

# Enline

SMART ENERGY SOLUTIONS

**Energy is vital for our society, as blood is to human bodies**

- **Early diagnosis**

- **Prevention**

**Health**

# Neural system acts as a natural transmitter

- Real-time and predictive alert system
- Status awareness
- Cognitive insights

**This is missing in power grids**

# UNIQUE TECHNOLOGY

## DIGITAL TWINS WITHOUT SENSORS



### 100% REMOTE, SENSORLESS

Highly scalable, fully digital solution.



### SCALABILITY AND INTEGRATION

Power and versatility to grow



### FASTER THAN EVER

100% Remote



### KNOWING THE FUTURE

Know when, where and what can happen. Artificial Intelligence and Machine Learning



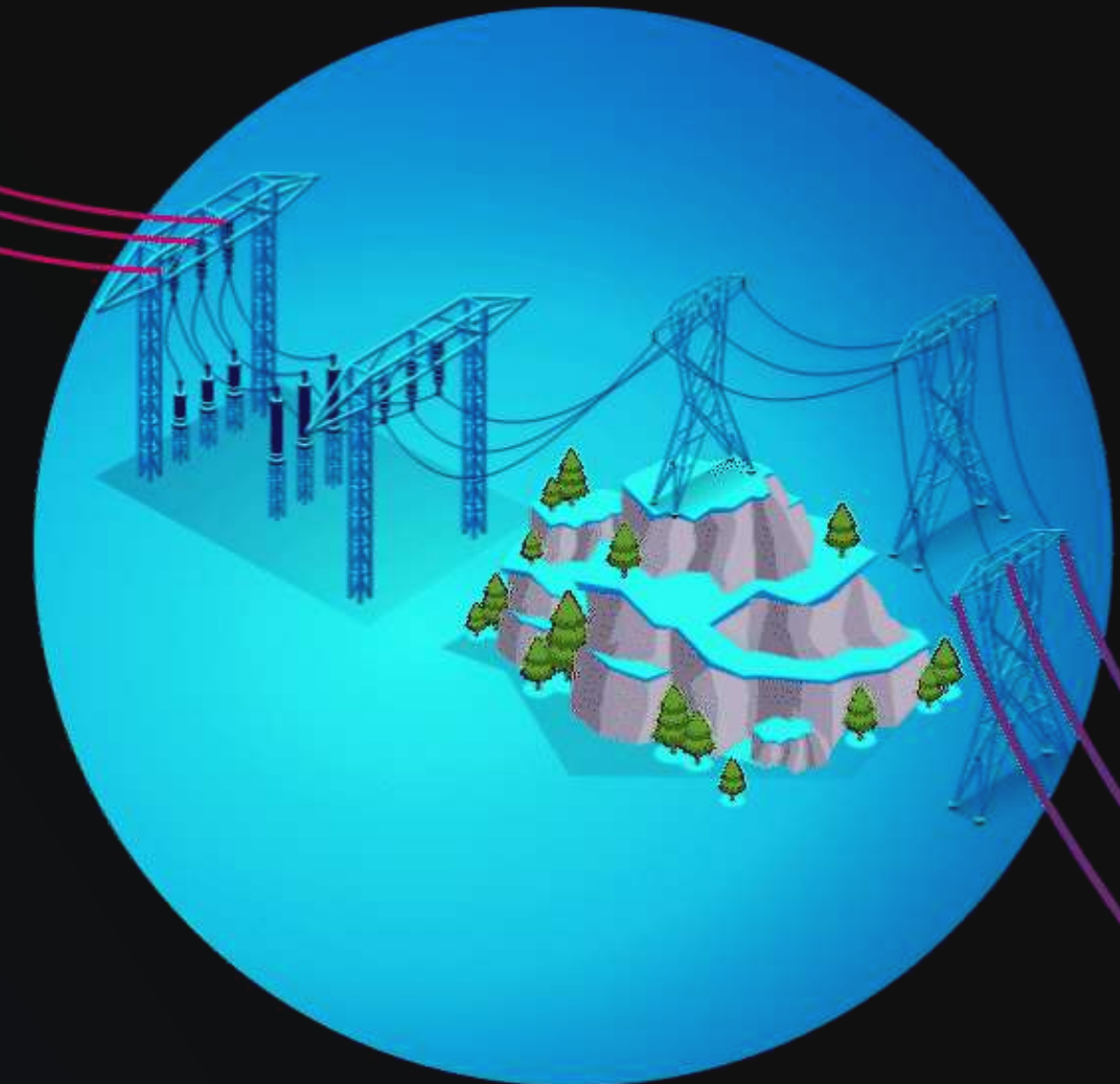
### MORE COMPETITIVE

Unbeatable solution in time, precision and price



### > 98% ACCURACY

High-precision digital twin



# Enline drives power grids to the next level...

**Enline**  
Monitoring System **EMS**

**Enline**  
Fault Location **EFL**

**Enline**  
Power Optimization **EPO**

**Enline**  
Dynamic Line Rating **E-DLR**

**Enline**  
Optimization Engineering **EOE**

**Enline**  
Vegetation Management **E-VGM**

**Enline**  
Wildfire Prevention **E-WFP**

... by an **UNIQUE** Digital Twin technology

# SOLUTIONS PORTFOLIO

**Enline**  
Monitoring System **EMS**

Real-time monitoring, diagnostics and predictive maintenance. Digital platform monitoring the whole line, knowing their electrical, thermal and mechanical status on each meter, for a holistic understanding of the power transmission system. Artificial intelligence with proactive risk management of any potential electrical and electromagnetic event, that may probably happen. Predictive alerts and warnings of any future risk

**Enline**  
Power Optimization **EPO**

EPO is a disruptive power losses reduction algorithm that identifies the combination of active and reactive power that minimizes power transmission losses and maximizes revenues.

**Enline**  
Optimization Engineering **EOE**

Design tool enabling to simulate the full operational behavior already in the design phase. Risk assessment of any transmission asset incl. considering local weather scenarios, even before the line installation has started. EOE also comprises the design optimization of new transmission lines in order to achieve a more competitive project in CAPEX cost and time, e.g. by optimizing the tower construction, foundations or selecting types of power conductors acc. to techno-economic criteria.

# SOLUTIONS PORTFOLIO

**Enline**  
Fault  
Location **EFL**

EFL combines electrical data, waveform records and Enline proprietary algorithms to precisely locate faults and events along the transmission line. EFL enables the line operator to correct the fault and to put the line back into service in the shortest possible time.

