Sustainability in Research and Teaching
Chair of Logistics, TU Berlin

TU Berlin
Chair of Logistics

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Contents

Motivation and Research Focus

Motivation for Sustainability Research

Numerous countries and companies have pledged to reach zero net-emissions by 2050, following the guidelines set by multiple COP meetings. As logistics is responsible for around 22% of worldwide emissions, it is essential to tackle decarbonization and sustainable logistics design in research and practice.

Urban Sustainability

Cities are focal points for economic activities and operate under a field of tension among global, societal and ecological challenges. . By investigating sustainable drive technologies, transport modes and the development of adapted logistics concepts, we contribute to achieving these goals within the framework of this research field.

Logistics Network Sustainability

Globally active logistics networks are a driver for international wealth but also emissions. These networks underly an increasing complexity along with different restrictions. Our research contributes to the visibility and understanding of logistics networks, enabling higher efficiency and better design towards meeting sustainability goals.

Sustainability Trends in Logistics Networks

Optimization of Transportation Modes

- Electrification of traditional transport (high importance for **urban transport** especially)
- Shift to **environmental-friendly transportation modes** (train, bikes and inland waterway vessels)
- Trip avoidance

Use of AI and Automation

- AI & Automation to **reduce waster** and **inefficiencies**
- **Resource consumption management**
- **Avoidance** of **environmentally harmful special processes** in the event of disruptions

Responsible Sourcing & Procurement

- Focus on **fair wages** and **sustainable production** in the **upstream supply chain**

Governmental Regulations

- Increasing **pressure from government agencies** on companies to **reduce CO2 emissions**

Customer Behavior

- Rising **customer demand** for **sustainable origin, production** and **reusability** increases the **pressure** on **logistics systems**

Logistics Definition and Fields of Action

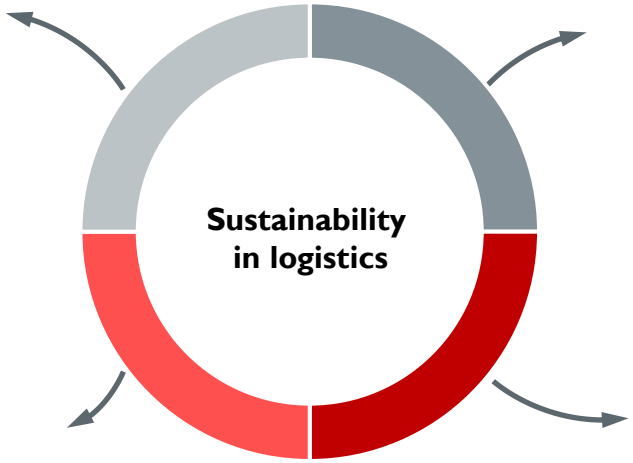
By smart logistics we mean the holistic, customer-oriented planning and control of highly integrated and automated information and goods flows in the customer order and innovation process of value creation networks.

Awareness

- Understanding of sustainability
- Sustainability in logistics strategy
- Stakeholder analysis

Transparency

- Measurement of sustainability and levers in logistics
- Minimum standards and certifications



Actions

- Selection of logistics service providers
- Integration of product development and production
- Logistics planning process
- Network and transport planning
- Urban logistics

Goals and governance

- Key figures and target system
- Decision criteria
- Application process and organizational anchoring

