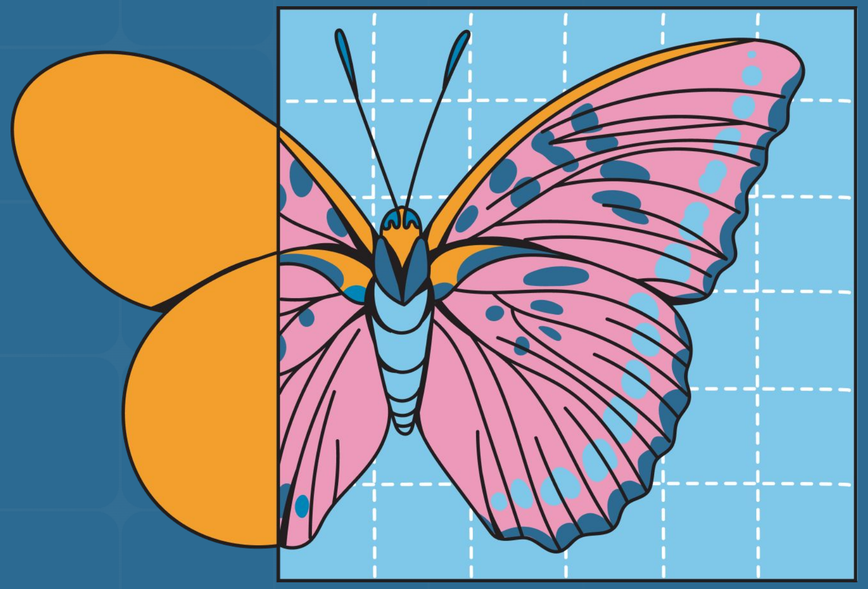
Quick & Dirty *vs.* *Built to Last:* Solar Layouts Done Right

Solar Layouts: Beyond the Drawing

Seems simple at first, but there's more to it than meets the eye



What people typically think when they hear *“Solar Layout”*...

Site area

Location	31° 47' 6" -106° 29' 42"	Meteodata ✓
Buildable area	1180.98 ac	
Footprint	1017.12 ac	

Equipment

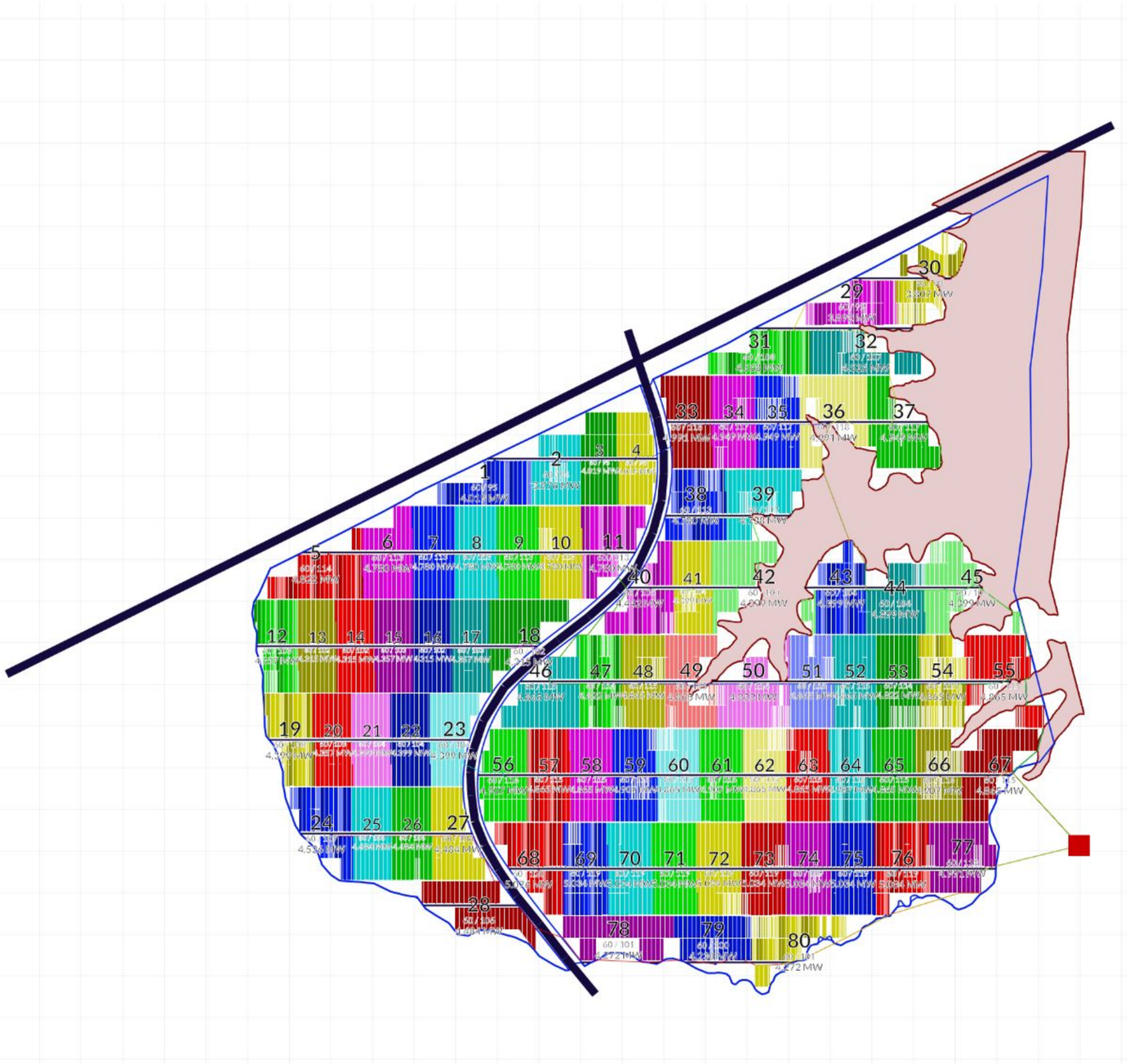
PV modules	**372070.80** kW	**527760**
CSI Solar CS7N-705TB-AG 705.0 W	372070.80 kW	527760
GCR	0.43	
Any trackers	**372070.80** kW	**8796**
DuraTrack HZ v3 CS7N-705TB-AG...	372070.80 kW	8796
Row to row	18.00-30.00 ft	
Combiner boxes		**1525**
DC Combiner Box 1500V 405.0 A		1525
Inverters		**80**
Generic Central 3605 3605.0 kW 1MOD		80
Transformers		**80**
Generic Transformer 8800.0 kW 35500.0 V		80

Energy

DC total	372070.80 kW	
AC total	288400.00 kW	
DC/AC ratio	1.29	
LV voltage drop	5453.87 kW	1.47 %
MV voltage drop	2323.69 kW	0.81 %
Year 1 energy yield and performance	917407.71 MWh	84.59 %
Specific annual yield	2465.68 Wh/W	

Civil

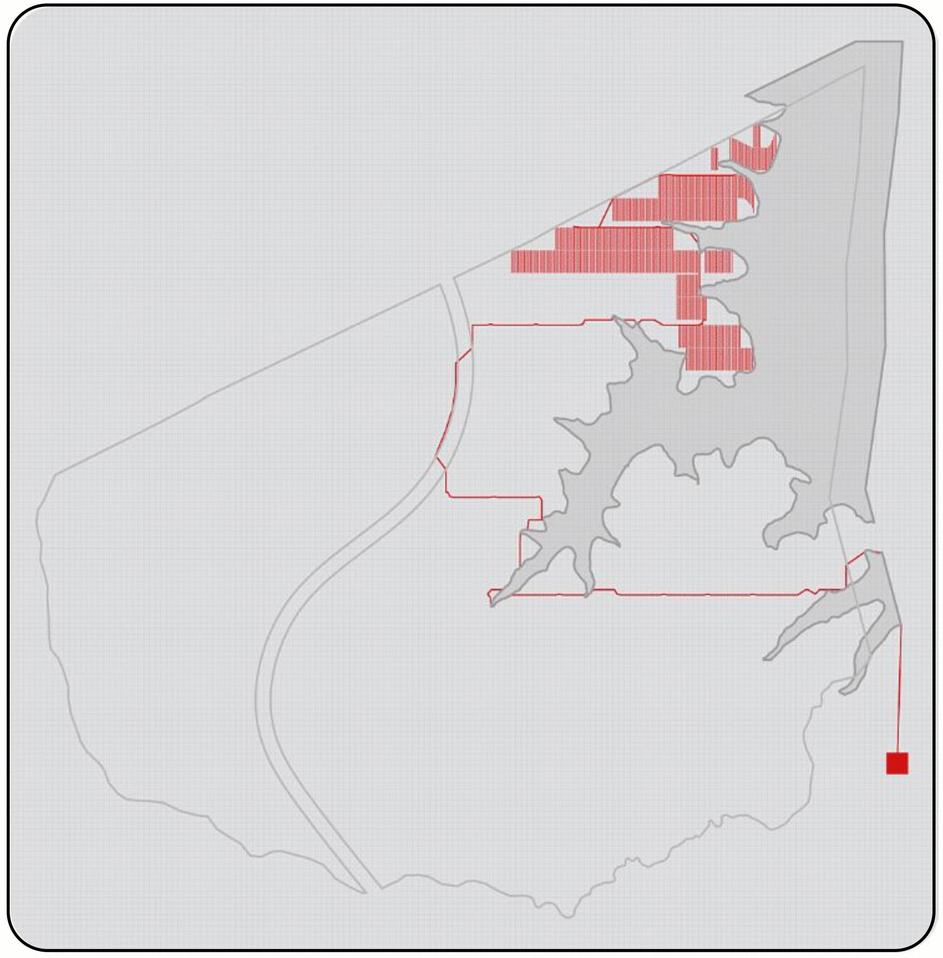
Trenches	78668 yd3	297542 ft
Cut fill total	3288112.88 yd3	
Cut fill net balance	613116.09 yd3	

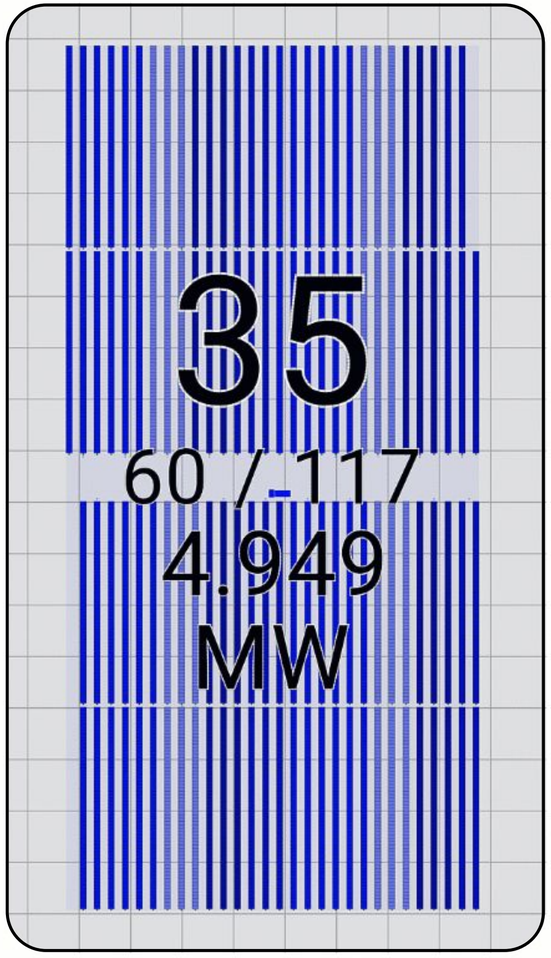


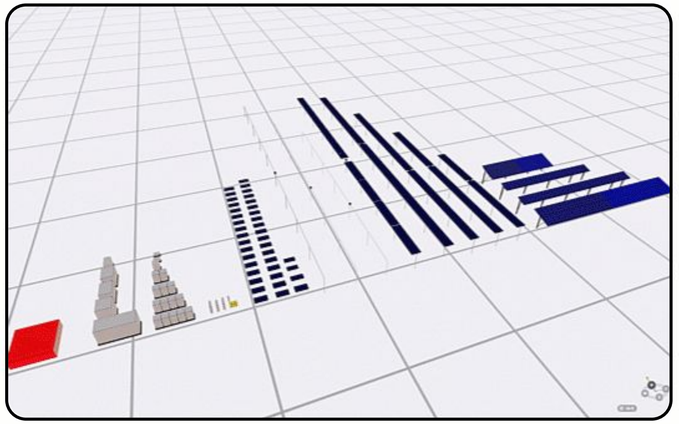
What a *“Solar Layout”* actually is?

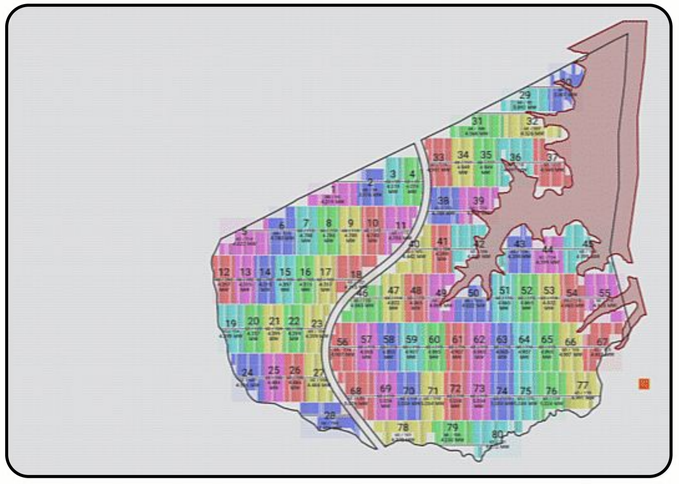
Multidisciplinary Harmony

Everything runs in sync, seamlessly connected to generate energy

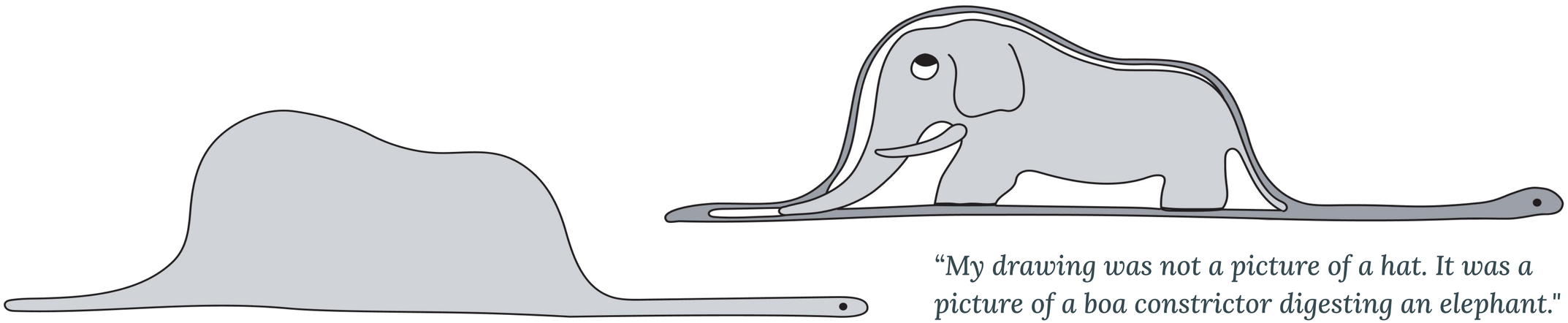






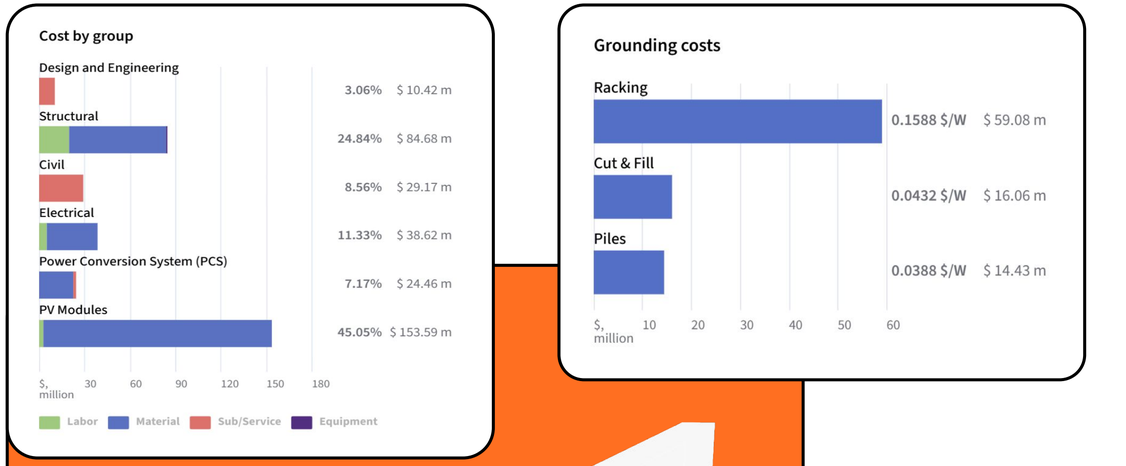


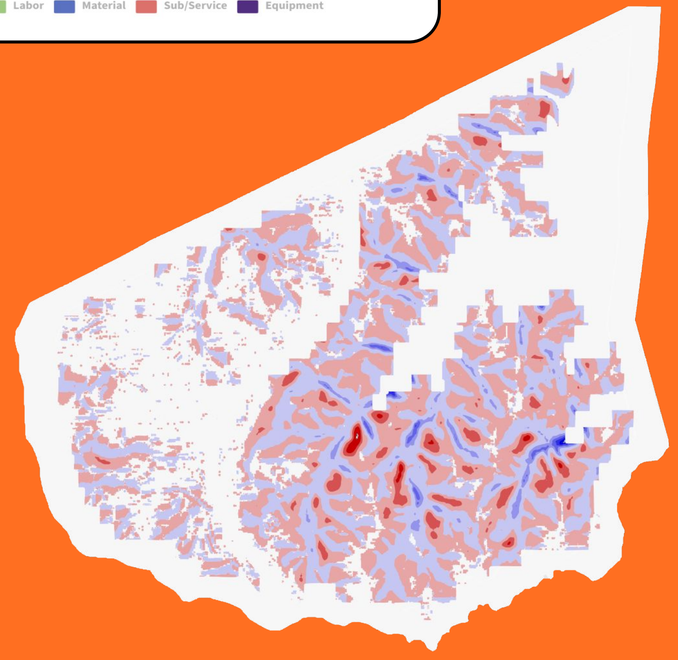
There are countless hidden considerations, making solar PV layouts deceptively simple at first glance but remarkably complex upon closer inspection

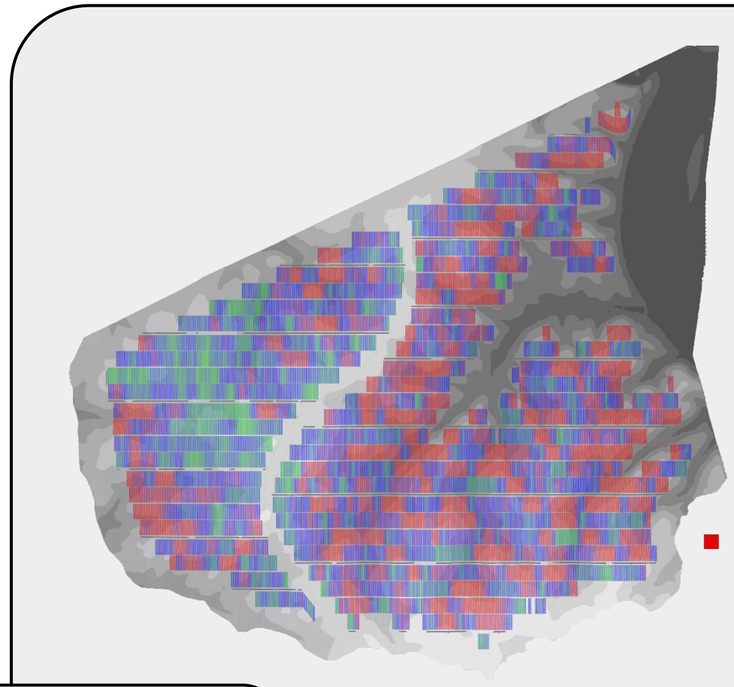


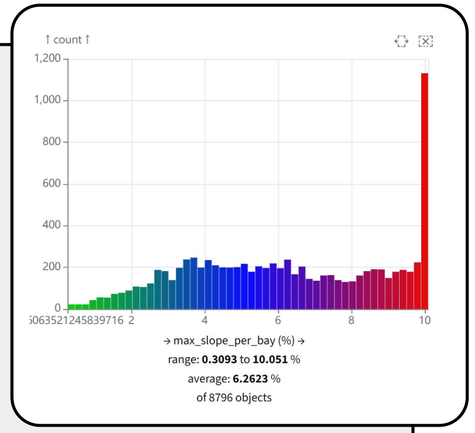
“My drawing was not a picture of a hat. It was a picture of a boa constrictor digesting an elephant."