**Enline**  
Dynamic  
Line Rating **E-DLR**

E-DLR enables the weather dependent operation of the line, maximizing power transmission and ensuring that the cable temperature and sag limits are preserved. The real ampacity limits of the power system can be provided in real-time or as forecasts

**Enline**  
Wildfire  
Prevention **E-WFP**

Is a key technology to accurately detecting the risks and probability of ignition of fires caused by transmission lines and locating the potential source before the ignition event occurs. Be it due to the dielectric breakdown in the air, electrical faults or mechanical, or even the conductors fall.

**Enline**  
Vegetation  
Management **E-VGM**

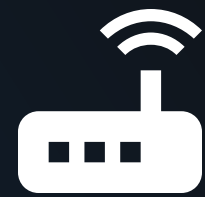
E-VGM combines on-the-ground meteorological data with high-resolution multispectral satellite images to offer visibility and forecast of vegetation growth around transmission and distribution grids. Artificial Intelligence allows the detailed identification of vegetation classes and its proximity to assets, determining in real-time and predictively the potential risk impact on the availability at any point of the assets. It is possible to prioritize clearing and corrective maintenance activities, optimizing economic resources, time and efficiency of operations. A regularly issued pruning plan indicates the exact areas for the vegetation cutting team. Vegetation Clearing Regulations are considered.

# State of The Art Technologies

Enline



Conductor Mounted Systems



Non-contact Systems



Optical fiber



Drones



Sensorless Digital Twin

Overall Price



Real-time Data



Predictive Diagnosis



Implementation Time



Maintenance Needs



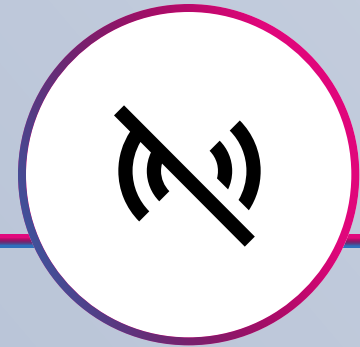
Legend

★★★★★ non-applicable

★★★★★ best value

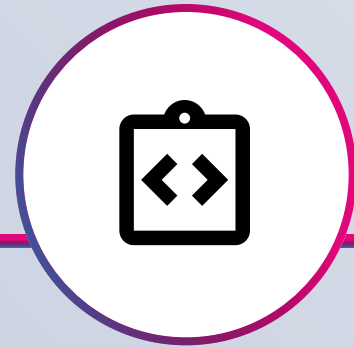


# Unique features



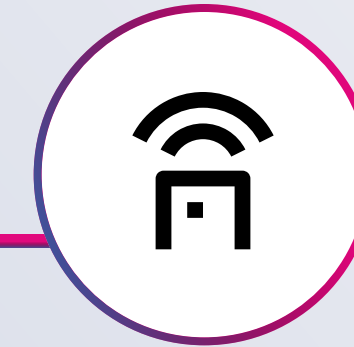
## **NO SENSORS NEEDED**

Unique and disruptive system



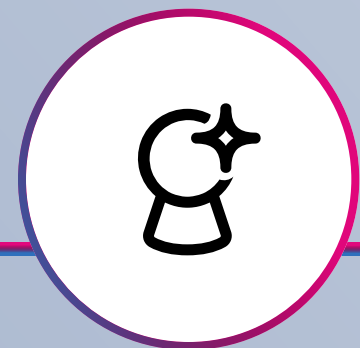
## **HIGH SCALABILITY AND INTEGRATION**

Power and versatility to grow



## **FASTER THAN EVER**

100% Remote



## **KNOWING THE FUTURE**

Know when, where and what will happen



## **MOST COMPETITIVE**

Unbeatable solution, in time, accuracy and price



## **> 98% ACCURACY**

High precision digital twin

# Enline Software House

```
Enter row and columns for second matrix: ";
int r2, c2;
// Enter elements of first matrix.
int i, j;
for (i = 0; i < r1; ++i)
    for (j = 0; j < c1; ++j)
        cin >> a[i][j];
// Enter elements of second matrix.
endl << "Enter elements of matrix 2:" << endl;
for (i = 0; i < r2; ++i)
    for (j = 0; j < c2; ++j)
        cin >> b[i][j];
// Enter element a
endl << "Enter element a" << i + 1 << j + 1 << " : ";
cin >> a[i][j];
// Enter element b
endl << "Enter element b" << i + 1 << j + 1 << " : ";
cin >> b[i][j];
```

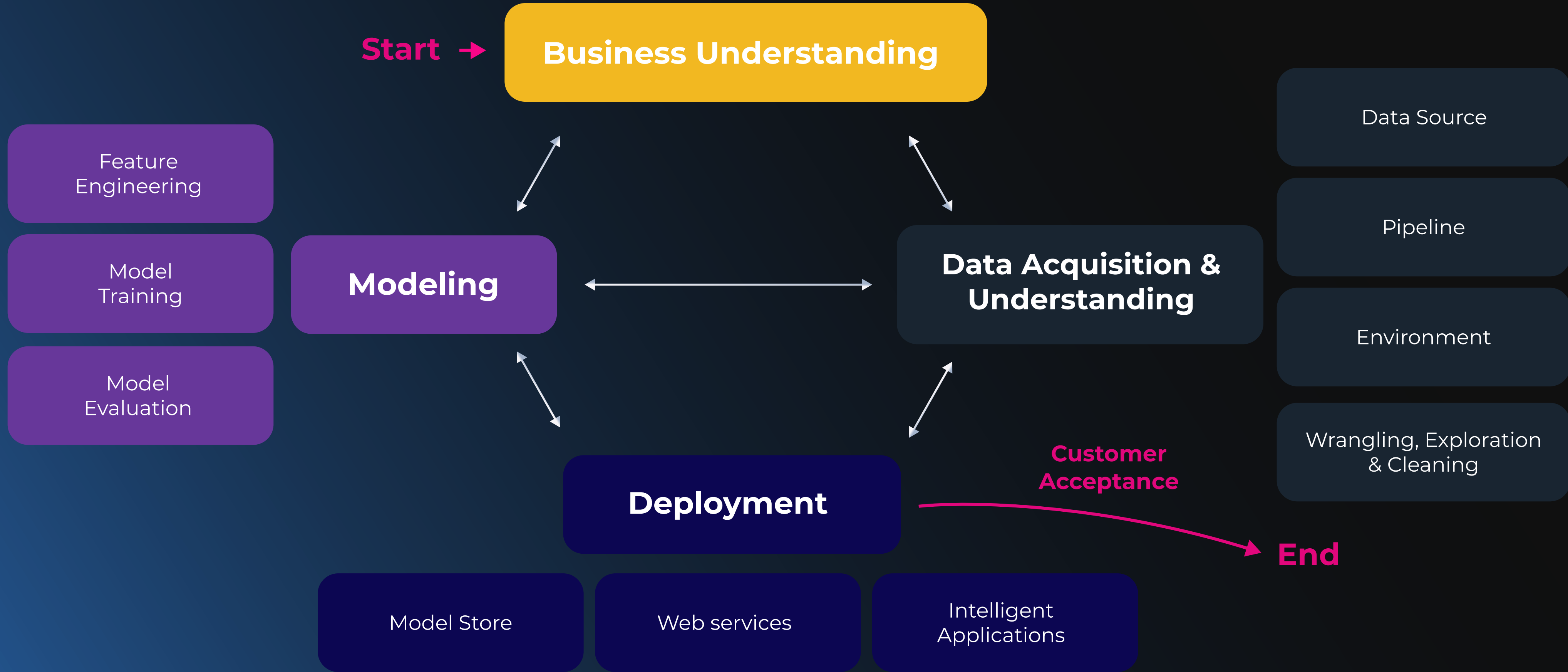
- Specialist in power management software
- Tailor made solutions
- Solutions on demand



