations

Policymakers should put more emphasis on the repairing and reuse of electronic devices. Government should formulate concrete policy goals with regard to increasing the reuse and repair of (among others) electronic appliances. To this end, low VAT rates for repair services and resold goods (especially if carried out by social enterprises) should be introduced as well as the possibility for tax reduction of repairing costs of “white goods” (following the example of Sweden).

An amendment of the ElektroG should facilitate the preparation for reuse of electronic appliances by strengthening the access of reuse companies and institutions to the municipal collection points. Public funding of repair cafés should be extended (e.g. municipalities providing spaces and tools for those initiatives). With regard to the recycling of worn out products, the visibility of collection points (especially at the newly established collection points in stores (including e-commerce) should be increased to raise the consumer’s awareness of return possibilities.

In addition, soft policy instruments such as communication, education and awareness-raising should be implemented (e.g. development of educational and communication measures for a more sustainable use and return of ICT devices) to stimulate a public discourse on sustainable production and use of ICT.

# 4 Scientific state of the art in the area of sustainable consumption and production

Whereas Chapter 3 focuses on societal and political developments, Chapter 4 investigates recent developments in the scientific discourse. It provides an overview on general thematic trends with regard to sustainable consumption and identifies key cross-cutting areas emerging from the scientific discourse. It further highlights how the scientific discourse in Germany, represented especially by the Scientific Advisory Councils to the German Government, contextualizes the key areas of consumption discussed in Chapter 3. On this basis, Chapter 3 derives conclusions regarding further research demand but also policy recommendations with regard to the cross-cutting areas identified.

## 4.1 Key themes identified in the scientific discourse

In summary, the scientific discourse examined herein adopts a consumer-centred perspective, especially in fields of consumption connected to urban lifestyles, and is partly orientated towards the concept of circular economy. In the following, different facets of the scientific discourse are discussed in more detail. The subsequent paragraphs and sections, first provide an overview on the general thematic strands in the scientific discourse on the basis of 172 documents published since 2015 by: the 16[12] Scientific Advisory Councils to the German Government; the UBA in the series “Texte”; the FONA and NaWi research programmes in form of project descriptions; and international research based on around 1,000 abstracts indexed in the SCOPUS database. Second, the following paragraphs highlight how individual areas of consumption are contextualised in particular by the Scientific Advisory Councils to the German Government. Third, the final sub-chapters provide detailed insight into recent research in selected fields based on a qualitative content analysis of literature.

A text mining methodology using wordclouds (analysis of term frequencies) and topic modelling using the so-called Latent Dirichlet Allocation (Blei et al. 2003) model (analysis of statistical relatedness of terms) served to generate the insights for the first and second part of the following paragraphs. The methodology is based on the R package textility[13] (Bickel 2019). For interested readers, more details on the methodology and exemplary graphical results, including wordclouds of texts from German research communities and a topic network of international research, are provided in the Appendix. In the following, the interpretations of the results are provided in text form.

[12] In total, there are 17 councils. However, after removing excluding simple press releases or short communications from the selection, documents of 16 councils remain.

[13] R packages are an extension to the base R language, i.e., an open source high-level programming language that was originally developed for statistical computing. The textility package utilizes various other packages for establishing a pipeline for applied text mining and provides comprehensive examples of applied code.

The role of lifestyles on consumption decisions and behaviour is a very prominent topic. Research clearly acknowledges the diversity of different social milieus that lead to particular consumption patterns. Most prominently, this is discussed or illustrated by examples from the food sector. Here, different diets such as veganism, vegetarianism, meat eating, or flexitarism are discussed as consumption patterns that may be a part of the various complex lifestyles. Further, behavioural aspects and environmental impacts connected to food waste generated by consumers but also along the whole value chain are taken into account. This kind of diverse perspectives on lifestyles is also applied with reference to other fields of consumption or individual consumption goods. As a crucial but intricate question, research seeks to find ways of integrating concepts such as sufficiency, degrowth, or sharing in modern lifestyles, especially in emerging urban lifestyles such as the stereotype that might be termed the “metropolitan materialist”.

The discourse is further concerned with the economic situation and expenditures of consumers, which may be viewed from different angles. For instance, the uneven distribution of financial burdens of the essential consumer spending and standard of life received in return across different income groups is discussed from an ethical perspective. While inequality within Germany is one part of this debate, the environmental and social impacts of consumption in Germany on developing or emerging countries are another.

Further, a very strong focus lies on understanding the complex consumer behaviour that is connected to behavioural and psychological research from a theoretical as well as practical perspective. The scientific discourse puts high efforts in unravelling the relation between imprinted norms, learned attitudes or consumption practices, and non-rational but emotional decision-making behaviour for understanding key factors of influence to support sustainable consumption. On this theoretical basis, various practical approaches are investigated. These include mindfulness trainings that might lead to changes in the long-run. Further, the reasonable and cautious use of product labels or psychological strategies such as nudging are actively examined as measures with short-term effects.

Unsurprisingly, digitalisation, as a cross-cutting megatrend, is present in almost every field of consumption. Various positive potentials of digitalisation are seen in, e.g., the dynamic tracking of resource use across value chains, the provision of broad and easy access to consumer information, or the raising awareness for resource consumption via smart metering. However, critical issues are also discussed, including the need to ensure digital sovereignty and privacy of consumers that becomes apparent considering the increasing use of online purchasing options and mobile data applications.

The concept of circular economy and related measures for supporting resource conservation are latent topics that act as an umbrella. While the strand of circular economy connected to waste management and recycling represents an important share of the discussion, the focus is also laid on other phases of product value chains. This includes, for example, resource extraction and criticality of resources, circular product design, or measures for increasing the lifetime of products in the use phase. The essential tool and basis for decision-making in this context are holistic life-cycle assessments. Recent research also includes advancements regarding the establishment of a bioeconomy that aims, amongst other goals, to reduce the use of fossil-based plastics.

Finally, two emerging topics that are present but not yet prominent in the scientific discourse are time welfare and transformational living lab approaches. Time welfare is particularly important in the context of digitalisation that offers high time saving potentials. Living labs are an important form of socio-technical experimentation for creating sustainable innovations

that might inform future decision-making or lead to concrete sustainable products or social innovations.

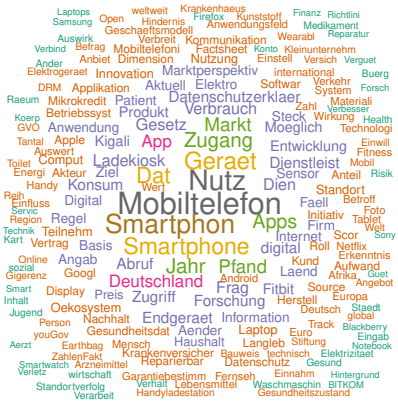
## 4.2 Contextualisation of key areas of consumption by scientific advisory councils

The following figures show how the Scientific Advisory Councils to the German Government contextualise the key areas of consumption: mobility, food, office and workplace, clothing, tourism and living. Some initial conclusions on the foci of the discourse are provided along with the figures. The wordclouds are based on 172 documents published since 2015 by 16 councils excluding press releases or short communications. Further, only sentences containing thematic search terms (e.g., individual transport) plus one sentence before and after were considered. More details on the database and the methodological approach are provided in the Appendix.

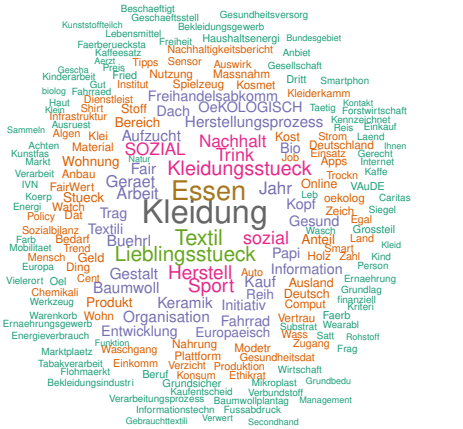
**Table 1: Contextualisation of key areas of consumption by scientific advisory councils based on documents published since 2015**

|  Search term: individualverkehr |  Search term: verzehr\|fleisch\|milch |
|---|---|
| With respect to individual transport, the focus lies on urban mobility and mobility behaviour. Ways of reducing car traffic are discussed, including the management of parking spaces, i.e., the stationary traffic, or urban planning measures. The latter is also seen as a measure for fostering and facilitating alternative modes of transport such as walking, cycling or using public transport. These alternatives are clearly connected to positive effects regarding the quality of | With respect to food consumption, especially regarding meat or dairy products, the discourse focuses on environmental effects such as GHG emissions or the living conditions of animals. Proposals for transformational solutions are only marginally addressed, mainly by referring to product labels or regulations on packaging. A possible interpretation is that the discourse is just beginning to take a different perspective on food consumption and is still building |

| | |
|---|---|
| life in cities, especially with regard to health. | up system knowledge but not yet transformational knowledge in a consolidated way. |



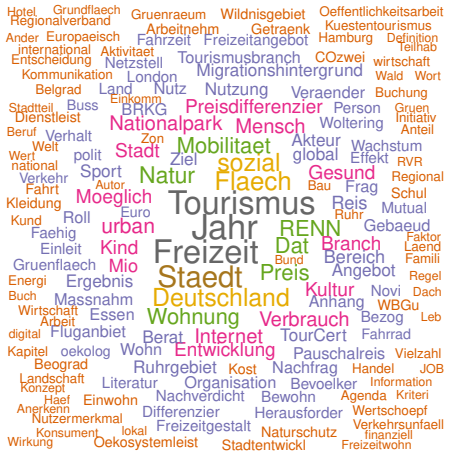

Search term: unterhaltungselektronik| PC |Laptop|Mobiltelefon|smartphone|EBookReader




Search term: Bekleidung| Kleidung

Smartphones and the possibility of using mobile digital services or media and the tremendous options for business models is the focus of the discourse. The questions of what kind of data are exchanged consciously or unconsciously and how they are used by whom, e.g., the use of data on health by insurances, are discussed as data protection and consumer rights concerns. Another, still minor strand addresses the material level of digital technologies in terms of the lifetime of productions, e.g. warranty and reparability.

The topic of clothing shows a complex embeddedness in the broader discourse on consumption goods. Environmental, social and health issues of production and manufacturing, international trading schemes, organisational and service structures, or product life time extensions in the use phase by increasing emotional product attachment or second hand use are part of the discourse. The only product phases that seem comparably underrepresented are recycling and disposal.




Search term: Freizeit|Tourismus|Flugreise


Search term: Heiz|Waschen

| | |
|---|---|
| | \|Einrichtungsgegen\|Haushaltsgroßgeraete \|Haushaltsgeraete\|Moebel |
| Regarding tourism, a major issue is seen in the associated need for transportation. In this context, the low price level of air transportation is discussed, for which easily accessible online offers are one of the enablers. For decreasing such $CO_2$-intensive tourism, various ways of upgrading local or regional tourism offers in terms of mental and physical recovery in urban areas, forests, wildlife parks, local beaches, or recreation areas are considered. | Heating is the major topic discussed in the context of living due to its relevance regarding the energy costs or rents. The relevance of $CO_2$ emissions per capita from heating seems to have a secondary priority. In response, various options for reducing energy demand are discussed, such as the modernisation of heating systems or buildings using different funding mechanisms, the certification of heating systems or buildings, or the education of consumers regarding heating behaviour and the use of passive technologies such as shutters. Also, future-oriented technologies related to primary energy sources are seen as options such as heat pumps or biofuels, e.g., in small combined heat and power plants. |

## 4.3 Recent developments in specific fields of research

### 4.3.1 Using digitalisation for sustainable consumption

The studies *Konsum 4.0* (Kahlenborn et al. 2018) and *Assessment Report – Impacts of the digital transformation on consumption* (Polanía Giese et al. forthcoming in 2019) provide a comprehensive overview on the status quo of digitalisation in relation to SCP. The content is not repeated here, and interested readers are kindly asked to refer to those studies. In addition, the present study seeks to highlight the relation between digitalisation and consumption explicitly in the context of SDG 12. This goal stipulates that a separation of consumption and production is not reasonable. Both of these steps in the value chain have to be regarded as an interconnected production-consumption-system. Research and implementation as well as political measures have to be thought of iteratively in this system. SDG12, therefore, combines both under one target area. It is also striking that, in the area of consumption 4.0, there is hardly any talk of the responsibility of (software) developers and designers. Here, for digital applications as well as R&D, guidelines geared to 1.5-degree lifestyles and households are necessary, which implicitly take into account cyclical principles.

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy: “Digital responsibility strategies for a sustainable digital common future“

1. Digital Responsibility Strategy (DRS): Establish a National DRS that integrates global sustainability objectives and digitalisation and potentially encourages the introduction of an SDG for “digitalisation“. A key issue should be avoiding rebound effects. This needs to be accompanied by a Consumer DRS addressing accessibility of digital innovations and safeguarding their interests (data protection) (SVRV BMJV 2017). In addition, DRSs are required for companies (ibidem) and science**.**
2. Our digital future dialogue: To clarify the roles and complex interactions for establishing digital responsibility strategies, it is necessary to initiate a dialogue process within and between the different stakeholder groups.
3. Establishing guidelines for the design of sustainable software and hardware as well as the digitalisation of consumer products, combined with corresponding market hurdles for products and services that do not meet sustainability requirements. Integration of these guidelines into the training of developers and designers.
4. State-organised databases for AI applications with high levels of protection for consumer data as well as product and infrastructure data of digitisation as a basis for R&D of sustainable digital applications and their market diffusion (= strategy for platform economy in the Federal Government and the Länder) as well as for monitoring developments in order to derive political measures.

**Research demand**

- How can SCP be embedded in a digital world, in particular with regard to products, services and infrastructures as well as companies and households, while considering social-ecological justice and balance?
- What role do lifestyles (cross-consumer fields) play in a digital world and future in relation to social-ecological situations of citizens that might be described, e.g., on the basis of a consumer panel?
- How can digital methodologies be utilized positively for solutions to sustainability problems?
- How can research on production and consumption be combined for more sustainable PSS and infrastructures as well as economic, consumer (including consumption fields), and environmental policies?

### 4.3.2 Consumption behaviour: nudging and its potential for promoting sustainable consumption

Research on behavioural economics and behavioural regulation has become increasingly important in the discussion about factors influence people’s consumption (Kahneman 2012; Kenning et al. 2014; Reisch and Sunstein 2016; UBA 2016a). The importance of behavioural change strategies is being recognised in politics and insights from behavioural sciences are being increasingly used in policymaking (d’Adda et al. 2017; Kenning et al. 2017; Lehner et al. 2016). New academic journals – such as *Journal of Behavioral and Experimental Economics; Review of Behavioural Economics*; *International Journal of Applied Behavioral Economics*, *Journal of Behavioural Economics for Policy* - are devoted entirely to this approach; as emphasized by UBA (2016a, p. 23). In the German context, several research projects in the energy sector have devoted themselves to the role of consumer information and advisory to consumers for achieving energy efficient or energy sufficient behaviour. It is unclear to what extent the insights gained on consumer-behavior can be transferred to the

broader context of sustainable consumption in other sectors but they are a potential starting point (Stieß and Kresse 2017).

In this context, there is also an increasing debate as to whether approaches such as nudging can help change consumption patterns towards more sustainability. This is linked to the challenge of making sustainable consumption as easy as possible, while changing day-to-day routines. Nudges fulfil this challenge because they are simple tools linked to the real decision-making of people with the potential of changing their everyday routines.

The concept of nudging assumes that the choice architecture can be used to alter people's behaviour (Thaler and Sunstein 2009; Sunstein 2014b, 2014a). Nudges are not laws or prohibitions, nor penalties (Sunstein 2014b). They are a kind of behavioural intervention that works through the design of decision-making situations and behavioural contexts (UBA 2016a, p. 20). Nudges are always context-dependent and case-specific. They can be adapted to other cultures or countries only with context-specific adaptation. According to some studies "green nudges" have a certain potential for reducing environmental impacts in the three environmentally critical areas of sustainable consumption: energy, food and transport (Lehner et al. 2016; Sunstein 2014a). Energy use in housing seems to be the domain with the highest proliferation of nudges compared to food and transport topics (Lehner et al. 2016, p. 175). The impact of nudging influences varies considerably across different studies (Hummel and Maedche 2019; Wilson et al. 2016; Benartzi et al. 2017). They are mostly limited to a certain context; many studies that want to find out the impact of nudging focus on health (Adam and Jensen 2016; Bucher et al. 2016). Many recent studies indicate limited influences of nudging (d'Adda et al. 2017; Esposito et al. 2017). However, nudging is very context-specific and the results of experiments in specific fields cannot be indiscriminately generalised to a different context (Lehner et al. 2016). There are also various examples showing positive effects of nudging. Nudges have a median impact of 21%, which depends on the category and context. Defaults are most effective strategies, pre-commitment strategies are least effective (Hummel and Maedche 2019).

The effectiveness of nudging is becoming increasingly important in the digital age due to more frequent decision-making in the virtual modern reality. Digital nudging is "the use of user-interface design elements to guide people's behaviour in digital choice environments" (Weinmann et al. 2016; Benz and Stryja 2018; Bertheim 2018; Stryja et al. 2017). According to scientific analysis, digital nudging is similarly effective and offers new perspectives of individualisation (Bertheim 2018; Hummel and Maedche 2019).

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy: "Choice architecture can be used to alter people's behaviour"

1. Integration of behavioural insights / nudging experience throughout the policymaking process (from idea generation to design, implementation and evaluation); testing of nudges in different areas of consumption policy (Lehner et al. 2016).
2. Establishing an independent consultancy company to conduct nudging experiments and support policy testing (starting within limited spatial boundaries, e.g., city districts). When learning from international good practices, it is necessary to carefully test their transferability to Germany.

3. Creating an experimental space (e.g. as part of a research program) for testing digital nudging[14] for changing behaviour connected to sustainable decisions; the result can be promising, for example in the field of electromobility (Benz and Stryja 2018).
4. Promotion of transdisciplinary projects for development of green nudges under the participation of communication designers. Designers can use their skills to specify complex solutions in real usage contexts, implement them prototypically as artefacts, validate and refine them.

**Research demand**

- How should digital nudges be designed so as to motivate users to make more sustainable decisions?
- What are the influencing factors for the effectiveness of different nudge treatments in the area of consumption?
- In which areas of consumption can nudges make a significant contribution? Which specific nudging strategy achieves the best cost-benefit ratio?

What are the effects of digital nudges especially using hardware, such as eye-tracking technology, virtual reality or neurophysiological measurements (Hummel and Maedche 2019).

### 4.3.3 SCP indicators

The data required to describe the consumption-relevant impacts on climate change and resource consumption are still scarce. Several studies (Wiedenhofer et al. 2017; Kalbar et al. 2016; Kalbar et al. 2018; Andersson and Nässén 2016; Schlosberg 2019; Liao et al. 2015; Buhl et al. 2018) (Salon et al. 2019) conducted socio-economic assessments and more differentiated assessments for the consumption fields – however, these studies are usually not representative for the various societal classes or milieus. Still, these kinds of studies are crucial to improving assessment methods and initiating the collection of data. There are, therefore, glaring gaps in the data still (Buhl et al. 2019; Laakso and Lettenmeier 2016), which urgently need to be closed in order to evaluate SDG 12. After all, the available studies show great potential for sustainable consumption, but also for avoiding rebound effects already during the development of products and services. In particular, the latter may be achieved by orientating towards recycling options (reverse thinking) and climate protection. However, as these are not yet included in the SDG 12 monitoring, they are not politically relevant either.

The indicators of the national sustainability strategy address the goals of the SDG 12 in different and sometimes very limited ways. For good reason, the report of the *Bertelsmann Stiftung* and *Sustainable Development Solutions Network* (Sachs et al. 2018) refer to the fact that the OECD countries in particular do not achieve any assessable progress here. They are far behind in reducing environmental and socio-economic spillover effects due to their intensive economic and consumption activities. There is no life-cycle-wide analysis of resource and energy consumption, nor is there a socio-economically differentiated analysis

[14] Nudges have to be designed as an intervention and offer with free decision possibilities (transformational objects, Laschke et al. 2014).

of people's socio-ecological situations (Büttgen et al. 2018). It is also necessary to monitor various sustainability indicators along the value chains. In target areas 12.2 and 12.3, for example, the consumption indicator NRW (Northrhine Westphalia is one of the German federal states or *Bundesländer*) already shows a higher possibility of differentiation into different consumption fields and product areas (Buhl et al. 2018), since it is based on the income and consumer sample. Overall, the consumption indicator NRW addresses fundamental target areas of the SDG 12, simply by being able to differentiate between the different consumption and product areas. It can serve as an information basis for households, lifestyles and companies and can be applied to them as well as to the state and federal levels. By linking it with socio-economic characteristics of consumption and the representation of total consumption, it is possible to identify problem shifts over time. It can also be coupled with an online survey (Buhl et al. 2018), which also dynamically identifies trends in society. This is currently not possible with the existing indicators targeting the federal level that have limited informative value and are not representative for everyday actions. They only collect specific information on socio-political key issues of sustainable consumption, such as the proportion of labelled products or total household energy consumption. Beyond measuring the carbon footprint, which currently is a popular indicator in societal discussions, the consumption indicator NRW uses the material footprint as an even more pre-emptive indicator (Wiesen et al. 2014; Schmidt-Bleek 1998; Liedtke et al. 2014).

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes** (based and summarized on Büttgen et al. (2018))

Core strategy: "Politics needs new complementary indicators supplemented by specific surveys to shape the area of sustainable consumption and production".