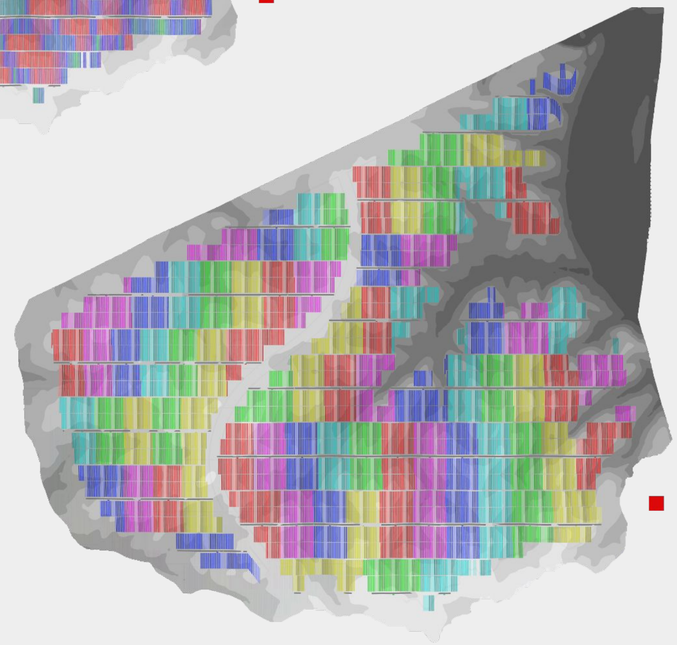
Civil Engineering











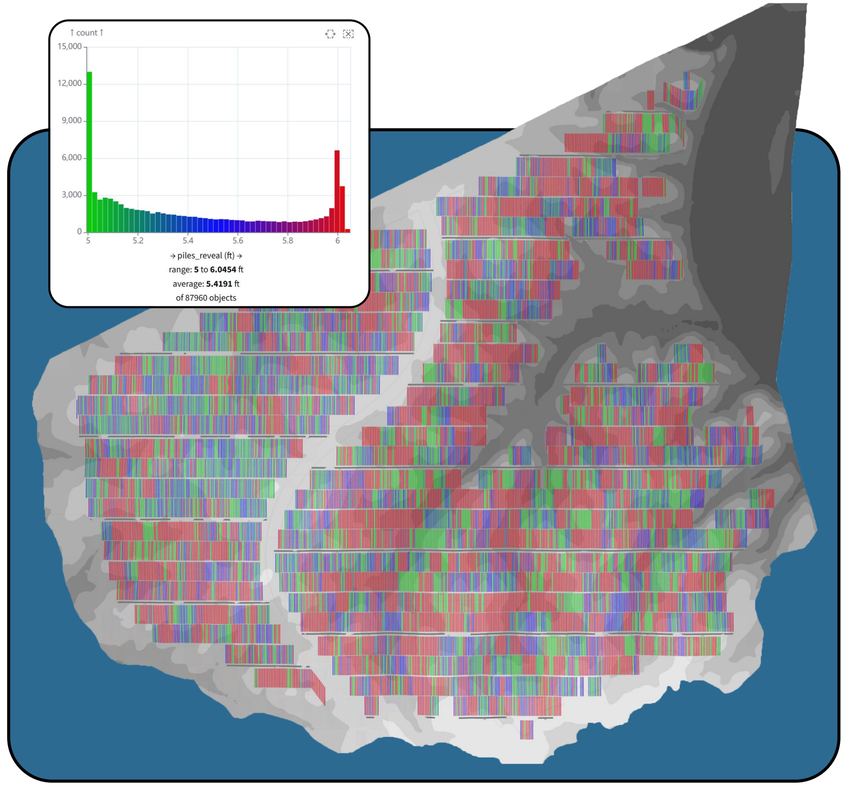
Results

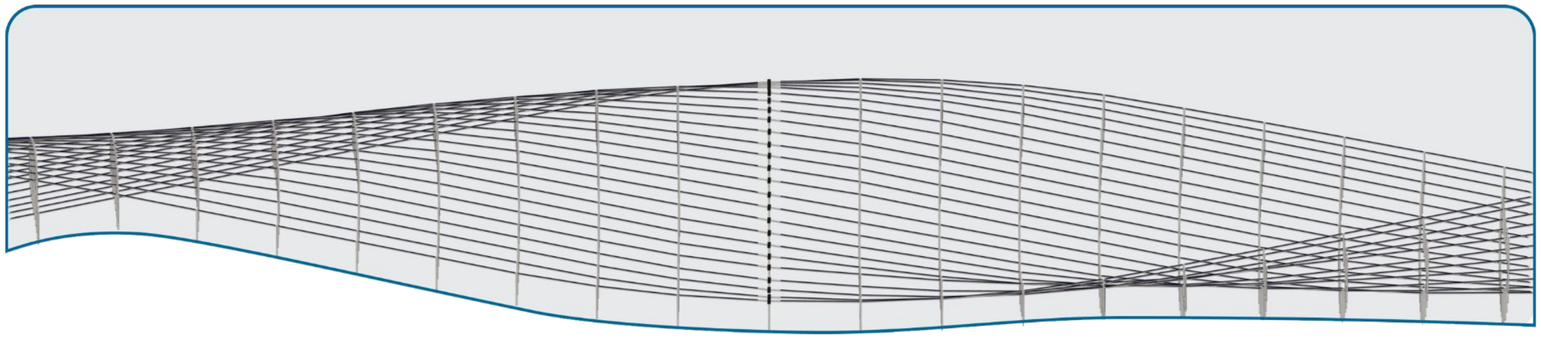
40.93 % Cut volume	Net balance	59.07 % Fill volume
1314388.43 yd3	582761.61 yd3	1897150.05 yd3

22.99 % Cut disturbed area	55.36 % Undisturbed area	21.66 % Fill disturbed area
389.95 ac	1696.45 ac	367.42 ac

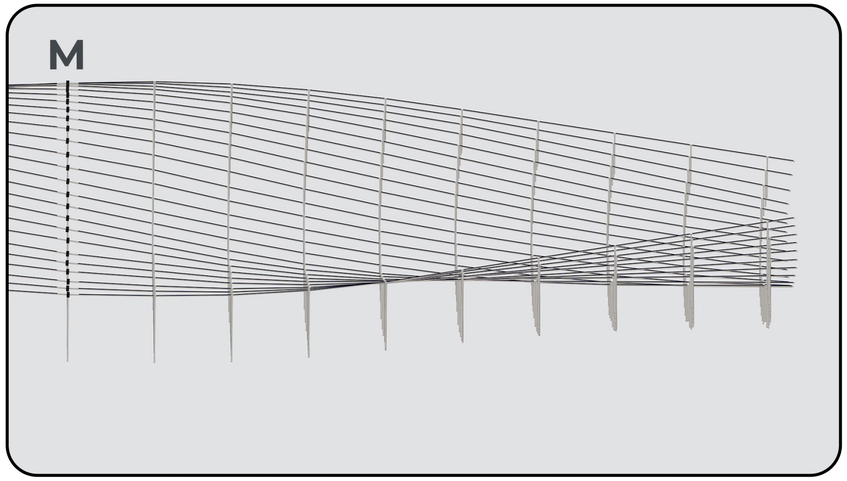
Results breakdown by depth

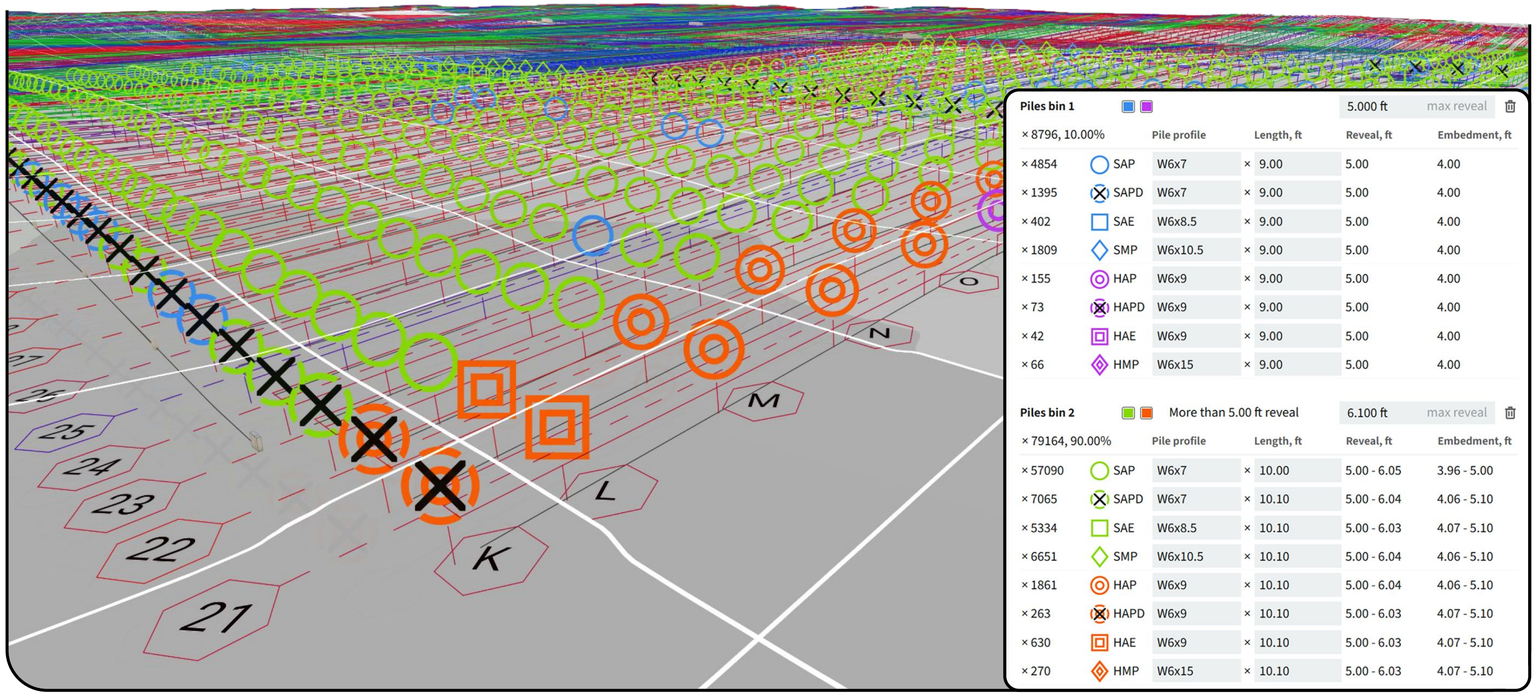
		Min	Max	Area		Volume	
		ft	ft	ft2	%	yd3	%
	-4	–	–				
	-3	-17.85	-17.23	3360.37	0.01	408.33	0.01
	-2	-17.23	-8.62	466927.27	0.74	56737.54	1.77
	-1	-8.62	-0.01	16515781.45	26.14	2006875.36	62.49
	0	-0.01	0.01	30195758.65	47.79	3669164.80	114.25
	1	0.01	8.62	14443836.78	22.86	1755108.00	54.65
	2	8.62	17.23	1462052.49	2.31	177657.78	5.53
	3	17.23	25.85	89291.54	0.14	10850.05	0.34
	4	25.85	34.45	9665.55	0.02	1174.49	0.04

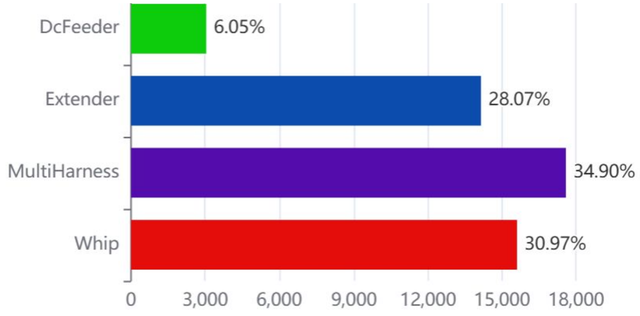




Structural Engineering






DcFeeder
6.05%
Extender
28.07%
MultiHarness
34.90%
Whip
30.97%
0
3,000
6,000
9,000
12,000
15,000
18,000

#10 AWG copper
6 Tables
CSI Solar CS7N-705TB-AG 705.0 W
DC Combiner Box 1500V 405.0 A #1
222 A
#10 AWG copper
6 Tables
CSI Solar CS7N-705TB-AG 705.0 W
DC Combiner Box 1500V 405.0 A #16
222 A
#10 AWG copper
4 Tables
CSI Solar CS7N-705TB-AG 705.0 W
DC Combiner Box 1500V 405.0 A #17
148 A
#10 AWG copper
4 Tables
CSI Solar CS7N-705TB-AG 705.0 W
DC Combiner Box 1500V 405.0 A #18
148 A
Generic Central 3605 3605.0 kW 1MOD #1
Generic Transformer 8800.0 kW 35500.0 V
MV Cable

Presenting *“Solar Layout”* in PVFARM?

Making layout is like cooking a dish...

Layout Conditions:

Context: meteo, terrain model, hydrology…

Requirements & Restrictions: DC capacity, energy

Layout Ingredients:

Spatial objects: roads, fence, boundaries…

Equipment: modules, combiner boxes, inverters, transformers…

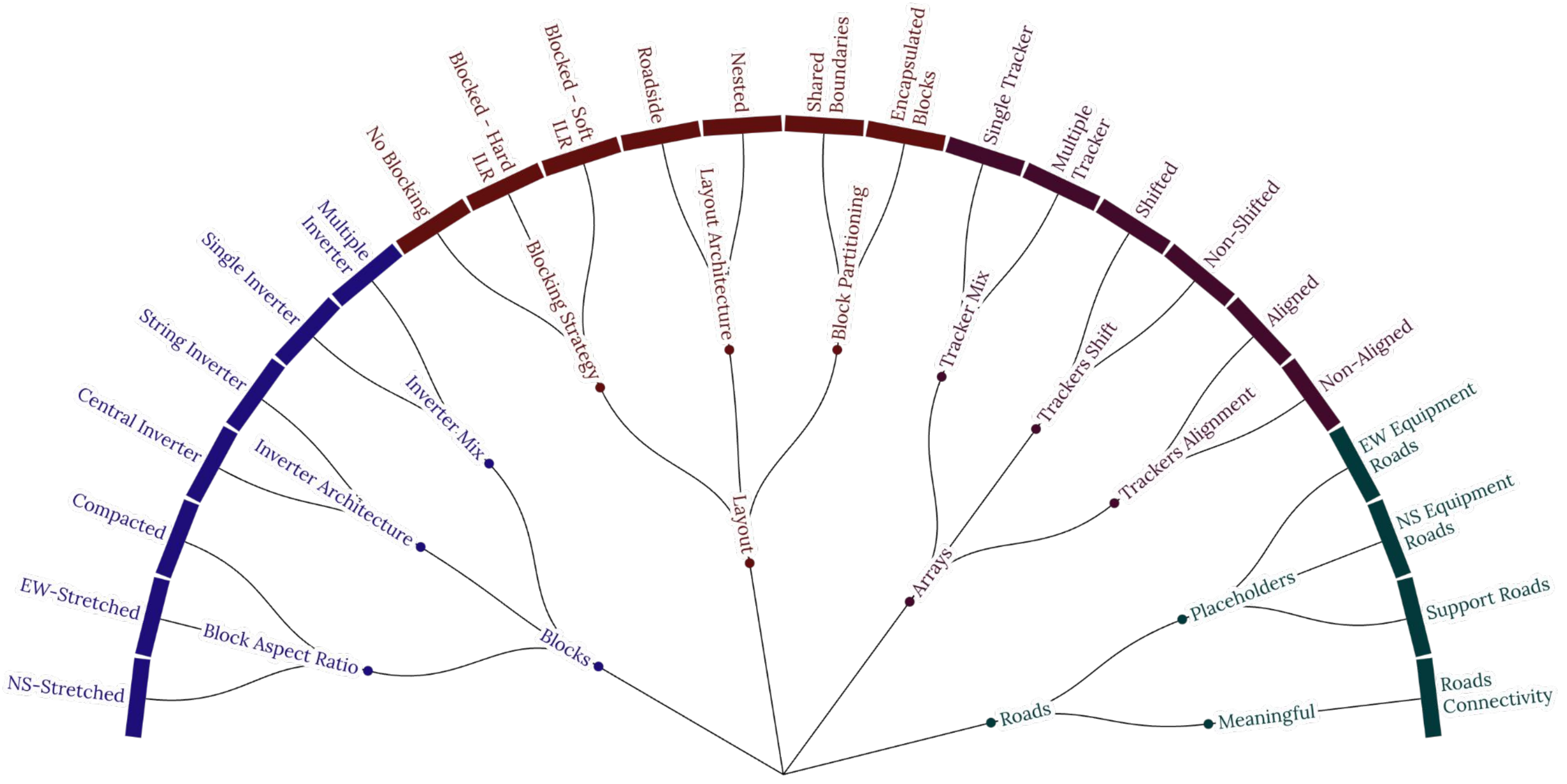
Electrical Groups: strings, combiner box groups, blocks, MV groups…

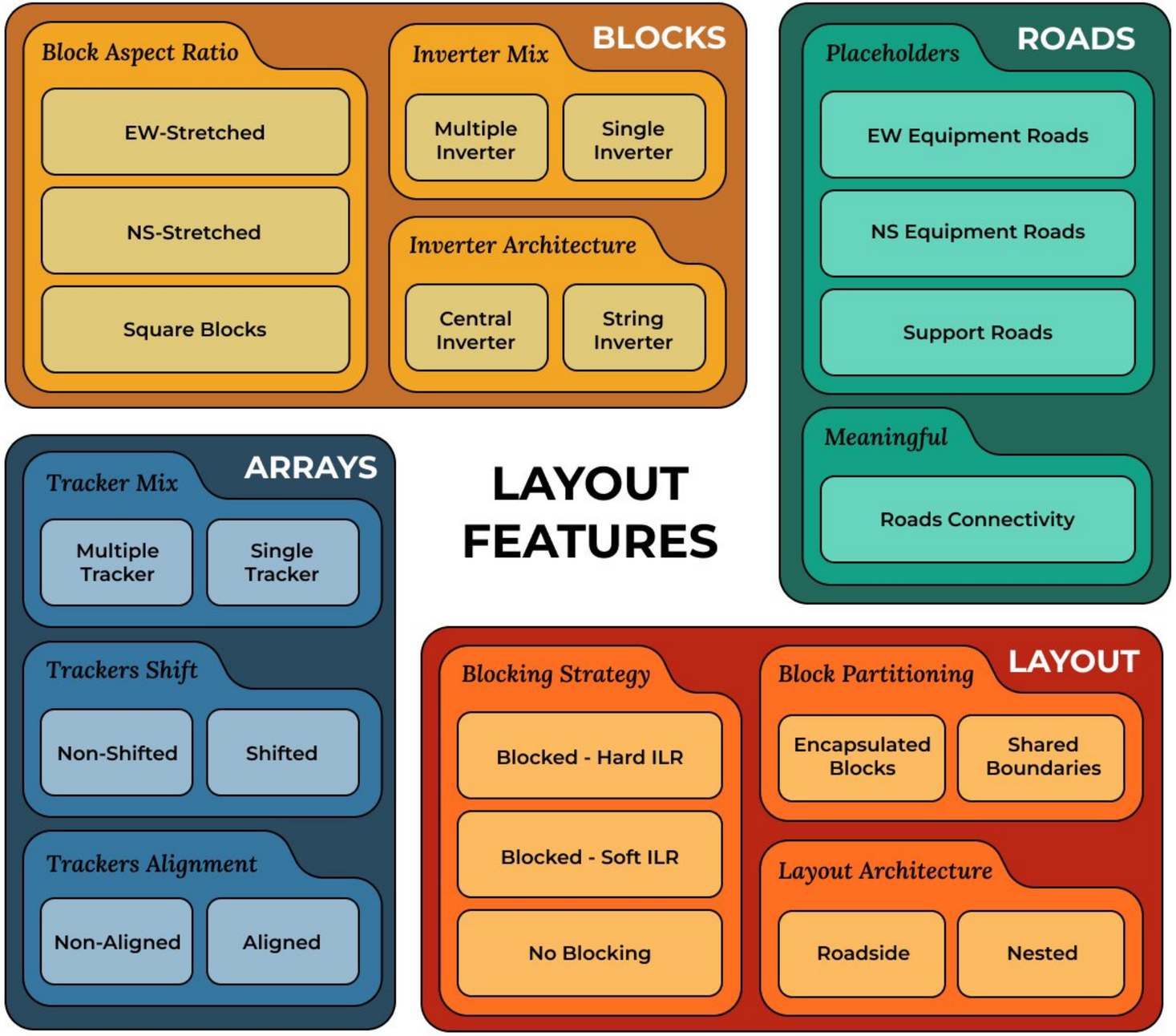
Structural Racking: SAT, FT…

Layout Conditions + Layout Ingredients => Recipe => **Layout**

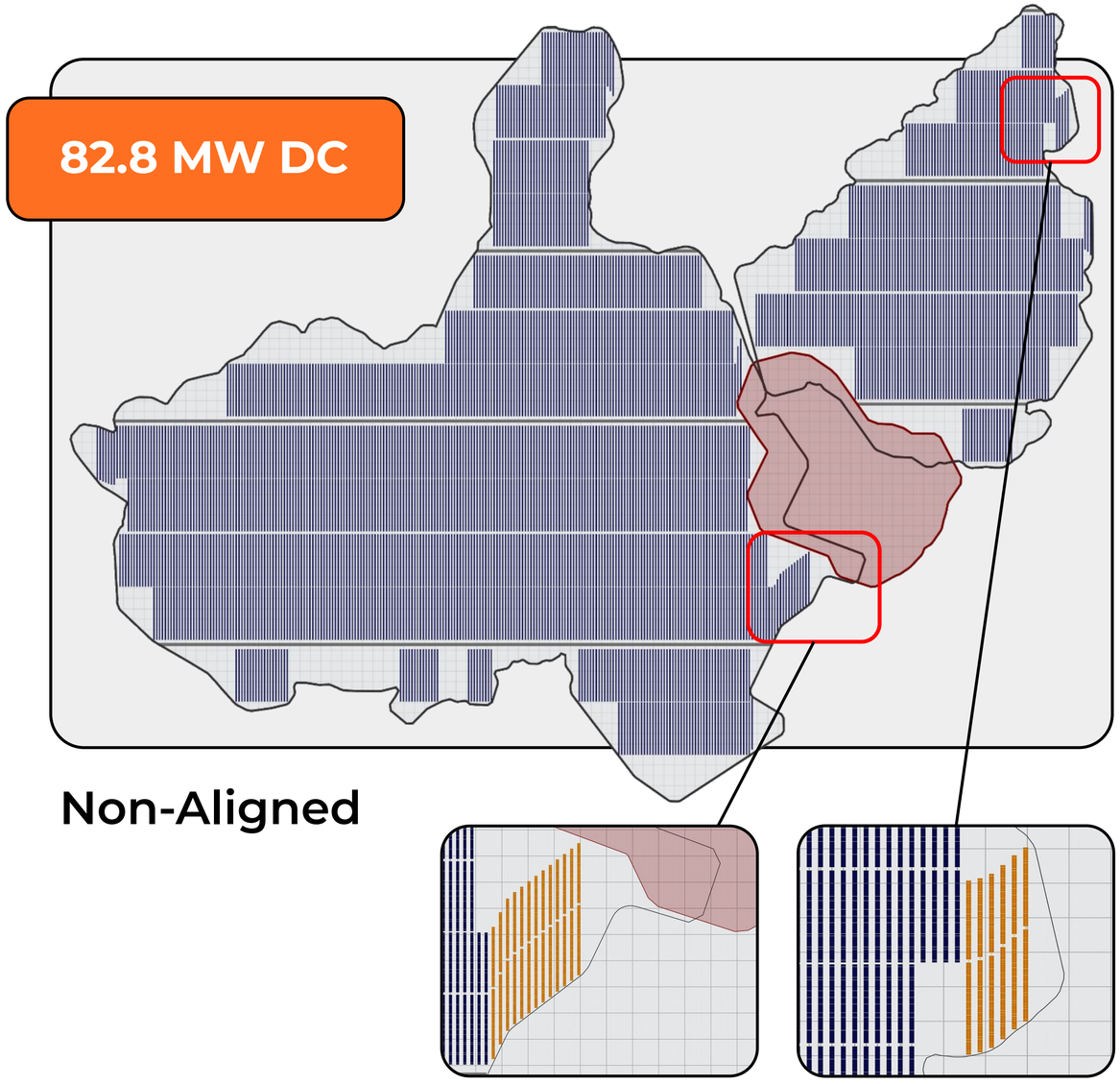
Solar Layouts: Key Features

A solar layout is a carefully crafted blend of design choices, each one shaping how it all fits, functions, and flows

