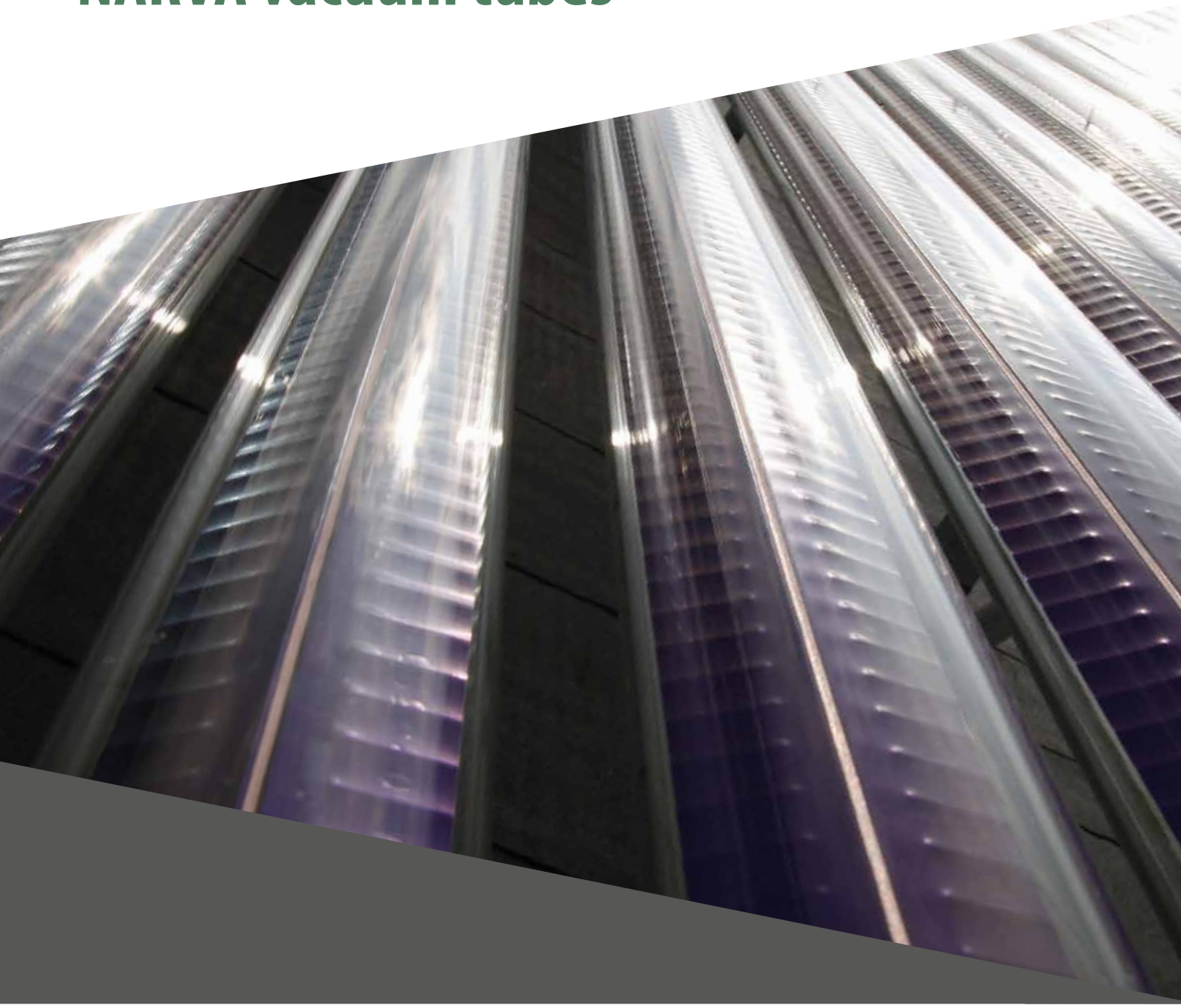
NARVA
The sunny side up.

NARVA vacuum tubes



- high performance
- long lifetime
- intrinsic safety heat pipe

NARVA vacuum tubes

In its capacity as an OEM supplier, NARVA currently offers vacuum tubes in the following layouts:

direct flow vacuum tubes
heat pipe vacuum tubes

Both models are available with absorber coated on one or both sides (type standard or power) and in the lengths 800 mm, 1,500 mm, 1,775 mm and 2,000 mm.

Federal Government subsidies for solar heat increased by up to 100%

New solar thermal systems are supported by the Federal Office of Economics and Export Control (BAFA) with fixed-rate subsidies by square metre of installed collector area. New subsidy rates for the Market Incentive Programme (MAP) have also been set as of 1 April 2015:

The **minimum subsidy** has been raised from € 1,500 to **€ 2,000**, with minimum funding for solar thermal system installation to serve hot-water production and space heating set at € 140/m^2. The subsidy applies to new installations in new and existing buildings.

