

Renewable Energies Expansion Campaign: Green energy & heating

SWM – At the forefront of the energy transition

The City of Munich has recognized the need for action and is leading the way on climate and environmental protection thanks to its municipal energy and infrastructure company Stadtwerke München (SWM). SWM is currently at the forefront of the energy transition.

SWM is committed to implementing Germany's energy transition across the board. As part of its Renewable Energies Expansion Campaign, the company is pushing the use of renewable energies in power generation as well as in heating. SWM firmly believes that the energy transition can only succeed if both power and heating are generated using renewable sources. SWM's aims:

- By 2025, SWM is aiming to produce as much green electricity at its own plants as required to power the entire city of Munich. This would make Munich the first city worldwide with over a million residents to have achieved this target! In 2008, SWM already started implementing its expansion campaign for renewable energies and earmarked a budget of nine billion euros for the project.
- With a view to also realizing the energy transition in the heating market, SWM developed a district heating vision in 2012. The aim is to make Munich the first German city to use district heating generated exclusively from renewable sources by 2040. Geothermal energy will be the primary source for providing green heating.

Green electricity: first expansion target achieved

SWM already achieved its first major climate protection target in May 2015 – its plants produce the green energy required to power all private households in Munich as well as MVG's electrically-powered public transport infrastructure. This was an important step on the road to achieving "100 percent green electricity for Munich". Other projects have also been realized in the meantime. Before long, SWM will therefore be able to draw on a generation capacity of over 3.5 billion kilowatt hours of green electricity – a figure that already corresponds with around 50 percent of Munich's electricity requirements. In addition to hydroelectric, geothermal, solar and biomass power, wind power also plays a central role in the SWM strategy.

Regional and Europe-wide commitment

Projects in Munich and its surrounding region have been prioritized by SWM. The company currently operates 22 photovoltaic plants in this region and holds a participation in another plant. The portfolio in Munich and the surrounding region also includes 13 hydroelectric power plants, a biogas processing plant, a geothermal cogeneration plant and a wind park. Further power plants are planned.

Nevertheless, SWM is unable to generate as much renewable power in the region around Munich as is required for the metropolis, as the regional potential is limited. That is why the company participates in projects in the rest of Germany and Europe. Across the continent, the company selects and uses the most suitable locations for constructing renewable power plants after taking energy and economic viability factors into consideration. SWM is harnessing this potential with a view to safeguarding Munich's energy future.

The power is fed into the grid where it is produced in an effort to avoid losses involved in transporting power over long distances with power lines. The integrated European power network is comparable to a huge lake. Everyone who generates power feeds into this "lake of energy", while everyone who consumes power draws from the lake. Every kilowatt hour of renewably-generated power helps to make this European lake a little cleaner.

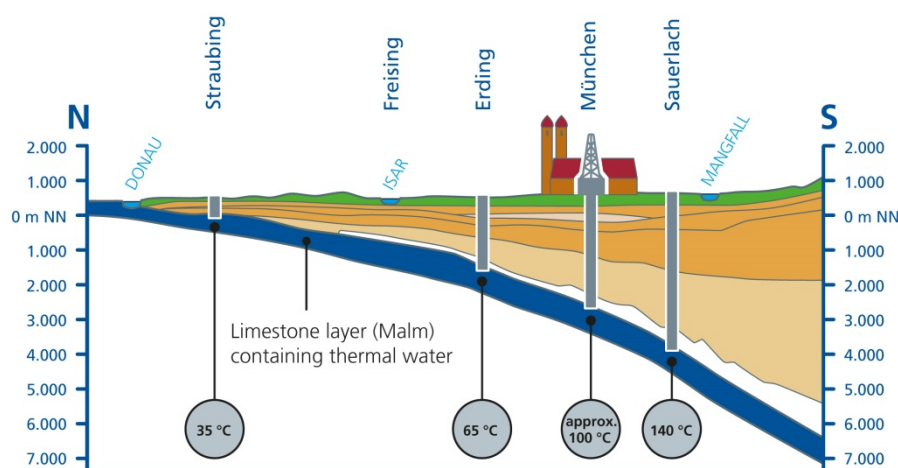
Being involved in climate-friendly energy generation plants away from Munich is therefore just as significant as doing so in Munich itself. After all, the positive effects on the environment also benefit the residents of Munich. **The renewable energy plants already operated by SWM alone save around 1.9 million tons of carbon dioxide emissions every year as well as more than 1.1 tons of radioactive waste.**

Green heating: a vision becomes reality

Munich has one of the largest district heating networks in Europe. SWM currently produces the majority of its district heating in highly efficient combined heat and power plants. However, the aim is to replace the fossil fuels used in heating with renewable sources in the long term. To this end, geothermal power is to make up the primary source of Munich's district heating supply from 2040. Until district heating can be completely switched to renewables, the cogeneration plants Nord and Süd with their environmentally-sound combined heat and power plants are indispensable for the security of Munich's heating supply and for bridging the gap into the new era.