1. Creation of a set of indicators in accordance with SDG12 that can actually map the targeted goals at sufficient level of detail. Further develop the German SDG12 indicator set in this direction. The indicators should be relevant for public institutions/ policymakers, companies, and households/individuals. These stakeholders should further be able to use the data in order to operate and live more sustainably. The indicators must be socio-economic, spatial and differentiable for the areas of consumption in order to reflect rebound effects, problem shifts and socio-ecological situations.
2. Representative sample surveys on specific questions (concerning e.g. trends in mobility or social differentiation) and to supplement more extensive surveys (e.g. also as an online survey ressourcen-rechner.de) can help to reduce effort and costs and optimize information density over time.
3. Traceability, comprehensibility and transparency of the indicator methodology in order to build trust and relevance for action – reliable information for consumption should go beyond existing labels and enable comprehensible differentiation.

**Research demands**

- How can a measurement and evaluation system be developed to represent trends and developments in consumption in a socio-ecological way and guide action in politics, consumer and business decisions? How can the use of time, expenditure and environmental impacts of everyday life and research be combined?

- How can the evaluation methodology be standardised in such a way that ecological and social indicators can be linked over specific periods of time in order to be able to make reliable statements about problem and quality of life situations?
- How can a consumer panel for social-ecological research be set up and made available for research in the long term?
- How can an atlas (= monitoring) of good life be created (spatially and socially differentiated) that can serve as the basis for research on sustainable consumption as well as for real laboratory LivingLab research?
- How can digital possibilities gain a foothold in this research in order to achieve good and fast results and avoid duplication?

### 4.3.4 Lifestyles and consumption indicators

In the rich societies of the industrialized world, lifestyle groups have differentiated themselves, reflecting social context groups in the sense of modern democracies that reflect a similar value attitude towards society and the economy. In research, forms of consumption – more or less sustainable behaviour – are associated with life satisfaction or well-being (Guillen-Royo 2019; Dhandra 2019). In this context, differentiations to new consumption trends such as online shopping are also linked to various consumption fields (Guillen-Royo 2019). Constructs are developed on how to understand wellbeing, to link it to the dynamic development of lifestyles and link it to economic, technological and demographic conditions and dynamics (Guillen-Royo 2019; Brown and Vergragt 2016).

Relatively uniform product/service systems can be developed for different lifestyle groups/types whose demand is relevant for climate protection and social balance. Research is also dealing with information management for consumers (Longo et al. 2019), the potentials and limits for a shift towards more sustainable consumption, in which leapfrogging is combined with a system-thinking approach (Schroeder and Anantharaman 2017). In some cases, particular focus is placed on groups that have been characterised as open to sustainable consumption, such as forest rangers or voluntary simplifiers, i.e., people who voluntarily simplify their lifestyles by adopting sufficiency-orientated behaviour (Gubíniova et al. 2017; Häyrinen et al. 2016; Peyer et al. 2017). The research addresses many areas of consumption such as smartphone use (Haucke 2018), being mobile (Anantharaman 2017), washing (Retamal and Schandl 2018), clothing (Nerurkar 2016), drinking (water) (van der Linden 2015), food/typologies (Thøgersen 2017; Oroian et al. 2017; Sassatelli 2015; Pfeiffer et al. 2017; Lo et al. 2017; Niamir-Fuller 2016; van Huy et al. 2019; Carley and Yahng 2018), waste management (Liao et al. 2015; Pandey et al. 2018). One focus of research is on nutrition, but – as mentioned – other consumer fields are also represented in lifestyle research.

In few approaches, social justice between high-income and low-income households also plays a role (Anantharaman 2017; Retamal and Schandl 2018; Lettenmeier et al. 2012; Malier 2019) as well as gender aspects (increasing workload for women (Wang 2016)). In terms of lifestyle, research on education works with students as a target group (Salo et al. 2019; Sippel et al. 2018), but also with families with children (Hadjichambis et al. 2015). An initial positive example of research in Germany in this direction is a project studying consumption practices of groups such as youth, migrants, or low-income households and their possibilities to access options of sustainable consumption conducted at the Institute for Social-Ecological Research (ISOE) from 2017 to 2020. Another approach for beginning to

link ecological and socio-economic data was a regional project in the state of Northrhine Westphalia calculating footprints of different types of households (Buhl et al. 2018; Büttgen et al. 2018).

With regard to urban consumption, there are numerous research approaches that concern norms, behaviour and lifestyle types (e.g. also LOHAS), (Vergragt et al. 2016; Choi and Feinberg 2018; Millward-Hopkins et al. 2017; Schröder et al. 2019); the research is less concerned with urban carbon and resource management in connection with lifestyle approaches (Millward-Hopkins et al. 2017; Laakso and Lettenmeier 2016; Greiff et al. 2017). Research fields such as spatial dynamics of change between regions, metropolises and neighbourhoods are also rare in lifestyle research (Lou et al. 2015; Lo 2016), as are lifestyle research in connection with technological development (Welch and Southerton 2019), sociotechnical change (Signori and Forno 2019), circular economy/sharing economy (Hobson and Lynch 2016), business models (Melkonyan and Krumme 2019) or mismatch between demand and supply of sustainable products (Shibin et al. 2016).

Research is more concerned with the gap between knowledge and action that has been described for decades and the solution strategy for this (Cohen et al. 2018; Maxwell-Smith et al. 2018; Geiger et al. 2017; Jackson and Smith 2018). Digitisation as a whole (there are some first works: (Santarius 2015)) is hardly addressed, but it is addressed in individual consumer fields (Haucke 2018; Erdmann et al. 2018; Welfens et al. 2016). In the field of media and communication research, there is work on narration approaches e.g. about stars or specific lifestyle groups, ethically based communication, marketing approaches (Lewis and Huber 2015; Chekima et al. 2016; Pelikán et al. 2017; Tölkes and Butzmann 2018; Liu et al. 2018).

Research on political science analyses and approaches is concerned with the relationship between changes in the economy and carbon footprints, energy biographies and social systems, the linking of technology, value change, consumer behaviour and degrowth, the moral consideration of poor households in society in the climate change process and the twin role of citizens and consumers (Liobikienė and Dagiliūtė 2016; Shirani et al. 2015; Haucke 2018; Tripathi and Singh 2016; Malier 2019).

The methods described in the papers are more classical in nature: social empirical methods, surveys, questionnaires, interviews (Dhandra 2019; Thongplew and Kotlakome 2019; Häyrinen et al. 2016), co-creation, personas (Onel et al. 2018), participatory visioning processes, back-casting methods (Schröder et al. 2019), or scenarios (ibidem). Less frequently mentioned are ethnographic studies (Malier 2019; Rapp et al. 2017), agent-based modelling (Allen et al. 2019), supply chain management (Melkonyan and Krumme 2019), LCA and online footprint calculators (Kalbar et al. 2018; Millward-Hopkins et al. 2017; Schlosberg 2019; Salo et al. 2019; Buhl et al. 2018; Sippel et al. 2018), input-output analysis (Liao et al. 2015), or descriptive and inferential statistics (Buhl et al. 2018; Oroian et al. 2017; Kalbar et al. 2016).

The linking of ecological and social lifestyle data with research on behavioural change towards sustainable consumption is almost non-existent. In strongly social and political science driven studies, in particular, there is almost no reflection of the effects on ecology and climate – rebound research e.g. on the ecological effects of sharing models or repair as well as their social structure (inclusion/exclusion of social groups) seems to be hardly known, although initial publications as well as funding are available. These seldom mention the keyword lifestyle as a topic and thus cannot always be related to each other. Recycling issues in sustainable consumption are also approached less systematically, as is the

necessary link to product-service design (product/communication design), in which changes in attitude would have to materialise.

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy: “Sustainable lifestyles have to be enabled – position Germany as pioneer in fulfilling SDG12 targets“

1. Initiation of a lifestyle or consumer panel in Germany (possible result: interactive, dynamic “Sustainable Lifestyle Atlas” with socio-economic and spatial differentiations and applications for research and consumer practice) as a contribution to the fulfilment of SDG 12 as well as a broad discussion about the related social-ecological situations of different social groups (e.g. energy poverty versus richness and related carbon footprints or digital divide between young and old, or poor and rich social groups etc.). Founding of a (new) Ministry of Good Living with focus on welfare of society and social-ecological justice.
2. Linking industry and consumption 4.0 in the relevant fields of consumption under the perspective of sustainable value chain management and circular economy design/product service design and digitalisation.
3. Detailed screening of the state of lifestyle research (topics and analogue/digital canon of methods) and related research fields focusing on sustainable production and consumption to develop a research agenda for diverse climate-friendly and low-resource lifestyles
4. Incentivisation of sustainable products, services, business models in the market (policy mix of economic, social and institutional instruments)
5. Interactive, dynamic “Sustainable Lifestyle Atlas” with socio-economic and spatial differentiations and applications for research and consumer practice)

**Research demand**

- How can lifestyle research be structured for establishing an integrated view on consumer fields as well as for recognizing synergies and problem shifts?
- How can sustainable design support sustainable lifestyles?
- What are suitable monitoring and indicator systems for assessing the implementation of SDG 12?
- How can a growing database for sustainable consumption/SDG 12 be established?
- How can a living lab innovation infrastructure be established for developing and implementing sustainable product service systems for the local and global market?

### 4.3.5 Experimentation: real world-labs and living labs

Experimentation is an important method to understand and encourage transformation towards sustainable consumption and production (BMU 2016b; Caniglia et al. 2017; INNOLAB 2017; Liedtke et al. 2012; Luederitz et al. 2017; Loorbach 2007; Singer-Brodowski et al. 2018). Recently, experimentation has been widely used to explore and exploit the potential of social innovation in so called real-world laboratories (RWL) seen as “... a societal context in which researchers carry out interventions in the sense of “real experiments” in order to learn about social dynamics and processes” (Schneidewind 2014; Engels and Walz

2018; Engels and Rogge 2018; Jahn and Keil 2016; Grunwald 2016; Schäpke et al. 2018; Schneidewind et al. 2018; Wagner and Ertner 2016) and living labs (LL) – socio-technical innovation infrastructures for the development of new products, services, product-service systems and business models (Baedeker et al. 2017; Liedtke et al. 2015; Erdmann et al. 2018; Bódi et al. 2015).

The border/demarcation between real-world labs and living labs is not sharp; both are "socio-technical hybrids" in which the processes of co-creation future production and consumption patterns will be developed.

**RWL: Example of real-world laboratories in an urban context**

Interactive socio-technical innovation processes take place gradually in users' real-life surroundings (Liedtke et al. 2015; Laakso and Lettenmeier 2016; Greiff et al. 2017; Teubler et al. 2018). This is particularly important in relation to urban lifestyles in the context of progressive urbanization. The latest research emphasizes the importance of cities in transition towards sustainability (Kraas et al. 2016; Wolfram et al.; Schäpke et al. 2017)(WBGU 2016; Wolfram et al. 2016; Schäpke et al. 2017). The WBGU's report (2016) shows that there are no universal templates for the transformation towards sustainability in the highly diverse urban societies. For this reason, the research in urban real-world laboratories, including the living lab approach, has attracted attention in German and European science. This is reflected in a long series of publications (Beecroft and Parodi 2016; Bernert et al. 2016; Heiskanen et al. 2018; Rhodius et al. 2016; Rogga et al. 2018; Marquardt and West 2016; Parodi et al. 2018). Empirical findings from different urban real-world laboratories confirm that this kind of experimentation generates new knowledge and validates tested solutions to transform urban and global consumption towards sustainability (EC 2018; Wirth et al. 2019; Evans et al. 2018; Steen and van Bueren 2017).

**LL: Living labs**

The living-labs infrastructures allow the development of prototypes and service concepts in real living and working environments together with users (Baedeker et al. 2017; Keyson et al. 2017; Liedtke et al. 2012; INNOLAB 2017). According to the European Network of Living Labs (EnoLL) (Ruijsink and Smith 2016) five key elements should be present in a living lab: 1) active user involvement; 2) real-life setting; 3) multi-stakeholder participation; 4) a multi-method approach; and 5) co-creation. Understanding daily living at home is key to designing products and services that support households in their transition to more sustainable lifestyles. Lab users explore new ways of gaining insights into daily practices, but also discusses developing and testing design methods to create sustainable solutions for households (Keyson et al. 2017; Wirth et al. 2019; Voytenko et al. 2016). The German innovation infrastructure comprises more than 100 living labs, with more than 50 in the fields of housing, shopping and mobility, and a growing number of testbeds in Industry 4.0. This offers considerable potential for sustainable-consumption research. The EnoLL is the international federation of benchmarked living labs in Europe and worldwide. It aims to support co-creative, human-centric and user-driven research, development and innovation.

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy: “User integration is the best way for designing and implementing transition pathways”

1. Develop an accelerator mechanism: Establish a German network of regional LivingLab centres to push smart, sustainable products and services – implementing sustainable product service systems, e.g. bike or ride sharing services or assistance and feedback devices in the field of living, mobility and shopping (Erdmann et al. 2018).
2. Expand SME support programs for small-volume funding with non-bureaucratic procedures (e.g. “Fast Track to Experimentation”) for start-ups and SMEs to support creative stages of development and experimentation.
3. Systematic approaches, methods and incentives for the mobilization and integration of people/households in urban districts and rural areas for transformation research are needed. The strategies and funding programmes on urban labs and citizen science at the regional, national and EU level should be adapted to use synergy effects. (see more: *https://manifestoforinnovationineurope.org*)
4. The establishment of integrated data and knowledge platforms for knowledge transfer on smart living and smart cities (AR augmented reality (AR)/virtual reality (VR) and artificial intelligence (AI)-Approaches) for more effective innovation processes regarding future-oriented technologies and for education reasons.

**Research demand**

- What are the abilities and limitations of RWL and LL as an instrument for the transition of urban lifestyles towards sustainability?
- What kind of urban labs are needed for what kind of research questions/transformation research?
- What are the long term effects of RWL/LL on sustainability transitions?
- How can be the role of urban labs in governing urban sustainability transitions “beyond experiments“?
- How can people/households in city districts be mobilized and integrated in the development of urban transformation processes towards sustainability?

### 4.3.6 Collaborative economy

Going through global crises (financial crisis, violation of ecological planetary boundaries, etc.) and transitions (climate change, socio-technical transitions, e.g., energy transitions, etc.) various practices associated with a collaborative economy are discussed and are tried out in the market (Gruszka 2017). The notion itself describes different routines, which are for example named “sharing economy”, “peer-to-peer economy” and “demand economy”, showing that its definition and outline is still under development (EC 2016a). However, the term “collaborative economy” suitably matches collaborativity – meant as direct or indirect exchange of consumers − and economy and combined with the sharing economy expression. Overall it is an attempt to describe an entirely new type of economy (Kostakis and Bauwens 2014).

In the literature, the shared understanding of its outline encompasses peer-to-peer activities for instance sharing, swapping, trading, or renting products and services matched by online services which provide access to enable the exchange and usage (Lyons and Wearing 2015;

Botsman 2013). The key principal is receiving access to goods and services through paying for the experience of temporarily using them, with no intention of changing the ownership (Bardhi and Eckhardt 2012).

A great variety of sectors are already captured by collaborative economy practices and the usage is fast spreading across Europe and beyond. In society many people have already tried out or know of collaborative economy services like sharing apartments (e.g. Airbnb) and car sharing service (EC 2016b). The European Commission defined three different categories of actors within the collaborative economy:

(i) service providers (private individuals or professionals) who share assets, resources, time and/or skills occasionaly or consistently;
(ii) users of these services; and
(iii) (iii) intermediaries that provide access for example through an online platform and facilitate the transactions between providers and users. Transactions can be carried out on a profit or non- profit basis.

The collaborative economy offers diverse opportunities for citizens and entrepreneurs leading to the idealistic vision of a so-called 'collaborative society'. These new and strongly increasing activities have also led to tensions and conflicts between the new service providers and those already existing on the market. Regarding its exponential growth the EU estimated the gross revenue to be 28 billion Euros in 2015 (Vaughan and Daverio 2016). In five key sectors (short-term letting, passenger transport, household services, professional and technical services, collaborative finance) the revenues almost doubled compared with the previous year. The development seems to further continue offering high potentials for new businesses in these fast growing markets. Also the interest of consumers − as prospective costumers − is quite strong regarding a recent public consultation and a Eurobarometer poll (EC 2016b)

Being a flourishing and rapid growing business, the activities within the collaborative economy challenge industries and governments as the regulation cannot keep up and traditional regulatory mechanisms still being in place (Lyons and Wearing 2015). Overall, the findings show that the collaborative economy is going to change the way of living fundamentally and indicates a deep socio-economic drift (Vaughan and Daverio 2016). It will transform the ways in which transactions and marketplaces are set (Sigala 2017): From freelancing platforms, which alter the way we work, to food-sharing platforms, or energy cooperatives (Stieß and Kresse 2017), shifting the ways we share and connect in our local communities, leading to novel forms of economic and social interactions. Furthermore it could support individual citizens to offer services leading to new employment opportunities and sources of income as well as flexible working conditions. For consumers, the collaborative economy could for example provide benefits like an extended supply or lower prices. Asset-sharing and the efficient use of resources are also encouraged. However, to reach a *sustainable* collaborative economy it should be evaluated and monitored with suitable sustainability indicators. The risk of rebound effects must also be considered and controlled.

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy**:** Using collaborative economy potentials for economic transformation towards sustainability

1. New and innovative *sustainable* services and the temporary use of assets should be supported, accompanied by the development of adequate consumer protection, e.g. warranting fair working conditions and tax compliance. Any approach has to be evaluated and monitored via sustainability indicators. The risk of rebound effects must also be considered and controlled.
2. The development of the collaborative economy should continuously be reviewed by mapping regulatory developments, collecting statistical data and evidence, engaging in stakeholder dialogue and fostering the exchange of best practices.
3. The current degree of regulatory fragmentation should be decreased because the benefits of harmonized regulations, in terms of reducing costs and uncertainty, are clearly seen.
4. Nevertheless, the significant differences in local environments should also be taken into account by making the process a joint effort between the e.g. European Commission and national/local authorities.
5. Market access requirements should be simplified and modernised with the aim to avoid unnecessary regulatory requirements.

**Research demand**

- How does the collaborative economy satisfy the personal values, which are associated with sustainability and a sustainable lifestyle?
- What are the main motivations for choosing collaborative economy services?
- Which national difference exists and how does cultural diversity affect the choice of collaborative economy services?
- How can local approaches, e.g. at the municipal level, help to governance the development, particularly in a multi-stakeholder setting?

### 4.3.7 Design for circular economy

The ideal of a circular economy (CE) can be a guiding principle for developing a sustainable, resource-light, closed-loop economy that accounts for the technical and social aspects along product life cycle phases, from resource extraction, to production and use, to recycling (Kalmykova et al. 2018; Schroeder et al. 2019). Achieving a CE would directly contribute to SDG12 and other SDGs as well as to the goals of the European Commission, e.g., by increasing resource efficiency or product life-cycles, reducing waste, or promoting moderate and socially responsible consumption (Liedtke 2018).

To establish sustainable consumption patterns and systems that support such patterns, we need not only technological advancements (e.g. in the recycling sector), but also inter-organisational and inter-governmental cooperation to create manageable regional and global material cycles under a consolidated regulation scheme (Genovese et al. 2017; Hobson et al. 2018; Young et al. 2010; Korhonen et al. 2018). The responsibility for and ownership of materials is dispersed across value chains, from producers over consumers to recyclers, which complicates management and development of responsible material use (Korhonen et al. 2018).

With respect to the type of products required to establish sustainable consumption patterns, a product design for circularity is crucial. This includes that products communicate circularity to the consumers as well as stakeholders along the value chain. This requires re-thinking and restructuring the education of designers and engineers towards understanding product

design as a large-scale socio-technical challenge that switches from insular to systemic design and from technological to human design (los Rios and Charnley 2017; Ceschin and Gaziulusoy 2016). The business models to be established and connected with the design process will, in particular, increase value by services during the use phase and in the end-of-life phase (los Rios and Charnley 2017). Designing this kind of sustainable product system is possible using corresponding design guides (Liedtke et al. 2013) or methodologies for user-integrated sustainability innovations (Liedtke et al. 2015).

While pro-actively designing and manufacturing circular products contributes to the circular economy, at the same time, the communication of product properties and the sustainability of products via product labels are crucial to informed consumer decisions (KRU 2017). Product information is a decisive factor in distinguishing between non- or less sustainable products and sustainable products and increasing the market share of the latter (ibidem).

With respect to the use phase, national statistics typically distinguish between primary and recycling material flows, however, usually there are no separate categories that allow to analyse and steer reuse, repair, or remanufacturing, or refurbishment (Korhonen et al. 2018). In terms of consumers attitude towards products that are not new, one important aspect is the perception and understanding of what is waste, recycled materials, or refurbished products and the value associated with it (Hobson et al. 2018; Vehmas et al. 2018; Korhonen et al. 2018). Regarding repair services in particular, in Western Europe, one barrier is the high cost of labour (CRR 2013). However, e.g., in the field of comparably high-priced smartphones, repair is a viable business model for small shops (Riisgaard et al. 2016). Hence, the interaction between market design, taxation, and value of primary products clearly has an impact on possibilities to extend product lifetime by reverse engineering approaches (Genovese et al. 2017).

