

FP6 WP9 T9.2 and T9.3
Dissemination Workshop

“Demonstration of LX and Switches energy self-sufficient and wireless controlled for Regional Railways”

FP6 WP9 T9.2 (DEMO 20) & T9.3 (DEMO 21)

Enyse, 02/October/2026 - Online (Teams)



This project has received funding from the Europe's Rail Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101101962



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(1.1) Enyse - WHO WE ARE

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Spanish company, supplier of **Signalling** solutions for railway markets.

>100 years of life & experience!

>200 employees.

Strong presence both nationally and internationally.

As part of the **COBRA IS** Group, we are also part of the **VINCI** Group.



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(1.2) Enyse - WHAT DO WE DO FOR ERJU

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- **FP1 MOTIONAL - WP17/WP18**
Implementation of AI-based algorithms for the automatic detection and resolution of conflicts during traffic regulation.
- **FP3 IAM4RAIL - WP3/WP4**
Diagnosis and predictive maintenance of track assets using Machine Learning techniques.
- **FP6 FutuRe - WP3/WP8 & WP4/WP9**
(WP3/8) Application to Regional Lines of AI-based algorithms for the automatic detection and resolution of conflicts during traffic regulation.
(WP4/9) Energy self-sufficient and Wireless controlled track Assets (LX and Switches).

(2.1) Task 9.2 - WHAT IS ABOUT

Task 9.2 Demonstration of wireless enabled energy self-sufficient level crossings (Leader: ENYSE; Participants: ÖBB-INFRA) (M19-M48) (TRL 4/5).

This task will contain two demonstrators: One with traditional power supply (Demo Leader ENYSE) and one containing a smart energy module (Demo Leader ÖBB-INFRA).

Demo 1 (TRL 4/5): Within this task a prototype of a level crossing with TRL 5 according to the specified requirements (task 4.1.1) will be developed and demonstrated and its integration with other filed elements ensured. This task will:

- By considering the specificities and variances from one regional line and location to another, this task will test the requirements and provides feedback to test 9.1 if necessary;
- Perform test adapted to regional lines reaching TRL 5 on a representative environment which are used to assess and report the actual benefits of this technology;
- Describe system requirements, a high-level design of the test set-up, tests specification/use cases, and tests result report.

Those requirements (WP4) are focused on the next functionalities:

wireless enabled
energy self-sufficient
able to provide remote maintenance
able to be controlled either from IXL or RBC (G1 lines)

(2.1) Task 9.3 - WHAT IS ABOUT

Task 9.3 Demonstration of wireless enabled energy self-sufficient switches (Leader: ENYSE; Participants: ÖBB-INFRA) (M19-M48) (TRL 4/5).

Within this task a prototype of a Switches with TRL 5 according to the specified requirements (task 4.1.2) will be developed and demonstrated and its integration with other filed elements ensured. This task will:

- By considering the specificities and variances from one regional line and location to another, this task tests the requirements and provides feedback to test 9.1 if necessary;
- Perform tests adapted to regional lines reaching TRL 5 on a representative environment which are used to assess and report the actual benefits of this technology;
- Describe system requirements, a high-level design of the test set-up, tests specification/use cases, and Tests result report.

Those requirements (WP4) are focused on the next functionalities:

wireless enabled
energy self-sufficient
able to provide remote maintenance
configurable to work at any track gauge