## Know how & expertise

- Machine learning
- Artificial intelligence
- Data mining
- Cyber security
- Usability

# Online Data Science Lifecycle



# Value proposition for a needy market

Immediate startup by remote installation

Increase transmission capacity by dynamic control

Increase revenues by losses reduction

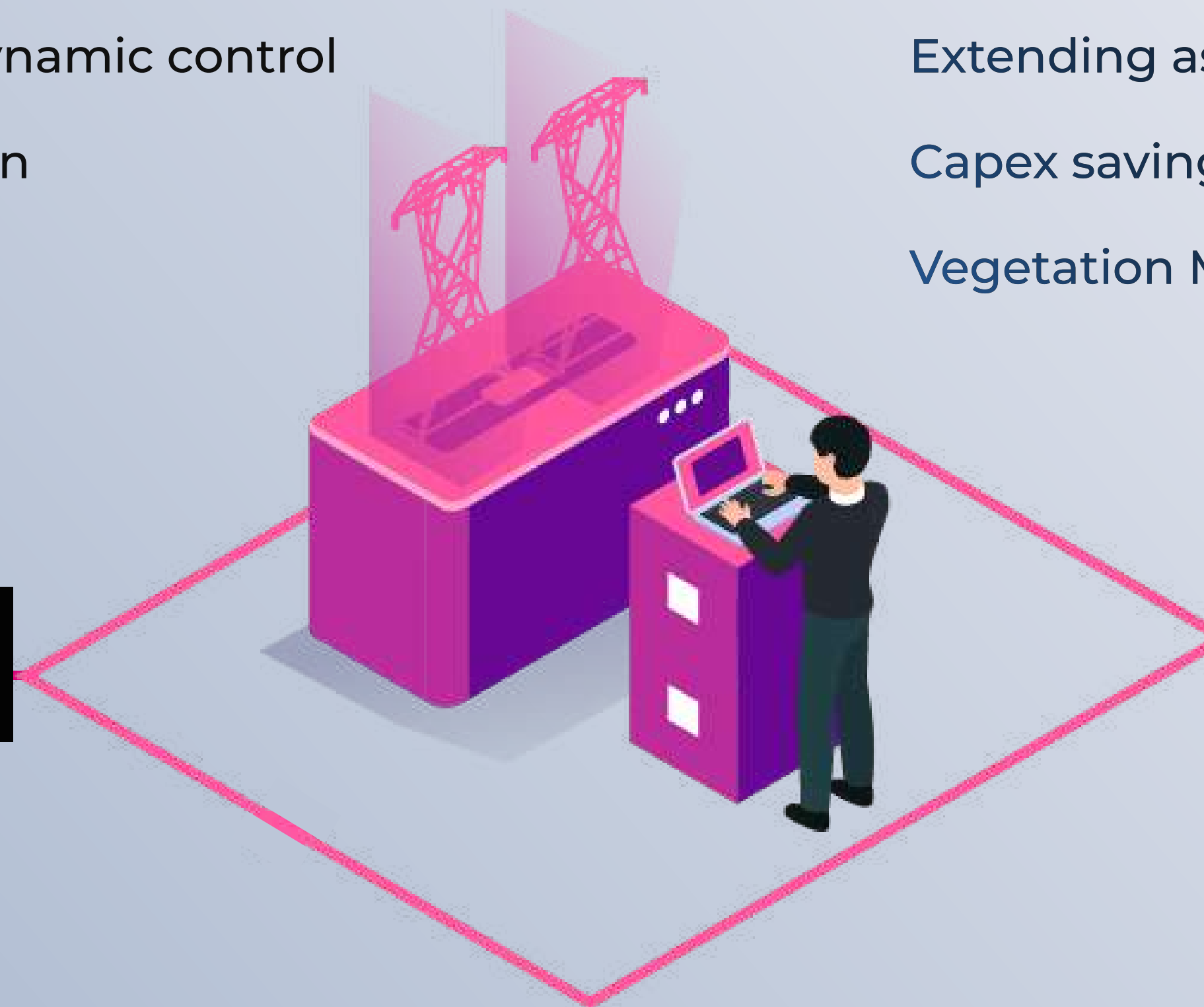
Enhance existing asset capacity

Opex savings by realtime and predictive monitoring

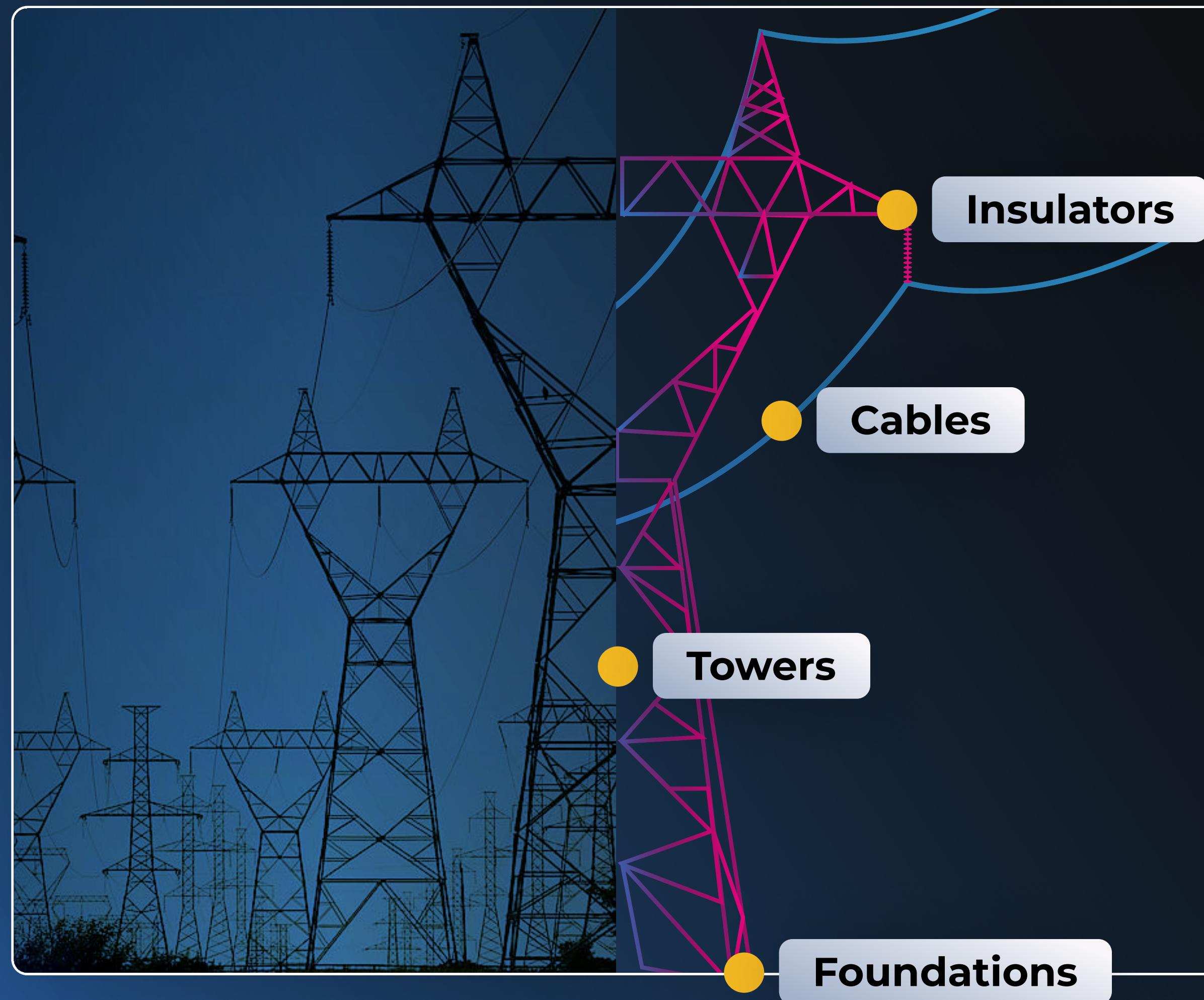
Extending asset life cycle by health assessments