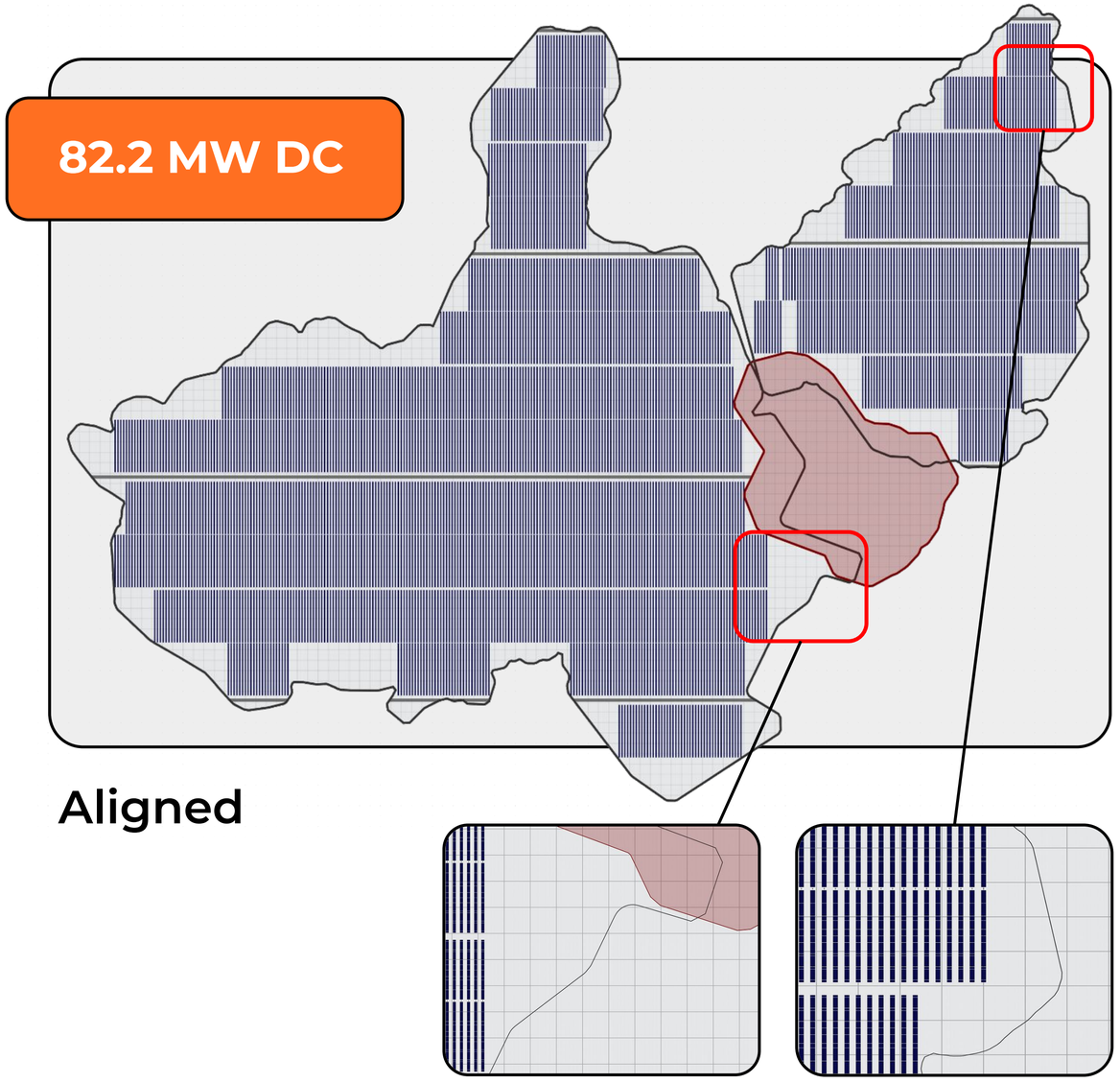

Multiple Inverter
Single Inverter
String Inverter
Central Inverter
Compacted
EW-Stretched
NS-Stretched
No Blocking
Blocked - Hard ILR
Blocked - Soft ILR
Roadside
Nested
Shared Boundaries
Encapsulated Blocks
Single Tracker
Multiple Tracker
Shifted
Non-Shifted
Aligned
Non-Aligned
Inverter Mix
Inverter Architecture
Block Aspect Ratio
Blocking Strategy
Layout Architecture
Block Partitioning
Tracker Mix
Trackers Shift
Trackers Alignment
Inverters
Blocks
Layout
Arrays
Roads
Placeholders
Meaningful
EW Equipment Roads
NS Equipment Roads
Support Roads
Roads Connectivity


BLOCKS
Block Aspect Ratio
EW-Stretched
NS-Stretched
Square Blocks
Inverter Mix
Multiple Inverter
Single Inverter
Inverter Architecture
Central Inverter
String Inverter
ROADS
Placeholders
EW Equipment Roads
NS Equipment Roads
Support Roads
Meaningful
Roads Connectivity
ARRAYS
Tracker Mix
Multiple Tracker
Single Tracker
Trackers Shift
Non-Shifted
Shifted
Trackers Alignment
Non-Aligned
Aligned
LAYOUT FEATURES
LAYOUT
Blocking Strategy
Blocked - Hard ILR
Blocked - Soft ILR
No Blocking
Block Partitioning
Encapsulated Blocks
Shared Boundaries
Layout Architecture
Roadside
Nested