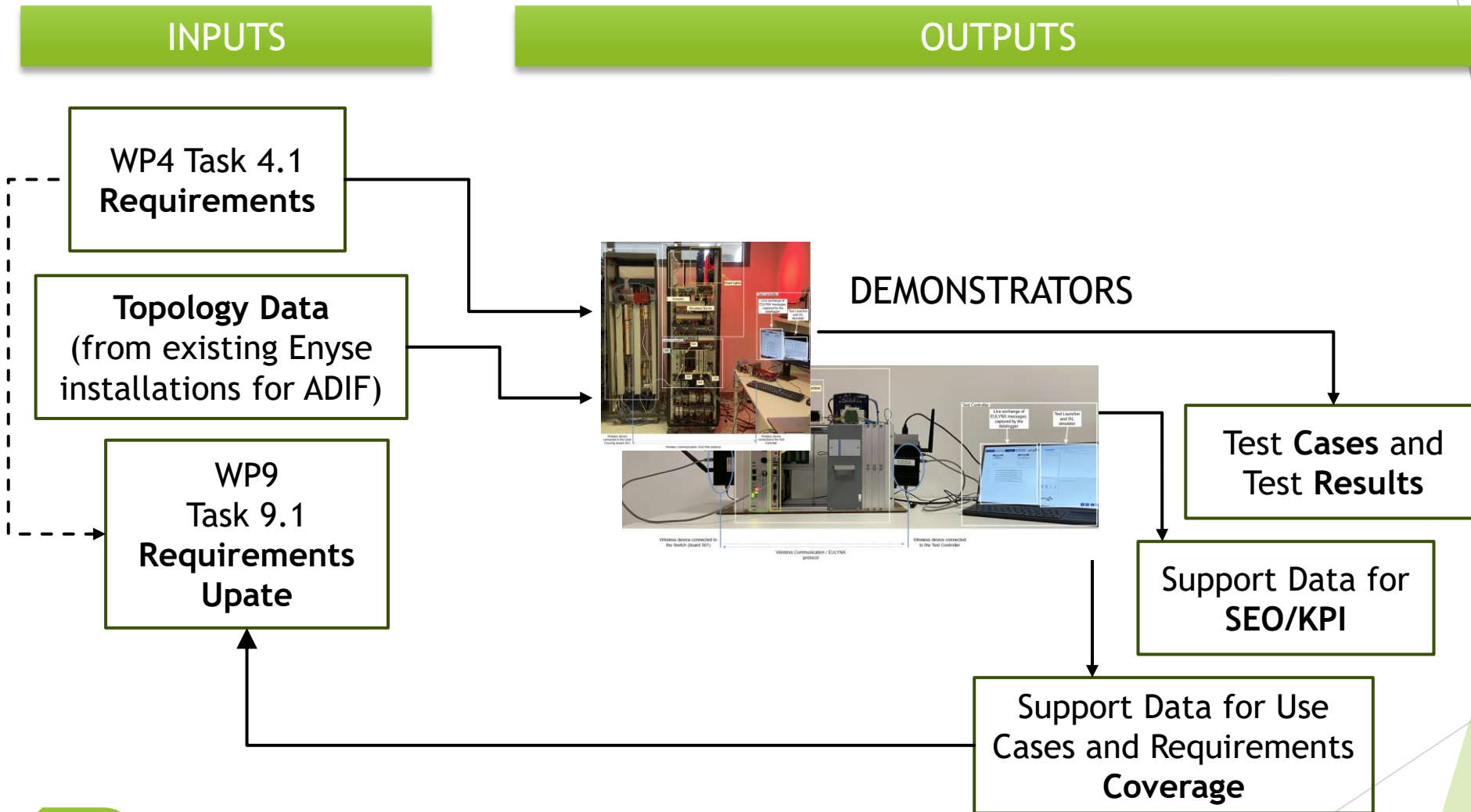
(2.2) Tasks 9.2 & 9.3 - OBJECTIVE

To build demonstrators to prove the previously mentioned features:

- Applicable to both assets:
 - ➔ ○ **wireless enabled** - by providing an Ethernet port
 - ➔ ○ **energy self-sufficient** - by combining grid, battery and one renewable source of energy (in these demonstrators, solar panels)
 - **remote maintenance** - thanks to the wireless capability and by implementing EULYNX SDI protocols
- For each asset individually:
 - ➔ ○ LX: able to be **controlled** either from IXL or RBC - by using EULYNX SCI-LC protocol
 - Switch: configurable to work at **any track gauge** - implemented in a way that is completely transparent for the switch

(2.3) Tasks 9.2 & 9.3 - INPUTS AND OUTPUTS

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(3.1) Demo 20 LX - ARCHITECTURE