In Germany, most energy is consumed for heating. It makes up around 40 percent of overall energy consumption, while the heating and warm water supply even account for some 90 percent of energy consumption in private households. The energy transition can only succeed overall if renewable energy sources can also be used to replace conventional power in this area. SWM is therefore taking an integrated approach. Its Renewable Energies Expansion Campaign encompasses this key area of energy generation – one which has been largely neglected both politically and economically up to this point.

NORTH-SOUTH CROSS SECTION OF BAVARIA'S VORALPENLAND REGION



Green heating: Geothermal power under Munich

By switching district heating to renewable energy sources in the long term, SWM will therefore once again significantly improve the already excellent carbon footprint of district heating. Due to the unique characteristics of the Munich region, geothermal energy will make a substantial contribution to these efforts. In fact,

hardly any other region in Germany can compete with the excellent geological potential held by Munich and its surroundings in this respect.

The geothermal energy comes from hot thermal water drawn out of permeable limestone layers (Malm). Munich is located right on top of a huge reservoir of this environmentally friendly energy source. At a depth of 2,000 to 3,000 meters, the water has a temperature of between 80 and over 100 °C. The heat from this thermal water is ideal for use in heating. To this end, the water is pumped to the surface and fed through a heat exchanger, extracting its energy. Once cooled, the water is then fed back deep underground. As a result, the geothermal power cycle doesn't impact on the ecosystem.

In the Riem district as well as in the municipality of Sauerlach to the south of Munich, SWM has already been using geothermal power successfully for some time. The next project, a geothermal power plant in the Freiham district, is currently under construction. Another plant is due to be built from 2018 on the site of the combined power and heating plant "HKW Süd". SWM is aiming to build up to five geothermal plants in the period up to 2025.

In addition, depending on the required heating, technical development and availability, both of the "green fuels" biogas and ultimately power-to-gas¹ are available for generating renewable district heating. The renewable portion of residual waste can also make a contribution in this respect.

One aspect supporting SWM in realizing its vision is the likelihood that energy requirements for heating purposes will gradually sink in the long term due to energy-saving and energy-efficiency measures like building renovations, while demand for hot water will remain relatively constant.

1) Power to gas is a form of renewable gas that can be used to produce electricity and heating. Methane gas is created in a two-step process using "excess" power produced by renewable energies. First, electrical power, e.g. from wind parks, is used to make hydrogen from water using electrolysis. In the second step, the hydrogen is combined with carbon dioxide to create methane, which can be used in the same way as natural gas.

Renewable Energies Expansion Campaign – An in-depth look at green power projects:



Havelland (photo: SWM)

SWM operates **more than 100 onshore wind plants in Germany**, e.g. a 75 percent stake in the Havelland project; yield: 236 million kWh/year (corresponds with the requirements of 95,000 households in Munich); SWM onshore wind parks (North Rhine Westphalia, Rhineland Palatinate, Saxony-Anhalt, Brandenburg); yield: approx. 100 million kWh/year (corresponds with the requirements of 40,000 households in Munich)

SWM owns **three onshore wind parks in France**. Yield: 64 million kWh/year (corresponds with the requirements of 26,000 households in Munich)



Dehlingen wind park (photo: VSB)



Fillières wind park (photo: Nordex)



photos: SWM



Since 2015, SWM has owned **one onshore wind park in Sweden**. Yield: 400 million kWh/year (corresponds with the requirements of 160,000 households in Munich)

Planning, construction and operation of onshore wind parks in Europe:

SWM holds a 33 percent participation in wpd europe – a company currently active in 11 European countries. To date, wind parks in Poland, Croatia, Belgium, France and Finland have been realized, among other projects.

Together with Vattenfall, SWM holds a participation in **two offshore wind parks off the coast of the island of Sylt:**

The **DanTysk** wind park has been in operation since 2015.

