

C A S E S T U D Y

SOLAR POWER ON PORTUGAL'S A24



■ **TECHNOLOGY:** PV PANELS, NO BATTERIES

PORTION OF ELECTRICAL NEEDS COVERED: 20% AT O&M CENTERS / 17% (FORECAST) AT TUNNELS

PAYBACK PERIOD: 6 TO 10 YEARS (O&M CENTERS/TUNNELS)

THE DILIGENT APPROACH BRINGING BIG ENERGY GAINS

A team of concessionaire Norscut and operator Egis has invested prudently in roll-out of solar power on Portugal's A24 motorway. In step with an ongoing process of evaluation, arrays of photovoltaic panels are being installed to reduce energy costs and environmental impact.

Road networks consume a lot of energy. For example, it takes about 216MWh of electricity just to power two Operation & Maintenance (O&M) Centres (CAMs) on the A24 in Portugal for one year.

At both of these facilities and other points along a 157km stretch of the A24 motorway, the A24 operator Egis Road Operation Portugal and its client, the concessionaire Norscut, have stepped up efforts to **reduce energy costs and the carbon footprint** of their highway.

The **two O&M Centres are now powered partly by arrays of photovoltaic (PV) panels** installed on the buildings' roofs. During 2019, further PV systems will be installed to power the lighting, ventilation and other electrical systems in **at least one tunnel** on the A24 route between Viseu and Chaves.

Contracts for this work are being procured following a process of evaluating the merits and associated risks involved when making a substantial investment in installing PV panels. The likely benefits were already understood, as a similar exercise had already been undertaken for the O&M Centres – at Pedras Salgadas and further south at Lamego, which houses the A24 traffic control centre and all of its energy-hungry electronic equipment.

“The idea for installing PV panels came in 2015,” says Egis Portugal's Chief Executive Officer, Luís Simão. “In line with the ESG (Environmental, Social and Governance) strategies of Egis and Meridiam, we were looking for ways to reduce the environmental impact and the costs of operating the A24. We had already seen similar initiatives undertaken by Meridiam

projects in Austria and elsewhere. It was a good time to look at doing the same on the A24.”

Simão Pereira is the Chief Executive Officer for Norscut. He says: “The proposal was progressed with Egis and Norscut working in partnership. Egis studied the consumption of energy at each operational centre and the capability for solar panels to generate this electricity, while we focused on the costs involved and the expected time required to generate a return on the investment.”

Egis' investigations focused on areas where electricity consumption is at its highest during daylight hours. This pointed to the two A24 operational centres and to road tunnels where lighting and electrical equipment is in use at all times. Battery technology is currently insufficiently developed to store power needed for lighting the road at night.

“The large batteries that would be required would need too much space and would not be efficient enough to be cost-effective,” Simão says. “Solar panel technology has progressed a lot, however, so they have become more efficient and more affordable.”





Egis studied the energy consumption of the Lamego and Pedras Salgadas facilities on a daily, monthly and annual basis; comparing the figures with the potential for solar power over the same periods. Provisional designs were then drawn up to provide systems of PV panels that were optimised economically – **ensuring the majority of electricity needs were met through solar power as much of the time as possible**, without making the systems unaffordable.

“The designs also had to take other factors into consideration, including available space and all that would be required for

installation, plus the capital costs and payback criteria,” says Filipa Morais, Chief Technical Officer for Norscut. “Close inspection of the rate of return on the investment was very important to us. Potentially there were significant energy and cost savings to be made, but the capital costs of PV systems are high. Payback would take some time and it would have to be reached within the remaining time of our concession.”

The critical numbers for Norscut showed that for an investment of €7,400 in the PV panels at Pedras Salgadas, a rate of return (IRR) of 5.4% would bring payback after 10.4 years. At Lamego, the

capital cost was a lot more, at €21,600, but the greater energy generated by a larger array of panels would produce a more rapid IRR of 14.9% and a shorter payback period of 6.8 years.

Most importantly, both sites represented a viable investment. Business plans were given the green light by the Norscut board. An array of 80 PV panels was installed on the roof of the Lamego O&M Centre, designed to produce 33MWh per year. At Pedras Salgadas, 20 panels supply 8MWh annually.

“Through our concession agreement, infrastructure energy costs are the motorway

A SIMILAR INITIATIVE ON ANOTHER MERIDIAM ASSET, IN TEXAS



On the 13.3-mile (21.4-km) Lyndon B Johnson (LBJ, I-635) Interstate Highway, installation of solar panels on the roof of all the existing buildings was completed in December 2018 and the project is now operating at 100% capacity. The system has a power production capacity of 200 kW and an estimated energy production of 305 MWh per year, representing about **30% of the electricity consumption in the administrative building**. This initiative is benefiting from a rebate (federal funds, already cashed) as well as certain tax incentives. ■

operator's responsibility, so both Egis and Norscut benefit financially," says Filipa. "Egis is also responsible for the PV systems' operation and maintenance costs, of about €400 per year, but it benefits more from a significantly reduced annual electricity bill. Norscut receives a corresponding regular remuneration payment from Egis; an amount which will be profit after the payback period."