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From right to left:

Test Controller (tools)

- Test Launcher
- IXL Simulator
- Datalogger

Wayside

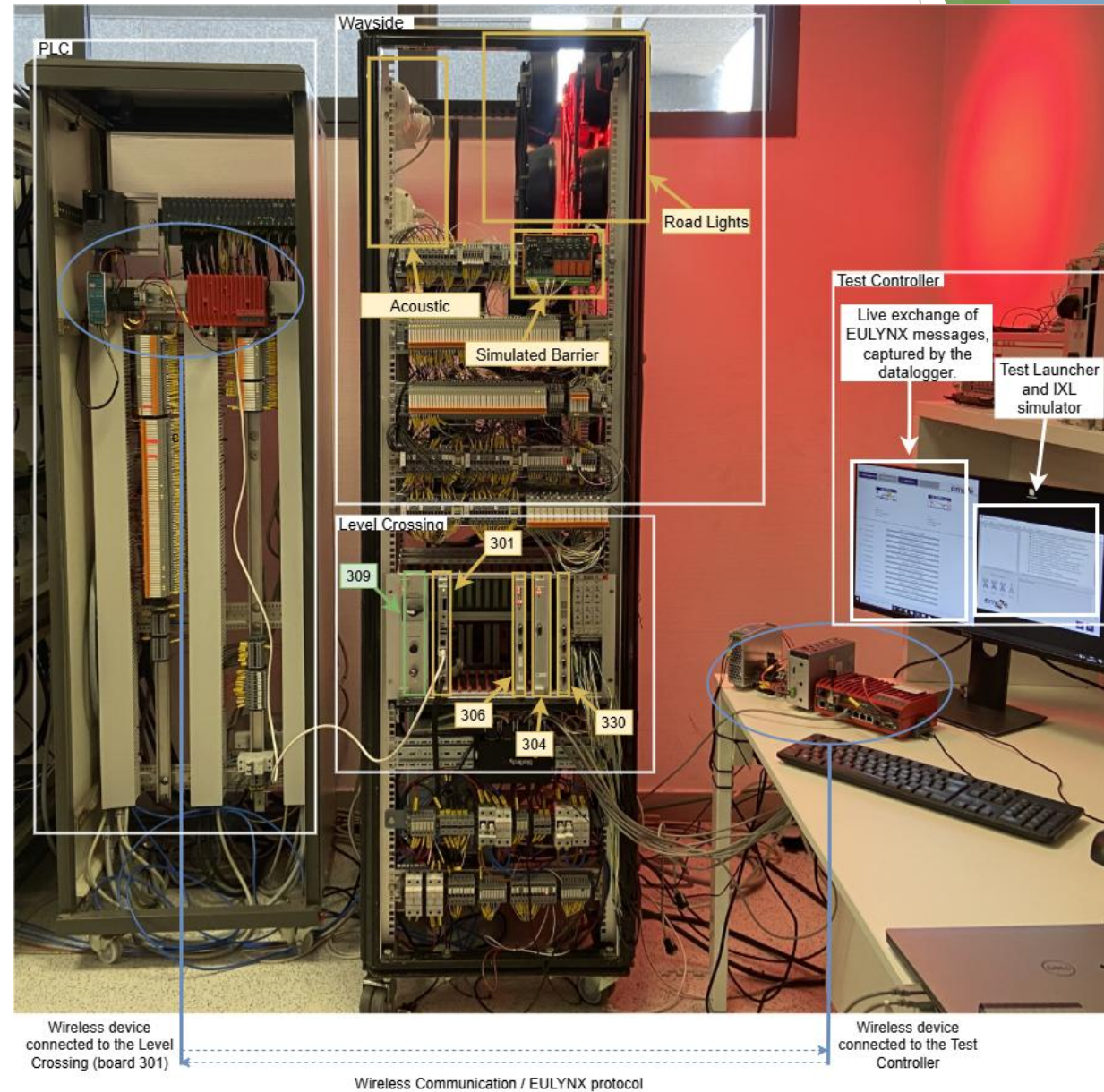
- Road Lights (real)
- Acoustic (real)
- Barrier (simulated)

