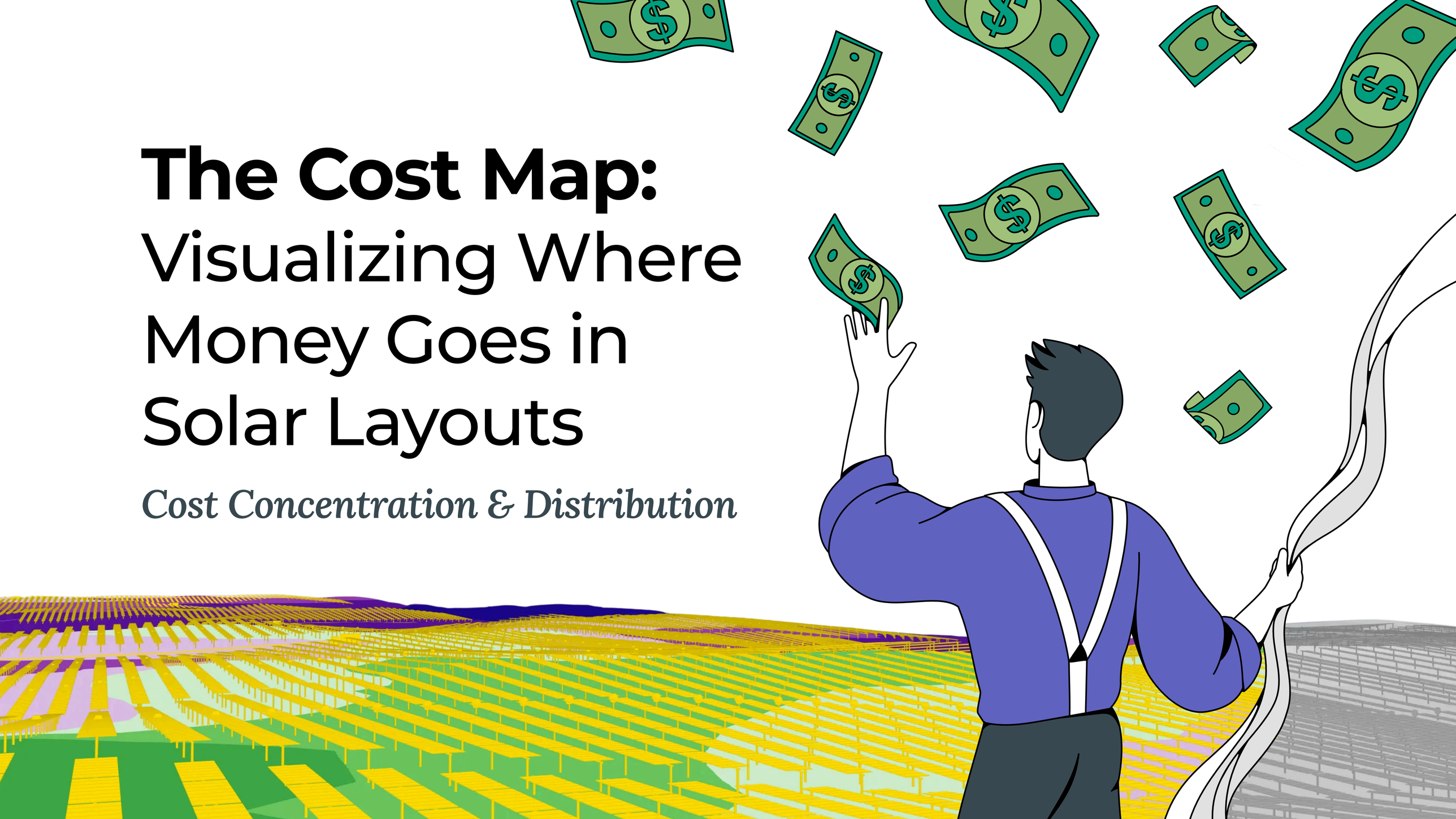
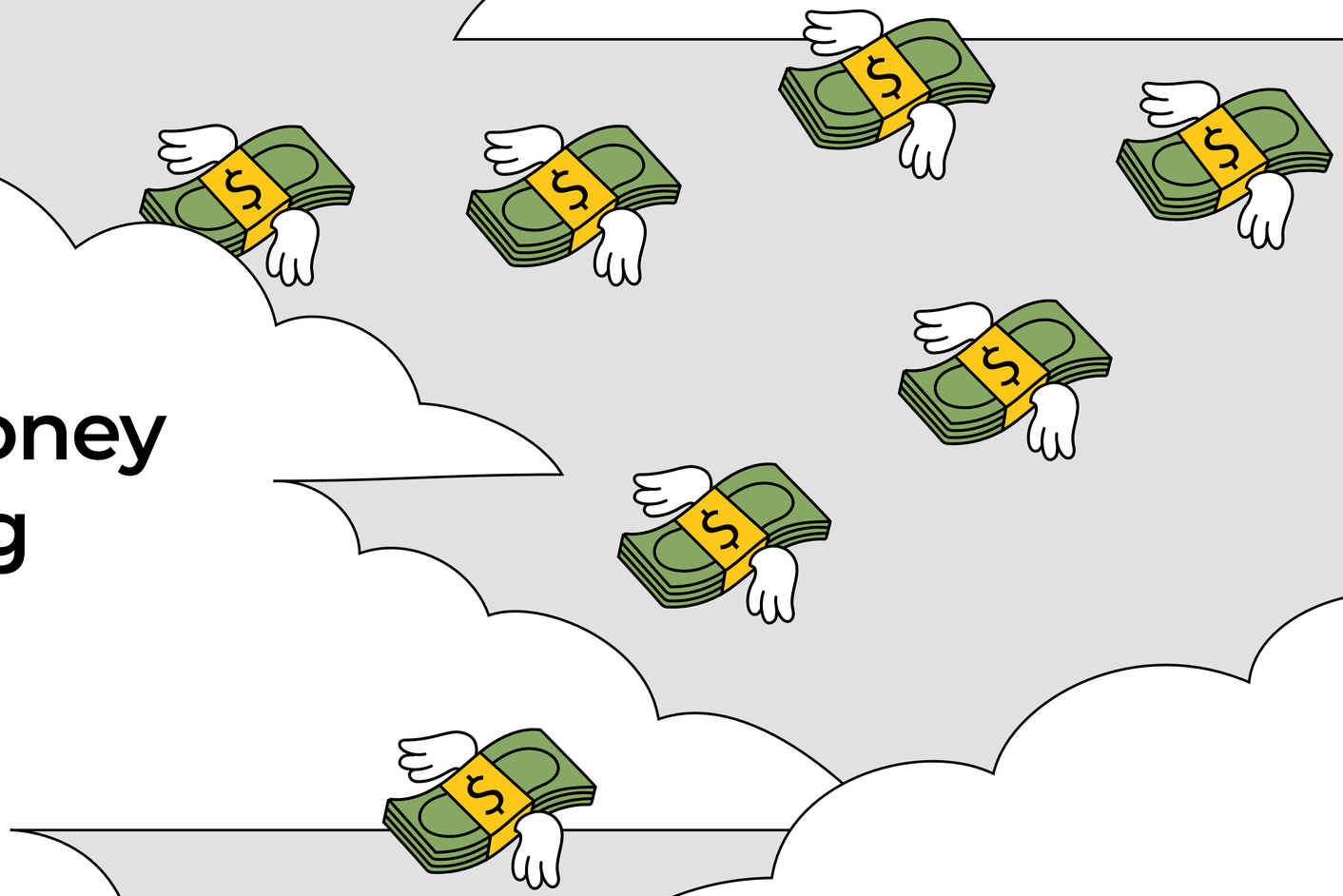
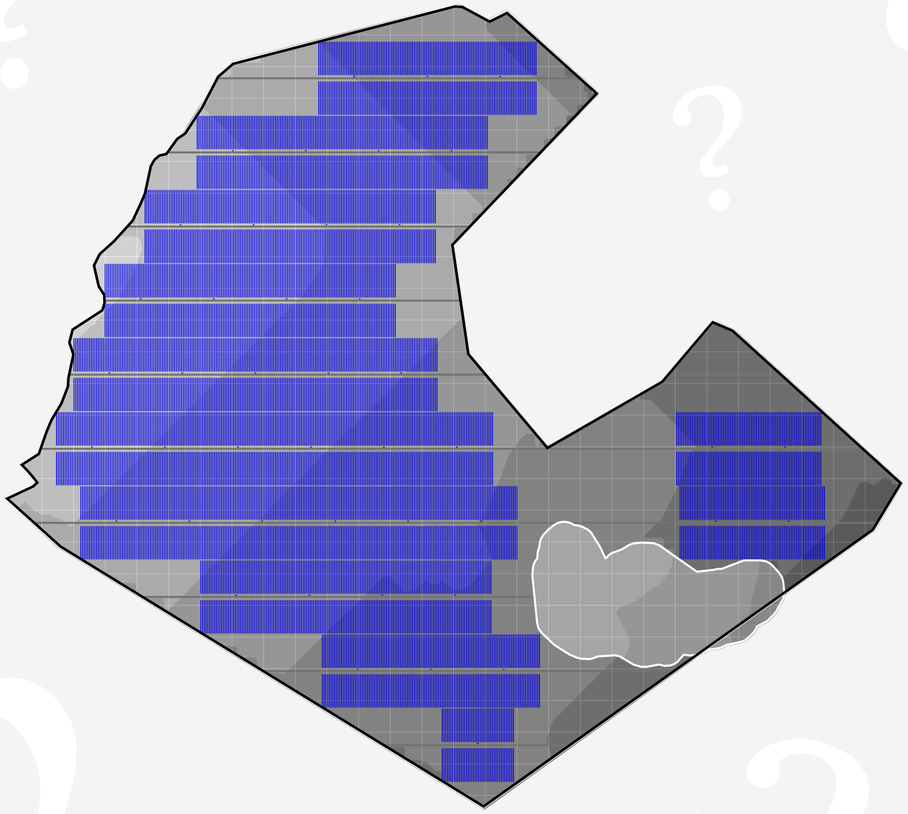
The Cost Map: Visualizing Where Money Goes in Solar Layouts

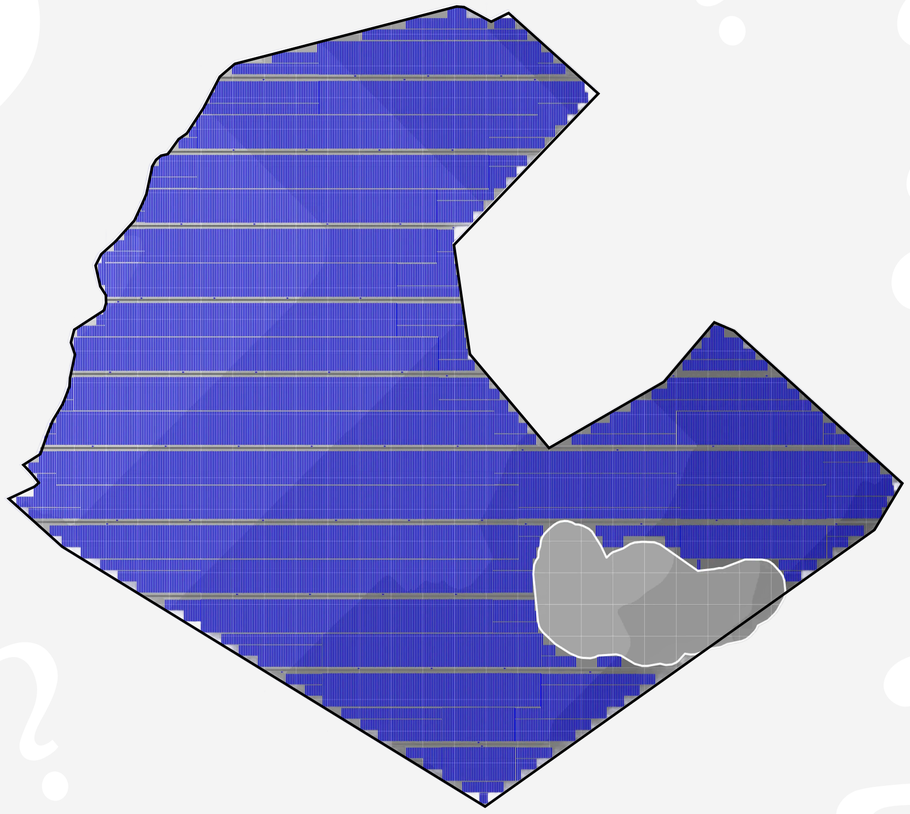
Cost Concentration & Distribution

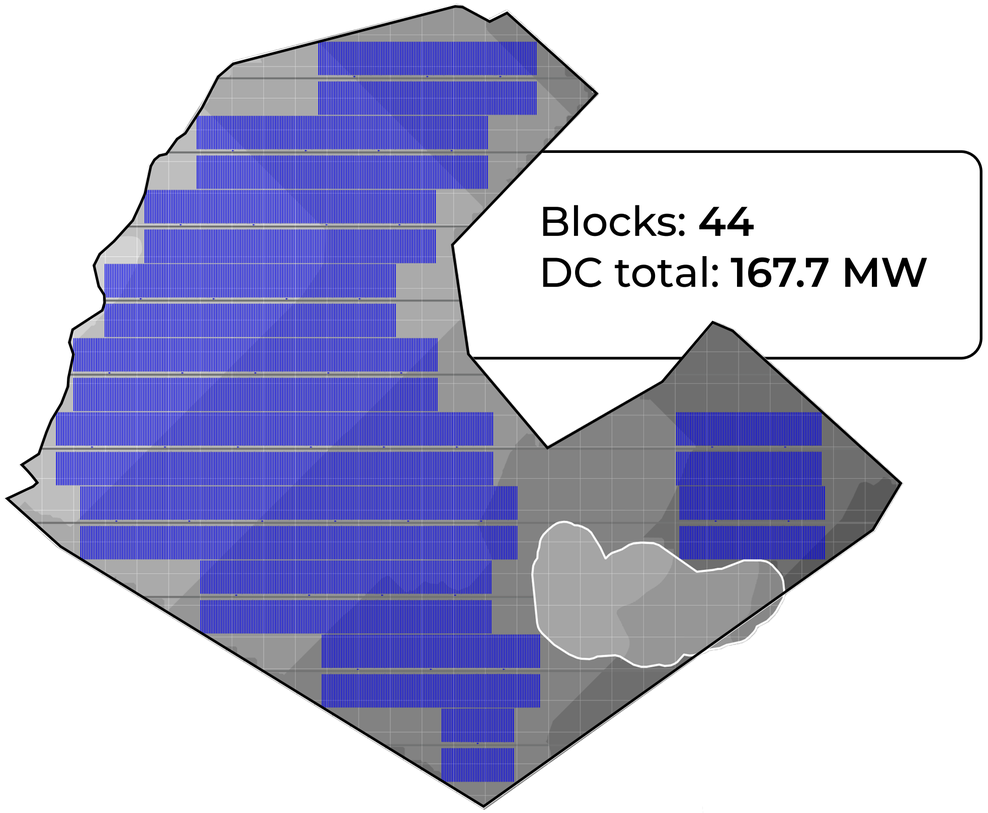


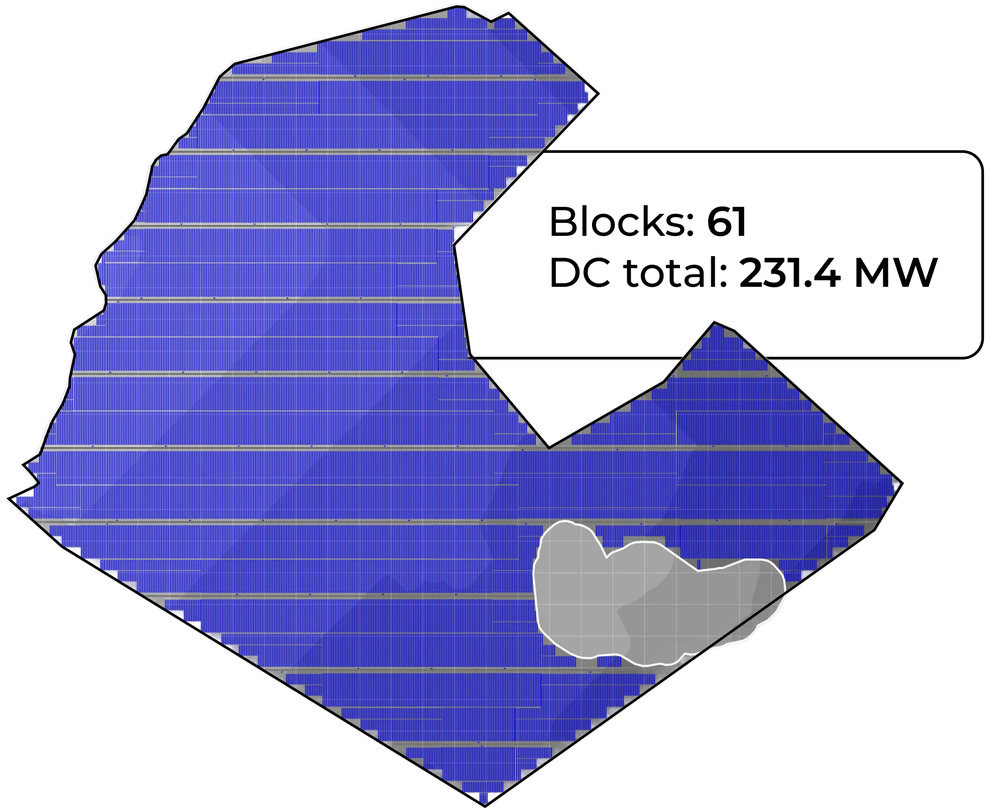
Where Does the Money Go When Designing Solar Layouts?