Ecological Sustainability in Logistics Can Be Achieved in Various Areas

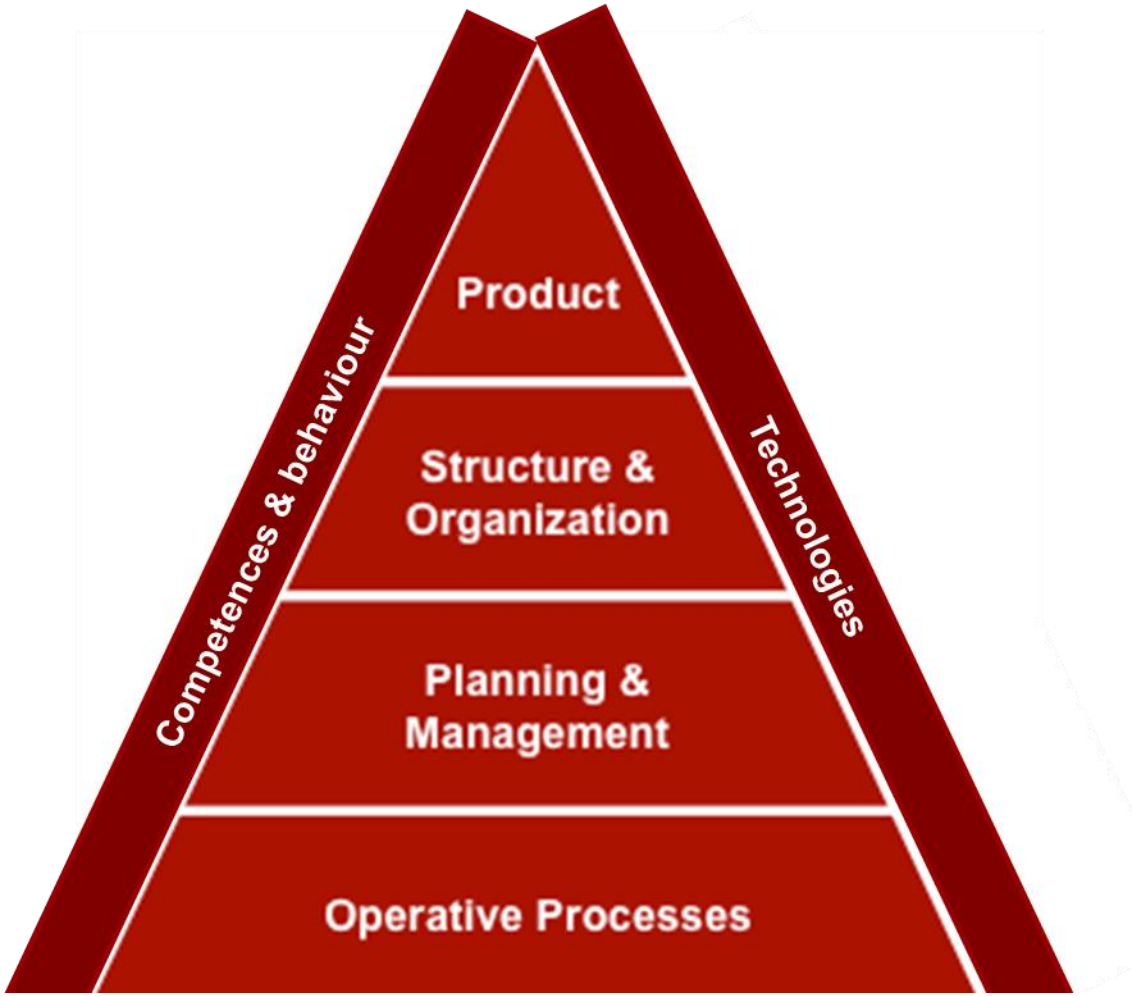
Scope

All Products

Entire Value Chain

Single Business Functions

Single Tasks and Processes



Overview of Research Activities in Sustainability

General Contributions

Prof. Dr.-Ing. Frank Straube was called to be part of the Global Knowledge Network for Sustainable Logistics and Growth in Washington in 2013

Innovation Award at Hannover Messe in 2017 for the development of a wholistic emission reporting system

Contribution to DIN SPEC 91224 with a practice orientated emission reporting system

Research on the use of technology and network design to lower emissions of logistics systems

Researchprojects

Use of sustainable drive technologies and reorganization of urban transport:

- Mobility2Grid – Part 1 and 2
- Route Charge
- Smart e-User
- Distribut(e)

Network visibility and sustainable network design:

- ILNET
- SMECS
- SELECT
- BestLog
- MULi-Project
- Sustainable Supply Chains
- IPLOGE
- ASONG
- SUDlogER

Dissertations

Christina Wiederer
Overcoming logistics-related barriers to higher value international trade: Evidence from middle income countries and implications for policymakers and financiers.