LX Controller (real)

- 301 - Control, Barrier & Comms
- 309 - Energy board
- 304 - Acoustic board
- 306 - Road Lights board
- 330 - Juridical Recorder board

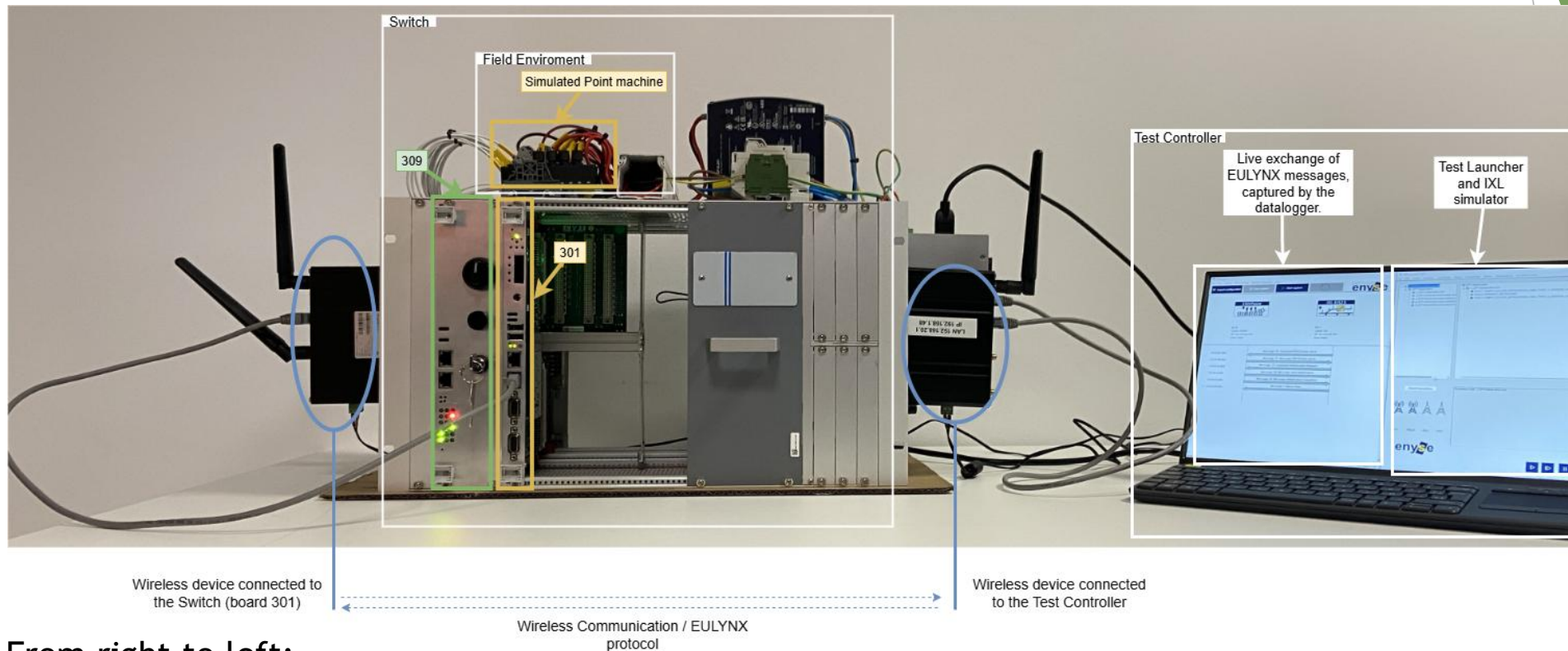
PLC: connects the LX Controller to the Wayside elements and simulate some as the track circuits or obstacle detector

Wireless Radios: connected to the LX and the to IXL simulator, enabling wireless comms between them



(3.1) Demo 21 Switch - ARCHITECTURE

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From right to left:

Test Controller (tools)

- Test Launcher
- IXL Simulator
- Datalogger

Field Environment

- Point Machine (simulated)

Switch Controller (real)

- 301 - Control & Comms
- 309 - Energy board

Wireless Radios:

connected to the Switch and the to IXL simulator, enabling wireless comms between them

(3.2) Demos - SEO/KPI COMPLIANCE

SEO/KPI08 is about:

- to **reduce OPEX** cost/km for railway assets,
- to be **qualitative** measured with the objective to get a **decrease of 30%**,
- with the next reference scenario:
 - 1,5 average of number of maintenance interventions per year per LX
 - 0,5h average overall time invested in a maintenance intervention (logistic + failure detection + replacement + reconfiguration/test) per LX

Conclusion: wireless communication capability + solar panels near the LX controller, substantially reduce cabling when compared to conventional LX → failures associated with cable breaks, cable ducts/conduits are not any longer present, thus less maintenance interventions, and then time spent on logistics and replacement tasks is also reduced.

(3.2) Demos - SEO/KPI COMPLIANCE

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SEO/KPI09 is about:

- to **increase energy efficiency** for trackside railway assets → consume less,
- to be **quantitative** measured with the objective to get a **decrease of 30%**,

SEO/KPI12 is about:

- to **improve energy efficiency** for trackside railway assets → consume better,
- to be **quantitative** measured with the objective to get an **increase of 15%**,

Analysis: In three steps:

1. Measure the demand
2. Measure the offer for energy from batteries and solar panels
3. Compare and define the best algorithm to manage the energy

(3.2) Demos - SEO/KPI COMPLIANCE

Analysis: 1. Measure the demand

the peak power consumption was measured under two operating conditions: LX in Standby mode (with no train approaching or in the vicinity) and LX in Operation mode

DEMAND OF POWER/ENERGY (measured in a LX controller at Enyse Factory)				
Watts (W) = Power Joules (J) = Energy 1 W = 1 J/s	PEAK	PER OPERATION (1 train + 20sc)	PER DAY 100 trains a day ~ 6 per hour * 18 hours	
	power		energy	
LX in Standby	24,63 W		2.078.772,00 J	577,44 Wh
signals + audible warnings	19,91 W		1.680.404,00 J	466,78 Wh
barrier	4,72 W		398.368,00 J	110,66 Wh
LX in Operation	356,32 W	7.126,40 J	712.640,00 J	197,96 Wh
signals + audible warnings	199,12 W	3.982,40 J	398.240,00 J	110,62 Wh
barrier	157,20 W	3.144,00 J	314.400,00 J	87,33 Wh
TOTAL DEMAND OF POWER/ENERGY PER DAY			2.791.412,00 J	775,39 Wh

assuming a regional railway network with approximately 6 trains per hour operating for 18 hours per day, a rounded figure of 100 level crossing operations per day was considered (i.e. total operational time of 2.000sc per day); the LX controller remains in Standby mode for the rest of the day (i.e. 10sc per day)

the total energy consumption was calculated by combining the energy required during operational periods with the energy consumed while the LX was in Standby mode. The resulting daily energy demand was estimated at **775,39Wh** barriers, road traffic signals, and audible warning devices

(3.2) Demos - SEO/KPI COMPLIANCE

Analysis: 2. Measure the offer for energy from battery and solar panels

Battery:

- sealed gel lead-acid battery
- prevents electrolyte leakage even if the casing cracks → minimizes risk of environmental contamination
- compared with lithium batteries, gel lead-acid batteries are up to 5 times less expensive, avoid impact on CAPEX
- 24V and 200Ah, providing a nominal energy capacity of 4.800Wh when fully charged
- the recommended operating range is between 100% and 70% of charge → the 30% of the nominal capacity, equivalent to 1.440Wh ($4.800\text{Wh} * 30\%$), is considered the most efficient usable value

→ based on the estimated daily energy consumption of 775,39Wh and a usable battery capacity of 1.440Wh, the estimated battery autonomy is approximately 1,86 days.