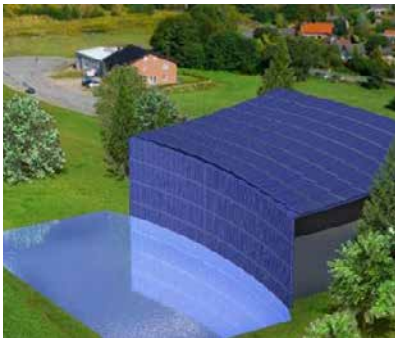
An **income-related** solar thermal collector subsidy is another new development:

The subsidy is based on reported annual collector yield at **50°C collector temperature** according to EN 12975 in the first subsidy programme to promote the **quality of heat generated**. This change will take the **high efficiency of vacuum tube collectors** into account, especially in process heat and in heating networks.

Gross subsidies at **€ 278/m^2** are achievable for tube collectors with NARVA vacuum tubes spaced at 62 mm apart and high-quality insulation, or See www.solarwirtschaft.de for more details on MAP.

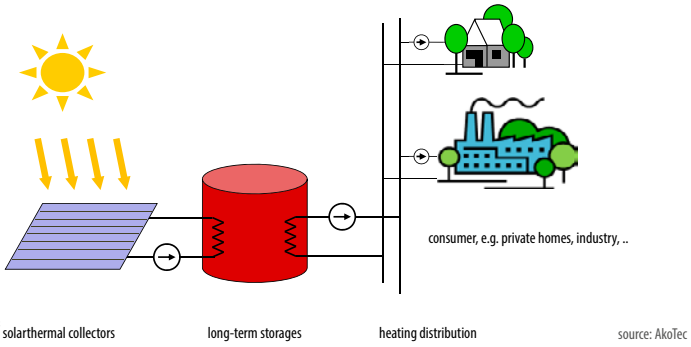
Solar district heating

solar district heating, Nechlin



solarthermal heating (draft)

hotel, Mexico



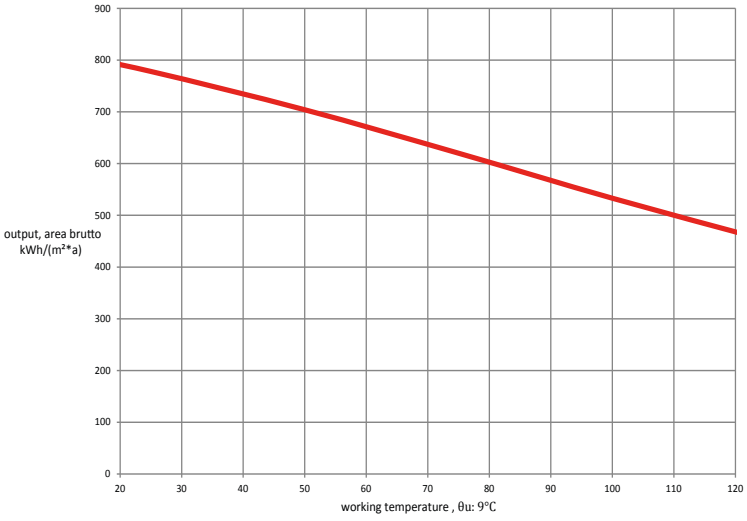
source: AkoTec

District heating networks in residential areas, communities and bioenergy villages support transporting decentrally generated heat to consumers.

District heating systems excel in high energy efficiency and value added for the region.

Biogas cogeneration, biomass heating or combined heat and power plants have always taken the lion's share in powering district heating systems, but solar thermal energy with 100% coverage has since become economically viable. Seasonal heat storage size using hot water as a medium plays a crucial role – volumes vary from 1,000 m^3 to 12,000 m^3 in solar heating concepts covering a full year's heating requirement.

Example - output of solar district heating



NARVA vacuum tubes used in heating networks operated at a supply temperature of 75°C can deliver 620 kWh/m^2 per annum.

Process heat

Rottweil, Germany

Lodz, Poland

Oberkirch, Germany

It is in the field of process heat that solar thermal applications with vacuum tubes reveal their real strengths.

If the heat requirements of the process are always higher than the maximum output of the solar collectors, the system benefits from the high degree of efficiency of the direct flow NARVA vacuum tubes.

If the system is dimensioned towards maximum solar fraction, then a customer-specific temperature can be achieved via the intrinsically safe NARVA heat pipe.