Further good news for Norscut and Egis has come from subsequent monitoring of the PV systems' performance in-situ, which showed the **first year of operation matched the energy outputs forecast**. It was then logical for Egis to progress with a similar treatment for the A24 tunnels.

The longest, the Castro Daire tunnel, is 818m in length and the largest of the three in terms of its energy consumption. Given that PV panels would be located on technical support buildings or surrounding land near the tunnel

entrances, Castro Daire was also long enough to require a study of solar energy performance at each end. This meant four separate studies for the three tunnels, including the 337m-long Varosa Tunnel and the 275m Régua Tunnel.

The best outcome in terms of IRR is expected from the northern end of Castro Daire, where, for an investment of €33,800, an IRR of 15% will bring payback after six years. The optimum PV system in that location will generate about 55MWh per year, **roughly a sixth of the annual consumption of the northern half of Castro Daire**. At the southern end, the IRR is predicted at 14% with a payback of 6.1 years, but with a bigger PV array generating over twice as much electricity and providing **over a third of the energy needed**.

Even the smallest of the systems studied, for the Varosa Tunnel, is expected to produce an IRR of 6% and payback within nine years. For a total investment of around

€130,000 in the PV systems for the tunnels, the savings in energy costs will be substantial.

Norscut and Egis are also sizing up a significant reduction in the size of the carbon footprint of the A24. So far the quantity of electricity generated per year from solar power at the two O&M Centres comes to 41MWh. If all of the PV arrays proposed for the A24 tunnels become operational, the **annual total of energy no longer drawn from Portugal's national grid will reach 248MWh**. So far Norscut has confirmed a PV system will be installed in the Castro Daire tunnel, with decisions on the others expected to follow.

"After achieving good performance and having experience from the O&M Centre solar power projects, it made sense to do the same for the tunnels and we will hopefully be able to install more on the A24, for its service areas as well," Luis Simão says.

Further developments may also see the next generation of large-





scale batteries introduced to support highway assets. As a side effect of the optimised designs, the PV panels produce a surplus of energy during peak sunlight periods. “We investigated the viability of selling this electricity, but we were not generating a sufficient quantity to make the exercise worthwhile, to justify the additional costs associated with seeking the changes to our concession that would be necessary to allow us to earn revenue from electricity,” says Simão.

At present the surplus electricity is fed free of charge back into Portugal’s national grid. With the advent of more efficient batteries, could this extra power be stored for night time operations? So far, **Norscut is supplying around 20% of the O&M Centres’ energy needs.** Would economic energy storage change the equations completely, making solar power viable for generating all motorway energy needs?

“Industry-wide we are beginning to see people exploring the potential for making use of battery technology developed for electric vehicles. This is the very cutting-edge of power storage, but it may be only five years until we see batteries efficient and affordable enough for large scale energy supply. There may then be another problem, due to maintenance costs. The lifecycle of batteries, of two to three years, is a lot shorter than the circa 25-year life of PV panels,” Filipa says.

“For now, however, we have a substantial overall system of solar-power coming together on the A24, with significant cost and energy savings and more possible in future. It’s very important to consider all of the risks, costs and benefits in full. Technically, peak daylight hours must be matched with energy consumption throughout the year to get maximum possible use of the technology, but with diligent analysis and good design, sustainable solar energy has a strong role to play in powering highway assets.” ■

A VITAL AND SCENIC ROUTE

The A24 is a **157km toll-road** from Viseu to Chaves close to the country’s northern border with Spain. It was built in seven sections – the first two through construction projects funded by the Portuguese Government. For developing the subsequent five stretches of the highway, the State adopted a public private partnership approach – awarding a 30-year design, build, finance and operate concession to the project company Norscut in December 2000.

Operation and maintenance of the two sections already built were transferred to the concessionaire at the same time. Norscut opened the five new lengths of dual carriageway between 2003 and 2007 and then took control of operating and maintaining the entire route.

In 2016, Meridiam purchased 100% of the equity of the project company from its previous owners Eiffage, Egis Projects, Sonae Capital and the BPCE bank. Egis remains involved as Egis Road Operation carries out routine operation and maintenance of the A24 for Norscut.

Part of the Trans-European Network, the A24 (E801) is **a vital transport corridor for the economies of the Viseu region and Portugal.** It is also a very scenic route passing through a mountainous area in the north of the country. The motorway is a dual two-lane carriageway throughout, with four service areas, 141 bridges, 23 interchanges, 35 special structures and four tunnels totalling 1.5km in length. ■



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