Saving electricity in industrial cooling processes

Activity	Installation and operation of solar cooling systems with natural refrigerants
Area	Energy Efficiency, Renewable Energy, Capacity Building
Country	Jordan
Project title	Solar Cooling for Industry and Commerce
Duration	2012 – 2017
Partner institution	Ministry of Environment
Implementing organisation	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Contact	Axel Ulmer, Axel.ulmer@giz.de

Summary

Solar cooling systems deliver air-conditioning during the cooling period in summer, provide hot water and can further support the heating system during winter months. In regions with high solar radiation such as Jordan, this kind of system can lead to considerable savings in electricity costs and greenhouse gas emissions. The project consisted of four pilot systems proving the viability of the system as well as capacity building activities through cooperation with the Technical University of Berlin (TUB) and the German Jordan University (GJU).

Initial situation

Jordan has a rapidly increasing demand for air-conditioning. Currently, the available technologies in Jordan and the Middle East are mostly chillers with low efficiencies, refrigerants with ozone or climate-damaging effects, and high leakage rates. Overall, cooling of commercial buildings in Jordan contributes to about 600,000 tons of CO_2 equivalent annually. At the same time, the country is one of the global locations with optimal conditions for the use of solar power in combination with air-conditioning systems. Absorption chillers, as the ones developed by the TUB for this project, make use of these climate conditions by profiting from solar energy to generate cooling and reducing the high amount of electricity required by conventional, compression-based cooling systems. In addition, the absorption heat pump also supplies useful heat for space heating or hot water production.

Contribution to GHG mitigation

The project followed a multi-level approach in which technology was transferred through demonstration projects for solar cooling at four sites:

- German Jordan University (Madaba): Absorption chiller with a nominal cooling capacity of 160 kW (avoiding 6,700 t of CO_2 emissions over the lifetime of the project), saving more than 4500 EUR electricity costs per month.

On behalf of

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

- Irbid Chamber of Commerce: Absorption chiller with a cooling capacity of 50 kW.
- Petra Guest House: 388 m² solar field consisting of 114 compound parabolic concentrator (CPC) collectors supplying an absorption chiller with a cooling capacity of 160 kW.
- Royal Cultural Center (Amman): 160 kW absorption chiller with 132 CPC evacuated tube collectors.

The operation of the demonstration projects was augmented by a comprehensive monitoring system to collect reliable data, the development of recommendations for an improved sector strategy, and upscaling of solar cooling projects through respective regulations in Jordan and on a regional level.

The four solar cooling demonstration projects are expected to save about 20,000 t CO_2 equivalents over the lifetime of the systems. The projects have also contributed to economic, social, and ecological development by reducing expenses for fossil energy and cryogen costs leading to improved economic feasibility in the long-term. These projects were used to develop local capacities for planning, installation and maintenance. They were implemented in partnership with technology providers, local companies, research institutes and the public sector.

Moreover, the project has created the base for sustainable air conditioning in Jordan (and in the region) by installing and operating solar cooling systems with natural refrigerants, thus reducing direct and indirect GHG emissions of F-gases.

Success factors/Replication potential

The cooperation with the research institutes (in this case TUB and GJU) has helped to build up local capacity, test and document the systems and their parameters and allows future training possibilities for interested suppliers.

In order to raise awareness of the cost saving potentials, the project has put further efforts into communication and outreach activities.

The replication potential for solar cooling systems is great in all MENA countries where hot summers and high irradiation levels are prevalent. The technology is available on a patent-free basis and can thus be used and applied by any interested private or public sector company.

Lessons learned

The pilot projects were intended to demonstrate to the local private engineering sector the viability of alternative cooling options. However, as the technology is fairly complex and requires customization to the specific sites, it calls for a strong commitment of the stakeholders (suppliers and engineering firms) as well as a stable demand for such systems. In the Jordan context – but also likely in other countries – the public sector (schools, administration, hospitals, hotels) would be well suited to create this demand.

Building up local and on-site technical capacities for installation and maintenance as well as in research, production and services are crucial to ensure long-term functioning of the systems, create a robust supply chain and stable jobs. Providing financing support may be another way of increasing the interest of the sector and potential clients. It is also recommended to communicate the technology to different ministries and local administrations in order to raise interest in the cost saving potentials.

This project has been selected as a good practice by the GIZ project "Policy dialogue and knowledge management on LEDS in the MENA region". Within this framework, ten projects of the International Climate Initiative have been selected in total.

giz