

# Tunnel Energy Recovery Pipe (TERP)

## Introduction

International agreements on the use of renewable energy in the future in order to be more independent of fossil fuels more and more innovative solutions are applied. Because the demand for energy continues increasing worldwide, it is important to investigate in the first place on how much energy can be saved by using energy efficiently. The next step is to investigate on how sustainable energy can be applied. If both measures are not yet in the entire energy requirement can be scheduled that for the remaining energy using fossil fuels in the most efficient way.

The idea of the Tunnel Energy Recovery Pipe (TERP) is recovering waste heat from traffic tunnels. By using this waste heat as a heat source for heat pumps, buildings can be provided with heat in the surrounding of the tunnel. This has been investigated in the Ketheltunnel, a 2 km long tunnel in the Netherlands on the A4 between Rotterdam and Amsterdam.



## Pilot study on Ketheltunnel in the Netherlands

On average 3277 vehicles per hour drive through the Ketheltunnel. The heat emission of the passing traffic is determined by the number of vehicles, the composition, the speed and the fuel consumption of the traffic. The amount of heat in a single traffic tube of the tunnel is on average 3960 kW. With both tunnel tubes more than 2000 buildings can be allowed with heat.



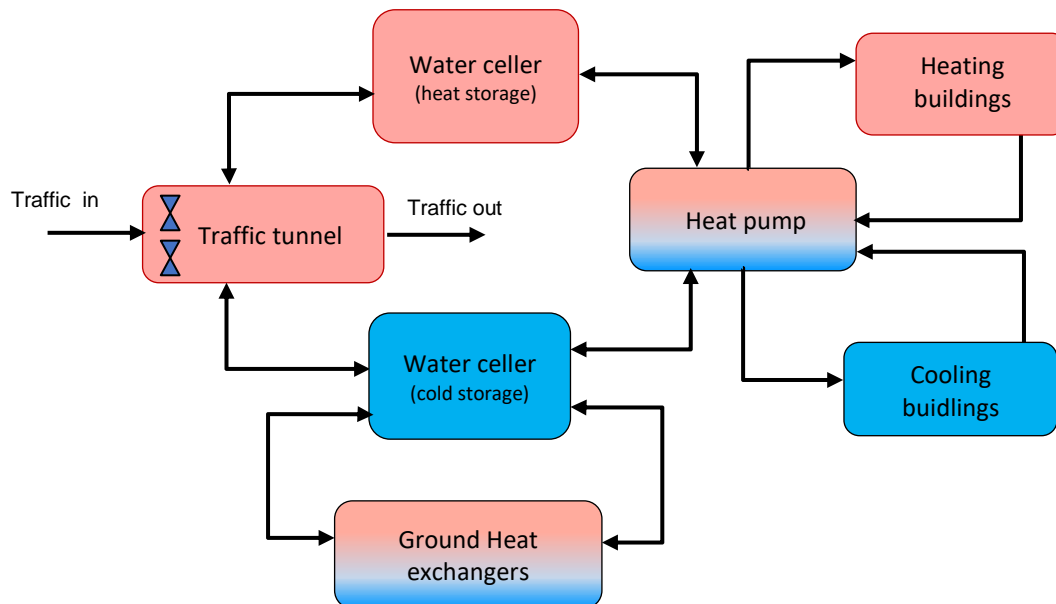
*Ketheltunnel on the highway A4 in the Netherlands*

## Heat pump

This residual heat (10-30 degrees) can serve as a heat source for a heat pump, which makes it 80 degrees useful heat. This system can be extended with ground heat exchangers which makes it possible to also use cooling for buildings. A heat pump is extremely capable for this. To store this thermal energy, it is possible to extend the water cellars of the tunnel.

### Temperature measurements

In 2017/2018 temperature measurements were done for one year in one traffic tube of the Ketheltunnel at 3 locations: beginning, middle and at the end of the tunnel where temperature sensors placed in the tunnel walls. The temperature in the tunnel rises on average 3.5 degrees Celsius.



*Model for the Tunnel Energy Recovery Pipe*

### Future fuels

Of course, there are currently many developments of full electric driving but also of alternative fuels such as hydrogen and biofuels. When we drive electric with a fuel cell on hydrogen the heat output will be in any case at least 50% compared to an internal combustion engine [source: ECN]. However, there is still enough heat that can be used as a source useful heat for the heat-recovery system in a traffic tunnel.

### Waste heat recovery projects

The use of waste heat from road tunnels is one of the possibilities to apply heat usefully, other forms using waste heat are heat from underground tunnels, industrial installations, data centers, effluent and -surface water. There is already succeeded in reuse the waste heat from London Underground for high rise apartments.

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