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BRIDGING THE GAP IN REMOTE POWER:

METHANOL FUEL CELLS FOR AUSTRALIA'S OFF-GRID DEMANDS

Enabling continuous power with EFOY Pro methanol fuel cells for security, telecommunications, monitoring, and critical systems across Australia.

JAMES RUTTY

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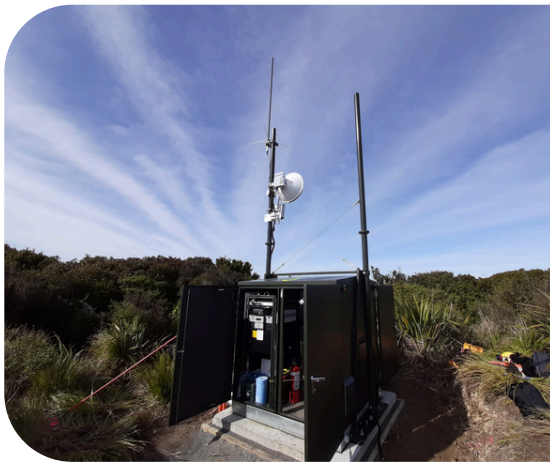
EXECUTIVE

SUMMARY

The Power Problem in Remote Australia

In today's connected world, critical systems must operate without interruption - regardless of location, availability of grid power, or environmental conditions. Applications such as Security & CCTV; Radio and Communications; Environmental Monitoring demand reliable and long-duration power. Traditional methods of powering this equipment often fall short. Grid access is frequently unavailable or too costly; solar conditions can be inconsistent, and battery swaps or generator servicing introduce cost, risk and maintenance overhead.



Introducing EFOY Pro Fuel Cells

EFOY Pro direct methanol fuel cells (DMFCs) from SFC Energy offer a compact, silent, and emissions-free alternative. By converting bottled methanol into electricity through a catalytic process - without combustion or moving parts - these fuel cells deliver dependable power with low noise and minimal maintenance. This makes them particularly well suited for both sensitive built environments and remote locations, where system uptime and long-term autonomy are critical.

This whitepaper outlines the operation of EFOY Pro fuel cells and explores their deployment across a range of critical off-grid applications in Australia and New Zealand, including:

Industry Applications at a Glance

Security and CCTV systems, such as event surveillance platforms, construction site towers, and council or police trailers

- Telecommunications infrastructure, including microwave links, hybrid solar sites, and comms trailers (CoW).
- Emergency services field kits and portable repeater setups for mission-critical radio coverage or charging field batteries
- Public safety and law enforcement surveillance, where silent, low-profile operation is essential
- Water utility telemetry, SCADA systems, and environmental sensors in shaded or solar-challenged areas
- Wind and environmental monitoring campaigns, where data continuity and simplified servicing are critical

POWERBOX'S

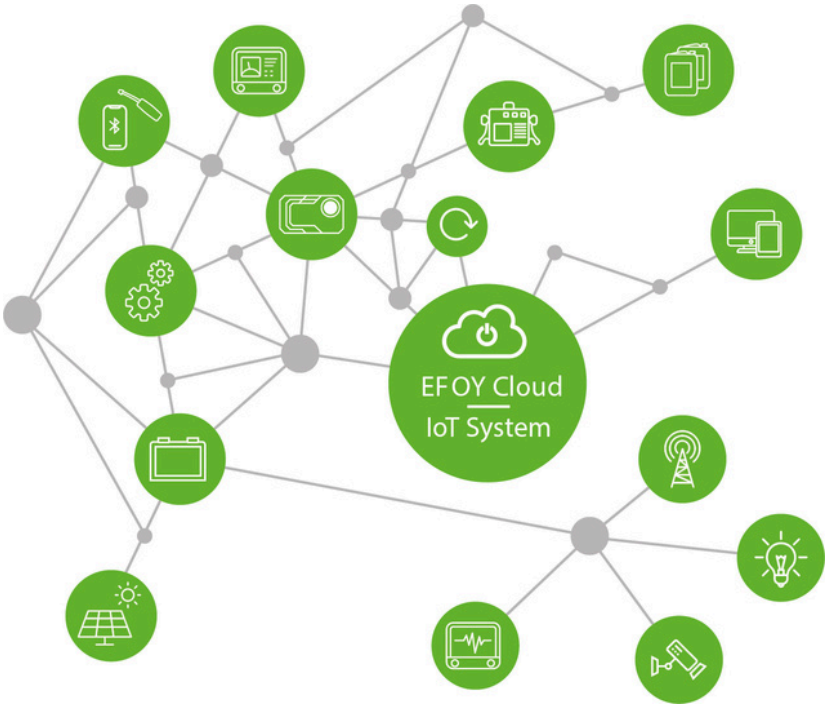
EXPERTISE

With over a decade of field experience, Powerbox Australia has successfully delivered and supported EFOY Pro-based solutions across a wide range of industries and government sectors throughout Australia and New Zealand. Our expertise spans everything from system design and component selection to turnkey deployment and ongoing service support. Whether for a single site or a nationwide rollout, Powerbox provides the local engineering insight, supply continuity, and technical credibility required to ensure project success.

This sets the stage for a deeper look at the core challenge driving fuel cell adoption: the difficulty of delivering reliable, autonomous power in remote and variable Australian conditions.

Key Takeaways

Beyond the technology itself, this paper also covers practical system integration strategies — including fuel logistics, hybrid solar–fuel cell configurations, remote diagnostics through the EFOY Cloud platform, and system sizing methodologies for varied load profiles.



