QATAR FOUNDATION
CITY OPERATIONS

FACILITIES & INFRASTRUCTURE DIRECTORATE
DISTRICT COOLING & INFRASTRUCTURE

SUMMARY

Qatar Foundation (QF) is a non-profit organization made up of more than 50 entities working in education, research, and community development. Our unique ecosystem is supported by partnerships with leading international institutions and built on initiatives that address our most pressing challenges, create global opportunities, and empower people to shape our present and future.

Education City, flagship initiative of Qatar Foundation, is a campus that spans more than 12 square kilometers and hosts branch campuses of some of the world's leading educational institutes, a homegrown university, and other research, scholastic, and community centers.

These institutes make Education City a unique model of academic and research excellence, pioneering a new approach to multidisciplinary, global education and enabling breakthroughs that benefit Qatar and the rest of the world.

Education City - District Cooling System:

Qatar Foundation was established in 1995-96 with primary school facilities to provide quality education for children. In 2001, QF enhanced its boundaries and collaborated with Cornell University, for establishment of Weill Cornell Medicine Qatar at South Campus of Education CIty.

The Qatar Foundation's first District Cooling Plant (Central Plant-1) was built with a capacity of 11000 RT and commissioned in 2003 at Education City South Campus as a centralized utilities supply provider of CHW, Potable Water, Fire Water, and Irrigation Water for the International Universities.

Meanwhile, between 2003 and 2013, a Master Plan was designed and 5 more District Cooling Plants with Centralized utilities were built in phases based on the expansion of Educational and research building facilities in Education City's North and South Campuses, with a total capacity of 145,000 RT.

- Central Plant-2 & 4 were commissioned in 2008 with 11000 RT each,
    - Central Plant 1,2 & 4 are built with similar capacity capacity chillers of 1000 RT each and the construction & Operation technology also similar to each other.
- CP-7 was built and commissioned in 2013 at Education City South Campus with the arrangement of 2 chillers in series for one chiller train with the capacity of 4000 RT each. In total 8 -train configuration are available with installed capacity of 32,000 RT.
- Similar to the design and construction of CP-7, two more chiller plants - CP-3 & 6 were commissioned in 2014-15 at Education City North Campus for production of 40,000 RT each.

Central Plants are built to serve a total area of 12 square kilometers in Education City, which includes,

- Seven primary and secondary schools,

- One school for children with special needs,
- Nine universities for higher education, including one homegrown Hamad Bin Khalifa University and eight international universities such as Weil Cornell Medicine-Qatar, Carnegie Mellon University, Texas A&M University, Georgetown University, NorthWestern University, Virgenia Commonwealth University, HEC Paris and UCL Qatar.
- In addition to schools and universities, Education City includes Science and Technology parks(QSTP – Tech-1,2 & 4), Qatar National Library, a Children's Education Satellite Channel, research laboratories and development centers.
- Qatar Foundation recently expanded its energy supply boundaries by signing a contract with Qatar Metro Rail for the delivery of cooling energy to their three energy transmission centers, from which Qatar Rail serves the cooling needs of nine metro stations via their pipe network.

Central Plants located at North and South campuses of Education City are connected within the site by a 14-kilometer pipeline that runs through the Utilities Tunnel. It allows for the operation of central plants based on demand on the distribution network in response to changing ambient conditions. Energy Transfer Stations of Fifty various Facilities are supplied from QF Central Plants to date.

District Cooling Plant – Education City Stadium:

The Qatar Foundation and the Supreme Committee for Delivery and Legacy have chosen a World Cup stadium within the Education City to make the FIFA World Cup 2022 a catalyst for social and human development. By being located in the heart of a knowledge center nurturing tomorrow's leaders, the stadium will host up to the quarter-finals stage during the FIFA World Cup 2022. It is destined to serve the sustainable, green, and healthy living needs of the future.

The Education City campus is a clear demonstration of Qatar's commitment to sustainability. Education City Stadium has grown up alongside neighbours who inspired it to become an example of sustainability to stadium developers worldwide. It also guides the way for others by using smart building systems, with an integrated water and energy control and monitoring system to manage real-time consumption. Environmentally conscious design and construction techniques assist the stadium's carbon footprint be reduced not only during construction but also over its lifetime. The parklands, LEED-certified buildings, green architecture, and home to various sustainable initiatives like the Qatar Green Building Council and Qatar Environment and Energy Research Institute (QEERI)—everything here is focused on promoting a green, healthy future for all.

With a capacity of 40,000 RT, the Central Plant of Education City World Cup Stadium (Central Plant-5) was completed and taken over in September 2020. The plant is equipped with 20 high-efficiency centrifugal chillers, which are arranged in a 10-train configuration to produce 4,000 RT per chiller train. The World Cup Stadium is now using a portion of the Central Plant-5's capacity, and the remaining capacity will be used for planned structures such as the Education, Sports, and Research Academy, which are being constructed near the stadium. It is monitored and controlled using a SCADA system and is equipped with the most up-to-date equipment and technology, resulting in exceptional energy efficiency. This plant is connected to the other 6 energy centers in Education City by utility tunnel pipes and a control system, allowing them more flexibility in terms of reliability, operation and control.

