RatedPower
A PART OF ENVERUS

Smart energy *flow*

May 2026

Redefining earthworks:

tracker-level grading for buildable PV plants

Your speaker today

Natalia Opie
Customer Success Lead

Currently leading a global team that supports customers in designing better solar projects with greater speed and confidence. She is an Energy Engineer specialized in renewable energy in electrical systems, and brings a strong mix of technical expertise, customer insight, and product knowledge to the intersection of engineering and software.

nopie@ratedpower.com

RatedPower
A PART OF ENVERUS

Index

01. Why Earthworks still break PV projects

Early-stage PV design often optimizes

- Installed Capacity
- DC/AC ratio
- Land usage
- Energy yield
- Electrical layout

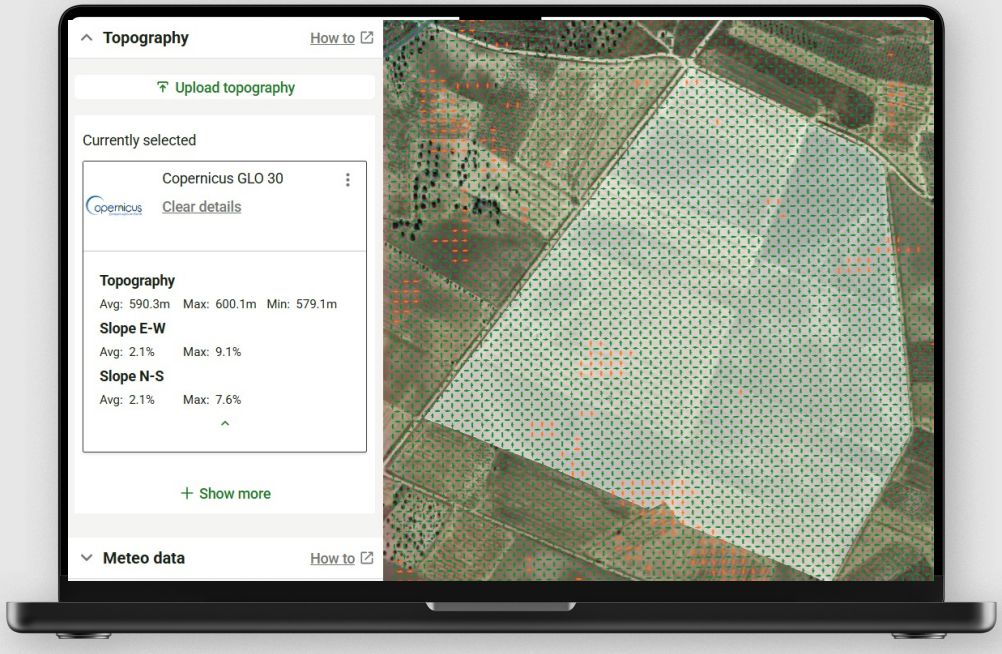
But terrain complexity impacts

- **Constructability**
- **CAPEX**
- **Structure choice**
- **Financial feasibility**
- **Schedule**

“Can we fit a PV plant on this site?”

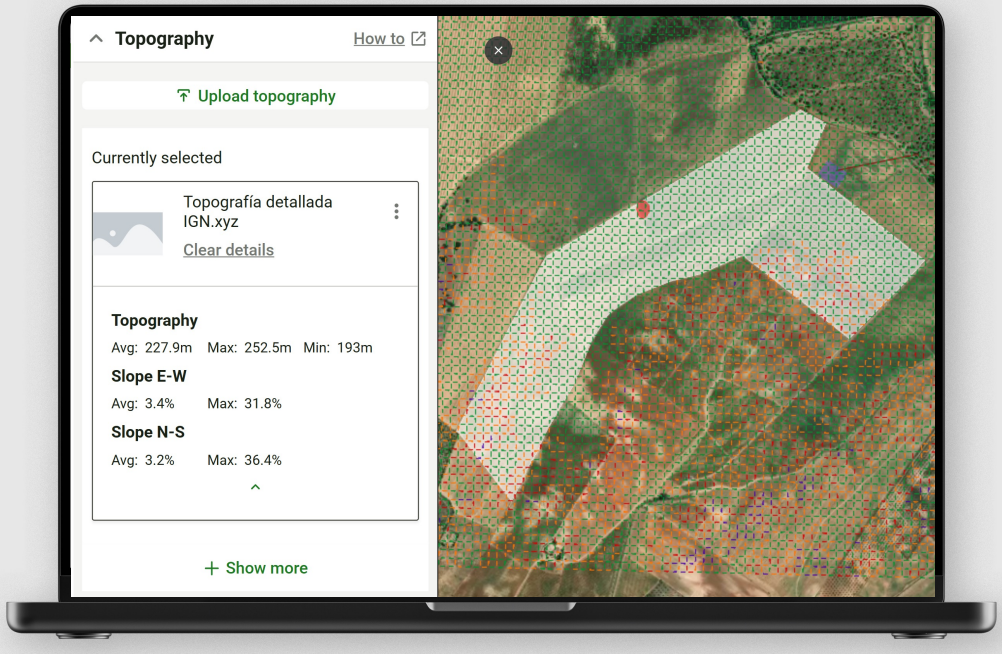
↓

“Can we build it realistically, economically, and at scale?”