Capex savings by planning optimization

Vegetation Management and Wildfires Prevention

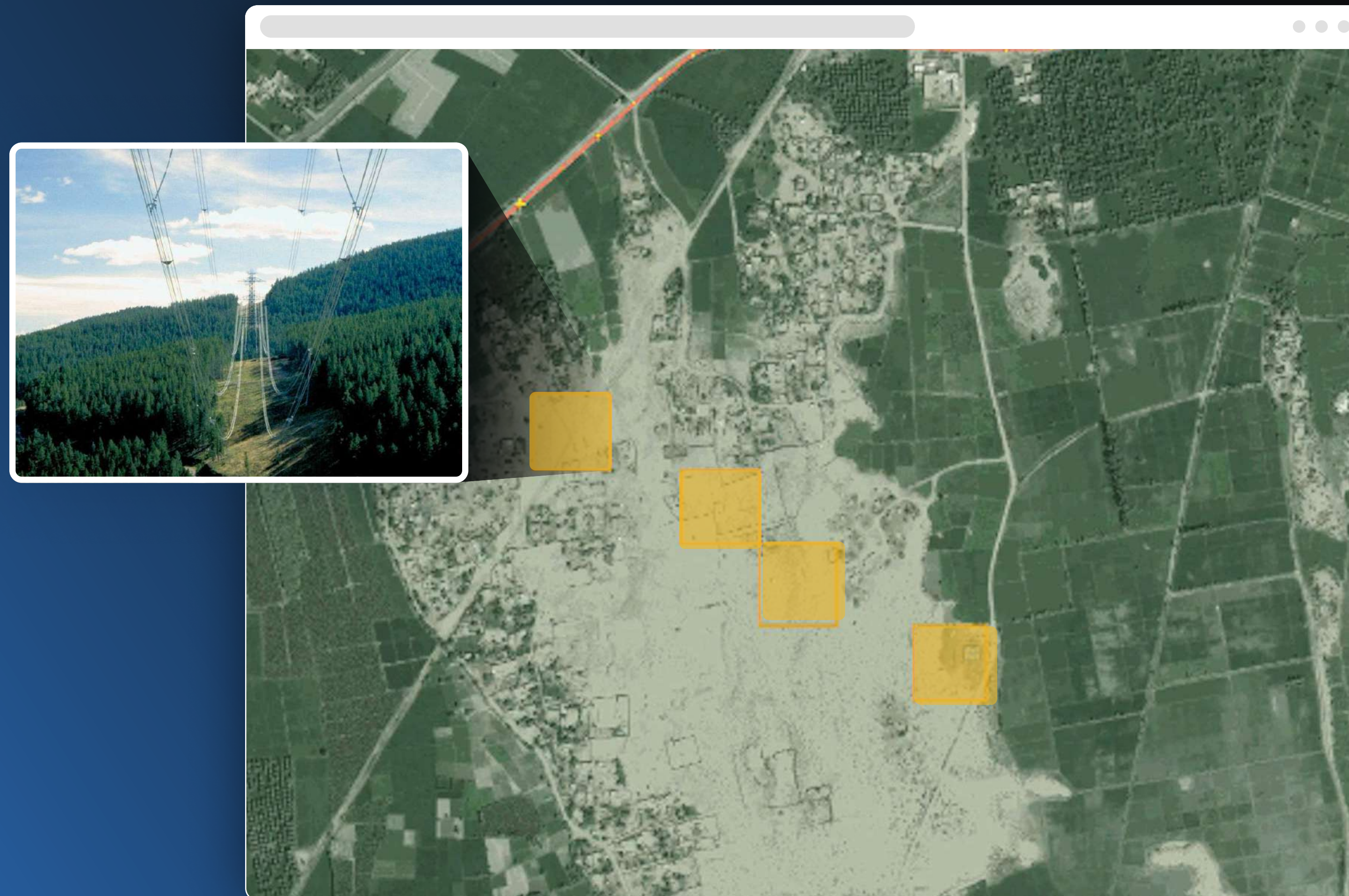


# Electromechanical & **Structural Analysis**



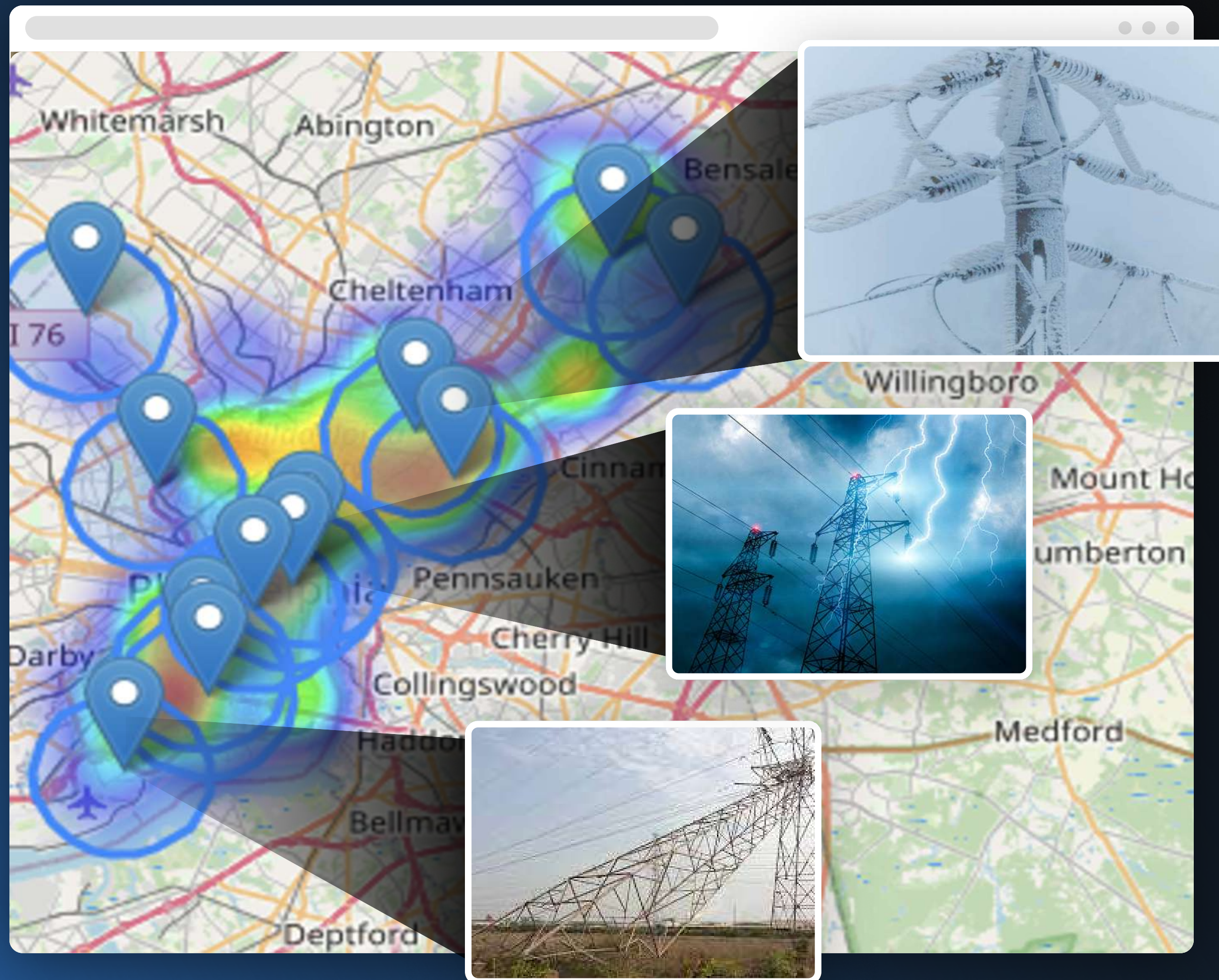
**Real-time and predictive** analysis of electromechanical variables and structural efforts in each component with real-time and predictive alarms for events and failures.

# Vegetation Management **System**



- **Intelligent mapping technology** based on smart satellite imagery
- **Digital Twin technology** and AI algorithms monitoring the vegetation zones including growth forecast
- **Predictive alerts** for upcoming risky distances between powerlines and vegetation
- **Risk mitigation** by generation of pruning plans
- **Supporting the prevention** of wildfire ignition