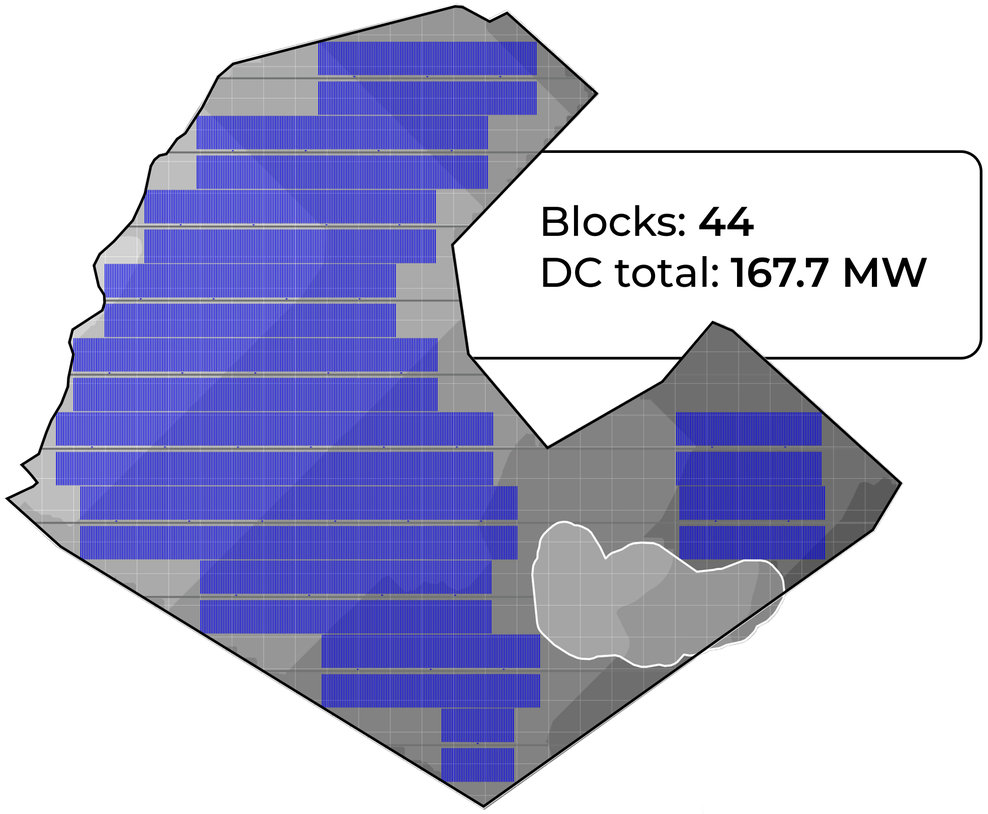




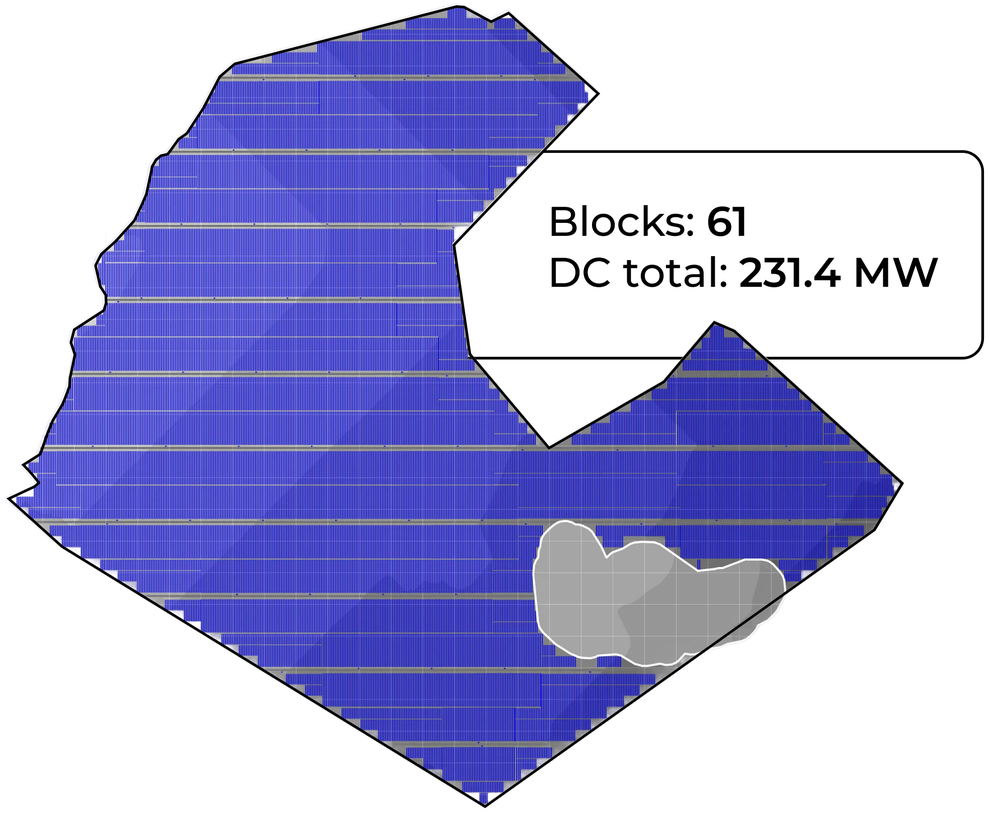



Blocks: **44**
DC total: **167.7 MW**


Blocks: **61**
DC total: **231.4 MW**

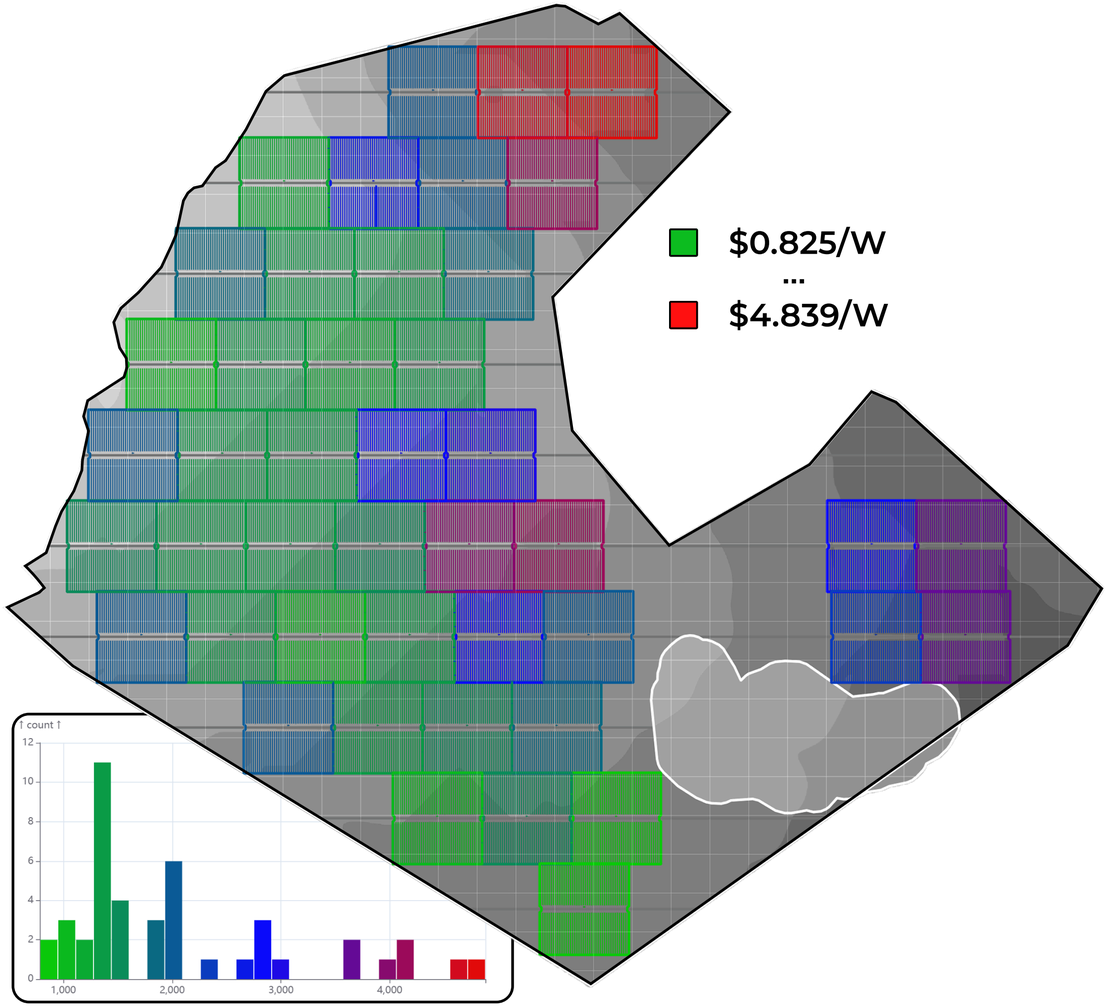


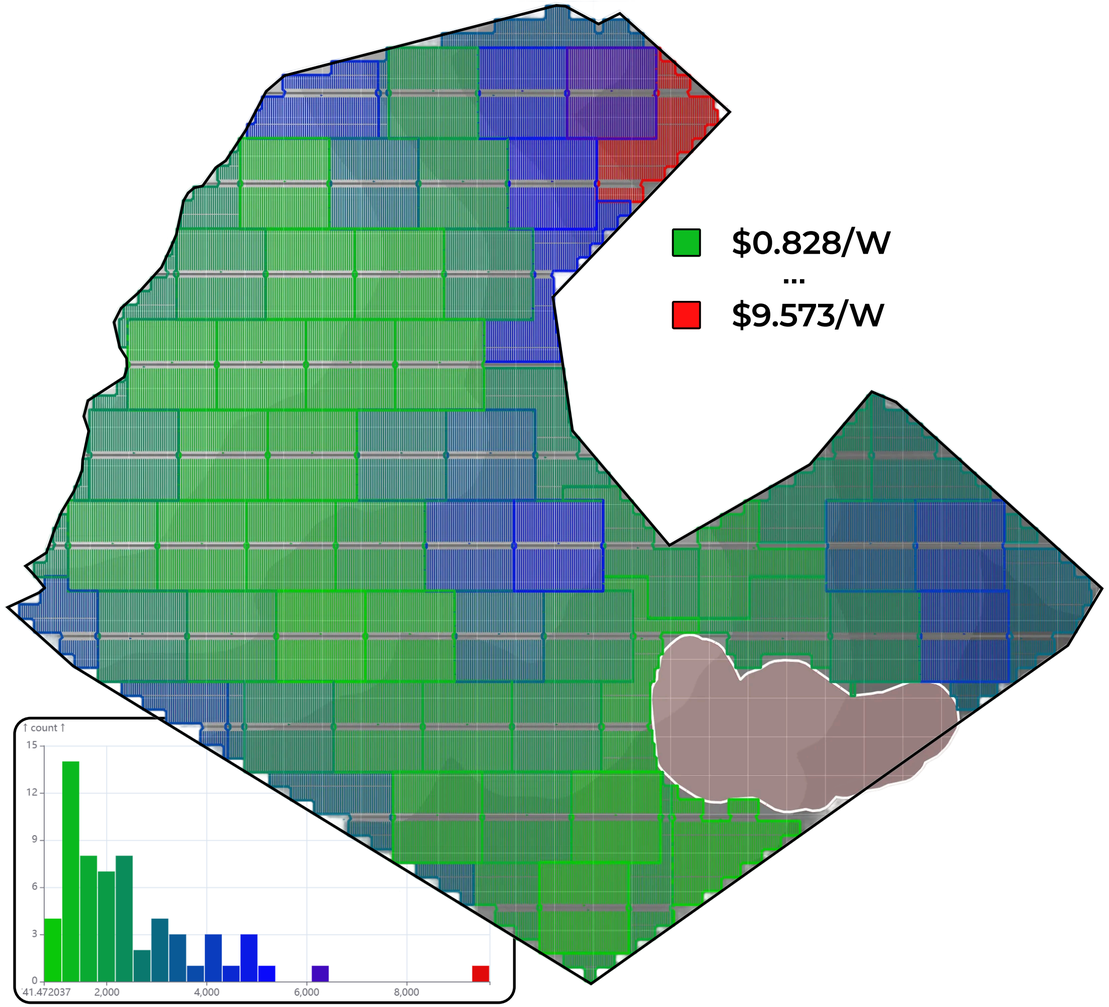
1.9 $/W



2.4 $/W

$/W Range Difference

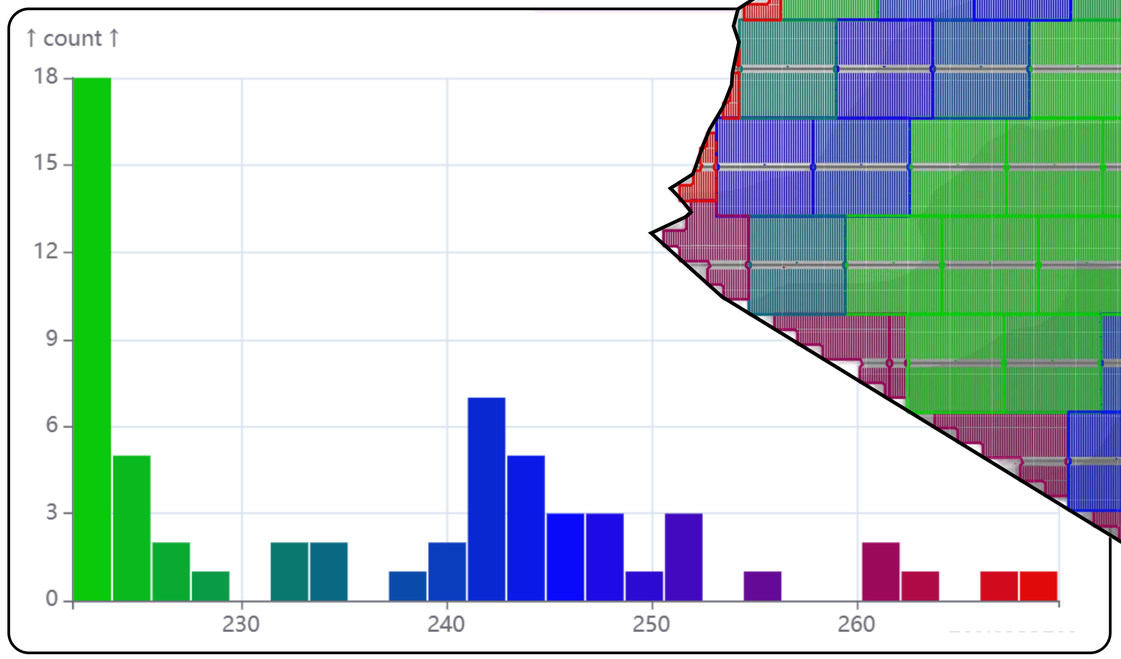


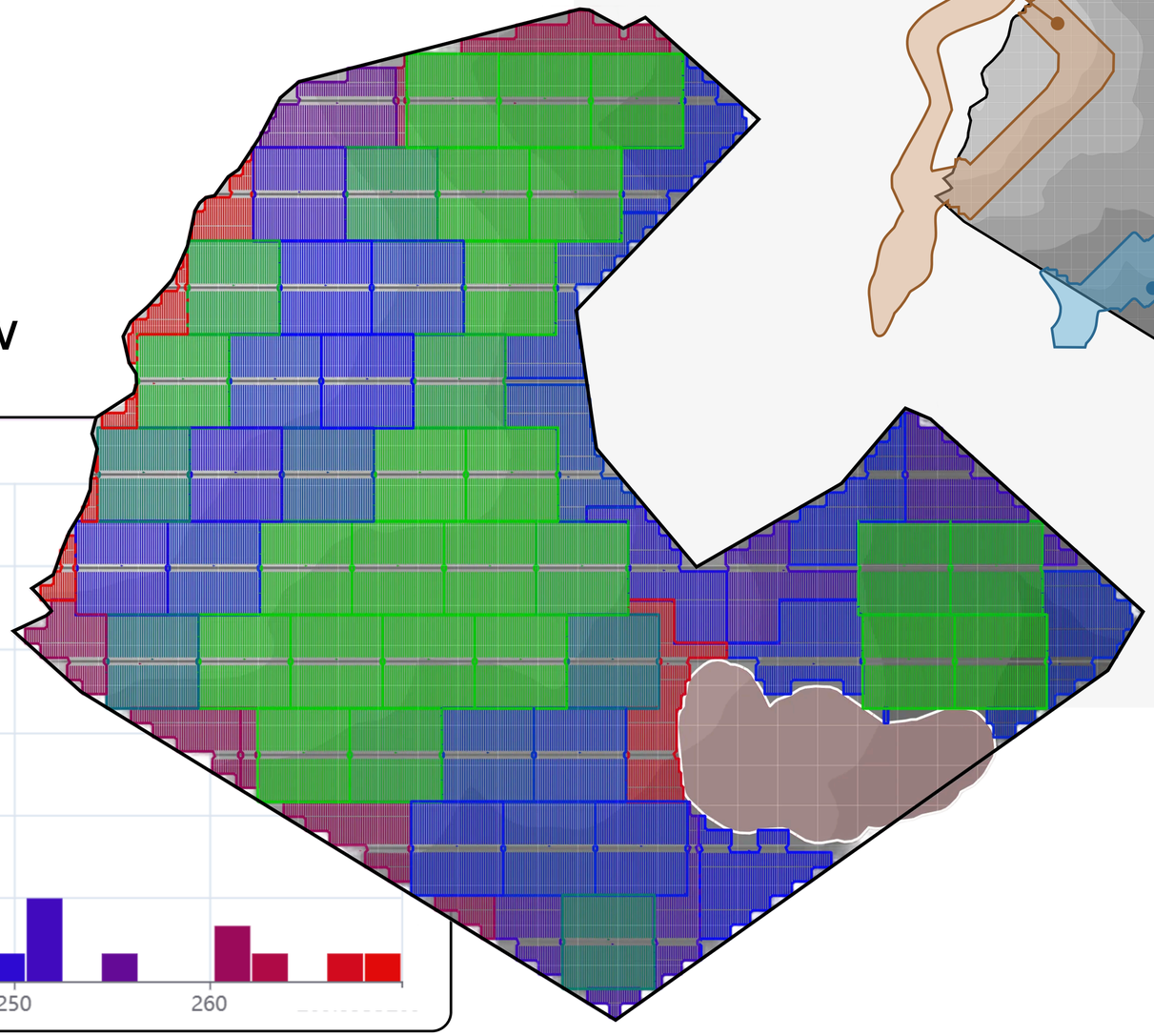


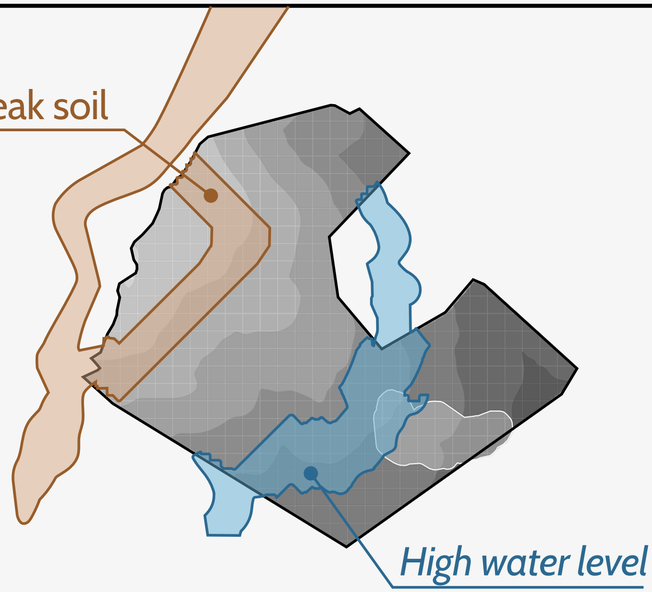
Structural Engineering

$/W Range

$0.222/W ... $0.269/W



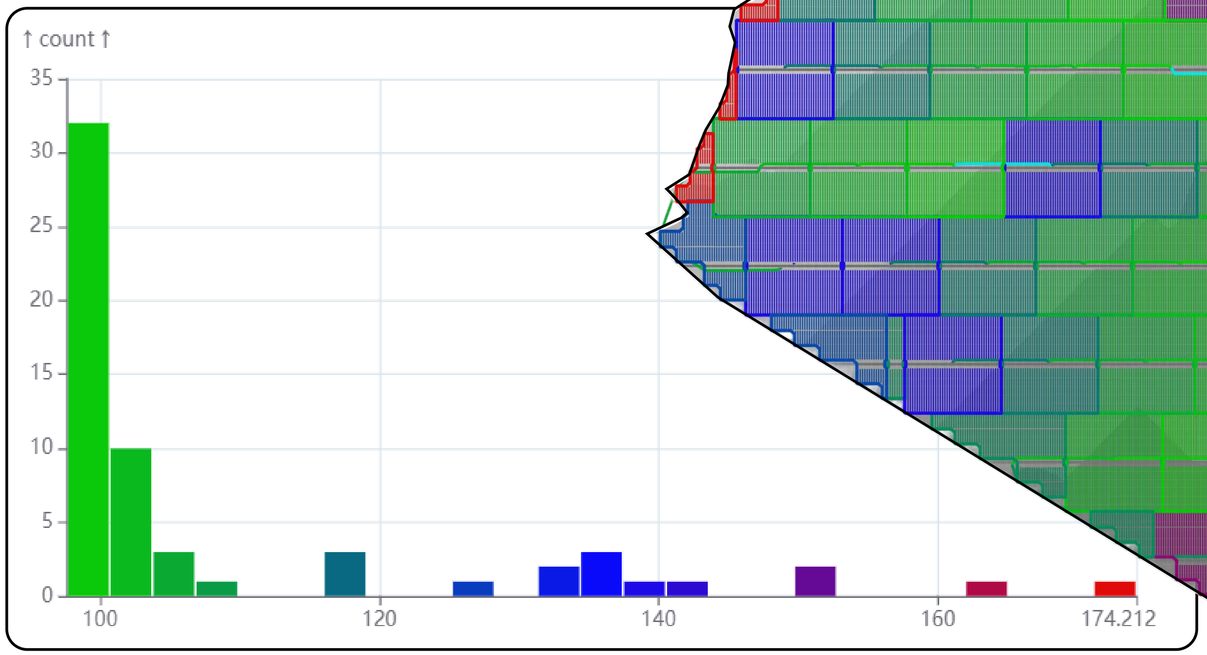


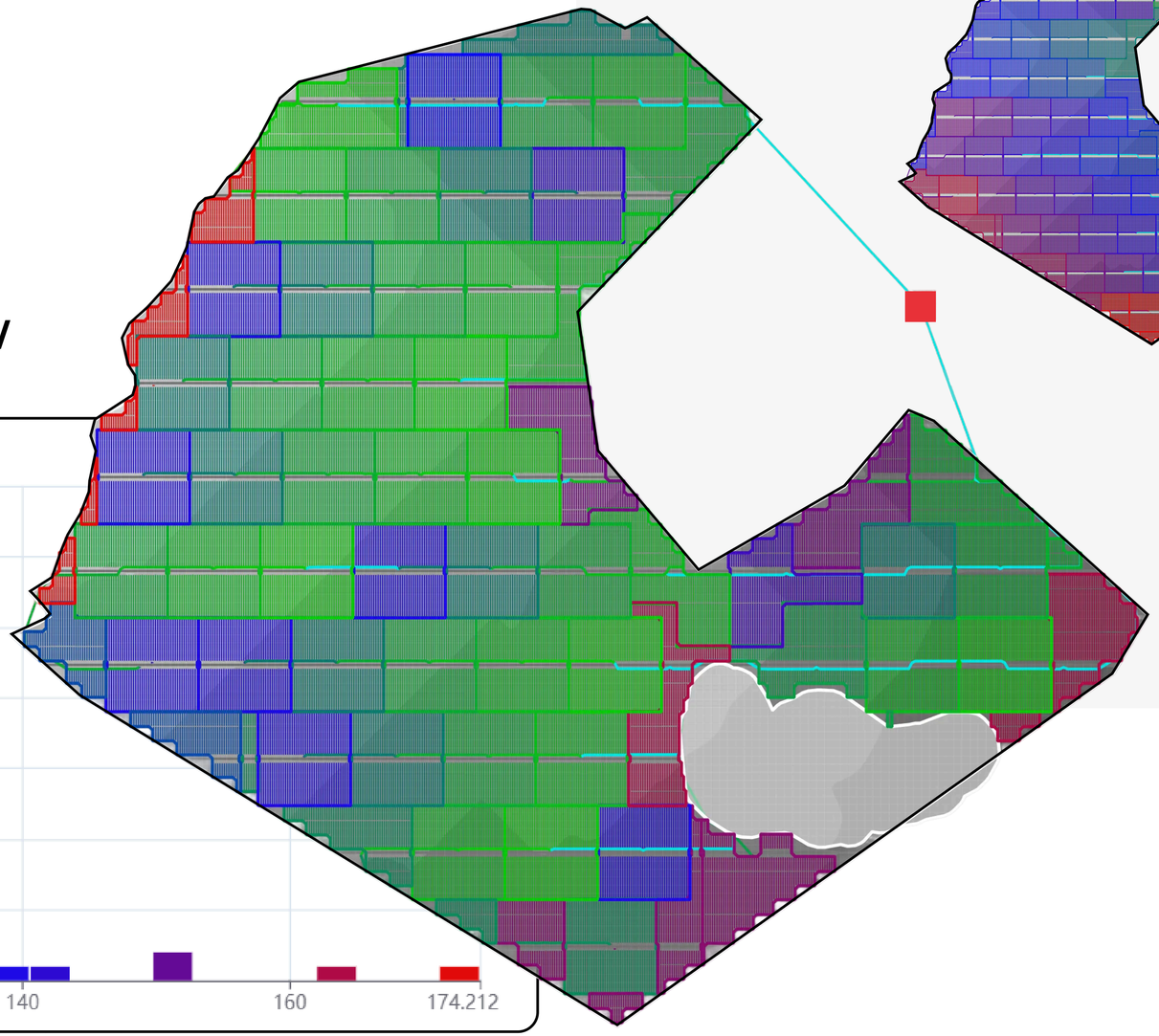


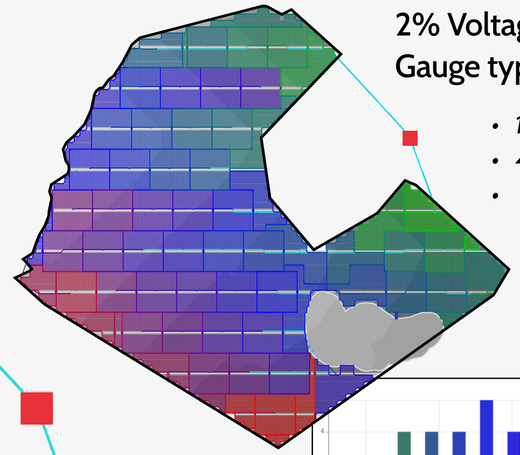
Electrical Engineering

$/W Range