In Germany companies receive subsidies of 50% of the investment costs (Bafa and KfW) when using solar thermal applications for the generation of process heat.

Innovative thermally driven cooling units run on the absorption principle at a power requirement comparable to that of an incandescent light bulb – less than 100 W. Conventional compression chillers, on the other hand, consume thousands of watts to reach the same cooling performance, posing a considerable burden on the power grid when the cooling requirement is at its highest.

Solar thermal systems are a suitable source of thermal drive power, but they still require collectors that reach constantly high temperatures as absorption chillers operate at drive temperatures between 85 and 90°C.

Conventional flat-plate collectors are significantly less effectively insulated than full-vacuum tube collectors, and are unsuitable for solar thermal systems. Full-vacuum tube collectors easily achieve the required drive temperatures, so combining absorption chillers with full-vacuum tube collectors is the first choice from a building services planning point of view.

Solar heating

Trackersystem, Austria

Private home, Germany

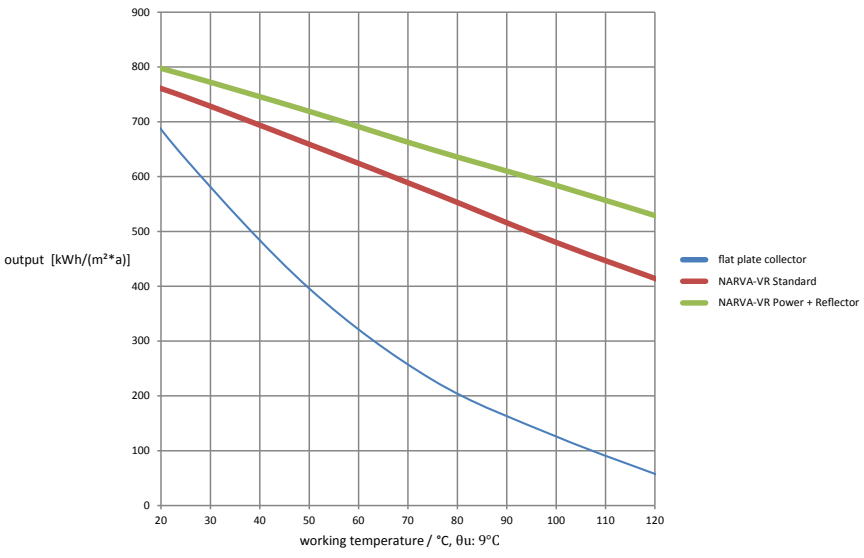
Hotel, Croatia

A frequent operational status in heating and hot water generation is a high loading temperature of the storage tank. This temperature level must be exceeded by the solar unit. Due to their low emission loss and highly rapid response, NARVA vacuum tubes are particularly well-suited to transporting heat to the storage tank at a temperature level of over 90°C.

In the scope of the German commercialisation programme launched in summer 2012 the minimum funding rate stands at € 1,500 per newly-installed solar heating unit.

Heat diversion pipe and absorber are located in a vacuum in NARVA tubes. This means that they are not exposed to ambient influences and are protected against aging which guarantees a long lifetime.

At a temperature difference between the heat transfer fluid and ambient temperature of just 20 Kelvin the vacuum tube collector already achieves higher annual yields than the flat plate collector.



Annual yield comparison between vacuum tube collector and flat plate collector (gross surface area)
Based on solar power in Würzburg, Germany

Thermosyphon systems

Private home, Italy

Private home, Germany

Private home, Slovakia

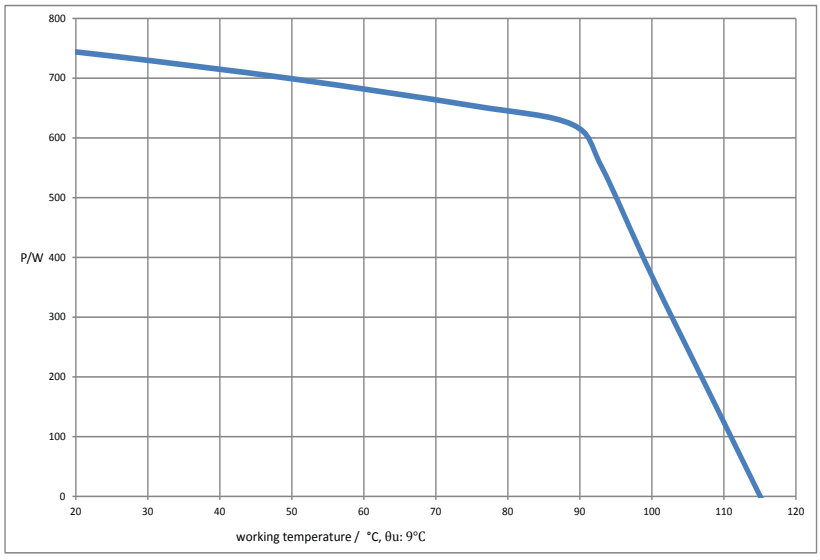
Thermosyphon systems are primarily utilised in the Mediterranean region and are available in two technical setups:

Thermosyphon systems with integrated condenser in buffer storage
Thermosyphon systems with a separate collector and buffer storage

With NARVA heat pipe vacuum tubes the system is intrinsically safe. The limitation of temperature via special evaporator fluid prevents vapour shocks when drawing from the outlets.