Avg. slope: 2.1%

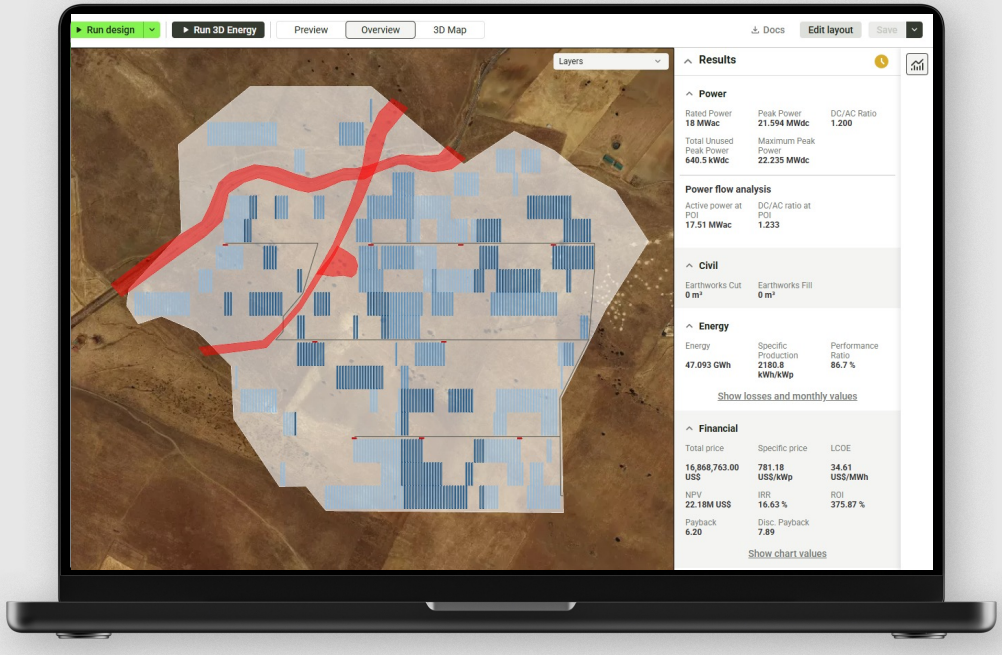
Max. slope: 9.1%



Avg. slope: 3.3%

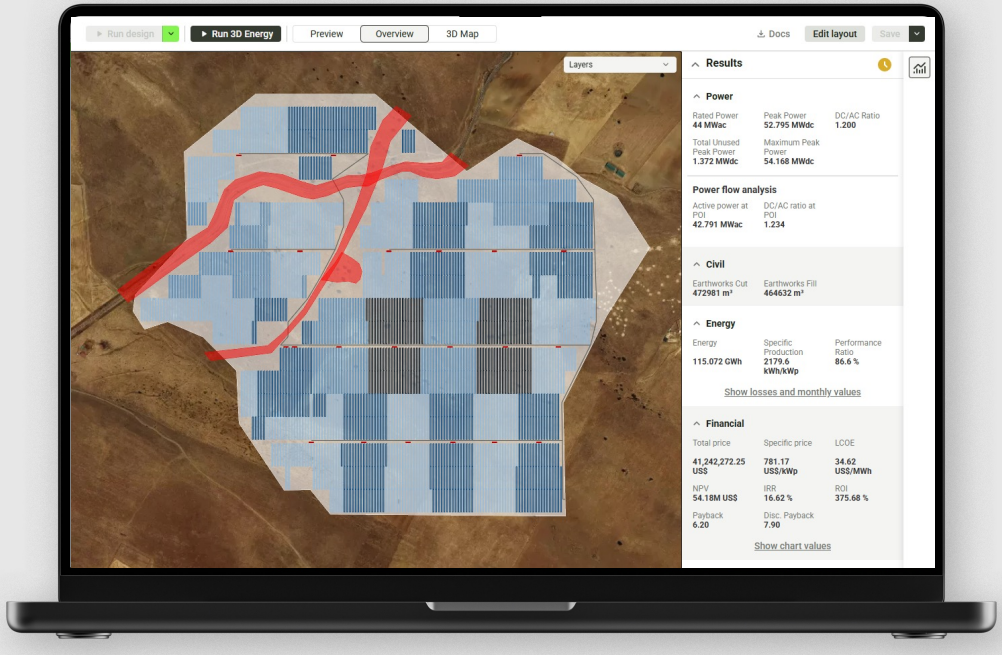
Max. slope: 36.4%

The hidden risk in PV feasibility



Peak power: 21.6 MWdc

Cut/Fill: 0 m^3



Peak power: 52.8 MWdc

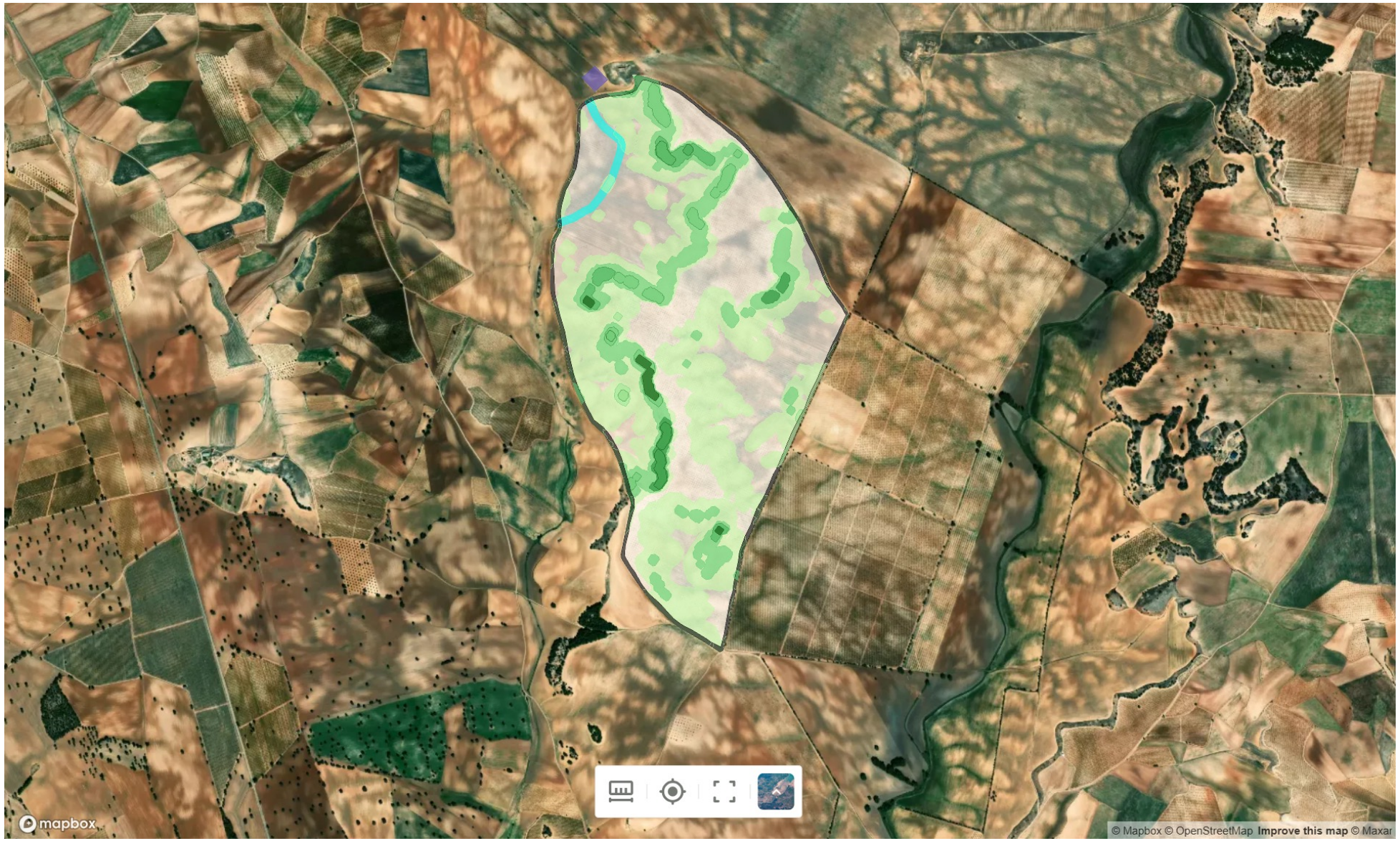
Cut/Fill: 473/474.6 km^3

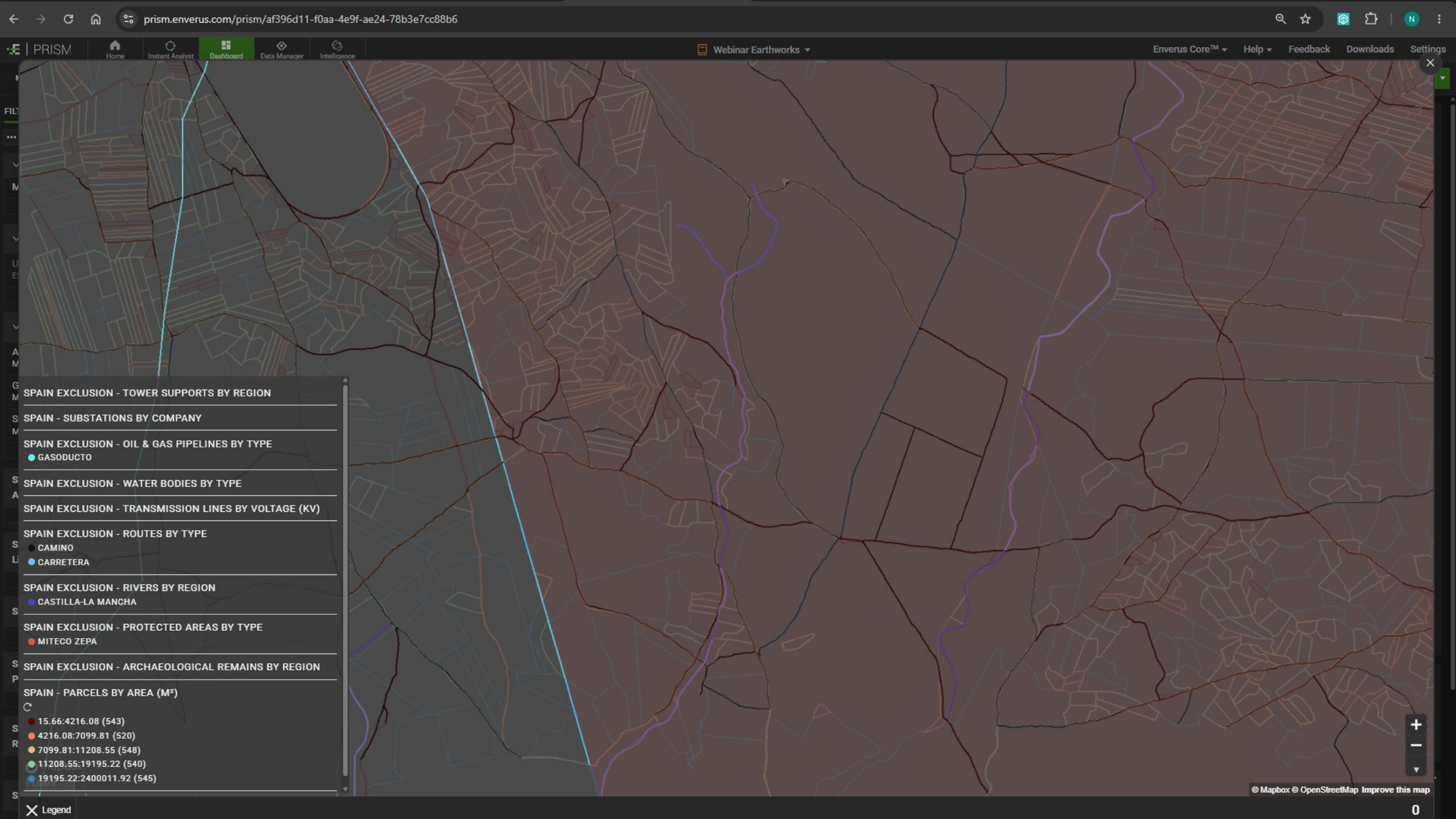
Earthworks is not just a cost output,
it is a design decision

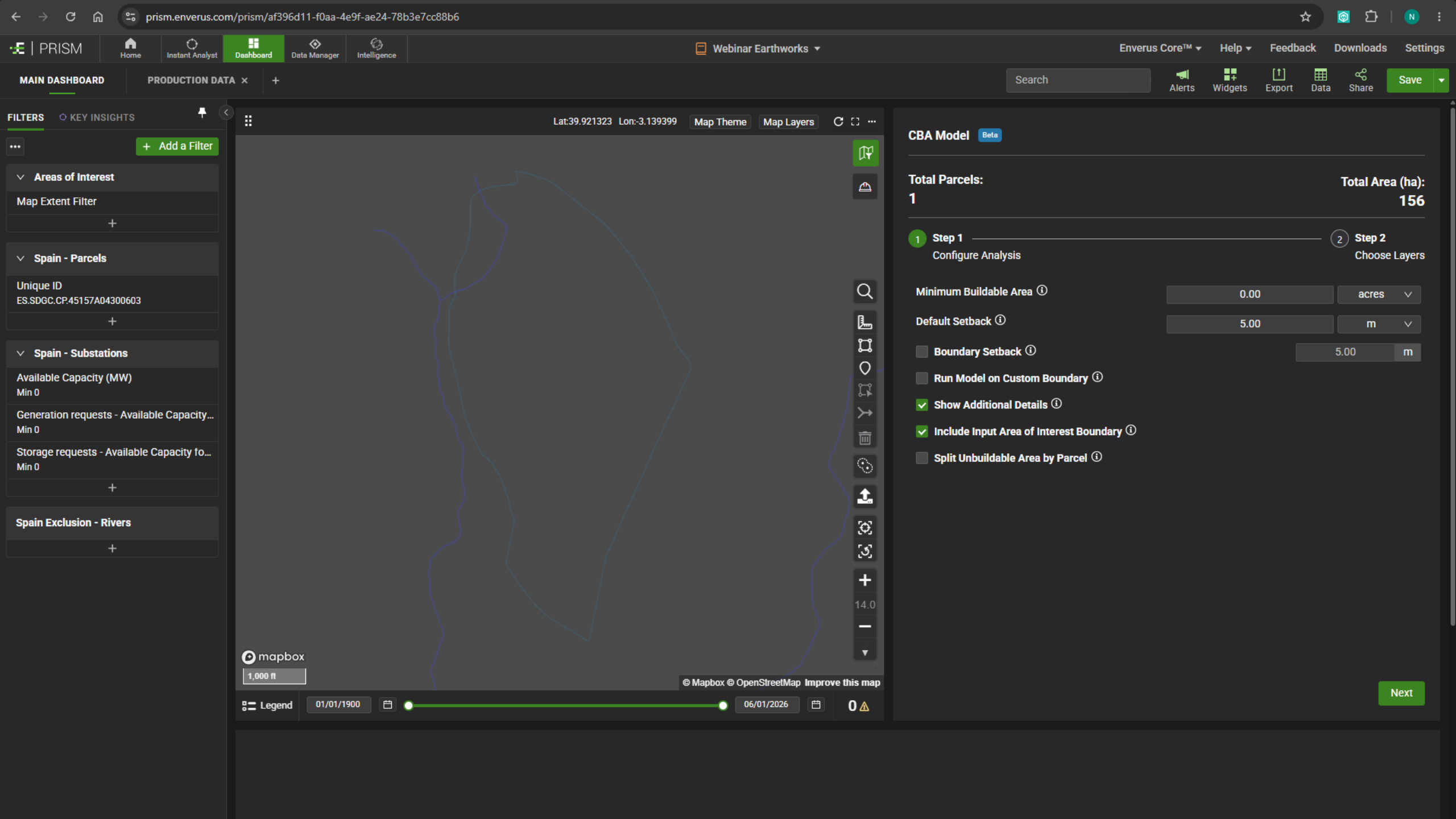
RatedPower
A PART OF ENVERUS

02. Simplified Grading Approaches

Terrain filtering




prism.enverus.com/prism/af396d11-f0aa-4e9f-ae24-78b3e7cc88b6
PRISM
Home
Instant Analyst
Dashboard
Data Manager
Intelligence
Webinar Earthworks
Enverus Core™
Help
Feedback
Downloads
Settings
SPAIN EXCLUSION - TOWER SUPPORTS BY REGION
SPAIN - SUBSTATIONS BY COMPANY
SPAIN EXCLUSION - OIL & GAS PIPELINES BY TYPE
GASODUCTO
SPAIN EXCLUSION - WATER BODIES BY TYPE
SPAIN EXCLUSION - TRANSMISSION LINES BY VOLTAGE (KV)
SPAIN EXCLUSION - ROUTES BY TYPE
CAMINO
CARRETERA
SPAIN EXCLUSION - RIVERS BY REGION
CASTILLA-LA MANCHA
SPAIN EXCLUSION - PROTECTED AREAS BY TYPE
MITECO ZEPA
SPAIN EXCLUSION - ARCHAEOLOGICAL REMAINS BY REGION
SPAIN - PARCELS BY AREA (M²)
15.66:4216.08 (543)
4216.08:7099.81 (520)
7099.81:11208.55 (548)
11208.55:19195.22 (540)
19195.22:2400011.92 (545)
© Mapbox © OpenStreetMap Improve this map
Legend
0