Arrays: Trackers Alignment



Non-Aligned

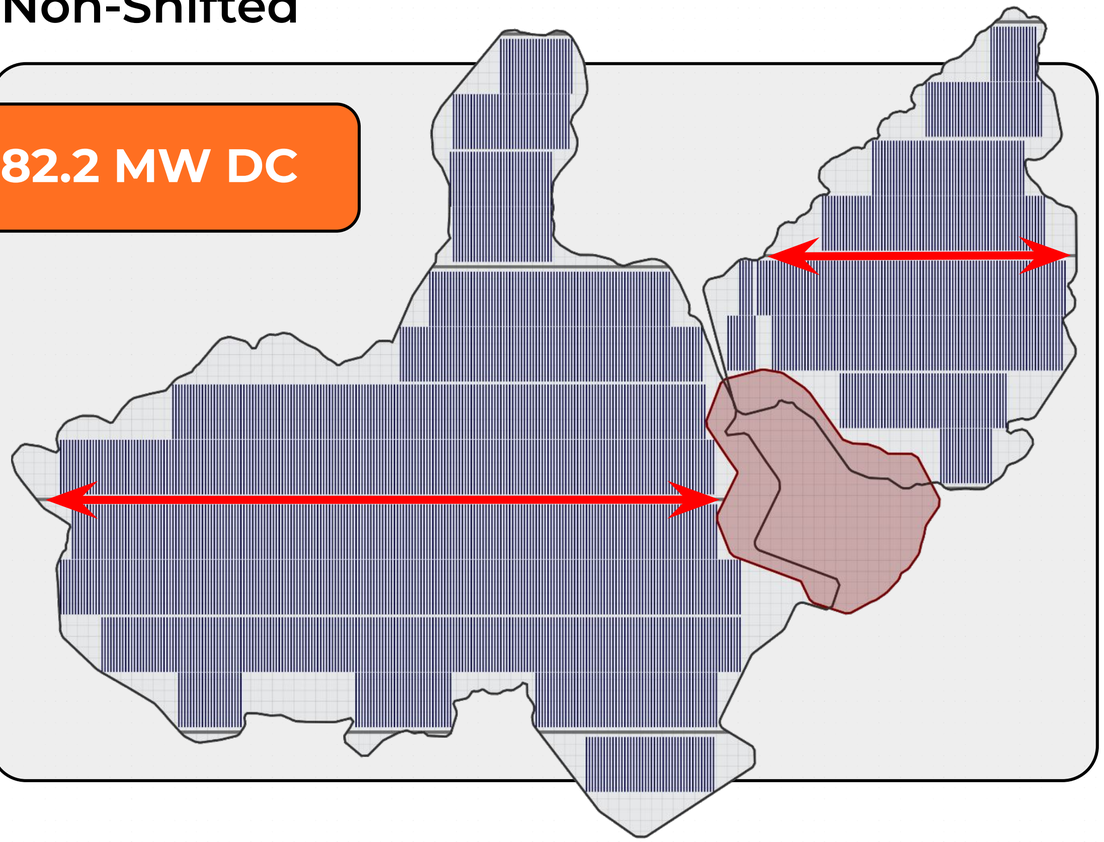


Aligned

Arrays: Trackers Shift

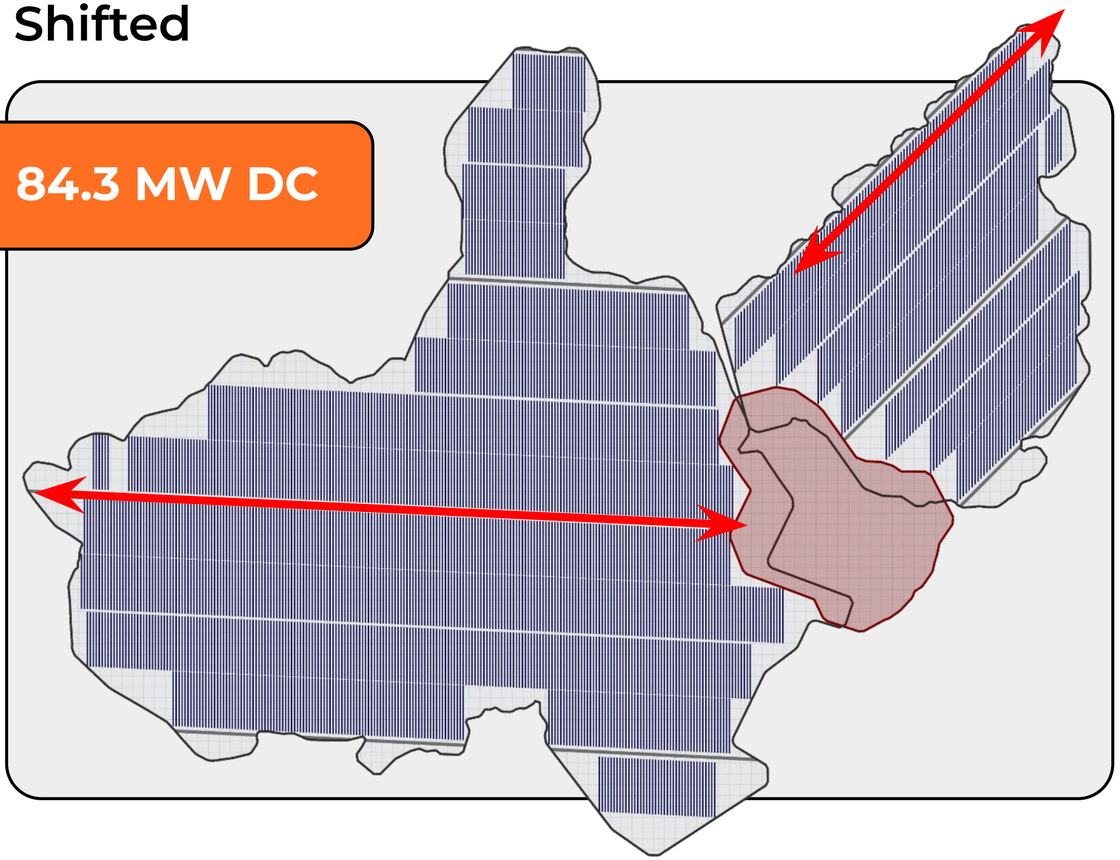
Non-Shifted

82.2 MW DC



Shifted

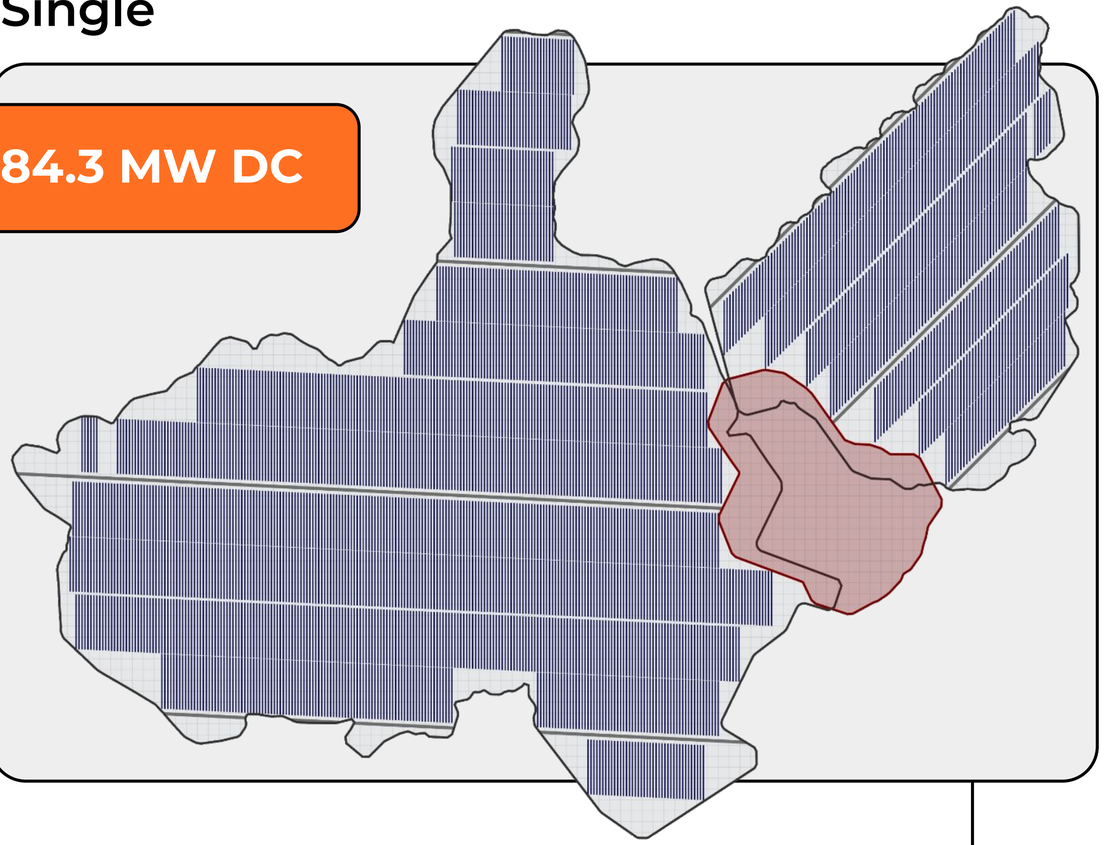
84.3 MW DC



Arrays: Tracker Mix

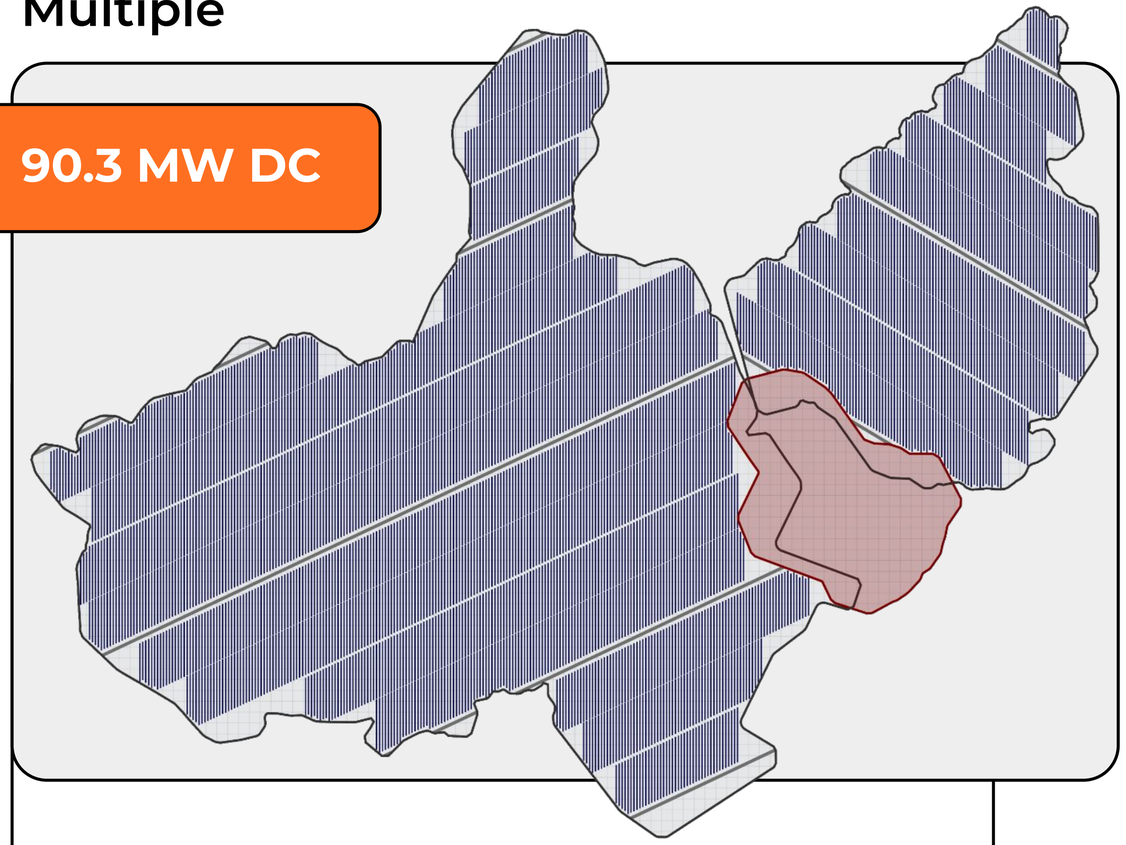
Single

84.3 MW DC



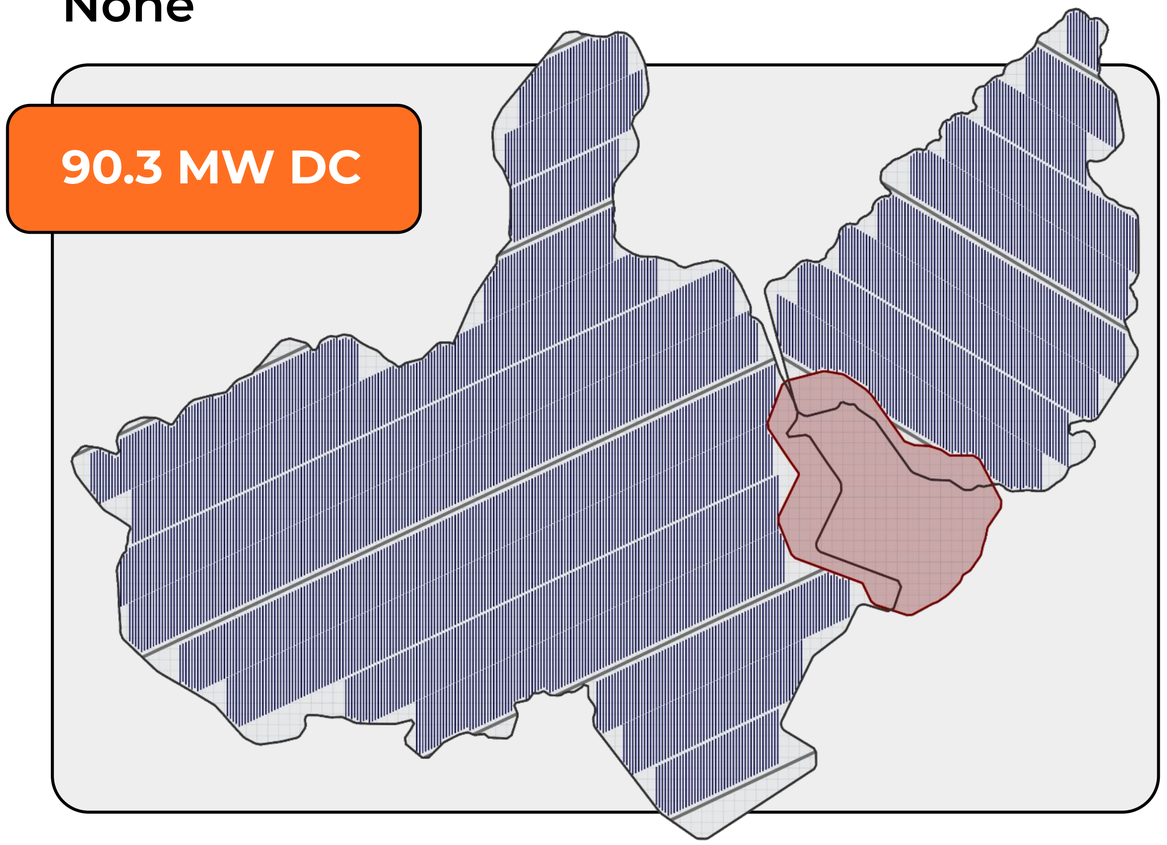
Multiple

90.3 MW DC

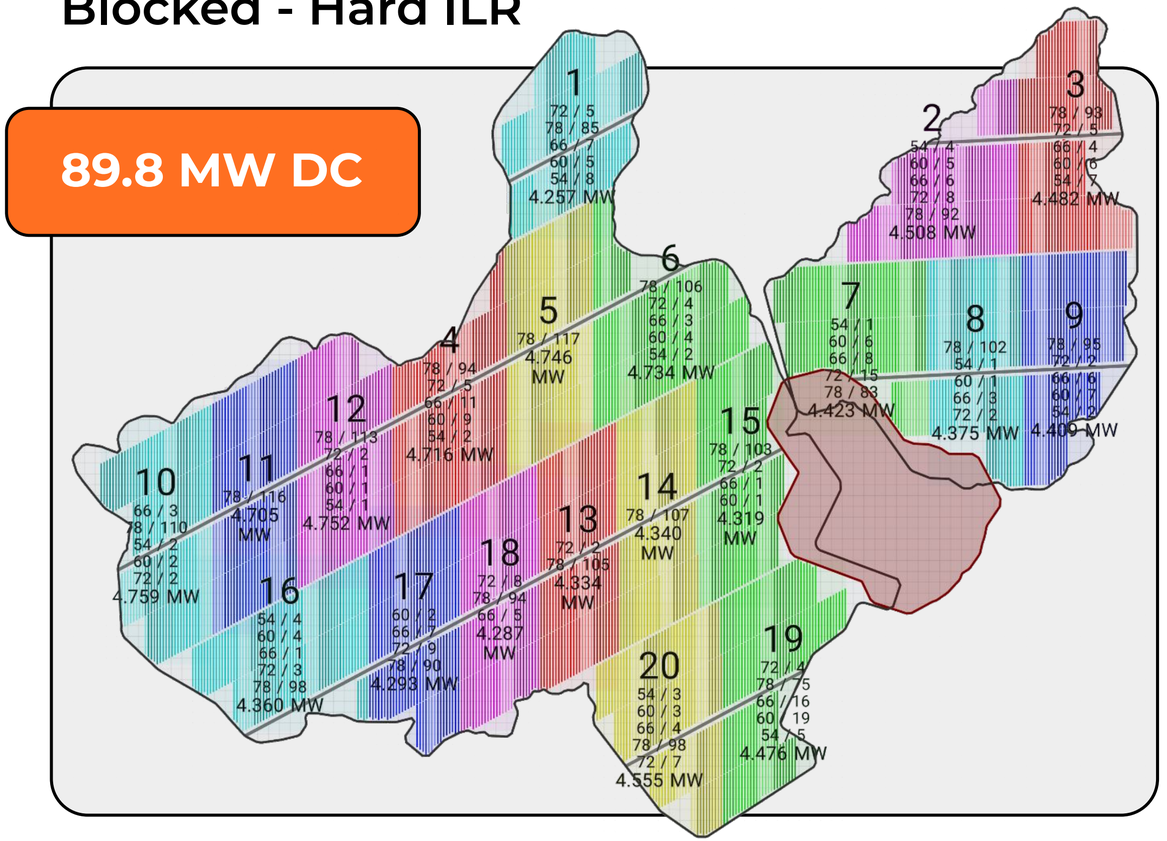


Layout: Blocking Strategy

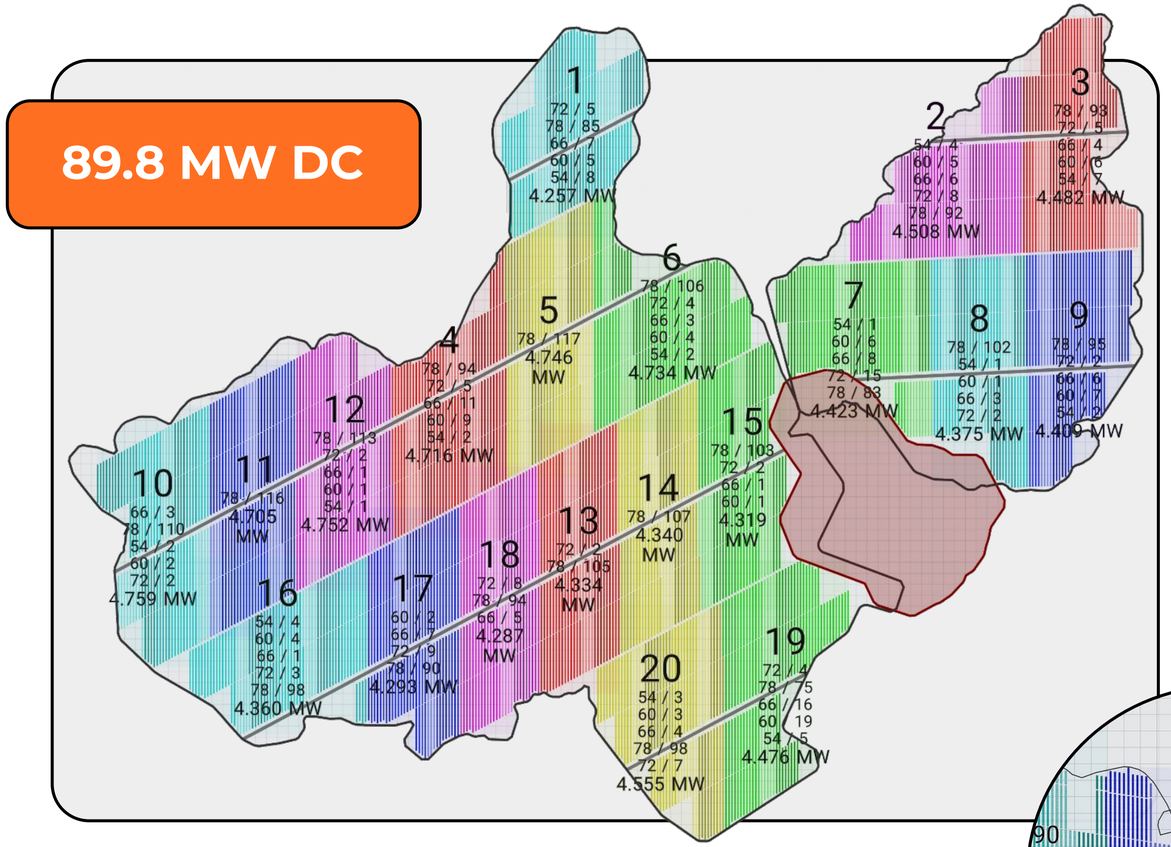
None



Blocked - Hard ILR

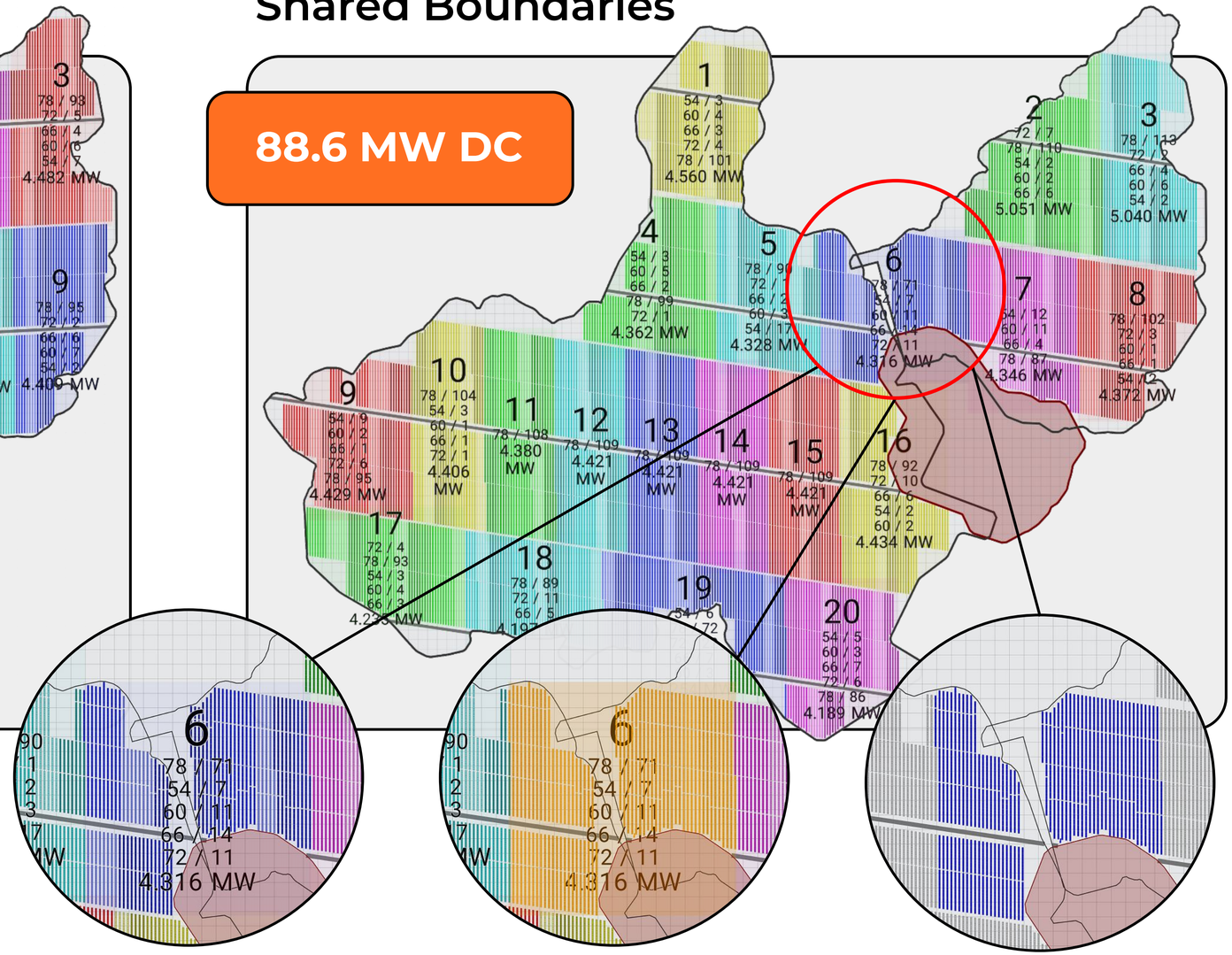


Layout: Block Partitioning



Encapsulated Blocks

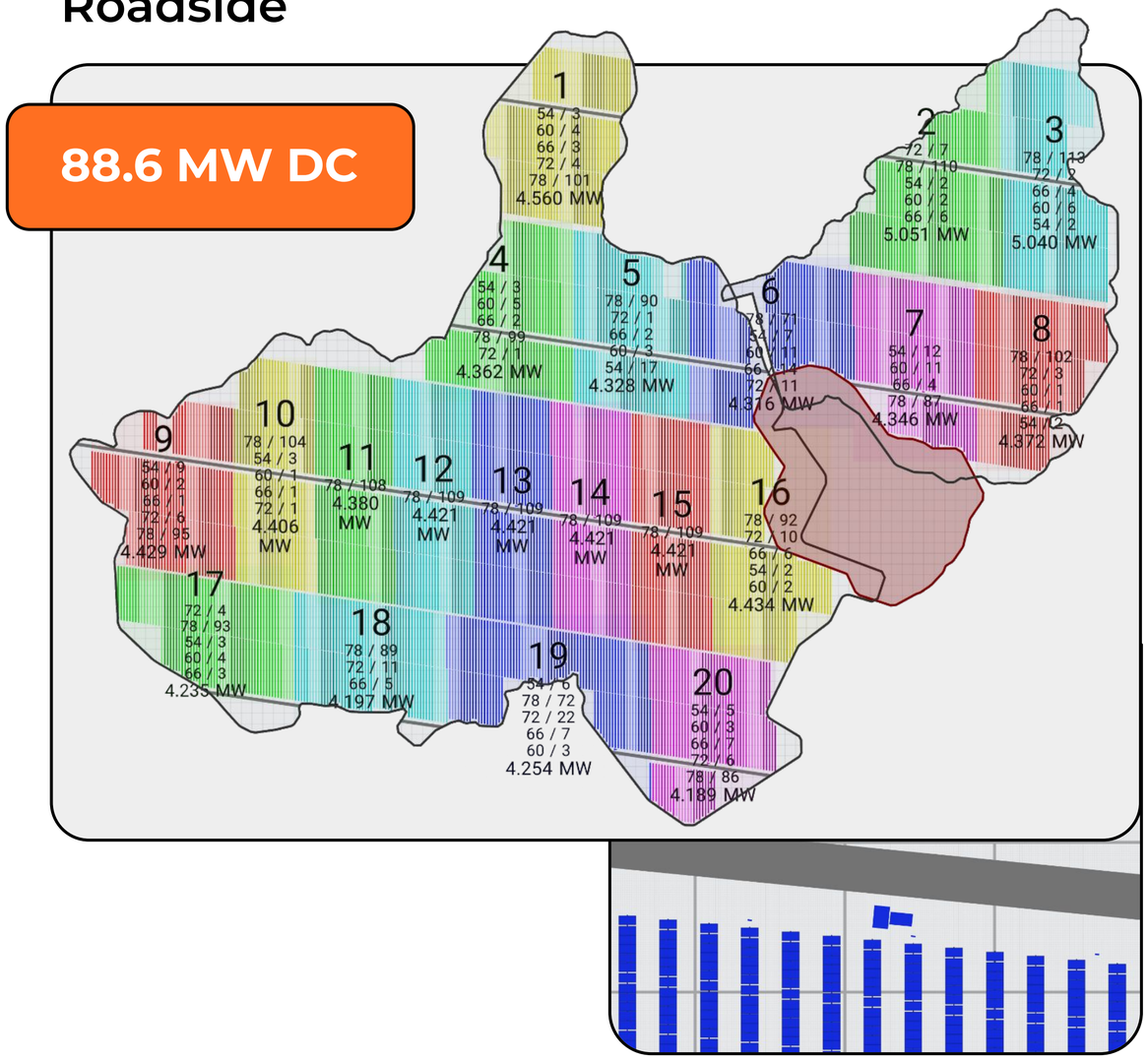
Shared Boundaries



Layout: Architecture

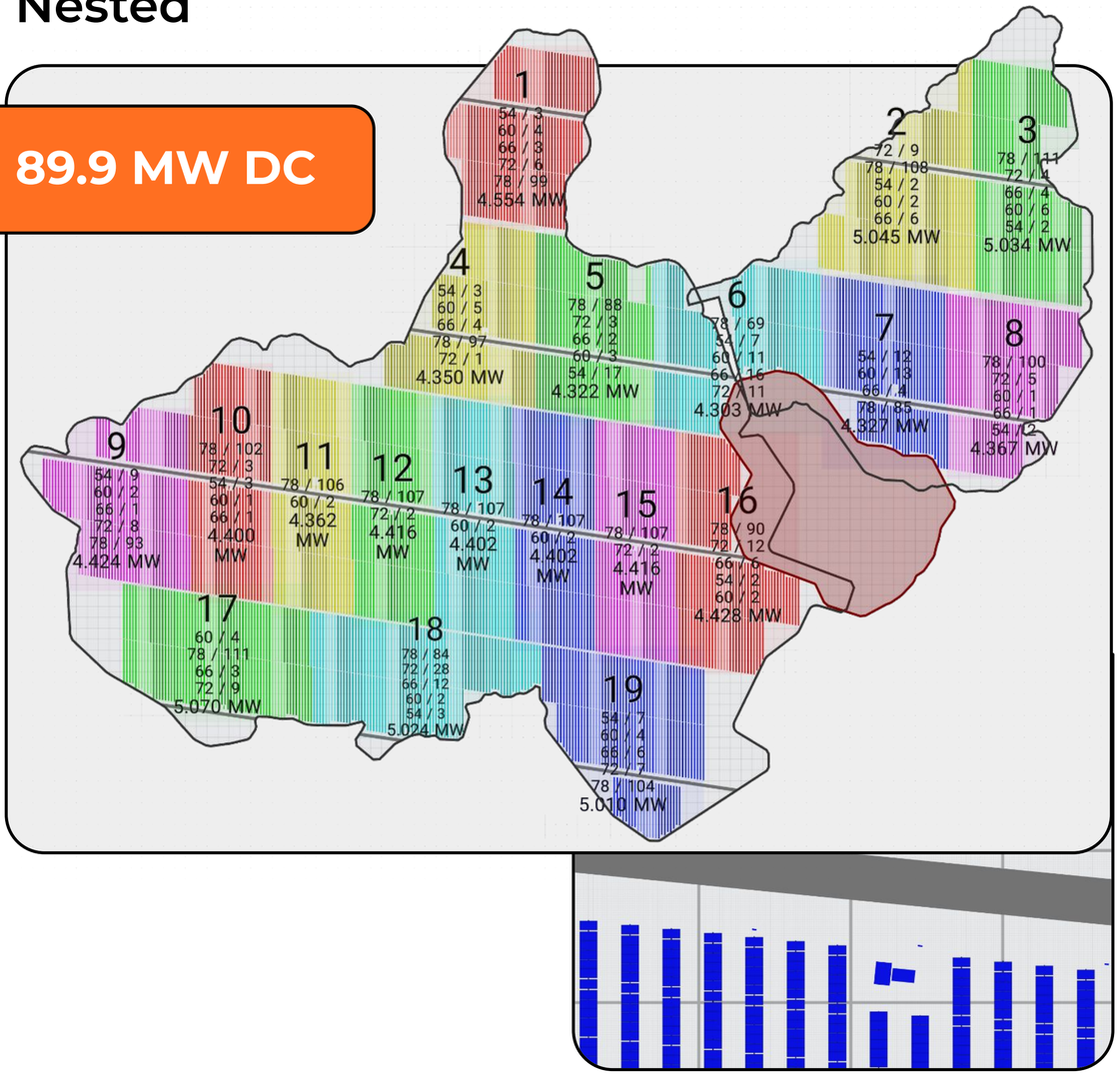
Roadside

88.6 MW DC



Nested

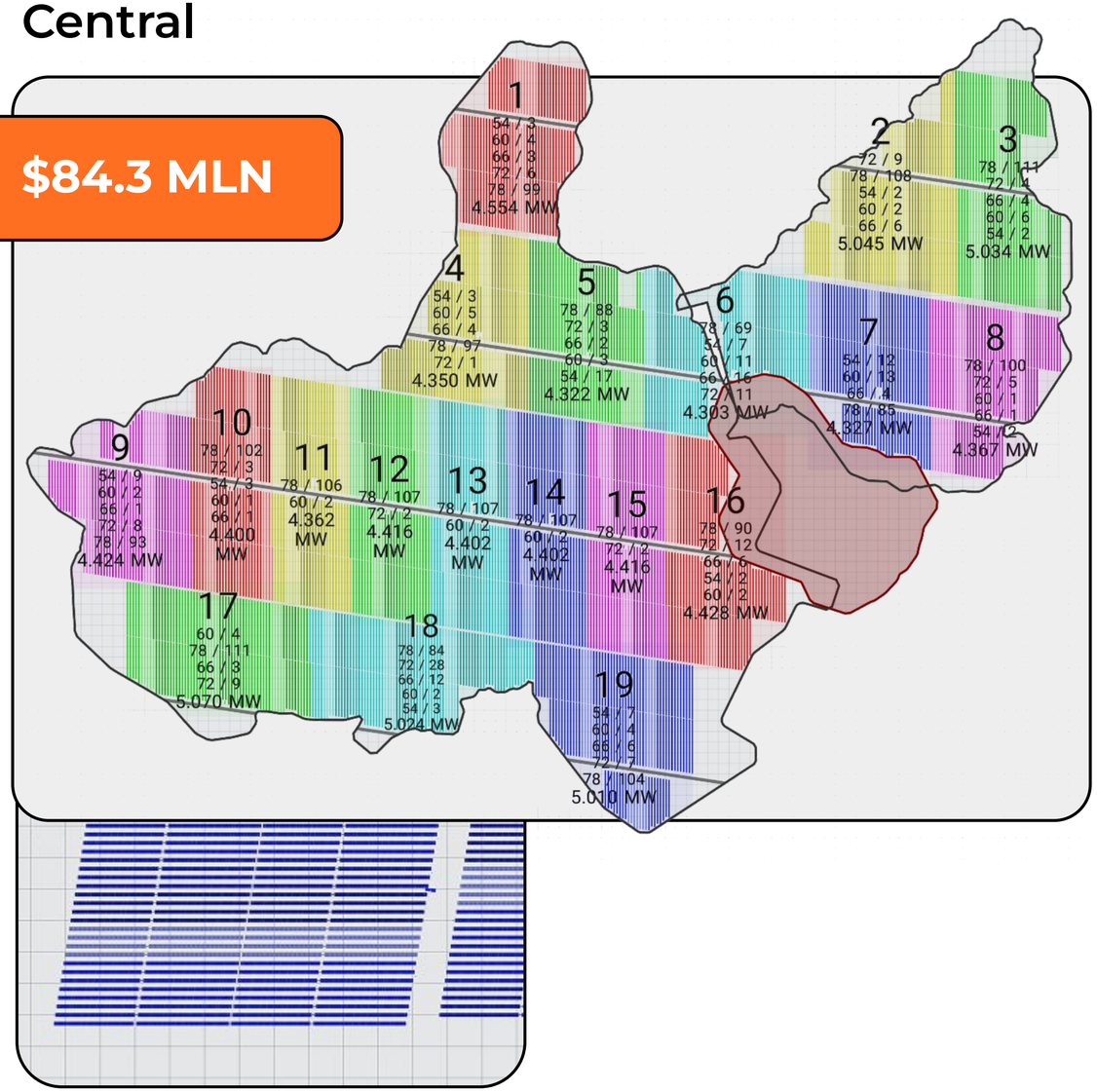
