THE NATIONAL HEAT PUMPS PROJECT OF LEBANON

May 2019

The National Heat Pumps Project

The National Heat Pumps Project of Lebanon aims to introduce heat pump technology for space heating and hot water production in the domestic and tertiary sectors of the country.

The heat pump can exploit renewable energy from different sources, including ambient heat from the environment, waste heat, and other sources, and can be a high-performing sustainable alternative to traditional heating systems.

This technology will increase in popularity if the quality of products in the market remains high. Introducing standards, regulations, and testing infrastructure; developing guidelines that support quality in design and installation; implementing capacity building activities; and demonstrating the economic and environmental advantage of heat pump technology on pilot applications are all important for ensuring its viability.

The project offers financial incentives for the installation of heat pump systems with vapour compression technologies in both the residential and tertiary sectors.

The National Heat Pumps Project Activities

The National Heat Pumps Project of Lebanon comprises the following activities:

01 Design and construction of a national test laboratory

02 Creation of national standards for product testing

03 Establishment of a financing mechanism

04 Design and implementation of an energy performance monitoring program

05 Dissemination activities for optimal design and installation

Italy and Lebanon Collaboration

The National Heat Pumps Project was born from the cooperation between the Italian Ministry for the Environment, Land, and Sea (IMELS) and the Lebanese Center for Energy Conservation (LCEC).

This cooperation dates back to January 2013 when the MEDiterranean DEvelopment of Support schemes for solar Initiatives and Renewable Energies (MED-DESIRE Project) was launched. As a result of this cooperation, LCEC started drafting a national solar ordinance, which is currently being finalized.

On July 7, 2016, a technical cooperation agreement on sustainable development was signed in Rome by IMELS and LCEC. The objective of the agreement, which will remain in force for 3 years and can be extended for a further 3 years, is to strengthen bilateral relations between Italy and Lebanon in the field of sustainable development and the fight against climate change.

In December 2016, the IMELS signed an agreement with the Central Bank of Lebanon that dedicated 5 million euros to promoting a subsidized financing line for projects on energy efficiency and renewable energy in Lebanon through the NEEREA financing mechanism.

Why Heat Pumps?

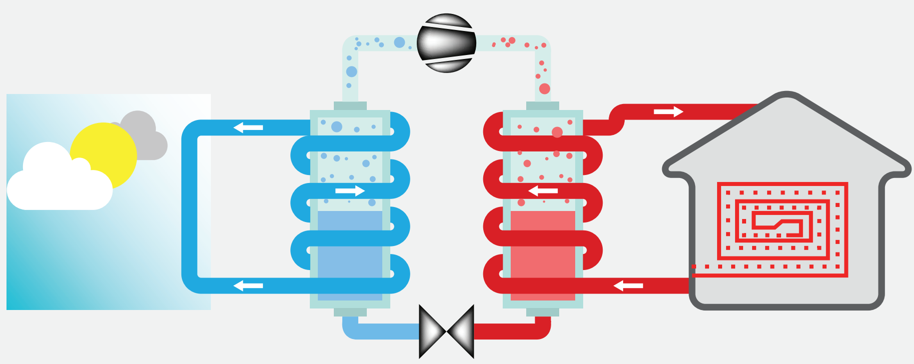
A heat pump is a high-performing technology that can recover and convert ambient energy (e.g., from air, water, ground) into useful energy.

A heat pump is able to produce more energy than the electrical energy it consumes (up to 4 times more), by recovering heat from renewable sources like outside air. No CO_2 emissions are generated on site, since electrical vapor compression heat pump burns no fossil fuel. Additionally, heat pumps completely eliminate a potential source of carbon monoxide in homes.

Major benefits:

- reduction of energy consumption
- reduction of CO_2 emissions on-site
- higher safety level

Heat pump technology can play a key role in reducing energy demand and improving quality of life in Lebanon.