Considering the end of product life, the same considerations regarding the communication strategies apply for increasing the collection and separation rate. Beyond this consumer related challenge, another is the recoverability of materials. Due to the increasing extraction of metals, the diversity of metals used in (electronic) products, and the diversity and number of miniaturised electronic products, it is crucial to consider the criticality or recoverability of metals (Reuter 2016; Zepf et al. 2014). Modular designs of mobile phones, for example, can increase the rate of metals recovered in recycling processes. However, it is still unclear how to find the best ensure modular design that is economically feasible, functionally reasonable, robust, and consumer-friendly (Reuter et al. 2018). Designing recyclable and resource-efficient electronic products is a complex task that might not be solvable without the use of computer-aided simulation and design tools (Reuter et al. 2018). Given the material inventory of products, simulation tools might further serve as the basis for developing a recyclability index that could extend recent efforts in eco design labelling with regard to recoverability of materials (Reuter 2016; Reuter et al. 2018).

It has been shown that following the circular economy concept can support various SDGs, especially targets 6, 7, 8, 12, and 15 (Schroeder et al. 2019). However, trade-offs with targets related to health and well-being (target 3.9 and 8.8) need to be considered (Schroeder et al. 2019). Furthermore, introducing the circular economy in free markets governed by the paradigm of profit maximization may also lead to rebound effects (Zink and Geyer 2017). For instance, the so-called income effect could lead to the emergence of secondary markets for cheaper recycled products in addition to primary markets instead of replacing them (ibidem). The substitution effect could result in an increase of the number of products produced due to cheaper production based on secondary material (ibidem).

Therefore, introduction of the circular economy concept requires conscious and forward-looking considerations.

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy: "A material and product data base enables an efficient circular economy"

1. Monitoring of central circularity indicators (KRU 2017) is necessary and has to be connected to an integrated indicator set for dynamically monitoring and managing SDG12 (focus on SCP) – without systemic integration, the 1.5° lifestyles will not be achieved.
2. Substitution rates of primary materials (KRU 2019) should be measured and an extended material and product responsibility across value chains should be supported. Tax exemptions might be granted for companies active in reverse engineering.
3. To inform rational decision-making at the national level, establish a consolidated material and product database including environmental, economic, and social information across value chains (e.g. widening such activities like materialarchiv.ch in a more for assessment AI-directed and dynamic user/target-group friendly way)
4. Support education programs with technical and social aspects for designers and engineers that aim at establishing sustainable, resource-light, circular material flows and measure their implementation.

**Research demand**

- How can product systems be digitalised for using computer-aided simulation and assessment tools, potentially using artificial intelligence, that allow designing sustainable resource-efficient products and services?
- What are suitable communication strategies that increase the acceptance of refurbished products / recycled materials or alternative use concepts?
- What are feasible cross-sectoral business models on the basis of open material networks that interconnect stakeholders based on a material flows?

### 4.3.8 Time welfare in the context of digitalisation

The discussions about the role of time use/time budgets are manifold and are spread across various political and social areas. In Germany, the debate at federal level and, in most cases, local level, has concentrated on family-time policy (Tappeser et al. 2016). Currently, the efficient and productive use of time is becoming increasingly relevant in the context of transformation towards sustainability (Buhl et al. 2017; Reisch 2015; Rosa et al. 2013). This topic is discussed from three different perspectives: (1) connection between time use and welfare/standard of living; (2) link between time budgets and resource consumption or environmental impact; (3) influence of digitisation on the world we live in and, consequently, on time budgets.

The issue of time use in connection with the discussion on "well-being", "happiness" and "prosperity" is discussed at the international level (United Nations, OECD) as well at the national level. The Gross National Happiness (GNH) index developed in Buthan includes the

use of time under nine domains of progress (Global Council for Happiness and Wellbeing 2019). In Germany and other European countries, the questions of time use in connection with living standards/welfare is increasingly discussed at the political level and in science (Deutscher Bundestag 2013; Dolan et al. 2017; Reisch and Bietz 2014; Rosa et al. 2013). The data on the use of time in private households are also collected regularly by the Statistical Office (Statistisches Bundesamt 2015). In the ecologically oriented sustainability discourse, time welfare is to be seen less as the goal of a good life than as a means of removing ecological pressure from the consumption and production system. Reisch and Bietz (2014) see time prosperity as an “attractive narrative” that could motivate people to adopt “resource light” lifestyles.

The dynamically advancing digitalisation influences individual time budgets: more and more people communicate via and shop on the Internet. Using the digital communication technologies has become part of millions of people’s daily lives in Germany and worldwide (Digitalisation Think Lab et al. 2014). In 2018, German Internet users spent an average of 196 minutes online per day, an increase of 47 minutes compared to the previous year (Statistisches Bundesamt 2018). The digital share of private communication is 37%, the digital share of business communication is 35%. It influences peoples’ behaviour: people search in the Internet for information about products and services, purchase them and communicate with others about their experiences (Cao et al. 2014; Stephen 2016). This trend towards more digital lifestyles changes time budgets of people and influences energy and resource use. In 2018, 36% of e-buyers made purchases from sellers in other EU countries, compared with 26% in 2013 (Eurostat 2018).

Research on sustainable consumption must therefore focus more on time, its use in connection with digitalisation and environmental impact of lifestyles in different social milieus. This would be a basis for an evidence-based time policy (Buhl et al. 2017; Reisch and Bietz 2014). The connection between time use, digitalisation and environmental impact of different time budgets is not reflected in the German Sustainable Development Strategy and in the National Programme on Sustainable Consumption.

**Policy recommendations for advancing the German Sustainable Development Strategy, the National Programme for Sustainable Consumption, and subordinate programmes**

Core strategy: “Time welfare” as an important element of “good living” should be taken into account in policymaking.

1. Development of an indicator “available time” - as an indicator of “quality of life” and its integration in the German Sustainable Development Strategy (Reisch and Bietz 2014; Buhl et al. 2017) and generating an empirical basis for evidence-based time policies as part of environmental and social policy in the most relevant areas of sustainable consumption.
2. Research on the relationships between time budgets of different social milieus and progressive digitalisation should be supported. That would allow a tailor-made consumption policy for different target groups. In addition, environmental impacts of digitalisation could be better assessed.
3. Political and sub-political actors at different governance levels should introduce time-policy approaches as cross-cutting issues in the relevant sectorial policies – family, health, consumer, nutrition, environmental, educational, technological, transport, urban and labour market policy; and develop appropriate time-policy strategies and instruments (Reisch and Bietz 2014).
4. A transformatively oriented research programme would be useful for testing and

evaluation of time policies (Tappeser et al. 2016).

**Research demand**

- What kind of resource is connected with social practices in everyday life in Germany and how is it changing households' time budgets and the long run environmental quality of lifestyles? (Sustainability assessment of the use of time)
- How can the use of time and resource policy incentive systems be integrated in a way that is geared towards a better quality of life and resource conservation?
- Which product service systems and business models for resource-light digital lifestyles need to be redesigned and how?
- How can education help to understand and communicate the connections between resource consumption and time budgets?

# 5 Final conclusions

Within this study, six key areas of sustainable consumption have been identified and recent developments within these fields on policy level, as well as important stakeholders etc. have been described. The quality and quantity of activities in the various fields differ: For instance, numerous concrete steps have been taken in the textile sector whereas there are only few political or business activities addressing the consumption of meat and dairy products. Besides the assessment of recent policy initiatives, key cross-cutting areas emerging from the scientific discourse have been identified. Even though those two strands (policy and science) have been investigated separately within different chapters, they are closely interlinked.

Research generates knowledge needed for sustainability transitions – also with regard to the six key areas identified above. For instance, insights from behavioural economics (chapter 4.3.2) can be applied to achieve more sustainability with regard to the key area “use of private cars”: Nudges can be used to motivate consumers to use public transport (e.g. by personal travel maps). Collaborative approaches (see chapter 4.3.6) may contribute to more sustainability within the key area “heating of private space”. For instance, district heating solutions or shared heating units (including, e.g., solar heating with seasonal storage) bare high efficiency and cost-saving potentials. Shared community space (kitchen etc.) has the potential to reduce individual living space and can increase energy efficiency. The success of these approaches can significantly be increased and steered by adopting a differentiated perspective on life-styles and using a broad set of SCP indicators accordingly (chapter 4.3.3 and 4.3.4). Applying the “living lab”-concept (chapter 4.3.5) with regards to the key area “consumption of electronic devices” education on sustainable use of ICT and motivation to recycle can be tested. In this context, the ideal of a circular economy (chapter 4.3.7) can be a helpful guiding principle to motivate action by inviting, e.g., consumers to be part of the “design for recycling” process. Finally, time welfare might be a fresh perspective on the benefits that consumers can potentially gain from ICT and digital applications with regard to the quality of life (chapter 4.3.8). More examples of this policy-science interrelation can be found in the following subchapter 5.1.

To improve Sustainable Consumption and Production (SCP) in the context of the German Sustainable Development Strategy, it is important to strengthen the link between science and policy and associated stakeholders, e.g., by trans-disciplinary approaches with proper knowledge transfer (especially from science to policy), for generating fruitful synergies and to trigger innovations. Thus, the policy recommendations distilled from the analysis above − which can be found in chapter 5.2 − include among others measures to promote such trans-disciplinary approaches.

## 5.1 Crosscutting approaches

As described above, science and policy are closely interlinked. The research approaches investigated in chapter 4 may provide solutions for a transformation in key areas as presented in chapter 3. It should be mentioned here, that science and policy influence each other vice versa. The tables 3-8 provide some first examples of how the different strands can be matched. (They should be elaborated further and with more detailed in the future.)

**Table 2: Matching key areas of consumption with cross-cutting areas – Mobility**

| Sector | Cross-cutting area | Connection |
|---|---|---|
| **Mobility**<br>*Shift of motorised individual transport to public transport, bicycle, etc.*<br>  | **Digitalisation** | Digital nudges (web-based decision support system) motivates consumer to test electric cars. Apps allowing ticket purchase and displaying travel connections in real time make use of public transport options more attractive. |
| | **Nudging/ Consumption behaviour** | Nudging (information, personal travel maps and changing framing) motivates to using public transport or cycling and walking. |
| | **Indicators /Monitoring** | Creation of indicators on sustainable/ vs. non-sustainable mobility in accordance with SDG 12 can help to transfer sustainable mobility patterns. |
| | **Lifestyles** | Linking the discussion on mobility with the discussion about sustainable lifestyles brings new insights for consumer and for politics. |
| | **Real world labs (RWL) and living labs (LL)** | RWL: Sustainable Mobility Labs develop and operationalize sustainability initiatives in urban and rural areas. |
| | **Collaboration/ Sharing** | Sharing concept in the area of mobility (e.g. bike sharing) help to reduce motorised individual transport. |
| | **Design for** | Vehicles can be designed for repair, recycling, upgradability, increased product life-time and use intensity; use of inseparable compounds / rare earth elements might be |

| | | |
|---|---|---|
| | **Circular Economy** | avoided. |
| | **Time welfare/ digitalisation** | "Slow mobility" concepts promote sustainable mobility patterns (reducing of environmental impact through using of public transport, bikes). |

**Table 3: Matching key areas of consumption with cross-cutting areas – Food**

| Sector | Cross-cutting area | Connection |
|---|---|---|
| **Food**<br>*Reducing consumption of meat and dairy products, and food waste*<br>  | **Digitalisation** | Consumer apps providing product information; tracking the value chain / food safety and information are the modern tools for encouraging sustainable nutrition. |
| | **Nudging/ Consumption behavior** | Nudges (design, labeling, display of food) can be efficient measures for motivating restaurant guests to choose sustainable vegetarian diets. |
| | **Indicators /Monitoring** | Indicators on food waste or types of diets in different households and the associated material and carbon footprints for supporting consumer's decision-making towards sustainable nutrition patterns. |
| | **Lifestyles** | Communication and transfer of sustainable nutrition patterns (vegetarian diets based on regional food) also in social media - as important measure for reduction of meat consumption. |
| | **Real world labs (RWL) and living labs (LL)** | Sustainable Food Labs - dissemination of knowledge through education and communication of sustainable nutrition patterns and development of business models for e.g. start-ups in the area sustainable nutrition. |

| | | |
|---|---|---|
| | **Collaboration/ Sharing** | Food sharing of leftovers enables reduction of food waste. Sharing models entire animals before slaughter increase awareness of value of meat and avoid waste or over-consumption (e.g.. Kaufnekuh.de ) |
| | **Design for Circular Economy** | Environmental benefits may stem from reducing food waste by planning food demand in advance; designing and using recyclable / reusable packaging, or awareness for circular flows of fertilizer materials |
| | **Time welfare/ digitalisation** | Promotion of "slow food" movement leads to regional consumption (less energy and resource intensive). |

**Table 4: Matching key areas of consumption with cross-cutting areas – Home/Heating**

| Sector | Cross-cutting area | Connection |
|---|---|---|
| **Home/Heating**<br>*Heating of private space and size of living space* | **Digitalisation** | Establishing smart energy systems that connect households and their heating units (e.g., heat pumps) with the energy infrastructure can optimize/reduce energy consumption. Using smart systems to increase transparency of energy use influence consumer behavior. |
| | **Nudging/ Consumption behaviour** | Prompts as reminders of appropriate behaviour can be effective: e.g. the room climate assistant PIAF (see more: https://wupperinst.org/a/wi/a/s/ad/4629/) encourages users to behave more energy efficient.<br>Opt-out green electricity offers (changes default option) are a good alternative for sustainable solution. Initiation of peer comparisons between similar households can lead to behaviour change. |
| | **Indicators/ Monitoring** | Monitoring heating energy consumption in different types of households and used living area inform about prevalent lifestyles and potential energy poverty or unequal taxation |

| | | |
|---|---|---|
|  | **Lifestyles** | Education of consumers regarding heating behaviour and the use of passive technologies supports saving of energy. |
| | **Real world labs (RWL) and living labs (LL)** | RWL: co-creation projects with users for reduction of residential energy use.<br>LL: prototypes and experiments for sustainable heating systems |
| | **Collaboration/ Sharing** | Collaborative approaches for local district heating solutions or shared heating units (including, e.g., solar heating with seasonal storage) bare high efficiency and cost-saving potentials. Share community space (kitchen etc.) with more people and reduce individual living space can increase energy efficiency. |
| | **Design for Circular Economy** | Heating systems can be designed for easy repair, further an integrated perspective on using insulation materials regarding their end of life may avoid critical waste streams. Using natural insulation materials is advantageous in that respect |
| | **Time welfare/ digitalisation** | Smart heating systems (intelligent networking of heating systems controlled by smartphone) save energy and time. |

**Table 5: Matching key areas of consumption with cross-cutting areas – Workplace and Office**

| Sector | Cross-cutting area | Connection |
|---|---|---|
| **Workplace and Office**<br>*Purchase/use of consumer electronic devices* | **Digitalisation** | Apps for more sustainable use of ICT can help to save energy and resources. |
| | **Nudging/ Consumption** | Physical setup of the recycling system (nudges) influences success of recycling efforts. Information on collection points for electronic equipment or collection activities at the |

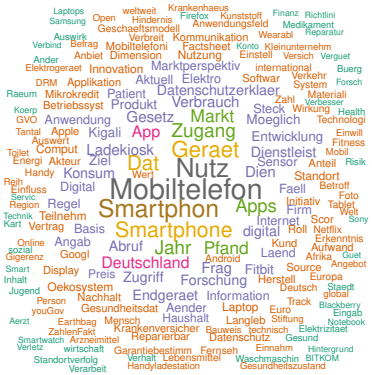
| | | |
|---|---|---|
|  | **behavior** | work place facilitate return rates and securing raw materials. |
| | **Indicators /Monitoring** | Monitoring product life times, repair & recycling rates, and the use of substitution materials supports a better management of metals |
| | **Lifestyles** | Longer use of electronic devices, fair products (such as Fairphone or Shiftphone) are elements of sustainable use of ICT |
| | **Real world labs (RWL) and living labs (LL)** | RWL: education on sustainable use of ICT and motivation to recycling.<br>LL: development of new, more sustainable models/prototypes of ICT-devices |
| | **Collaboration/ Sharing** | Co-working offices help more sustainable (joint) use of electronic devices. |
| | **Design for Circular Economy** | Modular design optimized use of metals and increasing awareness for their criticality while offering take-back-offers may increase recyclability / recycling rates. |
| | **Time welfare/ digitalisation** | Applications that limit the time use of electronic devices. |

**Table 6: Matching key areas of consumption with cross-cutting areas - Clothing**

| Sector | Cross-cutting area | Connection |
|---|---|---|
| **Clothing** | **Digitalisation** | New business models in area fashion rental economy as rent clothing and shoes with the app (e.g. Tulerie, US). These models are economically successful, helping to save |

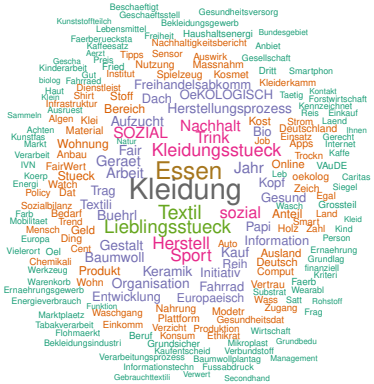
| | | |
|---|---|---|
| *Consumption of clothing, footwear and textiles*  | | energy and resources. |
| | **Nudging/ Consumption behavior** | Using nudges for supporting sustainable clothing shopping behaviour towards sustainable (slow) fashion. |
| | **Indicators /Monitoring** | Monitoring / highlighting environmental footprints of clothing may support consumer decisions; measuring repair, reuse and recycling or disposal rates can raise awareness for extending product life time |
| | **Lifestyles** | New trends of slow fashion and rental clothing are spread through social media and communities. |
| | **Real world labs (RWL) and living labs (LL)** | RWL: developing and supporting of sharing initiatives in urban and rural areas, education. |
| | **Collaboration/ Sharing** | Many sharing concepts, especially concept of renting of clothes and shoes or clothes swap parties are promising. |
| | **Design for Circular Economy** | Using recyclable materials or supporting development of recycling technologies (e.g., chemical recycling) may reduce material use; reducing taxation on labour may support increased repair rates |
| | **Time welfare/ digitalisation** | More time welfare can support slow fashion sustainable production and use of clothes. |

**Table 7: Matching key areas of consumption with cross-cutting areas – Leisure and Tourism**

| Sector | Cross-cutting area | Connection |
|---|---|---|
| **Leisure and Tourism**<br>*Travel by Air*<br>  | **Digitalisation** | Augmented Reality (AR) in tourism – simulation experience as alternative for traveling/flying. |
| | **Nudging/ Consumption behavior** | Using nudges for supporting sustainable (slow) tourism without flying. |
| | **Indicators /Monitoring** | Measuring efforts for establishing sustainable tourism offers without flying or with $CO_2$ compensation and the leisure behaviour of households is a crucial steering information. |
| | **Lifestyles** | Slow living – as a lifestyle emphasizing slower approaches to aspects of everyday life, also tourism focuses on reduced ecological impact, social, regional and local oriented. |
| | **Real world labs (RWL) and living labs (LL)** | RWL: Research on sustainable mobility approaches strengthens awareness for sustainable travelling patterns. |
| | **Collaboration/ Sharing** | Car sharing as alternative option for flying. |
| | **Design for Circular Economy** | Airplanes can be designed for repair and recycling (e.g. compound materials are still difficult to recycle). Further, leveraging the combination of alternative fuels (hydrogen, biofuels) and suitable turbine technologies might reduce the impact of flying. |
| | **Time welfare/ digitalisation** | Slow tourism/slow travelling - using of non-polluting transports, taking care to ecological impact of travelling as a part of time welfare.<br>Digital handy travel tools and apps as supporting information for slow travelling. |

## 5.2 TOP 14 recommendations

Within this study a broad set of policy recommendations has been identified. In chapter 3, a bundle of recommendations per key area (cf. chapter 2) has been formulated including e.g. market-based instruments, regulatory instruments and information-based instruments. Chapter 4 contains recommendation sets from eight different research fields with regard to the integration of cross-cutting approaches in SCP policies.

In order to reflect the breadth of fields of action to advance sustainable consumption, the project team selected one top recommendation per identified key area and one per field of research. Selection criteria were effectiveness and/or practicability of the respective recommendations. Generally, an enhancement of the German Sustainable Development Strategy should not only set clear priorities and focus on key areas of sustainable consumption but also strengthen the link between science and policy to achieve a stronger stimulus effect for sustainable consumption. The recommendations can be clustered in three types of actions: (i) national strategic actions and policymaking, (ii) monitoring indicators and creating a decision-making basis, and (iii) supporting the operational level. The recommendations largely lie within the responsibility of the German Government or the National Ministries that can support the recommended actions by corresponding national programmes, supporting transdisciplinary research initiatives, or by providing funding in the respective fields.

In particular, policymakers should:

**National strategic actions and policymaking**

- Focus on the equity and balance between different modes of transport and achieve a **mobility transformation** by shifting the current subsidies for the private use of cars (e.g. energy tax, vehicle tax, commuter allowance, tax benefit of company cars) towards promoting sustainable modes of transport (e.g. reduction of VAT on long-distance train tickets, expansion of bicycle infrastructure, social balanced and partly free, citizen tickets for public transport, services and business models e.g. socially balanced car/bike sharing offers).
- Promote the **consumption of plant-based meat and dairy alternatives** by setting an example in public procurement policies (e.g. climate-friendly public canteens with sustainable menu management and communication) and by taxing meat and dairy products at the standard rate of 19%.
- Implement a dynamic and socially balanced **$CO_2$ tax** to trigger investments in renovations of buildings in combination with interventions, incentives and digital information to change energy use behaviour to reduce heating needs.
- Strengthen sustainability in the **textile sector** by moving the NAP from voluntary self-commitment to mandatory measures of **corporate oversight**.
- Shift short haul flights onto rail e.g. by a clear price signal (reducing VAT on train tickets and raising the air ticket tax *(Luftverkehrsabgabe)* on domestic flights and foster the attempts to reach an effective global (or in a first step European) agreement **to reduce emissions in the aviation sector**.
- Formulate concrete policy goals for i**ncreasing reuse and repairing of electronic devices** and introduce low VAT-rates for repair services of and make the costs of repairing large household appliances tax deductible.