89.9 MW DC



Blocks: Inverter Architecture

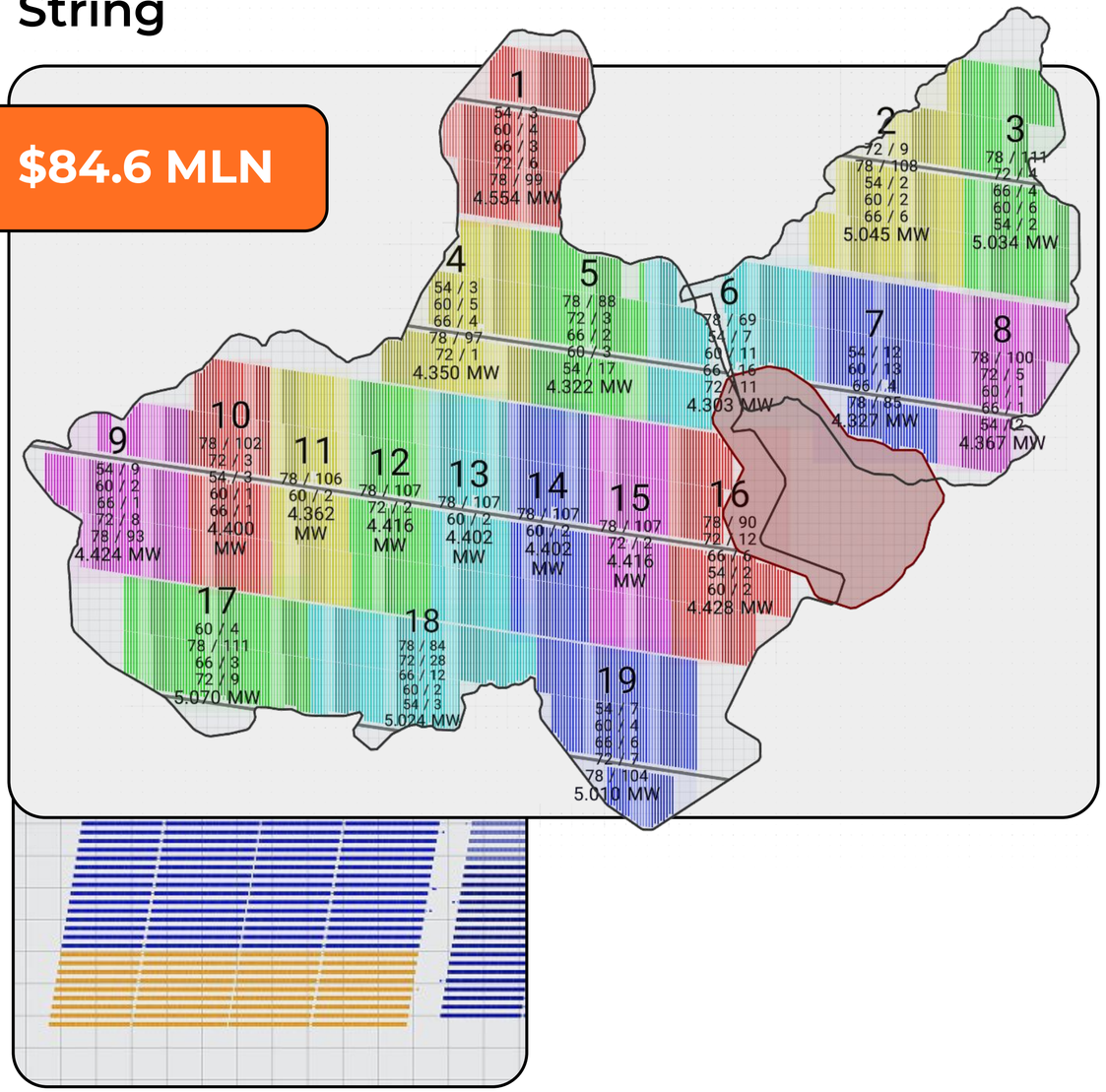
Central

$84.3 MLN



String

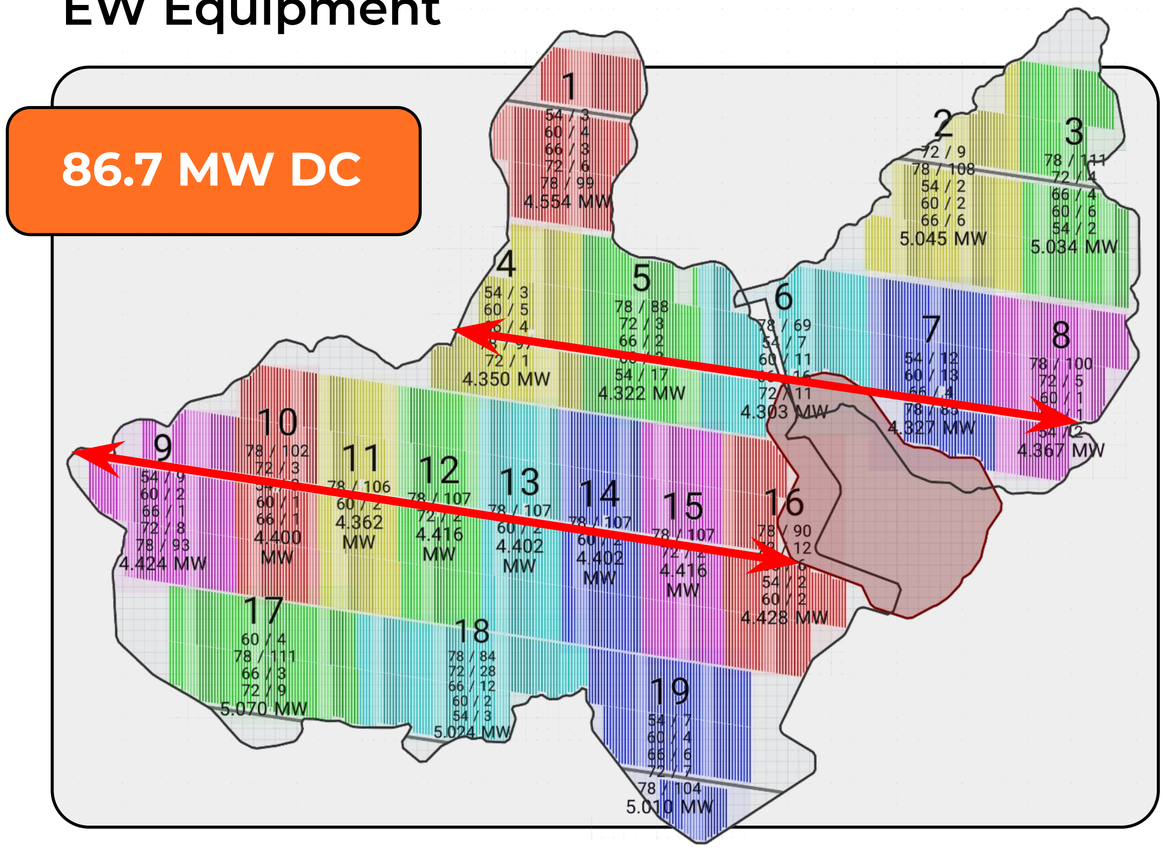
$84.6 MLN



Roads: Placeholders

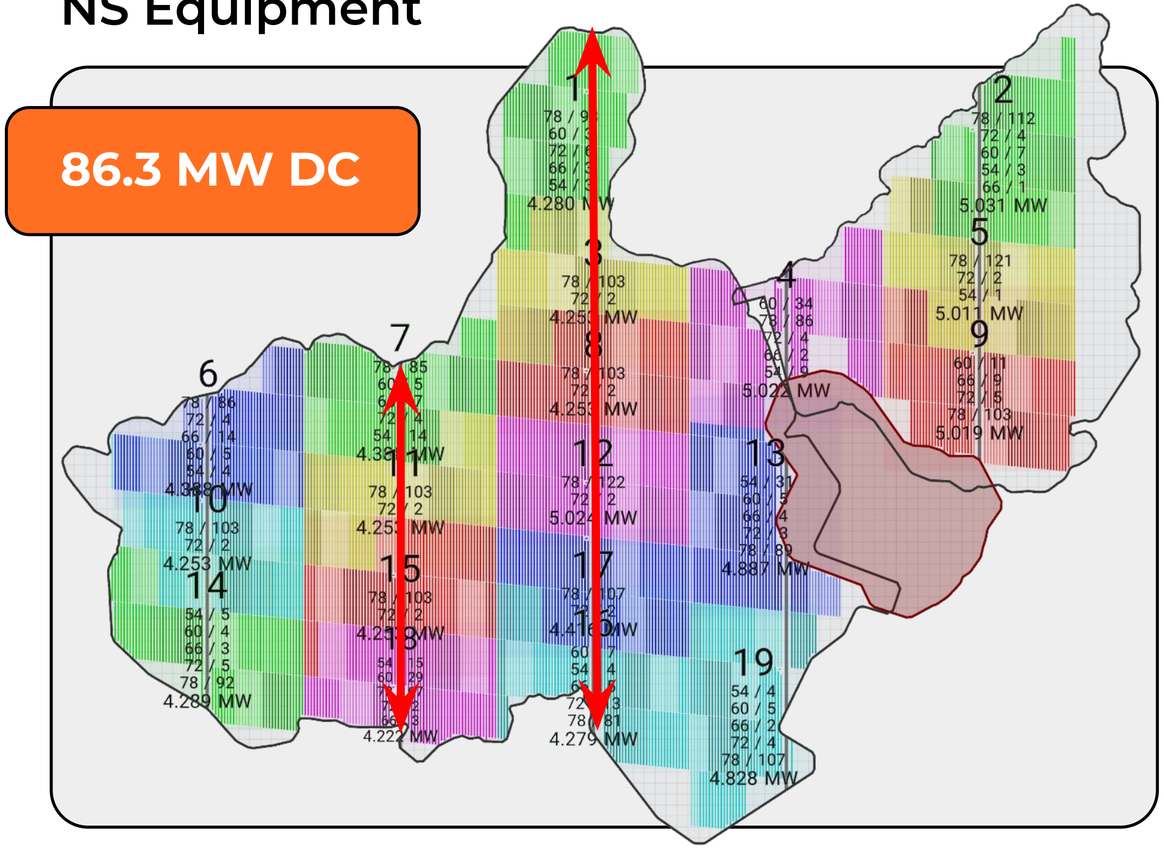
EW Equipment

86.7 MW DC



NS Equipment

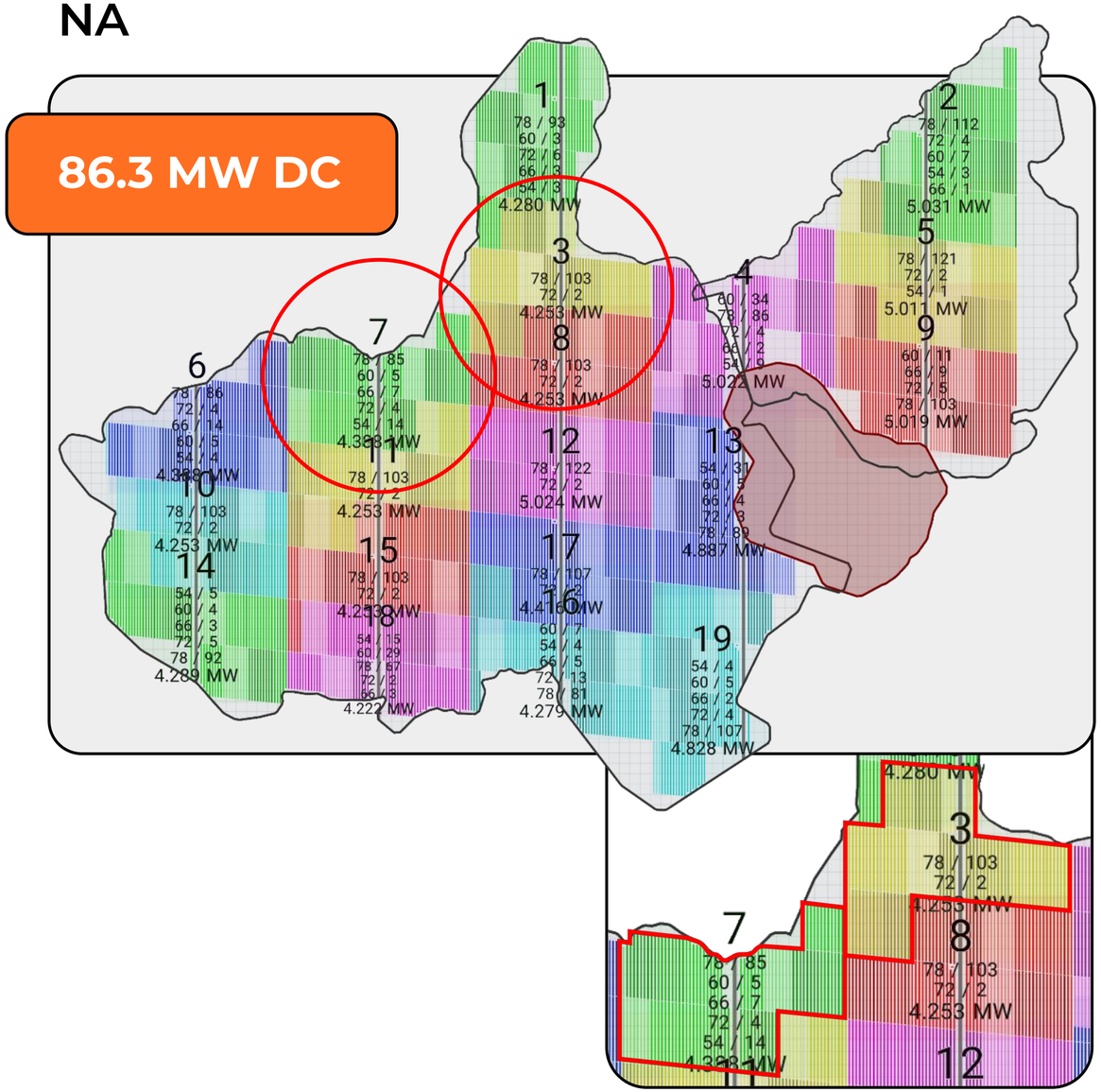
86.3 MW DC



Blocks: Block Aspect Ratio

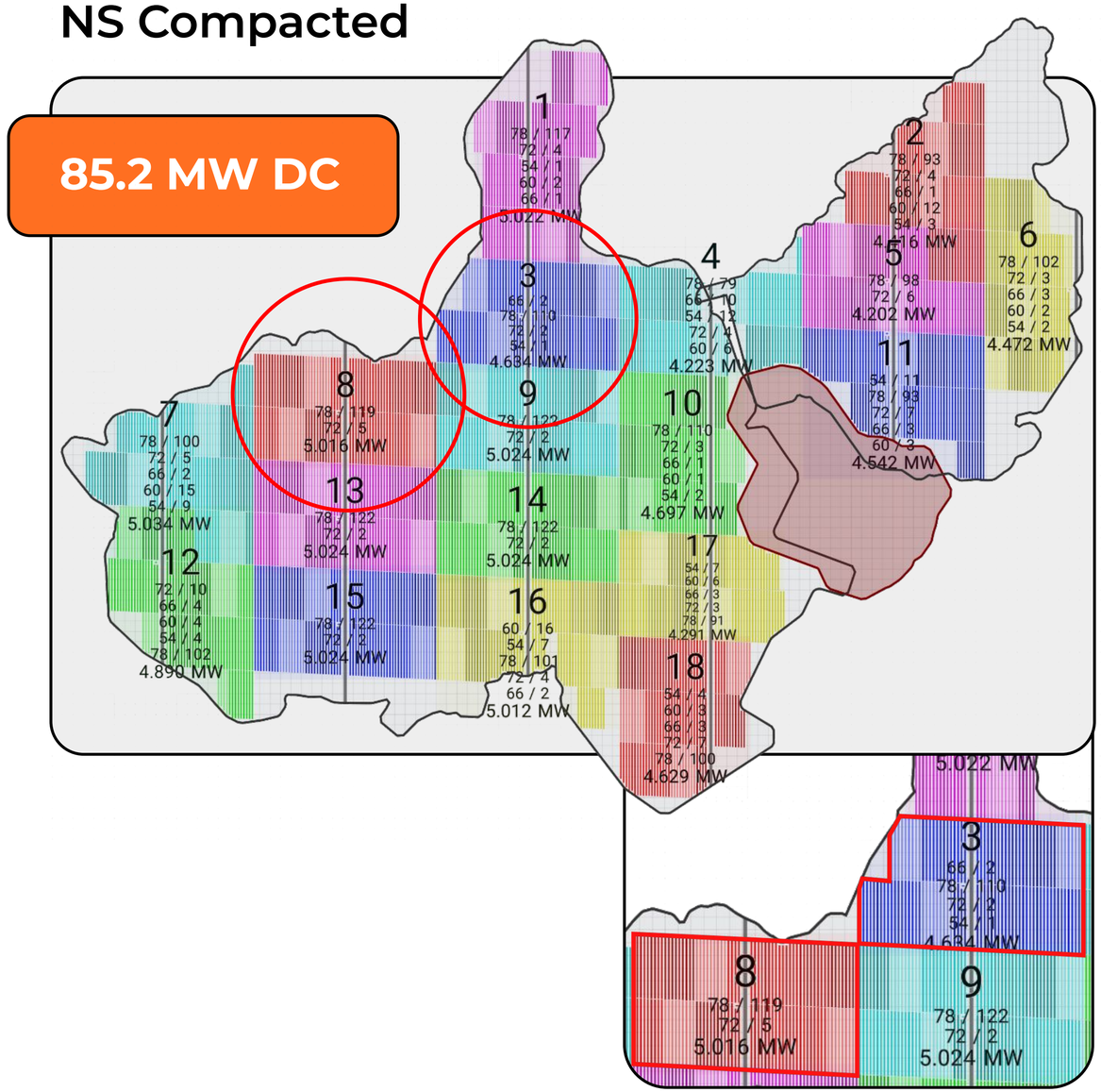
NA

86.3 MW DC



NS Compacted

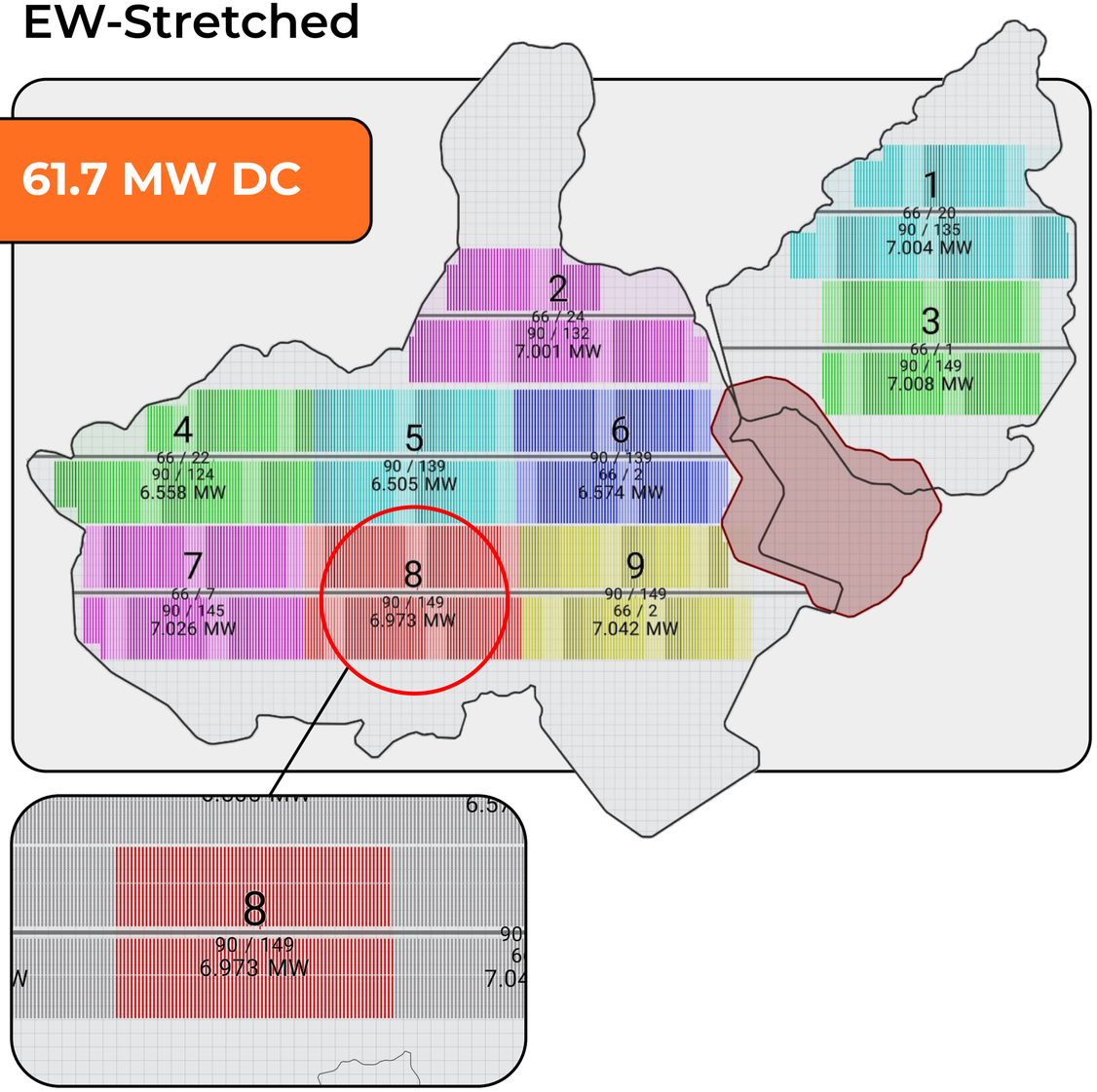
85.2 MW DC



Roads: Placeholders

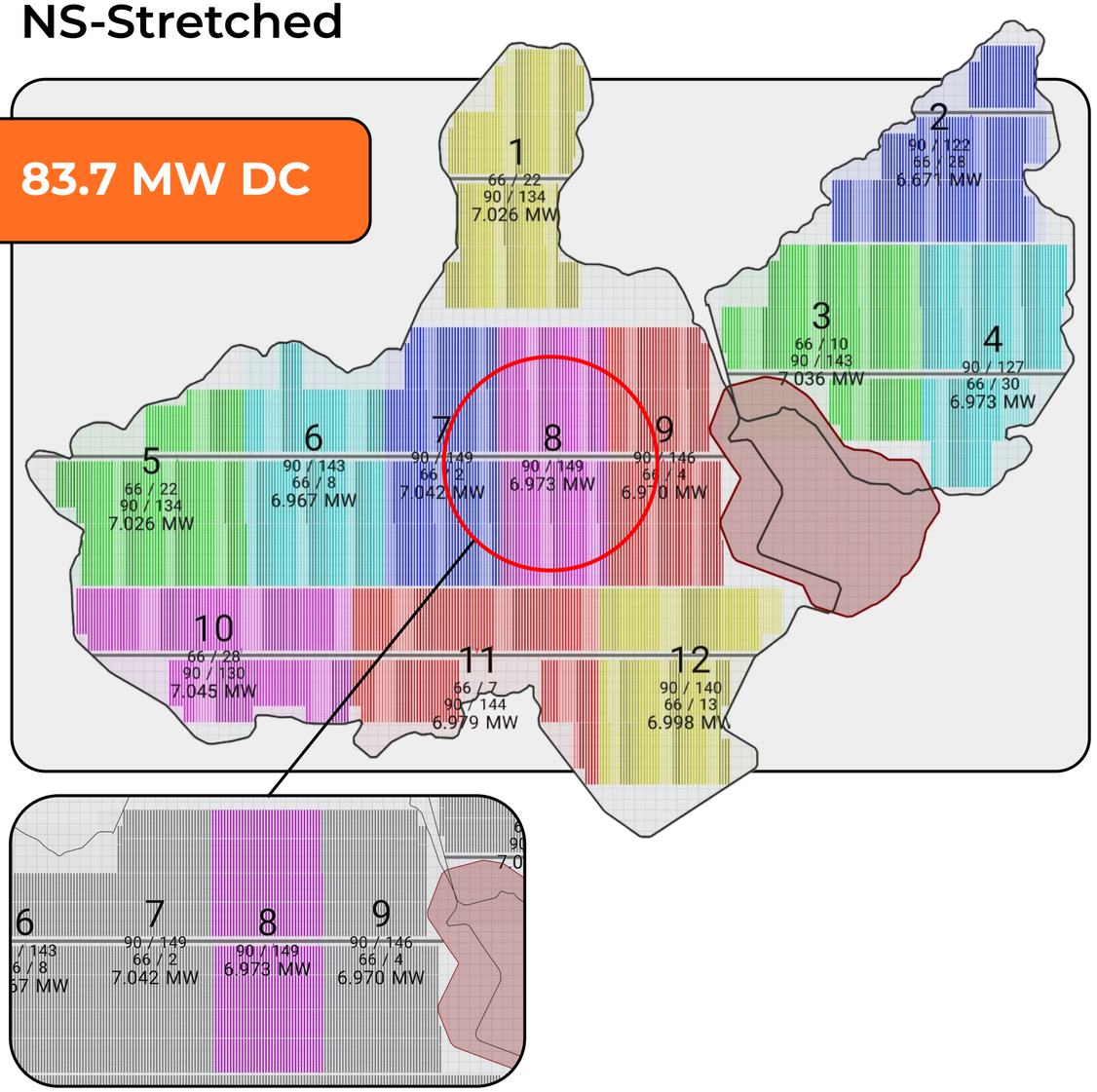
EW-Stretched

61.7 MW DC



NS-Stretched

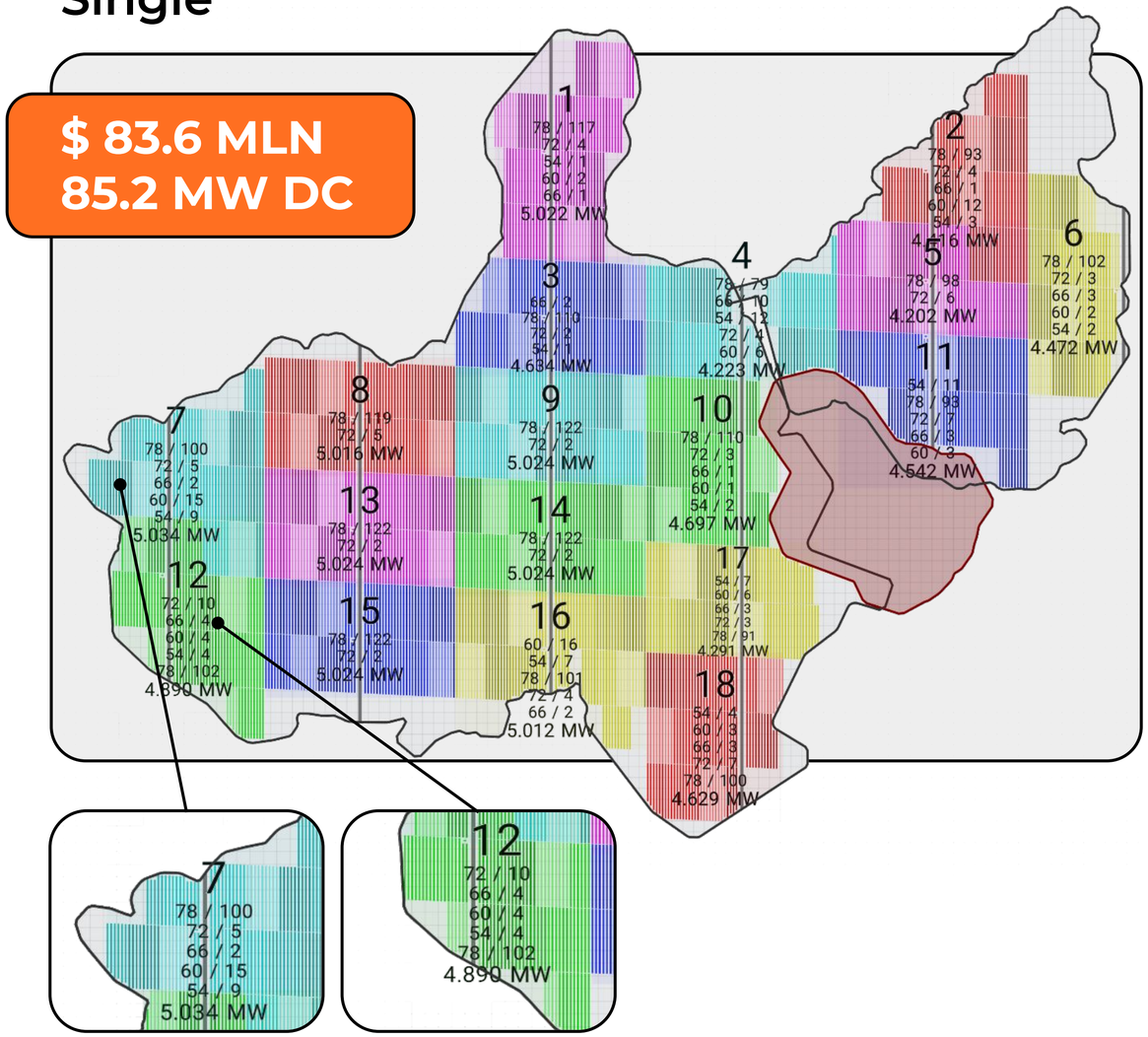
83.7 MW DC



Blocks: Inverter Mix

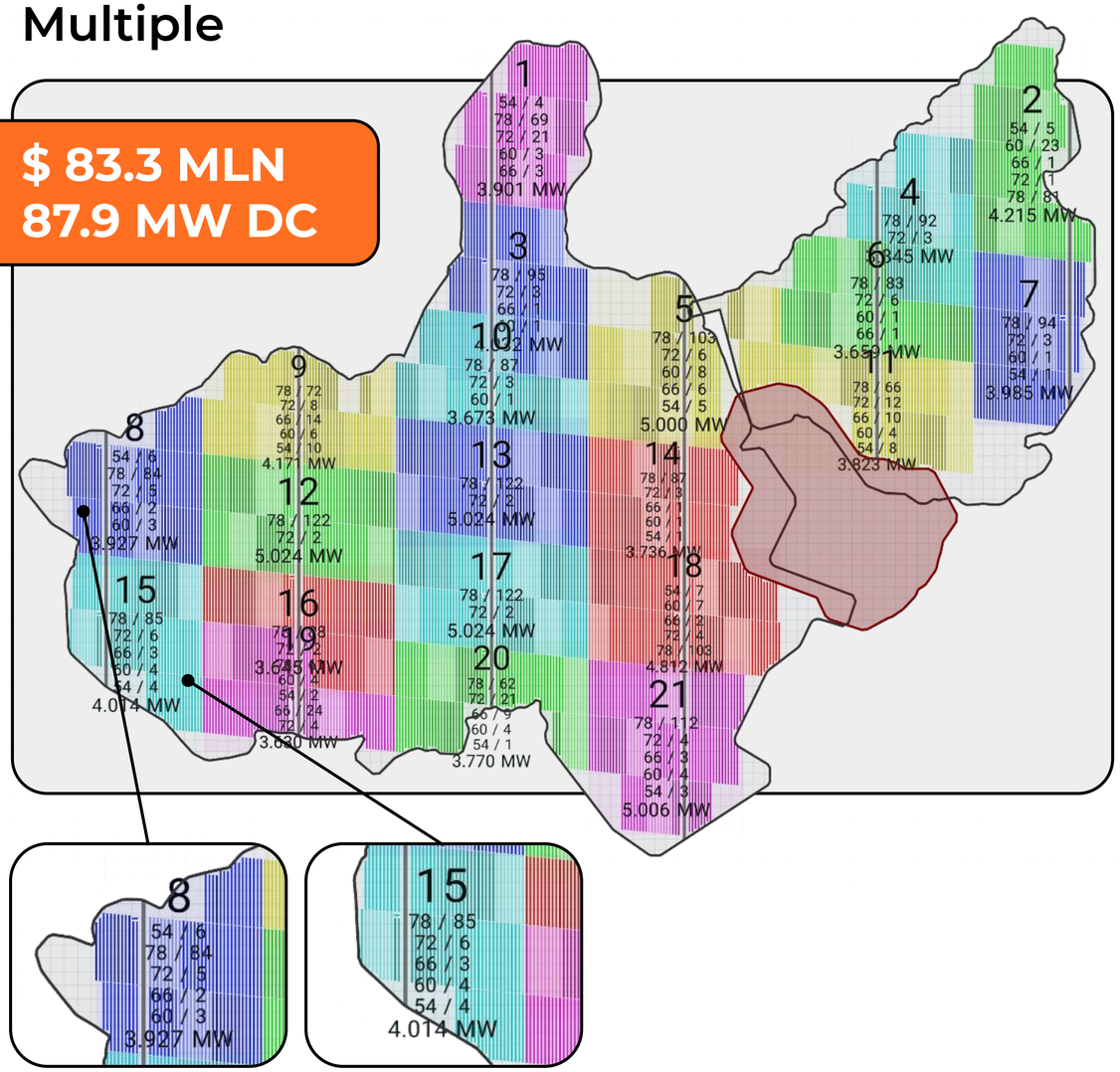
Single

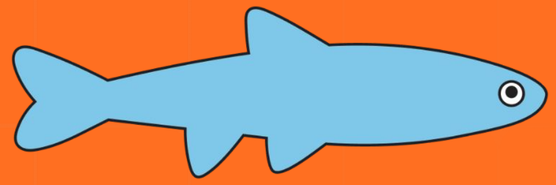
$ 83.6 MLN
85.2 MW DC



