

# **stadt:werk:lehen**

## **solar heating in a concerto district**

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### **Abstract**

**stadt:werk:lehen is a inner city district of Salzburg, Austria. The project comprises new residential and live science buildings on a demolished old commercial site and refurbishment of residential multi family buildings. Developers of the site, the city of Salzburg and other involved parties have signed a "high quality agreement". Goal is to realise within a five year period an energy efficient, ecological and social district**  
**The district of Salzburg-Lehen**

### **1 The district**

The district of Salzburg-Lehen is situated quite close to the city centre of Salzburg. The appearance of Lehen was for long years dominated by residential buildings from 1950 to 1970, high amount of school buildings, the main football stadium of Salzburg, the head-quarter of the utility and a main traffic road. Obviously caused by the living situation in mostly not renovated buildings and the traffic situation the district was endangered to get more and more social problems.

Considering the very attractive location the potential for establishing a new and attractive district in Salzburg was seen. With the opening of a new train station Lehen is now connected to the new city train which means another improvement of living quality of the district.

The movement of the utility and the football stadium to other sites mean new chances for further development. Meanwhile the main city library was established on the site of the former football stadium.

On the site of the former utility a new residential and commercial area was initiated. In a competition a master plan of the launched project "stadtwerk:lehen" was developed. Residential buildings with 300 apartments and commercial areas, a kindergarten, a student's hostel and a "Competence park" with four live science buildings, a hotel and the renovation of the former office building are foreseen. Together with further available sites there is an area of about 100.000 m<sup>2</sup> available for new construction within the next years. Besides that there is an existing building stock around the areas of the utility with residential buildings from 1950 – 1960, most of them without any thermal renovation and equipped with individual heating system with oil or gas. The City of Salzburg is the owner of these buildings.

### **stadtwerk:lehen**

- Building site: 43.000 m<sup>2</sup>
- Dwellings: app. 300
- Involved housing associations: 3 (2 social, 1 commercial)
- Final completion: 2011/12

## Retrofit area

- area: 50.000 m<sup>2</sup>
- Dwellings: app. 600
- Owner: City of Salzburg



## 2 Goals of district development

Besides the goals of urban development and motivated by the discussion of a new communal development plan which fulfils criteria of sustainability the project of stadtwerk:lehen was created as a pilot project for sustainable urban development. Main performance criteria concerning energy were defined as:

- Low energy standard for new buildings (HWB <20 kWh/m<sup>2</sup>.a)
- Energy efficient pumps and lightning of public areas
- High rate of renewable energy for energy supply

Actual energy supply of the site is based on district heating and natural gas. An integration of renewables in the existing structure of energy supply means a big challenge. It was decided to realize an energy concept based on the use of solar energy. Approximately 2.000 m<sup>2</sup> solar collector fields and about 2.000 m<sup>2</sup> of storage tank in combination with a heat pump, in order to increase the gap between high and low temperature in the storage tank, are planned. In addition to that an own low-temperature-micro-net for heat distribution will be realised. Reduced electricity demand for public areas should partly be covered by PV-modules.

The new-built area was seen as a chance also for the surrounding retrofit areas. An energy efficient supply of these areas with the low-temperature-micro-net of stadtwerk:lehen became a concrete perspective for city planners. This causes an over-all renovation as a requirement for the further project development.

## 3 Realisation

From 2005 on the several projects in the area are developed. Because of the approach of sustainability, the mixture of residential and commercial buildings, the mixture of renovation and new buildings the projects are funded by several funding programmes (EU-Concerto, Haus der Zukunft plus, Wohnbauforschung Land Salzburg).

### stadtwerk:lehen

To reach the goals of the new built area "stadtwerk:lehen" a "high-quality-agreement" with all involved partners (city of Salzburg, local utility, housing associations) was signed in December 2005. Besides the detailed performance criteria for buildings and energy supply there are other criteria of sustainability such as the mixture of land-use-types (housing,

commercial), the mobility or social aspects which are also part of the contract. All partners are obliged to participate in the whole planning and steering process of the project.

A steering committee was introduced in 2007. Monthly meetings of all involved partners shall guarantee a successful project implementation and the implementation of the "high-quality-agreement". The steering group is chaired by the city of Salzburg.

