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# Pathways to Sustainable Mobility at Universities - a Case Study at the Environmental Campus Birkenfeld

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**Abstract.** More and more universities are recognizing their role model and creative function in society and are acting accordingly - also in terms of mobility. In this way, universities can make an important contribution to climate protection, as mobility is responsible for more than 20 percent of global greenhouse gas emissions. The GreenMetric ranking also takes the area of mobility into account via the Transportation category, which is weighted at 18%. This paper uses the example of the Environmental Campus Birkenfeld at Trier University of Applied Sciences, Germany, to show what opportunities universities in rural areas have to reduce transportation-related emissions of students and employees. The possibilities of avoiding transportation as well as different solutions for the reduction of transportation-related greenhouse gas emissions are discussed. Furthermore, conflicts of objectives inherent to the university system in the area of mobility are considered, especially in the area of internationalization.

## Keyword:

Sustainable Transportation, Sustainable Mobility, Low-Emission Vehicles, Climate Protection, Sustainable Universities, Environmental Campus Birkenfeld

## 1. Introduction

The Sustainable Development Goals (SDGs) do not address mobility as a singular goal, but the concept of mobility is closely connected to the achievement of all targets of SDG 11 *Sustainable Cities and Communities* and SDG 13 *Climate Action*. Mobility is indispensable for social participation and therefore an integral part of a just and inclusive society. “Leaving no one behind” as overarching premise to all SDGs implies movement – to *leave behind* means to move, to *not leave behind* means to ensure movement is inclusive for all. Mobility is therefore inextricably interwoven with the central premise of “Leaving no one behind.” Therefore, how and where mobility and sustainability can be interconnected is essential to

achieving a global sustainable transition.

Universities contribute through education and research to enable the great transition towards sustainability. In doing so, they are not only responsible for integrating sustainability into teaching (Education for Sustainable Development), but also deliver through sustainable research and the transfer of the knowledge gained into society. It should not be forgotten that universities must also make their operations sustainable. It follows that universities must also ensure sustainable mobility for students and staff. This will guarantee that students and staff can participate in university life. By offering sustainable mobility options, universities can also make a contribution to climate protection. This article shows how universities can develop concepts for sustainable mobility and what is important in this context. The sustainability requirements defined in the category "Transportation" of the UI GreenMetric Ranking will also be addressed. Using the example of the Environmental Campus Birkenfeld of Trier University of Applied Sciences, the currently implemented and future planned solutions for sustainable mobility at a university campus in a rural area are presented.

## 2. Pathways to sustainable mobility at universities

The pursue of sustainable mobility is one of the greatest environmental challenges nowadays, not only because of the fact that mobility is responsible for about 20% of the global greenhouse gas emissions [1]. Within the last 50 years transport emissions have almost tripled due to growing populations and economies. Our current mobility system also has multiple negative impacts on human health, ecosystems and biodiversity. It requires a people mind shift, where the use of private vehicles give way to different modes of public transport like buses, bicycles, car sharing, electric cars, and walking lanes. This new call to make mobility sustainable has already been undertaken by policymakers and public managers in many urban contexts around the world, as well as, more recently, by the managers of university systems. Figure 1 shows different solutions for a sustainable transition of mobility systems which have been summarized by the German Federal Environmental Agency (Umweltbundesamt). The presented ways to an environmentally friendly mobility should be considered in the development of a mobility concept by and for universities.