Solar Panels:

- standard 72-cell polycrystalline photovoltaic (PV) panel with tempered glass
- dimensions are around 2m * 1m, and it provides a peak power output of 320W
- based on solar irradiation data published by official Spanish institutions in the least sunny month of the year (December), 1,83 days will be necessary to recharge the battery from 70% to 100% full charge → this charging time is considered acceptable as it is shorter than the battery autonomy ($1,83 < 1,86$)

→ although the panel's peak power output of 320W is not sufficient to meet the instantaneous power demand of a single LX operation, this does not represent a limitation, as the primary purpose of the solar PV panel is to recharge the battery and maintain its state of charge within the recommended operating range of 70% to 100%.

(3.2) Demos - SEO/KPI COMPLIANCE

Analysis: 3. Compare and define the best algorithm to manage the energy

OFFER OF POWER/ENERGY (worst case)			
	Demand per Day (1)	Battery Offer (2)	Solar Panel Offer (3)
Energy	775,39 Wh	1.440 Wh	320 W
(1) 100 trains a day ~ (6 per hour * 18 hours) (2) worst scenario = usage btw 100% and 70% of charge (3) standard solar panel			

Algorithm:

- Solar panels and grid are connected to the LX controller (309 board) and from here, to the battery
- Solar panels are used to keep the battery up its optimum level of charge (70% to 100%)
- The energy (while in Standby or in Operation) is obtained from the battery (as it satisfies higher peaks demand) or from a combination of the available sources (solar+grid, only solar, only grid)
- Only if the battery charge goes down under the 70%, the grid connection is used (while the solar panels energy is used for charging the battery)

(3.2) Demos - SEO/KPI COMPLIANCE

Conclusions:

- Considering the energy source configuration used in this study and the period of the year with the lowest solar irradiation in Southern Europe, **the energy demand can be fully supplied by the combination of the battery and solar panel system**. Under nominal operating conditions, no energy from the grid would be required
- The **battery autonomy allows the system to operate for 1,8 days** by using the stored energy from a full charge down to a 70% state of charge. Therefore, even in scenarios where no other energy source is available, this remaining 70% capacity can still be utilized to supply the energy demand

→ The energy consumption from the grid is drastically reduced (<30%) (consume less grid - SEO9).

→ The use of renewable energy sources is significantly improved (>15%) (consume better - SEO12).

(3.3) Demos - EXAMPLES PHOTOS

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(3.3) Demos - EXAMPLES PHOTOS

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Datalogger

File View Capture Protocols

Import configuration

OPC UA ReadResponse

- Metadata
- OPC UA / SDI-P ReadResponse
 - Service
 - ReadResponse
 - ServiceId
 - 634
 - SecureChannelId
 - 2
 - TokenId
 - 2
 - SequenceNumber
 - 286
 - SecureChannel RequestId
 - 299
 - RequestHandle
 - 100297
 - lastCommandedPosition
 - NodeId
 - ns=1;s=lastCommandedPosition
 - AttributeId
 - 13
 - OPC UA type
 - SByte
 - Raw value
 - 1
 - SDI-P value
 - Left (1)
 - StatusCode
 - Good (0x00000000) [implicit]
 - SourceTimestamp
 - 2000-01-01 16:38:51.0000000 UTC
 - movementStatus
 - position
 - positionDegraded
 - pointOperationTimer

4d:53:47:46:95:00:00:02:00:00:00:02:00:00:00:1e:01:00:00:2b:01:00:00:01:00:7a:02:00:b6:ae:af:76:54:bf:01:c9:87:01:00:00:00:00:00:ff:ff:ff:00:00:06

enyse

ready

CAP NUM SCRL

(3.3) Demos - EXAMPLES VIDEOS

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Video 1: Focus on **wireless enabled** and **energy self-sufficient** features for the Switch asset

Video 2: Focus on **controlling** the LX asset from **IXL** by using **EULYNX SCI-LC** protocol

THANK YOU!!!!