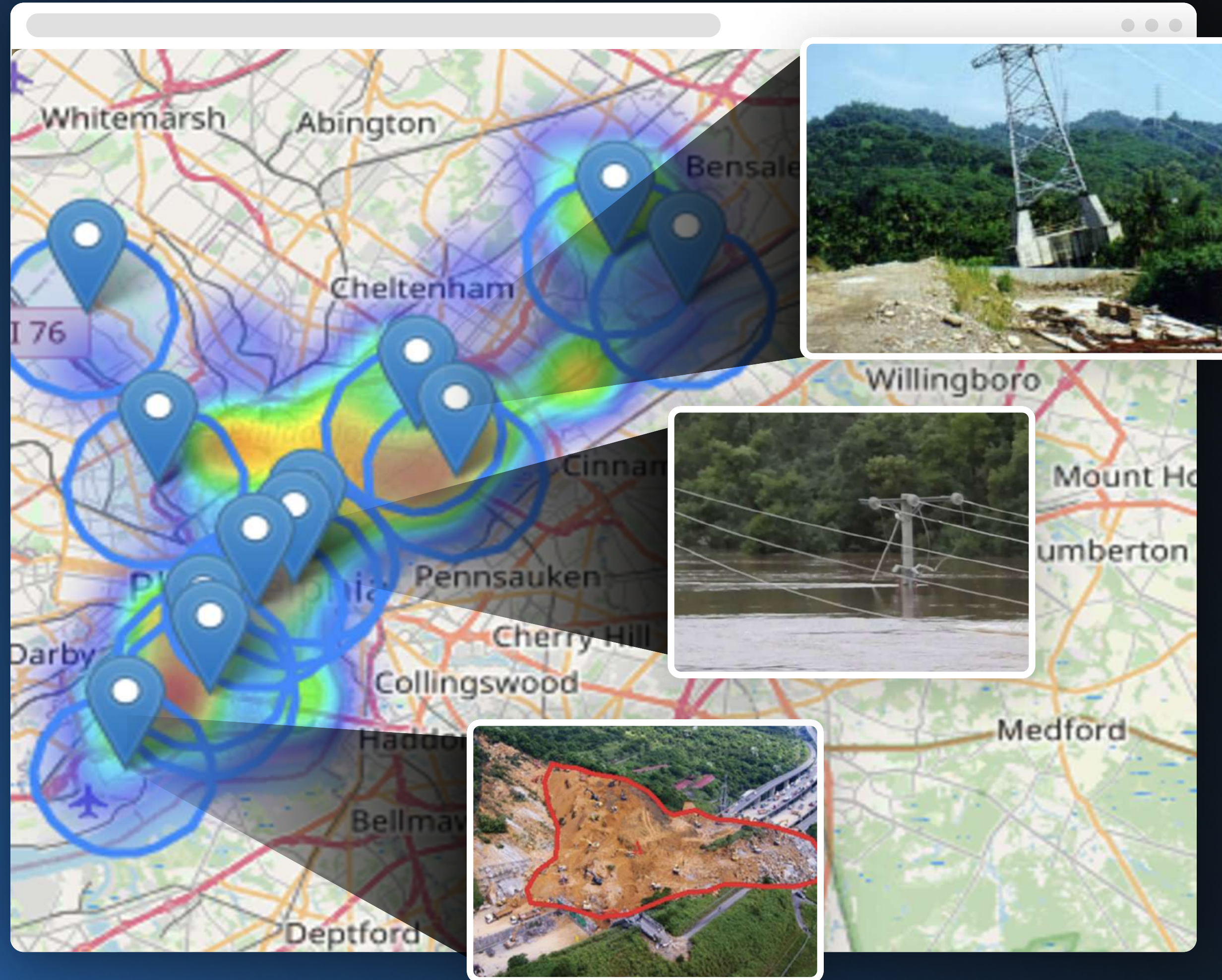
# Extreme Weather Prediction



Predictive analysis and diagnosis of events and failures

- **Extreme Weather**
- **Icing**
- **Storms and Hurricanes**
- **Lightning**

# Natural Disasters **Predictive Analysis**



Predictive analysis and diagnosis of events and failures

- **Earthquake**
- **Landslides**
- **Floodings**
- **Avalanches**



# Wildfires Predictive Analysis



- **AI based algorithms** correlating weather conditions with the current electromechanical and vegetation conditions along the power lines
- **Predictive analysis of high-risk** areas in which a short circuit could happen along the power lines
- **Identification of ignition risks** and spreading area of a wildfire
- **Identification of wildfires** crossing and impacting power lines

# Pricing model

**Implementation fee + SaaS**

**Enline**  
Monitoring System **EMS**

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Fault Location **EFL**

**Enline**  
Dynamic Line Rating **E-DLR**

**Enline**  
Wildfire Prevention **E-WFP**

**Enline**  
Vegetation Management **E-VGM**

**Success fee for avoided transmission losses**

**Enline**  
Power Optimization **EPO**

**Specialized consulting services**

**Enline**  
Optimization Engineering **EOE**

# GLOBAL PRESENCE

**Atlantica**  
Sustainable Infrastructure

**FGNIX**

**isa**  
CONEXIONES QUE INSPIRAN

**Hydroplus**  
GLOBAL

**MIMG**

**LAS BAMBAS**

**ElectroDunas**

**LITSA**

**COES**

**UTE**

**CORUMBÁ**  
CONCESSÕES S.A.

**Intertechne**

**CEMIG**

**STATE GRID**  
BRAZIL HOLDING S.A.  
国家电网巴西控股公司

**GEOMETRIC TALKS**  
CONSULTING

**REN**  
Redes Energéticas Nacionais

**finerge**  
WIND

**APG**  
Austrian Power Grid

**50hertz**  
E.ON Group

**RED**  
ELÉCTRICA  
DE ESPAÑA

**ELECTRICIDADE**  
DE MOÇAMBIQUE, E.P.

**ElectraNet**

### CUSTOMER CHALLENGE

- Reduce losses between the generation in the wind towers and the interconnection with the system.
- The transmission line was fed by a 252 MW Wind power plant.
- Finerge is operating both the Wind farm and the transmission line.

**Enline**  
Power  
Optimization **EPO**

### MAIN ACHIEVEMENTS

- **EPO installed remotely**, quickly, and easily, without requiring line de-energization
- **Immediate income** right after installation and short payback period are often met
- **0.45% of energy surplus** from the EPO
- **200.000 USD** of additional energy revenues

## CUSTOMER CHALLENGE

- Design optimization of a new transmission lines.
- Achieve a more competitive project in cost and term.
- Reduce and mitigate environmental, social, and property impacts, ensuring sustainability and efficiency throughout the asset life cycle.

## MAIN ACHIEVEMENTS

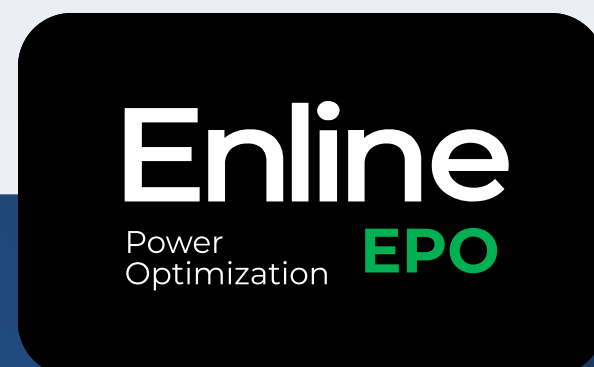
- **Remote process** completed in a few days
- **High precision** and dynamic analysis of all variables, and risk mitigation
- **10% Capex reduction**
- **Project schedule** and resources improvements
- **Opex optimization**, guaranteeing sustainability and minimizing socio-environmental impacts



# Case Studies **EDM**

## CUSTOMER CHALLENGE

- Reduce losses in the power grid system.
- The transmission lines were fed by a 750 MW of power plants.
- EDM is operating both the power plants and the transmission lines.