prism.enverus.com/prism/af396d11-f0aa-4e9f-ae24-78b3e7cc88b6
PRISM
Home
Instant Analyst
Dashboard
Data Manager
Intelligence
Webinar Earthworks
Enverus Core™
Help
Feedback
Downloads
Settings
MAIN DASHBOARD
PRODUCTION DATA
Search
Alerts
Widgets
Export
Data
Share
Save
FILTERS
KEY INSIGHTS
Add a Filter
Areas of Interest
Map Extent Filter
Spain - Parcels
Unique ID
ES.SDGC.CP.45157A04300603
Spain - Substations
Available Capacity (MW)
Min 0
Generation requests - Available Capacity...
Min 0
Storage requests - Available Capacity fo...
Min 0
Spain Exclusion - Rivers
Lat:39.921323 Lon:-3.139399
Map Theme
Map Layers
14.0
mapbox
1,000 ft
© Mapbox © OpenStreetMap Improve this map
Legend
01/01/1900
06/01/2026
0
CBA Model
Beta
Total Parcels:
1
Total Area (ha):
156
1 Step 1
Configure Analysis
2 Step 2
Choose Layers
Minimum Buildable Area
0.00
acres
Default Setback
5.00
m
Boundary Setback
5.00
m
Run Model on Custom Boundary
Show Additional Details
Include Input Area of Interest Boundary
Split Unbuildable Area by Parcel
Next

FILTERS | KEY INSIGHTS

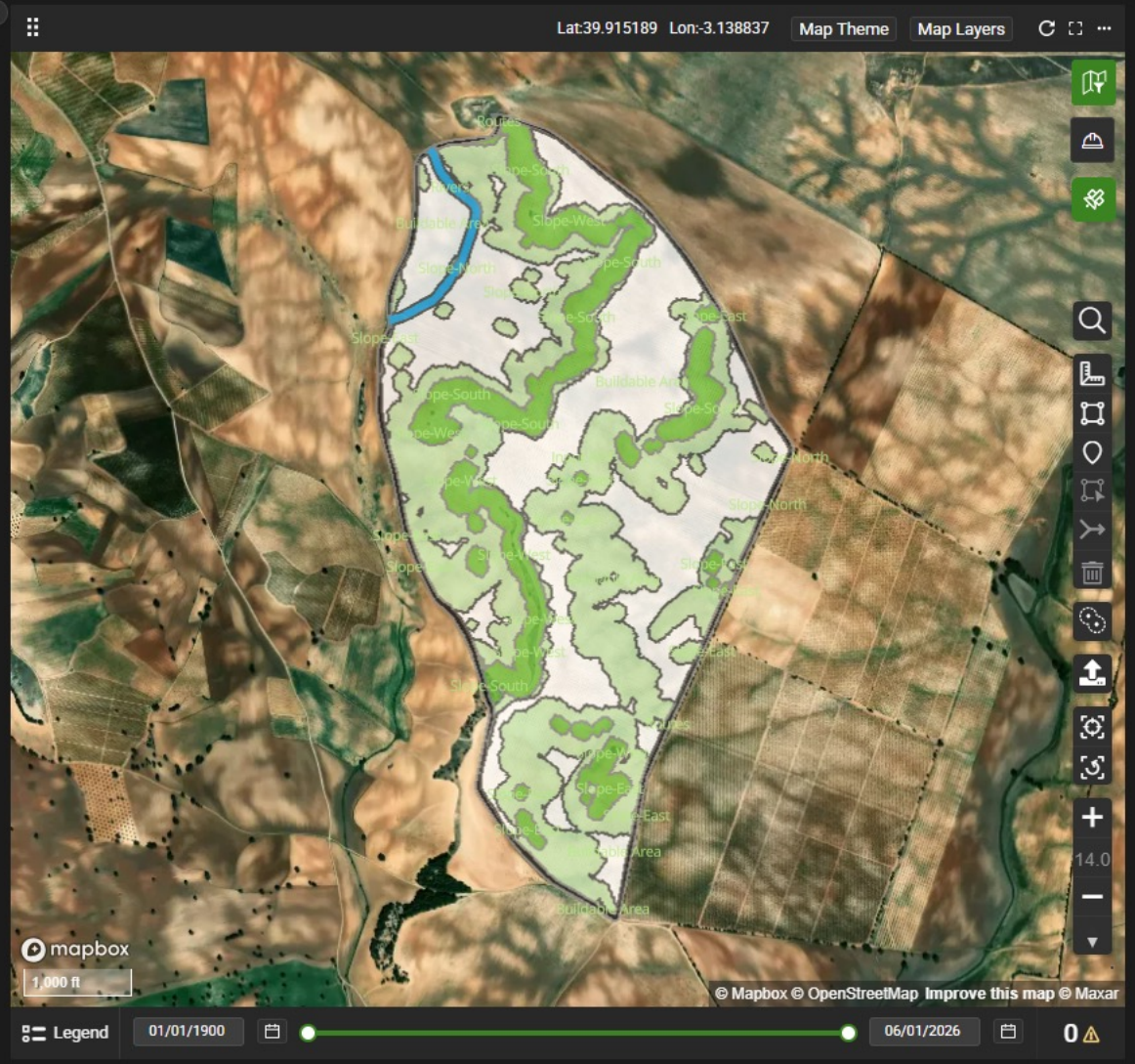
+ Add a Filter

Areas of Interest
Map Extent Filter

Spain - Parcels
Unique ID
ES.SDGC.CP.45157A04300603

Spain - Substations
Available Capacity (MW)
Min 0
Generation requests - Available Capacity...
Min 0
Storage requests - Available Capacity fo...
Min 0

Corral



CBA Model Beta

Total Parcels: 1

Total Area (ha): 156

Step 1 — Configure Analysis
2 Step 2 — Choose Layers

Environmental — Select All

Slope	20 %	5.00	m
By Aspect			
Biosphere Reserves		5.00	m
Protected Areas		5.00	m
Rivers		5.00	m
Water Bodies		5.00	m

Infrastructure — Select All

Archeological Remains	5.00	m
Pipelines	5.00	m
Routes	5.00	m
Support Towers	5.00	m
Transmission	5.00	m