$0.044/W ... $0.174/W

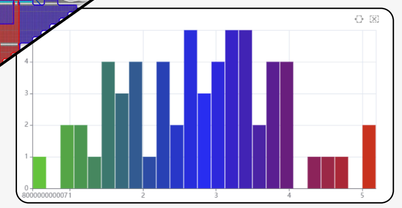






2% Voltage Drop
Gauge type limits:

- *1 Extender*
- *4 TrunkBus*
- *4 DC Feeder*



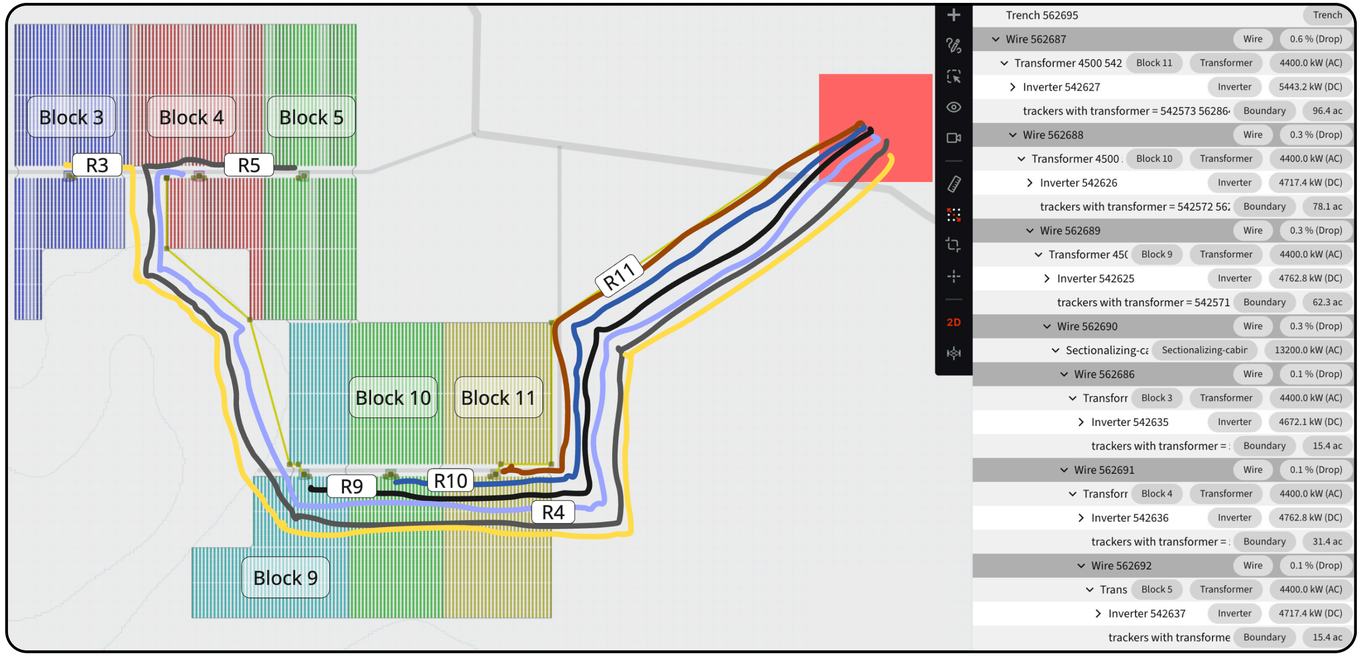
Cost Behavior

	Marginal	Access	Fixed
PV Modules	❤️		
PCS	❤️		
Electrical BOS	❤️	❤️	
Structural BOS	❤️		
Civil BOS	❤️	❤️	
Design & Engineering			❤️
Permitting			❤️
Taxes			❤️
Overhead & Margin			❤️

Fixed Cost:
You pay these whether you build 50 MW or 500 MW.

Marginal Cost:
This is the cost of the “next MW”.

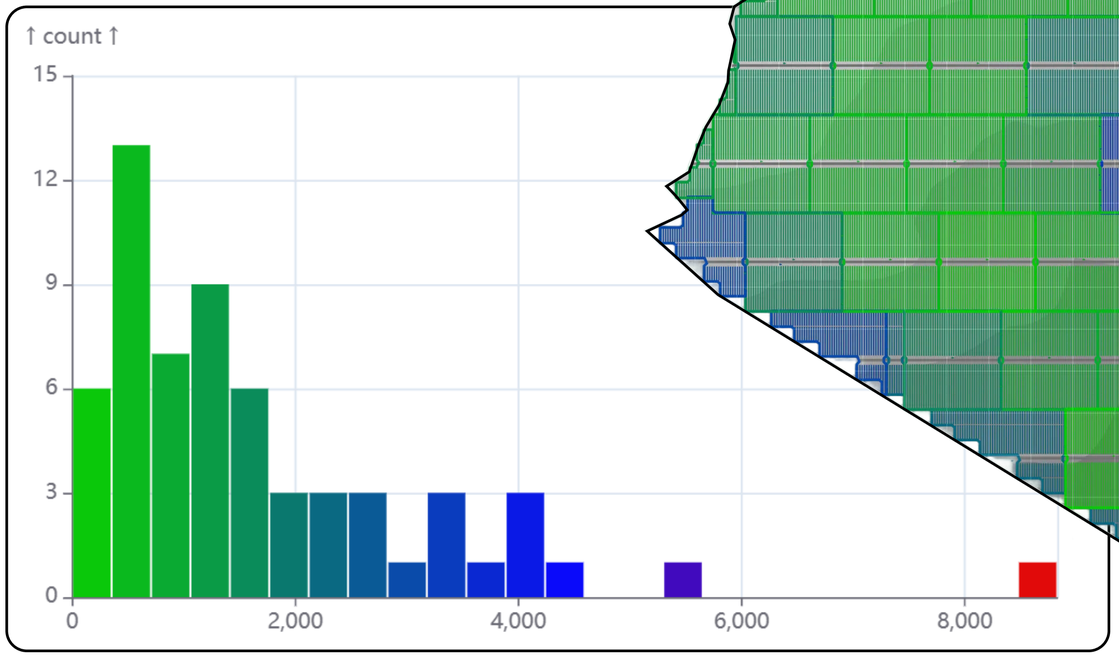
Access Cost:
These are the costs of connecting and enabling the site, not of generating electricity.

