

COMPANY OVERVIEW

ABOUT US

Power On The Roof is all about providing safe, reliable, and cost-effective alternative energy platforms. Starting with our first KangaRoof Factory Solar Panels in 2001, we introduced the idea of fair billing to the energy market - we cover the costs of putting solar panels on your roof, and charge you half of what the energy companies charge per kilowatt hour. For smaller customers, this can result in savings of up to 50%, year after year. We use economy of scale to minimise our capital costs, and technology to optimise energy production and provide a fantastic customer experience. We have a strong market presence in Australia, the United States, and Spain, with plans to expand to France, Canada and Mars.

A MESSAGE FROM OUR FOUNDER

Hello hello!

When I started Power On The Roof, I expected to be successful and make heaps of money. Thanks to our customers, I've done exactly that. It's absolutely crazy how many people want to be environmentally-friendly and reduce their dependence on electricity produced from fossil fuels. By using Power On The Roof, we can all do our part to save the planet, and have Really Stylish Roofing while doing it.

Our latest range of solar roofing panels is pretty special - as well as now being available in purple, yellow and blue, each panel includes a small battery and a miniature computer with it's own itty bitty Internet access. The computer continually monitors the health of the panel, and contacts us here at Headquarters to let us know if there are any problems, and make pretty charts of all the money you're saving on power bills. If there's a problem with your panel then we'll know about it, and will be on-site with a replacement within three days, at no cost in the first 7 years. We'll even send you e-mail in advance to let you know what's happening to that you don't freak out when you see our people are climbing on your roof. How's that for service!?

Thank you for being a customer of Power On The Roof - together we can save the planet (and pay for the backup plan of getting us off this stupid rock!)

Melon Tusk

Chief Exploration Officer

PRODUCTS AND SERVICES

Our company manufactures, installs, maintains and manages energy products:

- Solar cells and fittings
- Solar roof tiles (our specialty!)
- Batteries
- Power inverters
- Safety devices including interconnects and isolators

LOCATIONS

POTR is a global company, with facilities in key market locations.

AUSTRALIA

The POTR headquarters campus is located in Melbourne, Australia. This is the main location for Engineering, IT, and Corporate services, with around 1500 staff and contractors. Manufacturing and international logistics are managed from Sydney, with 900 staff and contractors. The service team consists of 800 mobile service and installation engineers (MOSIEs), servicing 80,000 installations. Our growth rate in Australia around 15% per year.

UNITED STATES

Both San Diego and Austin hold local manufacturing, sales and service facilities, with each being able to “back up” the other location if work is busy or there’s a local holiday. Due to the uniqueness of the North American marketplace, “manufacturing” here is customisation of products made in Australia to suit North American building codes and other market requirements. We have approximately 300 permanent staff in each of San Diego and Austin offices, and another 1500 MOSIEs across North America. Our installed base in North America as at the end of 2016 is 280,000 individual sites running POTR equipment, and our annual growth rate in this market is approximately 9%.

EUROPE

Our European office is in Barcelona, because it’s really sunny there, and allows us to test our new products, and have a little sleep in the afternoon if it gets too hot. Barcelona is small compared to the other offices, with only 50 permanent staff. We have 400 MOSIEs servicing customers in Spain, France, Portugal and southern Italy. There are 42,000 installations across these locations, with annual growth of 14%.

SUMMARY

The following table summarises our customer and staff composition; as a general guide, staff numbers (including MOSIEs) are expected to increase in line with customer base in a region.

Region	Installations	Growth	MOSIEs	Site Staff
Australia	80,000	15% p/a	800	2400 (Melbourne: 1500, Sydney: 900)

North America	280,000	9% p/a	1500	600 (San Diego: 300; Austin: 300)
Europe	42,000	14% p/a	400	50 (Barcelona: 50)

POTR SYSTEMS OVERVIEW

INFRASTRUCTURE GUIDE FOR STAFF AND EXTERNAL CONSULTANTS

PURPOSE

This guide has been created to describe the key internal and external IT systems that staff and external consultants and contractors may need to interact with when working for POTR.

OBTAINING ACCESS

Every staff member and consultant will need to obtain a POTR Identification Card ("PIC"). This card contains your photo and other important information, and is a multipurpose smart card used to:

1. Open doors and provide other physical access ("swipe card") to areas as required
2. Log in to IT systems
3. Show people in the surrounding areas that you're one of the "cool kids" working for POTR.

