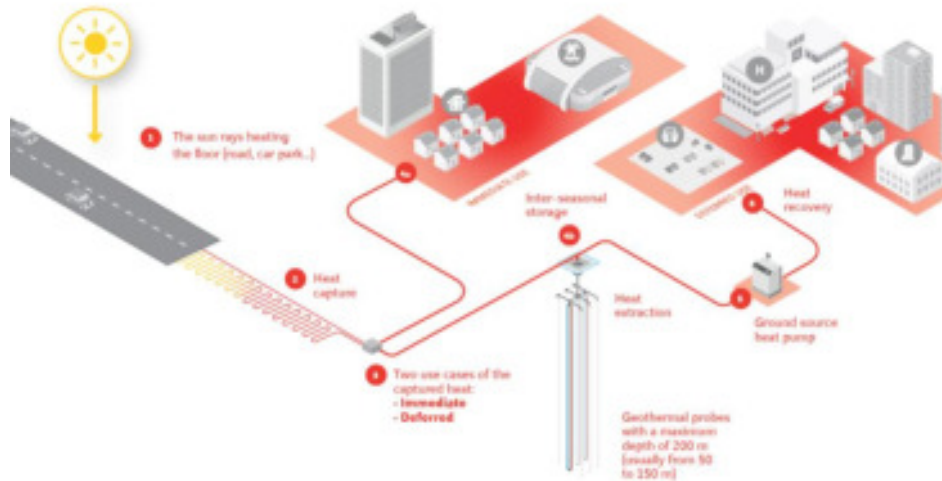


Power Road : the positive energy road



The Power Road® system deployed by Eurovia captures and recovers up to 25% of the sun's heat energy which is then used to heat buildings and equipment located near the roadway.

Starting date of the project	October 2017
Project Localisation Places of implementation of the project at this stage and targeted geography if replicable.	<p>6 projects in operation in France:</p> <ul style="list-style-type: none"> • First project carried out in 2018 in Saint-Arnoult-en-Yvelines (Greater Paris area), funded by the “Route du futur” investment programme operated by ADEME, the French Environment and Energy Management Agency; • Other installations commissioned: local-government technical centre in Olonzac (southern France), swimming complex in Feurs (east-central France), school car park in Pontarlier (eastern France), affordable housing complex in Fleury-sur-Orne (Normandy, north-west France), street in Egletons (south-west France). <p>3 projects in operation abroad: Czech Republic (2019), Quebec (2020), United Kingdom (2021)</p> <p>Target geography if replicable : Local road assets (streets, roads, car parks, pavements) can be truly leveraged thanks to Power Road®, a solution developed by Eurovia which captures solar heat and redistributes it to facilities of all kinds (housing, offices, public buildings, logistics centres, etc.). With Power Road®, the road not only connects residents by enabling them to move around; it also connects them to renewable energy produced nearby and benefits from the close intertwining of transportation networks, activity areas and living spaces. For this reason, Power Road® can be deployed wherever roads are adjacent to buildings or other facilities.</p>
Project objectives Type of climate innovation of the project with a description of the problem/issue addressed	To substitute fossil fuels used to heat buildings with heat captured (and potentially stored) by Power Road® pavements.
Detailed project description	<p>In France, the building sector absorbs almost half of final energy consumption. Nearly two-thirds of this energy is used for heating, with two-thirds of that share obtained by burning fossil fuels, which produce high greenhouse gas (GHG) emissions. In this context, public authorities are partly directing the development of renewable energies towards heat production.</p> <p>By capturing renewable heat produced by the sun's rays, Power Road® can contribute to this transformation thanks to a high level of efficiency – up to 25% of the sunlight received over the course of one day.</p> <p>Roads and streets are great solar collectors. Their surface temperature can reach over 60°C in summer. With the Power Road® process, up to 25% of this renewable thermal energy can be recovered to heat nearby buildings and equipment.</p> <p>To take advantage of this significant source of renewable thermal energy which has hitherto been untapped, Eurovia has developed the Power Road® process with the support of renowned institutional partners (ADEME, CEA Tech, Gustave Eiffel University, Cerema, BRGM, etc.).</p> <p>Thanks to Power Road®, the road surface operates as a high-performance collector, capable of partially recovering solar thermal energy. The principle is simple: the road surface captures the heat of the sun's rays, stores it and reuses it to help heat the surrounding buildings and infrastructure.</p>



With this process, up to 100% of heating needs can be covered. A road surface incorporating Power Road® technology features all the mechanical, durability and recyclability characteristics of conventional paving.