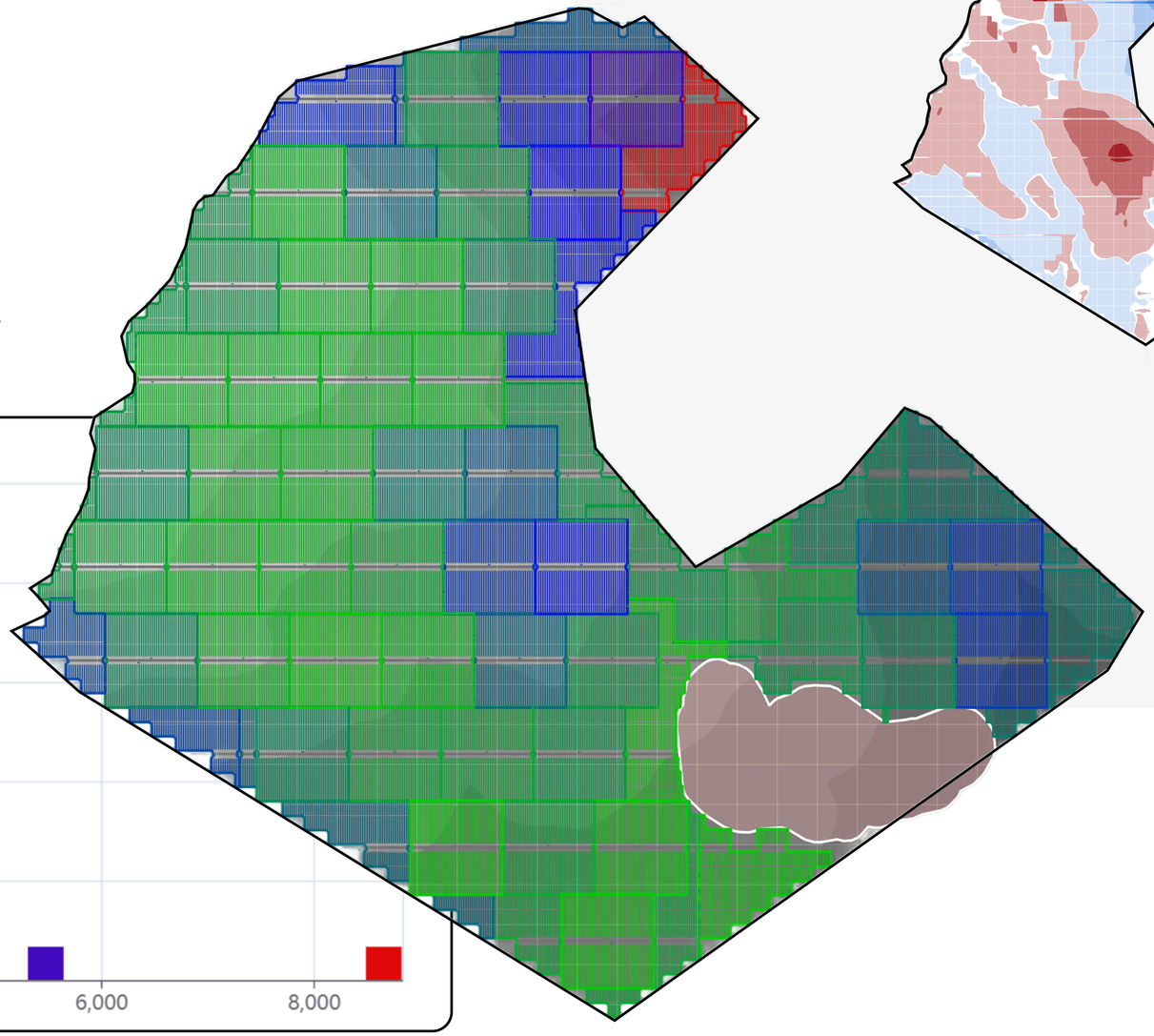


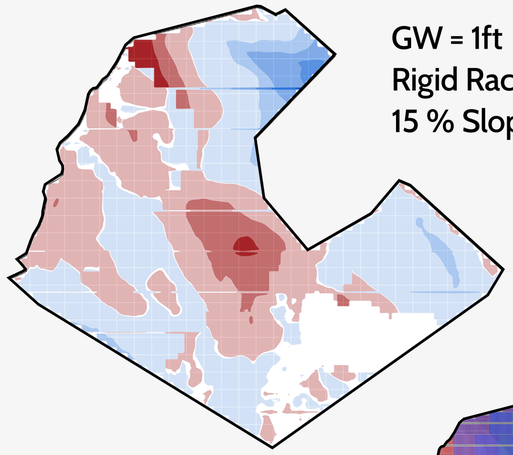
Civil Engineering

$/W Range

$0.033/W ... $8.741/W







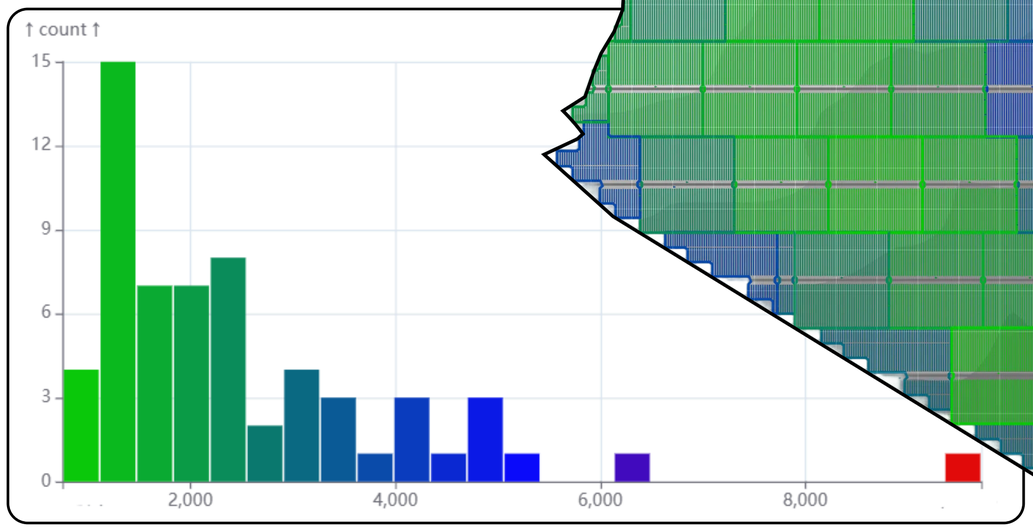
GW = 1ft
Rigid Racking
15 % Slope

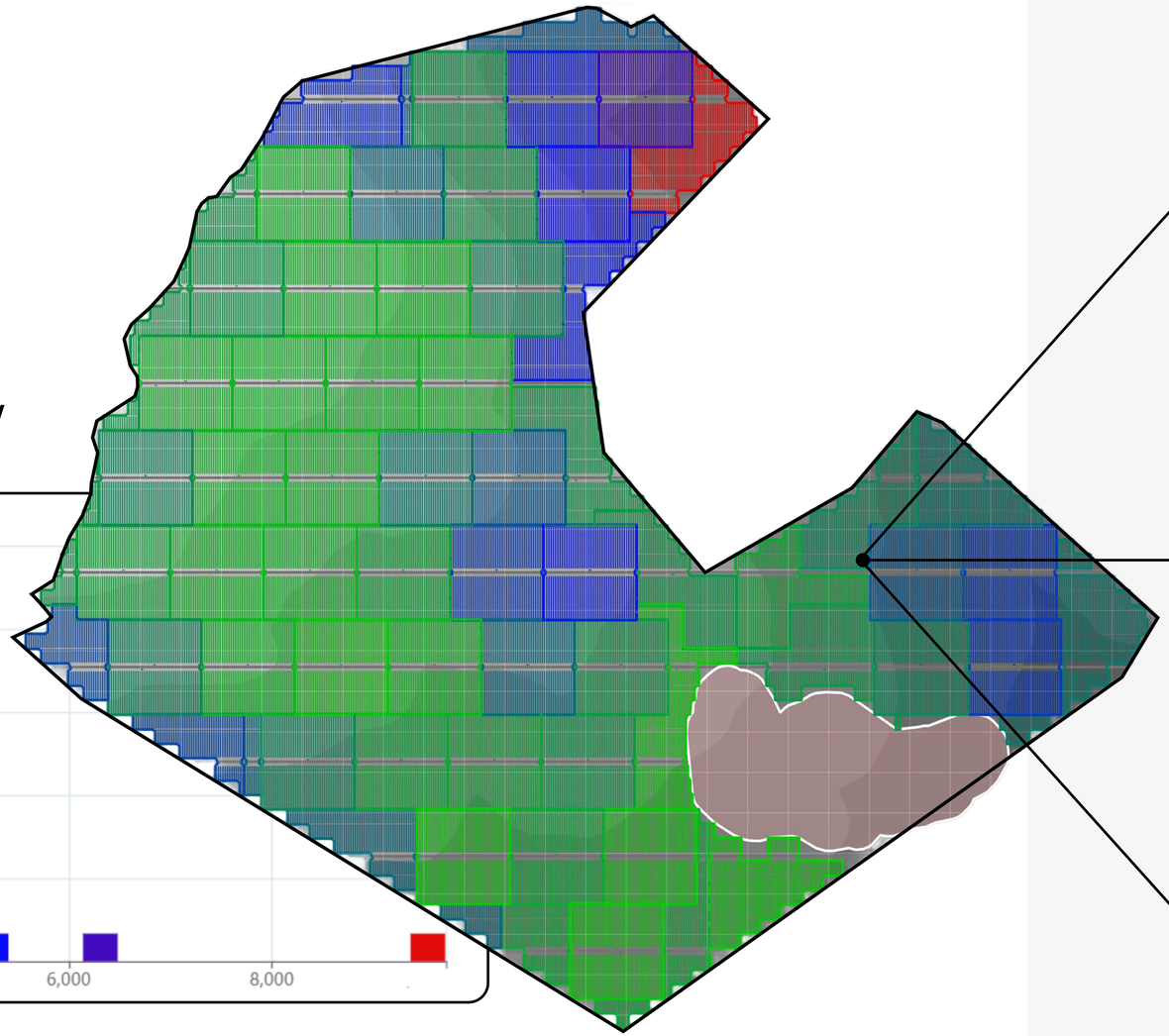
Roads Access

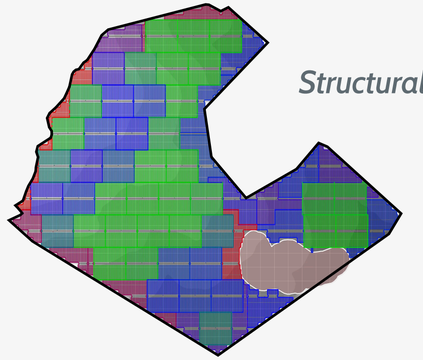
Holistic Engineering

$/W Range

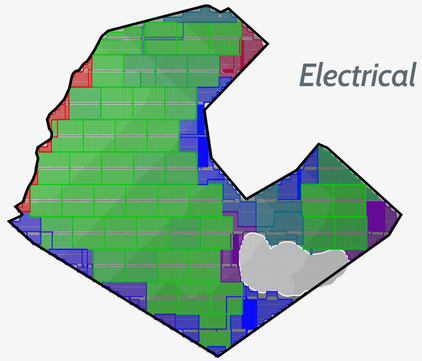
$0.786/W ... $9.028/W



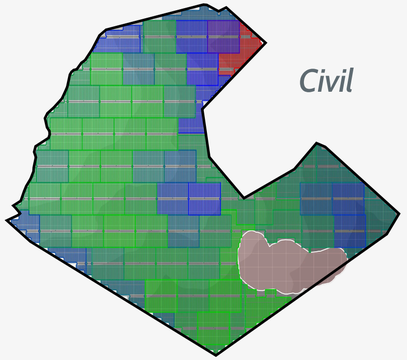




Structural



Electrical



Civil

The Beauty

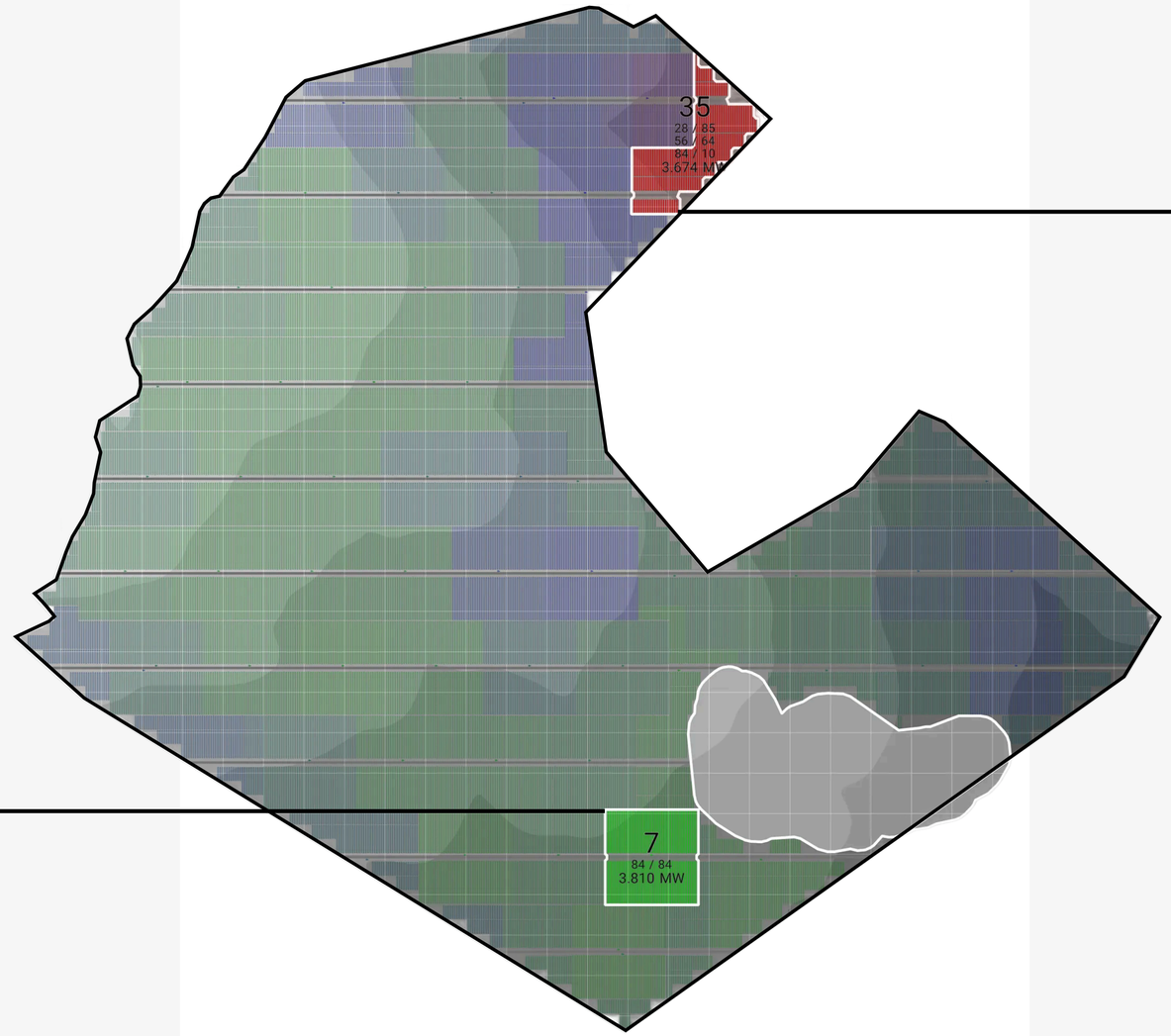
The Standard Block

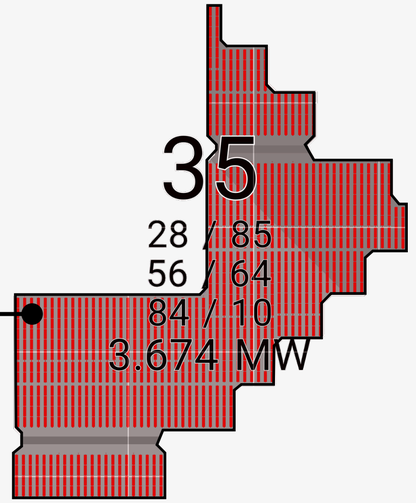
Total: $0.304/W

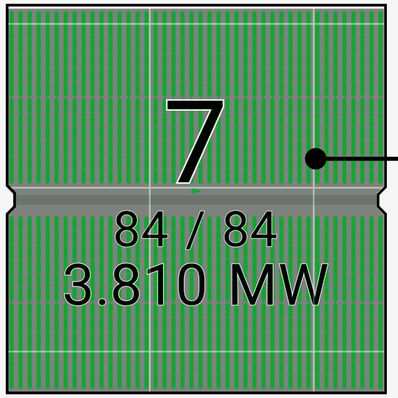
Civil: $0.033/W

Electrical: $0.028/W

Structural: $0.243/W







The Beast

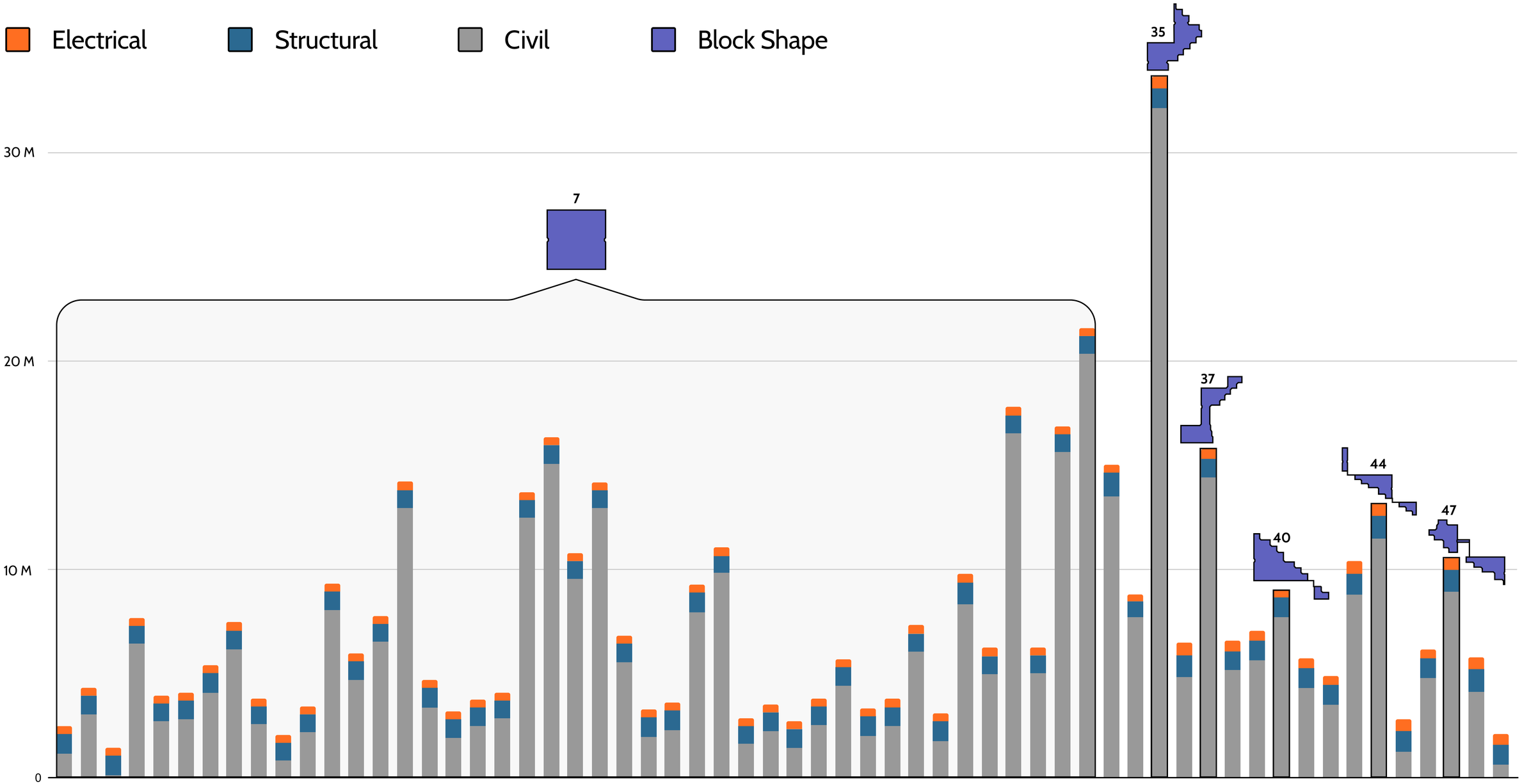
The Premium Block

Total: $9.028/W

Civil: $8.741/W

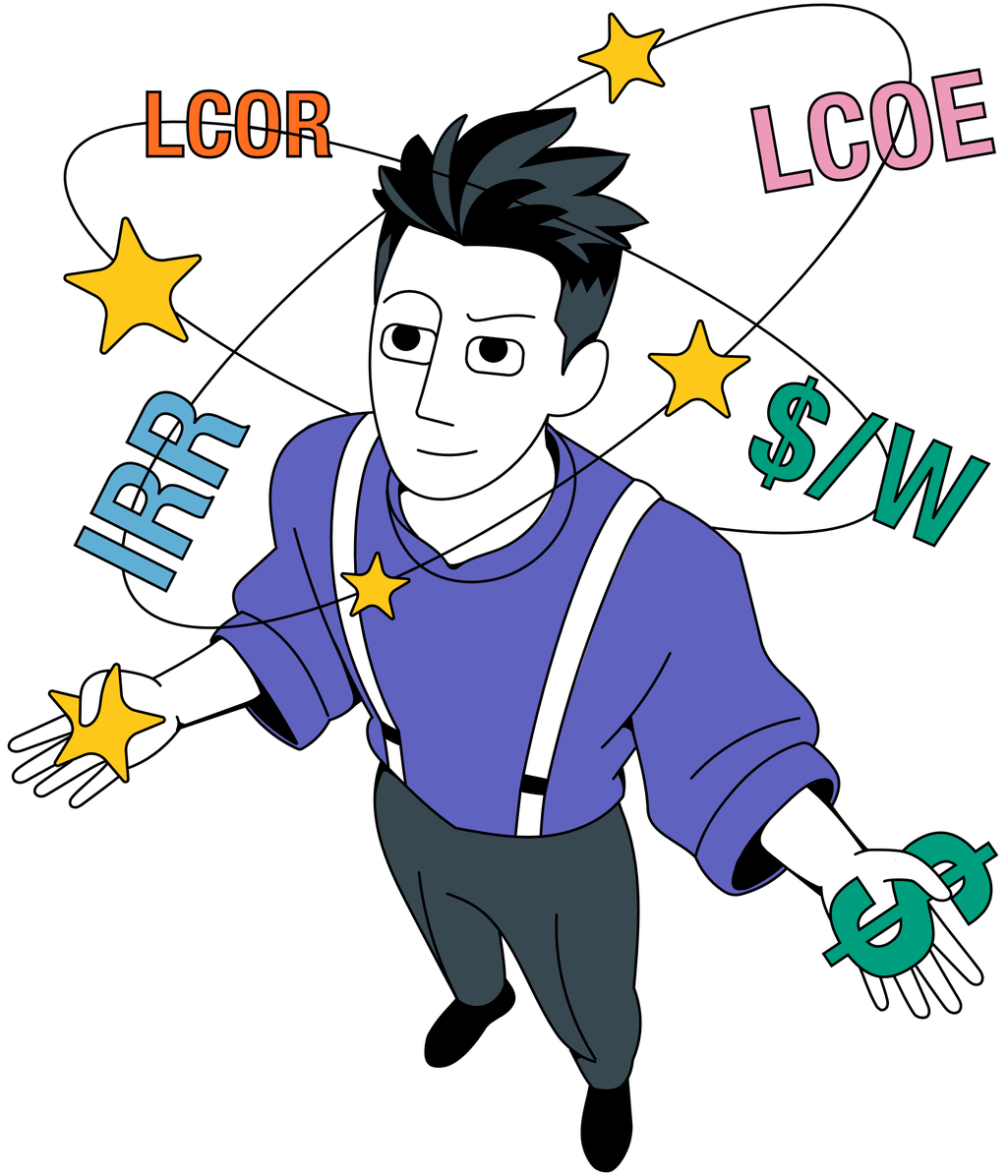
Electrical: $0.043/W

Structural: $0.244W


Electrical
Structural
Civil
Block Shape
30 M
20 M
10 M
0
7
35
37
40
44
47

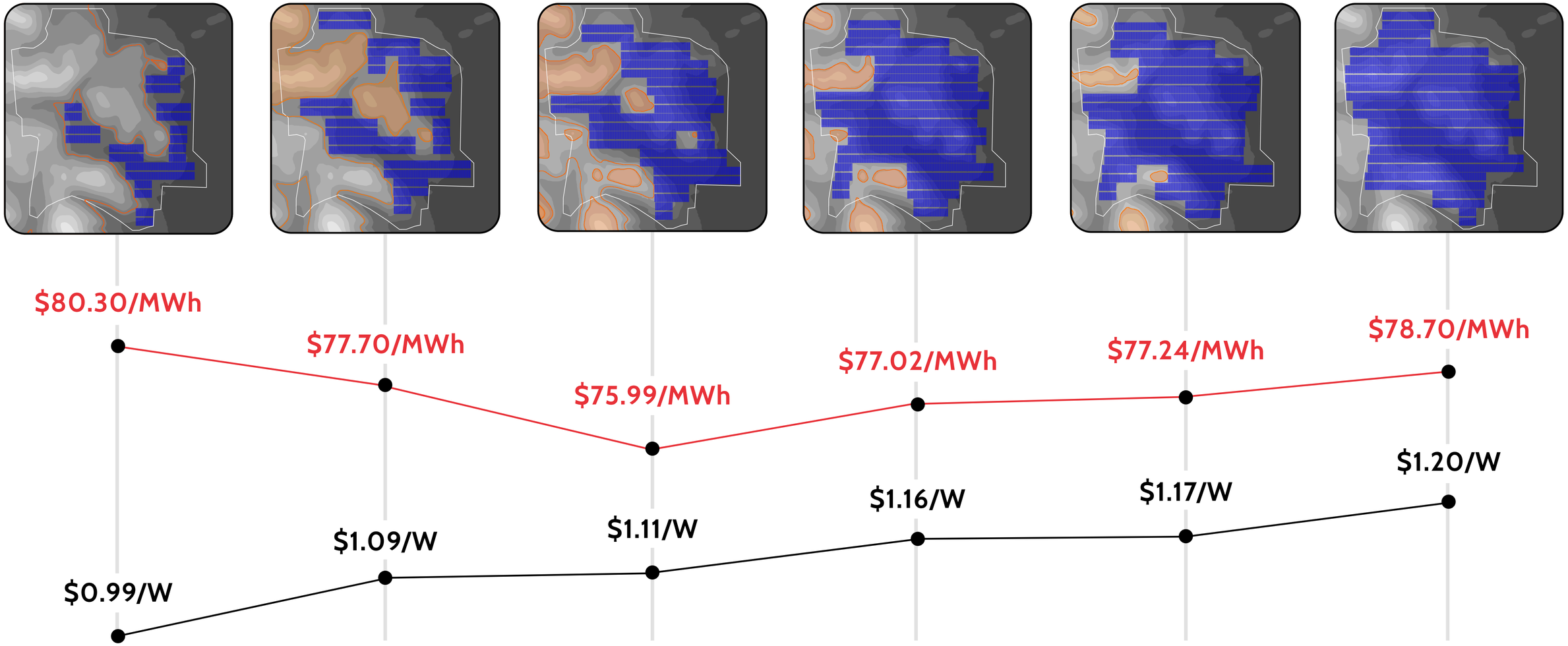
All metrics are wrong, but some are useful