Your access to buildings, secure areas and IT systems will be limited to only what you need to discharge your duties.

You must keep your PIC displayed at all times when working at a POTR facility. If you forget your PIC, you won't be allowed to enter or work, you won't be paid for the lost time, and you won't accrue vacation time if you're staff. **There are no temporary PICs issued.** If you lose your PIC, then you must report this to your supervisor; your old PIC will be cancelled, and a new one issued with the same (or a worse) photo. So take a good photo the first time **and don't lose your PIC!**

To obtain your PIC, please take your government-issued ID, letter of employment or engagement, and any required accreditations described in your letter, to the Human Resources office on your campus, as follows; an appointment is not required and the process will take about 60 minutes:

Facility	Building/Room Directions
Australia - Sydney factory	Building 1B, Room 51
Australia - Melbourne headquarters	Building 17, Room 201

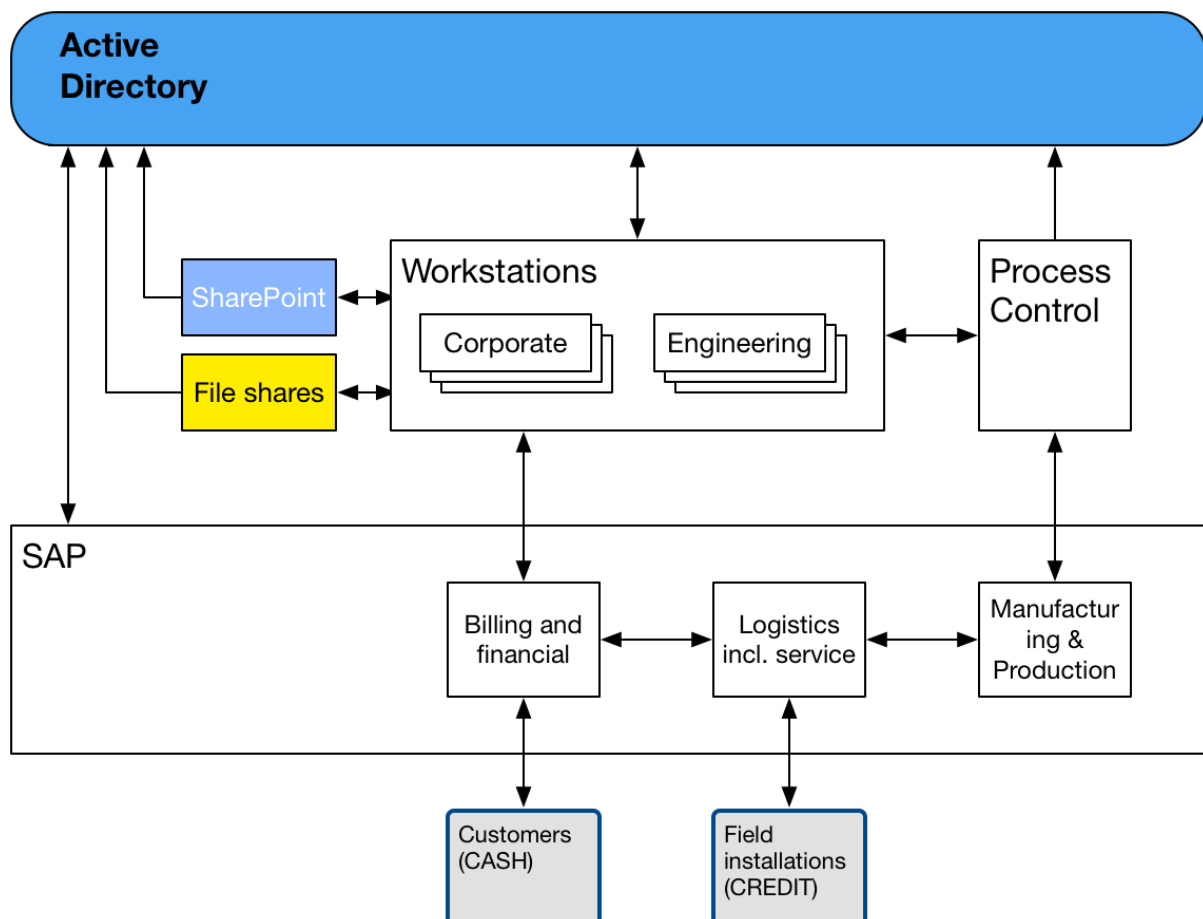
United States - San Diego (CA) campus	Building 3 - Ask at main reception area
United States - Austin (TX) campus	Power Tower (take train to Power Station, then elevator to Level 37)
Spain - Barcelona campus	Manana House, Level 2.

