

Energy from asphalt

for heating
and cooling
buildings and roads



road energy systems[®]

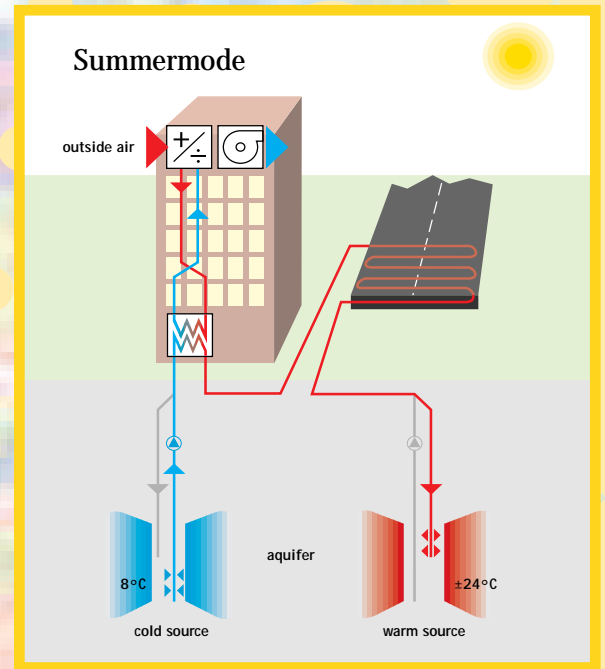
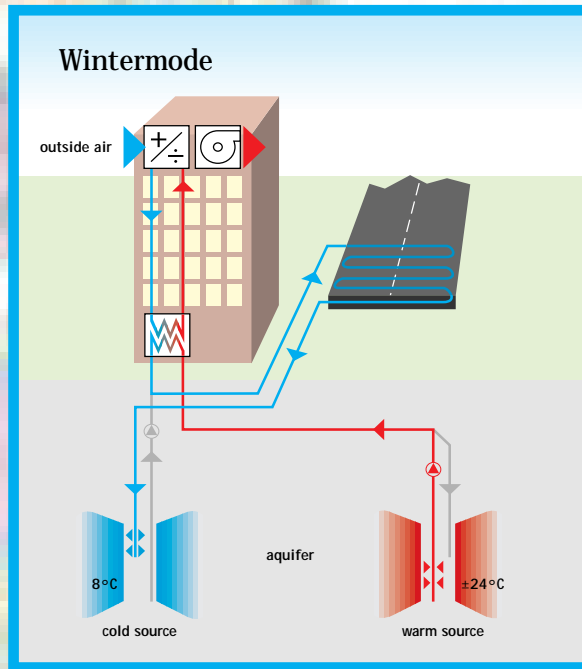
Energy from asphalt

Ooms Avenhorn Holding, Tipspit and WTH Vloerverwarming have jointly developed Road Energy Systems®, a method for heating and cooling buildings and roads.

Road Energy Systems® comprises an asphalt concrete layer with a reinforced structure and a water-bearing medium. Asphalt concrete's dark colour has an excellent heat-absorbing property.

The water-bearing medium is able to cool the asphalt in summer (energy extraction) and heat it during winter (energy addition). The asphalt collector represents a new way of harnessing solar energy. The longer and more intensively solar energy is used, the more important it becomes as an environmentally friendly way of meeting our energy needs. In recent years it has become increasingly evident that the fossil fuels used to generate energy are not inexhaustible and that their use is harmful to the environment (greenhouse effect).

The aim of Road Energy Systems® is to achieve energy savings by using thermal energy stored in aquifers for cooling and/or heating in commercial and industrial buildings, industry, residential constructions, earthworks, civil and hydraulic engineering and the agricultural sector.



Storing energy in the ground

Storing energy in the ground is an energy-saving, environmentally friendly heating and cooling technique. In summer, Road Energy Systems® generates considerable heat. This heat is stored in the ground and can be pumped up for heating purposes in winter. Conversely, the stored winter cold can be used for cooling in summer. The warm and cold water are separately stored in an underground water-bearing sandy layer (an aquifer). The hot and cold groundwater can be pumped up from the aquifer or it can be injected back. The vertical conveyor pipelines running from the hot and cold source are located approximately one hundred metres apart and can be as much as one hundred metres deep. In winter, groundwater is pumped up from the heat



source. After it has been used for heating, by allowing it through the asphalt collector, it is injected into the cold source. In summer the process works in the opposite direction, with water being pumped up from the cold source and used for cooling. The heated water is then once

again led through the asphalt collector, where it is further heated by the sun and then injected into the heat source in the ground. This system saves considerable primary energy (natural gas) as less cooling and heating is required by the central heating and cooling systems.

