

# HighFlex

## Publieke samenvatting / Public summary

### Aanleiding

Heat is the predominant final energy carrier in industry, representing about 2/3 of final energy consumption. Process heat is mainly produced by burning (natural) gas and therefore alternative low carbon process heating systems are required to meet the industrial contribution to the climate objectives. This can be realized by application of high temperature heat pumps delivering process heat with low carbon emission (zero emission in case of 100% renewable electricity). However, these heat pumps are commercially not available for high temperature heat delivery (>120 °C). The electrically driven thermoacoustic heat pump (TAHP) can fill this gap since it can deliver heat at very high temperature (up to 250 °C) and with high flexibility. Heat can be delivered over a very wide range of process and waste heat temperatures with a standard design.

### Doelstelling

The project objective is to demonstrate the technical feasibility of the compact electrically driven thermoacoustic heat pump (TAHP). This is achieved by enhancing the performance of the bench scale TAHP unit by means of development, implementation, and testing of two innovative thermoacoustic components on bench scale. The following detailed performance objectives for the bench scale heat pump are set: doubling of the thermal power output and increase of relative Carnot efficiency of the thermoacoustic unit to 50% (similar to compression heat pumps at low temperatures). Objective is to prepare for the up scaling of the main components of the TAHP from

#### Projectinformatie / Project information

##### Projectnummer / Project number

TIND23-03473950

##### Subsidiebedrag / Grant amount

€ 499.133,00

#### Algemene informatie / General information

##### Penvoerder / Secretariat

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO

#### Publicaties en materialen / Publications and attachments

- 17.09.2026

**Eindrapport TIND23-03473950**

#### Volg Topsector Energie op X / Follow Topsector Energie on X

@TSEnergie

bench to pilot scale and to assess the feasibility of the TAHP from end-user perspective.

### **Korte omschrijving**

The HighFlex proposal builds upon the bench scale TAHP available at TNO. This heat pump is electrically driven by a piston compressor. With this set-up steam production at 120, 150 and 175 °C is achieved with emperature lifts up to 100 °C.

Application of printed metal compact heat exchangers resulted in a strongly improved COP. Further improvement of the performance (power output and COP) is the main activity in HighFlex. This is achieved by development and testing of the innovative and patented booster component and implementation of measures which will lower internal heat losses. To prepare for the pilot and demo phases scalability of main components is studied. A strategy on 3D metal printing of compact TA heat exchangers on industrial scale is executed. The scalability of linear compressor and innovative components will also be evaluated.

### **Resultaat**

The results from HighFlex will form the basis for the design and realization of a pilot scale (100 kW) high temperature thermoacoustic heat pump as part of a follow-up project. A doubling of power density and increased COP in HighFlex will enable this step. After successful commercialization, this development will result in a net primary energy saving potential of 76 PJ/year and a CO<sub>2</sub> emission reduction of 6.3 Mton/year within the sectors food, paper & board, bulk chemical, and refineries in the Netherlands. Major fuel cost savings for Dutch industry can be realized. In the future renewable electricity system carbon free electricity would result in even higher CO<sub>2</sub> emission of 9.4 Mton/year. The worldwide market value for high temperature (steam) TA heat pump equipment and installation is estimated at 300 million euro per year during 20 years.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

Voor meer informatie over de Topsector Energie, ga naar [www.topsectorenergie.nl](http://www.topsectorenergie.nl).

Voor meer informatie over de TSE / Energie-Innovatie regelingen die RVO aanbiedt, ga naar [www.rvo.nl/tse](http://www.rvo.nl/tse).