INTRODUCTION

THE REMOTE POWER CHALLENGE

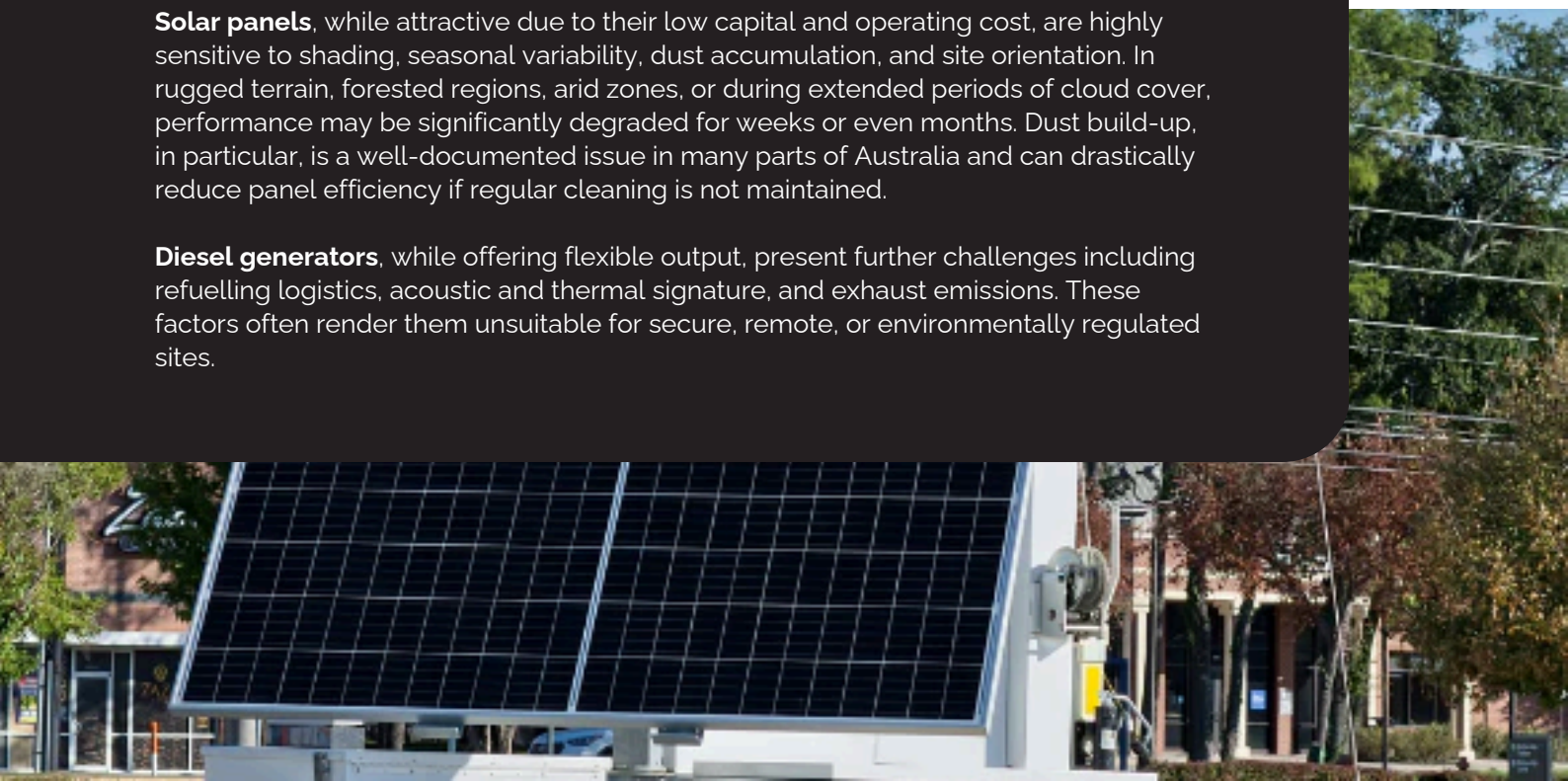
Across Australia and New Zealand, reliable power availability remains one of the most critical challenges in field-deployed infrastructure. Whether the application is a critical CCTV tower, a solar-powered radio repeater, or a LIDAR-based wind monitoring campaign, the ability to deliver continuous, autonomous power is often the limiting factor in successful deployment. Long distances between service centres, harsh environmental conditions, unpredictable solar yields, and a lack of grid infrastructure make conventional power strategies increasingly impractical, particularly when system downtime is unacceptable.

LIMITATIONS OF SOLAR-ONLY AND DIESEL SYSTEMS

Common off-grid solutions to these challenges often rely on oversized solar arrays and large battery banks that are disproportionate to the actual load, or the inclusion of trailer- or skid-mounted diesel generators. These industry-endorsed solutions frequently introduce their own complications. Larger battery banks increase capital costs, require larger enclosures or shelters, and necessitate expanded solar arrays to maintain adequate charge levels. If the system is incorrectly sized - whether undercharging or over-discharging batteries - it can result in system downtime, shortened battery life, more frequent maintenance visits, and higher long-term operational costs.

Solar panels, while attractive due to their low capital and operating cost, are highly sensitive to shading, seasonal variability, dust accumulation, and site orientation. In rugged terrain, forested regions, arid zones, or during extended periods of cloud cover, performance may be significantly degraded for weeks or even months. Dust build-up, in particular, is a well-documented issue in many parts of Australia and can drastically reduce panel efficiency if regular cleaning is not maintained.

Diesel generators, while offering flexible output, present further challenges including refuelling logistics, acoustic and thermal signature, and exhaust emissions. These factors often render them unsuitable for secure, remote, or environmentally regulated sites.



RISKS: VANDALISM, THEFT & **MAINTENANCE BURDEN**

In both cases, vandalism and theft pose a substantial risk to exposed equipment, particularly at unattended, high-traffic, or semi-secure sites. Damaged solar panels, stolen copper wiring, tampered fuel lines, or missing battery modules can result in significant outages and unplanned service callouts. These factors often render traditional solar and generator systems unsuitable for secure, remote, or environmentally regulated locations.