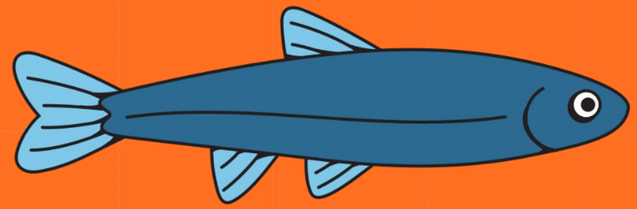
Multiple

$ 83.3 MLN
87.9 MW DC

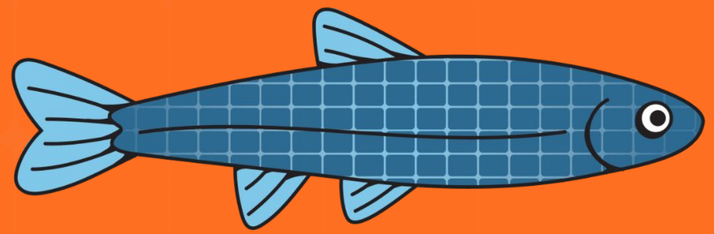




Layouts Evolution

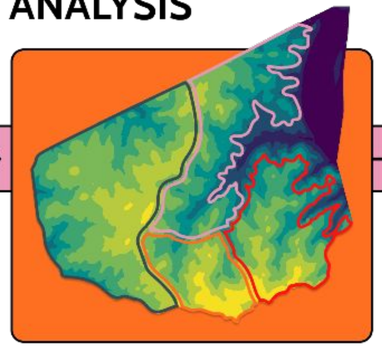


Layouts evolve naturally, guided by the available data

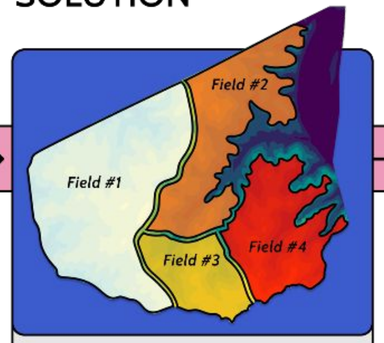


GOAL SETTING & REQUIREMENTS GATHERING

CONTEXT & RESTRICTIONS ANALYSIS

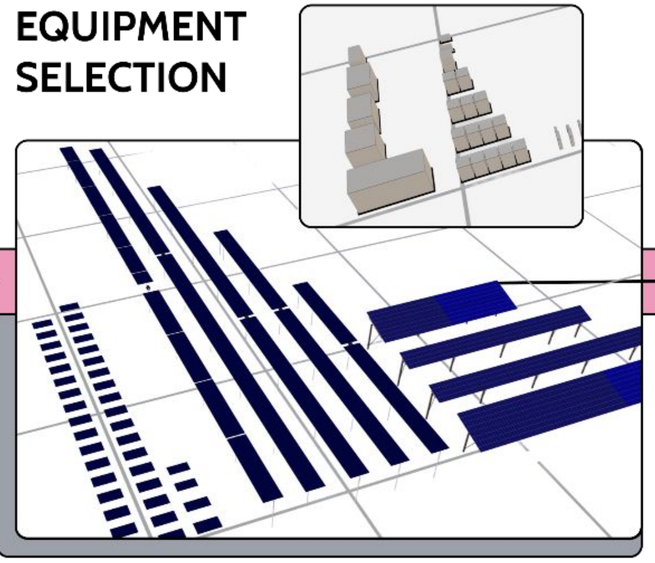


EXPLORATION
FINDING A FEASIBLE SOLUTION

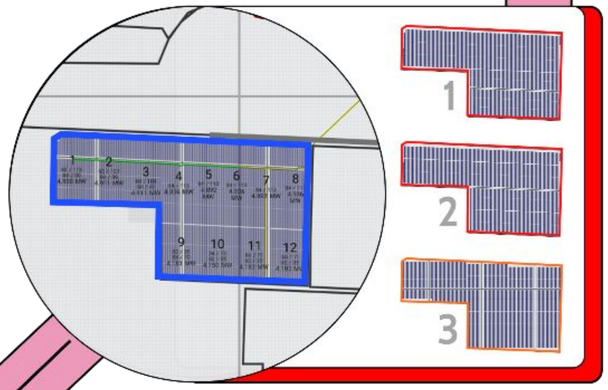


Inverters / Racking Types / ILR / GCR

EQUIPMENT SELECTION



OPTIMISATION

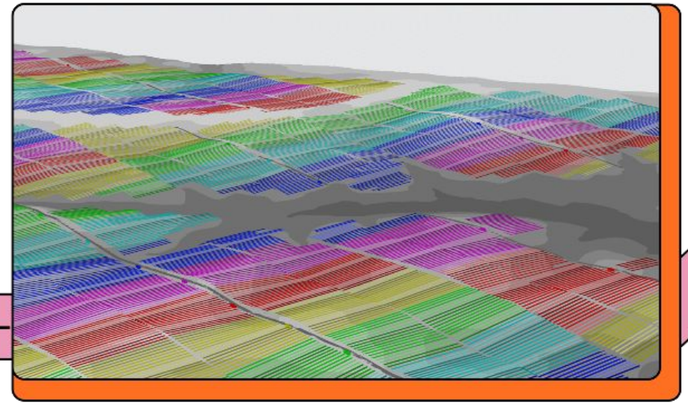


ELECTRICAL TEAM

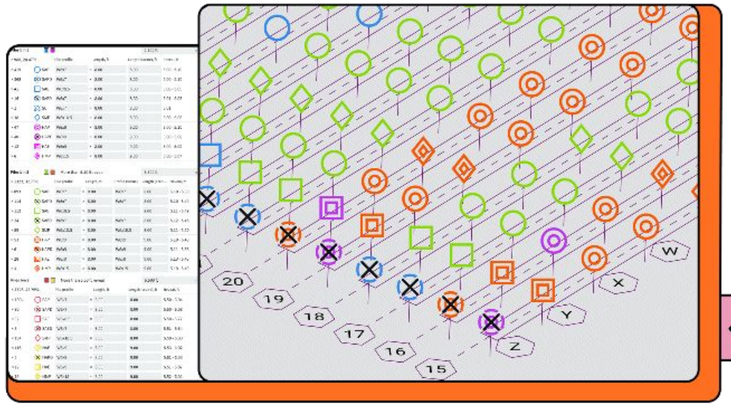
CIVIL TEAM

PERFORMANCE MODELING TEAM

DESIGN
POLISHING & REFINING



PRE-CONSTRUCTION
ENSURING CONSTRUCTABILITY

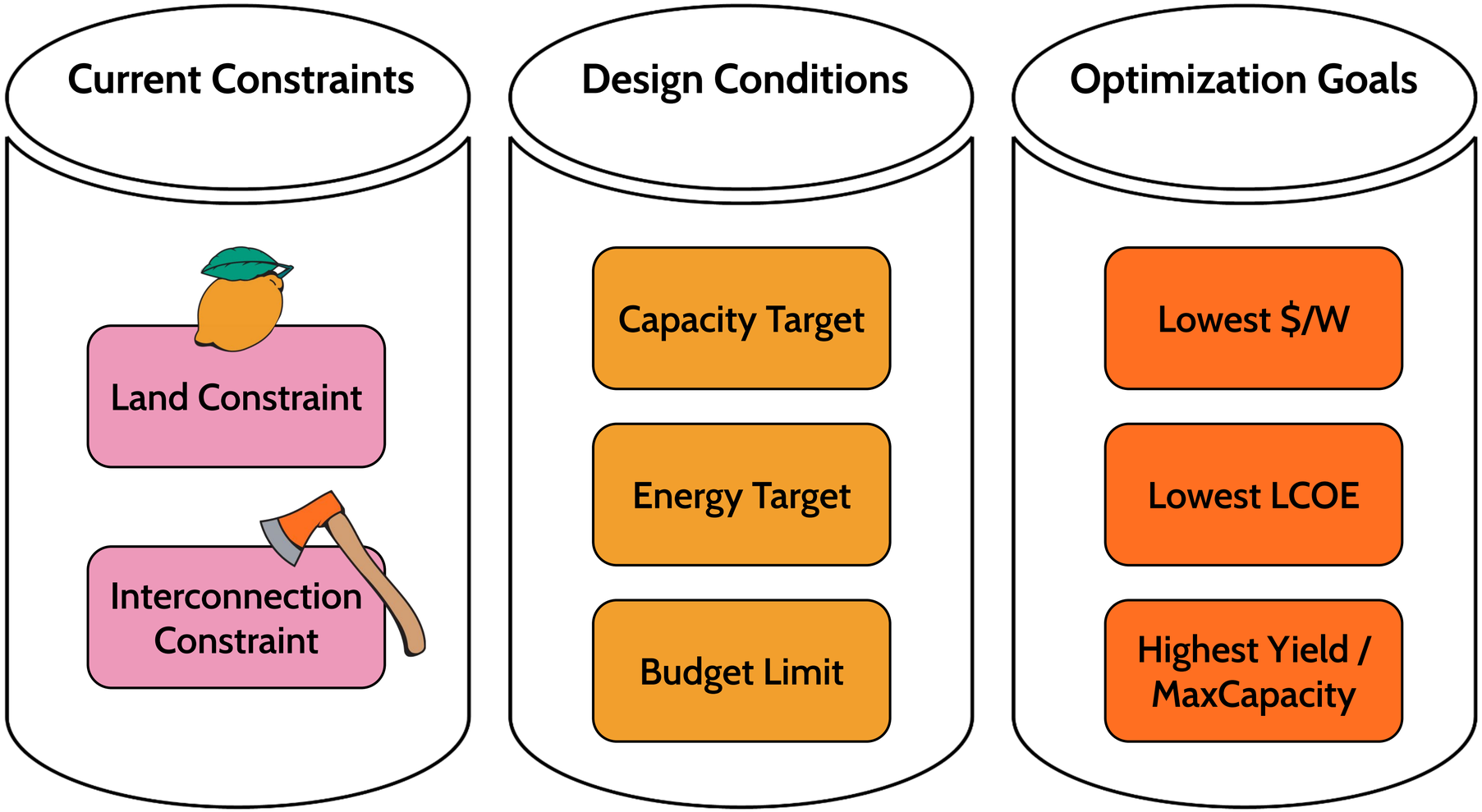


STAY IN SYNC!