## MAIN ACHIEVEMENTS

- **EPO installed remotely**, quickly, and easily, without requiring line de-energization
- **Immediate income** right after installation and short payback period are often met
- **0.4% of energy** surplus from the EPO
- **2.000.000 USD** of additional annual energy revenues

## CUSTOMER CHALLENGE

- Worldwide the infeed of highly volatile renewable energy into the High Voltage transmission system is growing.
- Operators are forced to manage fluctuating wind and solar energy generation and to provide enough transmitting capacity.
- Operators are looking for technologies to optimize the use of their available grid capacity and avoid power line congestion.

**Enline**  
Dynamic  
Line Rating **E-DLR**

## MAIN ACHIEVEMENTS

- **80% Saved cost** due to DLR digital twin implementation, compared to sensor based application
- **90% Time reduction** on unavailability and fault identification
- **98% Accuracy** of digital twin calculations vs real field measurement
- **0 Down time** hours



# Case Studies **ISA**

## CUSTOMER CHALLENGE

- Earthquake in southern Perú caused several short circuits along a main transmission line implying operational unavailability.
- Existing fault locators at the substations were not able to locate the faults, leading to several days of transmission interruption.
- The Peruvian grid was put under high operational risk.

**Enline**  
Fault  
Location **EFL**

## MAIN ACHIEVEMENTS

- **Up to 90%** saved cost for fault identification process to be done by operational teams, drones or helicopters
- **1 span accuracy:**  
within one span the fault will be detected and exactly located on the transmission line
- **60-90% time reduction** of unavailability and fault identification time





# Case Studies **ELETROBRAS**

## INPUT COLLECTION

- Analysis of satellite images
- Analysis of radars outputs and heat points
- Time series of electrical data
- Time series of weather variables
- Analysis of pruning events



## OPTIMIZATION OF PRUNING ACTIVITIES

- Search for fire tracks depending on vegetation height
- Optimize the pruning maintenance events
- Maximization of operating availability

## CUSTOMER CHALLENGE

- Customer intends to maximally increase the generated power and energy of an existing solar farm
- For budget reasons customer wanted to know to what extent he can use the existing grid also in future
- Consideration of meteorological values and keeping the operating limits (mechanical and electrical) by application of Dynamic Line Rating



## MAIN ACHIEVEMENTS

- Risk analysis by application of optimization engineering (EOE) has been carried out, based on historic weather scenarios
- Results showed the amount of transmittable power without any refurbishment or re-capacitation of the already existent transmission lines
- By using Dynamic Line Rating (E-DLR) customer can manage the increased power transmittal without violating the thermal limits of the conductors

## CONDUCTORS OPTIMIZATION CHALLENGES

- Optimize the electrical performance, reduce losses and gain financial savings
- Optimize cable position for a better atmospheric discharge response
- Complying with all design boundary conditions and regulations

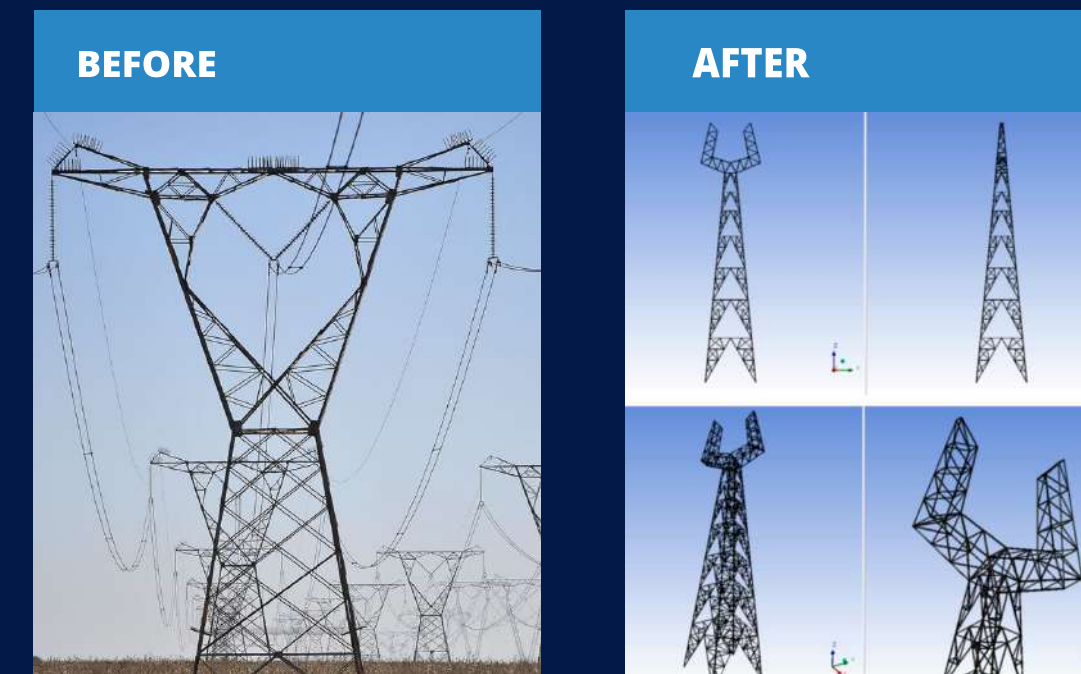
## MAIN ACHIEVEMENTS

- Up to 50% lower electromagnetic field levels
- Lower Corona effect and overall losses
- Better atmospheric discharge response achieved
- Potential avoidance in lightning blackout time

## TOWER OPTIMIZATION CHALLENGE

- Identify potential cost savings by application of artificial intelligence based algorithms
- Iterate mechanical design with the electromagnetic criteria
- Optimize foundation structure considering the geologic conditions

## MAIN ACHIEVEMENTS



- Nearly 40% more compact tower design allowing a narrower ROW
- 7M USD overall savings on towers and foundations on a 60km, 500kV line
- Easier installation work on towers



# Case Studies **Las Bambas**

## CUSTOMER CHALLENGE

- Historical weather scenarios along the transmission line.
- Meteorological correction considering the shapes of the catenaries.
- Calculation of the capacity curve considering the restrictions reported by the Client. The restrictions are divided into: thermal, mechanical and electrical.
- Calculation of the power quality operating area in terms of active and reactive power.
- Identification of the points and spans with the greatest operational risk such as: permanent regime overvoltages, low current reserves, sagging spans and losses.