Why Methanol Fuel Cells Are a Better Fit

In these contexts, direct methanol fuel cells (DMFCs) such as the EFOY Pro series present a compelling alternative. Compact, silent, and designed for long unattended runtimes, they can serve as either a primary power source or as a hybrid complement to solar, significantly extending autonomy and reducing service intervals. Unlike combustion-based systems, DMFCs produce no NOx, SOx, or particulates and generate only small amounts of water vapour and carbon dioxide, making them suitable for environmentally regulated areas or deployments with strict acoustic and thermal requirements.

As pressure grows to digitise infrastructure, monitor environmental conditions, and secure assets in challenging locations, the need for modular, reliable, low-maintenance power solutions has never been greater. Methanol fuel cell systems meet this need with a combination of predictable performance, simple fuel logistics, and integration flexibility. These benefits are explored in detail throughout this paper.

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HOW EFOY PRO WORKS:

DIRECT METHANOL FUEL CELL FUNDAMENTALS

This section provides a straightforward breakdown of the operating principles behind direct methanol fuel cells (DMFCs).

While the underlying chemistry is well-established in electrochemical engineering, the goal here is to explain in clear terms how EFOY Pro fuel cells convert methanol into reliable DC power - and why this process is ideally suited to powering off-grid applications across Australia and New Zealand.

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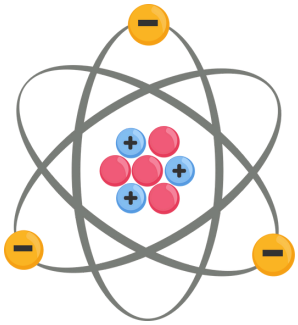
ELECTROCHEMICAL OPERATION

EFOY Pro fuel cells generate electricity using a clean chemical process called electrochemical conversion. Instead of burning fuel like a generator, they convert energy from methanol directly into electricity using a proton exchange membrane (PEM) fuel cell stack. This process takes place in three core steps:

1 FUEL INTRODUCTION

A mixture of methanol and water is drawn from a sealed EFOY fuel cartridge (M10, M28, MT60) and fed into the anode side of the fuel cell. Methanol (chemical formula CH_3OH) is a liquid alcohol that acts as the fuel source.



2 REACTION AT THE ANODE

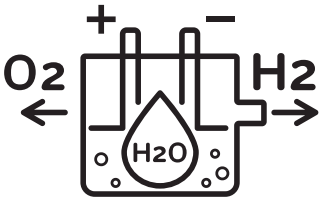
On the anode surface, a catalyst triggers a chemical reaction. This breaks down the methanol into three things:

- Carbon dioxide (CO_2), which is vented as a harmless gas
- Protons (H^+), which are positively charged hydrogen ions
- Electrons (e^-), which are negatively charged and carry electrical energy

3 POWER GENERATION AND WATER FORMATION

The fuel cell membrane separates the protons and electrons:

- The protons pass through the PEM membrane to the other side of the cell (the cathode)
- The electrons are forced to travel around an external circuit and in doing so, generate usable DC electricity
- At the cathode, the protons and electrons meet again and combine with oxygen from the surrounding air, forming water vapour

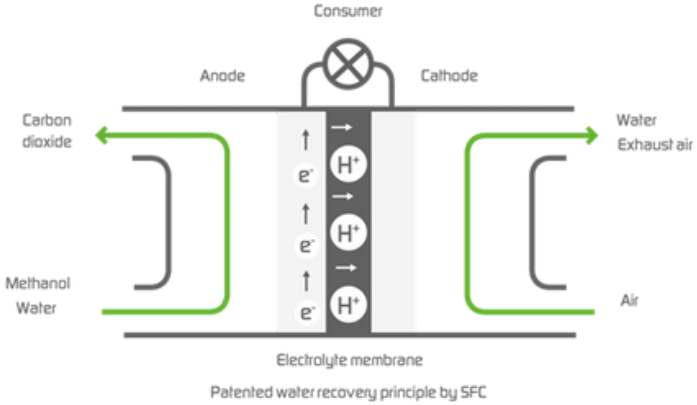


The overall chemical reaction can be summarised as: **$CH_3OH + 3/2\ O_2 \rightarrow CO_2 + 2H_2O$ + electricity**

This means the only by-products are:

- Carbon dioxide (CO_2) — comparable to the amount exhaled by a person breathing
- Water vapour
- A small amount of waste heat

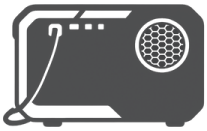
There is no combustion, no smoke, no loud engine, and no complex moving parts making the system quiet, clean, and highly reliable for use in remote or



SYSTEM ARCHITECTURE
& COMPONENTS

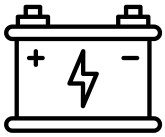
EFOY Pro fuel cells are delivered as compact, plug & play unit designed for easy integration into a power system.

At the heart of each system is the fuel cell module, which works in tandem with a battery bank to ensure continuous power delivery. Unlike a generator or inverter, the fuel cell does not power the load directly. Instead, it charges the connected battery, which acts as both an energy buffer and the primary power source for downstream loads.



FUEL CELL MODULE

The main unit containing the proton exchange membrane stack and internal catalyst layers. It handles methanol conversion, power output regulation, and safety management functions such as temperature control and fault shutdown.



BATTERY BANK (LEAD ACID, AGM, OR LIFEPO$_4$)

Serves as the energy buffer between the fuel cell and the load. The fuel cell monitors battery voltage and automatically activates when charging is required, then shuts down when the battery is full. This parallel configuration ensures stable power delivery, protects against load transients, and enables more efficient energy use.