HIGH LEVEL

KEY SYSTEMS

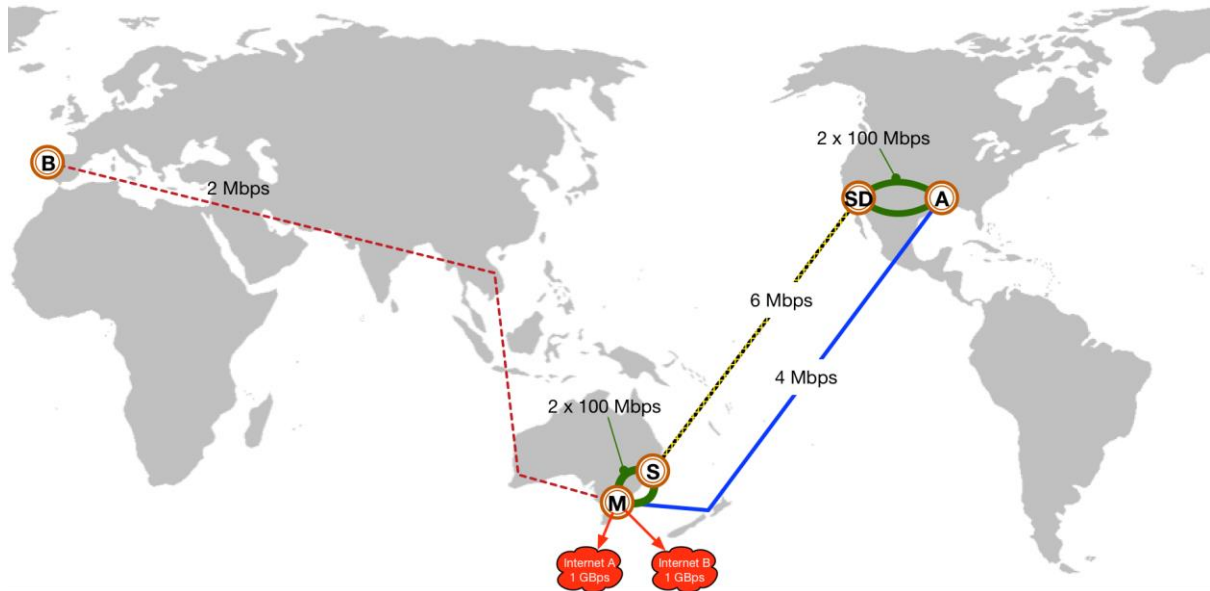
The key systems are (theoretically) all based in Melbourne, with components distributed if required for a particular application. For example, process control systems are located in factories in order to meet latency and real-time control requirements. There are a few cases where, for various reasons, that hasn't happened to plan.

The following block diagram shows the key POTR systems:



NETWORK CONNECTIVITY

The POTR network is a traditional spoke-and-hub network using private leased lines for all inter-office connections. External-facing services are delivered from the Melbourne data center. Sydney provides some disaster recovery support for critical services, but our rapid growth has meant that our overall DR has some definite weaknesses.



Each inter-office network link is implemented using a hardware-based¹ IPSEC VPN, carried over private (non-Internet) layer-2 service. Internal routing uses OSPF; external routing uses BGP with both of our Internet providers advertising our AS.

SPECIAL NOTES ABOUT BARCELONA

Most Barcelona users connect to virtual desktops hosted in Melbourne and/or Sydney; these virtual desktops are used to access all other POTR systems. The Barcelona office was an experiment in agile deployment practices and seems to be working reasonably well.² As far as “user infrastructure”, there are two local Windows Active Directory servers and the majority of user machines are thin clients. Some of the sales people have laptops but these are heavily locked down.

The shipping systems in Barcelona are standalone, as are the building management systems. These are managed remotely from Melbourne and frequently have odd problems; the solution to date has been to have

¹ PaloAlto Networks C5000 family of devices

² Our staff in Barcelona do report problems of “slow Internet”, but they shouldn’t be using the Internet during work hours anyway.

“spare” systems around and to use these to fix immediate problems. The “bad” systems are then rebuilt remotely and put back into a spares pool when completed.

