REPORT

SDH PERSPECTIVES IN AUSTRIA

Evolution of the Austrian district heating sector and the role of solar thermal energy: scenarios for 2030

Projektteam:
Hamid Aghaie
Paolo Leoni
Ralf-Roman Schmidt

16.11.2020

SOLAR DISTRICT HEATING IN AUSTRIA

Austrian district heating (DH) has experienced a fast increasing trend for the last 30 years (with the exception of the period 2010-2014), resulting in a triplication of delivered heat [1]; in the year 2018, with about 2400 networks and 20 TWh supply, DH covered 6.4% of the final energy consumption (1122.5 PJ) [2]. Worth to underline is also that this growth of Austrian district heating has been about twice faster than the one of the energy demand in the same period. Currently, district heating provides about 26% of the Austrian households with the energy requested for space heating and domestic hot water preparation [1].

Since last few decades, Austria has developed its climate and energy policy to commit international and European climate targets. One of the main objectives of the federal Government is to reduce greenhouse gas emissions by 2030 by 36% compared to 2005. In 2018, 33.5% of Austrian energy demand (and in particular 72% of the electricity demand) comes from renewable energy resources.

Regarding DH, the most important heat sources are biofuels (47%) and gas (36%), followed by municipal waste (7%), oil (5%), and coal (5%). Almost 60% of the heat is produced in CHP units, while the remaining part is produced in heat-only boilers. Solar thermal (ST) plays such a marginal role that it is not even mentioned in some official studies. However, at least 60 000 m^2 collectors were installed in 102 DH systems between 2010 and 2016. Significant success stories are for example the one of Lehen (urban district of Salzburg), with 2047 m^2 flat-plate collectors showing a year solar yield of 533 kWh/m^2_{ap} and 35% ST fraction, and the one of Fernheizwerk Graz, which with 7700 m^2 represents the largest SDH system in Austria. The possibility of an increasing trend in Austria appears quite realistic in consideration of the important role that ST has gained in other countries as well as of Austrian decarbonization targets.

SCENARIO FORECAST

AIT assessed the optimal share of ST in Austrian DH in 2030 by means of Balmorel[1]. Balmorel is an open-source bottom-up modelling tool based on partial equilibrium optimization and calculating the optimal dispatch and investment on different generation technologies in electricity and DH [3]. The model finds the optimal generation, transmission and consumption of electricity by maximizing social welfare (the utility of consumers minus the cost of electricity and DH heat generation, storage, transmission and distribution) subject to technical, physical and regulatory constraints. AIT calibrated and adapted Balmorel for Austrian power and heat system, as the original tool is developed for the Baltic Sea Region. The model (structure represented in Figure 1) minimizes the total investment and operation costs of the energy system by considering the balance between supply and demand of electricity and heat, possible investment in new generation and transmission capacity, transmission grid constraints, energy import and export between neighbor countries, techno-economic constraints of generation technologies, and flexibility resources such as storage facilities and CHP plants.

The results of the model include the economically efficient dispatch of electricity generation technologies and optimal investment in generation and transmission capacity based on different future energy scenarios.

The supply side consists of different generation technologies, their installed capacities, commissioning and decommissioning year, investment cost, operation and maintenance cost, fuel efficiency and price, expected lifetime, and environmental factors such as CO_2 emission factors. All these factors and assumptions are defined exogenously in the model. Optimal annual investment in new generation and transmission capacities in a target year are determined endogenously by the model. The results of the model consist of annual investment in electricity and heat generation capacities, hourly dispatch of generation technologies, annual import and export, and hourly electricity and heat prices. The modelling results provide perspectives on the technological developments and generation and investment planning in the existing and new emerging technologies in the Austrian electricity sector.

Austrian district heating demand in 2030 is assumed 28 TWh [4]. The main assumption for the techno-economic specification of different generation technologies are reported in Table 1.