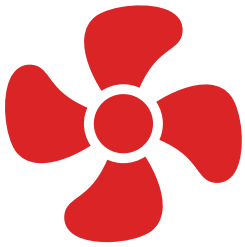
METHANOL FUEL CARTRIDGES

Available in M10 (10 L), M28 (28 L), and MT60 (60 L) sealed formats. These non-pressurised containers store a methanol/water mixture and are designed for safe handling, long shelf life, and field deployment without the need for decanting fuel. The addition of an EFOY Fuel Manager enables each fuel cell to automatically draw from 2, 4, or 8 cartridges in sequence, depending on configuration (Fuel Manager 2, 4, or 8). This dramatically increases operational autonomy — supporting systems in the field for several months or even over a year without requiring a site visit for refuelling. Cartridges are hot-swappable, and the system seamlessly switches between them as needed.

INTEGRATED POWER ELECTRONICS

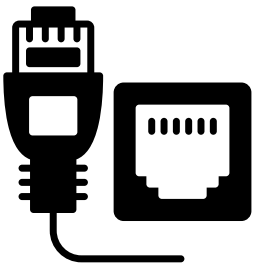
Manages automatic start/stop cycles based on user-defined voltage thresholds. Key parameters include:

- Start voltage (e.g. 12.2Vdc or 24.4Vdc)
- Stop voltage (e.g. 13.7Vdc or 28.0Vdc)
- Maximum runtime, temperature limits, or alarm triggers



COOLING AND VENTILATION

A quiet internal fan regulates temperature, and small amounts of CO_2 and water vapour are vented via a side exhaust. No mufflers or liquid-cooled components are required.



COMMUNICATIONS AND MONITORING

Optional interfaces include Ethernet, Modbus, and GSM for use with EFOY Cloud. Remote access enables runtime tracking, alarm alerts, fuel level monitoring, and preventive diagnostics.

MODULAR ARCHITECTURE

The modular architecture supports integration into cabinets, mobile trailers, repeater shelters, or standalone enclosures, and is suitable for both primary power or backup augmentation in hybrid systems.

THE ADVANTAGES OF METHANOL AS A FUEL FOR

OFF-GRID POWER SYSTEMS

Having explored how EFOY Pro fuel cells generate electricity and integrate into hybrid DC systems, it is the use of methanol as the fuel source that delivers many of the system's most compelling advantages — from simplified logistics to environmental suitability — particularly for off-grid applications across Australia and New Zealand.

Methanol (CH_3OH) is a liquid alcohol fuel that offers several key advantages for powering remote and autonomous systems via direct methanol fuel cells (DMFCs). In the context of EFOY Pro applications across Australia and New Zealand, methanol stands out not only for its high energy density and clean electrochemical properties, but also for its practical logistics, safety profile, and suitability for long-duration deployments.

SAFE, STABLE, AND EASY TO TRANSPORT

Methanol is a liquid at ambient temperatures and pressures, which simplifies storage, handling, and transport compared to pressurised gases or volatile hydrocarbons. EFOY Pro fuel cells use sealed, non-pressurised cartridges (M10, M28, MT60) that:

- Are UN-approved and compliant for land and sea transport
- Require no special handling of dangerous goods
- Have long shelf life (Typically 2-3 years)
- Are compact, stackable, and easy to carry and install on site

Because the cartridges are fully sealed and cannot be refuelled or tampered with, they minimise the risk of spillage, evaporation, or unauthorised use in the field.

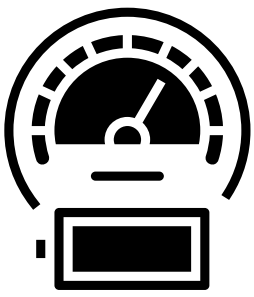
HIGH ENERGY DENSITY & LONG RUNTIME

Each EFOY Pro fuel cell cartridge delivers approximately 1 kWh of usable electrical energy per 0.9 litres of methanol, reflecting typical system-level efficiency under real-world conditions.

This translates into significant site autonomy:

- A 10 L (M10) cartridge provides approximately 11.1 kWh of electricity
- A 28 L (M28) cartridge provides approximately 31.1 kWh
- A 60 L (MT60) cartridge provides approximately 66.7 kWh

Using a 50W continuous load as a benchmark, even a single MT60 cartridge can power a system for over 55 days without intervention. With a Fuel Manager connected to 4 or 8 cartridges, autonomy can extend to several months or beyond one year. These runtimes assume ideal conditions and continuous operation at 50 W. In hybrid systems where solar generation is available, the fuel cell only operates when battery voltage drops below the threshold, significantly extending the effective runtime and further reducing fuel consumption.



CLEAN, NON-COMBUSTION-BASED OUTPUT

Unlike diesel or petrol generators, direct methanol fuel cells (DMFCs) produce electricity without combustion. The reaction yields only small amounts of:

- Carbon dioxide (CO_2)
- Water vapour
- Trace heat (no hot exhaust or radiated noise)

This means no smoke, no particulate emissions, and no local air pollution - making methanol fuel cells ideal for environmentally sensitive sites such as national parks. The quiet operation also ensures systems can be deployed near residential or public spaces without acoustic intrusion.

SIMPLIFIED LOGISTICS AND PREDICTABLE FUEL PLANNING

Methanol fuel cartridges enable predictable runtime planning based on actual electrical load and cartridge size. Since consumption is directly proportional to load and runtime, site operators can:

- Pre-calculate expected runtime for each deployment
- Schedule cartridge swaps or refills on a fixed cycle
- Avoid emergency service callouts

Cartridges can be stocked centrally, shipped easily, and hot-swapped in the field. They do not require permanent tanks, or fuel transfer equipment.