### **Retrofit area**

First renovation was started and already finished in housing area "Kuenburggasse". The renovation focussed on thermal insulation, there was no connection to the micro-net foreseen.

Concrete discussion process for over-all renovation was initiated with the example of a concrete housing area "Strubergasse" with more than 500 tenants. A detailed study on several opportunities of renovation showed that a concept of an over-all-renovation in almost passive-house standard is the most costs-efficient strategy. Further steps still started to find out the possibilities of realisation.

### **Social assistance**

With the new-building projects and the renovation processes there are massive chances in the district. Therefore an active communication to the population of the district about the project is essential for success. An information office situated in the area was launched. In regularly office times the office informs about the status of the projects and the planned activities. Besides these information activities a participation process for the renovation projects is planned.

## **4 Solar district heating**

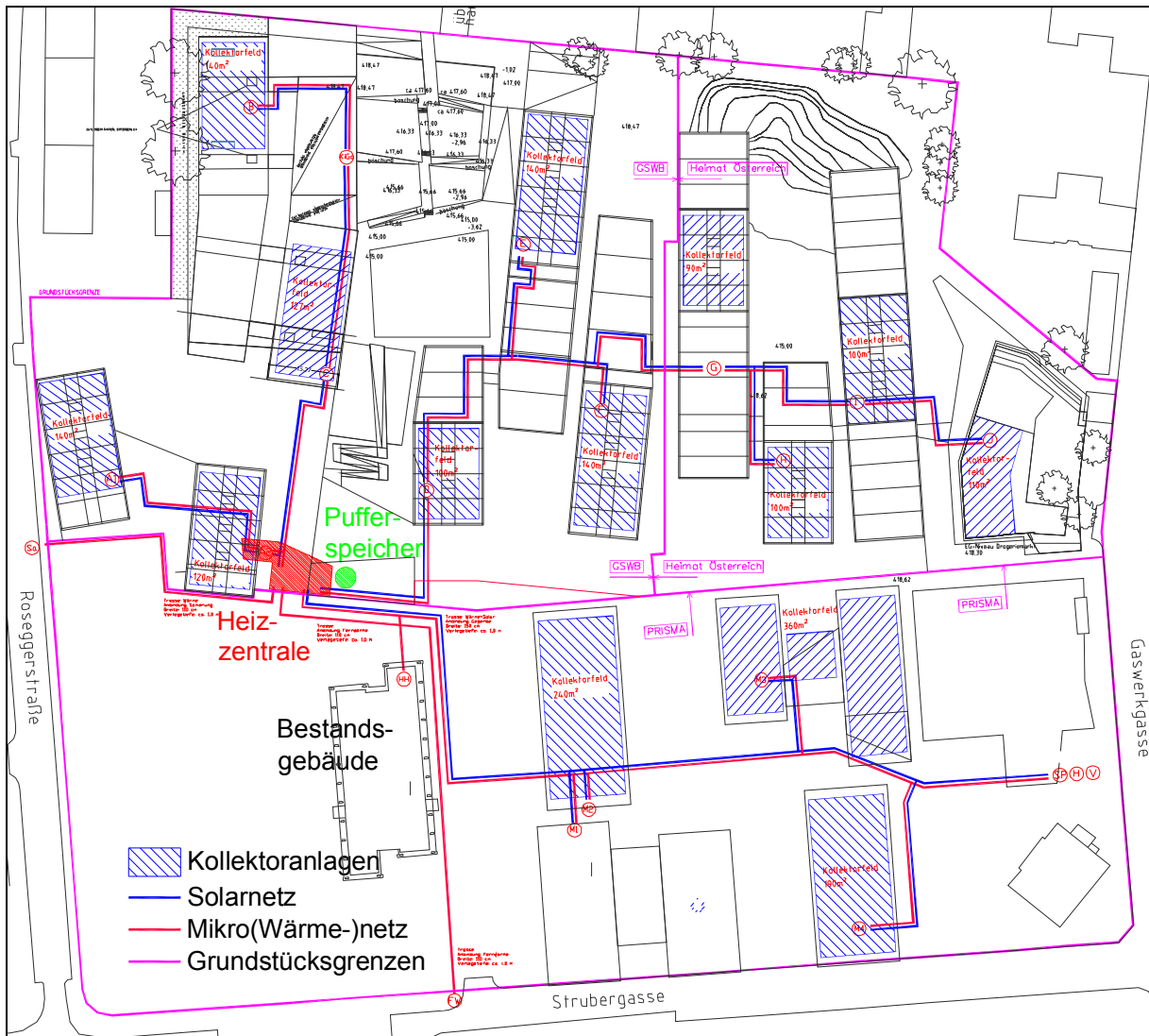
One main focus of the project is a heat supply with high share of renewable energy resources. Although a main district heating grid is close by, a new micro net will be installed using the main district heating as peak load supply. Within the micro net a large solar fraction of about 30% in combination with a high specific solar yield of 400 kWh/m<sup>2</sup>a at minimum is anticipated. To reach these high figures several aspects will be realised:

- reduction of heat demand by very well insulation of the buildings
- installation of 2.000 m<sup>2</sup> solar collectors
- installation of a 200 m<sup>3</sup> buffer storage
- use of 160 kWth heat pump to increase the storage capacity and solar yield
- low temperature supply system with heat substations in every flat

During the first two years of the Concerto project the building plan has been developed and the design of the buildings was realised. Basis for the overall energy concept is a very good insulation of all buildings including ventilation with heat recovery. Although the energy demand is almost as low as passiv-house standard, the share of energy for space heating increased compared to our initial assumptions because the business buildings have no heat demand for domestic hot water.

The design for the solar district heating was developed. The influence of several parameters on the system performance was investigated by using a dynamic simulation model.

- influence of the total load and return temperature
- influence of the solar collector area and collector incidence angle
- influence of the storage volume
- time with possible stagnation problems throughout the year
- power of heat-pump
- alternative types of heat-pump



**fig 1 buildings and solar collector roofs** *Stadt:Werk:Lehen*

Out of these simulation results several options have been investigated in respect to investment cost, operation cost, energy and CO<sub>2</sub>-savings.

In general the assumptions made during the Concerto proposal proved to be realistic concerning the system components and system performance. Because of the increase in total heat demand and a moderate change of the distribution of heat demand throughout the year, the absolute share of solar heat will be smaller than originally anticipated. Therefore about 34% solar fraction for the total heat demand with a specific solar yield of 400 kWh/m<sup>2</sup>a seem to be realistic.

The new idea to combine moderate large storage volumes with a heat pump to realise a high solar yield in combination with a high solar fraction proved to be the best combination even if the heat demand has changed to some extent.

Further optimization potential has been identified concerning the type of heat pump. The a gas-absorption heat pump intended for use at the first stage will not be realized as it takes more capacity from the storage.

