BMDV Network of Experts
Knowledge Ability Action

EMS 2023 annual meeting
OSA2.1 Energy meteorology

Federal Ministry for Digital and Transport

Potential of renewable energies along the German transport infrastructure

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Photovoltaic

A rough estimate of the potential of photovoltaic modules attached to noise barriers was calculated in the context of the question of potential energy generation along the road and rail transport routes.

For a conservative estimate, a low potential area occupancy of the noise protection facilities is assumed.

For the calculation, the location data of the noise protection facilities along the rail transport mode were available. For the road mode, the location data had to be estimated.

In a comparison of all existing types of noise barriers, noise barriers have the greatest photovoltaic potential, accounting for about 85 % of the total yield (table 1).

Figure 1: Photovoltaic system on the noise barrier on the A94 near Töging. Source: BASt.

This is possible due to their inclination, which is typically 30°, and a high percentage surface occupancy according to the statics. An example of such an installation can be seen in figure 1.

A Germany-wide evaluation, as shown in figure 2, reveals that due to the irradiation conditions, the possible yields are higher in the south of Germany than in the north. Noise protection facilities with an east-west orientation achieve a higher yield as facilities with a north-south orientation.

This study was a brief staking out of the possibilities of photovoltaics on noise barriers. A detailed study is currently underway with, among others, the BASt.

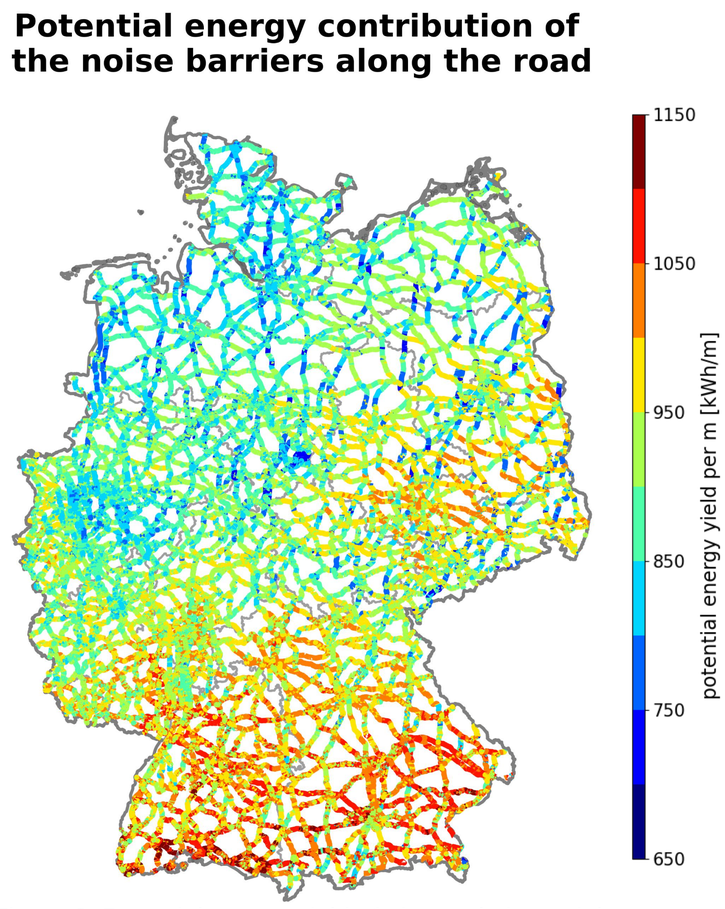

Figure 2: Potential energy yield of photovoltaic modules mounted on noise barriers. The energy yield is given in kWh per metre length at a height of 5 m and a surface utilisation of 50 %.

Table 1: Overview of the different potential energy yields per transport mode and noise abatement type and the resulting CO_2 savings.

transport mode	type of noise protection	space allocation	installable power [MW_p]	yield [GWh]	CO_2 savings [t]
trail	noise barrier wall	10 %	85	59	40437
road	noise barrier wall	10 %	193	134	91841
road	steep wall	10 %	8	8	5483
road	noise barrier embankment	50 %	1192	1211	830.269
total			**1478**	**1412**	**968.030**

Small wind turbines

Small wind turbines (SWT) can provide a more balanced supply of renewable energy at suitable locations in combination with photovoltaic systems.

However, the potential annual energy yield of small wind turbines is much lower than the potential annual energy yield of a photovoltaic system with the same area coverage.

The costs per kW_p are also 2 to 5 times higher compared to photovoltaic systems. Nevertheless, the placement of a small wind turbine can make sense for individual applications under given site conditions.

An assessment of the potential of three small wind turbines at three fictitious locations at motorway junctions in northern, central and southern Germany resulted in potential annual yields of 2 MWh to 43 MWh (table 2).

The decisive factor is the selection of the appropriate small wind turbine for the chosen location.

Table 2: Overview of the potential yield of various small wind turbines at fictitious locations in 2015.

SWT	Orientation	Energy yield [MWh] in…		
		…Kiel	…Leipzig	…München
1	horizontal	27	20	12
2	horizontal	43	26	18
3	vertical	3	3	2

Geothermal energy

Under special conditions, for example for switch heatings, geothermal energy can provide heat under suitable site conditions, which then does not have to be generated by electrical energy. Other possible uses of geothermal energy are bridge temperature control and building heating.

Figure 3: Switch heating in the train formation facility in Halle (Saale) in the freezing cold. Source: Deutsche Bahn AG / Volker Emersleben

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