FEWER COMPLIANCE AND SAFETY CONSTRAINTS

Methanol's classification as a flammable liquid (Class 3) is well understood and manageable within most industrial, mining, government, and commercial safety frameworks. Compared to diesel and LPG:

- There are no venting or sloshing issues
- Fuel cannot be siphoned, spilled, or misused
- There is no gelling or freezing risk in cold conditions

EFOY cartridges remain compliant across a broad range of use cases, particularly in areas where diesel handling is restricted or where clean-energy mandates are being adopted.

In summary, methanol offers a rare combination of energy density, transportability, clean emissions profile, and predictable runtime behaviour. When paired with EFOY Pro fuel cells, it enables highly autonomous, low-maintenance, and field-proven power solutions for the most demanding off-grid applications.

APPLICATIONS
IN AUSTRALIA & NEW ZEALAND

WHERE EFOY PRO DELIVERS VALUE

EFOY Pro fuel cells are already supporting a wide range of off-grid and autonomous applications across Australia and New Zealand. From mobile surveillance trailers deployed at major public events to powering critical radio links, EFOY Pro systems are field-proven in environments where traditional power approaches fall short. This section explores the key sectors where methanol fuel cell technology offers clear advantages over batteries, diesel generators, and solar-only systems.

ELECTRONIC SECURITY
& CCTV APPLICATIONS

WATER UTILITIES
& ENVIRONMENTAL MONITORING

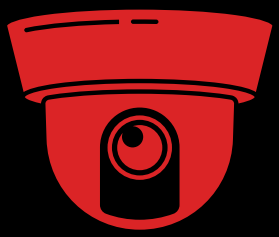
TELECOMMUNICATIONS
& CRITICAL COMMUNICATIONS

WIND MEASUREMENT
& MONITORING

EMERGENCY SERVICES
& PUBLIC SAFETY

ELECTRONIC SECURITY &

CCTV APPLICATIONS



Power reliability is a critical requirement for remote and mobile surveillance systems such as CCTV towers, trailers, and emergency help points.

These installations are often deployed in urban or infrastructure-rich environments where access to grid power is unavailable, and where solar-based systems are limited by shading, vandalism risk, or restricted installation space.

Shading in particular is a recurring challenge in built-up areas, with buildings, trees, and other vertical structures reducing solar generation to inconsistent levels. Battery-only systems may also struggle to support long-term autonomy or recover effectively during periods of poor sunlight.

TYPICAL APPLICATIONS WITHIN THE ELECTRONIC SECURITY & CCTV SPACE

Event Surveillance & Crowd Monitoring

Council rapid-deployment surveillance trailers

Police department observation and evidence-gathering platforms

Construction site monitoring for safety and theft prevention

Fixed pole-mounted CCTV in public spaces, transport hubs, and laneways

Emergency help points for safety monitoring, including duress alerts and emergency communication.

WHY EFOY PRO?

Security and surveillance systems demand continuous operation regardless of weather, access, or location. EFOY Pro fuel cells enable these deployments to function independently of solar availability and without the vulnerability of battery-only systems or the regular refuelling and noise of diesel generators. Units can be housed in compact enclosures with silent operation and no thermal signature, making them far less prone to vandalism or tampering. For mobile security platforms, such as trailer-mounted CCTV towers, the reduced weight and extended runtime of EFOY systems eliminate the need for regular site visits, fuel handling, or bulky solar infrastructure vastly disproportionate to the site's load.

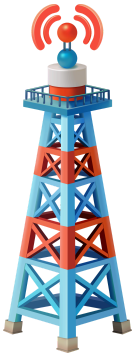
TELECOMMUNICATIONS &

CRITICAL COMMUNICATIONS

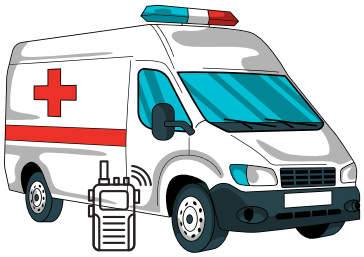
Telecommunications infrastructure often spans vast and remote areas, requiring base stations, repeaters, and mobile network platforms to operate in conditions that challenge traditional power solutions.

Radios in particular are a critical part of public safety infrastructure, relied upon by emergency services, councils, and utility operators for coordination and communication, especially during natural disasters such as bushfires and floods. These same events often render solar PV unreliable due to smoke, cloud cover, or physical shading from trees and surrounding terrain.

TYPICAL APPLICATIONS WITHIN TELECOMMUNICATIONS



Supports off-grid remote telecommunications equipment such as radio repeaters



Trailer- and vehicle-mounted radio and data transmission systems

WHY EFOY PRO?

Telecommunications infrastructure is often deployed in mountainous, coastal, or otherwise inaccessible regions, where reliability is critical and solar generation is inconsistent. EFOY Pro fuel cells supplement battery banks by maintaining charge during periods of low irradiance or adverse weather. The EFOY Pro 12000 Duo supports larger system architectures, delivering up to 500 W output at 24 Vdc or 48 Vdc - ideal for use to power radio transmission equipment. It features two independent fuel inputs and can be extended to four cartridges using a pair of DuoCartSwitches.

For smaller-scale or lower-power systems, the EFOY Pro 2800 provides 125W at 12Vdc or 24Vdc and is compatible with EFOY Fuel Managers, allowing for automated multi-cartridge support (2, 4, or 8 cartridges). This range of options makes EFOY Pro suitable for both fixed installations and mobile, trailer-based telecom deployments where solar infrastructure is impractical and generator noise or maintenance overhead is undesirable. Most importantly, these configurations deliver the multi-week to multi-month autonomy needed to ensure uninterrupted communications capability - even through prolonged poor weather, seasonal shading, or natural disasters.