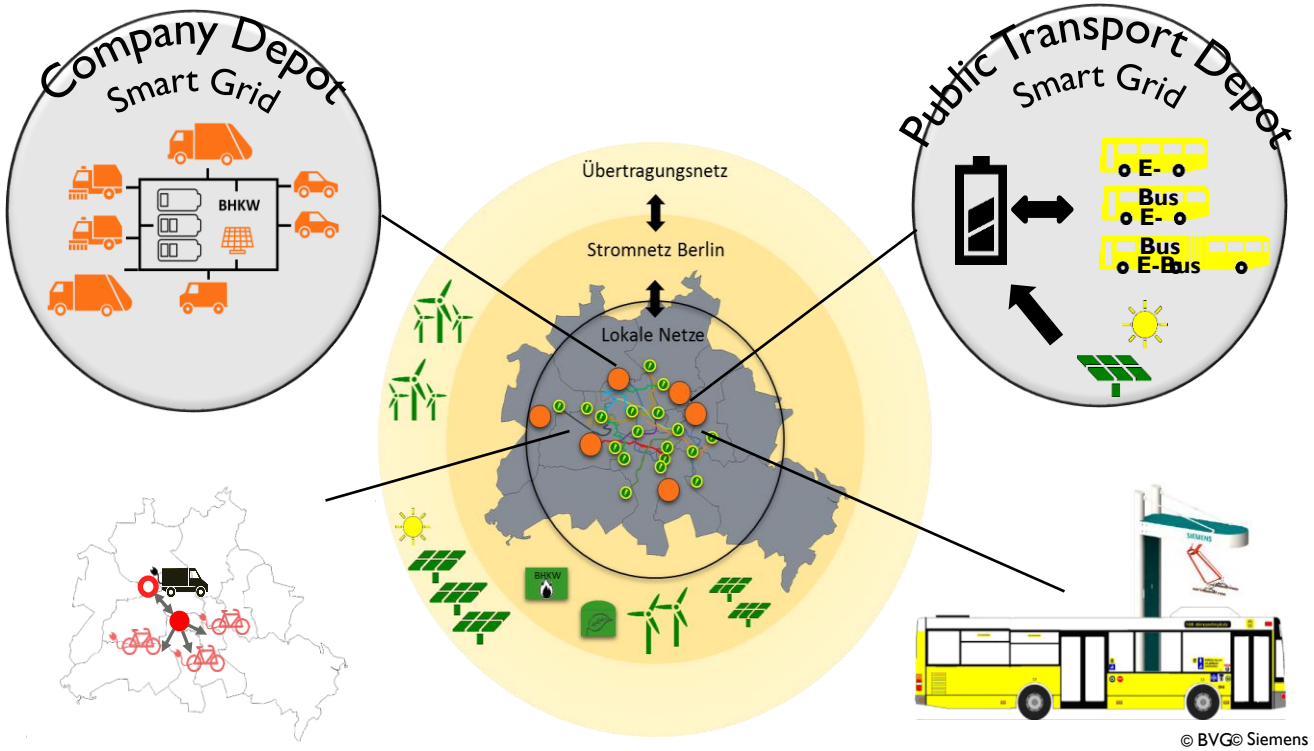
Dustin Schöder
Techno-economic evaluation of the use of battery electric commercial vehicles in the distribution of consumer goods

Juliana Campos
Integrated framework for managing sustainable supply chain practices

Anfried Nagel
Logistics in the Context of Sustainability - Ecological Sustainability as a Target Variable in the Design of Logistics Networks

Sustainability in Urban Mobility and Transport
Mobility2Grid - Thinking Energy Transition and Transport Together!

Forschungscampus Mobility 2 Grid EUREF



Development of electrified urban transport systems and integration of decentralized logistics hubs

Sub-Project Urban Logistics

Current trends and developments do not remain without influence on logistics. In addition to customer requirements, there are ecological and traffic developments that demand smart solutions from urban logistics. In addition, there are government initiatives and targets that also need to be taken into account.

A micro city hub is a comparatively small, inner-city logistics area where logistics activities (e.g. interim storage, transshipment, order picking) can be carried out. It is located in close proximity to the areas it serves. From a logistical and transport perspective, the implementation of Micro City Hubs in existing logistics networks can realize ecological, social and economic potentials. These are being investigated within the framework of the urban logistics sub-project.