Power Road® solutions can adapt to different needs and form part of a bespoke project, as they:

- Provide renewable heat as an alternative to conventional fossil fuels
- Increase user safety and quality of service by keeping roads, pavements and car parks clear of snow and ice
- Help to mitigate the effects of urban heat islands

Main project's drivers for reducing the greenhouse gas emissions	Reduction levers	Details on the aspects of the project
	<input type="checkbox"/> Energy and resource efficiency (including behaviour)	
	<input checked="" type="checkbox"/> Energy Decarbonisation	Fossil fuels used for heating buildings are replaced with heat captured by Power Road® technology.
	<input type="checkbox"/> Energy efficiency improvements	
	<input type="checkbox"/> Improving efficiency in non-energy resources	
	<input type="checkbox"/> Emissions absorption: creation of carbon sinks, negative emissions (BECCS, CCU/S, ...)	
	<input type="checkbox"/> Financing low-carbon producers or disinvestment from carbon assets	
<input type="checkbox"/> Reduction of other greenhouse gases emission		

Emission scope(s) on which the project has a significant impact and quantification of GHG emission reductions per emission scope	Aspects of the project contributing to the reduction of emissions by emission category	Quantification of associated GHG emissions by emission category
	Please follow the quantification methodology used in the Afep guidelines .	
Reduction of the company's carbon dependency		
Scope 1 <i>Direct emissions generated by the company's activity.</i>	Construction of the Power Road.	Construction of 1 km of dual-lane Power Road®: 175 tonnes CO ₂ eq emitted.
Scope 2 <i>Indirect emissions associated with the company's electricity and heat consumption.</i>		
Scope 3 <i>Emissions induced (upstream or downstream) by the company's activities, products and/or services in its value chain.</i>		
Increase of carbon sinks		
Emissions Absorption <i>Carbon sinks creation, (BECCS, CCU/S, ...)</i>		
GHG emissions avoided by the company at third parties		
Avoided Emissions <i>Emissions avoided by the activities, products and/or</i>	Fossil fuels used for heating buildings are replaced with	Emissions reduced by over 80% compared to a gas boiler.

	<i>services in charge of the project, or by the financing of emission reduction projects.</i>	heat captured by Power Road® technology.	
Modality of verification of the quantification.	<p>Clarification on the calculation or other remarks:</p> <p>In France, average energy consumption for heating buildings is associated with an emission factor of 79 kgCO₂eq/MWh (RE2020 projection) for electric heating and 240 kgCO₂eq/MWh for gas heating (ADEME 2018 database). Two-thirds of housing units are heated using fossil fuels.</p> <p>Over its entire life cycle, it is deemed that one kilometre of Power Road® installed across two traffic lanes will:</p> <ul style="list-style-type: none"> - Emit 370 tCO₂eq/km for a full Power Road® installation and a field of vertical geothermal probes for inter-seasonal storage. - Produce 1,200 MWh/km/year (under average conditions) - Emit, when in service, 18 kgCO₂eq/MWh of heat produced (coefficient of performance: 4.5). <p>The final emission factor of Power Road® is approximately 30 kgCO₂eq/MWh (minimum useful life of 25 years), thus saving 210 kgCO₂eq/MWh: Power Road® results in CO₂eq savings of over 80% compared to a gas solution.</p> <p>1,420 sq. metres of Power Road® have been implemented in the Caen area (Normandy); the system produces 270 MWh/year and avoids emissions of nearly 55 tCO₂eq/year (based on the assumptions above).</p> <p>Calculation standard used (ADEME base, GHG Protocol, etc.): Eurovia carried out a complete Life Cycle Assessment (LCA), a thorough standardised evaluation method that produces an environmental assessment of a system over its entire life cycle. Carbon emission factors used were drawn from the Ecoinvent 3.4 database; adjustments were made regarding construction equipment by incorporating emissions data collected by VINCI in the field (CO₂cerned software developed by I Care for VINCI). The energy emission factors are drawn from ADEME data (Base Carbone or forward-looking position).</p> <p>As a result of the LCA, an Environmental and Health Declaration (FDES) for construction products was completed and is presently being examined by the CSTB (French Scientific and Technical Centre for the Construction Industry) for inclusion in the INIES database (French national reference database of environmental and health declarations).</p> <p>Verification of the calculation (internal or external): Several Power Road® projects that are in service are subject to energy performance monitoring by public institutions (ADEME, CEREMA).</p>		
Other environmental and social benefits of the project	<p>Power Road® contributes to the following SDGs:</p> <ul style="list-style-type: none"> • SDG 7 – Affordable and clean energy: the Power Road® solution provides low-cost, low-carbon heat to the people who need it; • SDG 9 – Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation: the Power Road® solution develops innovative infrastructure that facilitates travel while generating renewable energy from the sun; • SDG 11 – Sustainable cities and communities: the Power Road® solution addresses the challenges related to transport and renewable energy supply in urban areas; • SDG 12 – Responsible consumption and production: the Power Road® solution limits consumption of carbon-based energy because it uses energy produced by the sun. 		
Project maturity level	<p> <input type="checkbox"/> Prototype laboratory test (TRL 7) <input type="checkbox"/> Real life testing (TRL 7-8) <input type="checkbox"/> Pre-commercial prototype (TRL 9) <input type="checkbox"/> Small-scale implementation <input checked="" type="checkbox"/> Medium to large scale implementation </p> <p>Remarks:</p> <ul style="list-style-type: none"> • 9 projects were carried out to provide renewable heat or to make the road safer for pedestrians and/or vehicles. • Power Road® has been deployed as a small-scale solar collector (<1,500 m²). • A medium-scale snow-clearing project was built (3,500 m²). • Eurovia has developed a technical and sales network to support the development of Power Road® on a medium and large scale. 		
Capacity and conditions of the project reproducibility, with associated climate impact mitigation potential	<p>There is unlimited potential for the replication of Power Road®, as the energy recovered by the system is suitable for use in all types of facilities (schools, public buildings, homes, office buildings, sports facilities, etc.). Since Power Road® replaces fossil fuels wherever it is installed, its CO₂ impact can be measured for each project.</p> <p>Eurovia has committed human and other resources to developing Power Road® (building up a technical sales network, providing technical expertise for performance monitoring).</p> <p>The success of this project depends on:</p> <ul style="list-style-type: none"> • The full participation of public and private customers in the 2°C trajectory, and therefore in the switchover to renewable energies • The commitment of the French and European authorities to support the development of Power Road® technology through simple and reliable subsidy programmes (French Renewable Heat Fund, ERDF, energy savings certificates...). 		
Amount of investment made (in €)	<p>The development of Power Road® received a boost from the “Route du futur” investment programme operated by ADEME (total amount of the project: €4.6 million). Thanks to funding for research and development, the technical</p>		