The combined use of this storage system with heat pumps and floor and wall heating requires the control systems to be thoroughly tuned to match the actual requirement.

Improved traffic safety

In winter the temperature of asphalt can be kept above freezing, preventing the formation of ice on the road. The evaporation rate of rain and meltwater is also speeded up. In summer, cooling the surface to below the temperature at which bitumen begins to soften prevents the asphalt structures from being deformed. This in turn prevents the formation of ruts or permanent deformation, which significantly improves traffic safety, especially

under poor weather conditions.

The combination of a reinforced asphalt structure with a heating system ensures that the road surface will develop fewer cracks in winter. An asphalt construction incorporating Road Energy Systems® has a longer life than traditional constructions. This means less road maintenance, resulting in fewer road closures and traffic jams and hence improved traffic safety mobility.

Environmental gain

Reduction in CO₂ emissions

Using Road Energy Systems® to heat buildings means using less fossil fuel, which reduces CO₂ emissions.

Reducing the use of salt
Using Road Energy Systems® to heat roads in winter results in savings on the use of salt on icy roads, thus lowering the environmental impact of salt.



Increasing the durability of road constructions

Road Energy Systems® can be used to reduce variations in temperature that can occur in an asphalt layer, thereby extending the life of the asphalt construction. Cooling and heating asphalt also reduces general wear and tear. Because these asphalt constructions are less prone to cracking, there

will also be less damage caused by freezing and thawing. In addition, the combination of temperature regulation and a specially reinforced structure will extend the life of the asphalt construction even further.

Increasing the durability of concrete structures

By controlling the temperature of a concrete structure within a certain range, it will not expand and contract as much, significantly reducing the expansion and contraction between the joints in the concrete structure. By using water-impermeable bituminous membranes in combination with Road

Energy Systems®, it is possible to use an asphalt covering layer on structures without the need for joints. By not having to spray as much salt or any salt at all, there is no damage to the concrete from corrosion of the reinforcement as a result of salt penetration.

Energy efficient buildings

The combination of a low EPC (Energy Performance Coefficient), energy-efficient installations and Road Energy Systems® can produce substantial savings on energy consumption when compared to traditional buildings.

Economic benefits (financial and sound business management)

- Major savings on energy consumption when used to heat buildings;
- Longer life of asphalt constructions;
- Reduced maintenance costs for roads and engineering structures;
- Reduced cost of anti-ice measures;
- Subsidy possibilities;
- Short pay-back period for the extra investment;
- Fewer traffic jams;
- Improved traffic safety;
- Green image.

Applications

- Loading platforms (at company premises and airports, harbours, bus and train stations/ platforms);
- Keeping roads, engineering structures and airport runways free of snow and ice;
- Heating and cooling buildings;
- Road Energy Systems® can be put down as thin asphalt layers on both new and existing pavement.

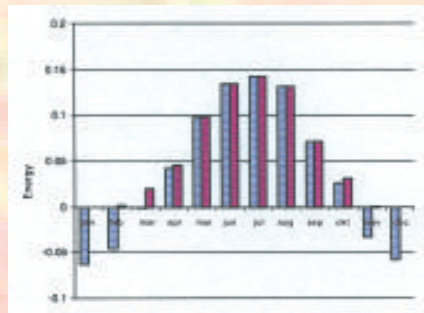
Alternative applications

Heating and cooling sports fields, soils used for cultivation of crops (cold crop cultivation) and greenhouses. The heat can also be used for biological soil sanitation purposes.

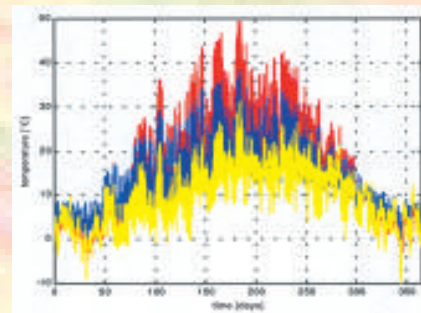
The process

Before using Road Energy Systems®, a number of tests need to be carried out during the preliminary stage:

- The energy requirements of the building, road or structure have to be determined;
- Determination of the surface area, structural division and location of the asphalt collector;
- The mix composition and engineering properties of the asphalt construction have to be determined, depending on the application of the level of loading and strength of the substrate;
- Before deciding on the aquifer system, a geohydrologic study needs to be carried out to assess the ground storage capacity and the quality and flow rate of the groundwater;
- When used in buildings, the measurement and control technology aspects of the various systems have to be attuned to one another (asphalt collector, aquifer system, heat pump and the heating/cooling system).



Energy balance asphalt collector



Red: asphalt (normal); blue: asphalt (cooled); yellow: air temperature



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