- Establish a National **Digital Responsibility Strategy (DRS)** that integrates global sustainability objectives and digitalisation and potentially encourages the introduction of an SDG Digitalisation". A key issue should be avoiding rebound effects. This needs to be accompanied by a Consumer DRS addressing accessibility of digital innovations and safeguarding their interests (data protection) (SVRV BMJV 2017). In addition, DRSs are required for companies (SVRV BMJV 2017) and science.
- Integrate **behavioural insights / nudging experience** throughout policymaking process (from idea generation to design, implementation and evaluation); test nudges in different areas of consumption policy (see more Mont et. al. 2017, 69).

**Monitoring indicators and creating a decision-making basis**

- Create a set of **indicators in accordance with SDG12** that can actually map the targeted goals at sufficient level of detail. Further develop the German SDG12 indicator set in this direction. The indicators should be relevant for public institutions / policymakers, companies, and households/individuals. These stakeholders should further be able to use the data in order to operate and live more sustainably. The indicators must be socio-economic, spatial and for the areas of consumption differentiable in order to reflect rebound effects, problem shifts and socio-ecological situations.
- Monitoring of **central circularity indicators** (KRU 2017) is necessary and has to be connected to an integrated indicator set for dynamically monitoring and managing SDG12 (focus on SCP) – without a systemic integration the 1.5° lifestyles will not be achieved.
- Develop an **indicator "available time"** as an indicator of "quality of life" which should be integrated in the *German Sustainable Development Strategy* (Reisch and Bietz 2014, Buhl/Schipperkes/Liedtke 2017) and generate an empirical basis for evidence-based time policies as part of environmental and social policy in the most relevant areas of sustainable consumption.
- Initiate a **Lifestyle or Consumer Panel** in Germany (possible result: interactive, dynamic "Sustainable Lifestyle Atlas" with socio-economic and spatial differentiations and applications for research and consumer practice) as a contribution to the fulfilment of SDG 12 as well as a broad discussion about the related social-ecological situations of different social groups (e.g. energy poverty versus richness and related carbon footprints or digital divide between young and old, or poor and rich social groups etc.). Founding of a (new) Ministry of Good Living with focus on welfare of society and social-ecological justice.

**Supporting the operational level**

- Develop an accelerator mechanism: Establish a German **network of regional LivingLab centres** to push smart, sustainable products and services - implementing sustainable product service systems, e.g. bike or ride sharing services or assistance and feedback devices in the field of living, mobility and shopping (Erdmann et al. 2018).
- Develop new and **innovative sustainable services; temporary use of assets** should be encouraged, while ensuring adequate consumer and social protection, e.g. warranting fair working conditions, and tax compliance. Any approach has to be

evaluated and monitored via sustainability indicators. The risk of rebound effects must also be considered and controlled.

# Bildnachweis

Title: Guus Baggermans / unsplashcom

# 6 Publication bibliography

Adam, Abdulfatah; Jensen, Jørgen D. (2016): What is the effectiveness of obesity related interventions at retail grocery stores and supermarkets? -a systematic review. In *BMC public health* 16 (1), p. 1247. DOI: 10.1186/s12889-016-3985-x.

adfc (2019): Minister-Entwurf zur fahrradfreundlichen StVO. Available online at https://www.adfc.de/neuigkeit/minister-entwurf-zur-fahrradfreundlichen-stvo/.

Agora Verkehrswende (2017): Mit der Verkehrswende die Mobilität von morgen sichern. 12 Thesen zur Verkehrswende. Berlin.

Agora Verkehrswende (2018a): Bikesharing im Wandel. Handlungsempfehlungen für deutsche Städte und Gemeinden zum Umgang mit stationslosen Systemen. Available online at www.agora-verkehrswende.de.

Agora Verkehrswende (2018b): Klimaschutz im Verkehr: Massnahmen zur Erreichung des Sektorziels 2030. Berlin.

Allen, P.; Robinson, M.; Butans, E.; Varga, L. (2019): Innovations for sustainable lifestyles: an agent-based model approach. In *Sustainability Science* 14 (2), pp. 341–354. DOI: 10.1007/s11625-018-0593-y.

Anantharaman, Manisha (2017): Elite and ethical: The defensive distinctions of middle-class bicycling in Bangalore, India. In *Journal of Consumer Culture* 17 (3), pp. 864–886. DOI: 10.1177/1469540516634412.

Andersson, David; Nässén, Jonas (2016): Should environmentalists be concerned about materialism? An analysis of attitudes, behaviours and greenhouse gas emissions. In *Journal of Environmental Psychology* 48, pp. 1–11. DOI: 10.1016/j.jenvp.2016.08.002.

atmosfair (2016): atmosfair Flight Emissions Calculator (https://www.atmosfair.de/wp-content/uploads/atmosfair-flight-emissions-calculator-englisch-1.pdf).

Baedeker, Carolin; Liedtke, Christa; Welfens, Maria Jolanta (2017): Green Economy as a Framework for Product-Service Systems Development: The Role of Sustainable Living Labs. In David V. Keyson, Olivia Guerra-Santin, Dan Lockton (Eds.): Living labs. Design and assessment of sustainable living, vol. 10. Cham: Springer, pp. 35–52.

BAFA (2019): Heizungsoptimierung. Available online at https://www.bafa.de/DE/Energie/Energieeffizienz/Heizungsoptimierung/heizungsoptimierung_node.html.

Bailey, R.; Froggatt, A.; Wellesley, L. (2014): Livestock – climate change's forgotten sector. Chatham House. Available online at https://gastronomiaycia.republica.com/wp-content/uploads/2014/12/estudio_consumo_carne.pdf.

Bardhi, Fleura; Eckhardt, Giana M. (2012): Access-Based Consumption: The Case of Car Sharing. In *Journal of Consumer Research* 39 (4), pp. 881–898. DOI: 10.1086/666376.

BDL (2018): Klimaschutzreport 2018. Available online at https://www.bdl.aero/de/publikation/klimaschutzreport/, checked on 8/7/2019.

Beecroft, Richard; Parodi, Oliver (2016): Reallabore als Orte der Nachhaltigkeitsforschung und Transformation. In *Einführung in den Schwerpunkt. Technikfolgenabschätzung – Theorie Und Praxis* 25 (3), pp. 4–8.

Benartzi, Shlomo; Beshears, John; Milkman, Katherine L.; Sunstein, Cass R.; Thaler, Richard H.; Shankar, Maya et al. (2017): Should Governments Invest More in Nudging? In *Psychological science* 28 (8), pp. 1041–1055. DOI: 10.1177/0956797617702501.

Benz, Carina; Stryja, Carola (2018): How to motivate consumers to test electric vehicles – an approach to design consumer interfaces to foster innovation adoption. In : Multikonferenz Wirtschaftsinformatik. Lüneburg. Leuphana Universität Lüneburg; Multikonferenz Wirtschaftsinformatik 2018: Data driven X - Turning Data into Value; MKWI.

Bernert, Philip; Haaser, Angelika; Kühl, Lena; Schaal, Tamara (2016): Towards a Real-world Laboratory: A Transdisciplinary Case Study from Lüneburg. In *GAIA - Ecological Perspectives for Science and Society* 25 (4), pp. 253–259. DOI: 10.14512/gaia.25.4.7.

Bertheim, Jane (2018): Designing Digital Nudges to Encourage Sustainable Decisions : Developing and Testing a Framework. Master Thesis. Umea University. Department of Applied Physics and Electronics, Sveden. Available online at http://www.diva-portal.org/smash/get/diva2:1223069/FULLTEXT01.

Beylot, Antoine; Secchi, Michela; Cerutti, Alessandro; Merciai, Stefano; Schmidt, Jannick; Sala, Serenella (2019): Assessing the environmental impacts of EU consumption at macro-scale. In *Journal of Cleaner Production* 216, pp. 382–393. DOI: 10.1016/j.jclepro.2019.01.134.

BfEE (2019a): Deutschland macht's effizient. Available online at https://www.bfee-online.de/BfEE/DE/Effizienzpolitik/Deutschlandmachtseffizient/deutschlandmachtseffizient_node.html, checked on 8/14/2019.

BfEE (2019b): Nationale Energieeffizienzpolitik. Available online at https://www.bfee-online.de/BfEE/DE/Effizienzpolitik/NationaleEnergieeffizienzpolitik/nationaleenergieeffizienzpolitik_node.html, checked on 8/14/2019.

Bickel, Manuel W. (2019): textility - An R package for applied text mining with an example of topic modellling in the field of research on sustainable energy: Zenodo.

Bilharz, Michael (2009): "Key Points" nachhaltigen Konsums. Ein strukturpolitisch fundierter Strategieansatz für die Nachhaltigkeitskommunikation im Kontext aktivierender Verbraucherpolitk. 2. Aufl. Marburg: Metropolis-Verl. (Wirtschaftswissenschaftliche Nachhaltigkeitsforschung, 4). Available online at http://www.keypointer.de/fileadmin/media/Bilharz_2007_Key-Points-nachhaltigen-Konsums_Buchbeitrag.pdf.

BLE (Ed.) (2019a): Bericht zur Markt- und Versorgungslage mit Milch und Milcherzeugnissen. Bonn. Available online at https://www.ble.de/SharedDocs/Downloads/DE/BZL/Daten-Berichte/MilchUndMilcherzeugnisse/JaehrlicheErgebnisse/Deutschland/2019BerichtMilch.pdf?__blob=publicationFile&v=2.

BLE (Ed.) (2019b): Bericht zur Markt-und Versorgungslage. Fleisch 2019. Bonn. Available online at https://www.ble.de/SharedDocs/Downloads/DE/BZL/Daten-Berichte/Fleisch/2019BerichtFleisch.pdf?__blob=publicationFile&v=2.

Blei, David M.; Ng, Andrew Y.; Jordan, Michael I. (2003): Latent dirichlet allocation. In *The Journal of Machine Learning Research* 3, pp. 993–1022. Available online at http://dl.acm.org/ft_gateway.cfm?id=944937&type=pdf.

BMAS (2019): Über den NAP. BMAS. Available online at https://www.csr-in-deutschland.de/DE/Wirtschaft-Menschenrechte/Ueber-den-NAP/ueber-den-nap.html, checked on 7/4/2019.

BMEL (2017a): Daten und Fakten. Land-, Forst- und Ernährungswirtschaft mit Fischerei und Wein- und Gartenbau.

BMEL (2017b): Deutschland, wie es isst – Der BMEL-Ernährungsreport 2018. Berlin. Available online at https://www.bmel.de/SharedDocs/Downloads/Broschueren/Ernaehrungsreport2018.pdf.

BMi (2018): Gemeinsame Wohnraumoffensive von Bund, Ländern und Kommunen. Ergebnisse des Wohngipfels. Available online at https://www.bmi.bund.de/SharedDocs/pressemitteilungen/DE/2018/09/wohngipfel.html, checked on 8/27/2019.

BMU (Ed.) (2016a): Klimaschutzplan 2050. Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung. 2nd ed. Berlin. Available online at https://www.bmu.de/publikation/klimaschutzplan-2050/.

BMU (Ed.) (2016b): Nationales Programm für nachhaltigen Konsum. Gesellschaftlicher Wandel durch einen nachhaltigen Lebensstil. Available online at https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/nachhaltiger_konsum_broschuere_bf.pdf, checked on 3/19/2019.

BMU (Ed.) (2019): Radverkehrsprojekte. Nationale Klimaschutzinitiative. Available online at https://www.klimaschutz.de/projekte/radverkehrsprojekte.

BMU; UBA (2019): Umweltbewusstseinsstudie in Deutschland 2018. Ergebnisse einer repräsentativen Bevölkerungsumfrage. Edited by Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU), Umweltbundesamt (UBA). Available online at https://www.umweltbundesamt.de/publikationen/umweltbewusstsein-in-deutschland-2018, checked on 7/11/2019.

BMUB (2018): National Programme on Sustainable Consumption. From Sustainable Lifestyles towards Social Change. Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). Available online at https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/nachhaltiger_konsum_broschuere_en_bf.pdf, checked on 7/4/2019.

BMUB, UBA (2017): Umweltbe-wusstsein in Deutschland 2016. Ergebnisse einer repräsentiven Bevölkerungsumfrage. Berlin, Dessau--Roßlau.

BMVI: NRVP 3.0 - der neue Nationale Radverkehrsplan. Available online at https://zukunft-radverkehr.bmvi.de/bmvi/de/home/info/id/12, checked on 7/23/2019.

BMVI (2019): StVO-Novelle – eine Radreform für mehr Sicherheit. Available online at https://www.bmvi.de/SharedDocs/DE/Artikel/K/deinleben.html.

BMWI (2017): Bundeswirtschaftsministerium stellt neues Instrument der Energieberatung vor: der individuelle Sanierungsfahrplan. Available online at https://www.bmwi.de/Redaktion/DE/Pressemitteilungen/2017/20170504-bmwi-stellt-neues-instrument-der-energieberatung-vor.html, checked on 8/14/2019.

BMWI (2019a): Gebäudeenergiegesetz (GEG). Gesetz zur Vereinheitlichung des Energieeinsparrechts für Gebäude. Available online at

https://www.bmwi.de/Redaktion/DE/Artikel/Service/Gesetzesvorhaben/gesetz-zur-vereinheitlichung-des-energieeinsparrechts-fuer-gebaeude-gebaeudeenergiegesetz.html.

BMWI (2019b): Zweiter Fortschrittsbericht "Energie der Zukunft" - Kurzfassung. Available online at https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/fortschrittsbericht-monitoring-energiewende-kurzfassung.html.

Bódi, Zusanna; Garatea, Jokin; Robles, Ana García; Schuurman, Dimitri (2015): Living Lab services for business support and internationalisation. European Network of Living Labs (ENoLL). Brüssel (Living Lab Services for Business Support and Internationalisation), checked on 8/20/2019.

Boland, Mike J.; Rae, Allan N.; Vereijken, Johan M.; Meuwissen, Miranda P.M.; Fischer, Arnout R.H.; van Boekel, Martinus A.J.S. et al. (2013): The future supply of animal-derived protein for human consumption. In *Trends in Food Science & Technology* 29 (1), pp. 62–73. DOI: 10.1016/j.tifs.2012.07.002.

Botsman, Rachel (2013): The Sharing Economy Lacks A Shared Definition. Fast Company. Available online at https://www.fastcompany.com/3022028/the-sharing-economy-lacks-a-shared-definition, checked on 8/20/2019.

Bouvard, Véronique; Loomis, Dana; Guyton, Kathryn Z.; Grosse, Yann; El Ghissassi, Fatiha; Benbrahim-Tallaa, Lamia et al. (2015): Carcinogenicity of consumption of red and processed meat. In *The Lancet Oncology* 16 (16), pp. 1599–1600. DOI: 10.1016/S1470-2045(15)00444-1.

Brand, Kristen; Manteuffel, Bernhard von; Hermelink, Andreas (2018): Energy Performance Certificate Database in Denmark. Fact sheet. Ecofys and adelphi. Available online at https://www.euki.de/wp-content/uploads/2018/09/fact-sheet-energy-performance-certificate-database-dk.pdf, checked on 8/14/2019.

Brot für die Welt: Meilenstein für den Schutz der Menschenrechte. 24.03.2017. Available online at https://www.brot-fuer-die-welt.de/pressemeldung/2017-meilenstein-fuer-den-schutz-der-menschenrechte/, checked on 7/11/2019.

Brown, Halina Szejnwald; Vergragt, Philip J. (2016): From consumerism to wellbeing: toward a cultural transition? In *Journal of Cleaner Production* 132, pp. 308–317. DOI: 10.1016/j.jclepro.2015.04.107.

Bucher, Tamara; Collins, Clare; Rollo, Megan E.; McCaffrey, Tracy A.; Vlieger, Nienke de; van der Bend, Daphne et al. (2016): Nudging consumers towards healthier choices: a systematic review of positional influences on food choice. In *The British journal of nutrition* 115 (12), pp. 2252–2263. DOI: 10.1017/S0007114516001653.

Buhl, Johannes; Liedtke, Christa; Teubler, Jens; Bienge, Katrin (2019): The Material Footprint of private households in Germany: Linking the natural resource use and socioeconomic characteristics of users from an online footprint calculator in Germany. In *Sustainable Production and Consumption*. DOI: 10.1016/j.spc.2019.05.001.

Buhl, Johannes; Liedtke, Christa; Teubler, Jens; Bienge, Katrin; Schmidt, Nicholas (2018): Measure or Management?—Resource Use Indicators for Policymakers Based on Microdata by Households. In *Sustainability* 10 (12), p. 4467. DOI: 10.3390/su10124467.

Buhl, Johannes; Schipperges, Michael; Liedtke, Christa (2017): Die Ressourcenintensität der Zeit und ihre Bedeutung für nachhaltige Lebensstile. In Peter Kenning, Andreas Oehler,

Lucia A. Reisch, Christian Grugel (Eds.): Verbraucherwissenschaften. Rahmenbedingungen, Forschungsfelder und Institutionen. Wiesbaden: Springer Gabler.

BundesBauBlatt (2019): 41 Verbände appellieren gemeinsam an die Politik: Steuerförderung für Gebäudesanierung duldet keinen weiteren Aufschub. Available online at https://www.bundesbaublatt.de/news/41-verbaende-appellieren-gemeinsam-an-die-politik-steuerfoerderung-fuer-gebaeudesanierung-duldet-keinen-weiteren-aufschub_3349162.html, checked on 8/14/2019.

Bundesministerium der Finanzen (2011): Die Luft-ver-kehrs-teu-er. Available online at https://www.bundesfinanzministerium.de/Content/DE/Monatsberichte/2011/04/Artikel/analysen-und-berichte/b04-Luftverkehrsteuer/Luftverkehrsteuer.html.

Bundesministeriums für Verkehr und digitale Infrastruktur (2017): Luftverkehrskonzept des Bundesministeriums für Verkehr und digitale Infrastruktur.

Bündnis für nachhaltige Textilien (2019a): Eine Multi-Akteurs-Partnerschaft. Available online at https://www.textilbuendnis.com/uebersicht/#formanchor, checked on 7/4/2019.

Bündnis für nachhaltige Textilien (2019b): Portrait Textilbündnis. Available online at https://www.textilbuendnis.com/portrait-textilbuendnis/, checked on 6/27/2019.

Business & Human Rights Resource Centre (2018): "European textile industry and human rights due diligence: Key development, human rights allegations & best practices". Briefing, April 2018. Available online at https://www.business-humanrights.org/sites/default/files/EU_Textile_Briefing_Final.pdf, checked on 7/11/2019.

Büttgen, Alexandra; Kühlert, Markus; Liedtke, Christa; Teubler, Jens (2018): Konsum nachhaltig gestalten. Anforderungen an einen Konsumindikator im SDG 12. Wuppertal Institiut. Wuppertal.

BVE – Bundesvereinigung der Deutschen Ernährungsindustrie (2016): Rekordumsätze im deutschen Außer-Haus-Markt. Available online at https://www.bve-online.de/presse/bve-aktuell/aktuell-160422/aktuell-160422-001-ausser-haus-markt.

Caniglia, Guido; Schäpke, Niko; Lang, Daniel J.; Abson, David J.; Luederitz, Christopher; Wiek, Arnim et al. (2017): Experiments and evidence in sustainability science: A typology. In *Journal of Cleaner Production* 169, pp. 39–47. DOI: 10.1016/j.jclepro.2017.05.164.

Cao, Philine; Meister, Sandra; Klante, Oliver (2014): How Social Media Influence Apparel Purchasing Behavior. In *Marketing Review St. Gallen* 31 (6), pp. 77–86. DOI: 10.1365/s11621-014-0427-y.

Carley, Sanya; Yahng, Lilian (2018): Willingness-to-pay for sustainable beer. In *PLoS ONE* 13 (10). DOI: 10.1371/journal.pone.0204917.

CCC Germany (2018): Mehr Schein als Sein: Gerd Müller will Textilsiegel ‚Grüner Knopf' bald einführen. In *Kampagne Saubere Kleidung, Clean Clothes Campaign Germany*, 6/28/2018. Available online at https://saubere-kleidung.de/2018/06/gruener-knopf-mehr-schein-als-sein/, checked on 7/10/2019.

CE Delft (2019): Taxes in the field of aviation and their impact. Edited by European Commission.

Ceschin, Fabrizio; Gaziulusoy, Idil (2016): Evolution of design for sustainability: From product design to design for system innovations and transitions. In *Design Studies* 47, pp. 118–163. DOI: 10.1016/j.destud.2016.09.002.

Chekima, Brahim; Chekima, Sohaib; Syed Khalid Wafa, Syed Azizi Wafa; Igau, Oswald @. Aisat; Sondoh, Stephen Laison (2016): Sustainable consumption: the effects of knowledge, cultural values, environmental advertising, and demographics. In *International Journal of Sustainable Development & World Ecology* 23 (2), pp. 210–220. DOI: 10.1080/13504509.2015.1114043.

Choi, Sooyeon; Feinberg, Richard A. (2018): The LOHAS Lifestyle and Marketplace Behavior. In Satinder Dhiman, Joan Marques (Eds.): Handbook of engaged sustainability, vol. 48. Living edition. Cham: Springer International Publishing, pp. 1–19.

