Resilience of Energy Consumption in Portugal: Lessons from the Blackout

Conclusions and Recommendations

Introduction - An Urgent Debate

Associação Portuguesa da Energia (Portuguese Member Committee of the World Energy Council), with the support of the Ordem dos Engenheiros, organised the seminar "Resilience of Energy Consumption: Lessons from the Blackout" on July 1st. This event, catalysed by the recent experience of the 28 April blackout, brought together a wide range of participants, illustrating a collective commitment to the improvement of the security and robustness of the national energy system.

The event was exceptionally well attended by leaders and decision-makers from all the country's critical entities, including CEOs and Directors from the largest companies in the energy, telecommunications, water and transport sectors (Galp, FLOENE, Vodafone, EPAL, E-Redes, EDP Comercial, EDA, Águas de Portugal, ENSE, EMEL), as well as representatives from the main regulatory authorities (ERSE, ERSAR, ANACOM), academia (IST, ISEL) and associations (APRITEL, DECO, SUCH). This prompt adherence and the profile of the speakers and audience underlined the critical value that national institutions attribute to the issue of energy resilience.

Throughout the day, the discussions were of remarkable candour and cross-sector perspective. The assumption that " a good crisis can't go to waste" was the guiding principle, mobilising participants to identify vulnerabilities and propose concrete solutions. The experience of the blackout, although limited, served as a "small simulacrum" that exposed society's profound dependence on electricity and its weaknesses in times of crisis.

This document summarises the main conclusions and recommendations resulting from this working day, with the aim of providing concrete proposals for strengthening the resilience of energy consumption in Portugal. The event's detailed agenda can be found in Annex I.

Main conclusions

The panel discussions led to crucial conclusions about the state of energy resilience in Portugal:

1. **Systemic interdependence and cascade of failures** - The blackout of April 28th revealed Portuguese society's profound dependence on electricity and the critical interdependence between the various sectors of energy, communications, water, sanitation, fuel, health services and even mobility. Failure in one sector has cascading impacts on others, requiring an integrated approach to resilience, based on technological diversification and complementarity, to guarantee a more robust and effective response to future disruptions.

2. **Vulnerability of communications** - Communication networks, although crucial, showed significant vulnerabilities due to the limited autonomy of batteries and the overload of traffic on the telecoms network. Essential communication between citizens and service teams was severely impacted, emphasising the fragility of crisis communication and hampering recovery even more

3. **Insufficient *backup* scaling** - The current scaling of backup systems (batteries, generators) in critical and household infrastructures is often insufficient for total and prolonged blackout scenarios, both in availability, effectiveness of response and guaranteed operating time. The growing dependence on electricity in the residential context was also emphasised, even for simple uses.

4. **Logistical challenges in a generalised crisis** - Mobility and fuel replenishment for generators and operational vehicles had severely constraints due to power outages and traffic congestion, making it difficult for teams on the ground to respond.

5. **Relevance of older infrastructures and fuels** - older infrastructures, such as VHF radio networks, proved vital in situations of generalised failure of newer technologies. In addition, fuels were essential for maintaining critical services during the blackout, underlining their continued importance in ensuring energy security in transition scenarios.

6. **Growing complexity of the electricity system** - Today's electricity system is overly complex with the integration of multiple technologies and fluctuating energy flows. This complexity requires greater knowledge and holistic analysis for efficient decisions. Manual management by operators is complex, requiring the development of knowledge and more intelligent control systems.

7. **Need for a culture of preparedness and training** - The main lesson of the blackout is the need for a culture of preparedness and continuous training for emergency situations. Companies with regular protocols and exercises have demonstrated greater response capacity. Although the incident in question was unexpected, the possibility of a major earthquake with the potential to destroy critical infrastructure is plausible and must be considered in risk scenarios. For this reason, it is essential to consolidate and extend this culture of preparedness, making it increasingly cross-sectoral and transversal.

8. **Experience of isolated grids** - The Azores islands offer a natural laboratory for resilience, with stability challenges in isolated grids and the integration of renewables.

Experience with battery systems and advanced energy management systems (offers valuable *lessons*).

9. **Consumer vulnerability -** The blackout exposed the fact that essential services are more vulnerable than previously thought. For example, car parks were vandalised in the absence power driven video surveillance. In the domestic sphere, it emerged that self-consumption systems did not work due to inverters switching off in the absence of grid power. Most grid-connected self-consumption systems use inverters (connected to the grid), which for safety reasons switch off automatically when the power grid fails. It also became clear how important it is for consumers to be informed about the various energy options available and to prepared to respond appropriately to crisis situations, anticipating disruptions and adopting preventative measures that increase their individual resilience.