Perspective dictates the metric:
each one reflects a different layer of value



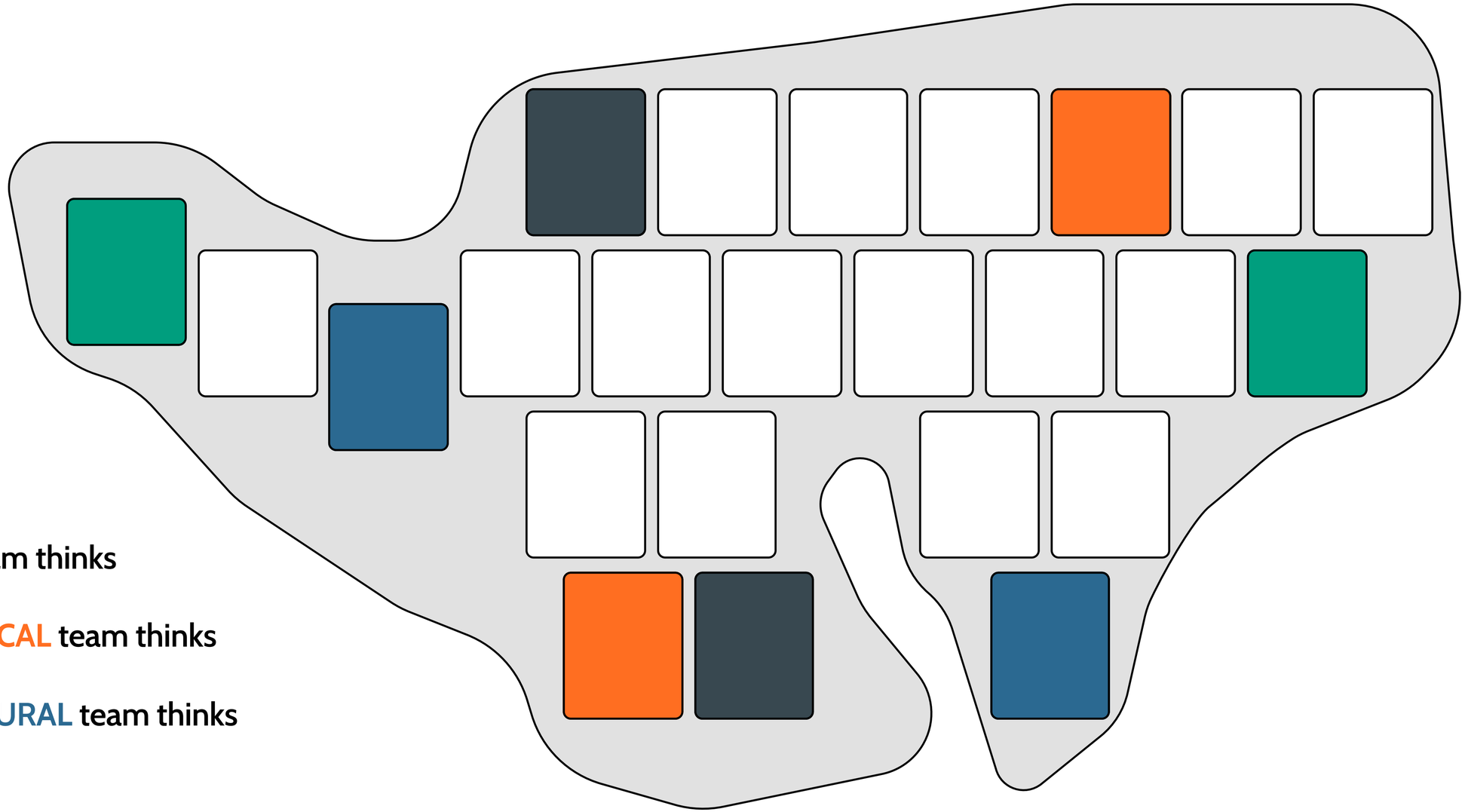
Why the “Best Layout” Depends on Who You Ask

LCOE and $/W simply measure different slices of reality



The Cost Map That Connects All Teams

Highest Cost Blocks:

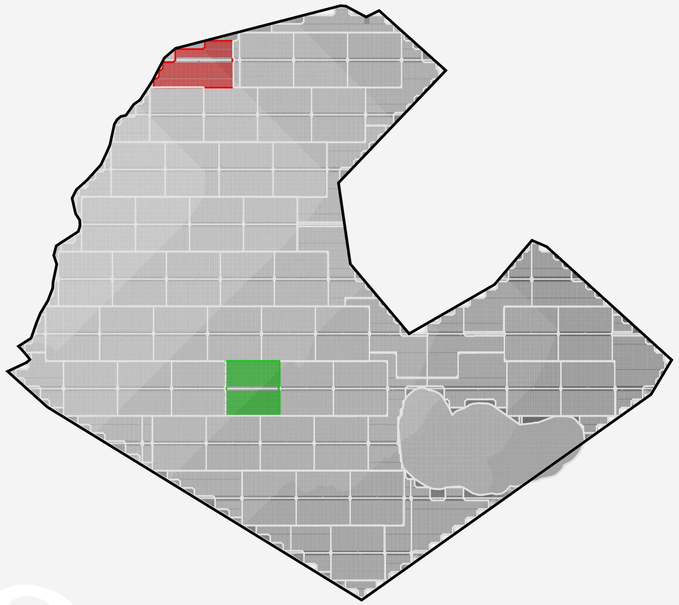


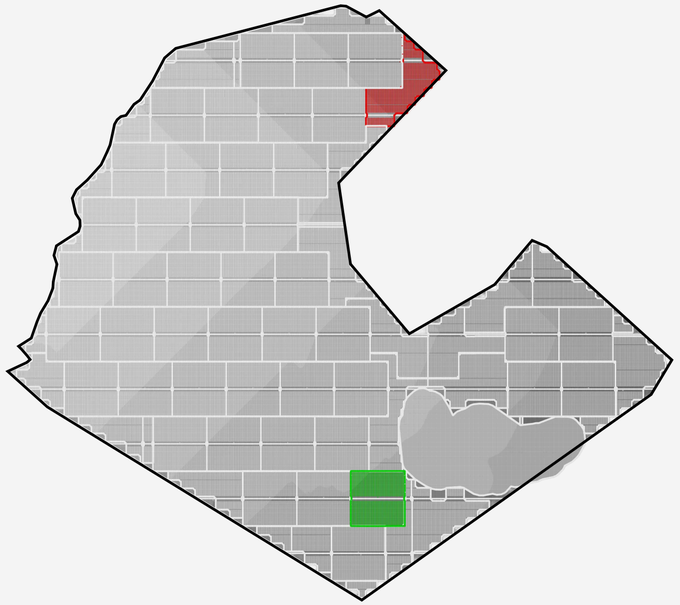
As CIVIL team thinks

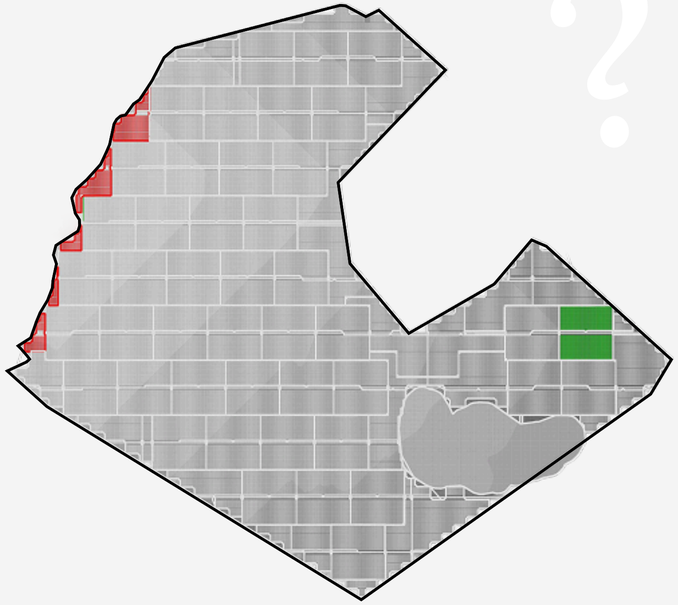
As ELECTRICAL team thinks

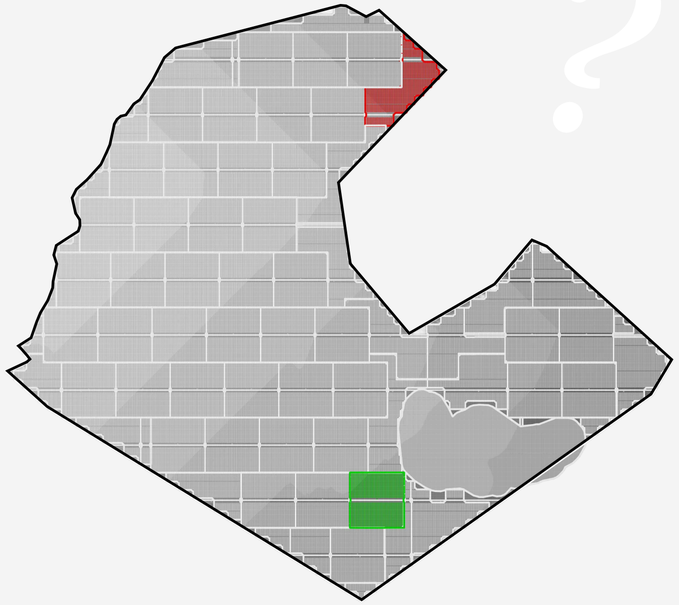
As STRUCTURAL team thinks

In FACT



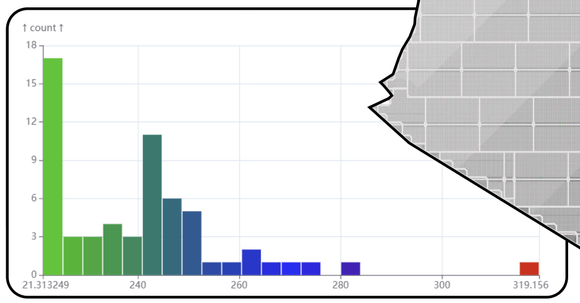


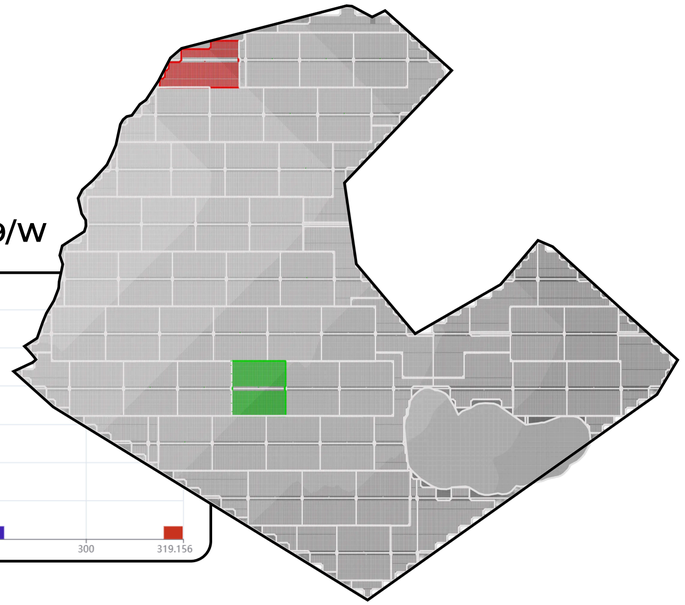




Structural

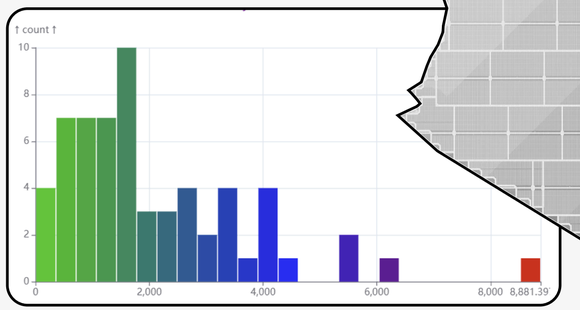
$0.222/W ... $0.269/W

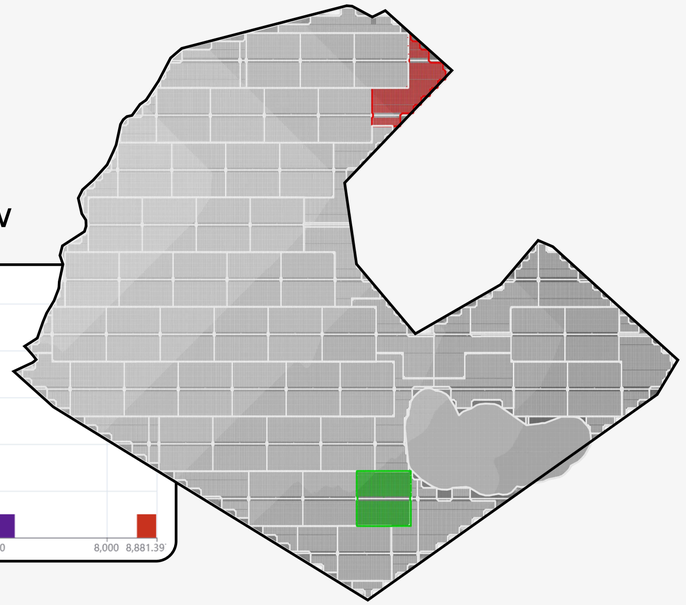




Civil

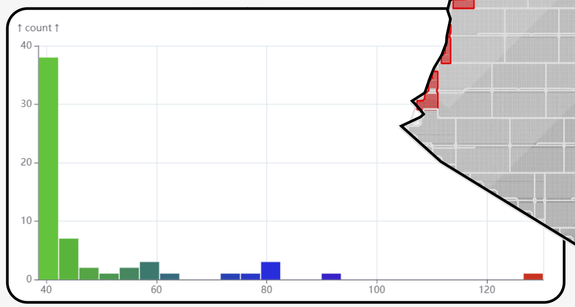
$0.033/W ... $8.741/W

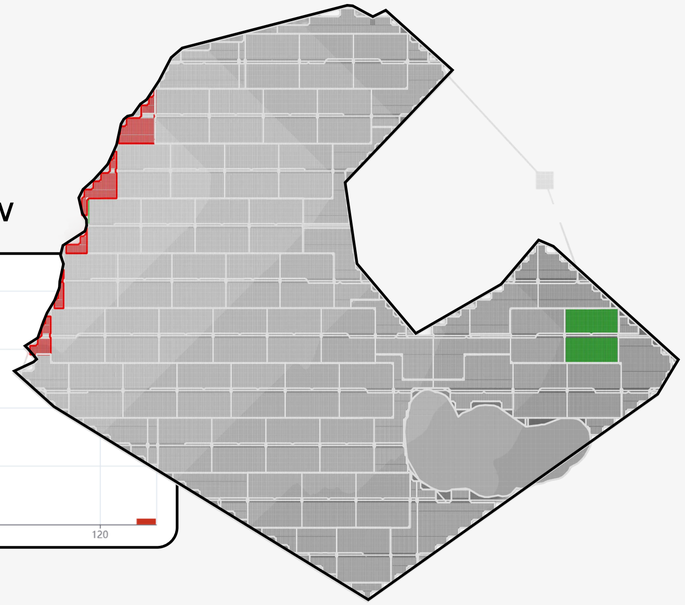




Electrical

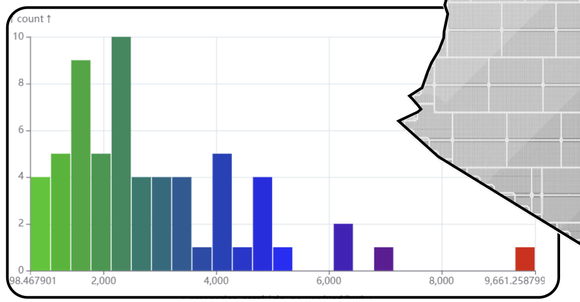
$0.044/W ... $0.129/W

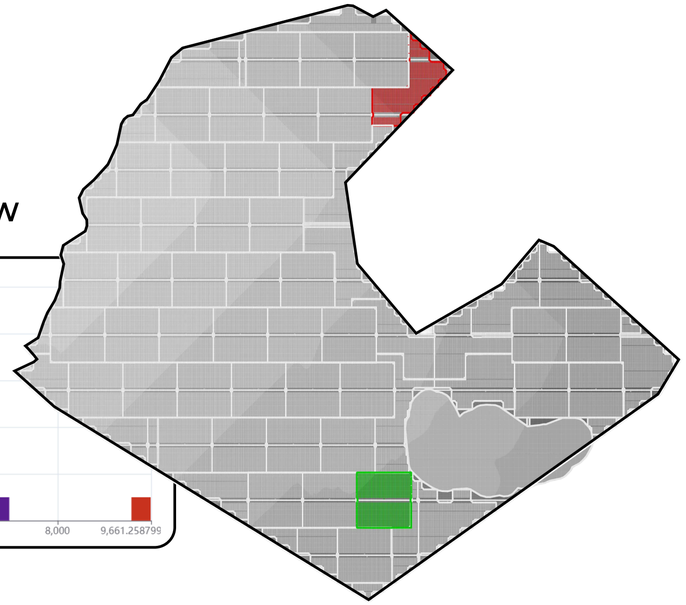




Total

$0.786/W ... $9.028/W





Cost Map Nuances

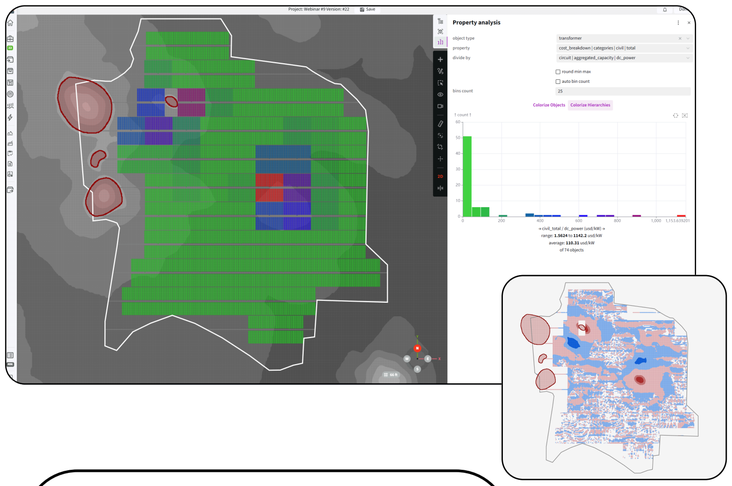
What to watch for

Waterbed Effect

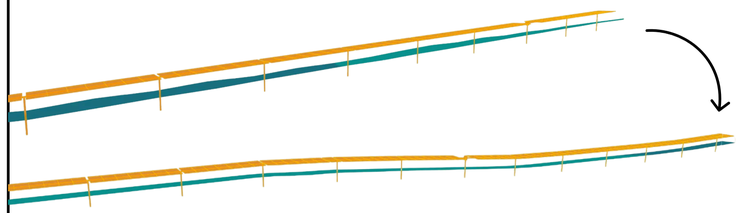
Push one metric down, another rises.
It's all connected

How to manage it?

