DJI Drones in Endesa Generación

Webinar

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Iberia Power Generation

OMI (Operation & Maintenance Improvement)

Green Power

Agenda

1. OMI - Operation & Maintenance Improvement
2. Drones in Endesa
3. Deep dive in use cases
4. Future insights

Agenda

1. OMI - Operation & Maintenance Improvement
2. Drones in Endesa
3. Deep dive in use cases
4. Future insights

OMI - Operation & Maintenance Improvement

Iberia

enel Green Power

- 350 Plants
- 17.2 GW
- 1.9 GW
- 4.7 GW
- 2.9 GW
- 7.7 GW

Power Generation Iberia

OMI
Operation & **M**aintenance **I**mprovement

IRCTI
Industrial **R**isk &
Cross **T**echnology **I**mprovement

Industrial Risk

Communication & Knowledge

Automation & Robotics

- **RoBoost Program**
- Advanced Analytics
- Digital Twin

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Looking for the operational excellence in our fleet

Agenda

1 OMI - Operation & Maintenance Improvement

2 Drones in Endesa

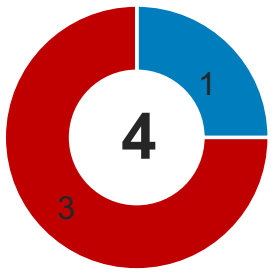
3 Deep dive in use cases

4 Future insights

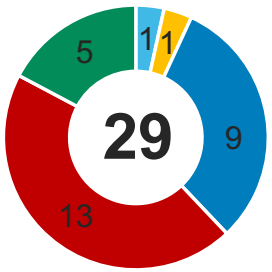
Drones Fleet

Iberia

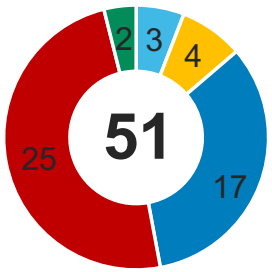
Indoor Drones



Outdoor Drones



Drones Pilots



Drones

Tipo Dispositivo	Marca	Modelo	N° Drones
Exterior	DJI	Avata	1
Exterior	DJI	M30T	1
Exterior	DJI	Matrice 210	2
Exterior	DJI	Matrice 300 RTK	3
Exterior	DJI	Matrice 350 RTK	1
Exterior	DJI	Mavic 2	14
Exterior	DJI	Mavic 3	2
Exterior	DJI	Mavic Air 2	1
Exterior	DJI	Mini	4
Interior	Flyability	Elios 1	2
Interior	Flyability	Elios 2	1
Interior	Flyability	Elios 3	1

33 Drones and 51 Pilots in Iberia

Drones Use Cases

In-house

AI/ML

enel Green Power

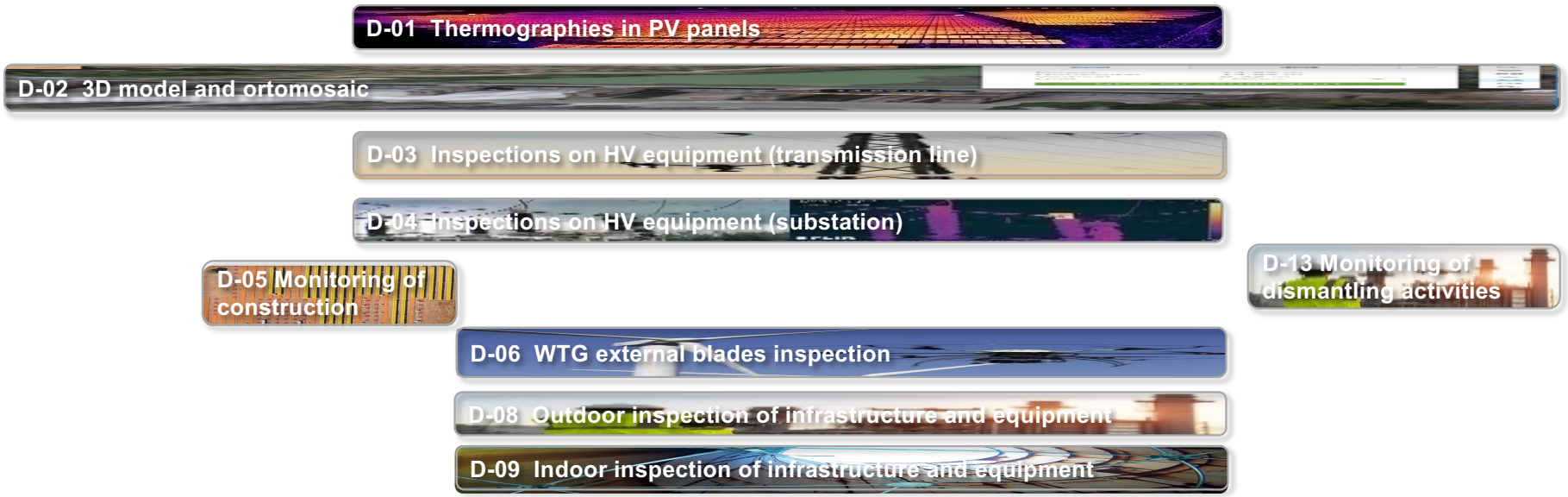
TL	Use Case	Flight	Processing
	D-01 Thermographies with drones over PV	exanter	exanter AI
	D-02 3D models and orthomosaics		
	D-03 Inspections on HV equipment (transmission line)	others Applus+ EIFFAGE ENERGÍA SISTEMAS	others Applus+ EIFFAGE ENERGÍA SISTEMAS
	D-04 Inspections on HV equipment (substation)	others	others
	D-05 Monitoring of construction	others topofor	SITEMARK DATASEE.AI AI
	D-06 WTG external blades inspection	galventus	Perceptual Robotics galventus AI