**Enline**  
Dynamic  
Line Rating **E-DLR**

**Enline**  
Optimization  
Engineering **EOE**

## CUSTOMER CHALLENGE

- Clear understanding of the maximum transmission capacity for Solar Thermal Power Plant
- Customer intends to maximally increase the generated power and energy in real-time and forecasted
- Consideration of meteorological values and keeping the operating limits (mechanical and electrical) by application of Dynamic Line Rating



## MAIN ACHIEVEMENTS

- Dispatch better according to the weather limitation
- Results showed the amount of transmittable power without any refurbishment or re-capacitation of the already existent transmission lines
- By using Dynamic Line Rating (E-DLR) customer can manage the increased power transmittal without violating the thermal limits of the conductors



# Case Studies **UTE**

## CUSTOMER CHALLENGE

- Electrical data processing
- Parametrization of installation older than 40 years
- Consideration of refurbished circuit
- Modelling of double circuit



## MAIN ACHIEVEMENTS

- Detecting low ampacity values throughout the day
- Identify overvoltage values along the line due to longer length and transposing
- Increase of transmitted power
- Identification of wider range power factor to operate with
- Identification micro weather conditions along the line

# STRONG FOUNDATIONS TO GROW



**Gabriel Pino**

CTO

M.SC. Electrical engineer



**Lacher Werner**

CEO

M.SC. Mechanical engineer



**Manuel Lemos**

CMO

M.SC. Civil engineer



**Martin Andrae**

CGO

M.SC. Electrical engineer



**Bruno Chagas**

Product Manager



**Fillipe Vasconcelos**

Power Systems Manager



**Matheus Cardoso**

IT Manager



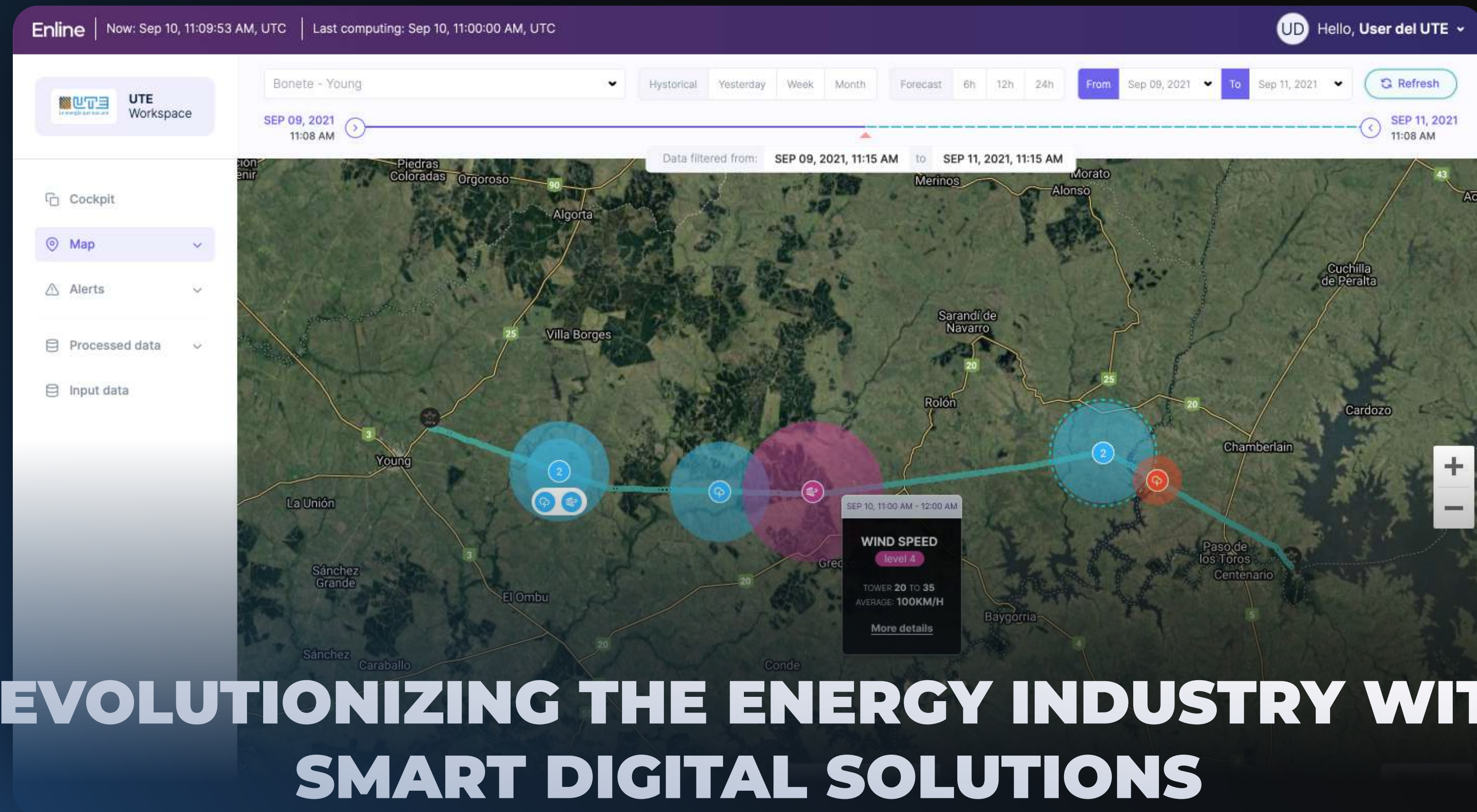
**Vladimir Mezzich**

Sales Manager

RECONOCIMIENTO  
DE BUENA REPUTACIÓN







# REVOLUTIONIZING THE ENERGY INDUSTRY WITH SMART DIGITAL SOLUTIONS

## Enline

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