	<p>performance of Power Road® (energy and mechanical performance, LCA, industrialisation) was validated. This work was coordinated by the Eurovia Research Centre.</p> <p>Further research and development work is under way which aims to optimise the technical, economic and environmental performance of Power Road® and to develop new uses (urban heat islands, heat recovery systems, etc.).</p>
<p>Economic profitability of the project (ROI)</p>	<p><input type="checkbox"/> ST (0-3 years) <input checked="" type="checkbox"/> MT (4-10 years) <input checked="" type="checkbox"/> LT (>10 years)</p> <p>Remarks: Power Road® has several economic benefits:</p> <ul style="list-style-type: none"> • For users: by harnessing the "free" and inexhaustible energy provided by the sun, Power Road® optimises the production of renewable heat and lowers operating costs for the project owner. Depreciation, maintenance costs, equipment replacement, energy expenditures: compared to other heating solutions, overall, a heating project incorporating a Power Road® system is cost-effective over the medium term. Savings generated by Power Road® projects are reflected in energy bills that are, on average, reduced by two-thirds. • For the designer: responsible support to the energy and environmental transition.
<p>Engaged partnerships</p>	<ul style="list-style-type: none"> • Research and development work was carried out with institutional and expert third parties in France: LITEN (CEA Tech, Le-Bourget-du-Lac), Université Gustave Eiffel (formerly IFFSTAR, Nantes), BRGM (Orléans) • Design work was carried out in partnership with engineering firm Ginger Burgeap, which holds qualifications 1007 and 2013 from the OPQIBI (French Engineering Qualification Organisation) • Supervision and performance optimisation were carried out with start-up Accenta.
<p>Open comments from the project owner</p>	<p>With an overall vision of the project and broad cross-disciplinary skills (and by partnering with the best specialists if necessary), Eurovia's teams have full command over the processes required to implement Power Road® and meet a wide range of needs and uses.</p> <p>Energy optimisation, road surface structure, <i>à la carte</i> maintenance... the process adapts to each project, addressing needs as they arise every step of the way.</p>
<p>More about the project</p>	
<p>Contact the company carrying the project</p>	<p>power-road@eurovia.com</p>
<p>Project URL links</p>	<p>www.power-road.com</p>
<p>Illustrations of the project</p>	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <div style="text-align: center; margin-top: 20px;">  </div>

