

Case Study: Hashemite University Solar

FB Group helps Jordanian university tap renewable energy wealth

In ancient times, Jordan was considered a rich and fertile land in an otherwise arid part of the globe. Today Jordan is rich with recent historical discoveries that date back thousands of years.

One of its most impressive wonders is the rediscovered city of Petra. Known as the Rose City, its magnificent temples, giant tombs, and staggeringly beautiful surroundings make it like no other site in the world.

While rich in culture and fertile land, Jordan has historically struggled with energy production as a result of limited natural resources.

A National Challenge

Until a recent discovery of shale oil, Jordan was considered to be almost entirely without oil reserves. Jordan is among the countries in the world that are most dependent on foreign energy sources, with 96% of the country's energy needs coming from imported oil and natural gas from neighboring Middle Eastern countries. A heavy reliance on foreign oil imports consumes a large portion of the country's GDP.

As a result, starting in 2007, the Jordanian government developed the National Energy Strategy Plan and committed to investing \$15 billion in renewable and nuclear energy. The plan calls for an increase in domestic energy sources from 4% to 40% by 2020.

These aggressive goals call for a dramatic ramp-up in renewable energy production across the country, from homes to hospitals to universities.

The Solution

One of the universities leading the adoption of renewable energy technology is Hashemite University (HU). Located on the outskirts of Zarqa, HU is one of the largest universities in Jordan at 300,000 square metres (3,200,000 sq ft).

The university includes Faculties of Arts, Science, Educational Science, Supporting Medical Sciences Nursing College, Engineering and Literature.

While many universities throughout Jordan have developed solar energy initiatives, HU turned to FB Group in Amman to develop an engineering, procurement, and construction (EPC) project to build a solar farm with enough photovoltaic (PV) capacity to power the entire university.

FB Group designed the solar plant to deliver a total capacity of 5 megawatts over several solar arrays:

- A 4 MW, ground-mounted and grid-connected medium-voltage solar farm delivers the majority of the university's energy requirements.
- An additional 1 MW low-voltage, grid-connected system is divided between a 400 kW car parking structure (single & double) for around 178 cars and a 616 kW canopy system installed throughout the campus.

While the system's electrical generation capabilities are state of the art, the canopy system also offers a modern design that provides convenient shade for the pedestrian walkways in the hot environment.

According to Dr. Firas Balasmeh, president and CEO of the Amman-headquartered FB Group, "The project was fully financed by the Jordan Commercial Bank and was completed in 7 months.

"Since completion, the renewable energy installation has received royal interest as being the first of its kind in



A 4 MW ground array provides the majority of the university's energy requirements.

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the kingdom and among all universities in the Middle East and North Africa. The project was launched with a huge opening ceremony under the patronage of his royal highness Prince El Hassan Bin Talal, the uncle of His Majesty King Abdullah II.”

At its completion, the solar farm delivered enough electricity to power the entire university, resulting in a total electricity bill of 1 JOD since July 2016.

The Control System

Designing the region's first net metering solar project was a complex task. The system required integration of hardware and software from multiple vendors, including ABB and Campbell Scientific.

To tie these various pieces of technology together and automate the solar plant, FB Group knew they would require a control system that met these requirements:

- Enhanced protocol support
- Industrial Internet of Things (IIoT) capabilities
- A solid track record of reliable operation in harsh, high-temperature environments like the Jordanian climate

FB Group turned to Opto 22 and its SNAP PAC control system to integrate and automate the various systems of the PV plant.

The SNAP PAC System is an integrated system of hardware and software for industrial control, remote monitoring, data acquisition, and IIoT applications.

The system's distributed I/O architecture features intelligent I/O that independently handles functions such as latching, counting, thermocouple linearization, watchdog timers, and PID loop control. These functions continue to work on the I/O processor even if communication with the system controller is lost.



Opening ceremony for the university's solar system

At the heart of the control system is the **SNAP-PAC-R1 programmable automation controller**. The SNAP-PAC-R1 includes two independent, 10/100 Mbps Ethernet network interfaces. Each interface has a separate IP address, so the PAC can be used to segment the control network from the company IT network, or to provide Ethernet link redundancy in case of link failure or maintenance.

SNAP controllers can communicate simultaneously using several different protocols, including EtherNet/IP, Modbus/TCP, SNMP for network management, and SMTP for emailing.

SNAP PAC controllers also feature a built-in REST API that makes all I/O point and strategy variable data available for secure access using a built-in HTTP/HTTPS server, with data delivered in JSON format.

For digital input monitoring, FB Group chose the guaranteed-for-life SNAP-IDC5D, which provides four channels of 2.5-28 VDC digital input.

Each channel senses the on/off status for DC voltages from sources such as proximity



A 616 kW canopy system throughout the campus also provides welcome shade for pedestrians.

switches, push buttons, or auxiliary contacts. The module has removable top-mounted connectors for easy access to field wiring, as well as channel-specific LEDs for convenient troubleshooting.

For digital output control, FB Group used the SNAP-ODC5-i with channel-to-channel isolation. The module provides four channels of 5-60 VDC digital output, each switching a separate DC load.