- Rapid Iterations
- Trade-offs
- Precision
- Pivots

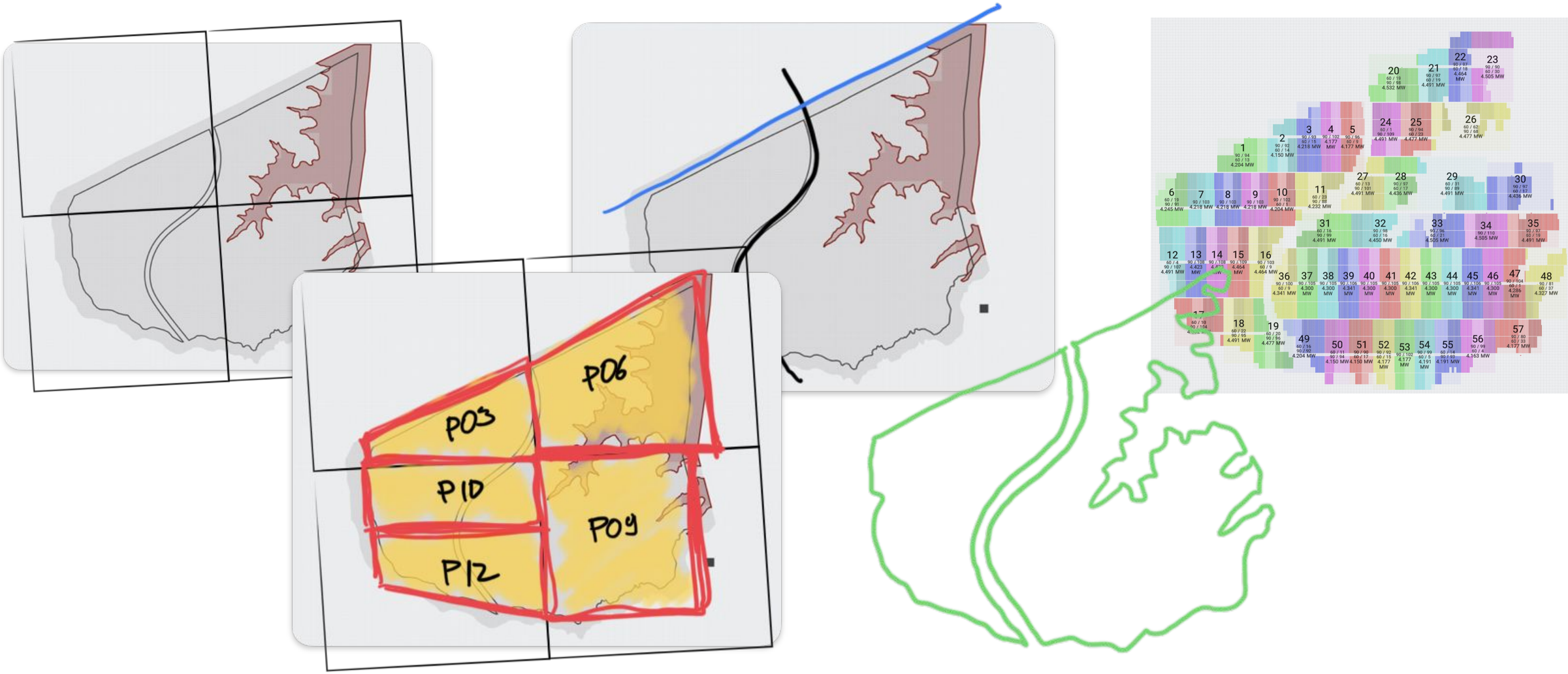
Goal Setting & Requirements Gathering

The essence of strategy is choosing what not to do



Context Analysis

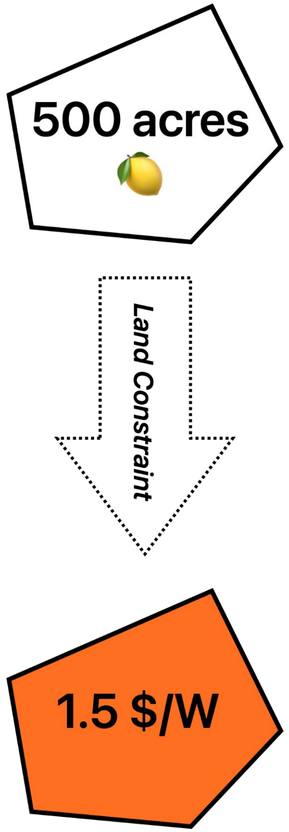
Section → Parcel → Site Area → Buildable Area → Solar Layout



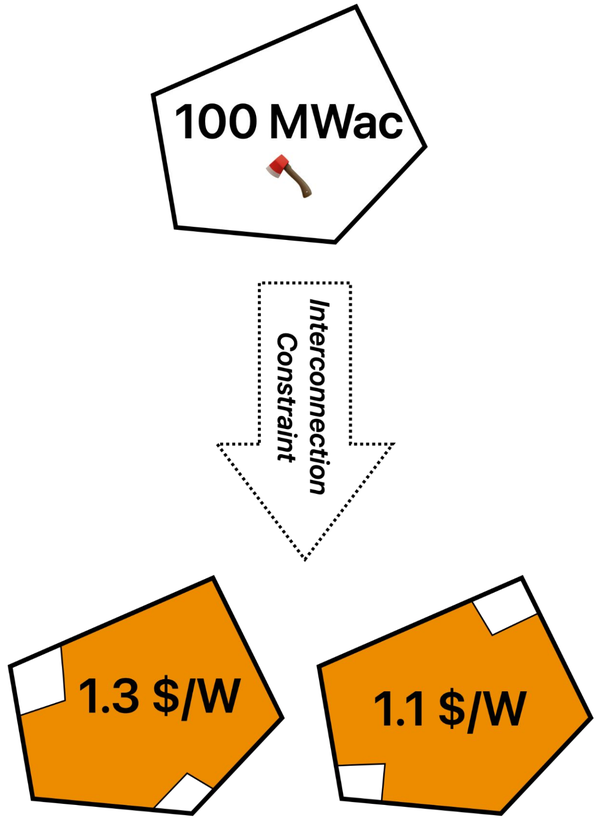
Restrictions Analysis

Optimization uncovers opportunities by eliminating what doesn't work

Squeezing Max



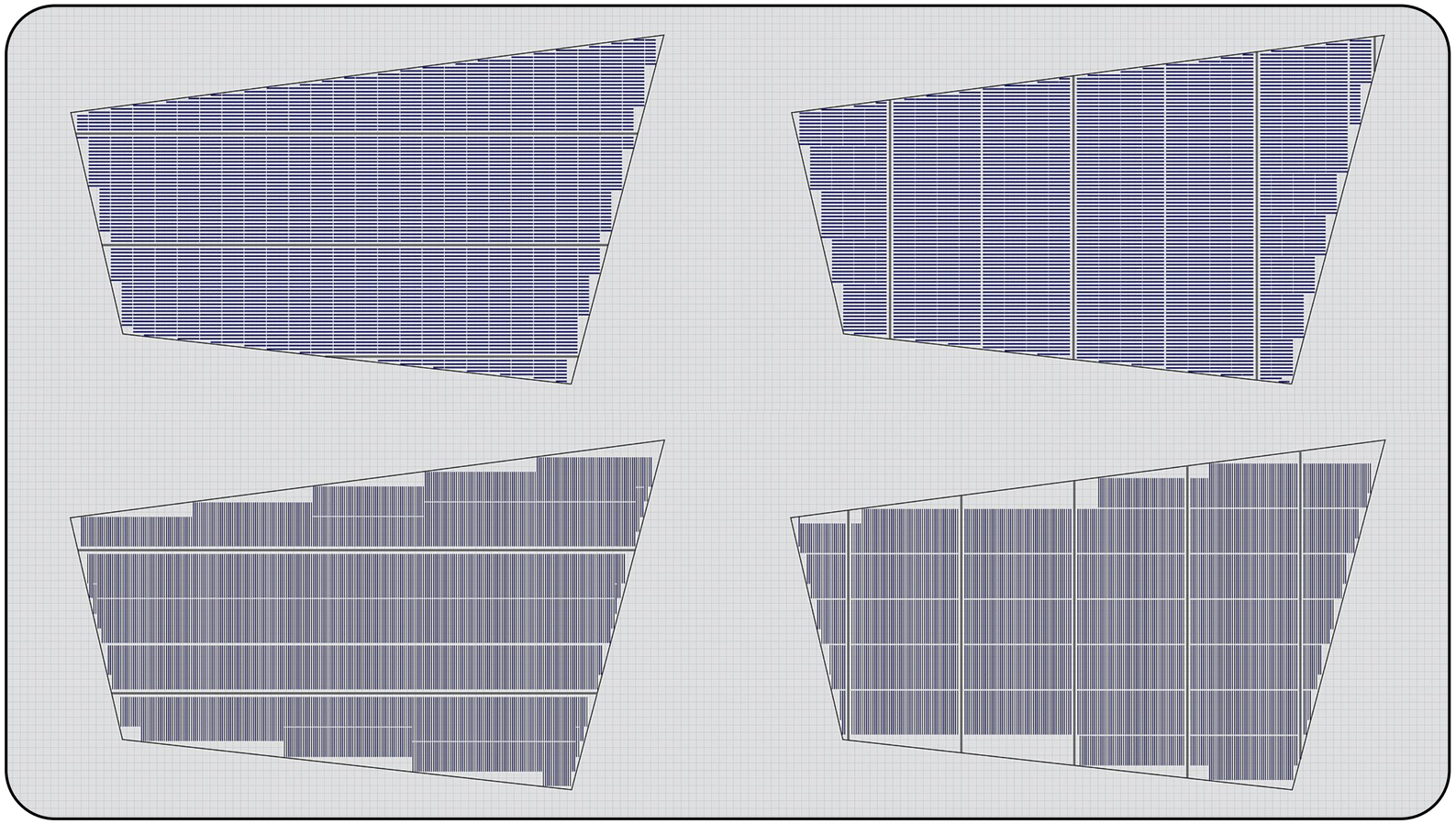
Chipping Away

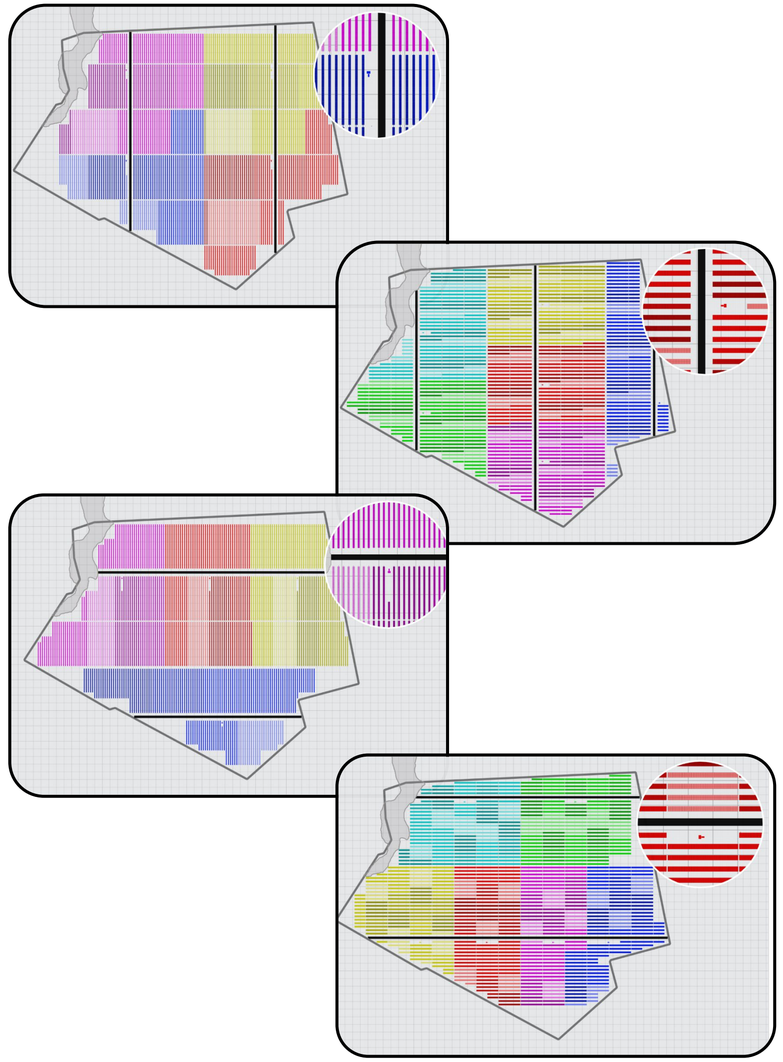


	Capacity Target	Energy Target	Budget Limit
Lowest $/W	🍋🪓	🍋🪓	🪓
Lowest LCOE	🍋🪓	🍋🪓	🪓
Highest Yield / Max Capacity			🍋🪓

Exploration: Finding a Feasible Solution

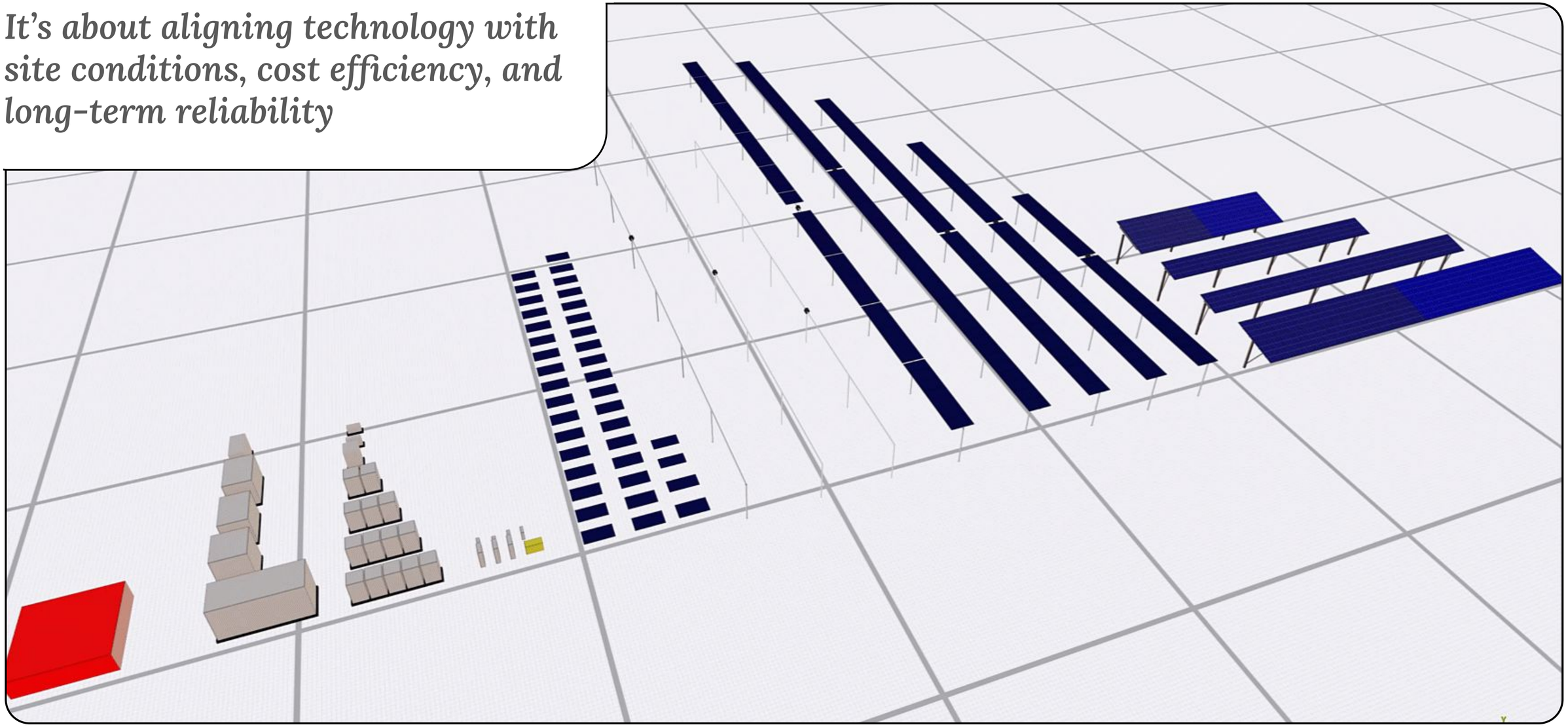
It's about uncovering possibilities, testing boundaries, and refining what works within constraints





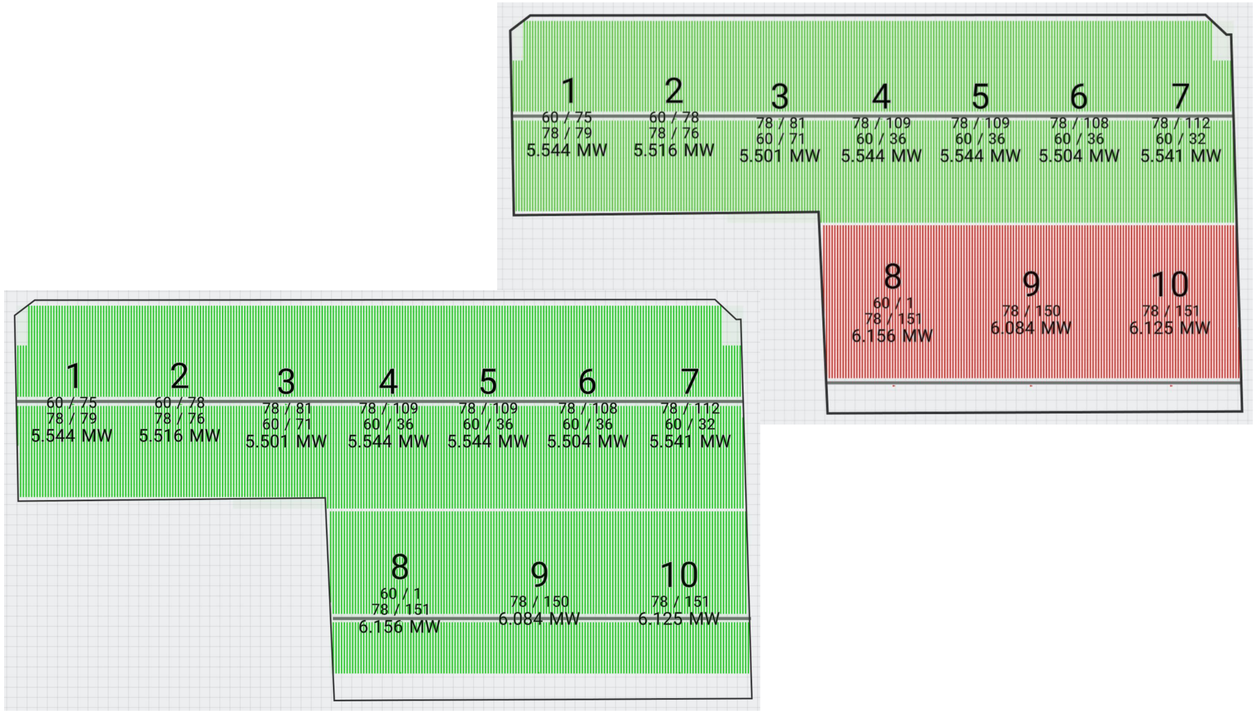
Equipment Selection

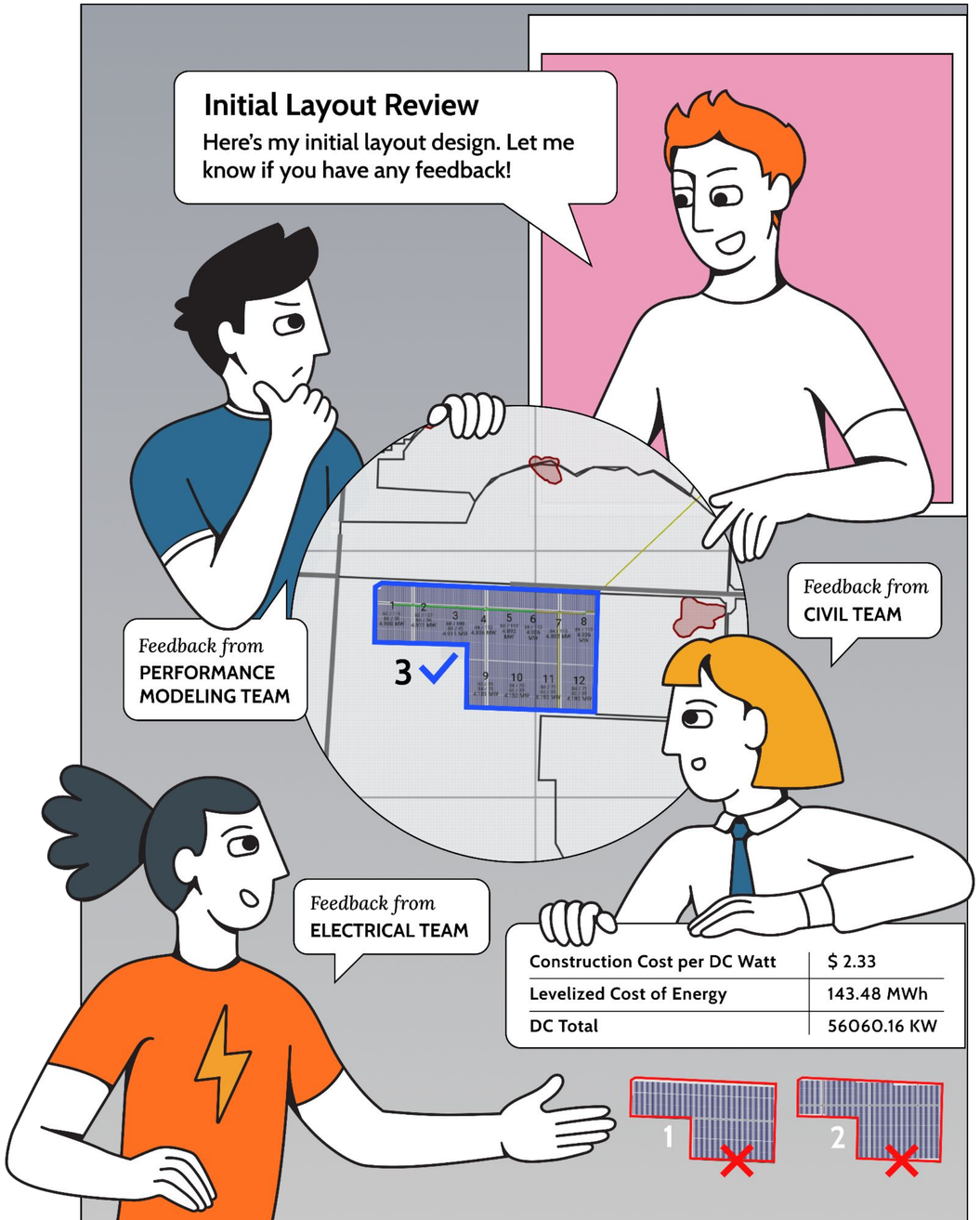
It's about aligning technology with site conditions, cost efficiency, and long-term reliability



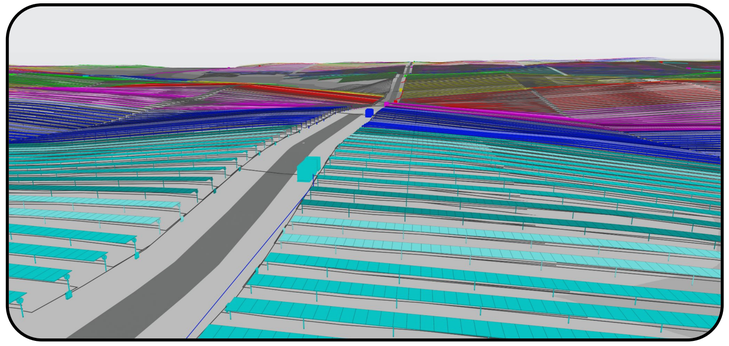
Optimisation: Iterating Trade-Offs

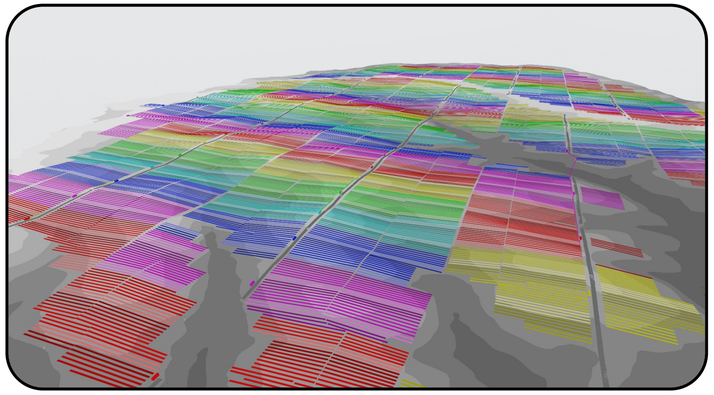
Feedback loops drive smarter trade-offs, refining efficiency with every iteration