Results Data Source
Corral Exclusions

Previous | Run Model

PRISM layers

PRISM preview

Region

Spain

Map layers Clear

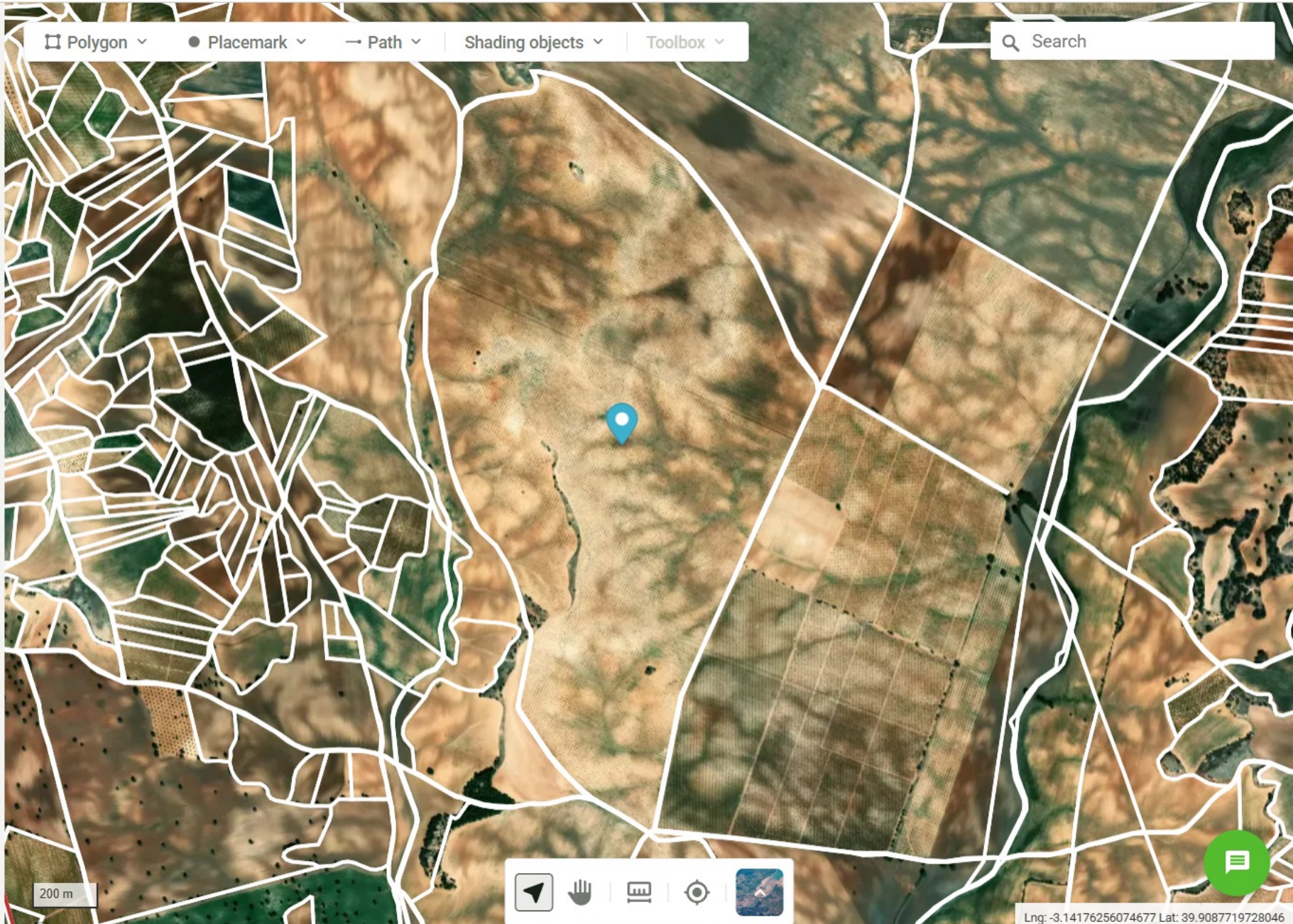
- Parcels

Exclusion layers

- Water bodies
- Protected areas

PRISM integration

Open shared CBA outputs



Advantages

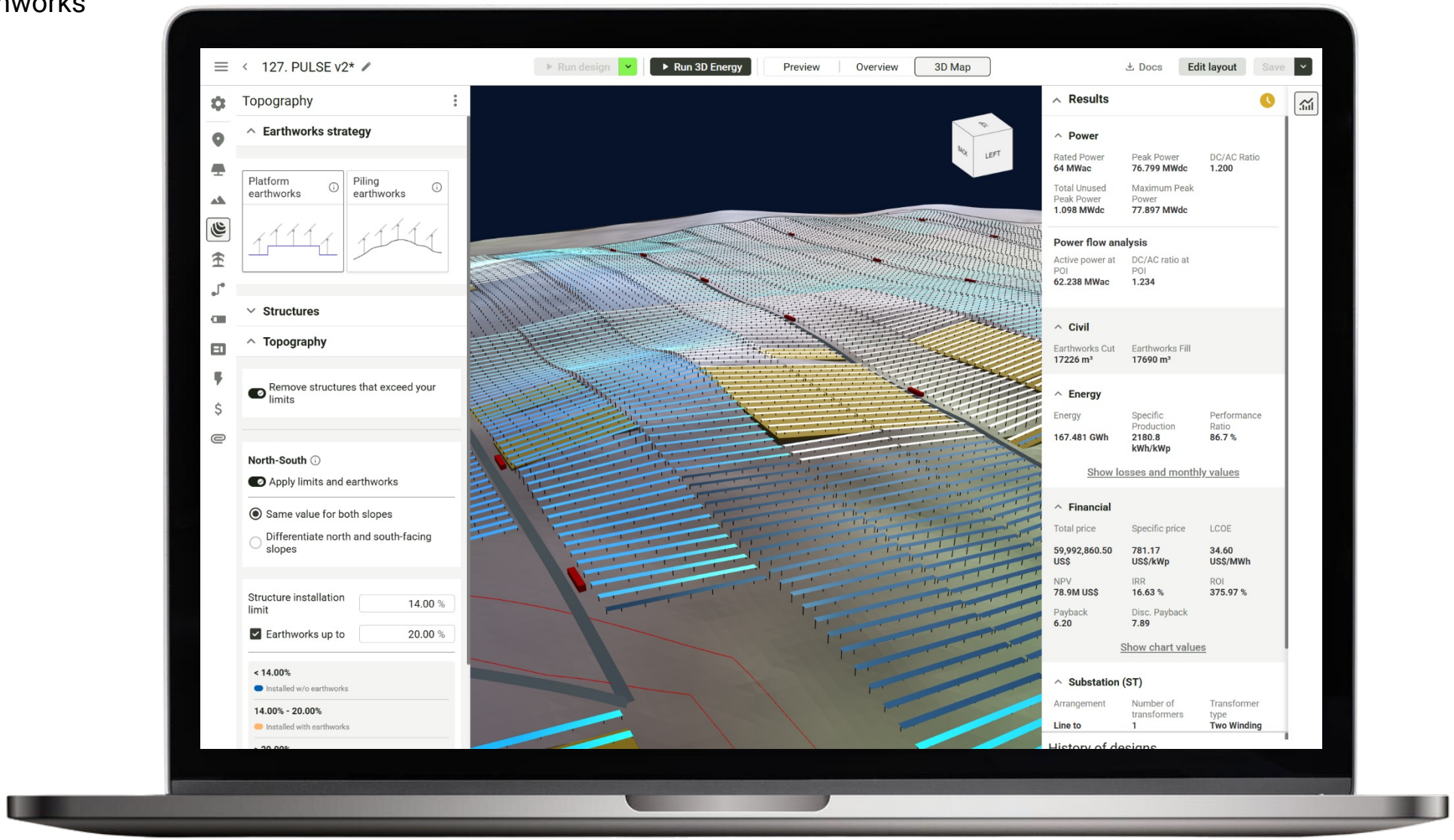
- Fast and simple screening methodology
- Effective for identifying clearly problematic terrain
- Useful during early-stage site selection

Limitations

- Terrain alone does not define constructability
- Potentially buildable areas may be discarded
- Local undulations are not fully understood
- Tracker adaptability is not evaluated directly

Filtering terrain before understanding structure behavior can lead to ***overly conservative decisions.***

Platform Earthworks



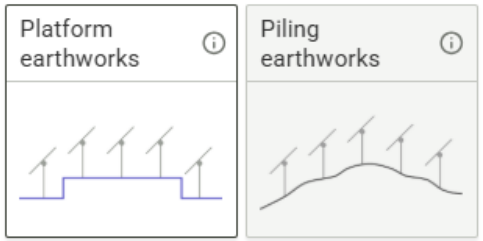
RatedPower
A PART OF ENVERUS

Platform Earthworks

Topography

Earthworks strategy

Platform earthworks | Piling earthworks



Structures

Mounting System

Ground clearance | Pile clearance

Minimum Ground Clearance	0.55 m
Pile length	3.5 m
	Min: 1.62 m
Pile clearance	1.617 m
Pile depth	1.883 m

Schematic diagram

Topography

Remove structures that exceed your limits

North-South

Apply limits and earthworks

- Same value for both slopes
- Differentiate north and south-facing slopes

North facing

Structure installation limit	5.00 %
Earthworks up to	20.00 %

< 5.00%
Installed w/o earthworks

5.00% - 20.00%
Installed with earthworks

> 20.00%
Exceeding the installation limit

South facing

Structure installation limit	15.00 %
Earthworks up to	20.00 %

East-West

Apply limits and earthworks

Structure installation limit	20.00 %
Earthworks up to	- %

< 20.00%
Installed w/o earthworks

> 20.00%
Rejected due to installation limit

Terrain undulation

Undulation tolerance and earthworks

Undulation tolerance	100 cm
Earthworks up to	200 cm

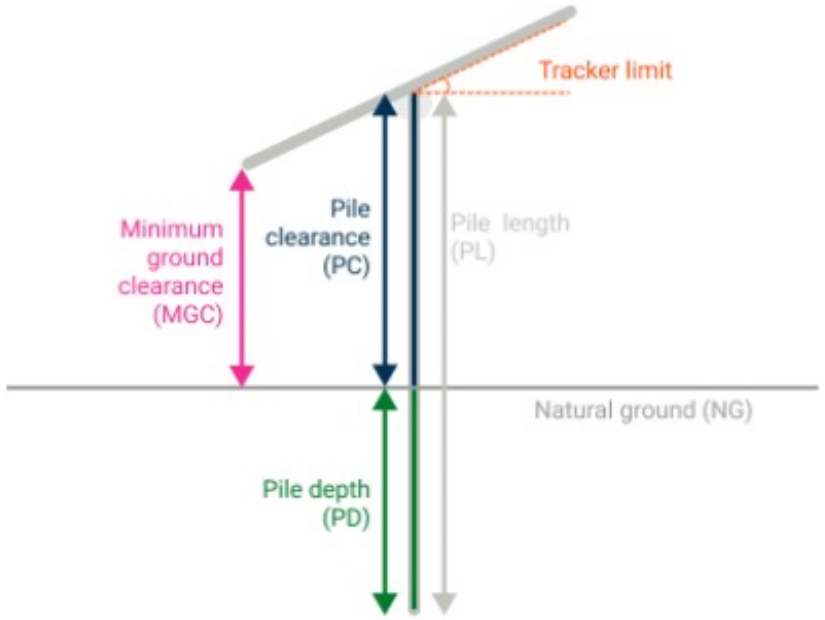
< 100cm
Installed w/o earthworks

100cm - 200cm
Installed with earthworks

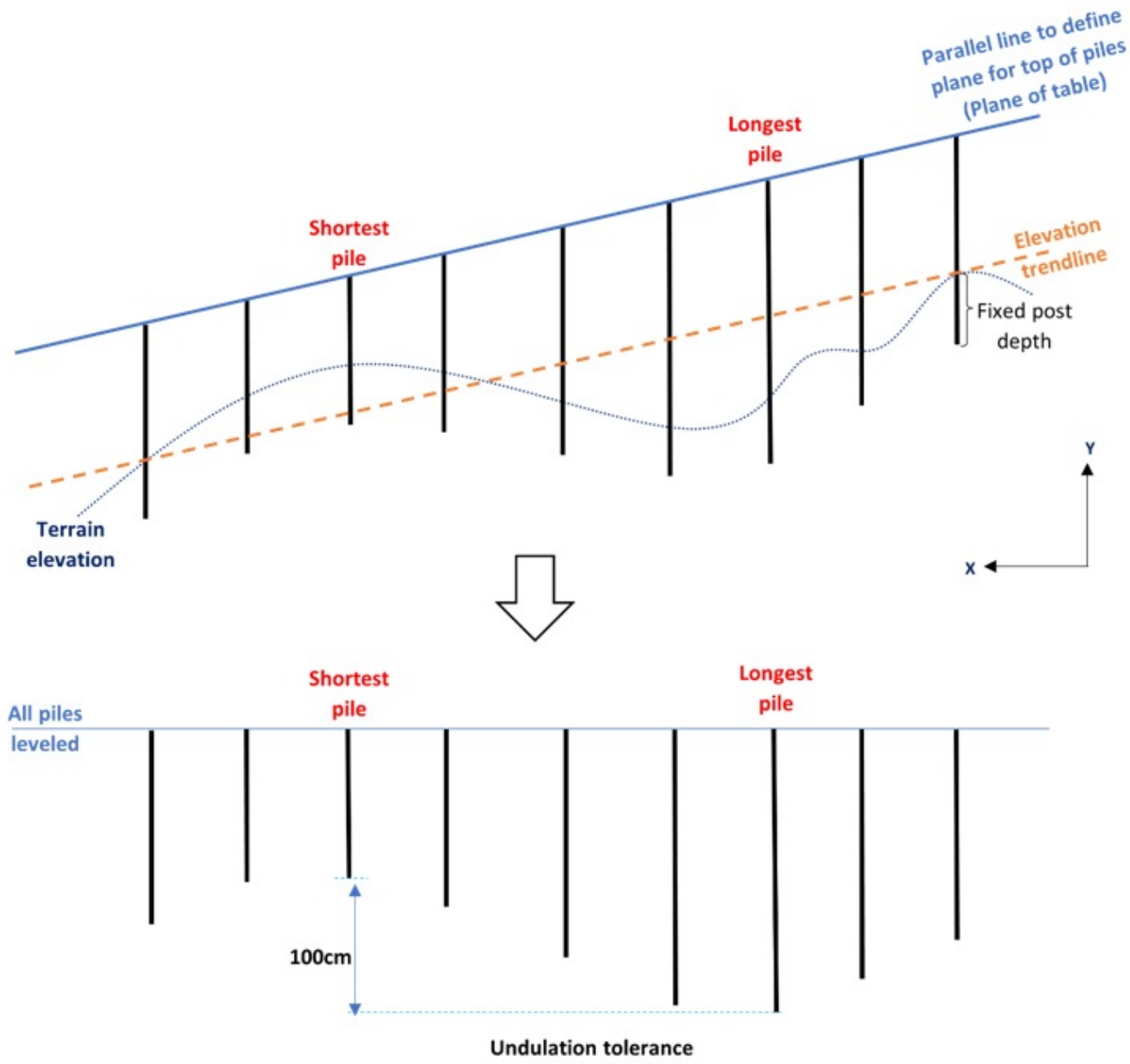
> 200cm
Exceeding the installation limit