---

[1] http://www.balmorel.com/

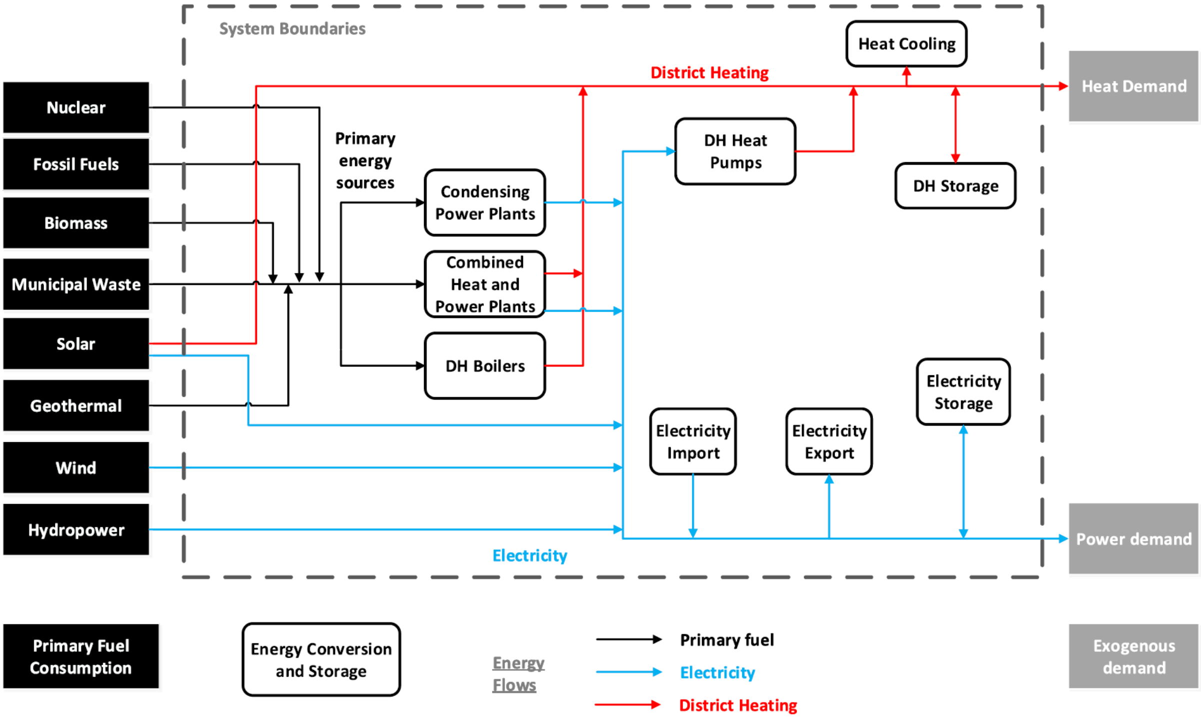

Figure 1: Core structure of Balmorel model [3]

Generation technology	Fuel efficiency	Investment cost (M€ / MW)	Annual O&M costs (k€ / MW)	Variable O&M costs (€ / MW)	Economic lifetime
Biomass CHP	0.92	3.5	45	0.6	20
Solar Thermal	1	0.46	1.8	0.3	30
Waste incineration CHP	0.98	7.3	202	5	25
Heat Pump	3.4	0.61	3	6	25

Table 1: Techno-economic input specifications of district heating generation technologies

Figure 2 shows a comparison between the share of different DH generation technologies in 2030 (model results) with the current DH generation portfolio in 2018. The results indicate an increase of ST production from almost zero in 2018 up to 3.8% of total DH generation in 2030. Besides, the production from heat pumps in Austrian DH will increase up 23.5% of total DH generation in 2030. On the other side, the share of natural gas in DH generation will drop from 37% in 2018 to 22% in 2030. The generation from oil and coal fuels will drop to zero in 2030, as the generation from these sources will not be economical anymore.
Figure 3 shows the result sensitivity assuming in the year 2030 prices of biomass and natural gas 20% higher than in the base scenario. This assumption will reflect in higher installed ST capacity, with ST generation consequently increasing from 3.8% up to 4.6% of total DH generation in 2030.