Because they are isolated, each channel can be wired as either sinking or sourcing. The module features channel-specific LEDs for troubleshooting and includes a connector clamp to prevent sparks.

One of the challenges FB Group faced in automating the solar plant was **integrating serial data** from ABB data loggers. Designed into the PV system to monitor PV performance, the data loggers require an RS-485 interface to connect to a control system.

FB Group added the SNAP-SCM-485-422 serial communication module for this purpose. It snaps onto the same rack that holds digital and analog I/O and the rack-mounted controller. The module provides two 2-wire RS-485 serial communication ports for two channels of high-speed, isolated serial data, or one 4-wire serial communication port for a single channel.

For added **wiring protection**, FB Group added the SNAP-TEX-FB16-H breakout board. Used primarily for wiring digital inputs and outputs, the SNAP-TEX-FB16-H provides a fuse and a fuse-blown indicator for each of its 16 channels.

In addition, it provides 120–240 volts of power to loads. With a power source attached to a single spot in the middle of the rack, power goes out to solenoids or switches, depending on the SNAP I/O module used.

An IIoT-enabled Solar Plant

FB Group also required Industrial Internet of Things capabilities in the form of remote monitoring and control via the Internet from mobile devices like cell phones and tablets.



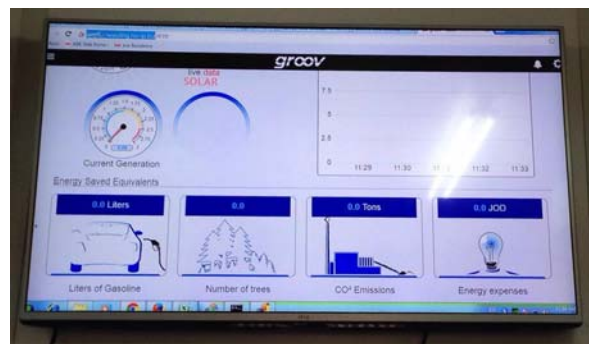
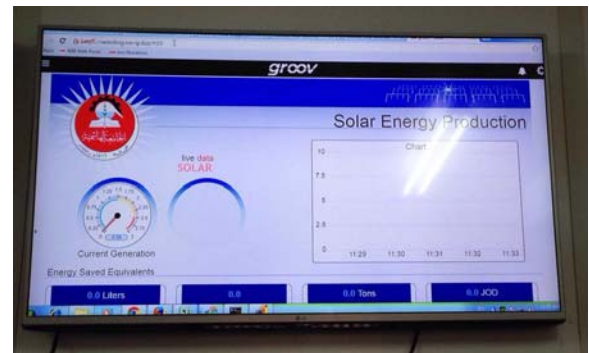
The compact Opto 22 SNAP PAC System

For this requirement FB Group chose the *groov* mobile operator interface appliance. *groov* is Opto 22's web-based IIoT and operator interface system that's simple, mobile, and connects easily to automation systems, software, databases, and devices of all kinds. Using *groov*, engineers at FB Group easily built their own mobile interface—a custom mobile app—with no programming or coding required. FB Group leveraged

groov's ability to mix devices and data from different manufacturers and sources in the same interface.

With mobile screens designed and served out of the *groov* appliance and viewed on mobile devices like phones, tablets, and web-enabled HDTVs, the entire plant can be controlled and monitored from wherever the operator is located.

The *groov* interface can be used on an Apple or Android mobile device with the free *groov* View app, or users can



A groov mobile operator interface lets operators monitor and control the solar plant from any location.

view the same interface on any brand computer or device with a web browser—even a web-enabled HDTV.

Photovoltaic production and sensor readings throughout the plant are displayed on *groov* web pages to provide operators with real-time information on the status of the solar plant.

About FB Group

FB Group is built to serve business organizations and people who aren't building hobbyists, who need to find quality vendors of reliable hardware, software, service, training & support. They need to use these quality vendors as they use their other professional service suppliers, as trusted allies. FB Group seeks to fulfill these needs and become the leader in Automation & Control, Process & Measurements, as well as Education & Training for business and technology to cover not only Jordan but the whole region.

FB Group provides both solutions and services useful to businesses. We are especially focused on providing integrated network systems and services. Our services include specification, pre-engineering, design, integration, upgrade, modifications, installations, support and maintenance, and training. In order to accomplish our objectives, our key to success over the next years is to differentiate from box-pushing, price-oriented businesses by offering and delivering service, training, and support.

About Opto 22

Opto 22 develops and manufactures hardware and software for applications involving industrial automation and control, the Industrial Internet of Things, energy management, remote monitoring, and data acquisition. Designed and made in the U.S.A., Opto 22 products have an established reputation worldwide for ease-of-use, innovation, quality, and reliability.

Opto 22 products, including the *groov* mobile operator interface, use standard, commercially available networking and computer technologies, and are used by automation end-users, OEMs, and information technology and operations personnel in over 10,000 installations worldwide.

The company was founded in 1974 and is privately held in Temecula, California, U.S.A. Opto 22 products are available through a global network of distributors and system integrators. For more information, contact Opto 22 headquarters at +1-951-695-3000 or visit www.opto22.com.