TL	Use Case	Flight	Processing
	D-08 Outdoor inspection of infrastructure and equipment	AVISTADRONE	AI
	D-09 Indoor inspection of infrastructure and equipment	AVISTADRONE	
	D-10 Bathymetry in dry areas	ECOFISH	
	D-11 Confined places inspection		
	D-12 Fly over power plant (communication and other)		
	D-13 Monitoring of dismantling activities		

Power Plant life cycle

BD (Business Development) → **E&C** (Engineering & Construction) → **O&M** (Operation & Maintenance) → **D&E - FuturE** (Design and Execution)

30 years | 40 years | 100 years



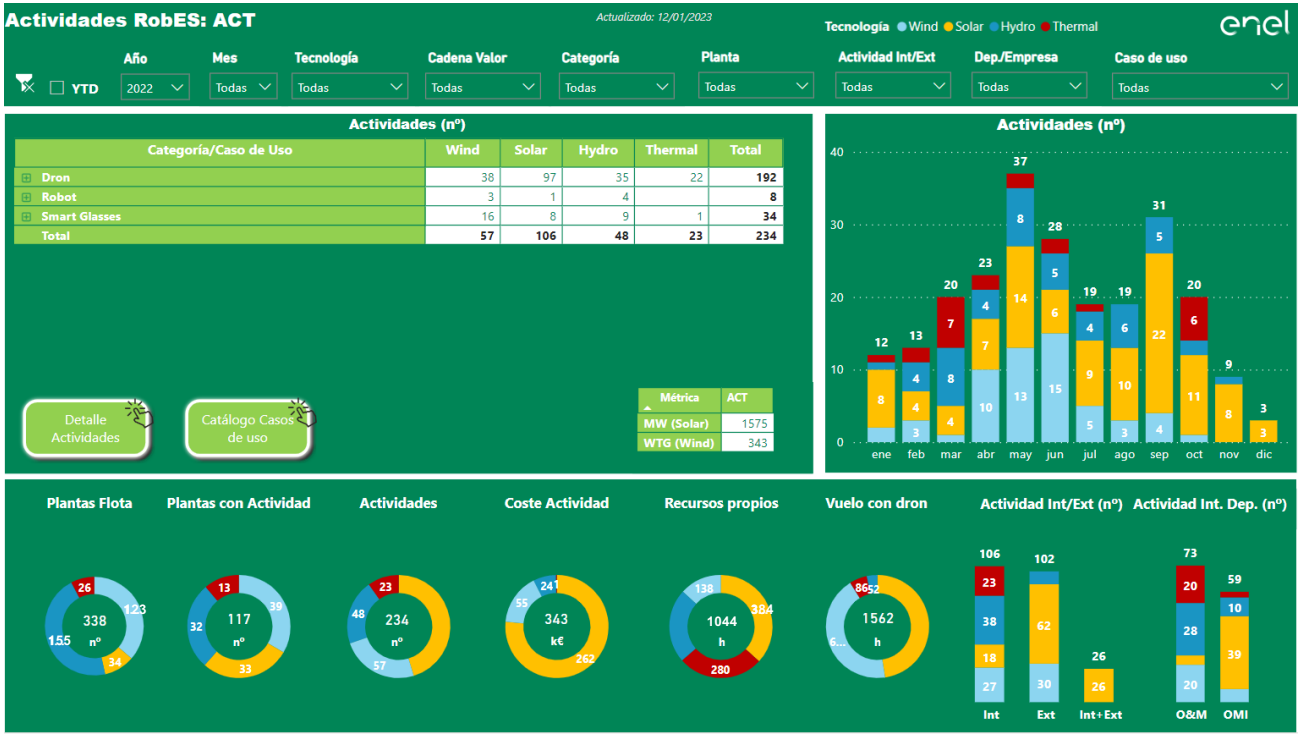
Drones in the entire value chain, in all technologies