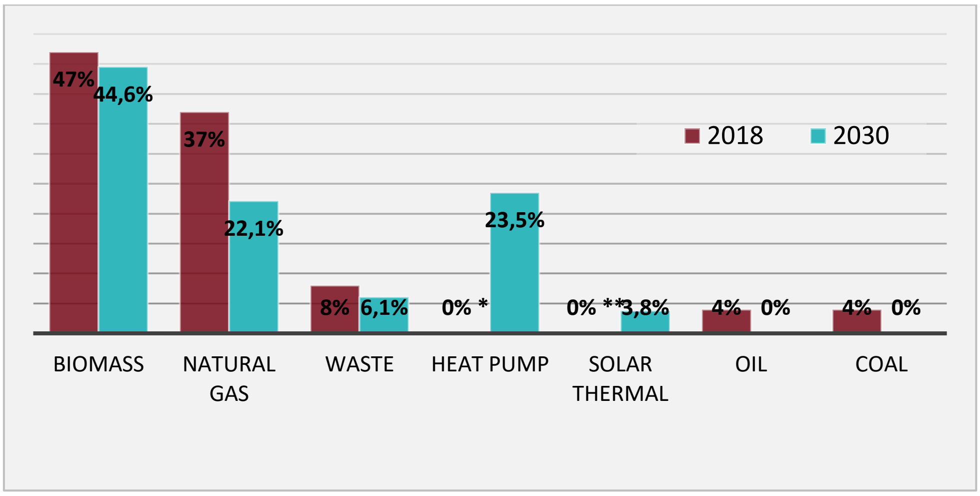

Figure 2: District heating generation in Austria (2018 vs 2030). In 2018, the heat supply from heat pumps and ST is about 150 and 16 GWh respectively.

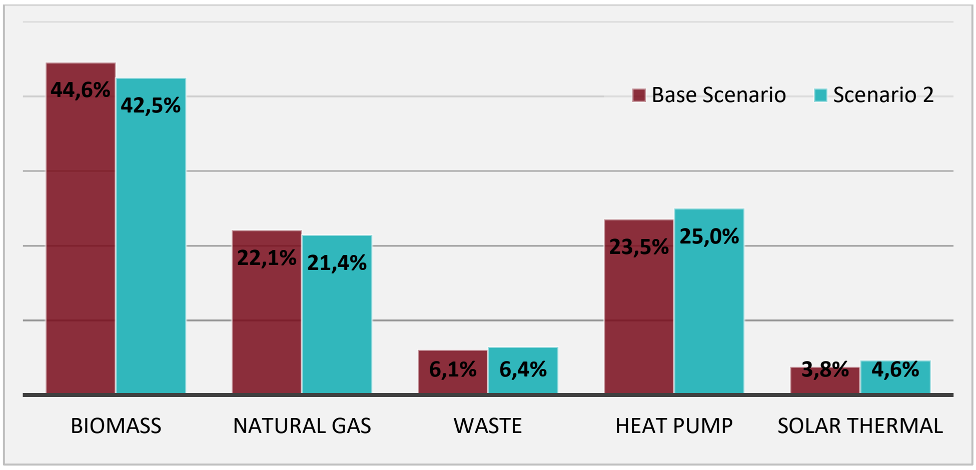

Figure 3: Sensitivity analysis of district heating generation in Austria (base scenario vs scenario with 20% higher price for gas and biomass)

REFERENCES

[1] FGW – Fachverband der Gas- und Wärmeversorgungsunternehmungen, „2019 Zahlenspiegel - Gas und Fernwärme in Österreich,“ 2019. [Online]. Available: https://www.gaswaerme.at/media/medialibrary/2019/09/zasp19_endversion.pdf.

[2] Austrian Ministry for Sustainability and Tourism, „Energie in Österreich 2019 - Zahlen, Daten, Fakten,“ 2019.

[3] F. Wiese, R. Bramstoft, H. Koduvere, A. Pizarro Alonso, O. Balyk, J. Kirkerud, Å. G. Tveten, T. F. Bolkesjø, M. Münster und H. Ravn, „Balmorel open source energy system model“.*Energy Strategy Reviews 2018;20:26-34.*

[4] International Energy Agency, „Energy Statistics,“ 2018. [Online]. Available: https://www.iea.org/statistics/.

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH
Giefinggasse 6, 1210 Vienna, Austria

www.ait.ac.at

Hamid Aghaie
Scientist
Integrated Energy Systems
Center for Energy
Hamid.Aghaie@ait.ac.at