RatedPower
A PART OF ENVERUS

Platform Earthworks



Platform Earthworks



Topography

15.00% - 20.00%
Installed with earthworks

> 20.00%
Exceeding the installation limit

East-West

Apply limits and earthworks

Structure installation limit: 20.00 %

Earthworks up to: - %

< 20.00%
Installed w/o earthworks

> 20.00%
Rejected due to installation limit

Terrain undulation

Undulation tolerance and earthworks

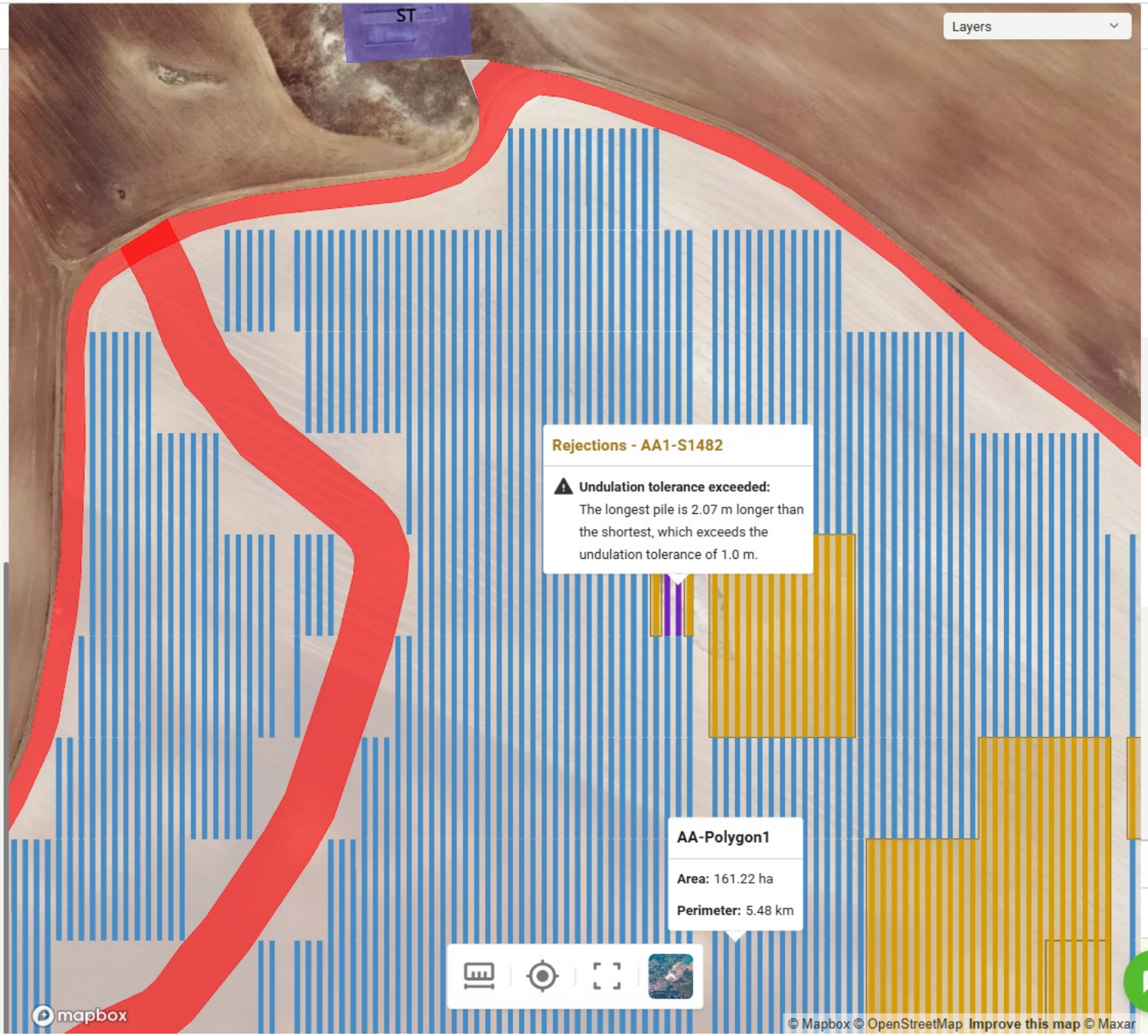
Undulation tolerance: 100 cm

Earthworks up to: 200 cm

< 100cm
Installed w/o earthworks

100cm - 200cm
Installed with earthworks

> 200cm
Exceeding the installation limit



Results

Power

Rated Power	Peak Power	DC/AC Ratio
97.02 MWac	117.588 MWdc	1.212

Total Unused Peak Power	Maximum Peak Power
0 Wdc	117.588 MWdc

Power flow analysis

Active power at POI	DC/AC ratio at POI
94.71 MWac	1.242

Civil

Earthworks Cut	Earthworks Fill
48964 m³	46580 m³

Energy

Energy	Specific Production	Performance Ratio
246.383 GWh	2095.3 kWh/kWp	87.2 %

Show losses and monthly values

Financial

Total price	Specific price	LCOE
96,673,017.06 US$	822.13 US$/kWp	37.48 US$/MWh

NPV	IRR	ROI
107.5M US$	15.13 %	334.57 %

Payback	Disc. Payback
6.78	8.82

History of designs

Select all

16. Platform Earthworks *

Notes

Topography

15.00% - 20.00%
Installed with earthworks

> 20.00%
Exceeding the installation limit

East-West

Apply limits and earthworks

Structure installation limit: 20.00 %

Earthworks up to: - %

< 20.00%
Installed w/o earthworks

> 20.00%
Rejected due to installation limit

Terrain undulation

Undulation tolerance and earthworks

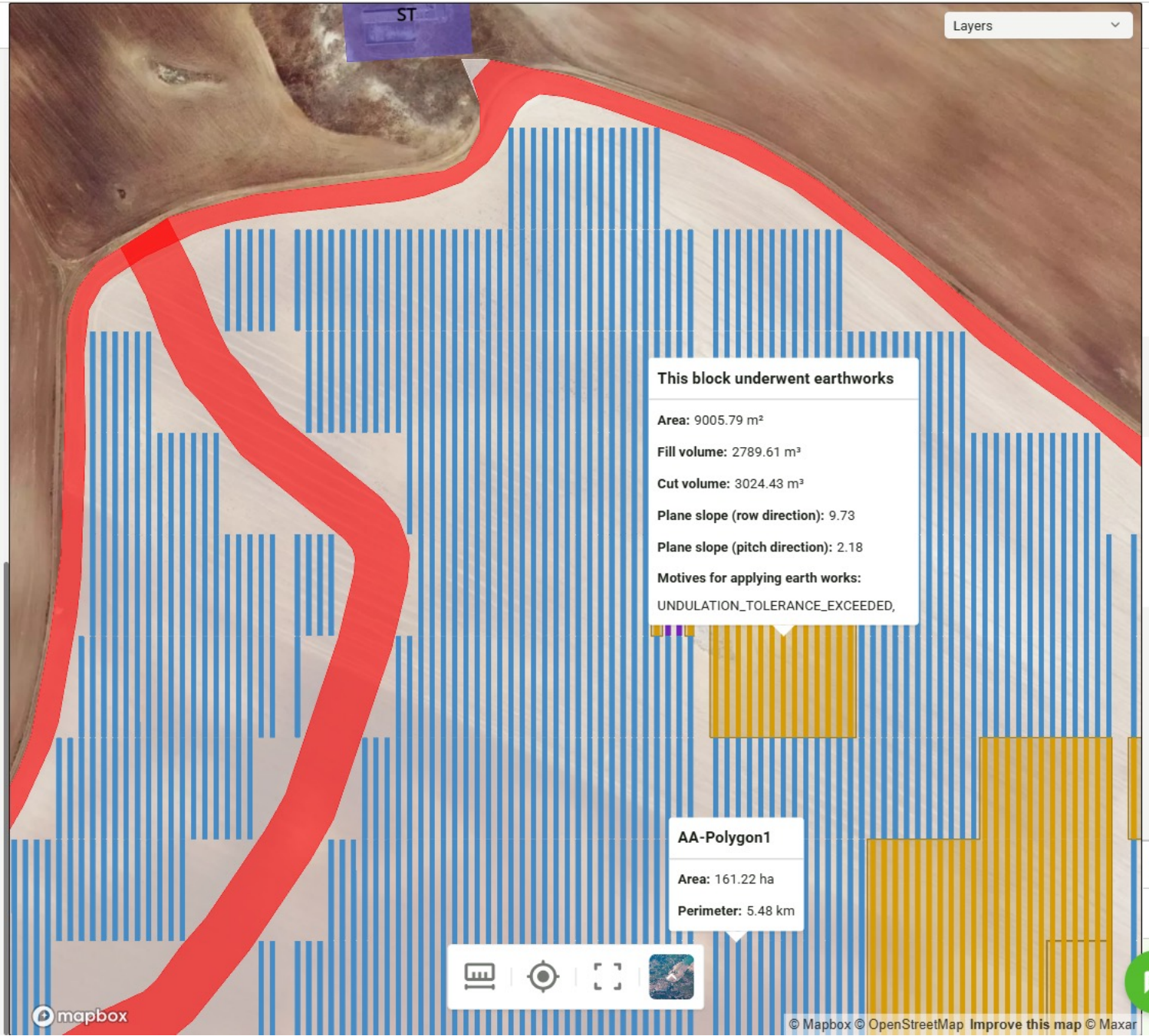
Undulation tolerance: 100 cm

Earthworks up to: 200 cm

< 100cm
Installed w/o earthworks

100cm - 200cm
Installed with earthworks

> 200cm
Exceeding the installation limit



Results

Power

Rated Power	Peak Power	DC/AC Ratio
97.02 MWac	117.588 MWdc	1.212

Total Unused Peak Power	Maximum Peak Power
0 Wdc	117.588 MWdc

Power flow analysis

Active power at POI	DC/AC ratio at POI
94.71 MWac	1.242

Civil

Earthworks Cut	Earthworks Fill
48964 m³	46580 m³

Energy

Energy	Specific Production	Performance Ratio
246.383 GWh	2095.3 kWh/kWp	87.2 %

Show losses and monthly values

Financial

Total price	Specific price	LCOE
96,673,017.06 US$	822.13 US$/kWp	37.48 US$/MWh

NPV	IRR	ROI
107.5M US$	15.13 %	334.57 %

Payback	Disc. Payback
6.78	8.82

History of designs

Select all

16. Platform Earthworks *

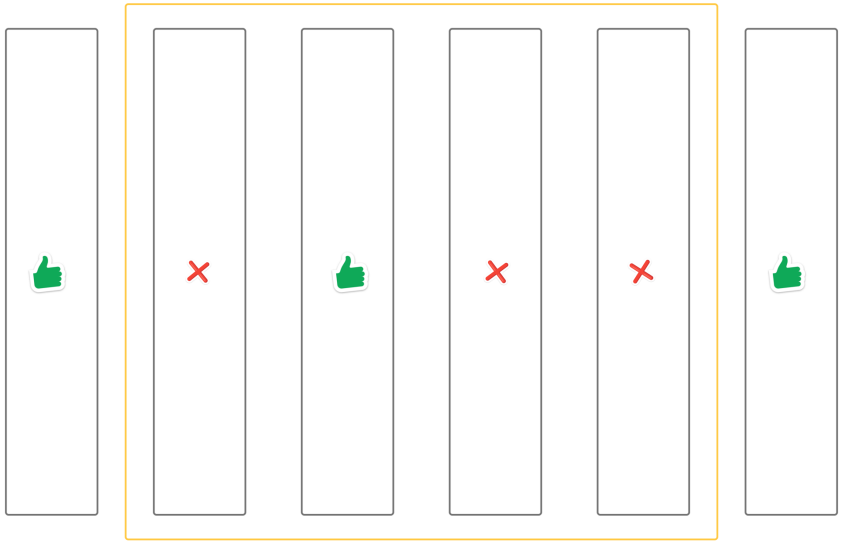
Notes

Advantages

- Effective for filtering out problematic structures
- Rough cut and fill estimates
- Rough extra steel estimates
- Platforms respect the pitch direction slope limit