Heat Pump Applications

Heat pumps can be used for space heating, domestic hot water, and air conditioning systems. They can be used by themselves or in hybrid systems with other heating devices (e.g., electrical heaters, gas boilers).

They can be coupled with other renewable energy technologies, such as photovoltaic panels, to provide even higher performance solutions.

Different applications:

- New residential buildings
- Refurbishment of existing buildings, by replacement or integration with existing heating systems
- Commercial and tertiary applications
- Public buildings (e.g., hospitals, schools, town halls)

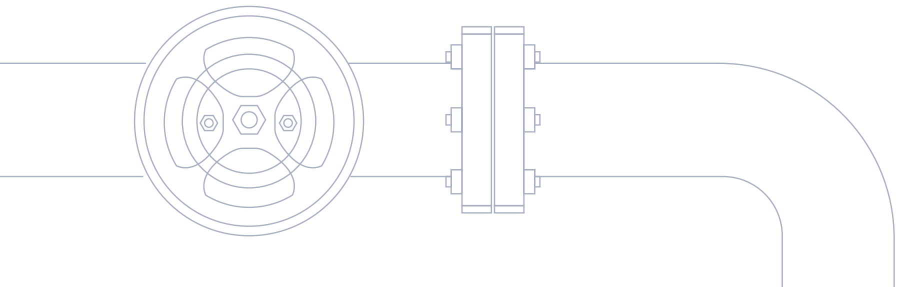
Different applications

Best Operating Conditions

Good design, installation, and control strategies are essential to achieve optimum heat pump performance. For this reason it is important to identify the best operating conditions and the factors that reduce heat pump efficiency.

Factors influencing the performance of the heat pump are listed below:

- Supply temperatures should be low for best performance
- For air source heat pump sensitivity to external climate conditions:
  - Best performance with average climate conditions
  - Impact of defrosting cycle on heat pump performance for external temperature around 0 °C and high humidity level
- Sensitivity to the compressor capacity ratio
- Proper integration with other system components (e.g., auxiliaries, back-up systems)



Domestic Hot Water

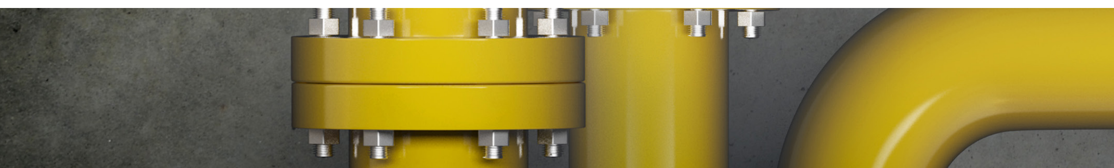
Heat pumps can be an efficient alternative to traditional heaters for the production of domestic hot water (DHW).

Most heat pumps for DHW available on the market are integrated with a storage tank. Typically hot water for a home with 4 occupants can be produced by a heat pump with 2 kW of thermal capacity and a volume tank of 80 liters.

A heat pump can heat a domestic hot water tank up to about 55 °C. The unit is usually equipped with an electrical back-up heater which contributes to the thermal input only when the heat pump is not able to cover it by itself or in case of failure. The electrical back-up heater is used for anti-legionella disinfection, heating the water to 80 °C.

Usually DHW heat pumps are installed indoors, and can easily replace existing electrical boilers. They are compact and require the same connection to the electricity supply.

A heat pump can get energy from an air source in the room where the unit is installed, or externally through an air duct system.



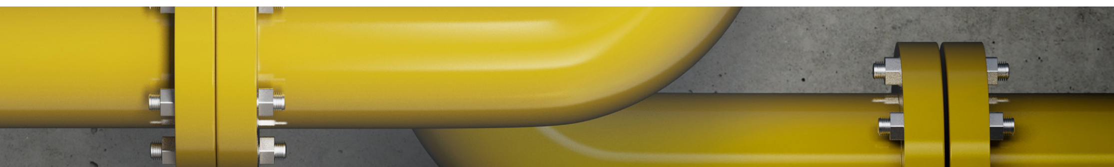
Residential Space Heating

Heat pumps are increasingly used for residential space heating both in new buildings and refurbished buildings.

