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## Sun-fuelled bathing: Islamic Republic of Iran



### GENERAL INFORMATION

◆ **Implementing institution**

Iranian Research Organization for Science and Technology (IROST)

◆ **Head**

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◆ **Details of institution**

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◆ **Implementation period**

Four months in 1993.

◆ **Costs**

US\$50,000, sponsored by IROST.

## SUMMARY

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The community of Bashagard is located in an isolated area in the southeastern region of the Islamic Republic of Iran. It enjoys 3,500 hours of sun a year and an average daily irradiation of 22 megajoules per square metre. In 1993, a project to use some of this solar power to heat the water for a new public bath complex was designed and initiated.

The solar bath project, which took four months to complete, broke new ground in two ways. It was the first time that public baths were built and opened in the area, and the project uses what is thus far the largest solar power system in the country.

The system consists of two collector fields, each containing four rows of ten collectors. The collectors are connected to a hot-header pipe that feeds a 3,000-litre storage tank by pumps circulating water through a U-tube heat exchanger. The water returns to the collectors via a cold-header pipe. Two 3,000-litre tanks are connected in series and hot water is stored in a 6,000-litre main tank that supplies hot water for 12 showers. The bath complex can serve up to 400 people a day.

## BACKGROUND AND JUSTIFICATION

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Bashagard is a remote community situated some 200 kilometres from the nearest city, Minab, which takes six hours to

reach because of precarious road conditions. The area has only five days of rain a year, but the rain that does fall is so heavy that it tends to wash everything away, including the road. Originally, local authorities built a public bath complex that used gasoline to heat water, but this turned out to be far too expensive because of the costs of transporting fuel to the site — in Bashagard, gasoline is 15 times more expensive than it is in Minab. It was decided, therefore, that solar energy would be a good replacement for fossil fuel, and the Iranian Research Organization for Science and Technology (IROST) sponsored a project to design and manufacture a suitable solar collector that can supply energy to heat water for the baths.

## DESCRIPTION

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The system designed under the IROST project is divided into three subsystems:

- the collector subsystem, which consists of two collectors (collector field 1 and collector field 2), each designed with a closed loop and heat exchanger;
- the storage subsystem, which consists of two storage tanks (storage tank 1 and storage tank 2); and
- the domestic hot water (DHW) delivery system, which consists of the main storage tank and the pipeline that delivers hot water to the baths.

Water in the main storage tank is heated by circulating hot water from storage tank 2 via a pump. A 200-litre expansion tank installed on the roof provides extra water to replace any that is lost through boiling in the collectors that would otherwise cause the build-up of pressure in the system. Water boils, for example, when the water-circulating pump fails, and the expansion tank refills the system as soon as it is put back into operation.

The solar collector is single-glazed with low-iron glass. The absorber consists of an assembly of copper tubes recessed into aluminium plates. The tubes run parallel to one another and are connected to copper manifolds at either end of the collector. The absorber plate is matt black and anodized to provide high solar absorption. It is backed with 25 millimetre-thick compressed fiberglass insulation.

The collector frame is made from hollow aluminium coated with anodized silver.

The collectors are inclined at 45° and face the sun in rows. Rows of collectors are positioned one behind the other in a north-south rectangular formation. The correct north-south distance between each row is calculated by positioning the collectors so that they do not cast shadows on one another between the hours of 10:00 and 14:00 on 21 December, the day on which, for the northern hemisphere, the sun is at its lowest in the sky.

## PARTNERSHIPS

In 1998, IROST designed a solar collector for mass production by Polar Co., which to date has produced 5,000 units. The organization also serves as an energy consultant for the Iranian Ministry of Energy.

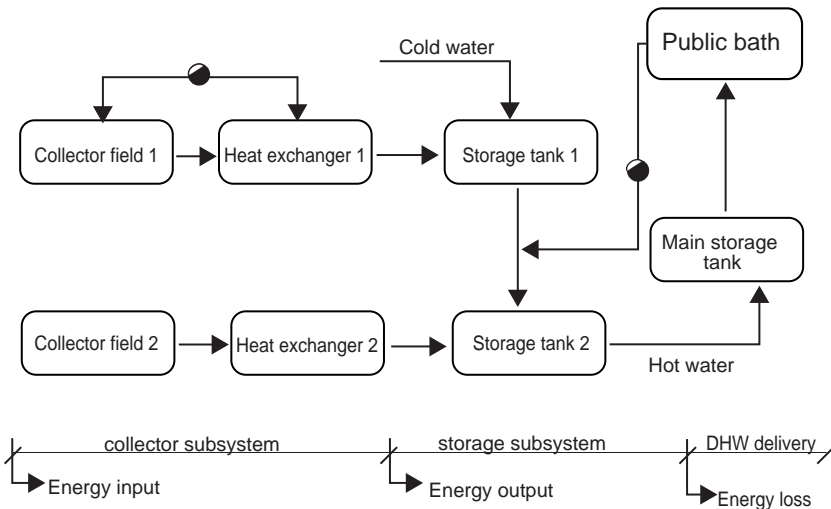


Figure 1 | IROST project system design

## REPLICABILITY

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The design of the solar water heating system installed in the Bashagard public baths can be adapted to the needs of many developing countries. It can be modified according to the location and the demand for hot water (i.e., the number of people using it).

## LESSONS LEARNED

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The following are the main lessons of the IROST project:

- Systems should be designed to use materials and skills that are available locally. For example, storage tanks can be built from raw brick and cement.
- In some cases, systems can be designed to operate as thermosyphons, thereby eliminating the need for pumps.
- Systems can be designed to supply hot water for bathing in winter and heat for drying agricultural products in summer.
- The centralized system used in the project is more economical than the batch (decentralized) system.
- In some cases, systems can be used to heat greenhouses. For example, systems can be designed to produce hot water for six months of the year, and greenhouse heating for the other six months.

## IMPACT

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At the outset of the Bashagard project, public baths were something of a novelty in the area, and people were wary of using them. Since then, public perceptions have changed and in the space of two years, six other solar-heated public baths have been constructed and are being used extensively throughout the eastern part of the Islamic Republic of Iran.

## FUTURE PLANS

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The future plans of IROST include improving the efficiency of collectors, designing and building systems in the Islamic Republic of Iran and other countries, and collaborating with other countries as well as with national and international organizations.