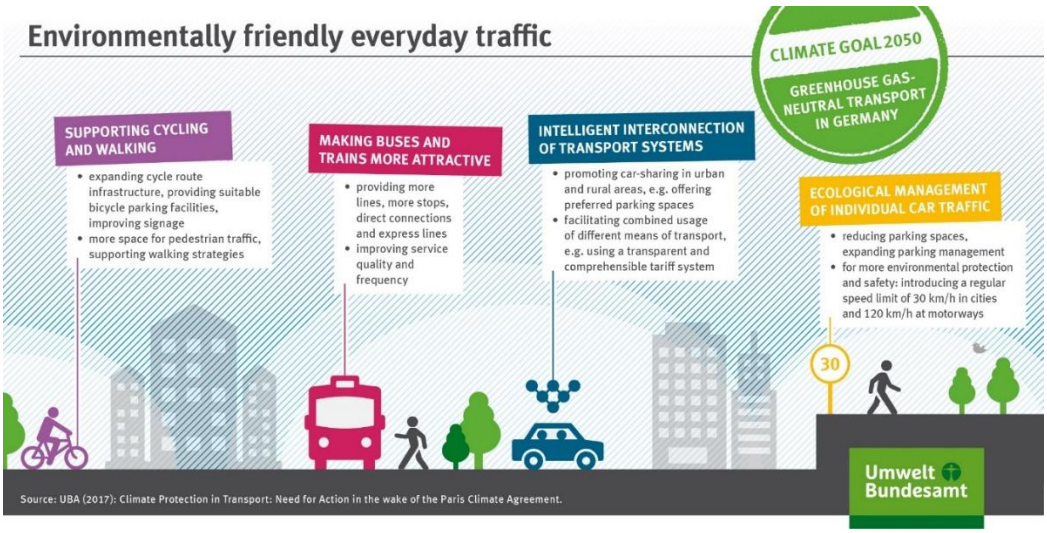


Figure 1. Paths to environmentally friendly mobility [2]

## 2.1. Development of an action plan for sustainable mobility

Changing the mobility system at a university is a complex task which needs the cooperation of several stakeholders. Figure 2 shows an action plan for developing a mobility concept for a university location. This action plan [3] consists of four steps, which can also be run through several times in the sense of the Plan-Do-Check-Act cycle and thus lead to a continuous improvement of the mobility concept, taking into account changing framework conditions.

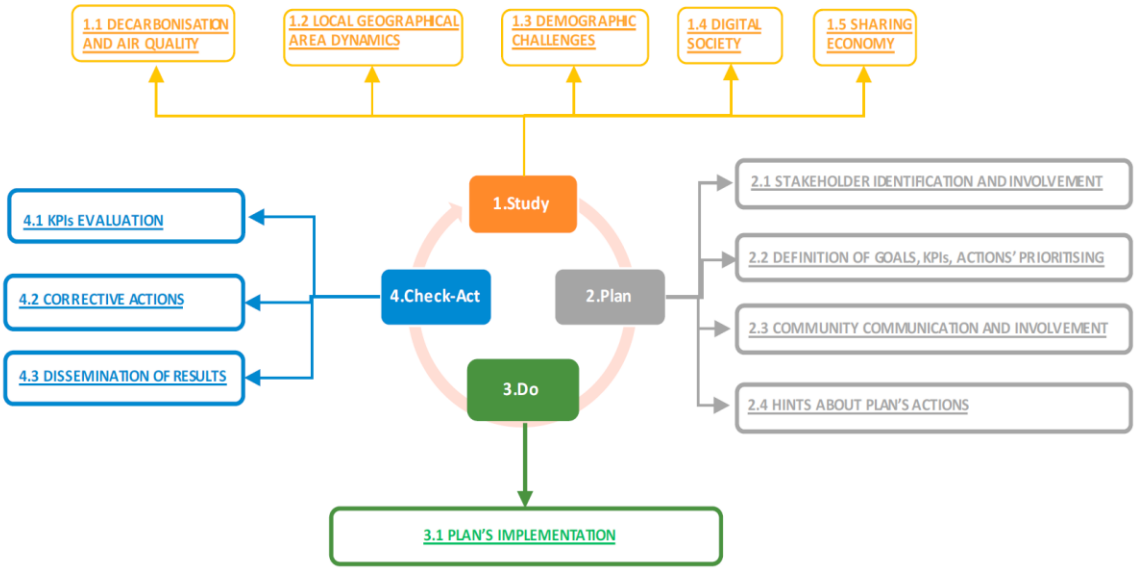


Figure 2. Action plan for sustainable mobility at universities [3]

In the first step, "Study", the initial situation is analyzed so that all the necessary basic data are available for the following steps. The inclusion of stakeholders and the local community are essential prerequisites for the definition of targets and key performance Indicators (KPIs) in step two "Plan". In step three "Do" the implementation of the planned measures takes place and in step four "Check & Act" it is checked whether the objectives could be achieved and if necessary corrective measures are initiated. The process model briefly presented here is only suitable for the comprehensive realignment of the mobility concept of universities, but can also be used for individual measures, such as the introduction of a ride-sharing app. The approach ensures that there are clearly defined goals and responsibilities for their implementation and for checking that the goals have been achieved. Through the precise analysis of the initial situation and the existing framework conditions as well as the involvement of stakeholders and the university environment, the outlined approach offers the best conditions for developing a university-specific action plan for sustainable mobility.