Sustainablity through AI-based Systems
SMECS and SELECT – ETA-Forecasts for Transport Networks

Development of an AI-based IT-System to enable smart decision making in logistics networks

The Results of AI-Based Systems

- Using historic transport data as well as data for external factors over a span of multiple years, different AI-models and methods were used to enable precise ETA-forecasts
- Combination of machine learning methods lead to models with over 80% forecast accuracy and demonstrators enabling network partners to make informed and automated decisions
- Increased transparency leads to more sustainable network and resource planning

ETA-Forecasts for Transport Chains

Decsision Making Assistance for Partners

Digital Exchange of ETA & Process Information

	Door-to-Port Transports along Roads and Rail	Port-to-Port Transports via Inland Shipping	
Scope			Scope
Project	SMECS – SMART EVENT FORECAST FOR SEAPORTS	SELECT – Smarte Entscheidungsassistenz für Logistikketten der **Binnenschifffahrt** durch **ETA-Prognosen**	Project
Partner	TU Berlin, DB, KLU	TU Berlin, BEHALA, Deutsche Binnenreederei, duisport, Imperial logistics, modal	Partner
Duration	01.09.2017 – 29.02.2020 *(completed)*	01.03.2020 – 28.02.2023 *(in progress)*	Duration

Bundesministerium für Verkehr und digitale Infrastruktur

IHATEC Innovative Hafentechnologien

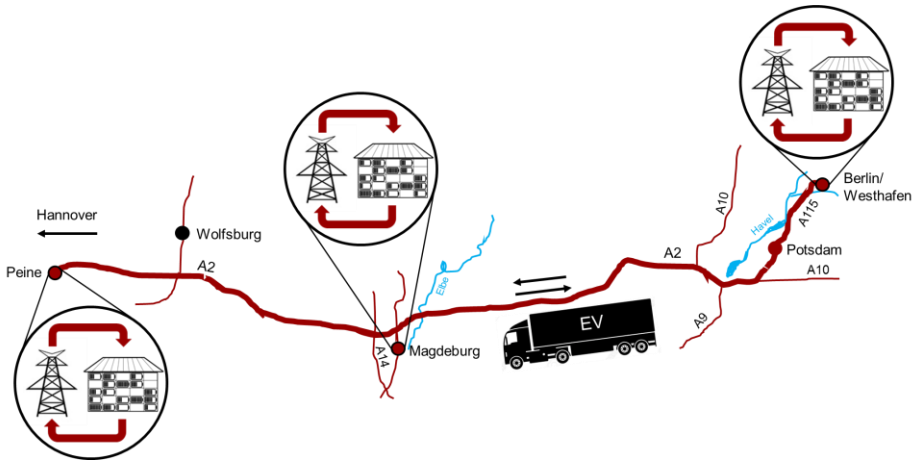
Sustainability through Technology
Route Charge – Battery Swap in Road Freight Transport Logistics

Motivation

Field tests to date have shown that electro mobile vehicles can only be operated within a narrow logistical corset - typically as an inner-city distribution vehicle with low tour variance. The goal is therefore to develop and implement a concept that enables the advantages of an electro mobile vehicle and at the same time guarantees the fleet operator the freedom of disposition comparable to that of a diesel vehicle. The aim is to improve the economic acceptance of electric commercial vehicles so that the share of electric vehicles in the fleet can grow more strongly than before.

Goal

The aim of this project is to open up medium distances (300 km) for freight transport with electrically powered commercial vehicles and to include long-distance supply chains in distribution logistics with e-NFZs.
The use of battery exchange stations is intended to broaden the possible range of applications for e-NCVs from the point of view of the fleet operator, thereby achieving further progress in the economic viability of e-NCVs.