EMERGENCY SERVICES &

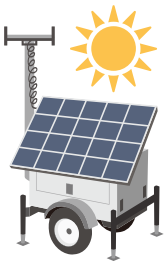
PUBLIC SAFETY

Emergency response deployments operate under unique constraints: sites are often temporary, mobile, and activated with minimal notice.

Whether dealing with natural disasters, large-scale public safety events, or remote search-and-rescue, consistent off-grid power is essential for communications, lighting, and sensor systems.

TYPICAL APPLICATIONS & USER CASES FOR EMERGENCY SERVICES

Field-deployable radio repeaters



Mobile command units and communications trailers

Portable surveillance and sensor kits for fire, flood, search-and-rescue

WHY EFOY PRO?

Emergency service deployments require power systems that are light, reliable, and rapid to deploy under high-stakes conditions. EFOY Pro systems can be pre-configured in ruggedised transport cases and deployed with minimal setup time. Their silent operation avoids acoustic signature issues in tactical or populated areas, and the lack of exhaust gases is particularly beneficial in fire-prone environments. These units reduce generator reliance in the field and allow command trailers or repeater kits to remain operational for days or weeks without maintenance.

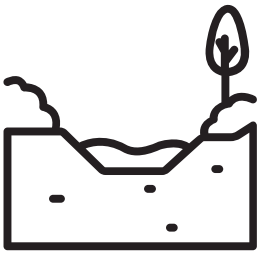
ENVIRONMENTAL MONITORING &

WATER UTILITIES

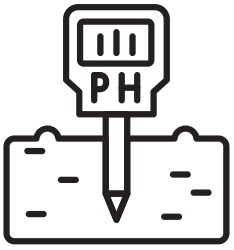
Monitoring and instrumentation systems in water management and environmental science are often located in shaded, humid, or flood-prone areas that limit the practicality of solar-only power systems. These locations may be unattended for months, with limited access during adverse weather or wet seasons.

TYPICAL APPLICATIONS & USER CASES FOR ENVIRONMENTAL MONITORING

SCADA and telemetry for water quality, flow and pumping infrastructure



River and floodplain monitoring



Air, soil, and groundwater monitoring stations

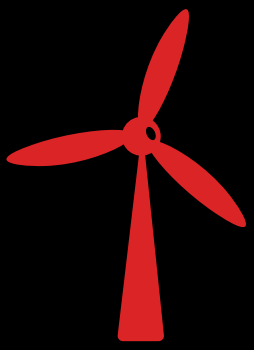
WHY EFOY PRO?

Remote monitoring points across water utility and environmental systems are frequently located in terrain unsuitable for large solar arrays. Shaded embankments, wetland zones, or valley floors can limit solar viability for much of the year.

EFOY Pro systems provide a dependable, low-maintenance power source that supports telemetry devices, environmental sensors, and low-power PLCs with long unattended runtimes. They are simple to integrate into small, DC-coupled off-grid systems, with straightforward battery connections and no need for complex fuel handling or control logic. The quiet and clean operation makes them ideal for environmentally regulated zones and catchment protection areas.

WIND MEASUREMENT &

MONITORING



Wind resource assessments are an essential part of both onshore and offshore wind farm development projects. These campaigns often extend over many months or even years, requiring uninterrupted, high-integrity data collection to model turbine siting, yield expectations, and long-term investment viability.

Campaigns are frequently conducted in remote or harsh locations where grid infrastructure is not available, and where solar performance is inconsistent due to weather conditions, coastal fog, or seasonal variability.

TYPICAL APPLICATIONS WITHIN THE WIND INDUSTRY

Wind LIDAR campaigns used to measure wind profiles for selecting turbine locations and modelling long-term energy output

WHY EFOY PRO?

EFOY Pro fuel cells provide long-duration autonomous power for LIDAR and other wind monitoring instrumentation. Their compact size and silent operation make them ideal for temporary installations, both inland and coastal.

EFOY systems have also been successfully deployed on buoy platforms for offshore wind data collection, where maintenance access is limited and reliability is critical. To simplify field setup, EFOY systems can be delivered as turn-key energy solutions that combine the fuel cell, battery storage, and methanol cartridges into weatherproof enclosures, ready for integration into standalone LIDAR platforms or mobile data collection kits.

Unlike diesel generators, EFOY systems do not require frequent servicing or fuel handling, and unlike solar, they continue to operate consistently through poor weather conditions. EFOY systems help wind developers maintain continuous data acquisition with minimal intervention, supporting regulatory approvals and investment-grade energy modelling.

MONITORING EFOY SYSTEMS REMOTELY

CONNECTED POWER

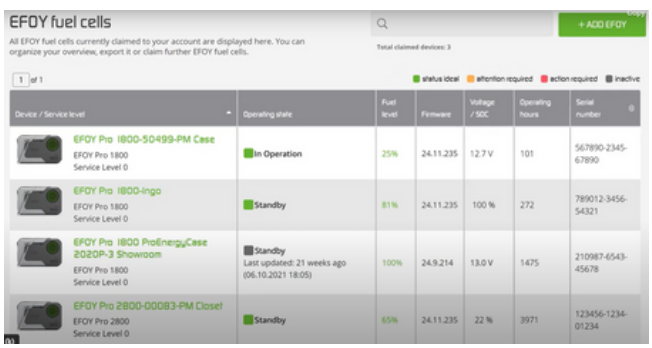
EFOY Pro fuel cells are designed not just for autonomous operation in the field, but also for seamless integration with remote monitoring systems. For organisations managing widespread deployments across challenging geographies, the ability to track, manage, and optimise energy assets from a central location is critical to reducing operating costs and maintaining uptime.