TECHNICAL ENVIRONMENT

INTERNAL SYSTEMS

ACTIVE DIRECTORY

We use Microsoft Active Directory as our single “source of truth” regarding users and resources. We’ve got AD **everywhere** for staff and contractors. Your PIC card is actually a smart card that you use to log in to workstations, enter the building, and badge into the bathroom. For this reason, we’ve put a lot of effort into getting our AD design and infrastructure “just right”. We use a third-party product (Centrify) to integrate Linux machines neatly into the AD infrastructure. The only approved exception to using Active Directory is process control equipment which doesn’t support Active Directory at all, but can use a special track which we have on our PIC cards - so no problem!

Each office location has at least two Domain Controllers (virtualised, running on different physical servers) and at least two supporting DHCP/DNS instances. Logins to workstations and servers use AD accounts and the integrated PKI facilities within AD (ie. require your PIC card). Single-sign-on (SSO) is available to all of the key systems; SAP takes this further and access within SAP is managed within AD based on container membership and some simple custom schemas provided with SAP (and approved by Microsoft). There are some renegade staff members running laptops, Apple Macintoshes and various tablets that can’t access some resources because they aren’t integrated (e.g. No smart card reader, not on AD domain) or don’t have compatible software.

DOCUMENT MANAGEMENT: SHAREPOINT + FILE SHARES

SHAREPOINT

The primary means of document management at POTR is Microsoft Sharepoint. Sharepoint is home to ~200,000 documents, spanning most business departments. Many business functions are supported and managed using Sharepoint lists and associated workflows + custom code, e.g., issue registers, complaints+remediation, contacts.

System details:

Sharepoint 2013 Enterprise.

Total content database size: 450GB

5x Frontend servers. Each 8GB RAM, 4 cores

3x Application servers. Each 4GB RAM, 4 cores

4x DB server cluster. Each 12GB RAM, 4 cores

2x Search application servers. Each 4GB RAM, 4 cores

4x Search DB server cluster. Each 12GB RAM, 4 cores

FILE SHARES

File shares (SMB) are per-office, for files that aren't an appropriate fit for Sharepoint and are particular to a geographic location. E.g., large storage such as schematics, graphic design, etc. This also includes redirected My Documents folders, and some sites have roaming profiles.

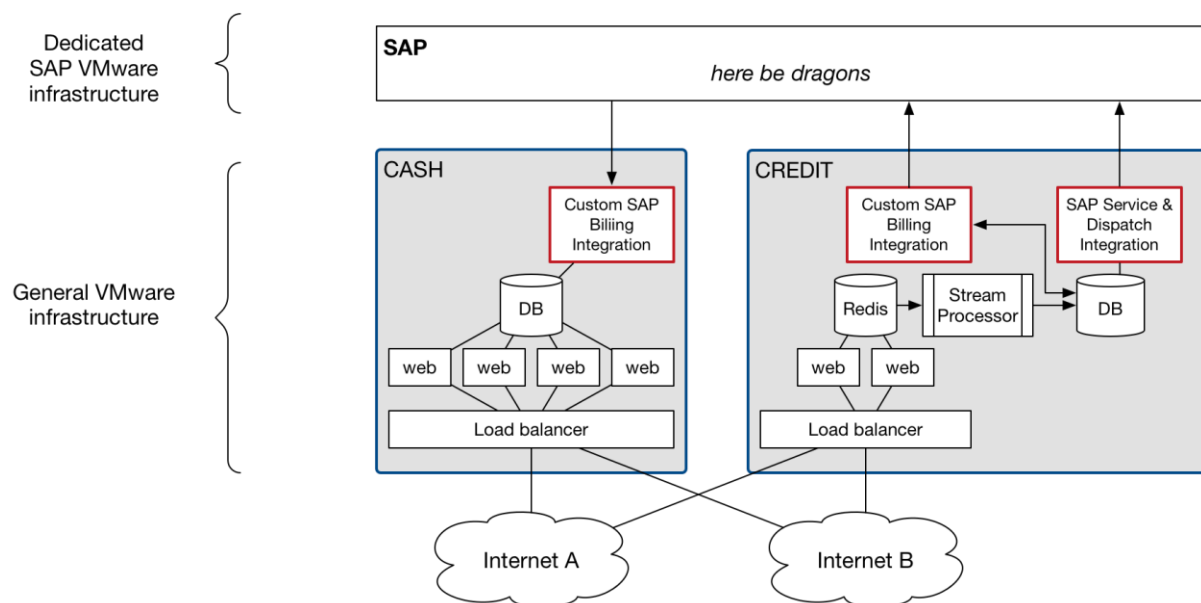
IT staff have become aware of an increasing amount of users who are using unauthorised services such as Dropbox, OneDrive, Google Drive, and ad-hoc file sending services such as YouSendIt. These services are being used to share (duplicate) files from Sharepoint and file shares with users in remote offices and with external people such as contractors. Individual occurrences of unauthorised service/software usage are dealt with by directing users towards security and computer use policies.