City of New York (2018): NYC Retrofit Accelerator. Available online at https://retrofitaccelerator.cityofnewyork.us/, checked on 8/15/2019.

Cohen, Maurie J.; Brown, Halina Szejnwald; Vergragt, Philip (Eds.) (2018): Social change and the coming of post-consumer society. Theoretical advances and policy implications. London: Routledge.

CorA et al. (2018): Zwei Jahre Nationaler Aktionsplan für Wirtschaft und Menschenrechte - eine magere Halbzeitbilanz. CorA Netzwerk für Unternehmensverantwortung, DGB, Forum Menschenrechte, Venro - Verband Entwicklungspolitik und Humanitäre Hilfe. Available online at https://dev.hmpxl.de/cora/wp-content/uploads/2019/06/2018-12-20_NAP_Halbzeitbilanz_CorA-DGB-ForumMR-VENRO.pdf, checked on 7/10/2019.

CRR (2013): The Centre for Remanufacturing and Reuse. Available online at www.remanufacturing.org.uk, checked on 8/13/2019.

d'Adda, Giovanna; Capraro, Valerio; Tavoni, Massimo (2017): Push, don't nudge: Behavioral spillovers and policy instruments. In *Economics Letters* 154, pp. 92–95. DOI: 10.1016/j.econlet.2017.02.029.

Deloitte (2016): Used smartphones: TMT Predictions 2016. Available online at https://www2.deloitte.com/me/en/pages/technology-media-and-telecommunications/articles/tmt-pred16-telecomm-used-smartphones-17-billion-market.html, checked on 8/8/2019.

DENEFF; VfW (2019): Stellungnahme der Deutschen Unternehmensinitiative Energieeffizienz e.V. (DENEFF)und des Verbands für Wärmelieferung e.V. (VfW). zum gemeinsamen Referentenentwurf von BMWi und BMI für ein Gesetz zur Vereinheitlichung des Energieeinsparrechts für Gebäude vom 28. Mai 2019. Berlin. Available online at https://www.deneff.org/fileadmin/downloads/GEG_Stellungnahme_DENEFF_VfW.PDF.

Denstadli, Jon Martin; Gripsrud, Mattias; Hjorthol, Randi; Julsrud, Tom Erik (2013): Videoconferencing and business air travel: Do new technologies produce new interaction patterns? In *Transportation Research Part C: Emerging Technologies* 29, pp. 1–13. DOI: 10.1016/j.trc.2012.12.009.

Destatis (4/9/2019): Automobilindustrie: Deutschlands wichtigster Industriezweig mit Produktionsrückgang um 7,1 % im 2. Halbjahr 2018. Pressemitteilung Nr. 139 vom 9. April 2019. Wiesbaden. Available online at https://www.destatis.de/DE/Presse/Pressemitteilungen/2019/04/PD19_139_811.html.

Deutsche Bahn (2018): Das Flugzeug überholt. Ein Jahr nach Start der Schnellfahrstrecke Berlin-München: Bahn ist Verkehrsmittel Nummer 1. Available online at https://www.deutschebahn.com/de/konzern/im_blickpunkt/Das-Flugzeug-ueberholt-3529496.

Deutsche Energie-Agentur GmbH (2018): Statistiken und Analysen zur Energieeffizienz im Gebäudebestand. dena-Gebäudereport Kompakt 2018. Berlin.

Deutsche Umwelthilfe e.V. (2016): Blaupause Wärmewende. Positionspapier der Deutschen Umwelthilfe für mehr Energieeffizienz und erneuerbare Wärme. Berlin.

Deutsche Welle (2019): France to impose green tax on flight tickets from French airports, 2019. Available online at https://www.dw.com/en/france-to-impose-green-tax-on-flight-tickets-from-french-airports/a-49523359.

Deutscher Bundestag (2013): Drucksache 17/13300: Schlussbericht der Enquete-Kommission „Wachstum, Wohlstand, Lebensqualität – Wege zu nachhaltigem Wirtschaften und gesellschaftlichem Fortschritt in der Sozialen Marktwirtschaft".

Deutscher Bundestag (2019): Drucksache 19/7567: Antwort der Bundesregierung auf die Große Anfrage der Fraktion BÜNDNIS 90/DIE GRÜNEN - Drucksache 19/3166. Ökologische, soziale und menschenrechtliche Kriterien in der öffentlichen Beschaffung als Beitrag für eine nachhaltige Entwicklung weltweit. Deutscher Bundestag, 19. Wahlperiode. Available online at http://dip21.bundestag.de/dip21/btd/19/075/1907567.pdf, checked on 7/4/2019.

Deutschlandfunk (2018): Klimaschutz in Schweden. Die Scham fliegt mit, 2018. Available online at https://www.deutschlandfunk.de/klimaschutz-in-schweden-die-scham-fliegt-mit.697.de.html?dram:article_id=433784.

Dhandra, Tavleen Kaur (2019): Achieving triple dividend through mindfulness: More sustainable consumption, less unsustainable consumption and more life satisfaction. In *Ecological Economics* 161, pp. 83–90. DOI: 10.1016/j.ecolecon.2019.03.021.

Di Donato, Monica; Lomas, Pedro L.; Carpintero, Óscar (2015): Metabolism and Environmental Impacts of Household Consumption: A Review on the Assessment, Methodology, and Drivers. In *Journal of Industrial Ecology* 19 (5), pp. 904–916. DOI: 10.1111/jiec.12356.

Die Bundesregierung (2018): Ein neuer Aufbruch für Europa - Eine neue Dynamik für Deutschland - Ein neuer Zusammenhalt für unser Land. Koalitionsvertrag zwischen CDU, CSU und SPD. 19. Legislaturperiode. Berlin.

Die Bundesregierung (2019a): Sofortprogramm Saubere Luft 2017-2020. Berlin. Available online at https://www.bundesregierung.de/breg-de/themen/saubere-luft, checked on 7/22/2019.

Die Bundesregierung (2019b): Bezahlbare und saubere Energie. Ziele für nachhaltige Entwicklung. Available online at https://www.bundesregierung.de/breg-de/themen/nachhaltigkeitspolitik/bezahlbare-und-saubere-energie-1581908.

Die Bundesregierung (Bearbeitungsstand: 2019): Gesetzentwurf der Bundesregierung. Gesetz zur Vereinheitlichung des Energieeinsparrechts für Gebäude, Bearbeitungsstand: 5/28/2019. Available online at https://www.bmwi.de/Redaktion/DE/Downloads/Gesetz/gesetz-zur-vereinheitlichung-des-energieeinsparrechts-fuer-gebaeude.pdf?__blob=publicationFile&v=8, checked on 8/14/2019.

Die Bundesregierung (2019c): Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Christian Dürr, Grigorios Aggelidis, Renata Alt, weiterer Abgeordneter und der Fraktion der FDP. Reduzierung der Mehrwertsteuer auf Tickets des Fernverkehrs und Mehrwertsteuerbefreiung für Universaldienstleistungen der Deutschen Post AG. Deutscher

Bundestag, 19. Wahlperiode. Berlin (Drucksache 19/10265). Available online at http://dip21.bundestag.de/dip21/btd/19/108/1910805.pdf, checked on 7/18/2019.

Diekmann, L.; Gerhards, E.; Klinski, S.; Meyer, B.; Schmidt, S.; Thöne, M. (2011): Steuerliche Behandlung von Firmenwagen in Deutschland. Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln. Köln (FiFo-Berichte, 13).

Dolan, Paul; Kudrna, Laura; Stone, Arthur (2017): The Measure Matters: An Investigation of Evaluative and Experience-Based Measures of Wellbeing in Time Use Data. In *Social indicators research* 134 (1), pp. 57–73. DOI: 10.1007/s11205-016-1429-8.

Donaldson, Tara (2017): Why Blockchain Could Revolutionize the Apparel Industry and How it Will Happen. In *Sourcing Journal*, 11/20/2017. Available online at https://sourcingjournal.com/topics/technology/blockchain-revolutionize-apparel-industry-will-happen-td-75017/, checked on 7/10/2019.

Druckman, Angela; Jackson, Tim (2016): Understanding Households as Drivers of Carbon Emissions. In Roland Clift, Angela Druckman (Eds.): Taking Stock of Industrial Ecology. Cham: Springer International Publishing, pp. 181–203.

EC (2016a): A European agenda for collaborative economy. COM(2016) 356. Available online at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2016%3A356%3AFIN, checked on 9/2/2019.

EC (2016b): Communication from the Commission to the European Parlament, the Council, the European Economic and Social Committee and the Committee of the Regions. A European agenda for the collaborative economy. Available online at https://ec.europa.eu/growth/single-market/services/collaborative-economy, checked on 8/13/2019.

EC (2018): Collaborative economy Conference October 2018 - Report. Brussels.

eco-bot (2019): ABOUT – eco-bot. Available online at http://eco-bot.eu/about/, checked on 8/14/2019.

Eco-systèmes (2019): All about Eco-systèmes. Available online at https://www.eco-systemes.fr/en/all-about-eco-systemes, checked on 8/8/2019.

EEA (2017): Aviation and shipping — impacts on Europe's environment. TERM 2017: Transport and Environment Reporting Mechanism (TERM) report.

Engels, Anita; Walz, Kerstin (2018): Dealing with Multi-Perspectivity in Real-World Laboratories: Experiences from the Transdisciplinary Research Project Urban Transformation Laboratories. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 39–45. DOI: 10.14512/gaia.27.S1.10.

Engels, Franziska; Rogge, Jan-Christoph (2018): Tensions and Trade-offs in Real-World Laboratories - The Participants' Perspective. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 28–31. DOI: 10.14512/gaia.27.S1.8.

Erdmann, L.; Geibler, J. v.; Dönitz, E.; Stadler, K.; Zern, R. (2018): Roadmap Living Labs für eine Green Economy 2030. Langfassung mit Roadmaps in den Konsumfeldern Wohnen, Einkaufen und Mobilität. Ergebnis des Arbeitspakets 7 (AP 7.4) des INNOLAB Projekts. Fraunhofer-Institut für System- und Innovationsforschung ISI; Wuppertal Institut für Klima, Umwelt, Energie. Karlsruhe und Wuppertal.

Esposito, Gabriele; Hernández, Penélope; van Bavel, René; Vila, José (2017): Nudging to prevent the purchase of incompatible digital products online: An experimental study. In *PLoS ONE* 12 (3). DOI: 10.1371/journal.pone.0173333.

European Coalition of Corporate Justice (2017): The French Duty of Vigilance Law - Frequently Asked Questions. Edited by European Coalition of Corporate Justice. Available online at https://www.business-humanrights.org/sites/default/files/documents/French%20Corporate%20Duty%20of%20Vigilance%20Law%20FAQ.pdf, checked on 7/11/2019.

European Commission (2019a): Reducing emissions from aviation. Available online at https://ec.europa.eu/clima/policies/transport/aviation_en, updated on 2019.

European Commission (2019b): School fruit, vegetables and milk scheme. Available online at https://ec.europa.eu/agriculture/school-scheme_en, checked on 7/16/2019.

Eurostat (2018): E-commerce statistics for individuals. Available online at https://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals, checked on 8/20/2019.

Evans, James; Karvonen, Andrew; Raven, Rob (Eds.) (2018): The experimental city. First published in paperback. London and New York: Routledge (Routledge research in sustainable urbanism).

Fashion revolution CIC (2019): Fashion Transparency Index - 2018 Edition. Available online at https://issuu.com/fashionrevolution/docs/fr_fashiontransparencyindex2018?e=25766662/60458846, checked on 7/10/2019.

FCRN (2019): Sweden's supermarkets campaign to reduce meat consumption. Available online at https://www.fcrn.org.uk/research-library/sweden%E2%80%99s-supermarkets-campaign-reduce-meat-consumption.

Förster, Hannah; Kunert, Denise; Hünecke, Katja; Schumacher, Katja; Siemons, Anne; Zell-Ziegler, Carina (2018): Hintergrundpapier: 50 Jahre Mehrwertsteuer. Ein Blick durch die Klimaschutzbrille. Aktualisierte Fassung. Öko-Institut.

Franken, Marcus; Drewes, Sabine (2019): Energiesprong: Warmmietenneutrale Sanierung als Programm. Heinrich-Böll-Stiftung. Available online at https://www.boell.de/de/2019/03/18/besser-wohnen-energie-selber-machen-keine-mehrkosten, checked on 8/15/2019.

future fashion foward: future fashion foward - der verein. future fashion forward e.V. Available online at https://future.fashion/uber-uns, checked on 7/4/2019.

Geiger, Sonja M.; Otto, Siegmar; Schrader, Ulf (2017): Mindfully Green and Healthy: An Indirect Path from Mindfulness to Ecological Behavior. In *Frontiers in psychology* 8, p. 2306. DOI: 10.3389/fpsyg.2017.02306.

Geiger, Sonja Maria; Fischer, Daniel; Schrader, Ulf (2018): Measuring What Matters in Sustainable Consumption: An Integrative Framework for the Selection of Relevant Behaviors. In *Sust. Dev.* 26 (1), pp. 18–33. DOI: 10.1002/sd.1688.

Genovese, Andrea; Acquaye, Adolf A.; Figueroa, Alejandro; Koh, S. LennyC. (2017): Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications. In *Omega* 66, pp. 344–357. DOI: 10.1016/j.omega.2015.05.015.

Gerbens-Leenes, Winnie; Nonhebel, Sanderine (2005): Food and land use. The influence of consumption patterns on the use of agricultural resources. In *Appetite* 45 (1), pp. 24–31. DOI: 10.1016/j.appet.2005.01.011.

Gesellschaft zur Förderung des Tierwohls in der Nutztierhaltung mbH (2019): Initiative Tierwohl. Bonn. Available online at https://initiative-tierwohl.de/.

GfK (Ed.) (2016): Immer schön flexibel bleiben (Consumer Index, 03/2016). Available online at https://www.gfk.com/fileadmin/user_upload/dyna_content/DE/documents/News/Consumer_Index/CI_03_2016_oD.pdf.

Global Council for Happiness and Wellbeing (2019): The Global Happiness and Wellbeing Policy Report 2019. New York. Available online at http://www.happinesscouncil.org/report/2019/, checked on 8/13/2019.

Godfray, H. Charles J.; Aveyard, Paul; Garnett, Tara; Hall, Jim W.; Key, Timothy J.; Lorimer, Jamie et al. (2018): Meat consumption, health, and the environment. In *Science (New York, N.Y.)* 361 (6399). DOI: 10.1126/science.aam5324.

Greenpeace (2018): Wegwerfware Retouren. Greenpeace-Umfrage zum Kauf- und Retouren-Verhalten bei Online-Bestellungen. Edited by Greenpeace e.V. Available online at https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/umfrage_zum_online-kaufverhalten_2018-se.pdf, checked on 7/11/2019.

Greenpeace International (2018): Weniger ist mehr. Die Greenpeace-Vision der Nutztierhaltung im Jahr 2050. Greenpeace International. Amsterdam. Available online at https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/05.03.18_greenpeace-report_weniger_ist_mehr_-_weniger_fleisch_und_milch.pdf, checked on 7/16/2019.

Greiff, Kathrin; Teubler, Jens; Baedeker, Carolin; Liedtke, Christa; Rohn, Holger (2017): Material and Carbon Footprint of Household Activities. In David V. Keyson, Olivia Guerra-Santin, Dan Lockton (Eds.): Living labs. Design and assessment of sustainable living. Cham: Springer.

Grießhammer, Rainer; Brommer, Eva; Gattermann, Marah (2010a): C02-Einsparpotenziale für Verbraucher. Öko-Institut e.V.

Grießhammer, Rainer; Brommer, Eva; Gattermann, Marah; xxxx (2010b): C02-Einsparpotenziale für Verbraucher. Available online at https://www.oeko.de/oekodoc/1029/2010-081-de.pdf.

Grunwald, Armin (2016): Nachhaltigkeit verstehen. Arbeiten an der Bedeutung nachhaltiger Entwicklung. München: oekom Verlag. Available online at http://www.content-select.com/index.php?id=bib_view&ean=9783960061472.

Gruszka, Katarzyna (2017): Framing the collaborative economy —Voices of contestation. In *Environmental Innovation and Societal Transitions* 23, pp. 92–104. DOI: 10.1016/j.eist.2016.09.002.

Gubíniova, Katarína; Trelóva, Silvia; Mruškovičová, Juliana (2017): Voluntary Simplicity in Consumer Behaviour. Necessity, Challenge or Utopia. Madrid (Proceedings oft he 30th IBIMA Conference: 8-9 November 2017).

Guillen-Royo, Mònica (2019): Sustainable consumption and wellbeing: Does on-line shopping matter? In *Journal of Cleaner Production* 229, pp. 1112–1124. DOI: 10.1016/j.jclepro.2019.05.061.

Hadjichambis, A. Ch.; Georgiou, Y.; Paraskeva-Hadjichambi, D. P.; Ioannou, H.; Manoli, C. C. (2015): Integrating sustainable consumption into environmental education: a case study on environmental representations, decision making and intention to act. In *International Journal of Environmental and Science Education* 10 (1), pp. 67–86.

Haucke, Franziska Verena (2018): Smartphone-enabled social change: Evidence from the Fairphone case? In *Journal of Cleaner Production* 197, pp. 1719–1730. DOI: 10.1016/j.jclepro.2017.07.014.

Häyrinen, Liina; Mattila, Osmo; Berghäll, Sami; Toppinen, Anne (2016): Lifestyle of health and sustainability of forest owners as an indicator of multiple use of forests. In *Forest Policy and Economics* 67, pp. 10–19. DOI: 10.1016/j.forpol.2016.03.005.

Hedenus, Fredrik; Wirsenius, Stefan; Johansson, Daniel J. A. (2014): The importance of reduced meat and dairy consumption for meeting stringent climate change targets. In *Climatic Change* 124 (1-2), pp. 79–91. DOI: 10.1007/s10584-014-1104-5.

Heinrich-Böll-Stiftung (2018): The illusion of green flying. Available online at https://www.boell.de/en/2018/09/21/illusion-green-flying, checked on 8/7/2019.

Heinrich-Böll-Stiftung; Airbus Group (2016): Oben - Ihr Flugbegleiter. Available online at https://www.boell.de/de/2016/06/01/oben-ihr-flugbegleiter.

Heiskanen, Eva; Laakso, Senja; Matschoss, Kaisa; Backhaus, Julia; Goggins, Gary; Vadovics, Edina (2018): Designing Real-World Laboratories for the Reduction of Residential Energy Use: Articulating Theories of Change. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 60–67. DOI: 10.14512/gaia.27.S1.13.

Hertwich, Edgar G. (2011): THE LIFE CYCLE ENVIRONMENTAL IMPACTS OF CONSUMPTION. In *Economic Systems Research* 23 (1), pp. 27–47. DOI: 10.1080/09535314.2010.536905.

Hobson, K.; Lynch, N.; Lilley, D.; Smalley, G. (2018): Systems of practice and the Circular Economy: Transforming mobile phone product service systems. In *Environmental Innovation and Societal Transitions* 26, pp. 147–157. DOI: 10.1016/j.eist.2017.04.002.

Hobson, Kersty; Lynch, Nicholas (2016): Diversifying and de-growing the circular economy: Radical social transformation in a resource-scarce world. In *Futures* 82, pp. 15–25. DOI: 10.1016/j.futures.2016.05.012.

Hoekstra, Arjen Y. (2015): The Water Footprint: The Relation Between Human Consumption and Water Use. In Marta Antonelli, Francesca Greco (Eds.): The Water We Eat. Cham: Springer International Publishing, pp. 35–48.

Hummel, Dennis; Maedche, Alexander (2019): How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. In *Journal of Behavioral and Experimental Economics* 80, pp. 47–58. DOI: 10.1016/j.socec.2019.03.005.

IATA (2018): IATA Forecast Predicts 8.2 billion Air Travelers in 2037. Available online at https://www.iata.org/pressroom/pr/Pages/2018-10-24-02.aspx.

ICAO: Convention on International Civil Aviation. Ninth Edition.

ICAO (2019): Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Available online at https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx, checked on 8/7/2019.

ILO (2019): Vision Zero Fund. International Labour Organization. Available online at https://www.ilo.org/safework/projects/WCMS_517539/lang--en/index.htm, checked on 7/4/2019.

Infras (2012): Auswirkungen der Einführung der Luftverkehrssteuer auf die Unternehmen des Luftverkehrssektors in Deutschland.

INNOLAB (2017): Innovation infrastructures 4.0. A Position Paper to Support Germany´s Innovation Infrastructure with Respect to Networking, Development and Sustainability. Available online at http://www.innolab-livinglabs.de/downloads, checked on 8/13/2019.

IPCC (2019): Climate Change and Land. An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

Ivanova, Diana; Stadler, Konstantin; Steen-Olsen, Kjartan; Wood, Richard; Vita, Gibran; Tukker, Arnold; Hertwich, Edgar G. (2016): Environmental Impact Assessment of Household Consumption. In *Journal of Industrial Ecology* 20 (3), pp. 526–536. DOI: 10.1111/jiec.12371.

Jackson, Tim; Smith, Carmen (2018): Towards sustainable lifestyles: Understanding the policy challenge. In Alan Lewis (Ed.): The Cambridge handbook of psychology and economic behaviour. Second edition. Cambridge: Cambridge University Press.

Jahn, Thomas; Keil, Florian (2016): Reallabore im Kontext transdisziplinärer Forschung. In *GAIA - Ecological Perspectives for Science and Society* 25 (4), pp. 247–252. DOI: 10.14512/gaia.25.4.6.