RoBoost Program in Iberia

2022

234 Robotized activities in 2022

- 56% Internal + 44% External / **25% OMI**
- In all value chain: E&C, O&M, Inn.
- In all TL: Wind, Solar, Hydro, Thermal
- 45% in Solar
- 24% in Wind



Categoría/Caso de Uso	Wind	Solar	Hydro	Thermal	Total
Dron					192
Batimetría en zonas secas			4		4
Generación de modelo 3D y ortomosaico	1	7	7	2	17
Inspección externa de infraestructuras y equipos			23	15	38
Inspección externa de palas	36				36
Inspección interna de infraestructuras y equipos				5	5
Monitoreo de la construcción		44			44
Termografía de paneles fotovoltaicos		40			40
Vuelo divulgativo (comunicación y otros)	1	6	1		8

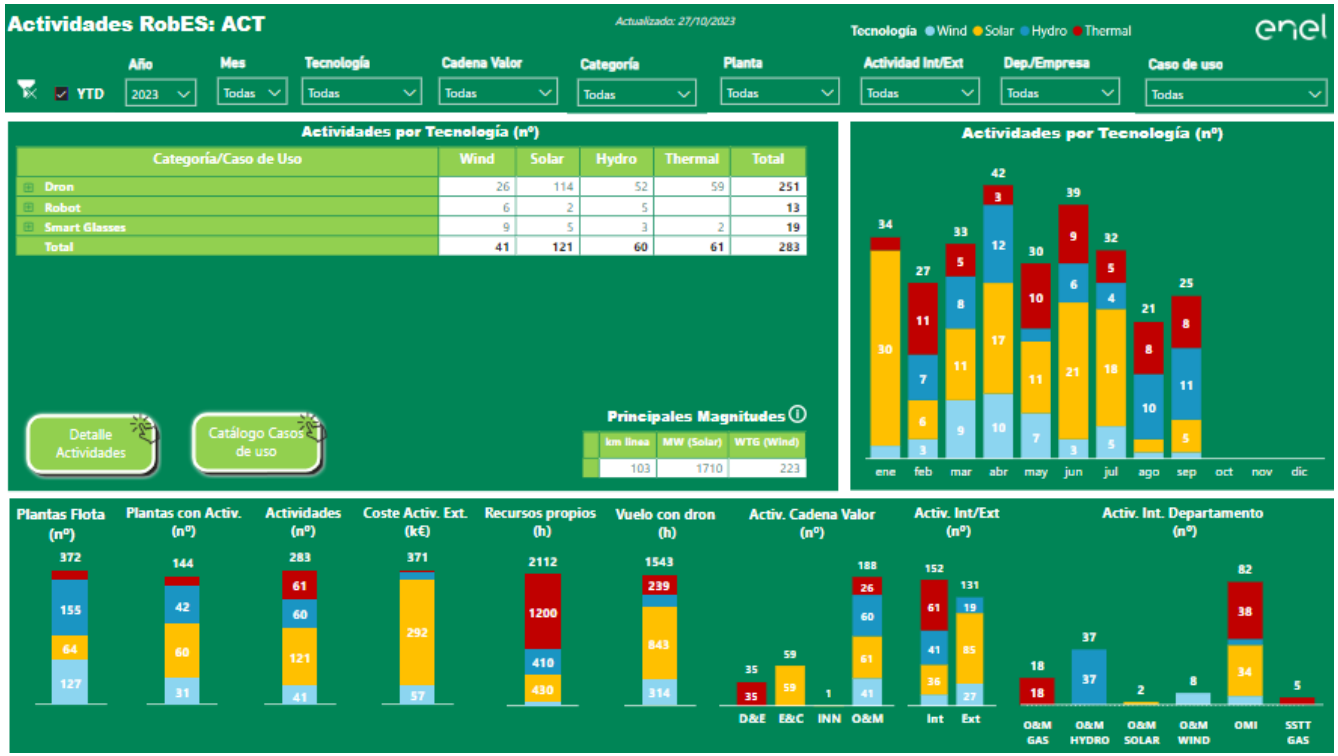
50% Internal, 25% by OMI in 2022

RoBoost in Iberia

2023 YtD

251 Robotized activities in 2023 (Jan-Sep)

- 60% Internal + 40% External / **33% OMI**
- In all value chain: E&C, O&M, **D&E**, Inn.
- In all TL: Wind, Solar, Hydro, Thermal
- 42% in Solar
- 21% in Thermal



Categoría/Caso de Uso	Wind	Solar	Hydro	Thermal	Total
Dron					251
Generación de modelo 3D y ortomosaico		17	21	6	44
Inspección externa de infraestructuras y equipos			30	35	65
Inspección externa de palas	18				18
Inspección interna de infraestructuras y equipos				8	8
Monitoreo de la construcción		31			31
Revisión y termografía de líneas eléctricas	4	12			16
Termografía de paneles fotovoltaicos		40			40
Vuelo divulgativo (comunicación y otros)	4	14	1	10	29

20% increase in 2023 vs 2022, 30% by OMI, Drones in D&E