THE EFOY CLOUD: CENTRALISED INSIGHT AND CONTROL

All EFOY Pro fuel cells are compatible with the EFOY Cloud platform, which enables remote access to operational data and status updates. Connected via 4G or Ethernet, the system provides real-time insights into:

- Fuel cell status (running, standby, error states)
- Battery voltage and charging trends
- Fuel cartridge levels and consumption rates
- Temperature and environmental conditions
- Runtime history and predictive servicing needs

This cloud-based visibility allows operators to manage large fleets of off-grid systems from a single interface. Technicians can be dispatched with the right fuel type, cartridge quantities, and timing to avoid unnecessary visits or unexpected outages.

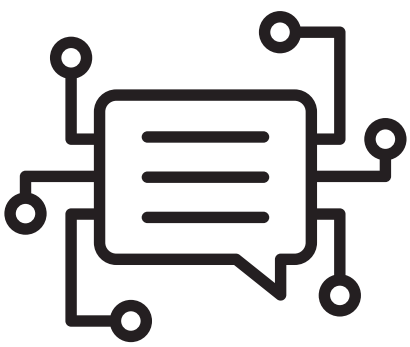


COMMUNICATION INTERFACES AND INTEGRATION

EFOY Pro fuel cells support multiple industry-standard communication protocols, allowing straightforward integration with third-party systems:

- Modbus RTU/TCP for SCADA and industrial control
- Dry contact alarms for basic status and alert relays
- Web-based dashboard access for standalone remote monitoring

This flexibility makes EFOY Pro suitable for everything from utility SCADA systems to law enforcement trailers and climate monitoring stations. Operators can receive proactive alerts when fuel levels are low, or when system parameters fall outside thresholds, enabling preventative maintenance.



SMART SERVICING &
LIFECYCLE EFFICIENCY

By combining real-time telemetry with long system autonomy, the EFOY Pro platform allows for highly efficient service planning. Fleet operators can:

- Schedule refuelling or cartridge swaps based on actual consumption.
- Track runtime and duty cycles to optimise sizing and placement.
- Identify underperforming or over-stressed assets.
- Monitor temperature or voltage trends to pre-empt hardware issues

This smart servicing model not only reduces maintenance overhead, but also enhances asset life and improves the overall cost efficiency of remote power operations.

Whether supporting a single fuel cell deployment or five hundred, EFOY Pro's monitoring and remote management capabilities ensure that operators maintain control, reduce risk, and make data-driven decisions about power reliability across remote, off-grid, and mission-critical sites.

SIZING AN EFOY PRO SYSTEM

SOLAR HYBRID SITE

Introduction

Accurate sizing is essential to ensure reliable and efficient operation of an EFOY Pro system. Whether you're powering a CCTV installation, a wind LIDAR station, or an off-grid telecom repeater, the goal is to balance energy demand, battery capacity, and fuel autonomy to suit your site conditions and operational requirements.

This section walks through the basic sizing steps for an EFOY Pro fuel cell deployment in a hybrid solar-battery-fuel configuration, using a practical example based on a **90W CCTV load**, requiring 24/7 operation.

Step 1 - Define the Load

The first step is to establish how much power your system consumes. Determine the average continuous load in watts (W), and then calculate the daily energy consumption.

The average continuous power draw is **90W**

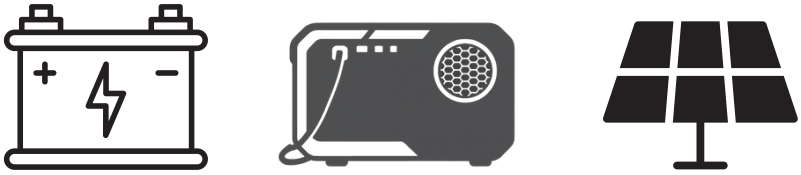
Daily energy consumption is:
90W x 24 Hours = 2.16 kWh/day

Important

It's important to use the average rather than peak load unless the system regularly operates at full capacity. If your load is intermittent (e.g. a PTZ camera or a radio transmitting on a duty cycle), you may consider a weighted average based on the percentage of time each device is active.

Step 2 - Determine Required Autonomy

Next, determine how long the system needs to operate without maintenance or refuelling. This will define the required autonomy period. In a hybrid setup, it's common to allocate part of the autonomy to battery storage, with the fuel cell covering extended low-solar conditions.



For example, if targeting 5 Days total autonomy:

Allocate **2 days to sizing the battery bank** to support regular cycling and ride-through for typical weather conditions.

Reserve **3 days for fuel cell** support during prolonged poor solar availability.

This results in:

- Battery Capacity Requirement: 2.16 kWh/day × 2 = 4.32 kWh
- Additional Energy required from EFOY Pro Fuel Cell: 2.16 kWh/day × 3 = 6.48 kWh

Step 3 - Size the Battery Bank

Batteries act as the primary energy buffer. To maintain battery health, calculate capacity based on the usable depth-of-discharge (DoD). For $LiFePO_4$ batteries, 80% DoD is standard.

Calculations

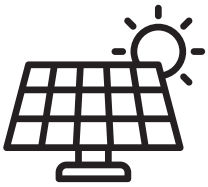
Required energy from batteries: **4.32 kWh**

Adjusting for 80% DoD: 4.32 ÷ 0.8 = **5.4 kWh**

At 24 Vdc: 5,400 Wh ÷ 24 V = **225 Ah**

A typical configuration could include **2 × 150 Ah $LiFePO_4$ batteries** in parallel at 24 Vdc. This provides energy resilience without oversizing, keeping the system compact and cost-effective.

Step 4 - Size the Solar Array



The solar array must be sized to support the system's total daily energy demand and restore the battery bank under average site-specific solar conditions. Begin by calculating the required solar array based on the site's calculated peak sun hours (PSH).

Daily load: **2.16 kWh**

Required Array: 2.16 ÷ 4.5 = **480 W**

Assume **4.5 peak sun hours (PSH)**

To account for real-world losses from temperature, dust, wiring, and component inefficiencies, apply a 25% system loss margin:

480 W × 1.25 = 600W of installed PV

This solar array will reliably recharge the battery bank each day under average conditions, helping to minimise fuel cell runtime and extend methanol cartridge autonomy.