SWM participation: 49 percent (corresponds with the requirements of 250,000 households in Munich)

The **Sandbank** wind park is still under construction.

SWM participation: 49 percent (corresponds with the requirements of 250,000 households in Munich)



photos: Paul Langrock



photo: Global Tech I/Derek Henthorn

The offshore wind park **Global Tech I** is located in the North Sea, around 180 kilometres off Bremerhaven. It has been in operation since 2015.

SWM participation: 25 percent (corresponds with the requirements of 140,000 households in Munich)

RWE Innogy, SWM and Siemens have been operating the **offshore wind park Gwynt y Môr** in the Irish Sea since 2015. Yield: 1.95 billion kWh/year.

SWM participation: 30 percent (corresponds with the requirements of 240,000 households in Munich)



photo: SWM



photo: SWM

Since 2012, SWM has been running the **parabolic trough power plant Andasol 3** in Spain together with partners.

SWM's participation corresponds with the requirements of 30,000 households in Munich

Solar park in Rothenburg/Oberlausitz – SWM participation: 40 percent (corresponds with the requirements of 3,200 households in Munich)



photo: SWM



photo: SWM

Thin-film solar plant Lauingen/Donau –

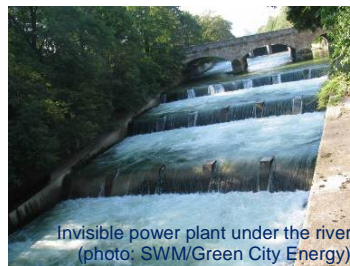
SWM participation: 49.9 percent (corresponds with the requirements of 2,000 households in Munich)

The **SWM geothermal heating and power plant in Sauerlach** produces electricity for 16,000 households in Munich as well as heating for Sauerlach's households.



Photo: SWM

The **Prater plant** is located in the heart of Munich below the Isar. SWM's participation corresponds with the requirements of 2,800 households



Invisible power plant under the river (photo: SWM/Green City Energy)



Prater plant turbines (photo: SWM)

SWM is planning **additional hydroelectric projects in the region**, e.g. a particularly environmentally and fish-friendly “moveable hydroelectric power plant” at the confluence of the Amper and the Isar near Wang. In addition, the company is investigating whether an innovative small-scale hydroelectric power plant can be realized on the grounds of Hellabrunn Zoo.

SWM is modernizing existing hydroelectric power plants on the Isar, which therefore produce more green power and save more carbon dioxide.



Hydroelectric plant Isar 1 (photo: SWM)



Hydroelectric plant Isar 2 (photo: SWM)

Notes:

- All calculations are based on an average consumption of 2,500 kWh/year per household in Munich.
- The production figures stated are average and planned figures, as the yield from solar, wind and hydroelectric power can fluctuate.

Do your bit for the climate with M-Ökostrom

If you would like to support SWM in its expansion campaign, you can opt for one of the M-Ökostrom products.



Moreover, if you choose 'M-Ökostrom aktiv' you can make a voluntary contribution to expanding the use of renewable energies in and around Munich. SWM has already invested around 8 million euros in renewable energy plants from the voluntary environmental surcharge.

Renewable Energies Expansion Campaign – Green heating projects in detail:

SWM launched its first geothermal plant in **Riem** in 2004. Thermal water with a temperature of over 90°C is extracted from 3,000 meters below the surface to cover a significant part of the heating requirements for the residential buildings in the Messestadt, the local businesses and Messe Munich.



In September 2015, work began on the **Freiham geothermal plant**. SWM already brought a heating plant with three heating boilers online in 2013. The feeding of geothermal energy into the plant and therefore into Munich's district heating network is planned from autumn 2016 onwards. The plant will therefore cover the base load of heating required in the new city district and neighbouring areas in Munich West with geothermal energy.

From 2018, another geothermal plant will be built at the **Süd power and heating plant** and is due to launch operations by the end of 2019. The anticipated thermal water temperature is in excess of 95°C. The plant is located at the intersection of three networks, meaning that up to 30 megawatts can be fed into the Innenstadt, Sendling and Perlach networks from here.



By 2025, SWM is aiming to construct **four further geothermal plants**. In an effort to find suitable locations, the company carried out wide-ranging 3D seismic surveys across large parts of the city between November 2015 and March 2016. The next locations will gradually be determined after evaluations have been completed.