To maintain the proper temperature for the stadium's amenities, the district cooling system feeds chilled water to a number of distributed power transmission centers inside the Education City Stadium, which then distribute it to a number of air treatment units stationed in the stadium.

The district cooling system utilized in stadium cooling is a cutting-edge, environmentally friendly technology that is also one of the most energy-efficient. It saves about 40% of electricity by reducing electricity generation and distribution capabilities, resulting in a 40% reduction in natural gas consumption and, as a result, a 40% reduction in greenhouse gas emissions when compared to conventional cooling solutions, as well as 98 percent of potable water by using treated sewage (TSE) water for condenser cooling.

The Central Plant-5 features ten cooling towers with Variable Frequency Drive (VFD) fans and each Cooling Tower is equipped with its own centrifugal vertex type sand filtration system with 40 micron cartridge type filters, as well as two side stream filtration systems, filtering 15% of the total condenser water capacity.

Central Plant is operated, controlled and monitored by latest SCADA system and it provides real time diagnostic of all the operating system and equipment for higher reliability and lower operating costs. To ensure consistent water qualities, the plant features an automatic chemical analysis and dosing system, as well as periodic examination through external labs.

Performance of the plant and Energy Transfer Stations are monitored continuously through SCADA system by manpower deployed for 24/7 operations. Operations meeting are conducted every morning and performance of the plant and connected facilities are reviewed in details and necessary actions are taken

to ensure maximum utilization of Chilled Water with highest Delta-T in return. Immediate escalation and follow-up matrix is followed if any of the facilities ETS is noted performing low for more than 2 hours continuously.

Energy Optimization in buildings:

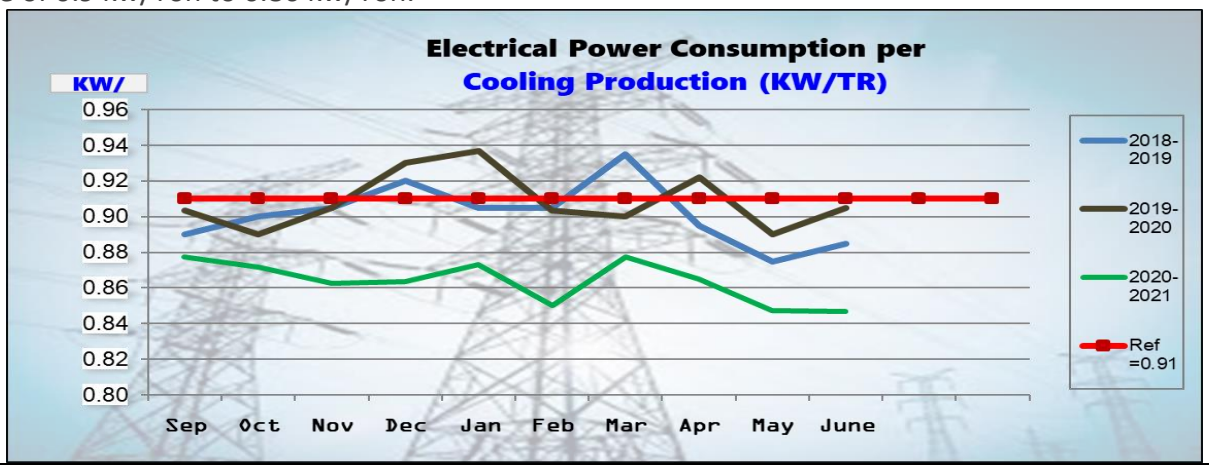
City Operations-Optimization Plan was Implemented and sustainable building awards to the facilities with lower enregy consumption for two consecutive years was announced. Awards with recognition resulted with high competition among the building users on energy conservation and results yielded with drop in CHW energy utilisation by 4% in 2 years.

Annual Energy audit on the universities and schools are carried out and recommendations for retrofitting their HVAC and Chilled Water System for performance improvements and energy conservation is suggested. Based on the energy audit, following improvements on energy savings are noted,

- Older buildings with low delta-T syndrome are corrected after replacement of existing AHU CHW flow control valves with energy efficient valves along with PICVs. Significant improvement in Delta-T upto 4^0C is noted.
- CHW hydronic systems are further reviewed and relocated the location of Differential pressure sensors of CHW system to eliminate the over pumping of CHW.
- No. of building users are recognised with Gold and Silver Certificate by Green building council after implementation of sustainability measures.

Energy Savings recorded:

Electrical Consumption is considerably reduced and Chiller Plant efficiency improved from previous years average of 0.9 kw/Ton to 0.86 kw/Ton.