Note: Peak Sun Hours (PSH) vary significantly depending on the installation location. For accurate PSH values, consult solar radiation data from the Australian Bureau of Meteorology, which provides irradiance maps and average insolation figures for different regions across Australia.

By using accurate regional data, you can fine-tune the solar array size to reflect seasonal variations and ensure robust energy performance year-round. **Remember to base your calculations on the worst-case winter PSH figures**, particularly for critical systems that require continuous operation.

While system performance will naturally improve during sunnier summer months, the fuel cell provides essential backup during extended periods of poor weather, shading, or higher-than-expected load demand.

Step 5 - Select Fuel Cell & Cartridge Capacity

With 3 days of energy to be supplied by the fuel cell:

Energy demand: 2.16 kWh/day × 3 = **6.48 kWh**
Methanol required: 6.48 × 0.9 = **5.83 L**

Add a 20% buffer:
5.83 × 1.2 = **7L** (minimum amount of methanol storage required to support calculated load for 3 Days)

Based on the above calculations, a single **M10 (10L) cartridge** is sufficient to support the site for short duration deployments.

For increased autonomy and; or sites that are difficult to service, it is common practice to implement a **Fuel Manager 2 (FM2)** within the system. This setup enables the use of 2 × M10 cartridges, providing greater backup runtime and introducing redundancy into the system.

With 20 litres of available methanol and an estimated fuel cell efficiency of **1 kWh per 0.9 L**, the system provides:

This configuration ensures the system can sustain the defined load for just over 10 days without solar input or intervention – providing critical backup during extended poor weather, shading, or temporary increases in load.

The extended runtime not only enhances system reliability but also contributes to longer servicing intervals and reduced site visits. This reduction in field maintenance directly translates to lower total cost of ownership (TCO), which is a key consideration in the economic justification for deploying fuel cell-based hybrid power systems.

ACCESSORIES &
EFOY PRO MODELS

EFOY Pro Fuel Cells

EFOY Pro 900

12 / 24Vdc | 42W

Low-powered sensors, telemetry, instrumentation.

EFOY Pro 1800

12 / 24Vdc | 82W

SCADA, RTUs, Monitoring, Single CCTV Camera installations.

EFOY Pro 2800

12 / 24Vdc | 125W

Higher powered CCTV installations (multi-cameras or PTZ) - trailer of fixed sites, Telecom (Radio Repeaters)

EFOY Pro 2800

24 / 48Vdc | 500W

Telecommunications Applications - Solar / Hybrid Systems; Trailers

Fuel Cell Cartridges

10L | 11.1 kWh

28L | 31.1 kWh

60L | 66.7 kWh

All Cartridges are sealed, non-pressurised, and approved for land and marine transport.

Fuel Manager and Cartridge Switching Accessories

Fuel Manager 2 (FM2)

Allows for connection of up to 2 x Methanol Cartridges (M10, M28 or MT60) per fuel cell.

Fuel Manager 4 (FM4)

Allows for connection of up to 4 x Methanol Cartridges (M10, M28 or MT60) per fuel cell.

Fuel Manager 8 (FM8)

Allows for connection of up to 8 x Methanol Cartridges (M10, M28 or MT60) per fuel cell.

DuoCartSwitch

For use with EFOY Pro 12000 Duo. Allows each of the two inputs to switch between two cartridges, enabling up to 4-cartridge configurations.

POWERBOX

LOCAL EXPERTISE & SUPPORT

As the authorised partner for SFC Energy in Australia and New Zealand, Powerbox brings more than a decade of experience deploying EFOY Pro systems across critical industries. We understand the local environmental, regulatory, and technical requirements that shape successful off-grid energy solutions.

What Powerbox Offers

Engineering Support: System design, battery sizing, enclosure integration, and hybrid system planning.

Local Stock: Rapid access to EFOY units, fuel cartridges, and accessories.

Project Deployment: Turn-key system assembly and testing for field readiness.

Ongoing Support: Technical assistance, replacement parts and methanol cartridge replacement

Whether you're building a single mobile camera trailer or deploying dozens of sensor systems across vast infrastructure, Powerbox ensures your EFOY system is right-sized, compliant, and built for long-term success.

CONCLUSION

Reliable power remains a defining challenge for modern remote operations. With unpredictable weather, limited access, and rising costs of field servicing, the need for autonomous, low-maintenance power has never been greater.

EFOY Pro fuel cells deliver dependable performance wherever solar and batteries fall short. From CCTV installations and telecom repeaters to wind studies and water infrastructure. Backed by clean methanol fuel, intelligent remote monitoring, and modular cartridge scalability, they offer a practical alternative to diesel generators in a wide range of off-grid applications.

Partnering with Powerbox means more than just hardware, it means expert local engineering, reliable logistics, and a long-term commitment to helping your systems run continuously, efficiently, and with confidence. If you're planning your next remote deployment or rethinking how to power a critical off-grid site, Powerbox and EFOY Pro provide the scalable, proven solution to keep your operations energised - no matter where the field takes you.

About the Author

James Rutty is Director of Powerbox Australia. With more than 15 years supporting off-grid power solutions across Australia and New Zealand for critical infrastructure, James brings practical insight to the deployment of solar hybrid energy systems.

He has helped drive the adoption of methanol fuel cell technology in both temporary and permanent field-based applications across security, communications, utilities, and environmental monitoring sectors, working closely alongside the team at SFC Energy to deliver reliable, scalable power solutions tailored to local conditions.

Contact the team at Powerbox today to speak with an engineer, request a demonstration, or start designing your next EFOY enabled off-grid energy solution.

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