Jannsen, Nils; Dudenhöfer, Ferdinand; Canzler, Weert; Knie, Andreas; Schneidewind, Uwe; Koska, Thorsten et al. (2019): Autoindustrie — auf dem richtigen Weg? In *Wirtschaftsdienst* 99 (7), pp. 451–469. DOI: 10.1007/s10273-019-2475-z.

Jetztke, Tobias; Richter, Stephan; Keppner, Benno; Domröse, Lena; Wunder, Stephanie; Ferrari, Arianna (forthcoming 2019): Trendanalyse Fleisch der Zukunft. Trendbericht zur Abschätzung der Umweltwirkungen von Insekten, pflanzlichen Fleischersatzprodukten und in-vitro-Fleisch. Edited by Umweltbundesamt.

John, Dominique; Empen, Jochen; Pscheidl, Charlotte (2017): Zur Situation in der deutschen Fleischindustrie. Standpunkte und Fallbeispiele. Edited by Deutscher Gewerkschaftsbund – Bundesvorstand. Berlin.

Kaenzig, Josef; Jolliet, Olivier (2006): Umweltbewusster Konsum. Schlüsselentscheide, Akteure und Konsummodelle. Edited by Bern Bundesamt für Umwelt (Umwelt-Wissen, 0616). Available online at https://www.bafu.admin.ch/dam/bafu/de/dokumente/wirtschaft-konsum/uw-umwelt-wissen/umweltbewusster_konsumschluesselentscheideakteureundkonsummodell.pdf.download.pdf/umweltbewusster_konsumschluesselentscheideakteureundkonsummodell.pdf.

Kahlenborn, Walter; Keppner, Benno; Uhle, Christian; Richter, Stephan; Jetzke, Tobias (2018): Die Zukunft im Blick: Konsum 4.0: Wie Digitalisierung den Konsum verändert. Trendbericht zur Abschätzung der Umweltwirkungen. Im Auftrag des Umweltbundesamtes. Dessau.

Kahneman, Daniel (2012): Schnelles Denken, langsames Denken. 23rd ed. München: Siedler.

Kalbar, Pradip P.; Birkved, Morten; Hauschild, Michael; Kabins, Simon; Nygaard, Simon Elsborg (2018): Environmental impact of urban consumption patterns: Drivers and focus points. In *Resources, Conservation and Recycling* 137, pp. 260–269. DOI: 10.1016/j.resconrec.2018.06.019.

Kalbar, Pradip P.; Birkved, Morten; Kabins, Simon; Nygaard, Simon Elsborg (2016): Personal Metabolism (PM) coupled with Life Cycle Assessment (LCA) model: Danish Case Study. In *Environment international* 91, pp. 168–179. DOI: 10.1016/j.envint.2016.02.032.

Kalmykova, Yuliya; Sadagopan, Madumita; Rosado, Leonardo (2018): Circular economy – From review of theories and practices to development of implementation tools. In *Resources, Conservation and Recycling* 135, pp. 190–201. DOI: 10.1016/j.resconrec.2017.10.034.

Kenning, Peter; Oehler, Andreas; Reisch, Lucia A.; Grugel, Christian (Eds.) (2017): Verbraucherwissenschaften. Rahmenbedingungen, Forschungsfelder und Institutionen. Wiesbaden: Springer Gabler.

Kenning, Peter; Raab, Gerhard; Reisch, Lucia A. (2014): Die Grenzen des „rationalen" Konsumierens – Empirische Erkenntnisse und verbraucherpolitische Konsequenzen. In *Journal für Verbraucherschutz und Lebensmittelsicherheit* 9 (3), pp. 263–295. DOI: 10.1007/s00003-014-0900-1.

Keyson, David V.; Guerra-Santin, Olivia; Lockton, Dan (Eds.) (2017): Living labs. Design and assessment of sustainable living. Cham: Springer.

Klima-Allianz Deutschland (Ed.) (2018): Wann, wenn nicht jetzt. Das Maßnahmenprogramm Klimaschutz 2030 der deutschen Zivilgesellschaft. Berlin. Available online at https://www.klima-allianz.de/fileadmin/user_upload/Maßnahmenprogramm2030_web.pdf.

Knie, Andreas (2018): Verbietet die Inlandsflüge! Edited by Klimareporter. Available online at https://www.klimareporter.de/verkehr/ueber-den-wolken-ist-die-freiheit-wohl-grenzenlos.

Köder, Lea; Burger, Andreas (2016): Umweltschädliche Subventionen in Deutschland. Aktualisierte Ausgabe 2016. UBA. Dessau-Roßlau. Available online at https://www.umweltbundesamt.de/publikationen/umweltschaedliche-subventionen-in-deutschland-2016.

Kodukula, Santhosh; Rudolph, Frederic; Jansen, Ulrich; Amon, Eva (2018): Living Moving Breathing. Ranking of European Cities in Sustainable Transport. Wuppertal Institut. Wuppertal. Available online at https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/living_moving_breathing_-_greenpeace_city_ranking_report_-_final.pdf, checked on 7/22/2019.

Kompetenzzentrum Textil & Bekleidung Niederrhein (2018): Blickpunkt: Digitalisiserung und CSR. csr.impuls.booklet. Edited by Kompetenzzentrum Textil & Bekleidung Niederrhein. Available online at https://www.csr-textil-bekleidung.de/, checked on 7/10/2019.

Korhonen, Jouni; Honkasalo, Antero; Seppälä, Jyri (2018): Circular Economy: The Concept and its Limitations. In *Ecological Economics* 143, pp. 37–46. DOI: 10.1016/j.ecolecon.2017.06.041.

Kostakis, Vasilis; Bauwens, Michel (2014): Network Society and Future Scenarios for a Collaborative Economy. London: Palgrave Macmillan UK.

Kraas, Frauke; Leggewie, Claus; Lemke, Peter; Matthies, Ellen; Messner, Dirk; Nakicenovic, Nebojsa et al. (2016): Humanity on the move: Unlocking the transformative power of cities. Flagship report. Berlin: Wissenschaftlicher Beirat d. Bundesregierung Globale Umweltveränderungen.

KRU (2017): Produktkennzeichnungsstelle zur Förderung der Ressourceneffizienz und Kreislauffähigkeit von Produkten. Edited by Ressourcenkommission am Umweltbundesamt (KRU).

KRU (2019): Substitutionsquote: Ein realistischer Erfolgsmaßstab für die Kreislaufwirtschaft. Edited by Ressourcenkommission am Umweltbundesamt (KRU).

Laakso, Senja; Lettenmeier, Michael (2016): Household-level transition methodology towards sustainable material footprints. In *Journal of Cleaner Production* 132, pp. 184–191. DOI: 10.1016/j.jclepro.2015.03.009.

Landers, Timothy F.; Cohen, Bevin; Wittum, Thomas E.; Larson, Elaine L. (2012): A review of antibiotic use in food animals: perspective, policy, and potential. In *Public health reports (Washington, D.C. : 1974)* 127 (1), pp. 4–22. DOI: 10.1177/003335491212700103.

Laschke, M.; Hassenzahl, M.; Diefenbach, S. (2014): Things with attitude: Transformational products. In : Create11 conference, pp. 1–2.

Lebensmittelzeitung (2019): GfK-Erhebung: Veggie-Trend stagniert bei Fleischalternativen. Available online at https://www.lebensmittelzeitung.net/industrie/GfK-Erhebung-Veggie-Trend-stagniert-bei-Fleischalternativen-139126, checked on 1/22/2019.

Lee, Joosung; Mo, Jeonghoon (2011): Analysis of Technological Innovation and Environmental Performance Improvement in Aviation Sector. In *International Journal of Environmental Research and Public Health* 8 (9), pp. 3777–3795. DOI: 10.3390/ijerph8093777.

Lehner, Matthias; Mont, Oksana; Heiskanen, Eva (2016): Nudging – A promising tool for sustainable consumption behaviour? In *Journal of Cleaner Production* 134, pp. 166–177. DOI: 10.1016/j.jclepro.2015.11.086.

Lettenmeier, Michael; Hirvilammi, Tuuli; Laakso, Senja; Lähteenoja, Satu; Aalto, Kristiina (2012): Material Footprint of Low-Income Households in Finland—Consequences for the Sustainability Debate. In *Sustainability* 4 (7), pp. 1426–1447. DOI: 10.3390/su4071426.

Lewis, Tania; Huber, Alison (2015): A Revolution in an Eggcup? In *Food, Culture & Society* 18 (2), pp. 289–307. DOI: 10.2752/175174415X14190821960798.

Liao, Meng-i; Chen, Pi-cheng; Ma, Hwong-wen; Nakamura, Shinichiro (2015): Identification of the driving force of waste generation using a high-resolution waste input–output table. In *Journal of Cleaner Production* 94, pp. 294–303. DOI: 10.1016/j.jclepro.2015.02.002.

Liedtke, Christa (2018): Design for sustainability. Available online at https://www.sustainablegoals.org.uk, checked on 8/13/2019.

Liedtke, Christa; Ameli, Najine; Buhl, Johannes; Oettershagen, Philip; Pears, Tristam; Abbis, Pablo (2013): Wuppertal Institute designguide. Background information & tools. Wuppertal: Wuppertal-Inst. für Klima Umwelt Energie (Wuppertal spezial, 46).

Liedtke, Christa; Baedeker, Carolin; Hasselkuß, Marco; Rohn, Holger; Grinewitschus, Viktor (2015): User-integrated innovation in Sustainable LivingLabs: an experimental infrastructure

for researching and developing sustainable product service systems. In *Journal of Cleaner Production* 97, pp. 106–116. DOI: 10.1016/j.jclepro.2014.04.070.

Liedtke, Christa; Bienge, Katrin; Wiesen, Klaus; Teubler, Jens; Greiff, Kathrin; Lettenmeier, Michael; Rohn, Holger (2014): Resource Use in the Production and Consumption System—The MIPS Approach. In *Resources* 3 (3), pp. 544–574. DOI: 10.3390/resources3030544.

Liedtke, Christa; Jolanta Welfens, Maria; Rohn, Holger; Nordmann, Julia (2012): LIVING LAB: user-driven innovation for sustainability. In *Int J of Sus in Higher Ed* 13 (2), pp. 106–118. DOI: 10.1108/14676371211211809.

Liobikienė, Genovaitė; Dagiliūtė, Renata (2016): The relationship between economic and carbon footprint changes in EU: The achievements of the EU sustainable consumption and production policy implementation. In *Environmental Science & Policy* 61, pp. 204–211. DOI: 10.1016/j.envsci.2016.04.017.

Liu, Chen; Valentine, Gill; Vanderbeck, Robert M.; McQuaid, Katie; Diprose, Kristina (2018): Placing 'sustainability' in context: narratives of sustainable consumption in Nanjing, China. In *Social & Cultural Geography* 22 (2), pp. 1–18. DOI: 10.1080/14649365.2018.1454978.

Lo, Ada; King, Brian; Mackenzie, Murray (2017): Restaurant customers' attitude toward sustainability and nutritional menu labels. In *Journal of hospitality marketing & management* 26 (8), pp. 846–867.

Lo, Alex Y. (2016): Small is green? Urban form and sustainable consumption in selected OECD metropolitan areas. In *Land Use Policy* 54, pp. 212–220. DOI: 10.1016/j.landusepol.2016.02.014.

Longo, Cristina; Shankar, Avi; Nuttall, Peter (2019): "It's Not Easy Living a Sustainable Lifestyle": How Greater Knowledge Leads to Dilemmas, Tensions and Paralysis. In *Journal of Business Ethics* 154 (3), pp. 759–779. DOI: 10.1007/s10551-016-3422-1.

Loorbach, Derk (2007): Transition management. New mode of governance for sustainable development. Utrecht: International Books.

los Rios, Irel Carolina de; Charnley, Fiona J.S. (2017): Skills and capabilities for a sustainable and circular economy: The changing role of design. In *Journal of Cleaner Production* 160, pp. 109–122. DOI: 10.1016/j.jclepro.2016.10.130.

Lou, Bo; Qiu, Yonghai; Ulgiati, Sergio (2015): Emergy-based indicators of regional environmental sustainability: A case study in Shanwei, Guangdong, China. In *Ecological Indicators* 57, pp. 514–524. DOI: 10.1016/j.ecolind.2015.03.017.

Luederitz, Christopher; Schäpke, Niko; Wiek, Arnim; Lang, Daniel J.; Bergmann, Matthias; Bos, Joannette J. et al. (2017): Learning through evaluation – A tentative evaluative scheme for sustainability transition experiments. In *Journal of Cleaner Production* 169, pp. 61–76. DOI: 10.1016/j.jclepro.2016.09.005.

Lyons, Kevin; Wearing, Stephen (2015): The Sharing Economy: Issues, Impacts and Regulatory Responses in the Context of the NSW Visitor Economy. Edited by NSW Business Chamber. Sydney.

Malier, Hadrien (2019): Greening the poor: the trap of moralization. In *The British journal of sociology*. DOI: 10.1111/1468-4446.12672.

Marquardt, Editha; West, Christina (2016): Co-Produktion von Wissen in der Stadt. Reallabor „Urban Office–Nachhaltige Stadtentwicklung in der Wissensgesellschaft" an der Universität Heidelberg. In *Technikfolgenabschätzung–Theorie und Praxis* 25 (3), pp. 26–31.

Maxwell-Smith, Matthew A.; Conway, Paul J.; Wright, Joshua D.; Olson, James M. (2018): Translating Environmental Ideologies into Action: The Amplifying Role of Commitment to Beliefs. In *Journal of Business Ethics* 153 (3), pp. 839–858. DOI: 10.1007/s10551-016-3404-3.

Meatless Monday (Ed.) (2019): NYC Expands Meatless Monday to All Schools — Reaching 1.1 Million Students Every Week. Available online at https://www.meatlessmonday.com/articles/nyc-expands-meatless-monday-schools/, checked on 7/16/2019.

Melkonyan, Ani; Krumme, Klaus (Eds.) (2019): Innovative Logistics Services and Sustainable Lifestyles. Interdependencies, Transformation Strategies and Decision Making. Cham: Springer International Publishing. Available online at http://dx.doi.org/10.1007/978-3-319-98467-4.

MietAnpG (1/1/2019): Mietrechtsanpassungsgesetz. In : Bundesgesetzblatt.

Millward-Hopkins, Joel; Gouldson, Andrew; Scott, Kate; Barrett, John; Sudmant, Andrew (2017): Uncovering blind spots in urban carbon management: the role of consumption-based carbon accounting in Bristol, UK. In *Regional Environmental Change* 17 (5), pp. 1467–1478. DOI: 10.1007/s10113-017-1112-x.

Mundt, Ingmar; Göll, Edgar (2018): Repair-Cafés. Fallbeispiel im Rahmen des Projekts Evolution2Green – Transformationspfade zu einer Green Economy.

Neitzke, H.-Peter; Moser, Stephanie; Kleinhückelkotten, Silke; Lannen, Anu; Bilharz, Michael (2016): Good intentions, big footprints: Facing household energy use in rich countries. Available online at https://boris.unibe.ch/89610/8/Moser_2016_Gute%20Absichten.pdf.

Nerurkar, Olive (2016): Designing Sustainable Fashion: Role of Psychosocial Factors of Fashion Consumption and the Challenges of Design. In *Indian Journal of Science and Technology* 9 (15). DOI: 10.17485/ijst/2016/v9i15/91980.

Niamir-Fuller, M. (2016): Towards sustainability in the extensive and intensive livestock sectors. In *Revue scientifique et technique (International Office of Epizootics)* 35 (2), pp. 371–387. DOI: 10.20506/rst.35.2.2531.

Niebank, Jan-Christian (2018): Bringing Human Rights into Fashion. Issues, challenges and underused potential in the transnational garment industry. Edited by German Institute for Human Rights. Available online at https://www.institut-fuer-menschenrechte.de/fileadmin/user_upload/Publikationen/ANALYSE/Analysis_Bringing_Human_Rights_into_Fashion.pdf, checked on 7/11/2019.

NKI (2019): Stromspar-Check (PLUS). Energiespar-Angebote für einkommensschwache Haushalte. Available online at https://www.klimaschutz.de/projekt/stromspar-check-plus-ssc-plus, checked on 8/14/2019.

Nobis, Claudia; Kuhnimhof, Tobias (2018): Mobilität in Deutschland – MiD Ergebnisbericht. infas, DLR, IVT, infas 360 (im Auftrag des BMVI). Bonn, Berlin. Available online at BMVI, infas, DLR, IVT, infas 360., checked on 7/23/2019.

Nordmann, Julia; Welfens, Maria J.; Fischer, Daniel; Nemnich, Claudia; Bookhagen, Britta; Bienge, Katrin; Niebert, Kai (2015): Die Rohstoff-Expedition. Entdecke, was in (d)einem Handy steckt. 2. Aufl. Berlin: Springer Spektrum. Available online at http://site.ebrary.com/lib/alltitles/docDetail.action?docId=11048010.

NPM, Arbeitsgruppe 1 "Klimaschutz im Verkehr" (2019): Zwischenbericht der AG1 Klimaschutz der NPM. Wege zur Erreichung der Klimaziele 2030 im Verkehrssektor. Edited by Bundesministerium für Verkehr und digitale Infrastruktur. Berlin. Available online at https://www.plattform-zukunft-mobilitaet.de/wp-content/uploads/2019/03/Zwischenbericht-03_2019-der-AG1-Klimaschutz-der-NPM-Wege-zur-Erreichung-der-Klimaziele-2030-im-Verkehrssektor.pdf, checked on 7/18/2019.

Ökolandbau.de (2018): Zahlen zum Ökolandbau in Deutschland. Available online at https://www.oekolandbau.de/landwirtschaft/biomarkt/oekoflaeche-und-oekobetriebe-in-deutschland/.

Onel, Naz; Mukherjee, Avinandan; Kreidler, Nicole Bieak; Díaz, Estela M.; Furchheim, Pia; Gupta, Shipra et al. (2018): Tell me your story and I will tell you who you are: Persona perspective in sustainable consumption. In *Psychology & Marketing* 35 (10), pp. 752–765. DOI: 10.1002/mar.21132.

Oroian, Camelia; Safirescu, Calin; Harun, Rezhen; Chiciudean, Gabriela; Arion, Felix; Muresan, Iulia; Bordeanu, Bianca (2017): Consumers' Attitudes towards Organic Products and Sustainable Development: A Case Study of Romania. In *Sustainability* 9 (9), p. 1559. DOI: 10.3390/su9091559.

Pandey, Rama Umesh; Surjan, Akhilesh; Kapshe, Manmohan (2018): Exploring linkages between sustainable consumption and prevailing green practices in reuse and recycling of household waste: Case of Bhopal city in India. In *Journal of Cleaner Production* 173, pp. 49–59. DOI: 10.1016/j.jclepro.2017.03.227.

Parodi, Oliver; Waitz, Colette; Bachinger, Monika; Kuhn, Rainer; Meyer-Soylu, Sarah; Alcántara, Sophia; Rhodius, Regina (2018): Insights into and Recommendations from Three Real-World Laboratories: An Experience-Based Comparison. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 52–59. DOI: 10.14512/gaia.27.S1.12.

Pelikán, Vojtěch; Galčanová, Lucie; Kala, Lukáš (2017): Ecological habitus intergenerationally reproduced: The children of Czech 'voluntary simplifiers' and their lifestyle. In *Journal of Consumer Culture* 13 (62), 146954051773656. DOI: 10.1177/1469540517736560.

Petersen, Rudolf; Reinert, Sandra (2018): Mobilität für morgen. In Oliver Schwedes (Ed.): Verkehrspolitik. Eine interdisziplinäre Einführung. 2. Aufl. 2018. Wiesbaden: Springer Fachmedien Wiesbaden, pp. 467–489.

Peyer, Mathias; Balderjahn, Ingo; Seegebarth, Barbara; Klemm, Alexandra (2017): The role of sustainability in profiling voluntary simplifiers. In *Journal of Business Research* 70, pp. 37–43. DOI: 10.1016/j.jbusres.2016.07.008.

Pfeiffer, Cynthia; Speck, Melanie; Strassner, Carola (2017): What Leads to Lunch—How Social Practices Impact (Non-)Sustainable Food Consumption/Eating Habits. In *Sustainability* 9 (8), p. 1437. DOI: 10.3390/su9081437.

Ploeger, Angelika; Hirschfelder, Gunther; Schönberger, Gesa (2011): Die Zukunft auf dem Tisch. Analysen, Trends und Perspektiven der Ernährung von morgen. 1. Aufl. Wiesbaden: VS Verl. für Sozialwiss. Available online at http://gbv.eblib.com/patron/FullRecord.aspx?p=799080.

Polanía Giese, Jan Christian; Keppner, Benno; Liedtke, Christa (forthcoming in 2019): Assessment report. Impacts of the digital transformation on consumption and their

implications for implementing the German Sustainability Strategy in, with and by Germany. adelphi. Berlin.

Poore, J.; Nemecek, T. (2018): Reducing food's environmental impacts through producers and consumers. In *Science (New York, N.Y.)* 360 (6392), pp. 987–992. DOI: 10.1126/science.aaq0216.

Popp, A.; Lotze-Campen, H.; Bodirsky, B. (2010): Food consumption, diet shifts and associated non-CO2 greenhouse gases from agricultural production. In *Global Environmental Change* (20), pp. 451–462.