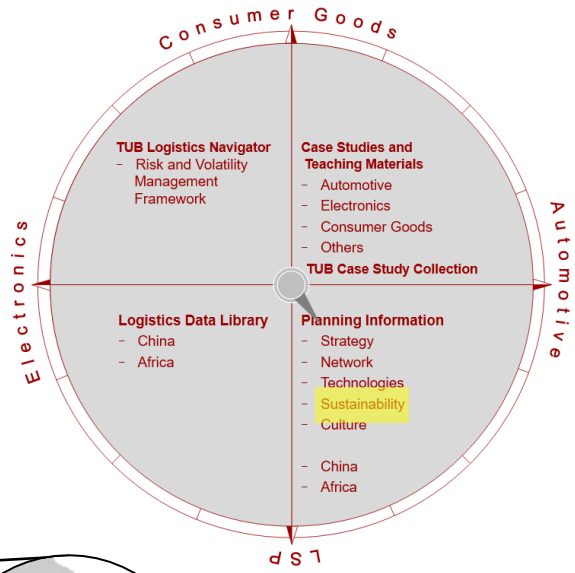
Dual-use: Depending on battery and control power demand, the batteries in the alternating battery station feed the grid with power, on the other hand, the batteries can be charged from the power grid.

The e-trucks developed during the project do not require a longer charging time to restore the ranges, but have modularly replaceable battery units.

Sustainability through Logistics Network Visibility | TUB Logistics Navigator

TUB Logistics Navigator

- The overall goal of the Navigator Tool is to **support practitioners** in **planning robust logistics networks**.
- It helps to **visualize supply chains**.
- It aims to **accumulate supply chain data** that is **widely spread** among different departments and suppliers.
- It provides **valuable planning information**, **logistics data** and **management concepts** for different steps of supply chain planning to **improve supply chain robustness**
- **Knowledge data base for research findings on international logistics networks generated bei ILNET and beyond**



What the Tool is not

- The tool is **not a strategic optimization tool** that automatically adjusts your network to fit an optimal solution.

Freely available at:

https://navigator.logistik.tu-berlin.de/

endowed by

KÜHNE-STIFTUNG

Activities of Chair of Logistics (TU Berlin) in with African countries | We seek to contribute to the sustainable development of African countries by teaching innovation and logistics performance improvements

Competence Center for International Logistics Networks

Focus: Advance research on current trends and strategies in international logistics networks at the interplay of digital technologies and the development of sustainable, robust international logistics networks, especially with Europe and Africa **endowed by** KÜHNE-STIFTUNG

Close cooperation | **Research & Cooperation with Africa** | **Generation of Synergies**

IPLogE (DAAD) / Ethiopia: Joint **improvement of practice oriented logistics teaching** at **Addis Ababa University**

SUDLogER (DAAD): Joint improvement of logistics teaching in the field of **sustainable city logistics and mobility concepts** at **University of Rwanda**

Log4Jobs (BMZ): Research project on **reducing food loss in East Africa** through efficient logistics and contribute to **sustainable job creation**

ASONG (DAAD): Research and training project on creating **affordable sustainability for logistics networks** in Ghana together with the KNUST

Founding member: **Pan African Mobility Alliance** (BMZ/GIZ)

Focus Countries

Ethiopia | **Rwanda** | **Ghana**

Focus Topics

Sustainable logistics network design | **Logistics performance improvements** | **Teaching improvement** | **Digital technologies in logistics networks** | **Intra-African trade**

Overview of Sustainability in Teaching

Motivation for Sustainability Teaching

As evidenced for instance by the large number of students participating in Fridays for Future activities prior to Covid-19, sustainability and the future of the planet are high up on the agenda of the current generation of students.

In almost every lecture, students demand more sustainability content, to be well equip to face future challenges.

A significant number of students visit the chair of logistics, as they have identified smart logistics strategies and network design to have a great impact on global sustainability, and want to acquire skills and knowledge to make an impact.

Sustainability Contents in Teaching

Lectures

Every lecture has parts associated with sustainability topics.
Especially **Global Logistics Management** and **Transport Logistics** focus on the sustainability of global networks. International Co-Working seminars discuss the influence of logistics on sustainability in Sub-Saharan Afrika.

Symposiums and Excursions

At least once a year, the chair organizes a symposium around a current topic in logistics research. Sustainability is always an aspect of the current topics, being in line with the interests of the students.
Beyond this, different excursions to industry partners in the Berlin area allow hands on observations of new sustainable technologies.