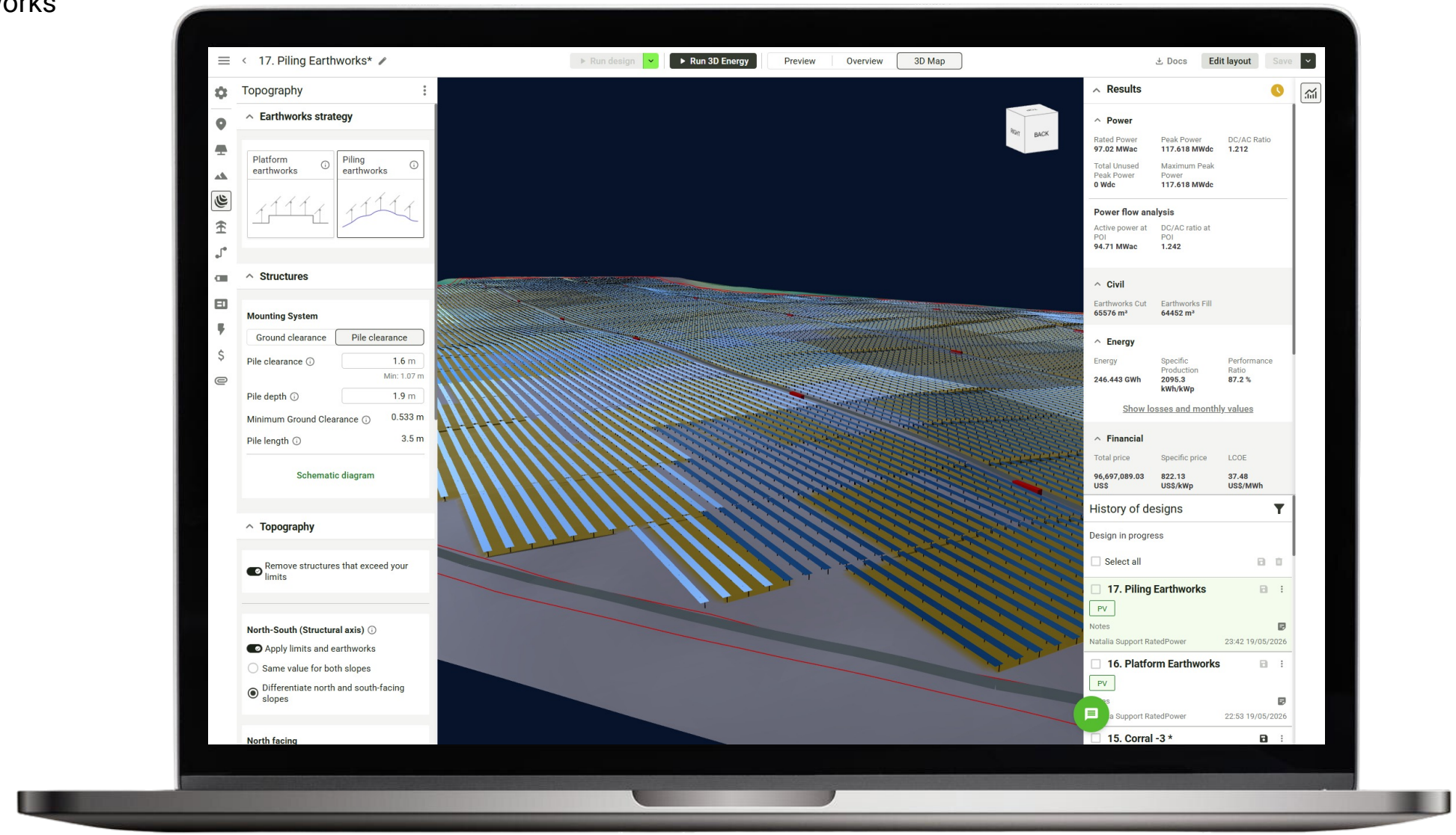
Limitations

- Creates steps between platforms and surrounding terrain
- Calculates many different piles lengths
- Not aligned with real engineering practice



03. Tracker-Level Grading

Piling Earthworks

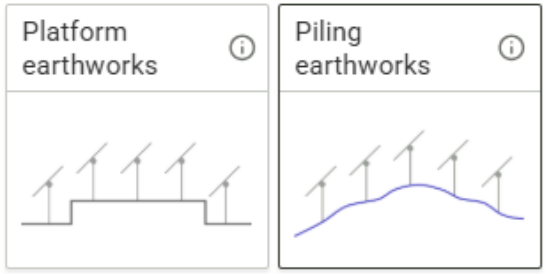


RatedPower
A PART OF ENVERUS

Piling Earthworks

Topography

Earthworks strategy



Structures

Mounting System

Ground clearance | Pile clearance

Pile clearance: 1.6 m
Min: 1.07 m

Pile depth: 1.9 m

Minimum Ground Clearance: 0.533 m

Pile length: 3.5 m

Schematic diagram

Topography

Remove structures that exceed your limits

North-South (Structural axis)

- Apply limits and earthworks
- Same value for both slopes
- Differentiate north and south-facing slopes

North facing

Structure installation limit: 5.00 %

Earthworks up to: 20.00 %

< 5.00%
- Installed w/o earthworks
- Installed with earthworks due to pile limits

5.00% - 20.00%
- Installed with earthworks

> 20.00%
- Exceeding the installation limit

South facing

Structure installation limit: 15.00 %

Earthworks up to: 20.00 %

< 15.00%
- Installed w/o earthworks
- Installed with earthworks due to pile limits

15.00% - 20.00%
- Installed with earthworks

> 20.00%
- Exceeding the installation limit

East-West

Apply limits

Target installation limit: 20.00 %

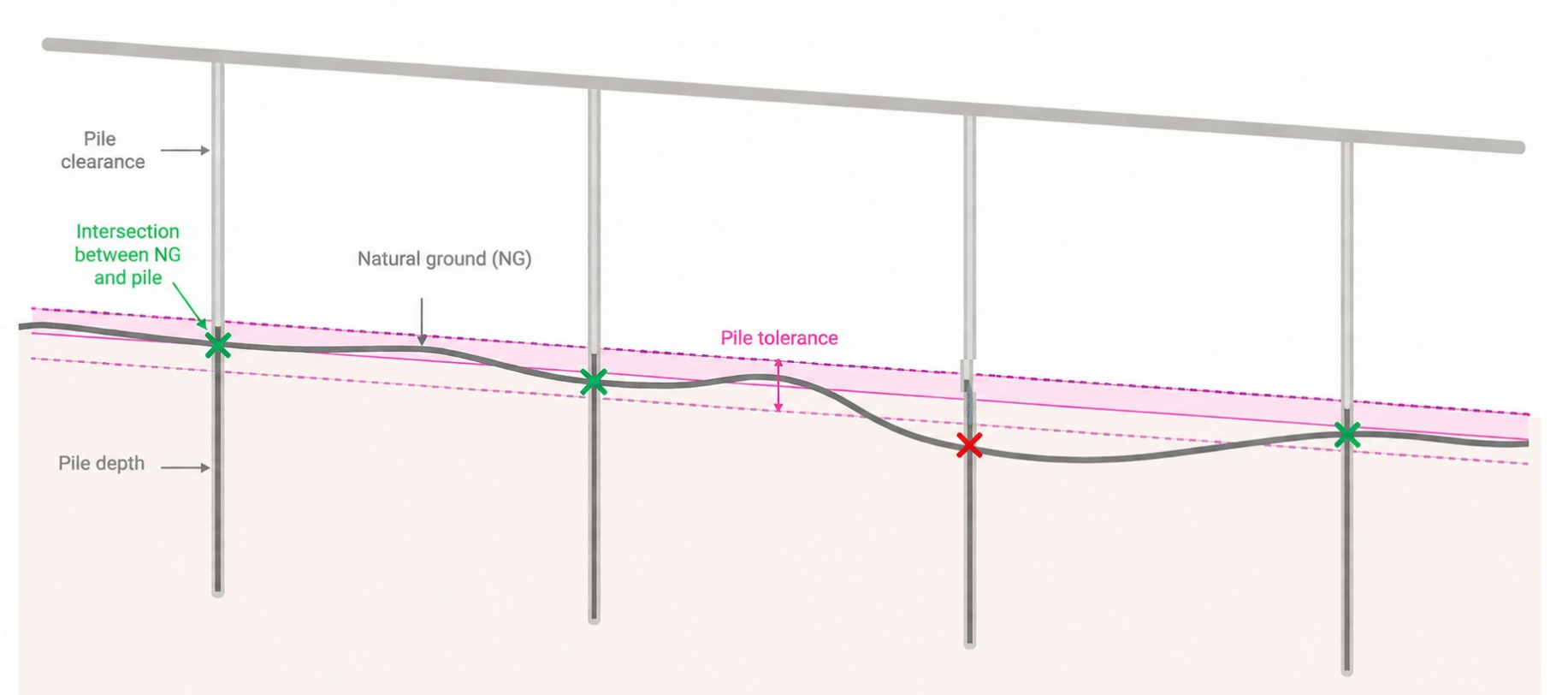
Pile tolerance

Cut/fill tolerance: 20 cm

Schematic diagram

RatedPower
A PART OF ENVERUS

Piling Earthworks



Topography

North facing

Structure installation limit: 5.00 %

Earthworks up to: 20.00 %

< 5.00%
- Installed w/o earthworks
- Installed with earthworks due to pile limits

5.00% - 20.00%
- Installed with earthworks

> 20.00%
- Exceeding the installation limit

South facing

Structure installation limit: 15.00 %

Earthworks up to: 20.00 %

< 15.00%
- Installed w/o earthworks
- Installed with earthworks due to pile limits

