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Potential of renewable energies along the German transport infrastructure

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The 'Network of Experts' (BMDV-Expertennetzwerk) of the German Ministry for Digital and Transport (BMDV) is a network of German government agencies. Their main topic is the future-oriented transition of the transportation infrastructure in Germany. Currently six topic areas are addressed. One of these topic areas ("renewable energies") has its focus on the assessment of the potential contribution of renewable energies along the transportation infrastructure in Germany (esp. along highways and railways). Germany's national meteorological service DWD coordinates the topic area and is responsible for provision of climatological data in support of the assessments of the potential energy generation. The assessments also benefit from the expertise of the partners for the specific modes of transport, esp. the Federal Highway Research Institute (Bundesanstalt für Straßenwesen, BAST) and the Federal Railway Authority (Eisenbahn Bundesamt (EBA) / Deutsches Zentrum für Schienenverkehrsforschung (DZSF)).

One option to use renewable energies along the transport infrastructure is the installation of photovoltaic on noise protection facilities. In one prominent study of the BMDV 'Network of Experts', the possible yields along already existing noise protection facilities along highways and railways in Germany were calculated on the basis of satellite-derived surface radiation data (dataset: SARAH-2; DOI:10.5676/EUM_SAF_CM/SARAH/V002_01), in combination with temperature and wind speed data of the regional reanalysis COSMO-REA6 (DOI:10.1002/qj.2486). This resulted in a possible installable capacity of approx. 1500 MW_p and a potential annual electricity production of about 1400 GWh, avoiding about 1 million tonnes of CO₂ annually. The area on the noise protection facilities theoretically occupiable with PV modules was conservatively estimated considering statics, noise protection properties, or shading. For vertical noise barriers and steep embankments, the occupiable area is estimated to be approx. ~10 %, while for dyke-like noise barriers with sloping surface (of ~30°) is estimated by the experts to ~50 %. For such noise barriers the largest potential for electricity production is estimated: 80 % of the installable capacity and 85 % of the potential yield can be attributed to these noise barriers. Recent political discussions on energy generation along transport routes have led to repeated media interest in these results. The use case illustrates the benefit of satellite and reanalysis data for large-scale energy studies. Studies on the quality of these climate data sets are also carried out in the Network of Experts.

In addition to the generation of renewable energy through photovoltaics, the installation of small wind turbines and the use of geothermal energy for heat generation on road and rail transport modes were investigated. While geothermal energy is used in some pilot studies and can lead to road salt reduction, small wind turbines can contribute to a continuous year-round energy supply in interaction with photovoltaics on a site-specific basis.