Presse- und Informationsamt der Bundesregierung (2018): Deutsche Nachhaltigkeitsstrategie. Aktualisierung 2018. Die Bundesregierung. Available online at https://www.bundesregierung.de/resource/blob/975292/1559082/a9795692a667605f652981aa9b6cab51/deutsche-nachhaltigkeitsstrategie-aktualisierung-2018-download-bpa-data.pdf?download=1, checked on 7/4/2019.

ProVeg e.V.; Absolute Vegan Empire GmbH & Co. KG; Dennree GmbH; Golßener und mago Vertriebs oHG; Happy Cheeze GmbH; Hobelz Veggie World et al. (2019): Leitsatz für vegane und vegetarische Lebensmittel mit Ähnlichkeit zu Lebensmitteln tierischen Ursprungs. Gemeinsame Stellungnahme von ProVeg e.V. und Herstellenden.

Quack, Dietlinde; Brohmann, B.; Fischer, C.; Grießhammer, R.; Wolff, F.; Heyen, D. (2017a): Nachhaltiger Konsum - Strategien für eine gesellschaftliche Transformation. Working Paper. Öko-Institut e.V.

Quack, Dietlinde; Brohmann, Bettina; Fischer, Corinna; Grießhammer, Rainer; Wolff, Franziska (2017b): Nachhaltiger Konsum - Strategien für eine gesellschaftliche Transformation. Working Paper. Edited by Öko-Institut e.V.

Rapp, Amon; Marino, Alessandra; Simeoni, Rossana; Cena, Federica (2017): An ethnographic study of packaging-free purchasing: designing an interactive system to support sustainable social practices. In *Behaviour & Information Technology* 36 (11), pp. 1193–1217. DOI: 10.1080/0144929X.2017.1365170.

Reisch, L.; Bietz, S. (2014): Zeit für Nachhaltigkeit - Zeiten der Transformation: Elemente einer Zeitpolitik für die gesellschaftliche Transformation zu nachhaltigeren Lebensstilen. Bericht des AP 4.2. Zeppelin Universität. Friedrichshafen.

Reisch, Lucia A. (2015): Time Policies for a Sustainable Society. Cham: Springer International Publishing.

Reisch, Lucia A.; Sunstein, Cass R. (2016): Verhaltensbasierte Verbraucherpolitik. In Wolfgang Büscher, Jochen Glöckner, Axel Nordemann, Christian Osterrieth, Rudolf Rengier (Eds.): Marktkommunikation zwischen geistigem Eigentum und Verbraucherschutz. Festschrift für Karl-Heinz Fezer zum 70. Geburtstag. With assistance of Karl-Heinz Fezer. München: C.H. Beck, pp. 69–86.

RepaNet (2019): Re-Use Toolbox – Gütesiegel. Available online at https://www.repanet.at/re-use-toolbox/re-use-toolbox-guetesiegel/, checked on 8/8/2019.

Retamal, Monique; Schandl, Heinz (2018): Dirty Laundry in Manila: Comparing Resource Consumption Practices for Individual and Shared Laundering. In *Journal of Industrial Ecology* 22 (6), pp. 1389–1401. DOI: 10.1111/jiec.12696.

Reuter, Markus A. (2016): Digitalizing the Circular Economy. In *Metallurgical and Materials Transactions B* 47 (6), pp. 3194–3220. DOI: 10.1007/s11663-016-0735-5.

Reuter, Markus A.; van Schaik, Antoinette; Ballester, Miquel (2018): Limits of the circular economy: Fairphone modular design pushing the limits. In *Metallurgy–ERZMETALL* 71 (2).

Rhodius, R.; Pregernig, M.; Koch, B. (2016): Herausforderungen transdisziplinären Arbeitens im Reallabor Wissensdialog Nordschwarzwald. In *Technikfolgenabschätzung–Theorie und Praxis* 25 (3), pp. 19–25.

Riesner, André (2014): Bedeutung und Förderung von Mobilität in ländlichen Räumen. In *zfv* 139 (1), pp. 41–49.

Riisgaard, Henrik; Mosgaard, Mette; Overgaard Zacho, Kristina (2016): Local Circles in a Circular Economy – the Case of Smartphone Repair in Denmark. In *European Journal of Sustainable Development* 5 (1), pp. 109–124. DOI: 10.14207/ejsd.2016.v5n1p109.

Rogga, Sebastian; Zscheischler, Jana; Gaasch, Nadin (2018): How Much of the Real-World Laboratory Is Hidden in Current Transdisciplinary Research? In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 18–22. DOI: 10.14512/gaia.27.S1.6.

Röös, Elin; Bajželj, Bojana; Smith, Pete; Patel, Mikaela; Little, David; Garnett, Tara (2017): Greedy or needy? Land use and climate impacts of food in 2050 under different livestock futures. In *Global Environmental Change* 47, pp. 1–12. DOI: 10.1016/j.gloenvcha.2017.09.001.

Rosa, Hartmut; Paech, Niko; Habermann, Friederike; Haug, Frigga; Wittmann, Felix; Kirschenmann, Lena (2013): Zeitwohlstand. Wie wir anders arbeiten, nachhaltig wirtschaften und besser leben. München: Oekom.

rreuse (2017): Reduced taxation to support re use and repair. http://www.rreuse.org/wp-content/uploads/RREUSE-position-on-VAT-2017-Final-website_1.pdf.

Ruijsink, Saskia; Smith, Adrian (2016): European Network of Living Labs (EnoLL). Available online at http://www.transitsocialinnovation.eu/resource-hub/european-network-of-living-labs, checked on 8/13/2019.

Runder Tisch Reparatur (2019): Reparatur und Öffentliche Beschaffung. Leitfaden zur Operationalisierung der Reparatur von Produkten in der öffentlichen Beschaffung.

Sachs, J.; Schmidt-Traub, G.; Kroll, C.; Lafortune, G.; Fuller, G. (2018): SDG Index and Dashboards Report 2018. Global Responsibilities Implementing the Goals. Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN). New York.

Šajn, Nikolina (2019): Environmental impact of the textile and clothing industry. Briefing: What consumers need to know. Edited by European Union. European Parliamentary Research Service (EPRS). Available online at http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/633143/EPRS_BRI(2019)633143_EN.pdf, checked on 7/10/2019.

Salo, M.; Mattinen-Yuryev, M. K.; Nissinen, A. (2019): Opportunities and limitations of carbon footprint calculators to steer sustainable household consumption – Analysis of Nordic calculator features. In *Journal of Cleaner Production* 207, pp. 658–666. DOI: 10.1016/j.jclepro.2018.10.035.

Santarius, Tilman (2015): Der Rebound-Effekt (Wirtschaftswissenschaftliche Nachhaltigkeitsforschung, Band 18).

Sassatelli, Roberta (2015): Consumer Culture, Sustainability and a New Vision of Consumer Sovereignty. In *Sociologia Ruralis* 55 (4), pp. 483–496. DOI: 10.1111/soru.12081.

Schader, Christian; Muller, Adrian; Scialabba, Nadia El-Hage; Hecht, Judith; Isensee, Anne; Erb, Karl-Heinz et al. (2015): Impacts of feeding less food-competing feedstuffs to livestock on global food system sustainability. In *Journal of the Royal Society, Interface* 12 (113), p. 20150891. DOI: 10.1098/rsif.2015.0891.

Schäpke, Niko; Stelzer, Franziska; Bergmann, Matthias; Lang, Daniel J.; Wagner, Felix; Miller, Eric (2017): Real-world Laboratories and Transformation Research: Call for Papers: GAIA Open Access Special Issue. In *GAIA - Ecological Perspectives for Science and Society* 26 (1), pp. 55–57. DOI: 10.14512/gaia.26.1.12.

Schäpke, Niko; Stelzer, Franziska; Caniglia, Guido; Bergmann, Matthias; Wanner, Matthias; Singer-Brodowski, Mandy et al. (2018): Jointly Experimenting for Transformation? Shaping Real-World Laboratories by Comparing Them. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 85–96. DOI: 10.14512/gaia.27.S1.16.

Schlosberg, David (2019): From postmaterialism to sustainable materialism: the environmental politics of practice-based movements. In *Environmental Politics* 8 (4), pp. 1–21. DOI: 10.1080/09644016.2019.1587215.

Schmidt-Bleek, Friedrich (1998): MAIA : Einführung in die Material -Intensitäts-Analyse nach dem MIPS -Konzept. Basel: Birkhäuser.

Schneidewind, Uwe (2014): Urbane Reallabore: ein Blick in die aktuelle Forschungswerkstatt. In *PND online* (3).

Schneidewind, Uwe (2018): Die große Transformation. Eine Einführung in die Kunst gesellschaftlichen Wandels. With assistance of Manfred Fischedick, Stefan Lechtenböhmer, Stefan Thomas. Originalausgabe. Frankfurt am Main: Fischer Taschenbuch (Forum für Verantwortung, 70259).

Schneidewind, Uwe; Augenstein, Karoline; Stelzer, Franziska; Wanner, Matthias (2018): Structure Matters: Real-World Laboratories as a New Type of Large-Scale Research Infrastructure: A Framework Inspired by Giddens' Structuration Theory. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 12–17. DOI: 10.14512/gaia.27.S1.5.

Schneller, Andreas; Hennig, Carmen (2018): The Energy Transition Tax Credit (CITE) in France. Fact sheet. Ecofys; adelphi. Berlin. Available online at https://www.euki.de/wp-content/uploads/2018/09/fact-sheet-energy-transition-tax-credit-fr.pdf, checked on 8/14/2019.

Schönduwe, Robert; Lanzendorf, Martin (2014): Mobilitätsverhalten von Heranwachsenden und Möglichkeiten zur Bindung an den ÖPNV : eine Synthese des Forschungsstandes von deutschsprachiger und internationaler Forschungsliteratur. Frankfurt am Main: Univ.-Bibliothek Frankfurt am Main (Arbeitsgruppe Mobilitätsforschung, Inst. für Humangeographie (Frankfurt am Main) : Arbeitspapiere zur Mobilitätsforschung, Nr. 1).

Schröder, Patrick; Vergragt, Philip; Brown, Halina Szejnwald; Dendler, Leonie; Gorenflo, Neal; Matus, Kira et al. (2019): Advancing sustainable consumption and production in cities - A transdisciplinary research and stakeholder engagement framework to address consumption-based emissions and impacts. In *Journal of Cleaner Production* 213, pp. 114–125. DOI: 10.1016/j.jclepro.2018.12.050.

Schroeder, Patrick; Anantharaman, Manisha (2017): “Lifestyle Leapfrogging” in Emerging Economies: Enabling Systemic Shifts to Sustainable Consumption. In *J Consum Policy* 40 (1), pp. 3–23. DOI: 10.1007/s10603-016-9339-3.

Schroeder, Patrick; Anggraeni, Kartika; Weber, Uwe (2019): The Relevance of Circular Economy Practices to the Sustainable Development Goals. In *Journal of Industrial Ecology* 23 (1), pp. 77–95. DOI: 10.1111/jiec.12732.

Seely, Antony (2012): Taxing aviation fuel.

Senatsverwaltung für Umwelt, Verkehr und Klimaschutz (2019): Berlin steigt um – Senat fördert Lastenräder. Berlin. Available online at https://www.berlin.de/senuvk/verkehr/politik_planung/rad/lastenraeder/.

Shevchenko, Tetiana; Laitala, Kirsi; Danko, Yuriy (2019): Understanding Consumer E-Waste Recycling Behavior: Introducing a New Economic Incentive to Increase the Collection Rates. In *Sustainability* 11 (9), p. 2656. DOI: 10.3390/su11092656.

Shibin, K. T.; Gunasekaran, Angappa; Papadopoulos, Thanos; Dubey, Rameshwar; Mishra, Deepa (2016): Sustainable consumption and production: need, challenges and further research directions. In *International Journal of Process Management and Benchmarking* 6 (4), p. 447. DOI: 10.1504/IJPMB.2016.079678.

Shirani, Fiona; Butler, Catherine; Henwood, Karen; Parkhill, Karen; Pidgeon, Nick (2015): ‘I’m not a tree hugger, I’m just like you’: changing perceptions of sustainable lifestyles. In *Environmental Politics* 24 (1), pp. 57–74. DOI: 10.1080/09644016.2014.959247.

Sigala, Marianna (2017): Collaborative commerce in tourism: implications for research and industry. In *Current Issues in Tourism* 20 (4), pp. 346–355. DOI: 10.1080/13683500.2014.982522.

Sigill Kvalitetssystem AB (Ed.): Climate certification for food. Available online at http://www.klimatmarkningen.se/in-english.

Signori, Silvana; Forno, Francesca (2019): Consumer groups as grassroots social innovation niches. In *British Food Journal* 121 (3), pp. 803–814. DOI: 10.1108/BFJ-08-2018-0523.

Singer-Brodowski, Mandy; Beecroft, Richard; Parodi, Oliver (2018): Learning in Real-World Laboratories: A Systematic Impulse for Discussion. In *GAIA - Ecological Perspectives for Science and Society* 27 (1), pp. 23–27. DOI: 10.14512/gaia.27.S1.7.

Sippel, Maike; Meyer, Daniel; Scholliers, Niklas (2018): What about greenhouse gas emissions from students? An analysis of lifestyle and carbon footprints at the University of Applied Science in Konstanz, Germany. In *Carbon Management* 9 (2), pp. 201–211. DOI: 10.1080/17583004.2018.1440851.

Smith, Julie; Andersson, Gunilla; Gourlay, Robin; Karner, Sandra; Mikkelsen, Bent Egberg; Sonnino, Roberta; Barling, David (2016): Balancing competing policy demands: the case of sustainable public sector food procurement. In *Journal of Cleaner Production* 112, pp. 249–256. DOI: 10.1016/j.jclepro.2015.07.065.

Sonnenschein, Jonas; Smedby, Nora (2019): Designing air ticket taxes for climate change mitigation: insights from a Swedish valuation study. In *Climate Policy* 19 (5), pp. 651–663. DOI: 10.1080/14693062.2018.1547678.

Spangenberg, Joachim H.; Lorek, Sylvia (2002): Environmentally sustainable household consumption: from aggregate environmental pressures to priority fields of action. In *Ecological Economics* 43 (2-3), pp. 127–140. DOI: 10.1016/S0921-8009(02)00212-4.

Spanish Ministry of Agriculture, Fisheries and Food: I RE-USE! WHAT ABOUT YOU? Available online at http://reutilizayevitaco2.aeress.org/en/.

Springmann, Marco; Godfray, H. Charles J.; Rayner, Mike; Scarborough, Peter (2016): Analysis and valuation of the health and climate change cobenefits of dietary change. In *Proceedings of the National Academy of Sciences of the United States of America* 113 (15), pp. 4146–4151. DOI: 10.1073/pnas.1523119113.

SRU (2012): Umweltgutachten 2012: Verantwortung in einer begrenzten Welt. Berlin. Available online at https://www.umweltrat.de/SharedDocs/Downloads/DE/01_Umweltgutachten/2012_2016/2012_06_04_Umweltgutachten_HD.html.

SRU (2017): Umsteuern erforderlich: Klimaschutz im Verkehrssektor. 1. Auflage, digitale Originalausgabe. Berlin: Sachverständigenrat für Umweltfragen (SRU) (Sondergutachten).

Staatssekretärsausschuss für nachhaltige Entwicklung (2017): Nachhaltigkeit konkret im Verwaltungshandeln umsetzen - Maßnahmenprogramm Nachhaltigkeit. Beschluss vom 30. März 2015 Änderungsfassung vom 24. April 2017.

Statista GmbH (Ed.) (2017): Entwicklung des Umsatzes mit Fleischersatzprodukten in Deutschland in den Jahren 2010 bis 2020 (in Millionen US-Dollar). Available online at https://de.statista.com/statistik/daten/studie/769415/umfrage/entwicklung-verkaufter-fleischersatzprodukte-in-deutschland/, checked on 7/16/2019.

Statista GmbH (2018a): 124 Mio. Alt-Handys in der Schublade. Available online at https://de.statista.com/infografik/13203/anzahl-alt-handys-in-deutschen-haushalten/.

Statista GmbH (Ed.) (2018b): Umsatz mit pflanzlichen Milchprodukten und Milchalternativen nach Produkten in Deutschland in den Jahren 2013 bis 2017 (in Millionen US-Dollar). Available online at https://de.statista.com/statistik/daten/studie/948582/umfrage/umsatz-mit-veganen-milchprodukten-in-deutschland/, checked on 7/16/2019.

Statista GmbH (2019a): Anzahl der Beschäftigten im Schlachterei- und Fleischverarbeitungsgewerbe in Deutschland nach Segmenten in den Jahren 2008 bis 2018. Available online at https://de.statista.com/statistik/daten/studie/458903/umfrage/beschaeftigte-im-fleischverarbeitungsgewerbe-in-deutschland-nach-segmenten/.

Statista GmbH (2019b): Anzahl der Beschäftigten in der Milchverarbeitung in Deutschland in den Jahren 1995 bis 2018. Available online at https://de.statista.com/statistik/daten/studie/12527/umfrage/anzahl-der-beschaeftigten-in-der-milchverarbeitung-seit-1995/.

Statista GmbH (Ed.) (2019c): Nettoumsatz im Großhandel mit Fleisch und Fleischwaren in Deutschland in den Jahren 2002 bis 2017 (in Millionen Euro). Available online at https://de.statista.com/statistik/daten/studie/232468/umfrage/umsatz-im-grosshandel-mit-fleisch-und-fleischwaren-in-deutschland/, checked on 7/16/2019.

Statista GmbH (2019d): Number of transported air passengers in Germany from 2004 to. Available online at https://www.statista.com/statistics/590285/germany-number-air-passengers/.

Statistisches Bundesamt (2015): Einkommen, Konsum und Lebensbedingungen. Zeitverwendung. Wiesbaden. Available online at

https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Einkommen-Konsum-Lebensbedingungen/Zeitverwendung/_inhalt.html, checked on 8/13/2019.

Statistisches Bundesamt (2018): Private Haushalte in der Informationsgesellschaft – Nutzung von Informations- und Kommunikationstechnologien. Wiesbaden (Fachserie 15, 4).

Steen, Kris; van Bueren, E. M. (2017): Urban Living Labs. A living lab way of working,. Edited by University of Technology. Amsterdam Institute for Advanced Metropolitan Solutions. Delft.

Stehfest, Elke; Bouwman, Lex; van Vuuren, Detlef P.; den Elzen, Michel G. J.; Eickhout, Bas; Kabat, Pavel (2009): Climate benefits of changing diet. In *Climatic Change* 95 (1-2), pp. 83–102. DOI: 10.1007/s10584-008-9534-6.

Stephen, Andrew T. (2016): The role of digital and social media marketing in consumer behavior. In *Current Opinion in Psychology* 10, pp. 17–21. DOI: 10.1016/j.copsyc.2015.10.016.

Stewart, Bernard W.; Wild, Christopher P. (2014): World Cancer Report 2014. Online-ausg. Lyon: International Agency for Research on Cancer/World Health Organization (EBL-Schweitzer).

Stieß, Immanuel; Kresse, Sarah (2017): Entwicklungsportfolio - Energiewende und nachhaltiger Konsum. Edited by ISOE. Available online at http://transformation-des-energiesystems.de/sites/default/files/WiKo_Entwicklungsportfolio_Energie_Nachhaltiger_Konsum.pdf.

Stryja, Carola; Satzger, Gerhard; Dorner, Verena (2017): A decision support system design to overcome resistance towards sustainable innovations. In Proceedings of the 25th European Conference on InformationSystems (ECIS). Guimarães, Portugal. Available online at http://aisel.aisnet.org/ecis2017_rip/38, checked on 8/13/2019.

Sunstein, Cass R. (2014a): Nudges and Nudging: Sustainable Marketing–Focus Nudging. De små puffarnas styrka. Stockholm.

Sunstein, Cass R. (2014b): Nudging: A Very Short Guide. In *Journal of Consumer Policy* 37 (4), pp. 583–588. DOI: 10.1007/s10603-014-9273-1.

SVRV BMJV (2017): Digitale Souveränität. Sachverständigenrat für Verbraucherfragen des Bundesministeriums der Justiz und für Verbraucherschutz.

Swedish Tax Agency (2017): 15 miljarder kronor betalades ut för rot- och rutavdrag 2016. Available online at https://www.skatteverket.se/omoss/press/pressmeddelanden/2017/2017/15miljarderkronorbetaladesutforrotochrutavdrag2016.5.5c1163881590be297b55c8f.html.

Swedish Tax Agency (2019): Fastigheter och bostad. Rot- och rutarbete. Available online at https://www.skatteverket.se/privat/fastigheterochbostad/rotochrutarbete.4.2e56d4ba1202f95012080002966.html, checked on 8/8/2019.

Tappeser, Valentin; Chichowitz, Lisa (2017): Wärmeenergieverbrauch und Sanierungsbedarf von Gebäuden. Transformationsfeldanalyse im Rahmend des Projekts Evolution2Green - Transformationspfade zu einer Green Economy. Arbeitspapier. adelphi, Borderstep, IZT. Berlin.

Tappeser, Valentin; Weiss, Daniel; Kahlenborn, Walter (2016): Nachhaltigkeit 2.0 - Modernisierungsansätze zum Leitbild der nachhaltigen Entwicklung. Diskurs „Zeit und Zeitpolitik. Umweltbundesamt (Text 93/2017).

Teubler, Jens; Buhl, Johannes; Lettenmeier, Michael; Greiff, Kathrin; Liedtke, Christa (2018): A Household's Burden – The Embodied Resource Use of Household Equipment in Germany. In *Ecological Economics* 146, pp. 96–105. DOI: 10.1016/j.ecolecon.2017.10.004.