- More detail early
- Awareness of gaps
- Ability to foresee trade-offs



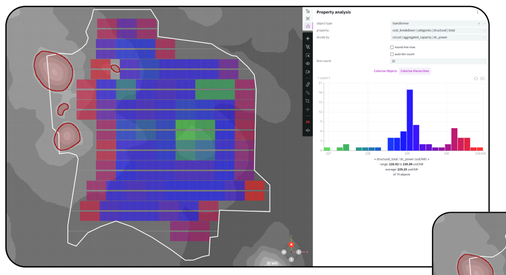
Civil is **$41.3M**, need to chip it down!

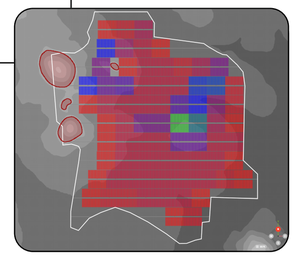


Let's switch rigid trackers to terrain-following

Wow, amazing! Down to **$38.5M.**

-$2.8M





Oh no... I forgot about structural engineering.

Was **$73M** but now it's **$78.8M**

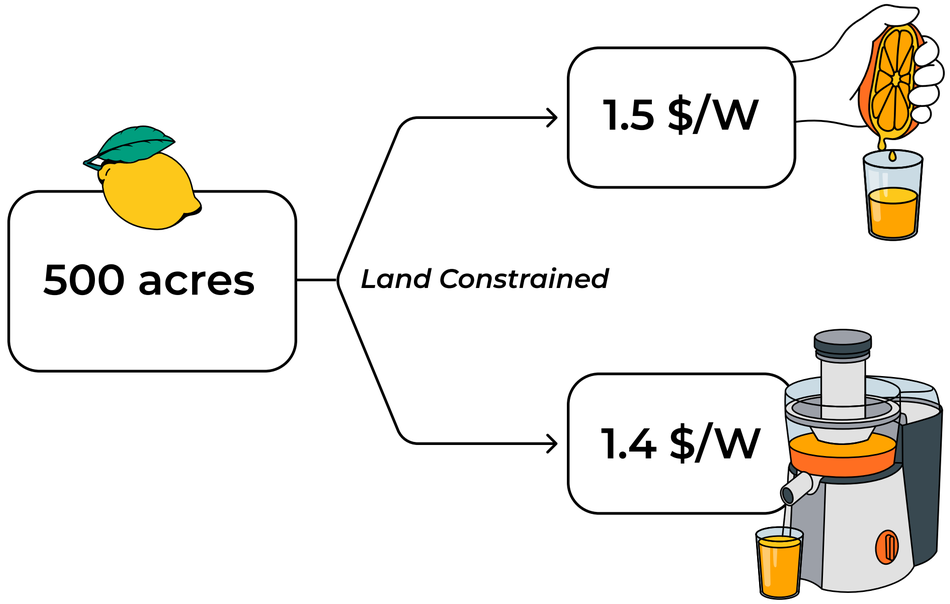
+$5.8M

PVFARM Workflows

Different ways to design smarter

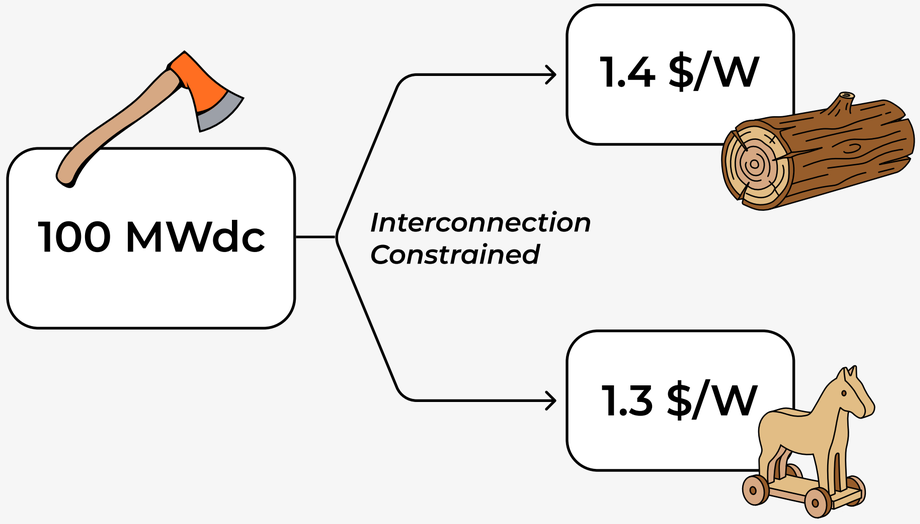
Squeezing Max

You can't move tables, but you can optimise everything that sits on top of them - piles, grading window, blocking, wiring strategy, inverter grouping.



Chipping Away

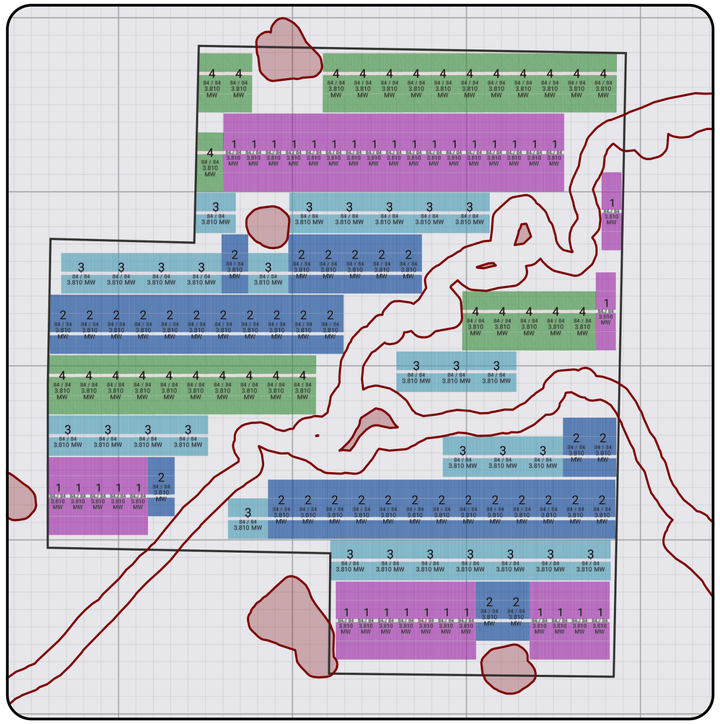
You can move tables, and the optimisation comes from choosing the best land to use and the worst land to avoid - balancing earthwork, MV cost, slope, and access.



Squeezing Max 

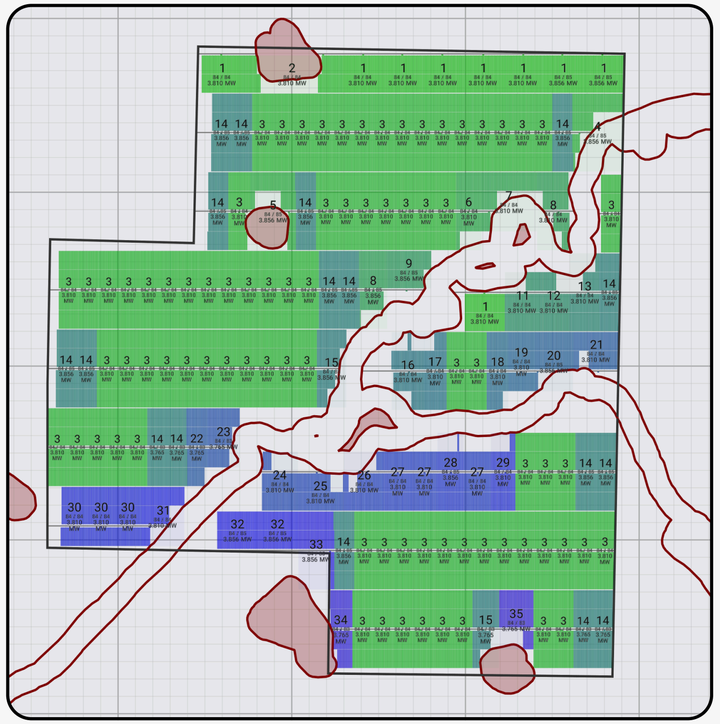
Land constraint thing

Emphasis	What It Prioritises	DC Trade-off	Buildability Trade-off	Electrical Trade-off
Electrical	Blocks library and optimal LV wiring	🔴 High DC sacrifice	🟢 Strong buildability	🟢 Excellent electrical quality
ILR-Buildability	Maximizing DC within ILR and buildability limits	🟠 Moderate or low DC sacrifice	🔴 Moderate buildability	🟠 Minor electrical compromises
Replication	Maximizing DC using a single replicated block plus edge-case adjustments	🟢 No DC sacrifice	🔴 Edges become expensive	🔴 Electrical messiness at edges



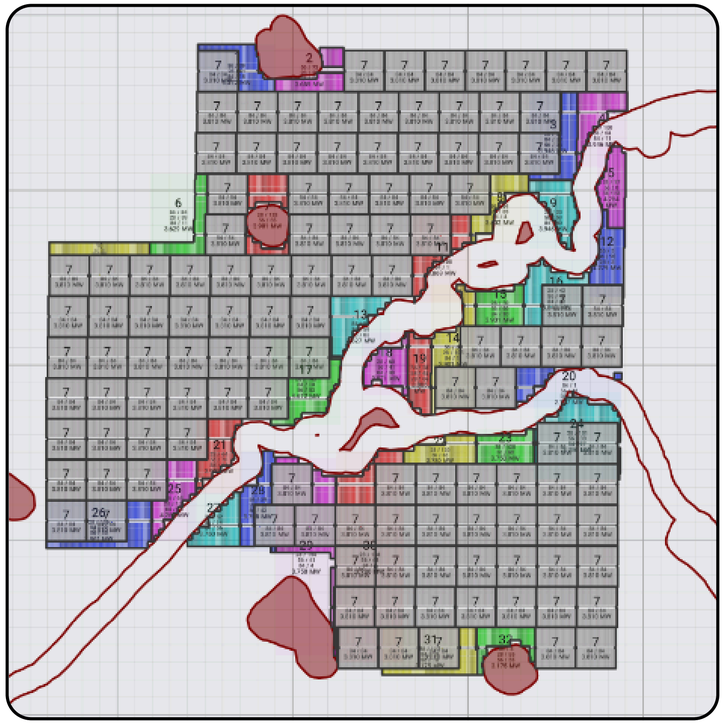
Electrical-First

Clean electrical behaviour, tidy block shapes, predictable wiring



ILR-Buildability Guided

Maximise DC within ILR limits and constructable rectangles



Replication-First

Replicate one ideal block across the site, maximise DC footprint

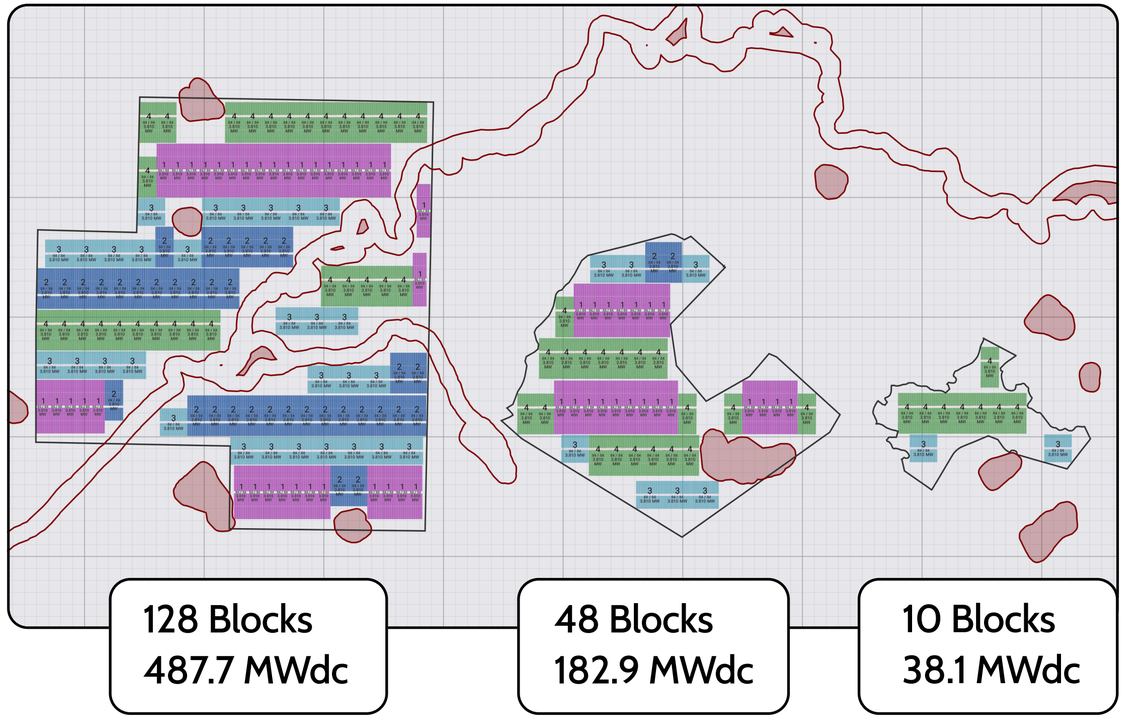
1 Block-Library Layout

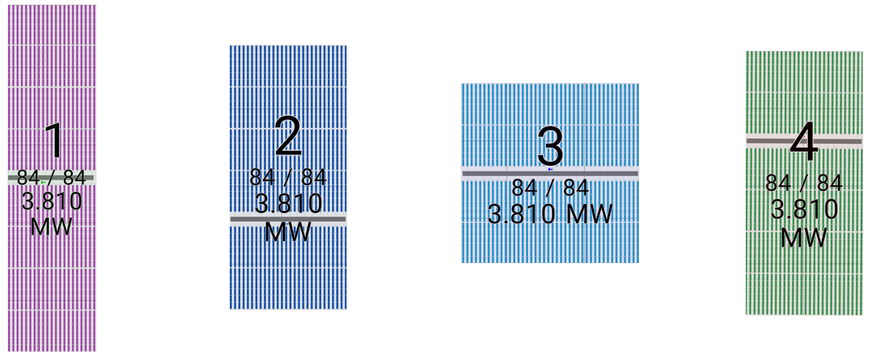
Total: ***708.7 MWdc***

Philosophy: Use a predefined library of electrically healthy block types.

How it works: Select from several “good citizen” blocks and arrange them to fit the site geometry.

Best for: Clean electrical behaviour + procurement predictability without forcing one block everywhere.





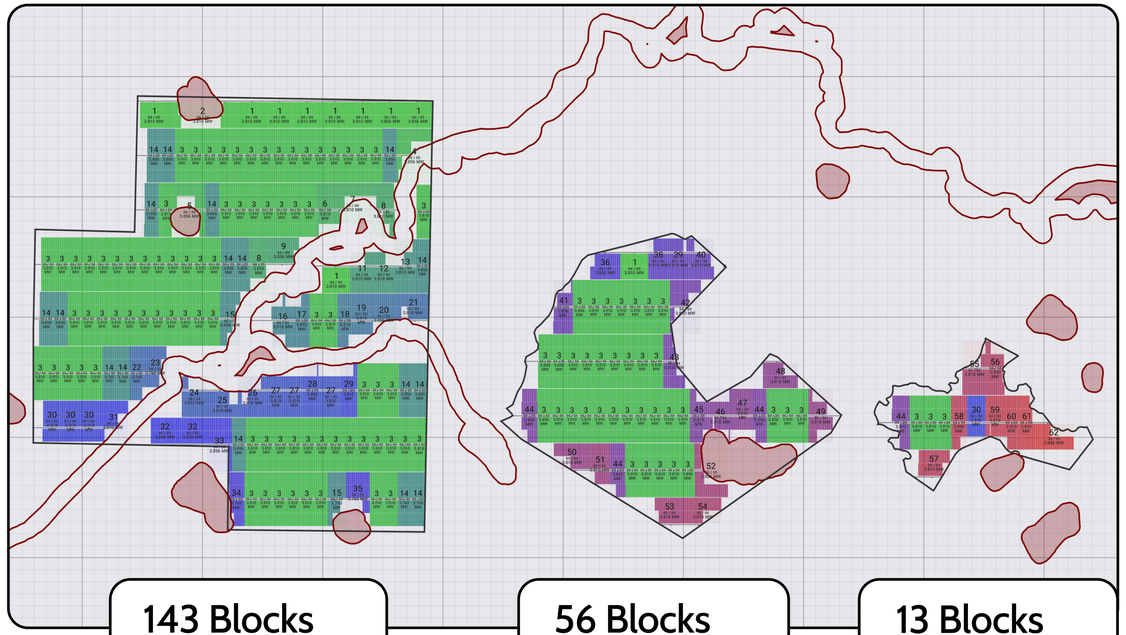
2 DC-Driven Hybrid Layout

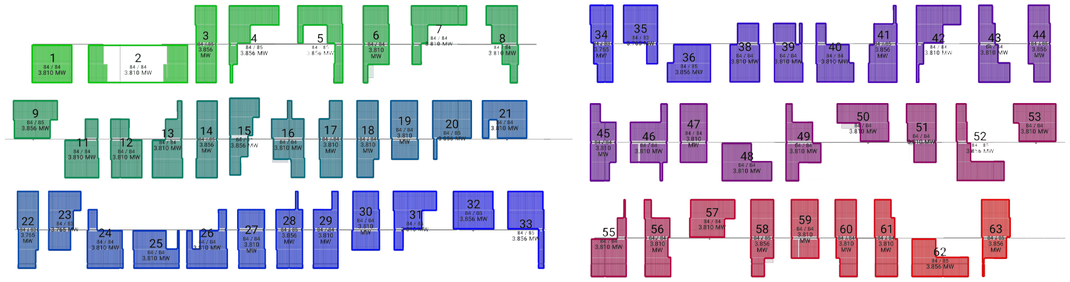
Total: ***809.1 MWdc***

Philosophy: Fill the site with tables first, then shape blocks around ILR + buildability.

How it works: Start with DC maximisation, then carve out blocks that stay within ILR corridors and constructability constraints.

Best for: Getting as much DC as possible while still producing buildable block shapes.