15.00% - 20.00%
- Installed with earthworks

> 20.00%
- Exceeding the installation limit

East-West

Apply limits

Target installation limit: 20.00 %

Pile tolerance

Cut/fill tolerance: 20 cm

Results

Power

Rated Power	Peak Power	DC/AC Ratio
97.02 MWac	117.618 MWdc	1.212

Total Unused Peak Power	Maximum Peak Power
0 Wdc	117.618 MWdc

Power flow analysis

Active power at POI	DC/AC ratio at POI
94.71 MWac	1.242

Civil

Earthworks Cut	Earthworks Fill
65576 m³	64452 m³

Energy

Energy	Specific Production	Performance Ratio
246.443 GWh	2095.3 kWh/kWp	87.2 %

Show losses and monthly values

Financial

Total price	Specific price	LCOE
96,697,089.03 US$	822.13 US$/kWp	37.48 US$/MWh

NPV	IRR	ROI
107.5M US$	15.13 %	334.58 %

Payback	Disc. Payback
6.78	8.82

Show chart values

Substation (ST)

Arrangement	Number of transformers	Transformer type
Single Busbar	2	Two Winding

Transformer's maximum capacity: 55 MW

History of designs

Topography

North facing

Structure installation limit: 5.00 %

Earthworks up to: 20.00 %

< 5.00%
- Installed w/o earthworks
- Installed with earthworks due to pile limits

5.00% - 20.00%
- Installed with earthworks

> 20.00%
- Exceeding the installation limit

South facing

Structure installation limit: 15.00 %

Earthworks up to: 20.00 %

< 15.00%
- Installed w/o earthworks
- Installed with earthworks due to pile limits

15.00% - 20.00%
- Installed with earthworks

> 20.00%
- Exceeding the installation limit

East-West

Apply limits

Target installation limit: 20.00 %

Pile tolerance

Cut/fill tolerance: 20 cm

Results

Power

Rated Power	Peak Power	DC/AC Ratio
97.02 MWac	117.618 MWdc	1.212

Total Unused Peak Power	Maximum Peak Power
0 Wdc	117.618 MWdc

Power flow analysis

Active power at POI	DC/AC ratio at POI
94.71 MWac	1.242

Civil

Earthworks Cut	Earthworks Fill
65576 m³	64452 m³

Energy

Energy	Specific Production	Performance Ratio
246.443 GWh	2095.3 kWh/kWp	87.2 %

Show losses and monthly values

Financial

Total price	Specific price	LCOE
96,697,089.03 US$	822.13 US$/kWp	37.48 US$/MWh

NPV	IRR	ROI
107.5M US$	15.13 %	334.58 %

Payback	Disc. Payback
6.78	8.82

Show chart values

Substation (ST)

Arrangement	Number of transformers	Transformer type
Single Busbar	2	Two Winding

Transformer's maximum capacity: 55 MW

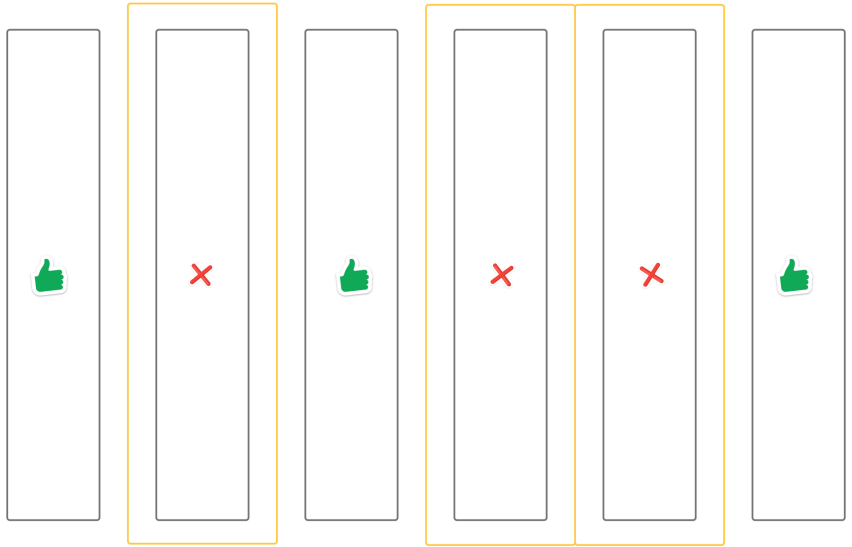
History of designs

Advantages

- Based on real engineering logic
- More reliable cut and fill volumes
- More realistic layouts
- Better constructability

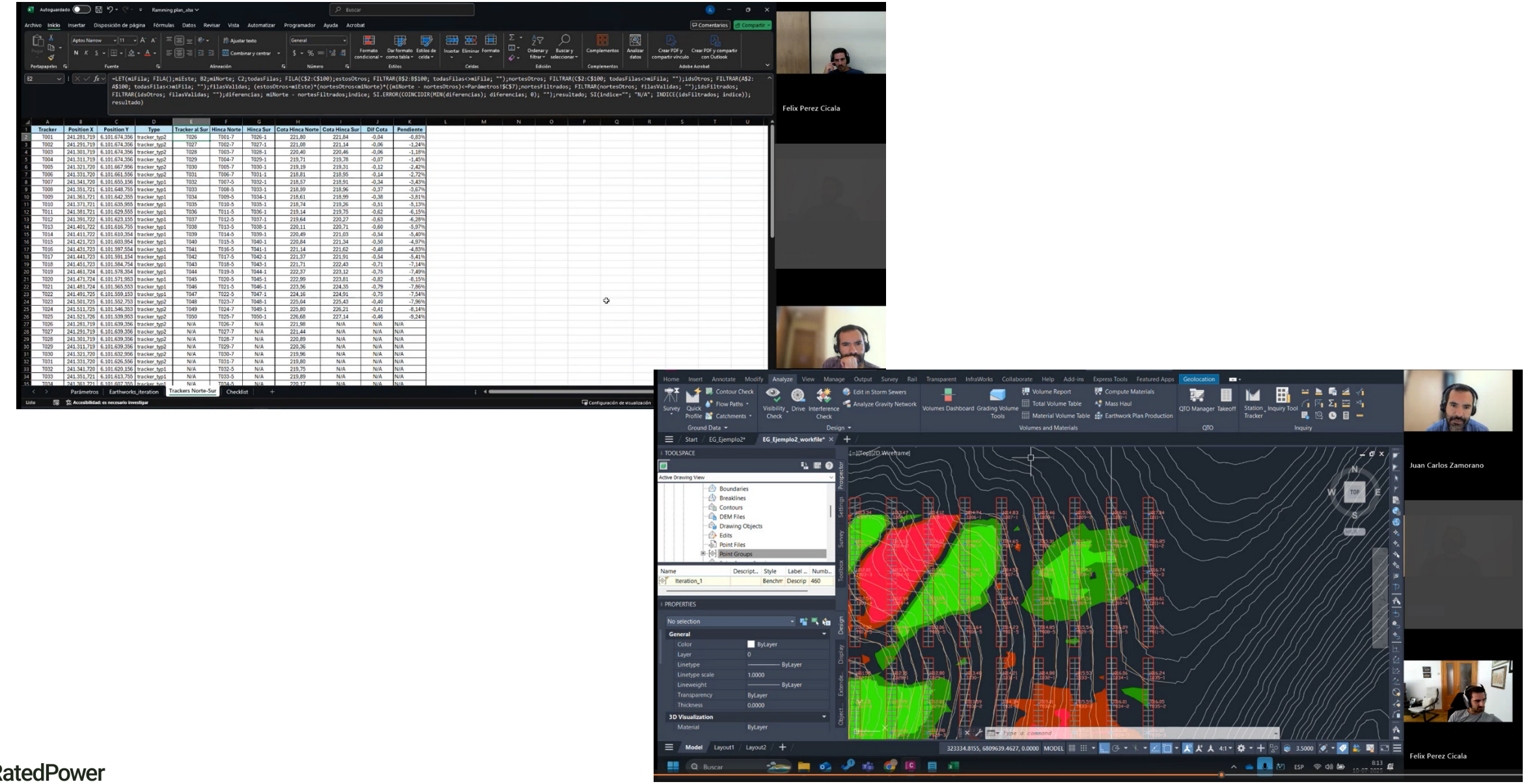
Limitations

- No option to filter out structures exceeding the pile tolerance
- No pitch direction earthworks
- Not ready-to-build



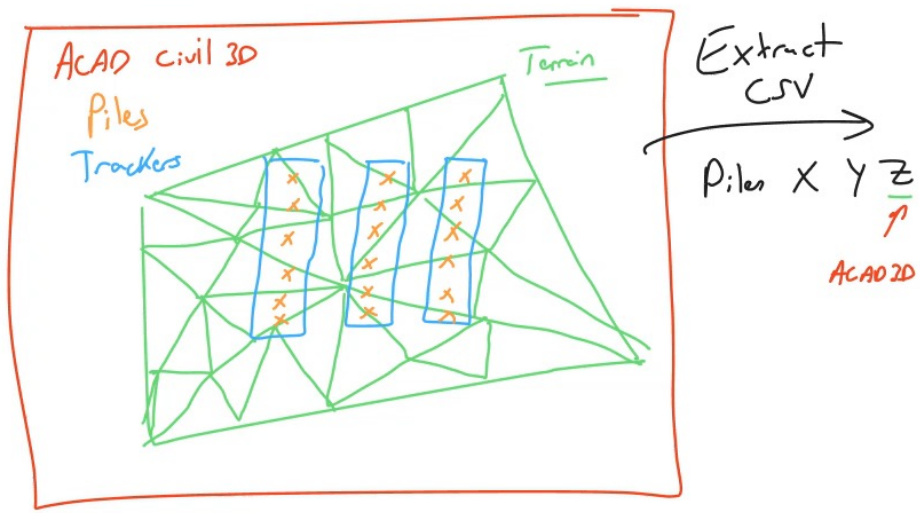
04. How the Piling Earthworks Engine Works

How the Piling Earthworks Engine Works



RatedPower
A PART OF ENVERUS

Proceso Manual



Extract CSV

Piles X Y Z

ACAD 2D

Excel

Step 1

Calculated with excel formula

Str	Pile	X	Y	Z	Slope (Axial)
1		–	–	10	1st
		–	–	11	
		–	–	12	
		–	–	11	
		–	–	11	
		–	–	10	Last
2		–	–	7	
		–	–	7	
		–	–	6	
		–	–	7	
		–	–	9	

13%

5%

Too High → Modify piles

Step 2: Correction

How the Piling Earthworks Engine Works

Inputs

RatedPower 2D Layout

3D Terrain Model

Constraints

Filtering

Find non-compliant structures.

Discard structures exceeding earthworks limits.

Grading

Slope rectification per structure

If the slope limit is surpassed, the new slope is the slope limit.

Cut and fill volumes are balanced by elevating or sinking the modified terrain versus the original.