Digital Tools and Case Studies

Software such as RStudio or AnyLogistix is used to evaluate data sets of logistics networks based on their performance, but also their environmental impact.
Students are tasked to use these tools for decision making in various tasks and case studies, to get an insight in practice orientated balancing of environmental and economical needs.

Bachelor and Master Theses

Every year, the chair contributes to over 60 theses around logistics topics. A significant number of the theses is written about sustainability in logistics, both in urban an global contexts.
Many other theses focusing on other topics still evaluate the sustainability impact of their findings, in line with societies current needs.

DIN SPEC 91224

1. Selection Reporting Level	2. Selective Data Collection	3. Data Transmission
Company Transport category Relation Consignment	Determination of required disclosures depending on reporting level and disclosure of result data	Transmission of data in DIN SPEC standardized data format

Example of data fields dependent on report level:

	Datenbereich						
	Transport-kategorie	Sendung	Absender	Empfänger	Transportabschnitt	Fahrzeug	Fahrt/Ergebnis
Berichtsebene	**Auszufüllende Datenfelder**						
Unternehmen							
Transport-kategorie							
Relation							
Sendung							

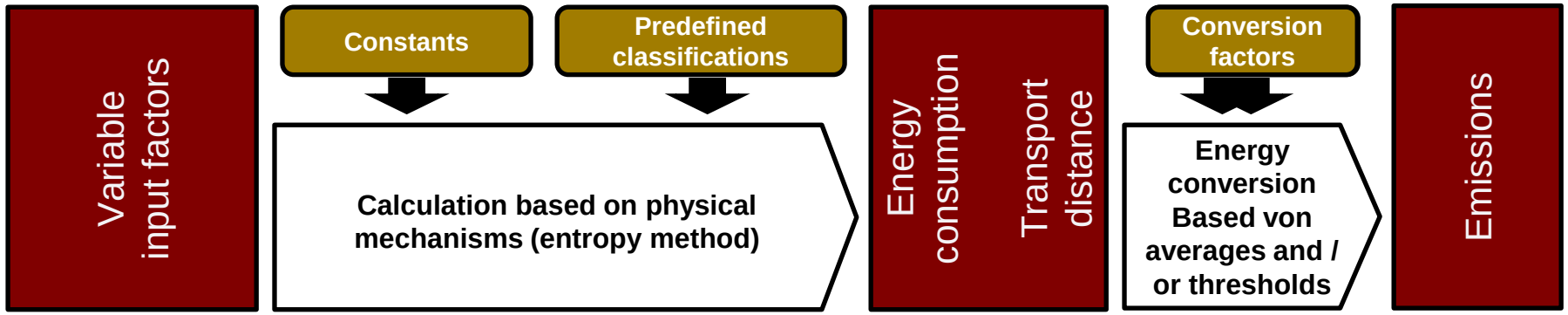
Pflichtangabe nach DIN SPEC 91224

Optional nach bilateraler Abstimmung

Nicht notwendig nach DIN SPEC 91224

- **Uniform data retrieval** from logistics service providers at the sub-service providers used
- **Uniform preparation** and transmission of **data** to clients
- Use of the service provider data for **emissions balancing** in a uniform process/system
- Query/use of data, e.g. for service provider **evaluation** during commissioning
- **Dissemination of the standard**, e.g. by specifying the reporting format for the assignment