Expanding Qatar's Solar vision at Qatar Foundation:

Governments across the globe are increasingly focusing on the benefits of sustainable energy and Qatar is no different. As part of its national vision, the country is working to create harmony between environmental protection and economic growth.

To that end, projects like the one being undertaken at Qatar Environment and Energy Research Institute (QEERI), part of Qatar Foundation (QF) member Hamad Bin Khalifa University, are a step towards fulfilling that goal – reflecting the efforts of QF, which is this year marking its 25th anniversary, to develop solutions in the field of research, development, and innovation that can make a pivotal contribution to securing a sustainable future for Qatar.

Paris-based T-lab which is part of Total's Gas, Renewables & Power branch, has expanded its solar research zone at QEERI's Outdoor Test Facility. The extension, featuring three trackers, bifacial modules, inverters, sensors and power optimizers, looks to improve the performance of Total's photovoltaic components in desert conditions. The zone will also monitor performance in real time and validate the results through simulation tools.

The project is part of not just Qatar's vision, but Total's increasing move into sustainable energy. The company aims to reach zero carbon emissions within their operations by 2050, and is therefore investing highly in low-carbon solutions.

In addition to the solar research zone at QEERI, Qatar recently signed an agreement with Total, alongside Japan's Marubeni, to build a solar power plant that will be capable of producing 800 megawatts – meeting 10 percent of Qatar's peak electricity demand.

Solar Energy Production:

Initiated the installation of solar panels at strategic locations across Education City to produce renewable energy sour in an environmentally friendly manner in order to reduce CO_2 emissions and thereby lower the carbon footprint of Qatar Foundation Facilities.

Increased investments in decarbonization through the sustainability department, and started efforts to harness the abundant solar energy. Solar panels were installed in all of the car parking shades, as well as extra solar panels at various points throughout the campus. Average renewable energy produced is 5 MWH per day through solar panels at Education City which is contributing about 1.0% of average Electricity demand of Central Plants at Education City.

To enhance the production of renewable energy through solar panels, Qatar Foundation is working with a goal of reaching 5% contribution to total electricity consumption by 2030. To increase the rate of production, we're collaborating with market leaders in renewable energy generation including our own subsidiary of QSTEC.

Every day, the sustainable measures taken through solar energy production reduce 3.5 metric tons of greenhouse gas emissions equivalent to CO_2. Regardless of the fact that it was accomplished in a country with plentiful natural gas, it was seen as a significant feat. The achievement of the target production of 25 MWH by 2030 will result in a significant reduction in carbon footprint, with a record production of 25 MWH of green power each day.

Community Developement:

All our work at Qatar Foundation revolves around offering people opportunities. While our other initiatives provide opportunities for excellence in education and research, it's through our community development initiatives that we provide a platform to fully engage communities on the ground and build programs that develop our nation as a whole.

We are proud of the diverse and international community we've grown and continue to foster here. In numbers, more than One MIllion books in the Qatar National Library which are free for public access and 900,000 people are reached through our community events.

Part of Social development, we are dedicated to helping and empowering every member of our community by providing platforms for development and discovery. Qatar Debates organized by Qatar Foundation is delivering a wide range of high-quality debate learning programs in Arabic and English. QatarDebate seeks to promote the culture and use of debate, open dialogue, and discussion as effective academic and personal development skills amongst secondary and university students.

Environmental Sustainability Initiatives by Qatar Foundation:

Sustainability is a common thread that runs through all we do. Qatar Foundation is trying the best to meet Qatar's long-term social and economic growth needs while remaining environmentally responsible. Qatar Foundation have always been big advocates for sustainability efforts in the country and the region. We work hand-in-hand with scientists, researchers, innovators, and entrepreneurs in Qatar and all over the world to make breakthroughs and develop new, sustainable solutions to grand challenges.

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Our Work – Qatar Foundation is committed to addressing the needs of the present without compromising those of the future. Our work spans across multiple areas and sectors. Translating our vision into reality starts from our very own campus. Our students live in the largest collection of LEED-certified student housing facilities in the world. Our community-led initiatives across Education City ensure that our campus is a green space that follows sustainable practices.

Qatar Foundation is big believers in making sure exciting ideas lead to exciting impact. And we don't just limit ourselves to those ideas that come from the PhDs. Our ecosystem is designed in a way that even enables students to submit research papers at a partner university, and then work with the pros to put their theory into practice at a nearby innovation hub.

Our researchers work within a unique Research, Development, and Innovation (RDI) ecosystem, spanning across academia and industry. The environmental research our community generates doesn't only address Qatar's needs, but effectively contributes to the wider global efforts.

Our RDI community benefits from the various partnerships we've formed over the years with key local, regional, and global stakeholders. These collaborations help us support the progression of our initiatives and open up possibilities for new ones.