Agenda

Monitoring of construction

Green Power

Before drones - Manual Inspection

- On foot
- High health and safety hazard

Mission Detail

Technology: Solar
Inspection purpose: Monitoring of construction (**check progress 1 month**)
Plant: Tico Solar
Inspection Date: October 2021
Image Type: RGB + IR
Drone: DJI Matrice 300 RTK, DJI Mavic 3
Payload: Zenmuse H20T, Zenmuse P1
Pilots: 1 Enel certified pilot
Flight Time: 100 MW/day
Post-Processing: Outsourced with AI (~1 week)

SITEMARK AI

Thermographies with drones over PV

Key points

exanter
Because excellence is a degree.

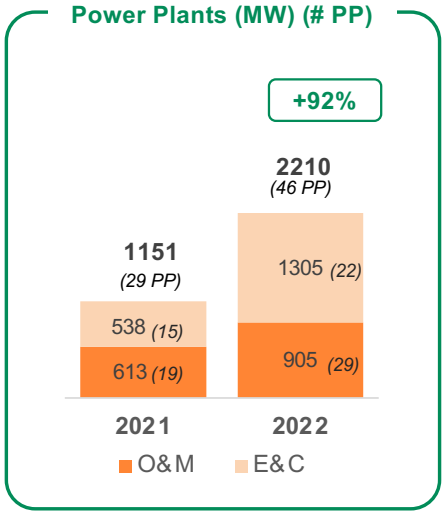
enel
Green Power

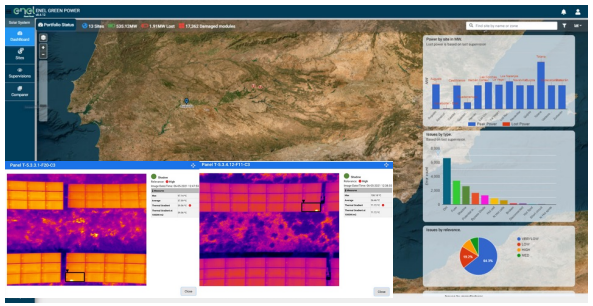
Benefits from thermography with drone

- Production improvement
- Safety
- Warranty claims

- **Frequency**
  - One Thermography in Commissioning /
  - One-two Thermography's per year in O&M
  - When a black-swan event happens (hail, thunderstorm, strong winds, …)
  - When the Operative Efficiency decrease unexpectedly
- **Flight Inspection**
  - Inspection time: 30-50 MW/day
  - Ground resolution: GSD 3cm/pix
  - RGB+IR Images
  - Need good weather and light conditions

- **Processing** (accuracy true positives near 100%)
  - Module indexing and Digital mapping: faults located at a module level
  - Defect identification





One Thermography in Commissioning / One-Two Thermography's per year in O&M

Thermographies with drones over PV

Processing

exanter
Because excellence is a degree.