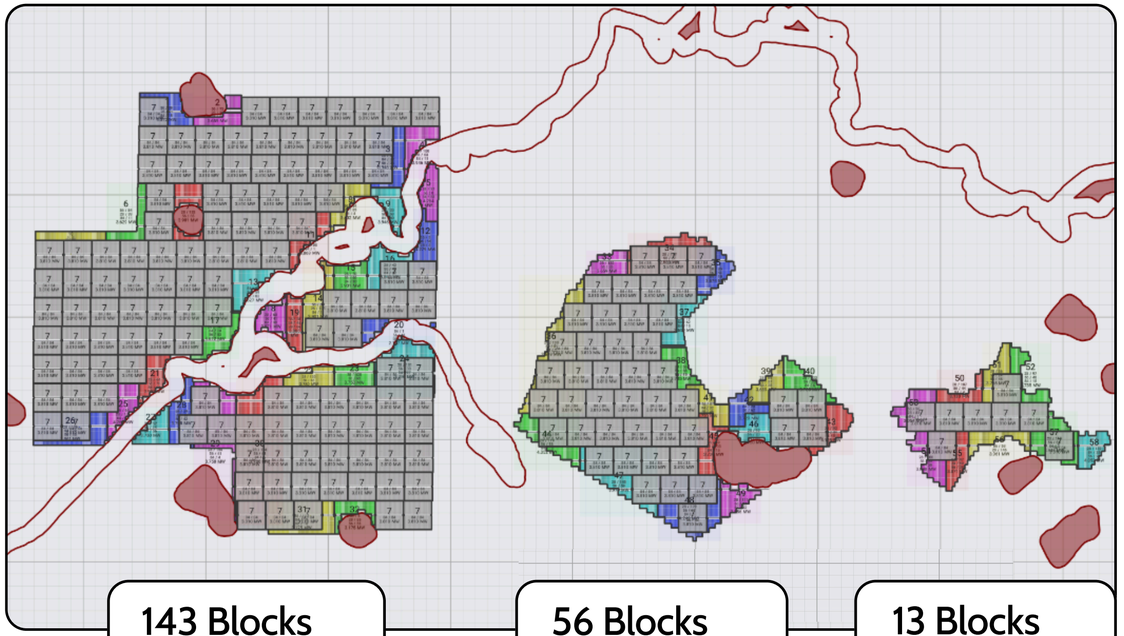
3 Single-Block Replicator Layout

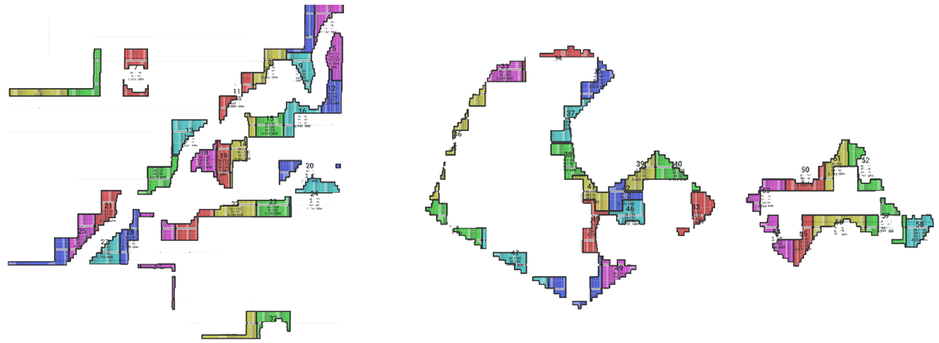
Total: ***860.9 MWdc***

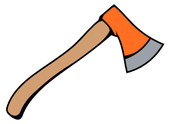
Philosophy: Choose one ideal block and stamp it across the site.

How it works: Replicate the same block everywhere it fits, then handle the edge cases last — maximum repetition, minimum variation.

Best for: Large sites where repeatability and consistency outweigh geometric perfection.



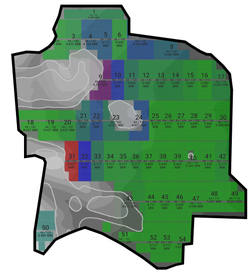


Chipping Away 

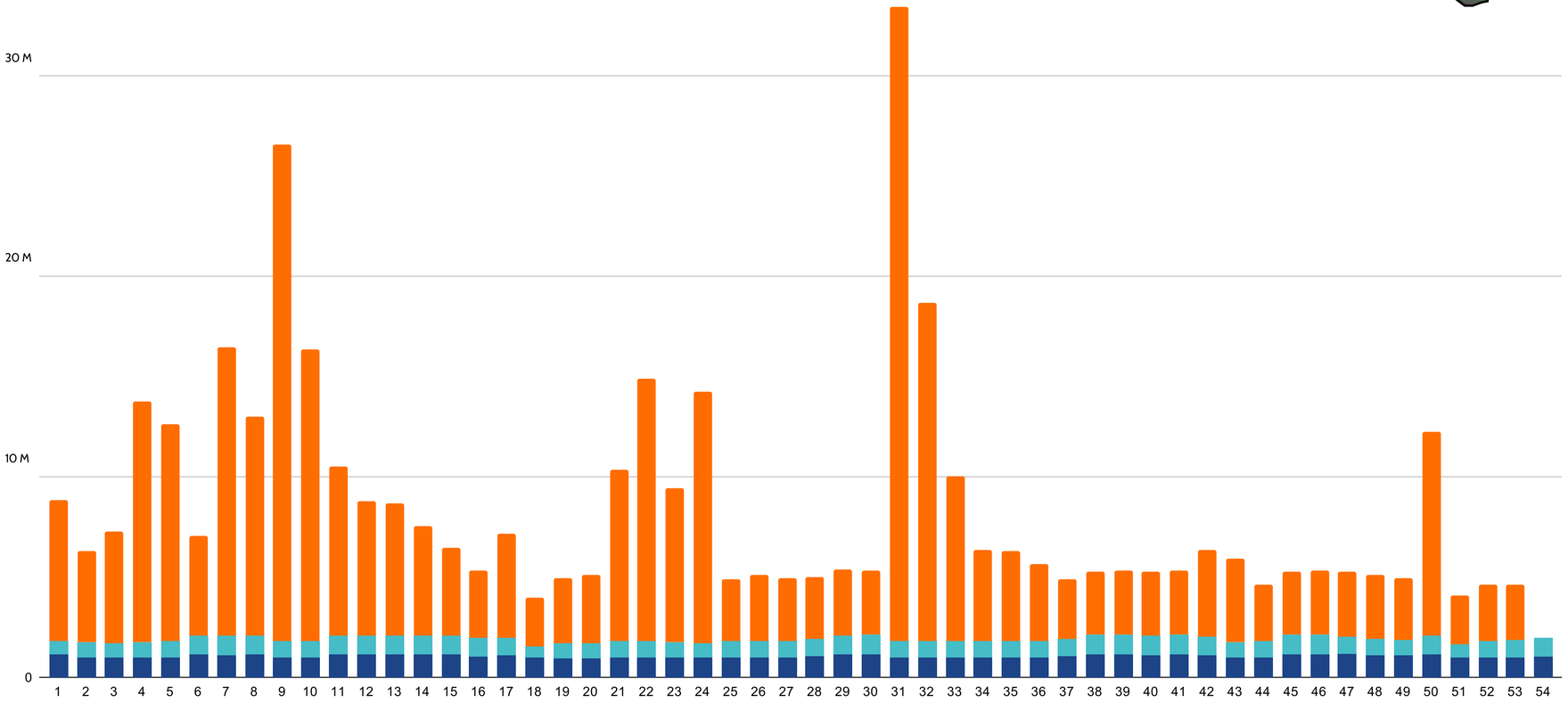
Which discipline is more expensive?	Granular Workflow	Electrical-Unit Workflow	Subarea Workflow
Civil	1. Find the most expensive trackers 2. Remove them until you meet DC target 3. Reblock layout	1. Find the most expensive blocks 2. Remove them until you meet DC target	1. Find the most expensive cut and fill areas 2. Exclude them and update layout
Electrical		1. Find the most expensive blocks 2. Remove them until you meet DC target 3. Align block lines to minimise electrical access cost	
Structural	1. Find the most expensive trackers and convert it into areas 2. Exclude them and update layout	1. Find the most expensive blocks 2. Remove them until you meet DC target	

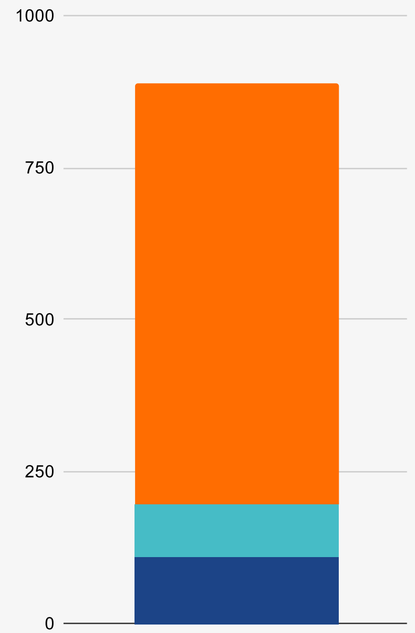
Defining Leading Discipline

Civil dominates

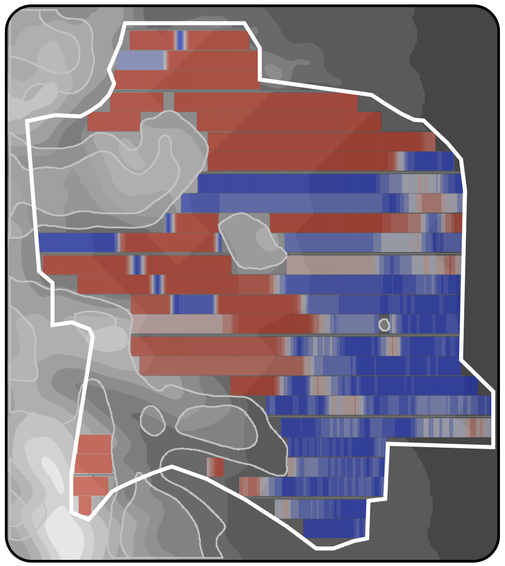


Civil
Electrical
Structural



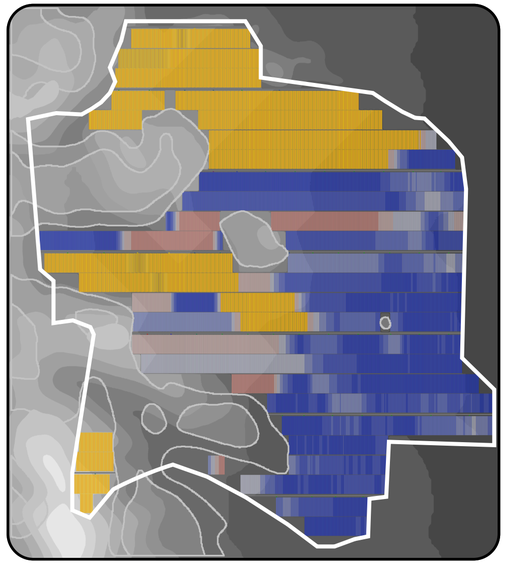


Civil: **Granular Workflow**



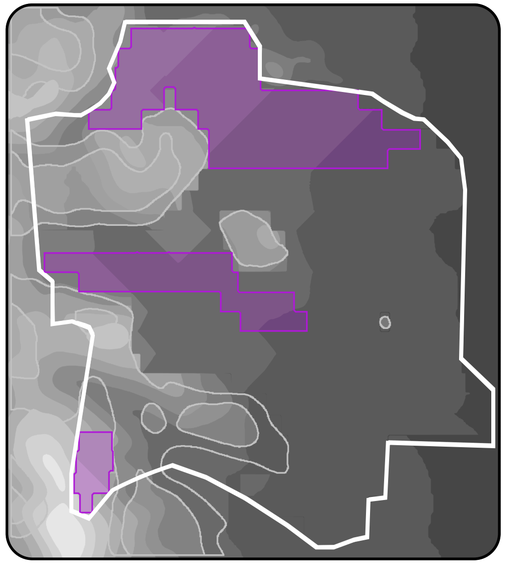
270 MWdc

0. Starting point



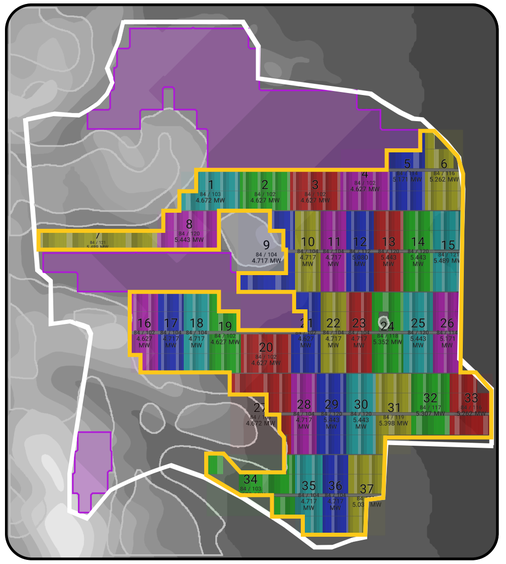
$0.325/W

1. Find the most expensive trackers



185 MWdc

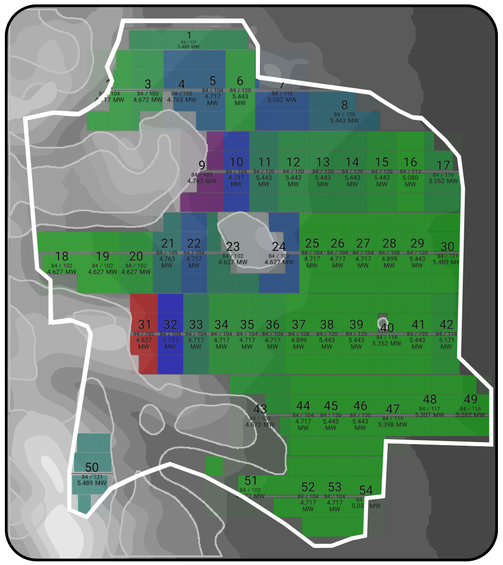
2. Remove them until you meet DC target



$0.243/W

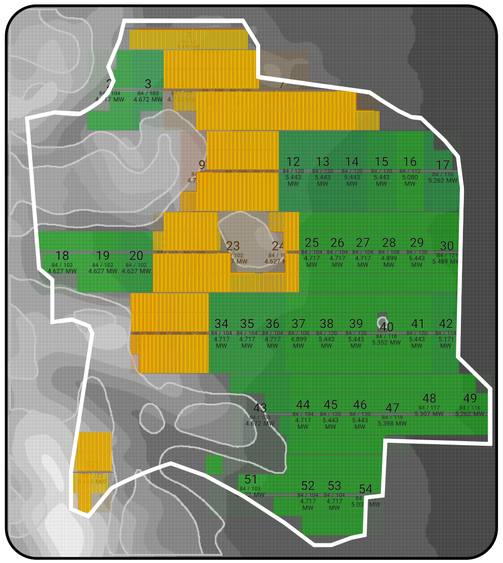
3. Reblock layout

Civil: **Electrical-Unit Workflow**



270 MWdc

0. Starting point



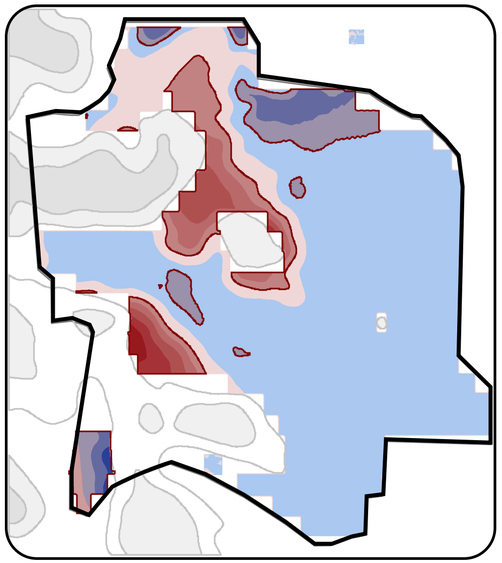
$0.325/W

1. Find the most expensive blocks

$0.197/W *185 MWdc*

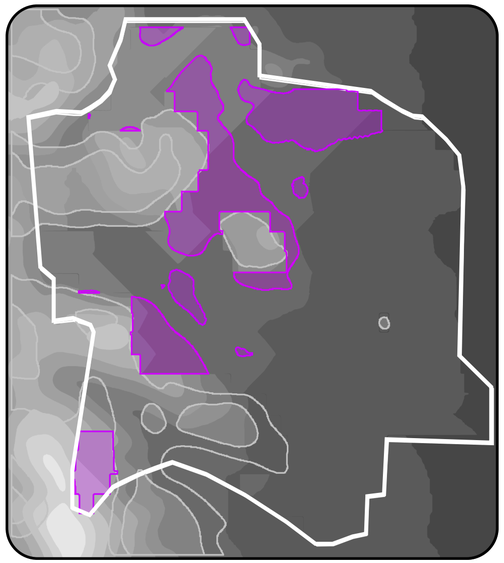
2. Remove them until you meet DC target

Civil: **Subarea Workflow**



270 MWdc

0. Starting point



$0.325/W

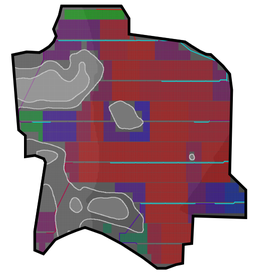
1. Find the most expensive cut and fill areas