TREASURY AND BILLING

Financial services are managed within SAP; the SAP team is a self contained and governed unit.

CUSTOMER FACING SYSTEMS

OVERVIEW



CASH (CONSUMER AND SERVICE HELP)

CASH is the main web-based system that our customers and support staff and technicians use to check billing, service health, ask for more power, and so on. Hosted in our Melbourne data center, CASH is pretty modern and is built on Linux servers with the following technology stack:

- **Front-end:** HTML5/React
- **Load balancer:** Envoy
- **Web server:** NGINX
- **Application:** In-house Django application (Python)
- **Database:** MySQL (version 4.1)
- **Integration layer:** Custom code that communicates between the SAP core and Django. Written in Python/Flask, this basically handles retrieving bills and billing status from SAP. It handles some requests from the CASH Django application and also has a batch mode for updating some records in the CASH database. One thing that the integration layer does is throttle the number of requests sent to SAP so that SAP performance isn't impacted by CASH.
- **Outbound customer contact:** (Not shown in diagram) e-mail via SendGrid, SMS using Twilio
- **Inbound customer contact call center:** (Not shown in diagram) A really old IVR system running on an OS/2 machine and using analog phone lines, that allows customers to speak to a human, obtain current balance, and verify a MOSIEs identity/job details.

Customers have reported that it can be difficult accessing CASH at certain times, but eventually (after thirty minutes) CASH is available again.

CREDIT (COLLECT ROOF ELECTRONIC DATA INTERNET OF THINGS)

One of our product differentiators is that our energy products contain built in telemetry functionality as a core element. Data on solar levels, temperature, energy production and consumption are collected on each device, and sent to our systems for analysis, billing and monitoring. Data is sent to CREDIT using the global Internet. Depending on the particular device installed and the local market conditions, this may make use of the customer's own Internet connection, or dedicated cellular/radio access. Every device we ship has the ability send telemetry in near-real-time or in batched modes; if a device loses real-time access, it automatically falls back into batch mode and can catch up later. The default for most devices is to send one standard update every 5 minutes. A standard update is about 800 bytes of data in size. A batch consists of multiple standard updates, sent 1 second apart to limit the impact on CREDIT (example: sending a batch of two days' data would take about $2 * 24 * 12 = 576$ seconds = ~10 minutes, best case).

The technical stack for CREDIT is reasonably modern too; we replaced the previous system (Basic Access Roof Telemetry & Energy Recorder) when our customer base got too big:

- **Front-end:** Restricted ReST API using JSON over HTTP (one update = one POST). Devices contain embedded IP stacks that can handle this easily.
- **Load balancer:** HA-Proxy
- **Web server/application:** Custom web server written in Node.js
- **Data store:** Redis as primary store, with data pulled out of Redis and processed in a processing pipeline written in a combination of Node.js and Ruby (and possibly some shell scripts, but who knows?!). Processed data is then stored in PostgreSQL.

- **Integration layer:** Custom code that communicates between the SAP core and Node.JS web server and data store. Billing and service related data is sent into SAP by the integration layer.

Our newest integrated tile product includes telemetry *on each tile*; this has really impacted CREDIT performance since instead of a customer having only one connection, they may have up to 20 (the average is 10.2). Around 4% of our customers have these new tiles. Engineering really messed up on this one!

CREDIT also has some other functionality related to service management. CREDIT is also the system that MOSIEs connect to using a purpose-built, dedicated tablet/phone application. This application allows MOSIEs to examine diagnostic information recorded in CREDIT, and to do some other cool things with inventory management (e.g. When replacing a panel) and energy tuning. The MOSIE application doesn't use AD directly to authenticate MOSIE users; each tablet is individually associated with a particular MOSIE user and uses NFC capabilities of the PIC card as a kind of session key.

MANUFACTURING AND PROCESS CONTROL

The systems used to manufacture our products are mostly standalone and use dedicated ModBUS process controllers. The controllers need real-time access to thousands of sensors to ensure safe and continuous manufacturing.