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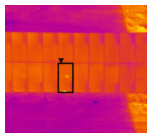
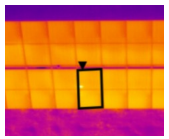
Defect identification

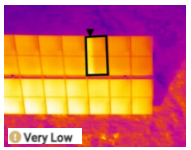
Hot spot/cell



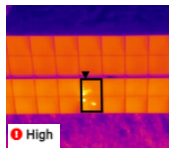
Dirt



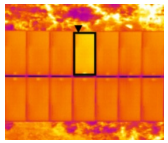
Bypass diode



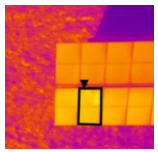
Broken



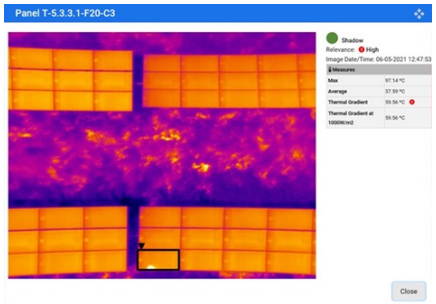
Disconnected module

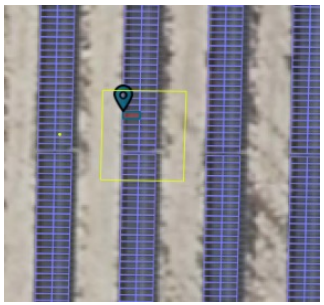


Shadow



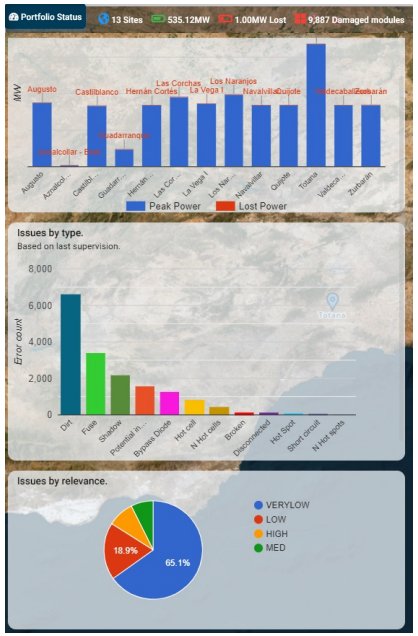
Module indexing and Digital mapping





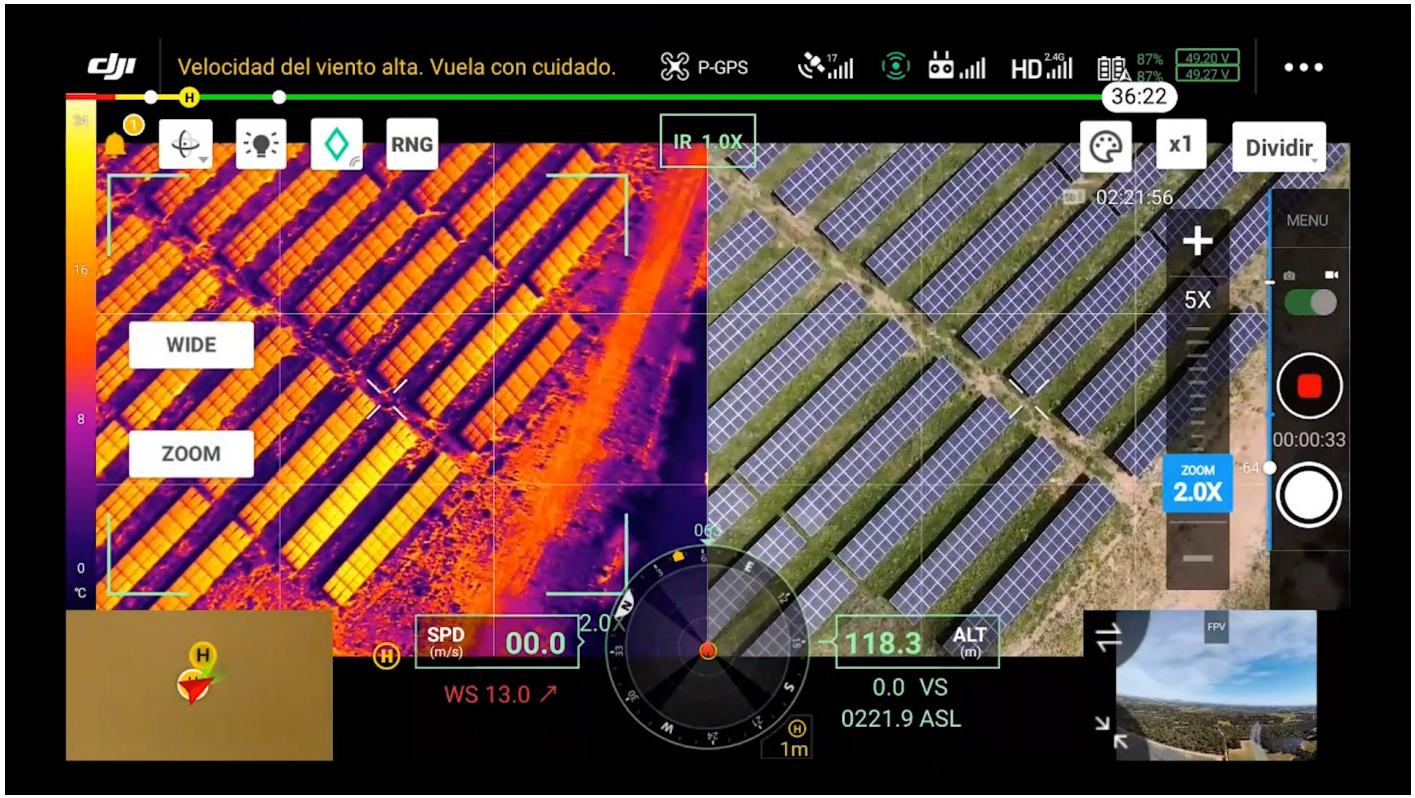
- Lost Power
- Pannel status