Thaler, Richard H.; Sunstein, Cass R. (2009): Nudge. Improving decisions about health, wealth, and happiness. Rev. and expanded ed., with a new afterword and a new chapter. New York, NY: Penguin.

The Danish Road Directorate (Ed.) (2016): The cycling fund 2009-2014. Preliminary evaluation study. Report 554 - 2016.

Thøgersen, John (2017): Sustainable food consumption in the nexus between national context and private lifestyle: A multi-level study. In *Food Quality and Preference* 55, pp. 16–25. DOI: 10.1016/j.foodqual.2016.08.006.

Thomas, A. (2012): Meat-free Thursdays yield multiple benefits. WWF. Available online at http://wwf.panda.org/?204421/Ghent-meat-free-Thursdays.

Thongplew, Natapol; Kotlakome, Ratchawut (2019): Getting a drink: An experiment for enabling a sustainable practice in Thai university settings. In *Journal of Cleaner Production* 218, pp. 294–303. DOI: 10.1016/j.jclepro.2019.02.006.

Tölkes, Christina; Butzmann, Elias (2018): Motivating Pro-Sustainable Behavior: The Potential of Green Events—A Case-Study from the Munich Streetlife Festival. In *Sustainability* 10 (10), p. 3731. DOI: 10.3390/su10103731.

Tripathi, Avinash; Singh, Manvendra Pratap (2016): Determinants of sustainable/green consumption: a review. In *International Journal of Environmental Technology and Management* 19 (3/4), p. 316. DOI: 10.1504/IJETM.2016.082258.

TU Dresden (2015): Sonderauswertung zum Forschungsprojekt Mobilität in Städten – SrV 2013. Städtevergleich. Dresden.

Tukker, Arnold; Cohen, Maurie J.; Hubacek, Klaus; Mont, Oksana (2010): The Impacts of Household Consumption and Options for Change. In *Journal of Industrial Ecology* 14 (1), pp. 13–30. DOI: 10.1111/j.1530-9290.2009.00208.x.

UBA (2016a): Nudge-Ansätze beim nachhaltigen Konsum: Ermittlung und Entwicklung von Maßnahmen zum „Anstoßen“ nachhaltiger Konsummuster. Forschungskennzahl 3714 93 303 0. Berlin.

UBA (2016b): Power-to-Liquids – Potentials and Perspectives for the Future Supply of Renewable Aviation Fuel.

UBA (2017): Daten. Luftbelastung. Luftschadstoff-Emissionen in Deutschland. Stickstoffoxid-Emissionen. Dessau-Roßlau. Available online at https://www.umweltbundesamt.de/daten/luftbelastung/luftschad-stoff-emissionen-in-deutschland/stickstoffoxid-emissionen#textpart-1.

UBA (2019a): Emissionen des Verkehrs. Dessau. Available online at https://www.umweltbundesamt.de/daten/verkehr/emissionen-des-verkehrs#textpart-2, checked on 7/23/2019.

UBA (2019b): Flugreisen. Available online at https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/flugreisen, checked on 7/16/2019.

UMID (2017): UMID: Umwelt + Mensch Informationsdienst.
Schwerpunkt: Antibiotikaresistenzen. Bundesamt für Strahlenschutz (BfS), Bundesinstitut für Risikobewertung (BfR), Robert Koch-Institut (RKI), Umweltbundesamt (UBA) (2/2017), checked on 2/26/2019.

Umweltbundesamt (2016): Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz".

Umweltbundesamt (2017): Development of consumption-based land use indicators. Synthesis report.

Umweltbundesamt (2018): Produkte länger nutzen: Gewährleistung, Reparatur und Neukauf. Available online at https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/elektrogeraete/produkte-laenger-nutzen-gewaehrleistung-reparatur#textpart-1.

Umweltbundesamt (2019a): Konsum und Umwelt: Zentrale Handlungsfelder. Available online at https://www.umweltbundesamt.de/themen/wirtschaft-konsum/konsum-umwelt-zentrale-handlungsfelder#textpart-1, updated on 5/23/2019.

Umweltbundesamt (2019b): Blauer Engel für Computer. Available online at https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/siegelkunde/blauer-engel-fuer-computer, updated on 8/7/2019.

UNEP (2010): Assessing the Environmental Impacts of Consumption and Production: Priority Products and Materials,. Report of the Working Group on the Environmental Impacts of Products and Materials to the International Panel for Sustainable Resource Management. With assistance of Hertwich, E., van der Voet, E., Suh, S., Tukker, A., Huijbregts M., Kazmierczyk, P., Lenzen, M., McNeely, J., Moriguchi, Y.

Valdes, Victor (2015): Determinants of air travel demand in Middle Income Countries. In *Journal of Air Transport Management* 42, pp. 75–84. DOI: 10.1016/j.jairtraman.2014.09.002.

van der Linden, Sander (2015): Exploring Beliefs About Bottled Water and Intentions to Reduce Consumption. In *Environment and Behavior* 47 (5), pp. 526–550. DOI: 10.1177/0013916513515239.

van Huy; Chi, Mai; Lobo, Antonio; Nguyen, Ninh; Long, Phan (2019): Effective Segmentation of Organic Food Consumers in Vietnam Using Food-Related Lifestyles. In *Sustainability* 11 (5), p. 1237. DOI: 10.3390/su11051237.

Vaughan, Robert; Daverio, Raphael (2016): Assessing the size and presence of the collaborative economy in Europe. Luxembourg: Publications Office of the European Union.

Vehmas, Kaisa; Raudaskoski, Anne; Heikkilä, Pirjo; Harlin, Ali; Mensonen, Aino (2018): Consumer attitudes and communication in circular fashion. In *Journal of Fashion Marketing and Management* 22 (3), pp. 286–300.

Vergragt, Philip J.; Dendler, Leonie; Jong, Martin de; Matus, Kira Jen Mendelsohn (2016): Transitions to Sustainable Consumption and Production in Cities. In *Journal of Cleaner Production* 134, pp. 1–12.

Voytenko, Yuliya; McCormick, Kes; Evans, James; Schliwa, Gabriele (2016): Urban living labs for sustainability and low carbon cities in Europe: towards a research agenda. In *Journal of Cleaner Production* 123, pp. 45–54. DOI: 10.1016/j.jclepro.2015.08.053.

VZBV (2019): Über uns. Energie sparen – besser leben. Available online at https://www.verbraucherzentrale-energieberatung.de/ueber_uns/, checked on 8/15/2019.

Wagner, Felix; Ertner, Stephan (2016): Reallabore für nachhaltiges Wissen - Forschung für und mit Zukunft. In *GAIA - Ecological Perspectives for Science and Society* 25 (1), pp. 57–58. DOI: 10.14512/gaia.25.1.12.

Wang, Sumei (2016): Green practices are gendered: Exploring gender inequality caused by sustainable consumption policies in Taiwan. In *Energy Research & Social Science* 18, pp. 88–95. DOI: 10.1016/j.erss.2016.03.005.

Weinmann, Markus; Schneider, Christoph; vom Brocke, Jan (2016): Digital Nudging. In *Business & Information Systems Engineering* 58 (6), pp. 433–436. DOI: 10.1007/s12599-016-0453-1.

Weitz, Heinrich (2019): Preisentwicklung im Baugewerbe. Hauptverband der Deutschen Bauindustrie e.V. Available online at https://www.bauindustrie.de/zahlen-fakten/bauwirtschaft-im-zahlenbild/preisentwicklung-im-baugewerbe_bwz/, checked on 8/14/2019.

Welch, Daniel; Southerton, Dale (2019): After Paris: transitions for sustainable consumption. In *Sustainability: Science, Practice and Policy* 15 (1), pp. 31–44. DOI: 10.1080/15487733.2018.1560861.

Welfens, Maria Jolanta; Nordmann, Julia; Seibt, Alexandra (2016): Drivers and barriers to return and recycling of mobile phones. Case studies of communication and collection campaigns. In *Journal of Cleaner Production* 132, pp. 108–121. DOI: 10.1016/j.jclepro.2015.11.082.

Wiedenhofer, Dominik; Guan, Dabo; Liu, Zhu; Meng, Jing; Zhang, Ning; Wei, Yi-Ming (2017): Unequal household carbon footprints in China. In *Nature Climate Change* 7 (1), pp. 75–80. DOI: 10.1038/nclimate3165.

Wiedmann, Thomas; Lenzen, Manfred (2018): Environmental and social footprints of international trade. In *Nature Geoscience* 11 (5), p. 314. DOI: 10.1038/s41561-018-0113-9.

Wiesen, Klaus; Saurat, Mathieu; Lettenmeier, Michael (2014): Calculating the Material Input per Service Unit using the Ecoinvent Database. In *International Journal of Performability Engineering* 10 (4), pp. 357–366.

Wilson, Amy L.; Buckley, Elizabeth; Buckley, Jonathan D.; Bogomolova, Svetlana (2016): Nudging healthier food and beverage choices through salience and priming. Evidence from a systematic review. In *Food Quality and Preference* 51, pp. 47–64. DOI: 10.1016/j.foodqual.2016.02.009.

Wirth, Timo von; Fuenfschilling, Lea; Frantzeskaki, Niki; Coenen, Lars (2019): Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation. In *European Planning Studies* 27 (2), pp. 229–257. DOI: 10.1080/09654313.2018.1504895.

Wolfram, Marc; Frantzeskaki, Niki; Maschmeyer, Steffen: Cities, systems and sustainability: status and perspectives of research on urban transformations. In *Current Opinion in Environmental Sustainability* 22, pp. 18–25.

Young, William; Hwang, Kumju; McDonald, Seonaidh; Oates, Caroline J. (2010): Sustainable consumption: green consumer behaviour when purchasing products. In *Sustainable Development* 18 (1), 20-31. DOI: 10.1002/sd.394.

Zeit Online (Ed.) (2013): Grüne wollen fleischlosen Tag in Kantinen. Available online at https://www.zeit.de/politik/deutschland/2013-08/vegetarier-kantine-kuenast, checked on 7/24/2019.

Zepf, Volker; Reller, Armin; Rennie, Cameron; Ashfield, Morgan; Simmones, John; Achzet, Benjamin (2014): Materials critical to the energy industry. An introduction. University of Augsburg.

Zink, Trevor; Geyer, Roland (2017): Circular Economy Rebound. In *Journal of Industrial Ecology* 21 (3), pp. 593–602. DOI: 10.1111/jiec.12545.

# 7 Appendix

## 7.1 Methodology for analysing the scientific discourse

### 7.1.1 Analyzing the scientific discourse

For shedding light on recent developments in the scientific discourse on sustainable consumption a two-step methodology comprising text mining and qualitative content analysis was applied. First, a high level analysis of the research landscape was performed for identifying general thematic trends. Second, based on these results, recommendations found in the analysed documents and other thematically relevant scientific publications were extracted and aggregated manually. The methodology is based on the R package textility[15] (Bickel 2019).

In the first step, a selection of documents (corpus) from relevant sources was compiled for generating a thematic map of the research field. Table 8 provides an overview of the sources. Due to the diversity of the texts regarding their length, longer documents, e.g., of the German scientific advisory councils, were limited to the sentences containing the term "consumption" plus one sentence before and after. This limitation served to focus on relevant content only. Furthermore, the German documents were limited to noun phrases and selected adjectives and verbs only for focussing on the most relevant concepts in the texts. In addition, the terms were harmonized by reducing them to their word stems.

Prominent keywords and overarching themes in the corpus were identified via wordclouds and topic models. Wordclouds basically visualize the frequencies of terms. Topic modelling, here using the basic Latent Dirichlet Allocation (LDA), is a machine learning method for automatically identifying groups of statistically related terms on the basis of term co-occurrence. Methodological details are provided in the Appendix. Wordcloud and topics models were generated for each German institution, e.g., each scientific advisory council. This way the nuances promoted by individual institutions could be highlighted. The international discourse, here, in the form of abstracts from SCOPUS, was studied as a whole. More detailed models of the international discourse might be subject to further studies.

The keywords resulting from the wordclouds and topic models were manually clustered into overarching cross-cutting themes (see section 4.1 "Key themes identified in the scientific discourse"). Definition of these themes was based on studying the data and expert knowledge, while acknowledging that alternative thematic clusters might be defined.

Furthermore, for highlighting how the key areas for sustainable consumption such as mobility are contextualised by the German scientific advisory councils, different proxy words, e.g.,

[15] R packages are an extension to the base R language, i.e., an open source high-level programming language that was originally developed for statistical computing. The textility package utilizes various other packages for establishing a pipeline for applied text mining and provides comprehensive examples of applied code.

individual transport or clothing, were used to extract the sentences plus one sentence before and after containing these central key words from the documents published by the councils. The frequencies of terms in these sentences indicate the context of the proxy words and allow several conclusions regarding key areas of consumption reported in section 4.2 “Contextualisation of key areas of consumption by scientific advisory councils”.

In the second step, relevant recommendations for achieving sustainable consumption in the identified trending thematic fields and the cross-cutting areas were extracted from the corpus manually. These were screened and synthesized to key recommendations. Furthermore, a gap analysis was performed for highlighting emerging topics that do not yet belong to the mainstream scientific discourse but are deemed highly relevant for the future (see section 4.3).

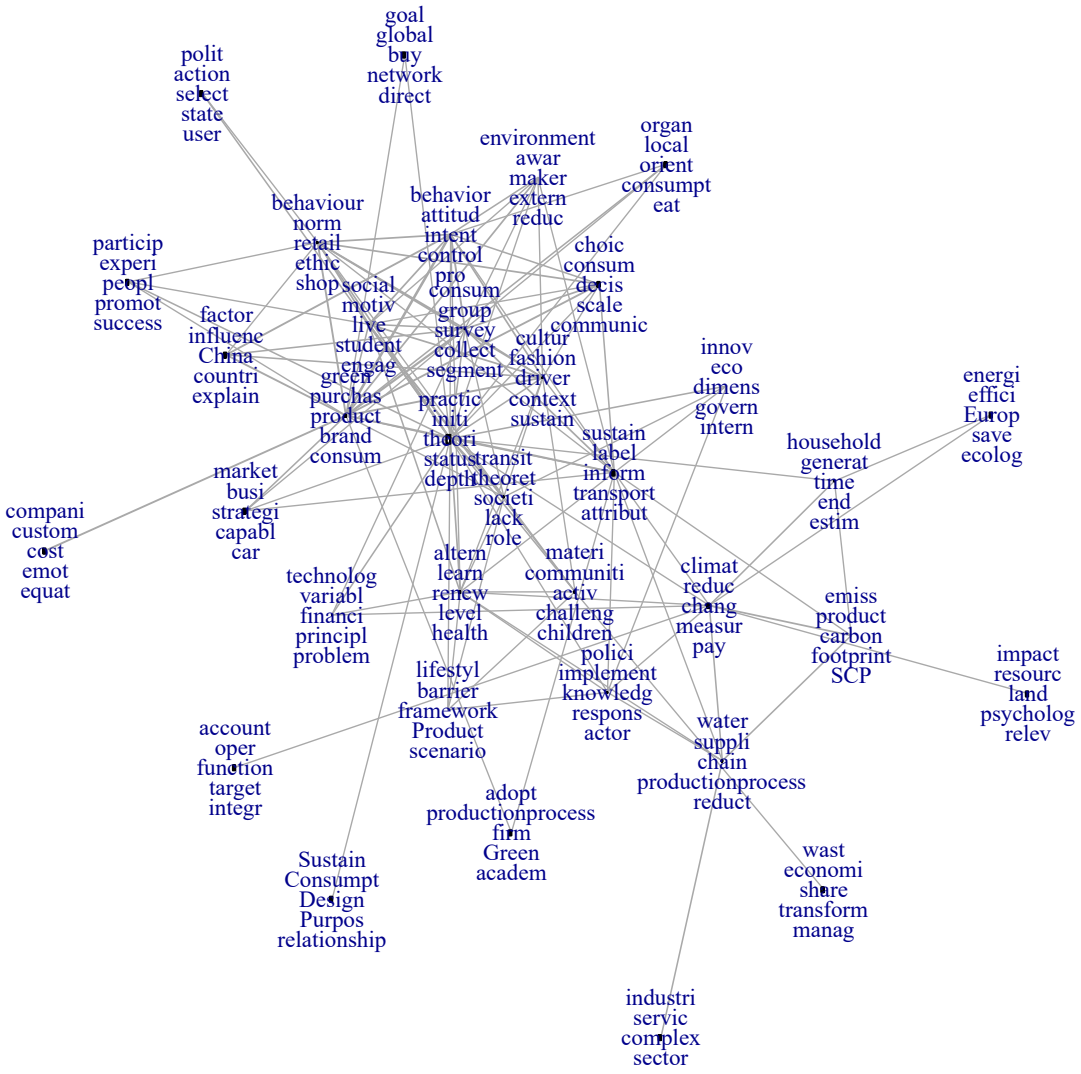
**Table 8 Sources considered for analyzing the scientific discourse**

| Source | Content |
|---|---|
| Scientific advisory councils to the German government | Documents published since 2015 by 16 councils. In total, there are 17 councils. However, after removing simple press releases or short communications from the selection, documents of 16 councils remain; Only sentences containing the term “consumption” plus one sentence before and after were considered. This applies to the figures in the Appendix. For the figures in Chapter 4 other search terms were used for extracting sentences. A detailed list of documents considered is provided below |
| Scopus | 929 abstracts from journal articles; search string (shortened version): sustainab*“ AND “consumption“ |
| FONA projects | Project profiles of the 30 FONA projects carried out from 2014 to 2019; only projects containing the term “consumption” were considered |
| UBA | Documents published in the series UBA Texte since 2015; only sentences containing the term “consumption” plus one sentence before and after were considered |
| NaWi | Project profiles of the 30 NaWI projects carried out from 2014 to 2019; only projects containing the term “consumption” were considered |

**Figure 3: Wordclouds of publications since 2015 by all scientific advisory councils (upper left), the WBGU (upper right), the UBA in the "Texte" series (lower left), or in FONA (lower right)**


Note: Only the sentences containing the term "consumption" plus one sentence before and after were considered; term frequencies are weighted with TF-IDF (term frequency – inverse document frequency); colors highlight classes of term frequencies.

**Figure 4: Topic network based on 929 scientific abstracts on SCP published since 2015 indexed in SCOPUS**




Note: Topics are lists of terms that statistically co-occur (based on Latent Dirichlet Allocation); connections between topics indicate how often topics (not terms) co-occur; the figure shows the 15% strongest topic connections identified in a model with a total of 40 topics (topics without strong connections are not shown)

wissenschaftsplattform_
nachhaltigkeit
2030

# Impressum


**Herausgeber**

Lenkungskreis Wissenschaftsplattform Nachhaltigkeit 2030

Geschäftsstelle Wissenschaftsplattform Nachhaltigkeit 2030
Dr. Falk Schmidt | Leiter der Geschäftsstelle
Institute for Advanced Sustainability Studies e.V. (IASS)
Berliner Straße 130
14467 Potsdam

Tel: +49 (0) 331-28822-456
Fax: +49 (0) 331-28822-310
Email: falk.schmidt@iass-potsdam.de

**ViSdP**

Prof. Dr. Dirk Messner, Co-Vorsitzender
Prof. Dr. Patrizia Nanz, Co-Vorsitzende
Prof. Dr. Martin Visbeck, Co-Vorsitzender

wissenschaftsplattform_
nachhaltigkeit
2030

# Über die wpn2030

**Die Plattform**

**Die Wissenschaftsplattform Nachhaltigkeit 2030 ist ein zentraler Ort der Wissenschaft, an dem sie drängende Fragen der Nachhaltigkeitspolitik reflektiert** und diskutiert – im Austausch mit Politik, Wirtschaft und Gesellschaft. Wissen für Nachhaltigkeit wird dort zusammengetragen und weitergetragen, insbesondere im Hinblick auf die Umsetzung der Deutschen Nachhaltigkeitsstrategie. Die Plattform arbeitet unabhängig und ist systematisch eingebunden in den offiziellen politischen Steuerungs-, Dialog- und Umsetzungsprozess der Agenda 2030. Träger der Plattform sind SDSN Germany, DKN Future Earth und das IASS Potsdam

**Mitglieder des Lenkungskreises**

Günther Bachmann, Marianne Beisheim, Jetta Frost, Jörg Hacker, Reiner Hengstmann, Thomas Holtmann, Adolf Kloke-Lesch (ex officio), Stephan Lessenich, Kai Lindemann, Karsten Löffler, Ursula Mathar, Dirk Messner (Co-Vorsitzender), Klaus Milke, Alexander Müller, Patrizia Nanz (Co-Vorsitzende), Jürgen Renn, Ulrike Schell, Falk Schmidt (ex officio), Dennis Snower, Olaf Tschimpke, Martin Visbeck (Co-Vorsitzender), Markus Vogt, Joachim von Braun, Hilmar von Lojewski, Marion Weissenberger-Eibl

**Vorsitzende des Lenkungskreises**

Prof. Dr. Dirk Messner
Prof. Dr. Patrizia Nanz
Prof. Dr. Martin Visbeck

**Kontakt**

**Geschäftsstelle Wissenschaftsplattform Nachhaltigkeit 2030**
c/o Institute for Advanced Sustainability Studies e.V. (IASS)
Berliner Str. 130, 14467 Potsdam
Tel.: +49–331–28822–456
www.wpn2030.de, info.wpn2030@iass-potsdam.de

**Gefördert durch**

Bundesministerium für Bildung und Forschung

FONA Forschung für Nachhaltige Entwicklung BMBF