Environmental influences such as wind or low ambient temperatures have no influence on the yield of the vacuum tube collectors. Electronic controls and pumps are not necessary, this makes the system less prone to breakdown and require less maintenance.

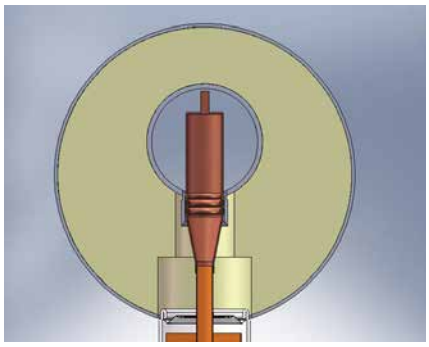
Collectors with NARVA heat pipe vacuum tubes have a significantly higher degree of efficiency compared to flat plate collectors. In combination with the temperature limitation they are ideally suited for use in siphon systems.



Power output of tube collector
at solar radiation of 1,000 W/m^2
(collector with 10 tubes - 1,75 m length)

Systems for industrial customers

intrinsic safety heatpipe with direct condenser integration



Collectors with directly traversed vacuum tubes – a technology that always involves significantly greater hydraulic losses – are often used for large fields.

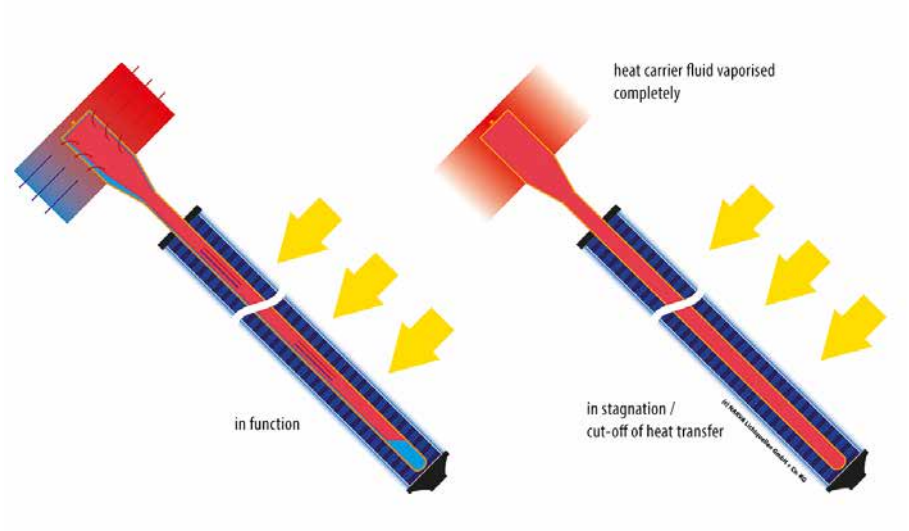
The market has so far desisted from heat pipe tubes due to the high transition and temperature gradients that cause heavy losses in the gap between the condenser and receptacle. Ageing thermal compound during thermal hardening in stagnation exacerbates this effect.

NARVA has been the first to combine the best of both worlds – temperature-limited intrinsically safe heat pipe vacuum tubes and condenser integration into the heat-transfer fluid: **Simple hydraulics and low thermal resistance.**

Comparison of heat transfer on outer condenser surfaces to HTF

Receptacle collector dry connection:	Direct flow around condenser installation in HTF
Tolerance between receptacle and condenser: Increased heat transfer resistance in the gap	Cost-saving potential: Thermal conductivity in the collector is irrelevant – materials such as steel and plastics are suitable
Risk of poor maintenance: Thermal paste hardening into a thermal insulator in stagnation state	Simple hydraulics: Minimising the cost of piping and installation

Cut-off behaviour of NARVA heat pipe tubes



NARVA heat pipe tubes are ideally suited for a wide range of solarthermal applications from thermalsyphons systems, solar heating to process heat. This is due to a customised cut-off behaviour developed by NARVA.

NARVA

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