## 2.2. UI GreenMetric criteria for sustainable transportation

The UI GreenMetric Ranking, which was developed by Universitas Indonesia in 2010, offers a holistic approach to assessing the sustainability activities of universities. In 2010, 95 universities from 35 countries participated in the UI GreenMetric Ranking, and the number of participants has been steadily increasing ever since. In 2022, 1,050 universities from 85 countries worldwide participated in the ranking. The large number of participating universities underlines the importance of the UI GreenMetric Ranking, which can be

classified as the world's leading sustainability ranking for universities. The evaluation is based on a transparent rating system that enables a multidimensional and comprehensible assessment of the participating universities. Table 1 shows the six categories of the UI GreenMetric Ranking and the maximum number of points achievable in each case [4]. For each category, the GreenMetric Ranking contains a weighted selection of indicators on which the participating universities must provide information. On the basis of predefined evaluation schemes, the points achieved per indicator are calculated and summed up for the respective category. As an example, Table 2 shows the key figures of the "Transportation" category, in which a maximum of 1,800 points can be achieved.

Table 1. Categories and weighting UI GreenMetric Ranking [4]

| **GreenMetric-categories** | **Points (max.)** |
|---|---|
| Setting and Infrastructure (SI) | 1,500 |
| Energy and Climate Change (EC) | 2,100 |
| Waste (WS) | 1,800 |
| Water (WR) | 1,000 |
| Transportation (TR) | 1,800 |
| Education and Research (ED) | 1,800 |
| Total | 1,000 |

Table 2. Category Transportation in detail [4]

| **Transportation (TR)** | **Points (max.)** |
|---|---|
| TR 1: The total number of vehicles (cars and motorcycles) divided by the total campus' population | 200 |
| TR 2: Shuttle services | 300 |
| TR 3: Zero-Emission Vehicles (ZEV) policy on campus | 200 |
| TR 4: The total number of Zero-Emission Vehicles (ZEV) divided by the total campus' population | 200 |
| TR 5: The ratio of ground parking area to the total campus' area | 200 |
| TR 6: Program to limit or decrease the parking area on campus for the last 3 years (from 2020 to 2022) | 200 |
| TR 7: Number of initiatives to decrease private vehicles on campus | 200 |
| TR 8: The pedestrian path on campus | 300 |
| Total | 1,800 |

Mobility aspects play an important role in the UI GreenMetric ranking, accounting for 18 percent of the total points. Essentially, the selected subcategories are aimed at relieving the campus of private vehicles and reducing parking areas. In addition, the transition to zero-emission vehicles, which can be cars, two-wheelers, bicycles and scooters, is rated positively. In addition, the safety of pedestrians is considered. The focus is therefore on the daily journey of students and staff to the university and on initiatives to make it more environmentally friendly. A major factor for transport-related emissions is not explicitly considered, the business trips of teachers, researchers and staff by train, car or plane. Air travel in particular is often a decisive factor for internationally active universities and contributes up to 50% to mobility-related emissions [5]. At this point, of course, there is a conflict of objectives between the international networking of universities and the avoidance of greenhouse gas emissions. From the author's point of view, this blind spot in

the GreenMetric ranking should be complemented by the inclusion of an indicator that evaluates the initiatives to reduce flight-related emissions. Important information on how universities can become active here without jeopardizing the necessary international networking is provided by "FlyingLess". The FlyingLess project develops approaches to reduce flight emissions in academia. In order to achieve the widest possible impact, the results and specific tools are made available as a toolbox through various communication channels [5].

## 3. The Environmental Campus Birkenfeld as case study for sustainable mobility

### 3.1. Facts and figures about the Environmental Campus Birkenfeld

Education for Sustainable Development is already firmly anchored in the founding mission of the Environmental Campus Birkenfeld, which started its operations in 1996 as the site of Trier University of Applied Sciences. The Environmental Campus Birkenfeld is one of the unique university locations in Germany focussing on sustainability and offers students interdisciplinary studies at a "Zero Emission University", which, in addition to an ecological building concept, has a climate-neutral energy and heat supply and innovative building technologies. The Environmental Campus Birkenfeld stands for a holistic orientation towards sustainability, which applies equally to teaching, research, transfer and operation of the university. Today, more than 2000 young people from over 80 countries study at the Environmental Campus. The networking of ecological, economic, technical and social concerns enables students to analyse and optimize complex systems. The Environmental Campus offers more than 30 bachelor's and master's degree programs in the following disciplines: Business Administration, Renewable Energies, Computer Science, Biotechnology and Pharmaceutical Engineering, Mechanical Engineering, Nonprofit and NGO Management, Process Engineering, Industrial Engineering as well as Business and Environmental Law. In the practice-oriented study courses, students have the opportunity to test the theoretically acquired knowledge in regional, national and international companies as well as in one of the numerous research institutions at the Environmental Campus. The campus model is based on the "residential campus" known from American universities, which combines living, learning and working in one place. Almost a third of the students live directly in student dormitories on the university campus, which thus becomes a small academic village on the edge of the Hunsrück-Hochwald National Park. Figure 3 shows an aerial view of the campus, which was an American reserve hospital before being used as a university.