- Type of defect
- Relevance
- Manufacturer
- Module type

Dashboard



One Thermography in Commissioning / One-Two Thermography's per year in O&M

Thermographies with drones over PV



Visual inspection after weather events: Windstorm

In-house

Green Power

Mission Detail

Technology: Solar

Inspection purpose: Plant status after weather event (heilstorm) for insurance claim

Plant: Minglanilla I and II

Inspection Date: January 2023

Image Type: RGB + IR

Drone: DJI Matrice 300 RTK, Mavic 3, Avata

Payload: Zenmuse H20T, Zenmuse P1

Pilots: 2 Enel certified pilot

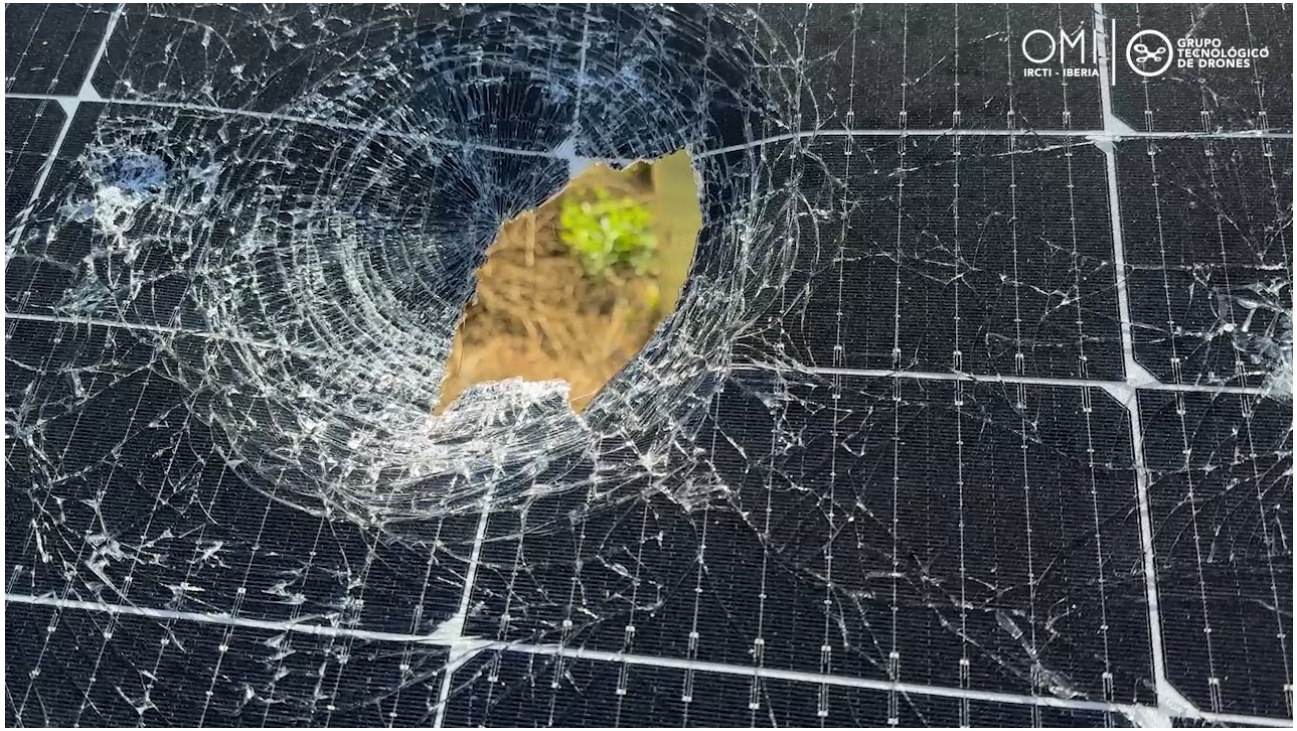
Flight Time: 3 days, 3 drone (8-10 h)