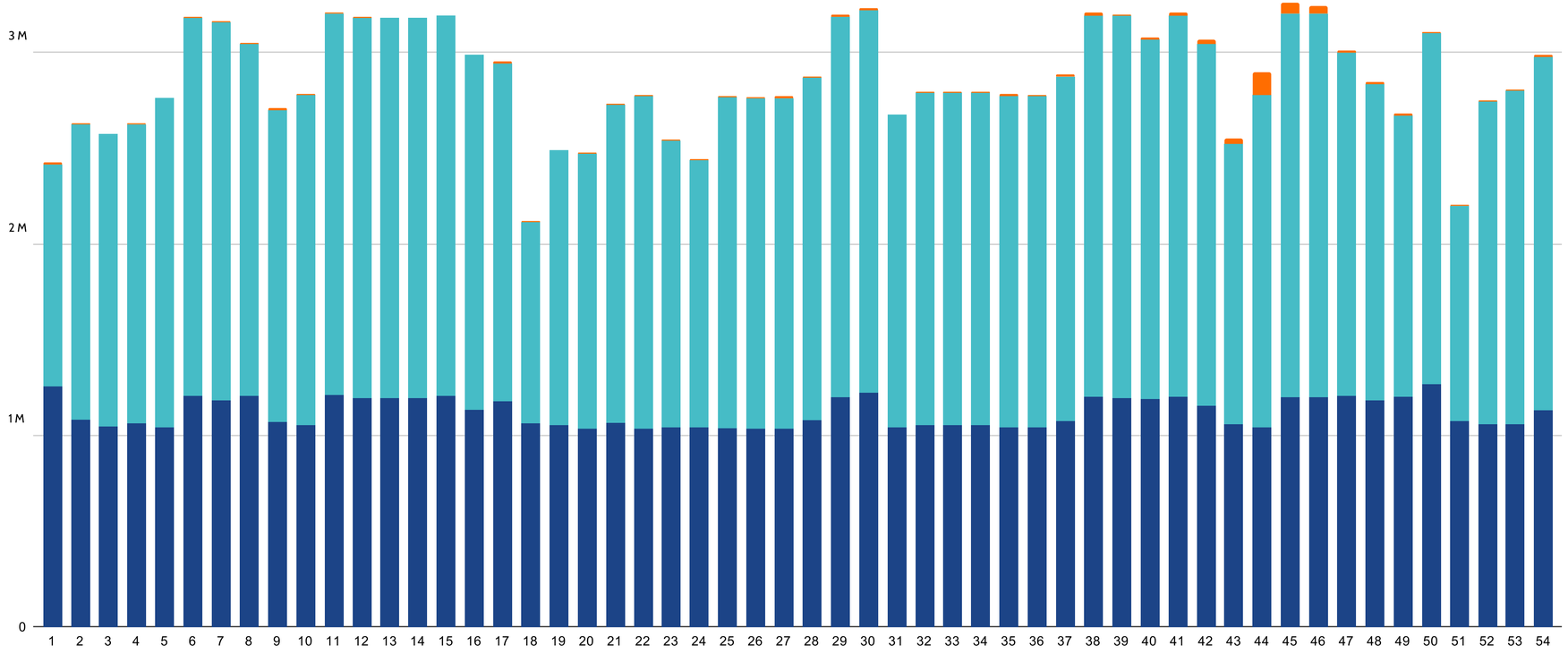
$0.242/W 185 MWdc

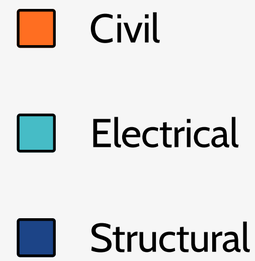
2. Exclude them and update layout

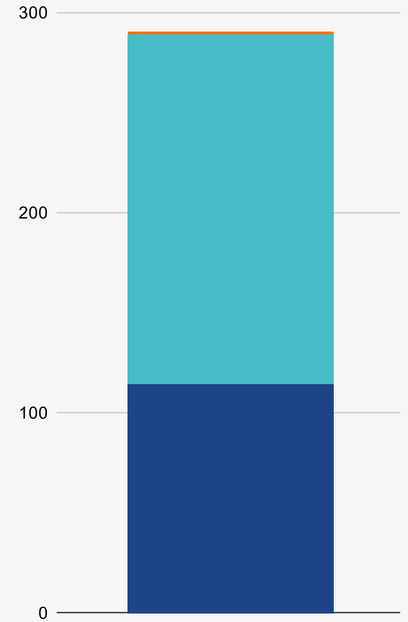
Defining Leading Discipline

Electrical dominates

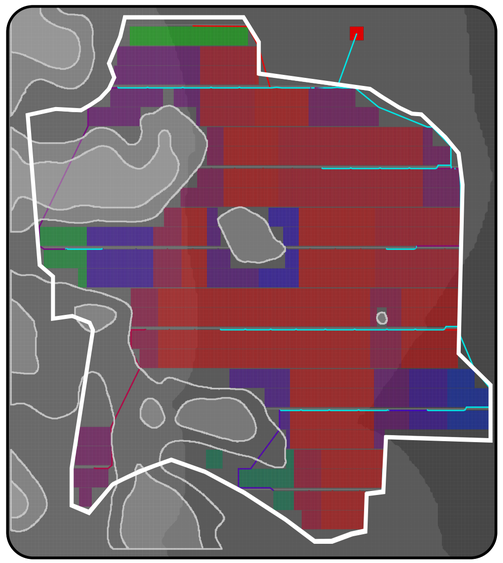






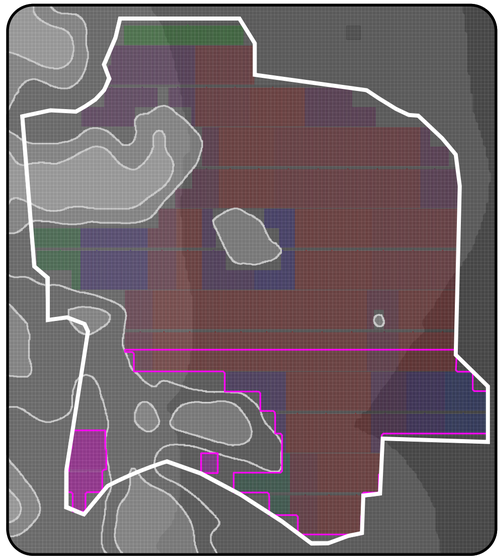


Electrical Unit: **Block Workflow**



270 MWdc

0. Starting point



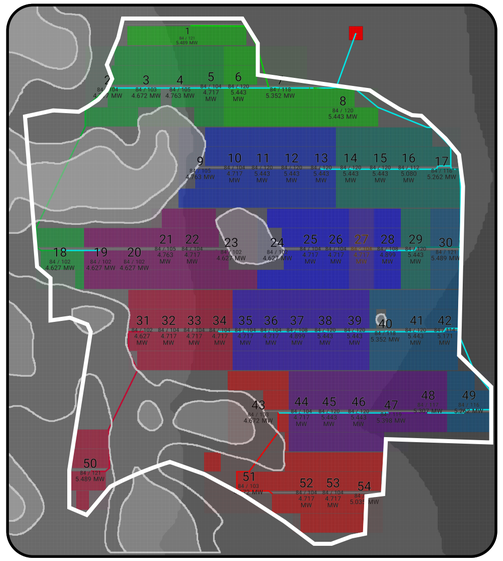
$0.344/W

1. Find the most expensive blocks

$0.059/W *185 MWdc*

2. Remove them until you meet DC target

Electrical Unit: **MV Group Workflow**

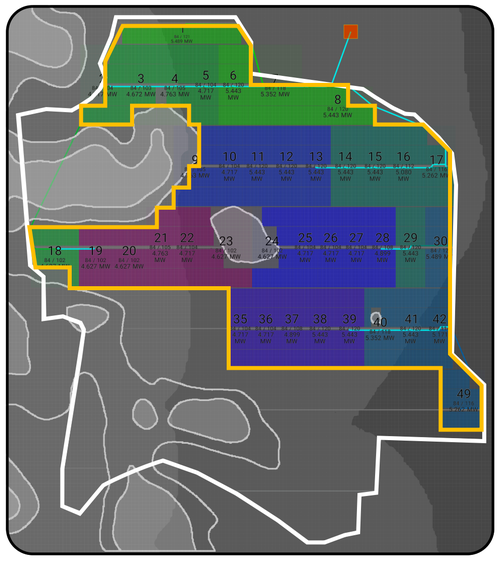


270 MWdc

0. Starting point

$0.344/W

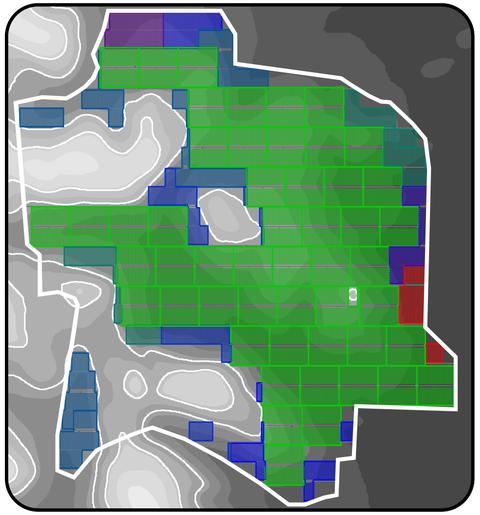
1. Find the most expensive MV groups



$0.320/W 185 MWdc

2. Remove them until you meet DC target

Electrical Unit: **Re-Shape Workflow**

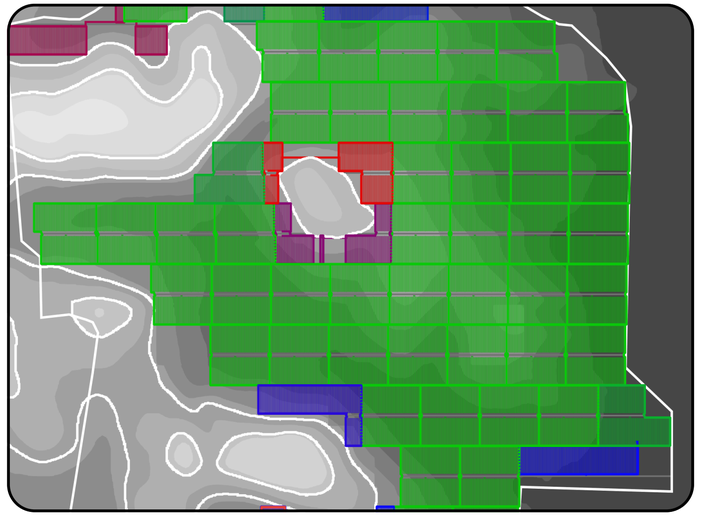


270 MWdc *$0.16/W*

0. Starting point

$0.126/W

1. Find the most expensive trackers



220 MWdc

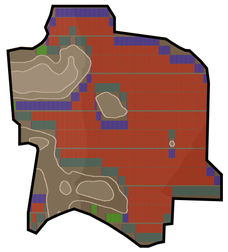
2. Remove them until you meet DC target

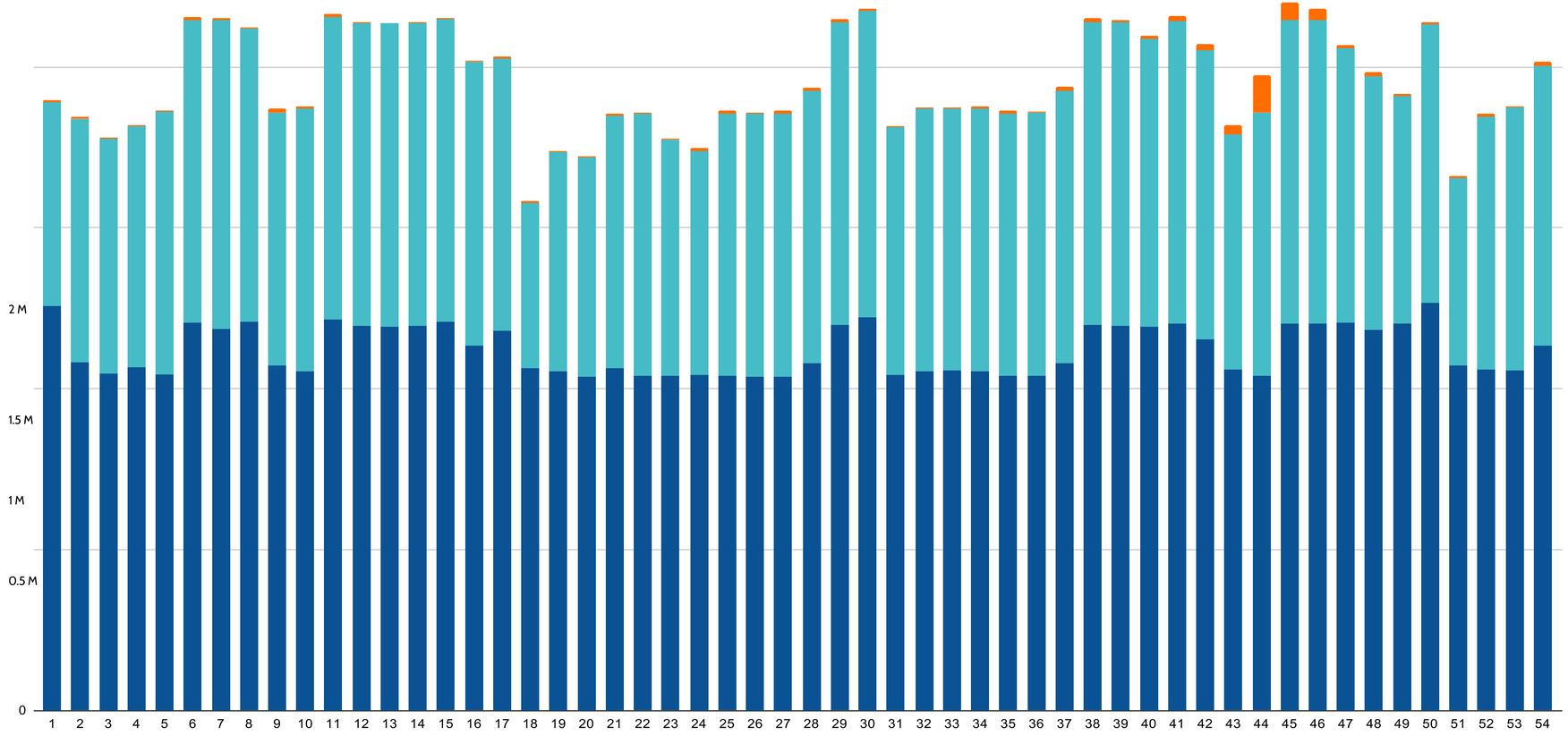
$0.105/W

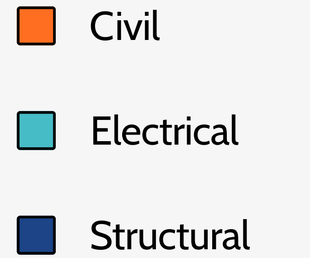
3. Reblock layout

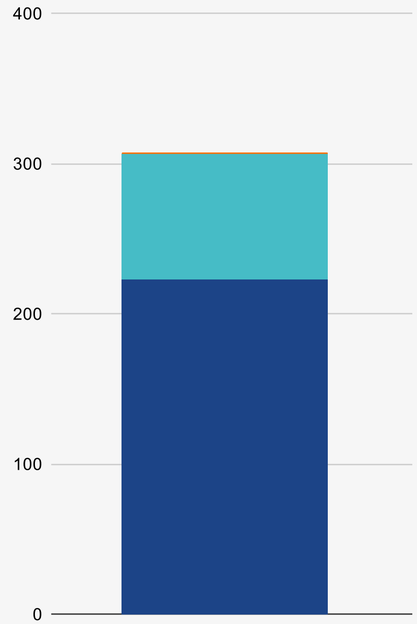
Defining Leading Discipline

Structural dominates

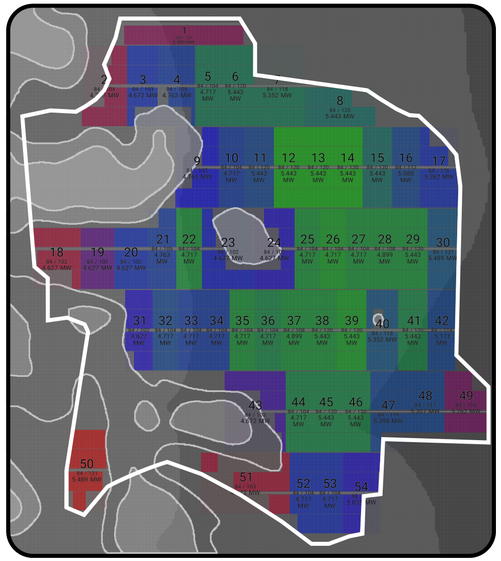






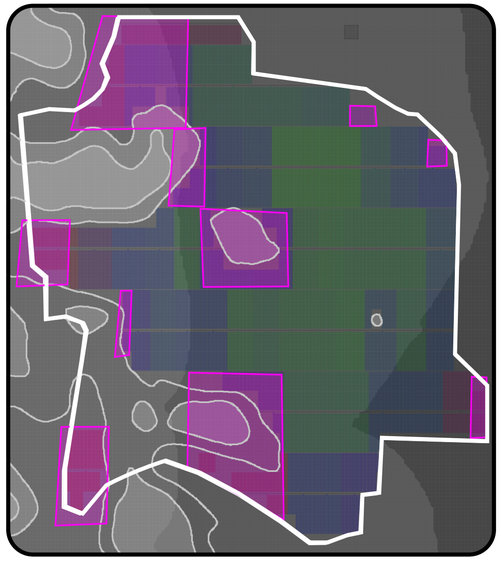


Structural: **Granular Workflow**



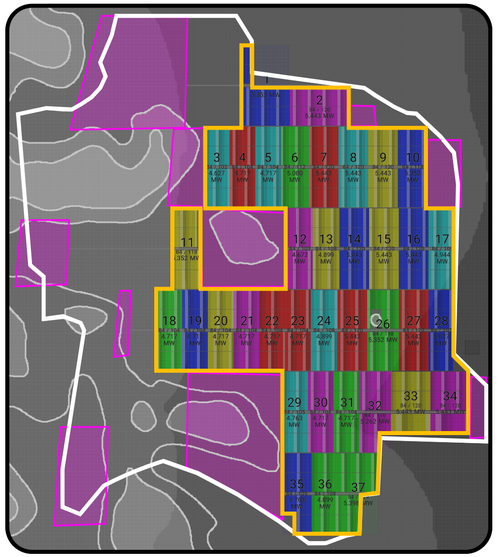
270 MWdc

0. Starting point



$0.223/W

1. Find the most expensive blocks



$0.212/W *185 MWdc*

2. Exclude them and update layout

$/W 🔥 Break Point

Workflow

When does adding more MW suddenly become too expensive?

1. Fill the site to 100%
   ↓
2. Expose the trouble spots
   ↓
3. Trim off the priciest areas
   ↓
4. Did trimming push $/W closer to the target?
   ↙ YES → Loop to 3
   NO ↘ → Stop trimming — further cuts either harm DC or don't help $/W
   ↓
5. Have we reached the required $/W target?
   ↙ YES → Lock the "Break Point" (Target achieved)
   NO ↘ → Continue trimming (Loop to 3)
   ↓
6. Run cross-discipline $/W optimisation (Civil ⇄ Structural ⇄ Electrical)
   ↓
7. Did optimisation free up headroom to add MW back?
   ↙ YES → Recover some MW (without breaking the $/W target)
   NO ↘ → Finalise the design ↓ End
   ↓

Loop back to Step 6 if needed

Target DC vs Lowest LCOE

Workflow

How to find the best layout
if you are constrained by the grid?

1. Fill the site to 100%
   ↓
2. Define the leading discipline
   ↓
3. Chip away the most expensive areas
   ↓
4. Is DC still ≥ target?
   ↙ YES NO ↘
   Loop to 3 Lock the Basis of Design
   ↓
5. LCOE Optioneering
   Shift for buildability, routing,
   grading, ILR, block structure
   ↓
6. Run Newton-style Pass
   (re-solve + re-optimise)
   ↓
7. Did LCOE barely move from run to run?
   ↙ YES NO ↘
   You're close enough Loop back to Step 6
   ↓
   End

Max DC vs Lowest LCOE

Workflow

How to find the best layout
if you are constrained by the land?

1. Fill the site to 100%
↓
5. LCOE Optioneering
Shift for buildability, routing,
grading, ILR, block structure
↓
6. Run Newton-style Pass
(re-solve + re-optimise)
↓
7. Did LCOE barely move from run to run?
↙ YES NO ↘
You're close enough Loop back to Step 6
↓
End

Budget vs Lowest LCOE

Workflow

How to find the best layout if you are constrained by budget?

1. Fill the site to 100%
   ↓
2. Calculate total CAPEX
   ↓
3. Identify the most expensive areas (Structural, Civil, Electrical)
   ↓
4. Trim the highest-cost areas first
   ↓
5. Did trimming reduce total CAPEX toward the budget?
   ↙ YES → Loop to 3
   NO ↘ → Stop — further cuts lose too much DC
   ↓
6. Are we now within the allocated budget?
   ↙ YES → Lock the Budget Point (Budget satisfied)
   NO ↘ → Continue trimming (Loop to 3)
   ↓
7. Run cross-discipline optimisation (Civil ⇄ Structural ⇄ Electrical)
   ↓
8. Did optimisation free enough headroom to add MW back?
   ↙ YES → Recover some MW (without breaking the budget)
   NO ↘ → Finalise the design
   ↓
   End

Loop back to Step 7 if needed

Thank you!

Any questions?