Figure 3. The Environmental Campus Birkenfeld

The holistic implementation of climate protection and sustainability on the Environmental Campus enables the university to achieve good results in all six criteria of the UI GreenMetric Ranking. Overall, the Environmental Campus Birkenfeld was able to increase its overall result in the current UI GreenMetric Ranking 2022 by 400 points to 9,125 points compared to the previous year.

**3.2. Sustainable Mobility at the Environmental Campus Birkenfeld**

The "Transportation" category is weighted with 1,800 points in the GreenMetric Ranking and the Environmental Campus achieved 1,700 (94.44%) of these points. In six of the eight transport-related indicators, the Environmental Campus achieved full marks in 2022. The location directly on the railway line from Frankfurt via Mainz to Saarbrücken makes it possible for a relatively large number of commuters to use the train. Figure 4 shows the location of the Environmental Campus, which is located in a rural region in the heart of Europe. The isochrone was created using an application from the University of Heidelberg [6] and illustrates that transport connections in rural areas are not particularly well developed, as the possible travel distance in one hour differs significantly depending on the starting point.

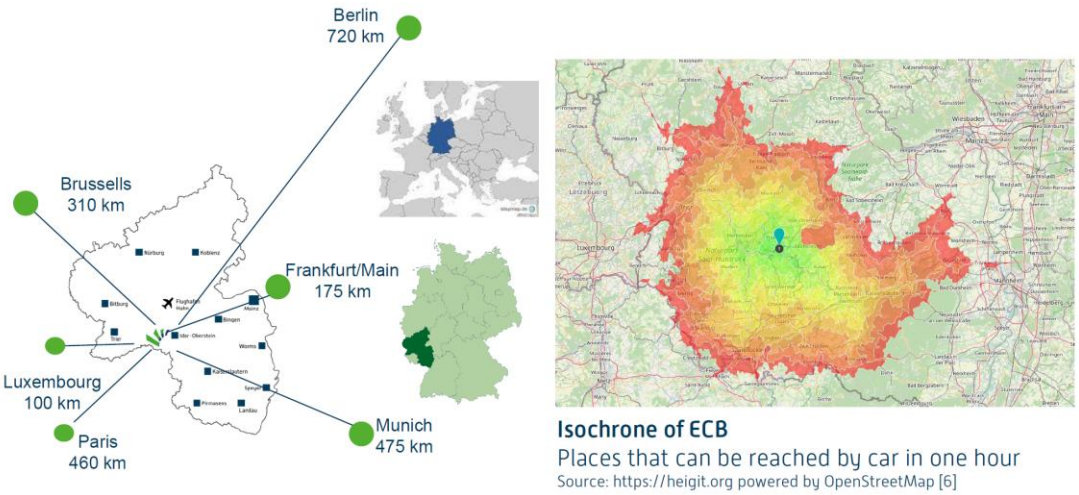


Figure 4. The Environmental Campus Birkenfeld

However, due to the rural structure of the campus environment, there are also employees and students for whom public transport is not an acceptable alternative. For this reason, the Environmental Campus is continuously expanding the charging infrastructure for electric vehicles and has established many initiatives to decrease private vehicles on campus. The following list provides an overview:

- **Make public transport more attractive**
  - free use of bus and train for registered students within a radius of about 100 km
  - offer a job ticket for employees that reduces the cost of monthly and annual bus and train tickets
  - creation of additional bus connections to Birkenfeld in cooperation with the municipal authorities
- **Implement zero-emissions mobility solutions**
  - e-car sharing concept for students, staff and the local community
  - The university owns 6 electric cars (from Renault Zoé up to a 9-seater electric bus), and only one fossil engine car is left.
  - Solar carports provide solar power to charge the vehicles and are connected to a battery and a storage unit so that excess solar power can be used for other university purposes
  - Charging infrastructure with more than 10 charging stations is installed and can be used by students, staff and visitors
  - access to the e-car pool for staff members
  - rental bikes, e-bikes and cargo bikes are provided for free for all
- **Higher utilization of private vehicles (more people per car)**
  - reserved parking spaces for carpools
  - social media groups and a mobility app for arranging carpooling
  - setting up passenger benches
  - Information events **for new students** on the possibilities of sustainable mobility
- **City Cycling – a community event** for sustainable mobility
  - Regular participation with a university team (students and staff)
  - The aim of city cycling is to cycle as many distances as possible within a period of three weeks and thus reduce traffic-related emissions.

Two important aspects of the sustainable mobility activities are explained in more detail below. First of all, the Deutschlandticket, which makes public transport very attractive for employees and students, and then the rules to reduce emissions related to business travel.

On May 1, 2023, the Deutschlandticket (Germany ticket) was launched by the German government. For 49 euros a month, citizens can use public transport throughout Germany. And this is independent of the federal state, transport association or tariff area. Travellers can therefore use all buses and trains of regional and local public transport throughout Germany. Based on the Deutschlandticket, employees of the university receive a worker subsidy of 25% of the cost and an additional discount of 5%, so that the monthly cost is only 34.30 euros. To encourage students to use public and eco-compatible transportation a free train and bus ticket/pass valid for the district and connecting trains to the cities Mainz and Saarbrücken (approx. 100 km in each direction) is provided that is included in the enrolment fee. From the winter semester 2023/2024, an upgrade to the Deutschlandticket is to be made possible.

Concerning the reduction of emissions from business travel the Environmental Campus has set up the following rules and measures:

- **Check the necessity of the business trip** - replace it with video conferencing as often as possible
- **Business travel regulations** to reduce emissions:
  - Public transport first
  - Electric company car before private car
  - Flight ban within Germany
- **Obligation to compensate for flight-related emissions**:
  - Since 2020, the state universities in Rhineland-Palatinate have to pay compensation amounts for GHG offsetting to the Nature and Environment Foundation of Rhineland-Palatinate for all air travel.
  - The following compensation amounts are due:
    - for flights within Europe one-way 10 Euro / flight 20 Euro
    - for intercontinental flights one-way 50 Euro / flight 100 Euro
- In addition, **compensation of the mobility related emissions of conferences** hosted by the Environmental Campus through tree planting campaigns in the region

## 4. Concluding remarks and future perspectives

For almost 25 years, the Environmental Campus Birkenfeld has been one of the largest bioenergy villages in Germany *and* is independent of fossil energy imports. The energy (electricity, heating, cooling) for students, staff and researchers comes from local and regional energy sources (biomass, solar energy and geothermal energy) in a climate-neutral way. As shown in this article, the challenging path to climate-neutral mobility is being actively shaped with the help of many initiatives and projects. But here, too, not all potentials for the energy transition and sustainable mobility have yet been exploited. With the hydrogen project, the municipality of Birkenfeld, in cooperation with the Institute for Applied Material Flow Management (IfaS) and the Rhineland-Palatinate Fuel Cell Competence Center at the Environmental Campus, is demonstrating how to plan and implement regional hydrogen potentials in the upcoming years [7]. A 6-million-euro

research project in cooperation with the local community of Birkenfeld is financed from the National Climate Protection Initiative of the Federal Ministry of Economics and Climate Protection and the State of Rhineland-Palatinate. To ensure that sufficient solar power is available, almost all parking spaces at the Environmental Campus will be covered with solar carports with a capacity of 870 kWp. In addition, a complex hydrogen infrastructure will be built:

- Electrolyzer (for the production of hydrogen from renewable electricity)
- three stationary fuel cells with 10 kW each (for partial regeneration of electricity in case of need)
- hydrogen storage & oxygen storage (plant flexibility)
- Hydrogen bus station & hydrogen bus (zero-emission mobility in the national park)
- Battery storage

Green electricity from existing and new solar systems will be converted into green hydrogen, used in a bus as a substitute for diesel or stored and converted back into electricity via fuel cells. Since the model project promotes the location of the Environmental Campus Birkenfeld as a starting point for sustainable and climate-neutral mobility in the National Park region, the system will be combined with a hydrogen filling station. Cross-sector coupling thus leverages further potential for sustainable mobility and avoids greenhouse gas emissions

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