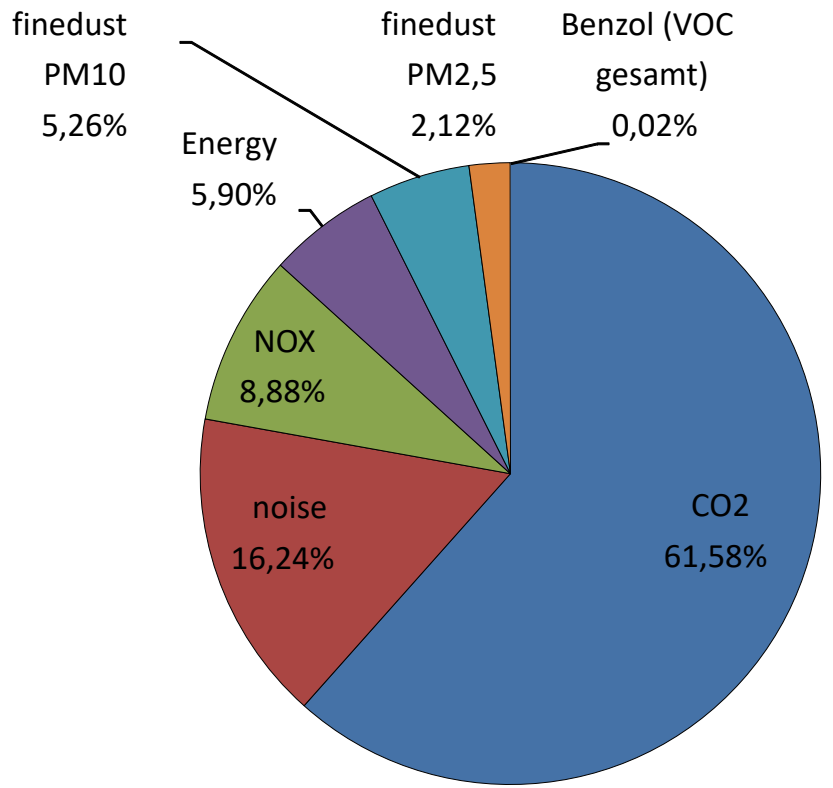
Green Logstics Assessment (1/2)



- **High level of detail:** Method for different transport modes and handling processes based on physical mechanisms (entropy method)
- **Universality:** Determination of different types of emissions within logistics processes including CO_2, NO_X, benzene, fine dust, area, noise, waste emissions
- **Decision and planning support:**
  - Tool-based determination of emission factors and ecological KPIs
  - Standardization of different types of emissions based on “pollution points”
  - Designation of comparable ecological KPIs (e.g. ecological efficiency) and visualization of the computed result

Green Logistics Assessment (2/2)

- Method of ecological scarcity as a concept to weight environmental impacts (record-manage)
- Different environmental impacts are converted into “pollution points” (UBP) and can then be compared.
- Ecological factors consist of
  - characterization (optional)
  - standardization
  - weight
- Input values for the calculation of ecological factors
  - current ecological situation
  - standardization of the current ecological situation in relation to a reference value
  - target situation recommended by environmental policy (priorities of the environmental policy of the government)
- Unit of an ecological factor is “pollution point” (UBP) per emission unit, e.g. 33.8 UBP per kg CO_2



Immediate Future of Sustainability in our Research

Recently Started Projects: Mobility2Grid & ASONG

Only recently started, these projects still have a lot of work ahead of them, but tackle major sustainability questions.
M2G aims to advance the use of hydrogen fueled trucks and other vehicles in logistics networks. Simulations and tests in large scale use cases can provide important insights to shape the future of hydrogen mobility and the infrastructure required to allow the use of green technologies on a national transport structure level. ASONG will help implement affordable and sustainable logistics networks in Ghana.

Research Project – DISTILL

The future path towards zero net emissions leaves former fossil fuel regions in decline. These regions, formerly thriving on coal deposits, now need to change along with the use of new energy sources.
DISTILL aims to shift the coal based economical strength of the Lausitz region towards being a European center for logistics activities, leveraging the region's location in central Europe. Digital tools are set to bring transparency and efficiency to the region.

New Teaching Module

Industrial Engineering students make up a great part of all students visiting logistics lectures. These students not only want to have lectures, where sustainability is a side subject.
To meet this demand, the GKWi of the TU Berlin is planning a combined lecture with relevant input from industry-focused chairs, to contribute to an overall view and approach to sustainability in complex industrial value networks. The interdisciplinary curriculum will allow for interesting experiences and discussions for and with the students.

Future Dissertations

The same movement observed in students can be seen in research associates: sustainability is a valuable research field. Currently active researchers contribute to the discourse on sustainability in literature, and aim to write corresponding dissertations. Future works are set to contain evaluations of urban supply chain control towers, sustainability frameworks for management and the impact of autonomous logistics networks on sustainability.