Post-Processing: Inhouse (5500 pic/video,30h postprocessing and report)

Visual inspection after weather events: Heilstorm

In-house

Green Power



Mission Detail

Technology: Solar
Inspection purpose: Plant status after weather event (windstorm) for insurance claim
Plant: Tico I and II
Inspection Date: July 2023
Image Type: RGB + IR
Drone: DJI Matrice 300 RTK, DJI Mavic 3
Payload: Zenmuse P1
Pilots: 1 Enel certified pilots
Flight Time: 3 days, 2 drones (8-10 h)
Post-Processing: Inhouse (8000 pic/video,40h postprocessing and report)

3D models and Ortophotos

In-house

Green Power

Mission Detail

Technology: All

Inspection purpose: 3D models and Ortomosaics

Inspection Date: October 2022

Image Type: RGB

Drone: DJI Matrice 300 RTK, DJI Mavic 3

Payload: Zenmuse P1

Pilots: 2 Enel certified pilots

Flight Time: 2-3 days per Power Plant

Post-processing

Software: Pix4D Mapper, Blender, etc.

Post-Processing: 3d Model 2 days, Animation and video 3 days

Monitoring of dismantling works

In-house

Green Power

Mission Detail

Technology: Coal

Inspection purpose:

- 3D models and ortomosaic,
- Monitoring of dismantling activities,
- Demolition analysis

Image Type: RGB +IR

Drone: DJI Matrice 300 RTK, Matrice 350 RTK, Matrice 30T, Mavic 3, Avata,

Payload: Zenmuse P1, Zenmuse H20T

Pilots: 2 Enel certified pilots

Flight Time: 1 week per Demolition work

Post-processing

Software: Pix4D Mapper, Blender, etc.