10. **Transport management -** To guarantee minimum services for all, traffic congestion must be prevented by prioritising essential mobility and eliminating unnecessary traffic. Public transport must be prioritised, and electric public transport must guarantee backup systems, which did not happen, resulting in situations with potentially compromise of user safety.

Main concrete recommendations

Based on the debate and conclusions of the seminar, we propose concrete recommendations to strengthen the resilience of energy consumption in Portugal.

A. Intersectoral Coordination

- **Implementation of legislation** - Speed up the definition and approval of security plans by critical organisations, the national risk assessment, and a national resilience strategy.
- **Coordinated national cross-sector resilience plan** - Create a holistic national contingency plan, with strategy integration for the several critical sectors (energy, communications, water and sanitation, health services, food distribution chains, transport), predicting interdependencies and coordinating action between public and private actors.
- **Coordination and information sharing** - Ensuring robust and redundant communication and coordination mechanisms between authorities and organisations, including the use of technologies not dependent on the traditional electricity or mobile network (satellite, dedicated radio).
- **Accountability -** Ensure clarified responsibilities and accountability those involved in the event of failures, encouraging compliance with safety and operational requirements.
- **Optimise resource management and priorities -** Define clear criteria for prioritising services and resources (energy, water) in crisis, communicating them to the population.

B. Investment and Autonomy of Critical Infrastructures

- **Integrated vision of the energy sector** - View the energy system as a diversified system, in which various technologies coexist and complement each other, contributing to greater resilience and ensuring a better response in disruption situations.

- **Strengthening energy autonomy -** Redimensioning backup autonomy (batteries, generators) in critical infrastructures (telecommunications, water, hospitals, transport) to withstand prolonged periods of power failure.
- **Ensuring mobility -** Preventing traffic congestion not only through the energy autonomy at strategic points, but also by establishing clear rules for citizens that allow priority traffic circulation. Favouring public transport and ensuring that electric public transport has a minimum amount of storage to allow passengers to safely leave the carriages.
- **Priority access to fuel -** Ensure priority access to generator fuel for generators and essential vehicles, with clear logistical plans and emergency stocks.
- **Energy diversification and decentralisation -** Support endogenous energy production, especially decentralised production (distributed solar with storage, energy communities, biomethane, other distributed sources) to strengthen security of supply, increase the resilience of the national energy system and contribute to greater energy sovereignty.
- **Re-evaluation of** national **strategic reserves -** Conduct an in-depth analysis of the adequacy of strategic natural gas and oil reserves and study the feasibility of interconnections between dams for water resilience.
- **Investment in equipment, infrastructure, and cybersecurity -** Increase investment in equipment, infrastructure, and cybersecurity, nationally and transnationally, to strengthen the system's robustness.
- **Cross-border cooperation -** Intensify coordination and collaboration with Spain in the management and security of shared critical infrastructures, due to the interdependence of the systems.

C. Research, Technology and Training

- **Encourage R&D in Network Resilience Solutions -** Prioritise research in storage technologies (batteries, flywheels), advanced power electronics, *black start* capability and system services, adapted to the Portuguese reality.
- **Investment in intelligent and predictive control systems -** Implement advanced Energy Management Systems to optimise the operation and integration of renewables, minimising dependence on human intervention.
- **Valuing engineering and technical knowledge -** Creating mechanisms to attract and retain talent in technical areas, guaranteeing the weight of national experts in strategic decisions and the development by academia of training programmes aligned with resilience.
- **Culture of preparedness and training -** Promote and encourage regular large-scale exercises and drills, involving multiple sectors, to evaluate plans and identify vulnerabilities.

D. Citizens and Communication

- **Improve communication in crisis situations -** Develop a multi-platform crisis communication plan to guarantee information to the population even through mobile network failures.
- **Promoting individual preparedness –** Raise the population awareness to the importance of individual emergency readiness, including emergency kits (water, radio, food reserves), reinforcing shared responsibility.
- **Energy literacy -** Informing and educating consumers about energy options, self-consumption, and the need for equipment to guarantee autonomy in the event of a failure.

This document reflects the urgency and complexity of the energy resilience challenge. The event on April 28th, 2025, should be an opportunity to prepare Portugal for other events that could be longer-lasting and equally disruptive, such as an earthquake, extreme weather events or even cyber or physical attacks on infrastructure.

We assure you that the conclusions and recommendations presented here are the result of an in-depth and pragmatic debate, and we are positive that, with the joint commitment of all organisations, we will be able to build a more secure and resilient energy future for Portugal. The Portuguese Energy Association hereby expresses its availability for any clarifications or involvement in subsequent work.