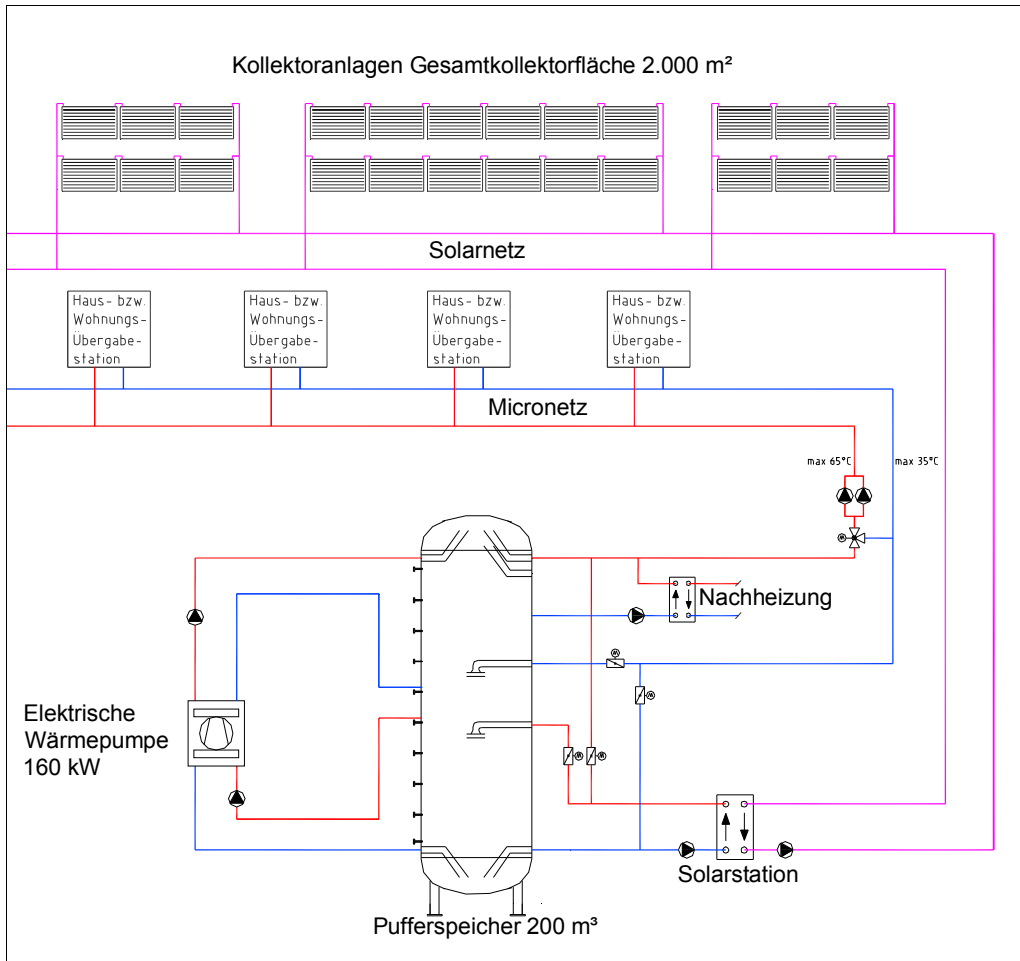


fig 2: hydraulic system

The variation of collector area showed that the anticipated 2.000 m<sup>2</sup> are well chosen concerning solar yield, solar fraction and low stagnation hours.