Post-Processing: 3D Model 2 days, Animation rendering and video - 3 days


endesa
GRUPO
TECNOLÓGICO
DE DRONES

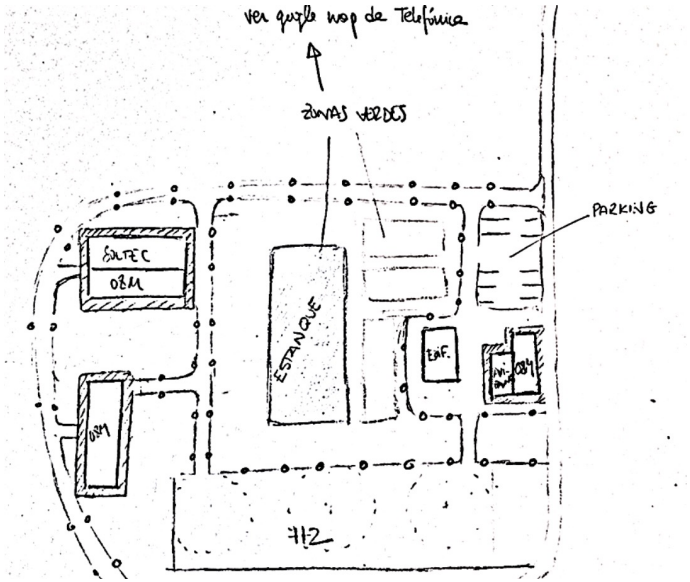

endesa
OMI
IRCTI - IBERIA
GRUPO
TECNOLÓGICO
DE DRONES

Metaverse and Virtual Reality

In-house

Green Power

Metaverse Scenario. From sketches to final result:



Sketches

+

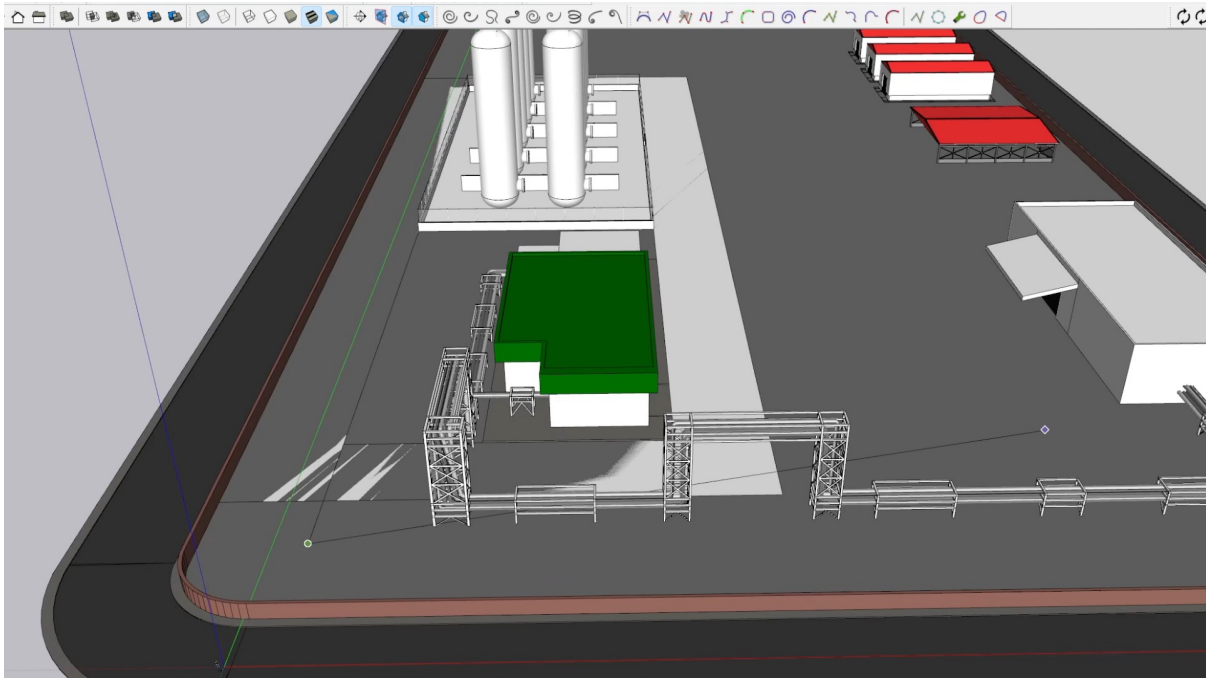
Drone georeference ortophoto 1:1 scale

Metaverse and Virtual Reality

In-house

Green Power

Metaverse Scenario. From sketches to final result:




endesa
Ítaca
56MW
OMI
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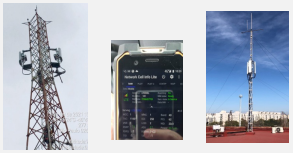
DE DRONES

Agenda

Future insights

Connectivity improvement



Data Security

Digitalization and Data Quality

to improve performance

AI/ML
Anomaly detection tools

Unlocking potential by enabling BVLOS flights without pilot

DRON EUROPA

U-Space

Drone in a box
Autonomous inspection

(indoor and outdoor)

Digital Twin

Metaverse and Virtual Reality

Technology development and regulation

Thanks

OMI
IRCTI - IBERIA

GRUPO TECNOLÓGICO DE DRONES

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