Pile tolerance

If the slope limit is respected but the pile tolerance isn't, the structure is subject to earthworks.

Outputs

New terrain*

Contour lines

Cut-and-fill

Heat maps

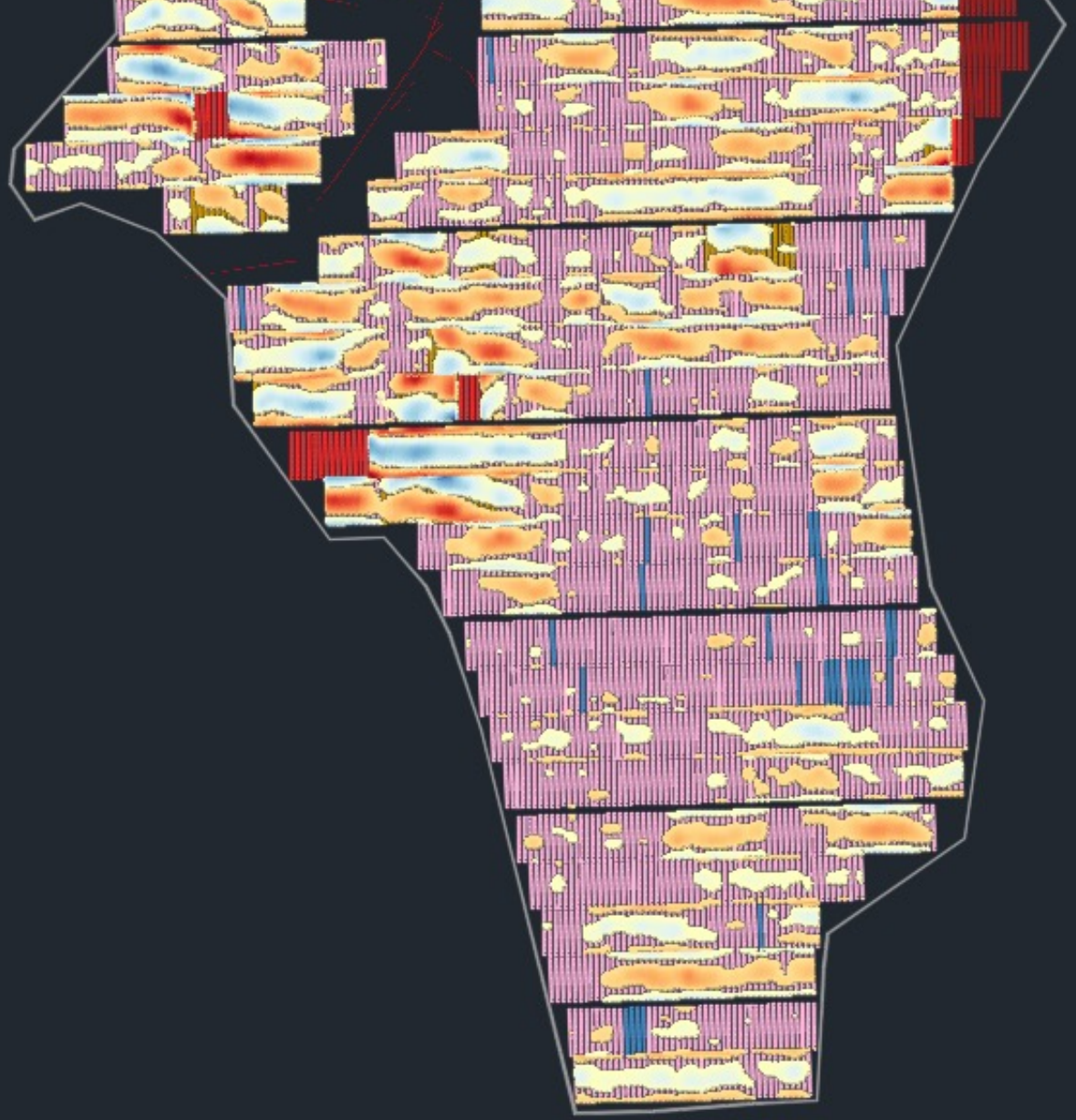
3D layout

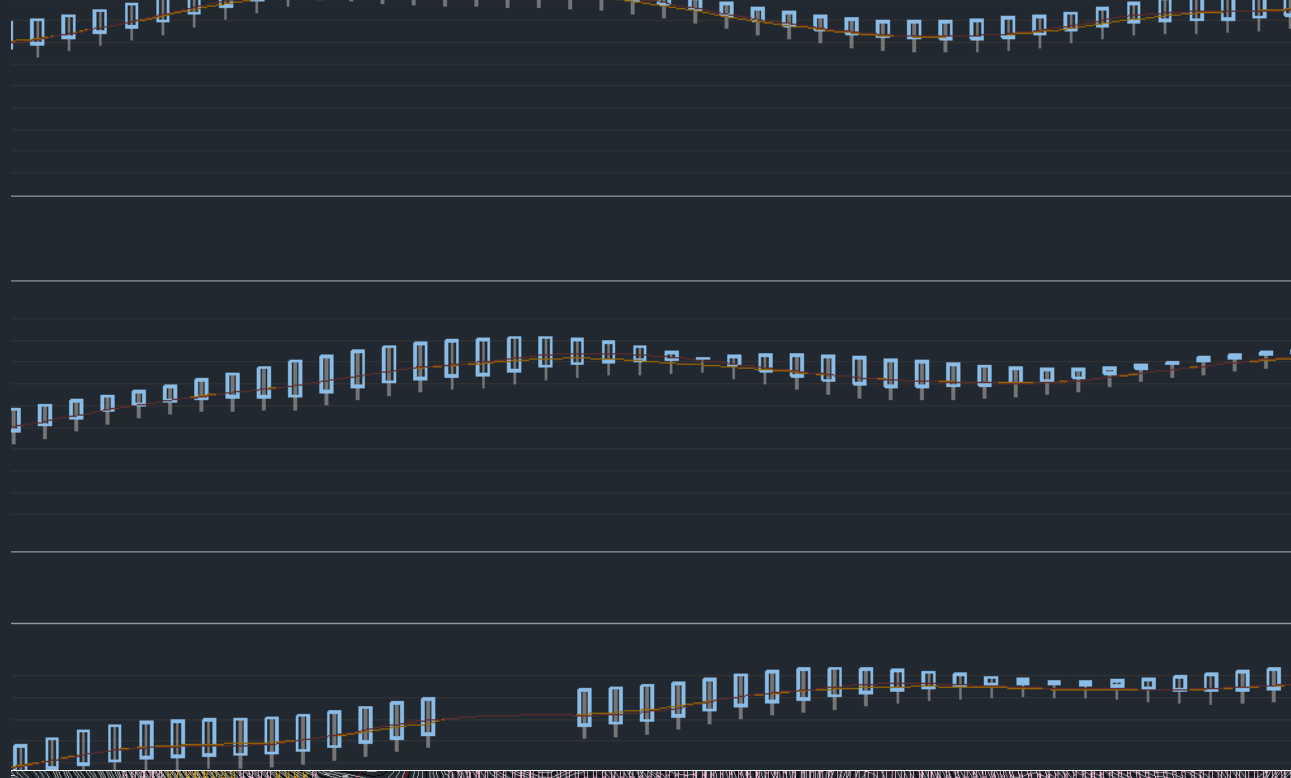
Cross-sections

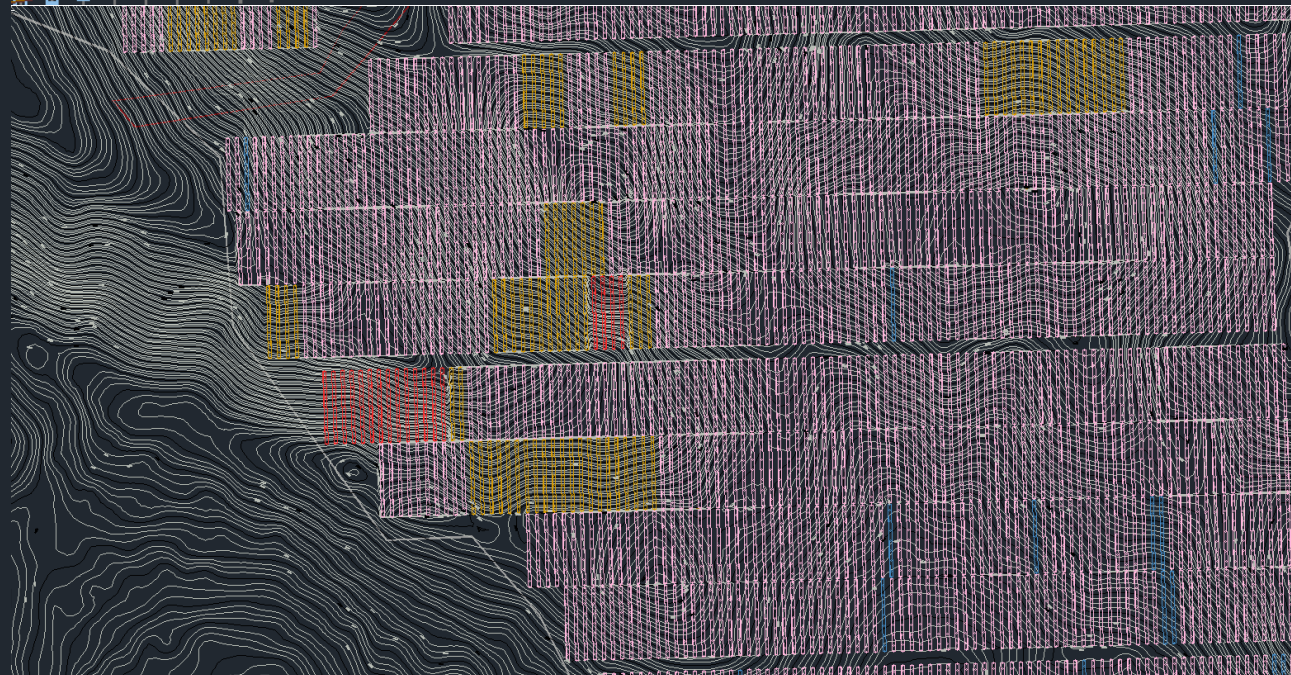
Longitudinal sections

*The terrain output is rebuilt using the mesh created from the z-values under each pile.

05. Practical Impact on PV Development







Earthworks height [cm]


More confidence from day one
RatedPower
A PART OF ENVERUS

RatedPower
A PART OF ENVERUS

Smart energy *flow*

May 2026

06. RatedPower Future Evolution

RatedPower Earthworks Improvments

- Smoother transitions between modified and natural terrain.
- Limit elevation differences between adjacent structures
- Custom cut-and-fill balance
- Earthworks for roads
- Earthworks for terrain-following trackers

Thank you!

RatedPower
A PART OF ENVERUS

Questions?

We're all ears! Drop yours in the question box!

Natalia Opie

nopie@ratedpower.com

ratedpower.com
Instagram: @rated_power
Linkedin: /ratedpower

RatedPower
A PART OF ENVERUS