This high-performing technology can reduce energy costs and emissions, but, due to its sensitivity to the operating conditions, its integration into an existing heating system requires special attention.

Major aspects to take into account are:

- Accurate choice of the heat pump size and compressor type: since energy needs for residential space heating can vary widely within the heating season, a multiple compressor or an inverter compressor pump could be a suitable choice to cover a wide range of capacities without compromising performance.
- Possible integration with an auxiliary heating system, which works at the lowest outdoor temperatures.
- Choice of a proper heating device, able to work with lower supply temperatures.
- Implementation of control logics and control devices to maximize heat pump performance (e.g., integration of an external temperature sensor for the compensation of the set point temperature with respect to the variation of external temperature).



Monitoring

The National Heat Pumps Project comprises the realization of an energy performance monitoring program for heat pump systems under real operating conditions.

The main objectives of monitoring are:

- Continuous commissioning to ascertain the real energy profiles of the building and the real heat pump performance.
- Fault detection and diagnosis to identify factors that can compromise the heat pump performance, including design errors, improper installation, or bad control strategies.
- The typical heat pump monitoring system collects data on energy consumption, thermal energy production, inlet and outlet temperatures of the heat pump, and air temperature for indoor and outdoor conditions. The minimum set of sensors to provide the previous measurements consists of:
  - Temperature sensors (e.g., thermoresistance)
  - Water flow meter
  - Heat meter
  - Electrical meter
  - Data logger, to collect all the sensors’ signals

Commitment to the Environment

In 2016 the Kigali Amendment to the Montreal Protocol initiated the global phase-down of Hydrofluorocarbons (HFCs), currently used in heat pump refrigerants, to reduce greenhouse gas emissions.

The most common refrigerants, R134a and R410A, have high global warming potential (GWP). To comply with the amendment, the heat pump market will have to move towards refrigerants with low global warming potential.

To this end, IMELS and LCEC want to promote, through financial advantages, heat pump systems, preferably technologies with low global warming potential refrigerants.

HFCs
e.g. R134a
(GWP = 1 430),
R410A (GWP = 2 088)

Alternative Low GWP Refrigerants
e.g. CO_2 (GWP = 1)

Financing

The National Heat Pumps Project introduces two support initiatives: NEEREA soft loans and IMELS grants.

NEEREA financing mechanisms provide interest-free loans to residential, commercial, and industrial users for the installation of heat pumps in new and existing facilities. Soft loans are offered at an interest rate of 2.25% for periods that should not exceed 14 years.

In addition to the subsidized loans, IMELS offers grants that cover up to 30% of the investment costs of Italian-made heat pump systems preferably using technologies with low GWP refrigerants.

Apply Now!

To benefit from the IMELS grant, applicants should submit a technical report, including a IMELS grant, comprehensive feasibility study with financial and technical analysis.

The report templates and guidelines can be downloaded at

http://www.lcec.org.lb/.

For Applicants

The Technical Report

The technical report should describe the feasibility study of the heat pump appliance in question, including estimated yearly energy needs, the size of the heat pump system, and an evaluation of the heat pump's seasonal performance.

A reference case should be included so that the savings in terms of energy, money, and greenhouse gas emissions can be assessed.

Technical drawings of the system should be attached to the report.

The report should also specify the type of refrigerant used by the heat pump and its GWP.

To quantify the actual energy consumptions and the heat pump's performance in the field, the system should be equipped with a monitoring mechanism with embedded or external gauges. The IMELS grant includes financing for an advanced monitoring system for some applicants. The technical report should include a description of the monitoring system.