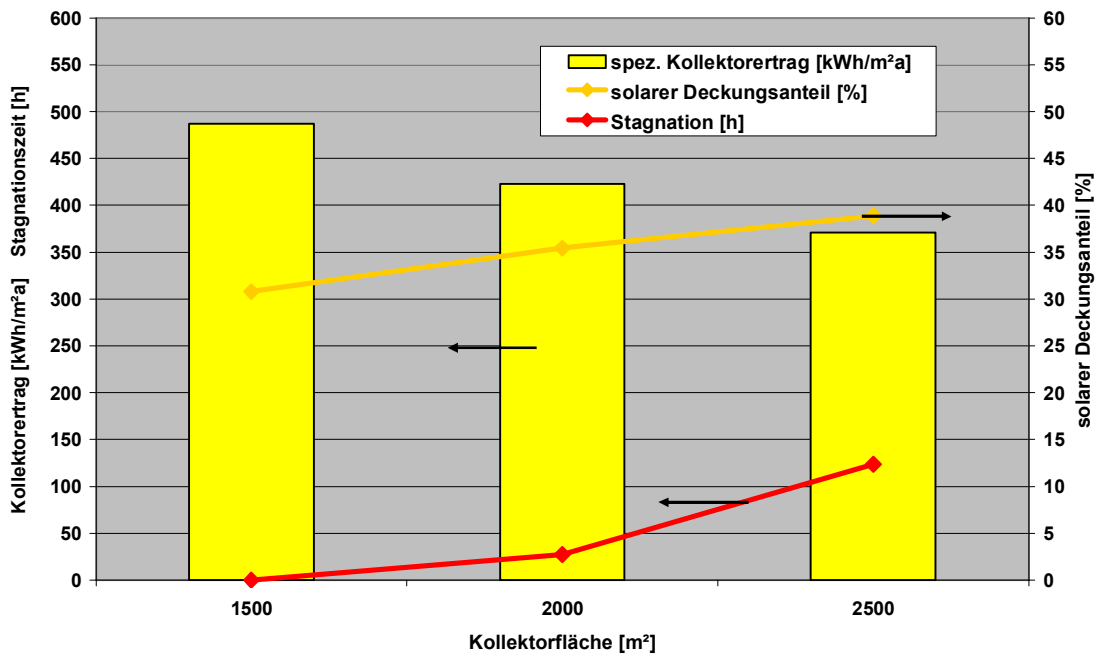


fig 3: system simulation variation of collector area

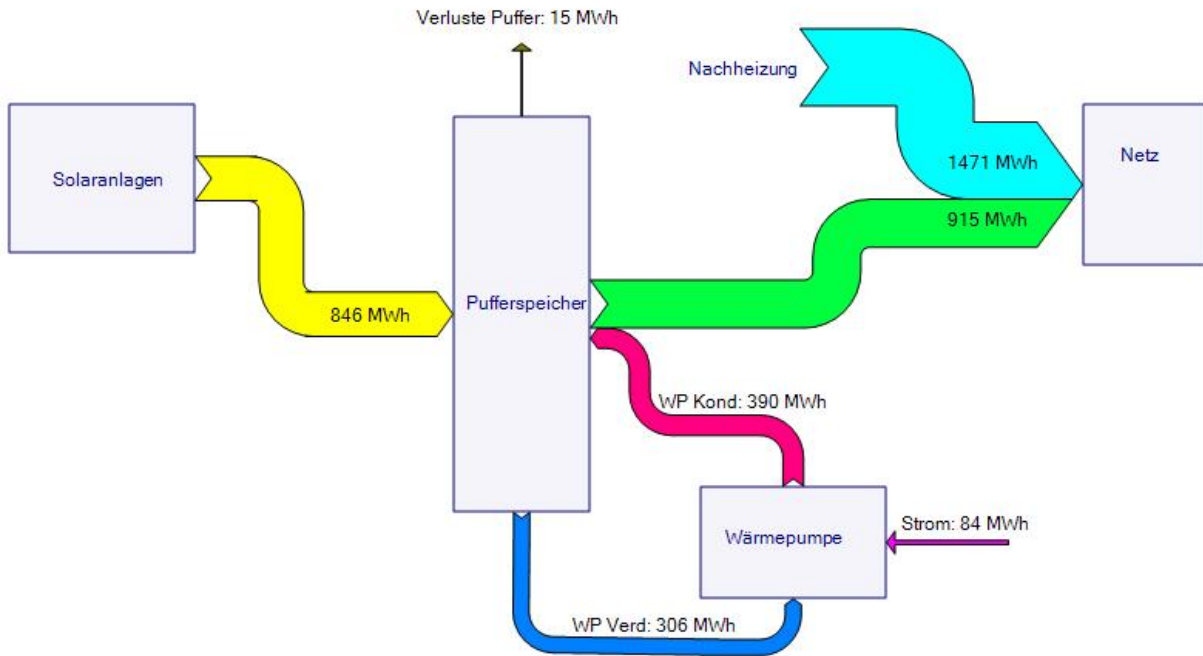


fig 4: sankey diagram of system as designed

The concerto project realizes a heat supply with specific emissions of approx. 8t CO<sub>2</sub>/MWh heat. This is 92% less than one can reach with gas supply. This remarkable value can be compared to 100% waste heat usage or renewable energy use:

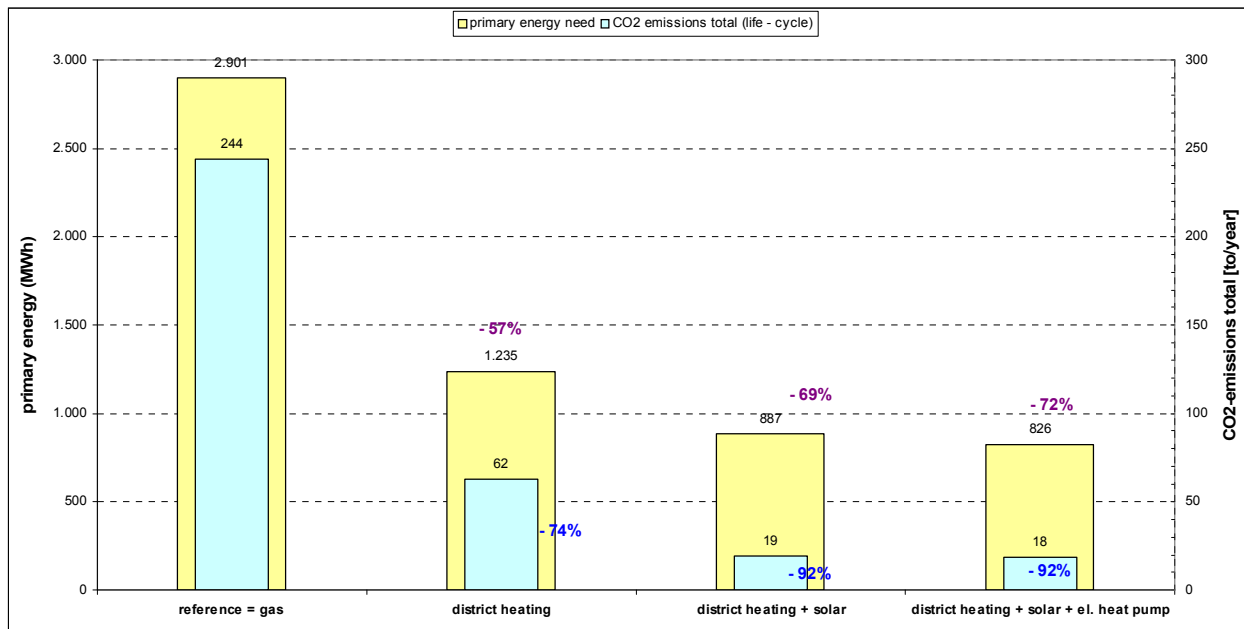
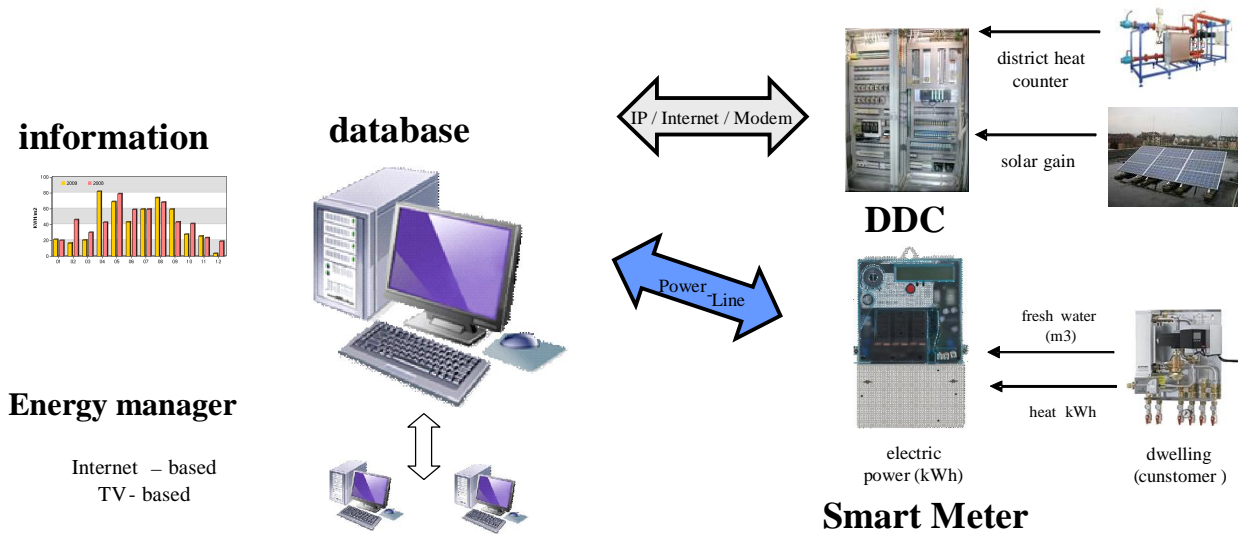


fig 5: primary energy and CO<sub>2</sub>-emissions for different central heating systems

Realisation started in autumn of 2009, the new buildings should be finished in 2011/12.

## 5 Monitoring

Monitoring will be made for heat, electric power and fresh water use (therefore branch-integrated) for each dwelling separately. It is realized by an M-BUS based integration of the counters into a smart metering infrastructure.



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- European Union / Concerto,
- Haus der Zukunft plus and
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