Installers Section

The installation of heat pump systems should be executed according to the requirements specified by the manufacturers in the installation manual. Some suggestions for proper heat pump system installation are displayed below.

General requirements

- The heat pump should not be exposed to particular environmental conditions or to aggressive atmosphere.
- It is important to leave a minimum clearance, according to manufacturer requirements, that allows for installation as well as ordinary and extensive maintenance.
- To limit heat loss along the piping, all pipework should be well insulated and the heat pump should be installed as close as possible to the points of use.
- Before activating the heat pump system, carefully wash the system's pipes in order to remove any residues of screw thread, welding, or dirt that could interfere with normal operation.

Installers Section

Requirements for air-water heat pumps for domestic hot water production

- This kind of heat pump is usually designed for indoor installation. If not ducted, the heat pump's outlet air may reach temperatures that are 5-10 °C lower than the inlet air and the temperature of the room may drop.
- For installation without air canalization, the room where the heat pump is installed shall respect the minimum volume declared by the manufacturer and must be adequately ventilated.
- The heat pump needs to be connected to a pipe that allows for condensation to be regularly released. This pipe should have a siphon attached.
- The "thermal disinfection cycles" function should be always implemented on DHW heat pumps with integrated storage tanks in order to prevent the growth of Legionella bacteria. As this function is not enabled by default, it is best to enable and verify it when the heat pump is installed.

Installers Section

Requirements for air-water heat pumps for space heating

- The external unit should be protected from relevant weather conditions (e.g., in locations with abundant snowfall, the unit should be installed above the usual level of fallen snow; in locations with strong wind, the use of wind breaker barriers is recommended).
- Choose a location where noise and air discharged from the external unit will not disturb the neighbours.
- External units should be installed on antivibration supports to limit disturbing noise.
- If the heat pump has an external temperature probe sensor, the probe should be installed outside, away from heat sources and not exposed to the direct radiation.
- Some heat pumps have a temperature probe sensor that can be used to stop auxiliary pumps when the supply temperature reaches the set point. Probe sensors are recommended to reduce power consumption.

The Testing Facility

The testing facility aims to provide services to Heating, Ventilation and Air Conditioning (HVAC) industries that intend to sell their products in Lebanon. It will offer perfor-mance assessments and certifications for appliances designed for space heating, space cooling, and domestic hot water preparation.

The evaluation will follow the major international standards and certification schemes, with adaptations for Lebanon.

Machines tested include:

- Air conditioners, chillers, heat pumps with electrically driven compressors.
- Domestic hot water heat pumps with electrically driven compressors connected to or including a water storage tank.

The laboratory will consist of a double-room calibrated calorimeter for testing units having capacity from 0 kW up to 20 kW in the following ranges:

- Air temperature range: -30 °C to +60 °C
- Relative humidity range: 20% to 95%
- Fluid temperature range: -20 °C to +90 °C

The tests will be done according to standardized load and climatic profiles.

Certification

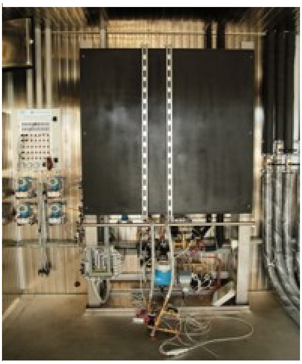
The testing facility performs accredited tests (UNI CEI EN ISO/ IEC 17025 - General requirements for the competence of testing and calibration laboratories) according to the international standards.

EN 14511 (1,2,3&4) - Air conditioners, liquid chilling packages, and heat pumps with electrically driven compressors for space heating and cooling.

EN 14825 - Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling, with testing and rating at part load conditions and calculation of seasonal performance.

EN 16147 - Heat pumps with electrically driven compressors, with testing and requirements for marking of domestic hot water units.

EN 1397 - Heat exchangers, including hydronic room fan coil units, with test procedures for establishing the performance.



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