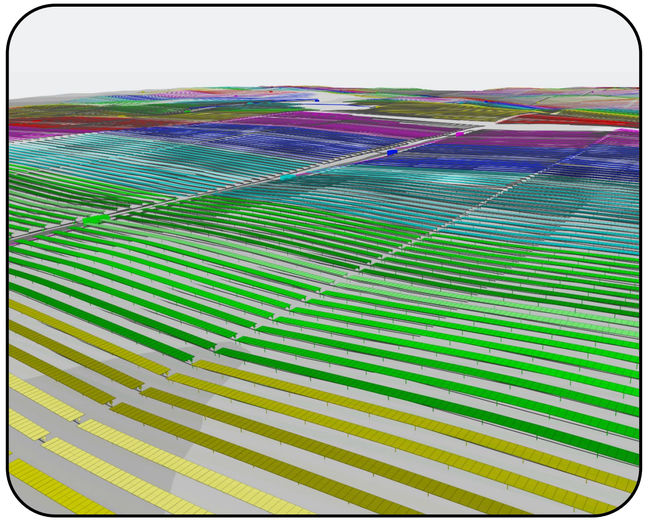


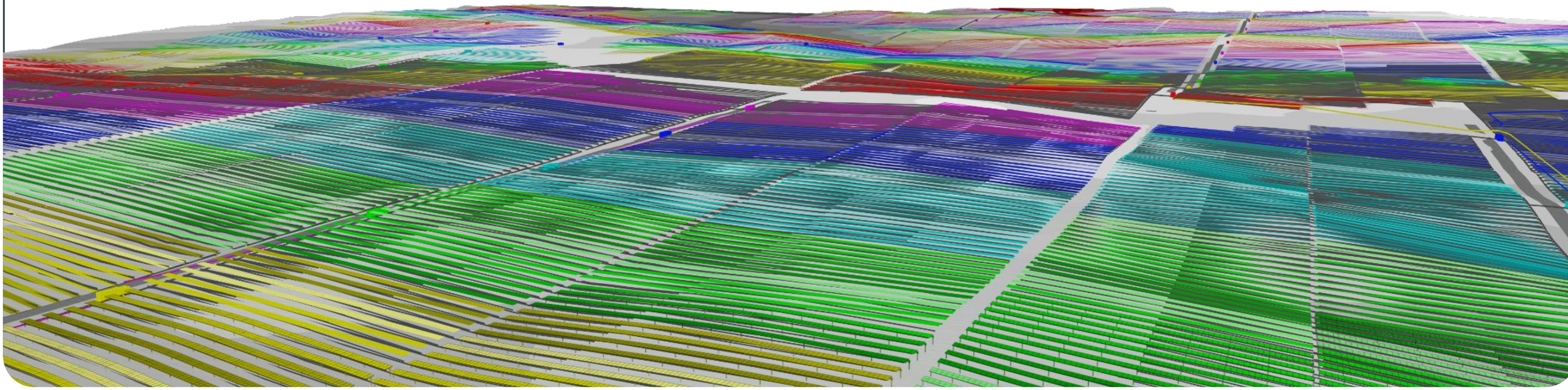


Design: Polishing & Refining

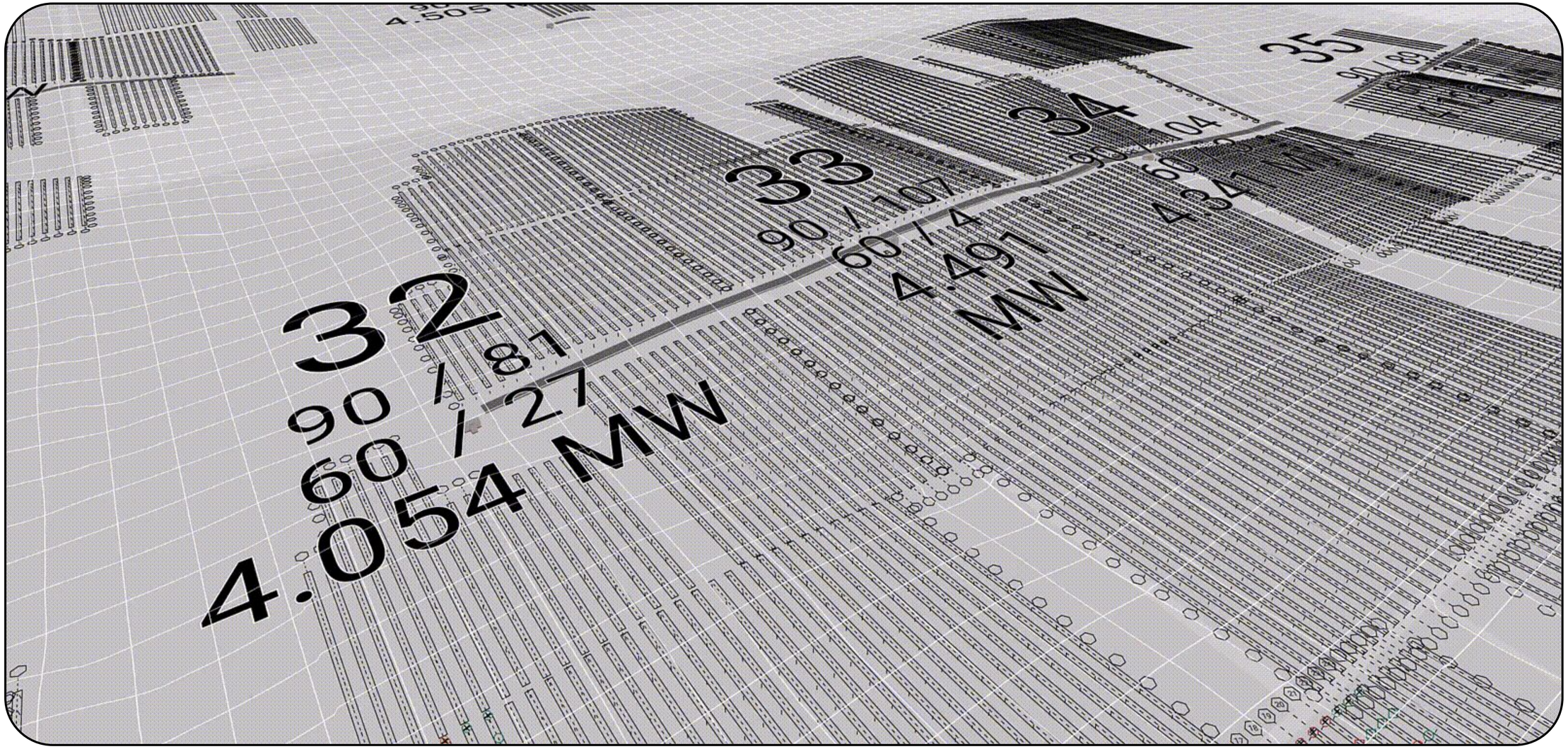


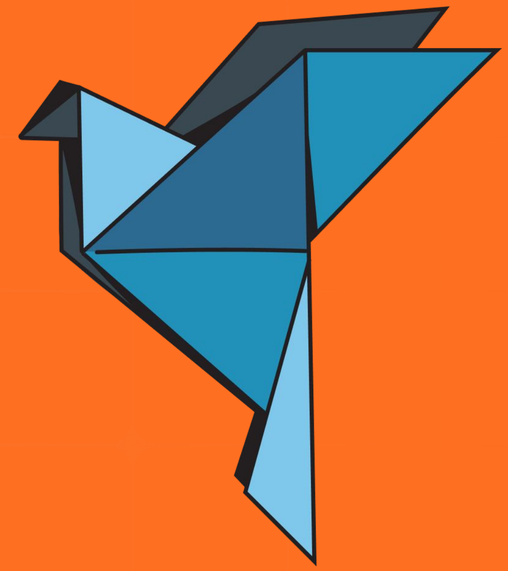






Pre-Construction: Ensuring Constructability



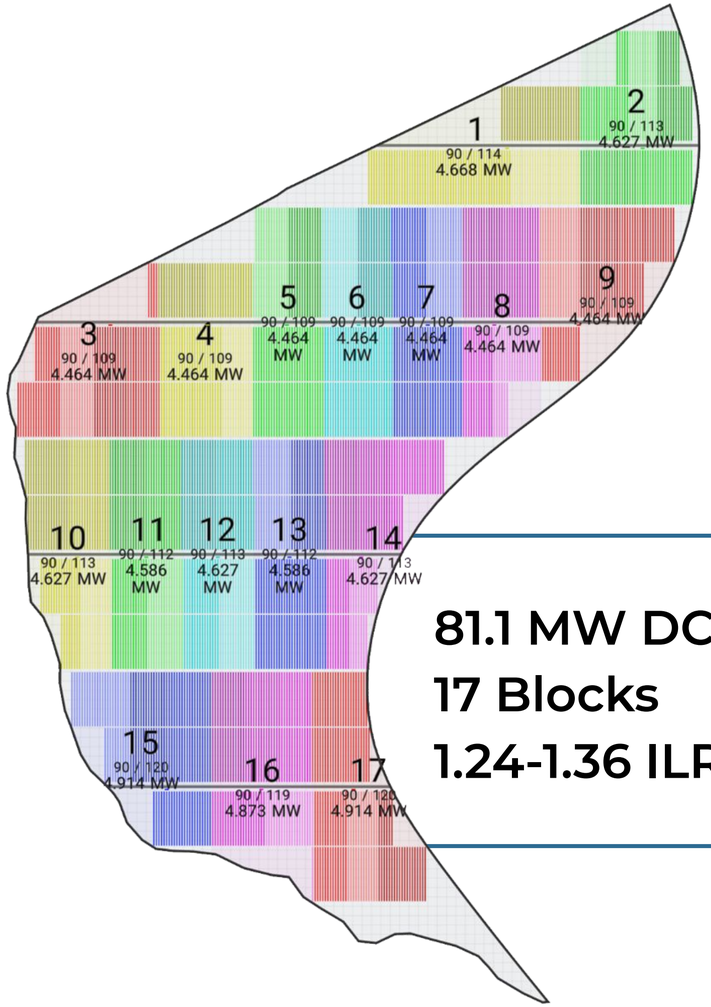


A ‘Good Enough’ Layout

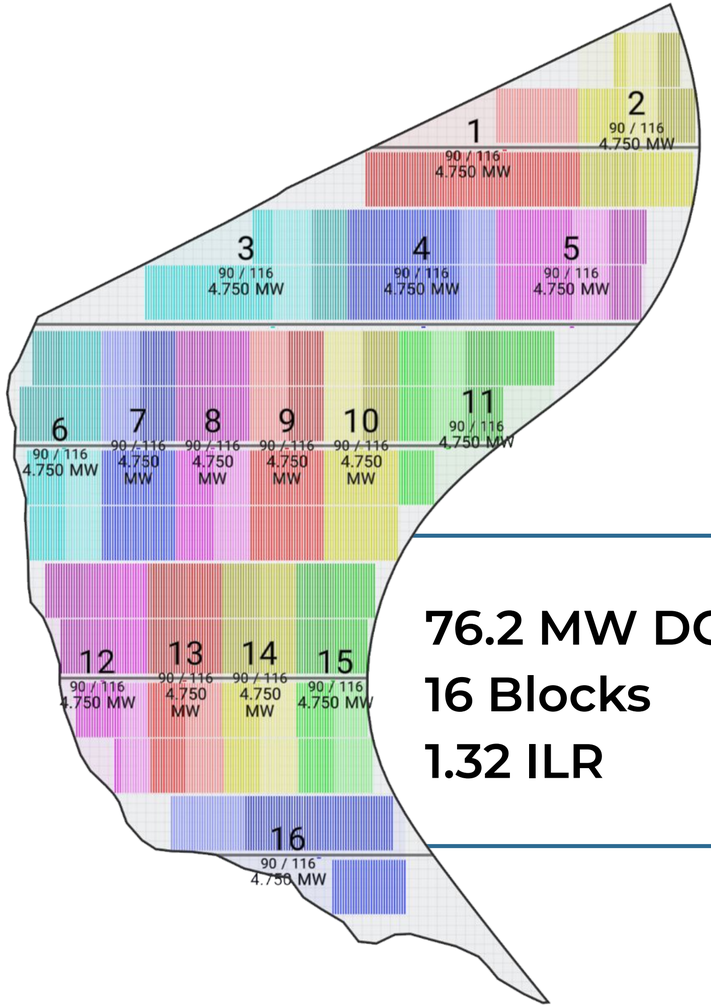
A good enough layout isn’t about chasing perfection but about making the right decisions at the right time — practical, well-informed, and adaptable for future evolution

Which one is good enough?

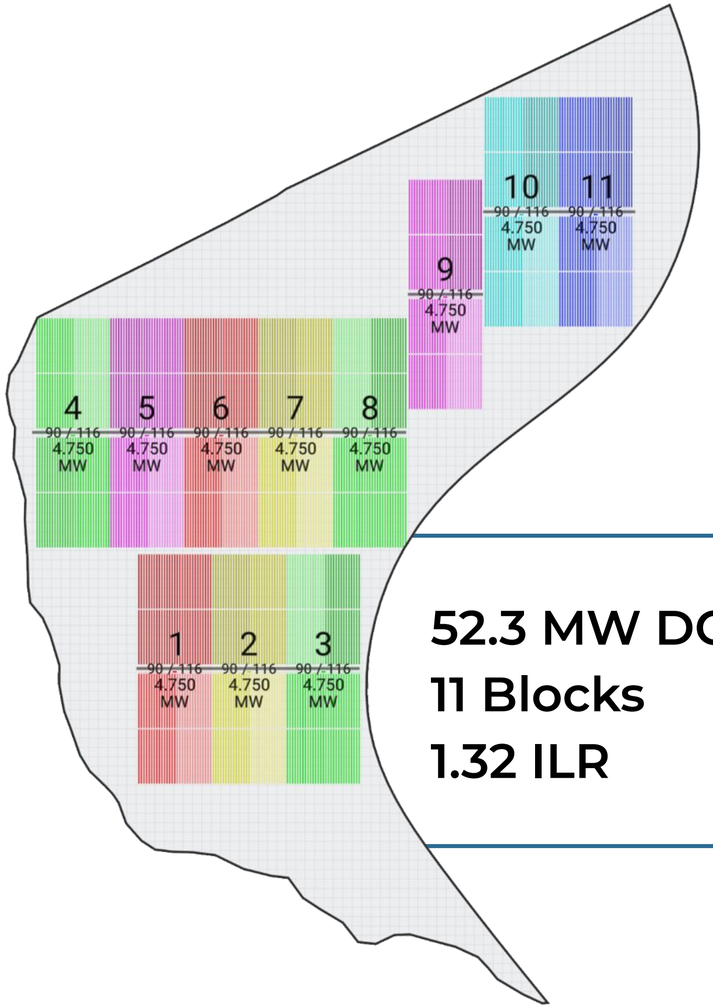
Every layout is a negotiation between competing priorities



81.1 MW DC
17 Blocks
1.24-1.36 ILR



76.2 MW DC
16 Blocks
1.32 ILR



52.3 MW DC
11 Blocks
1.32 ILR

The Contradictions of ‘Good Enough’

Great design is about embracing contradictions

A layout needs to be consistent...

unless we need more DC capacity!

We aim for rectangular, unified blocks...

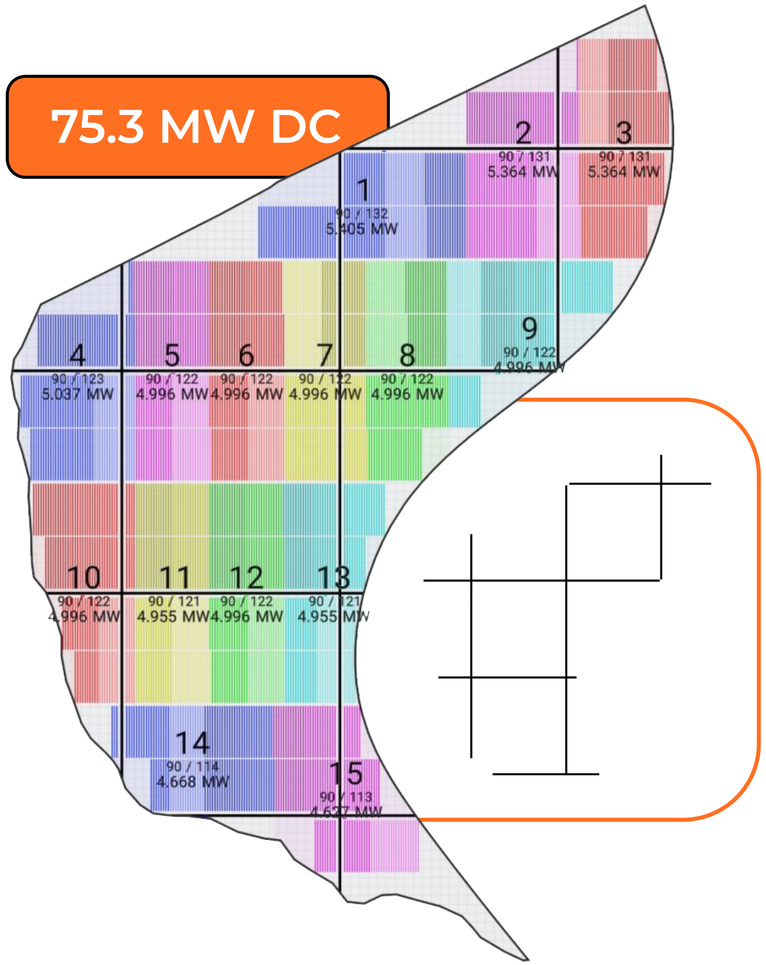
unless the site constraints force adjustments!

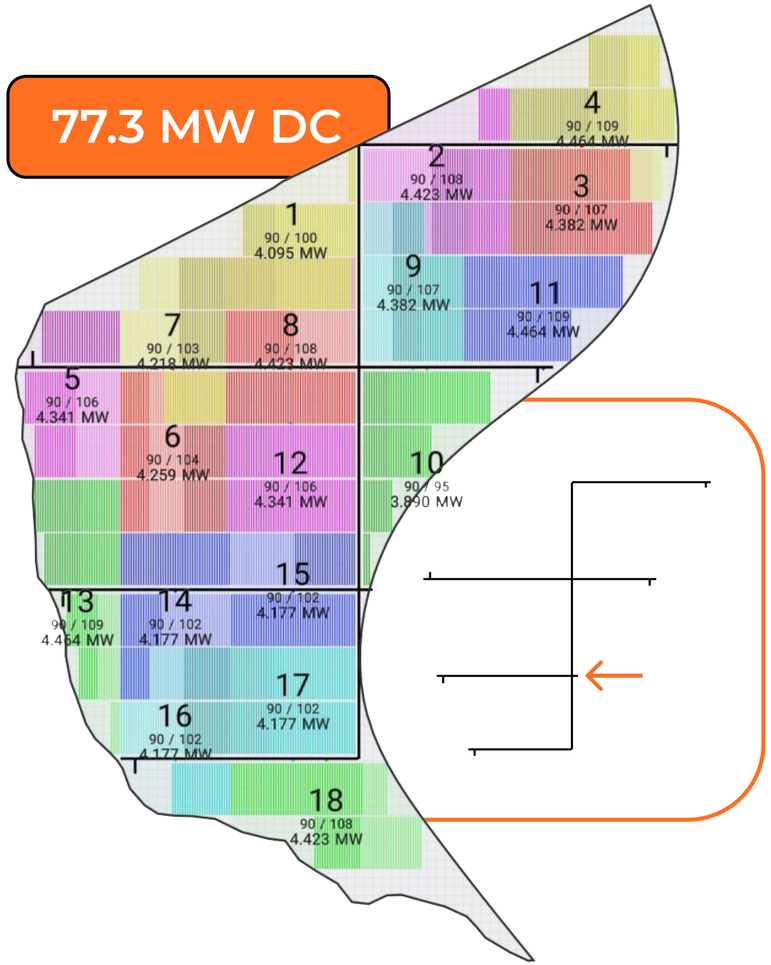
Blocks should remain compact

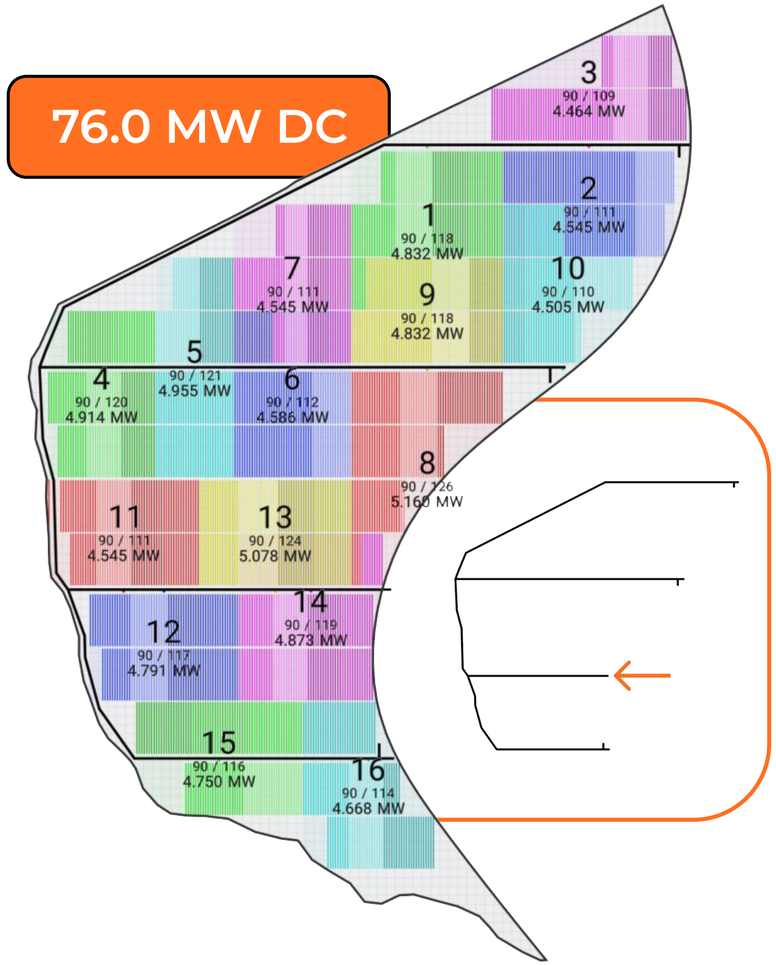
unless grading makes it too costly!

‘Good Enough’ is a Snapshot in Time

A ‘good enough’ layout today is just a step toward a better layout tomorrow

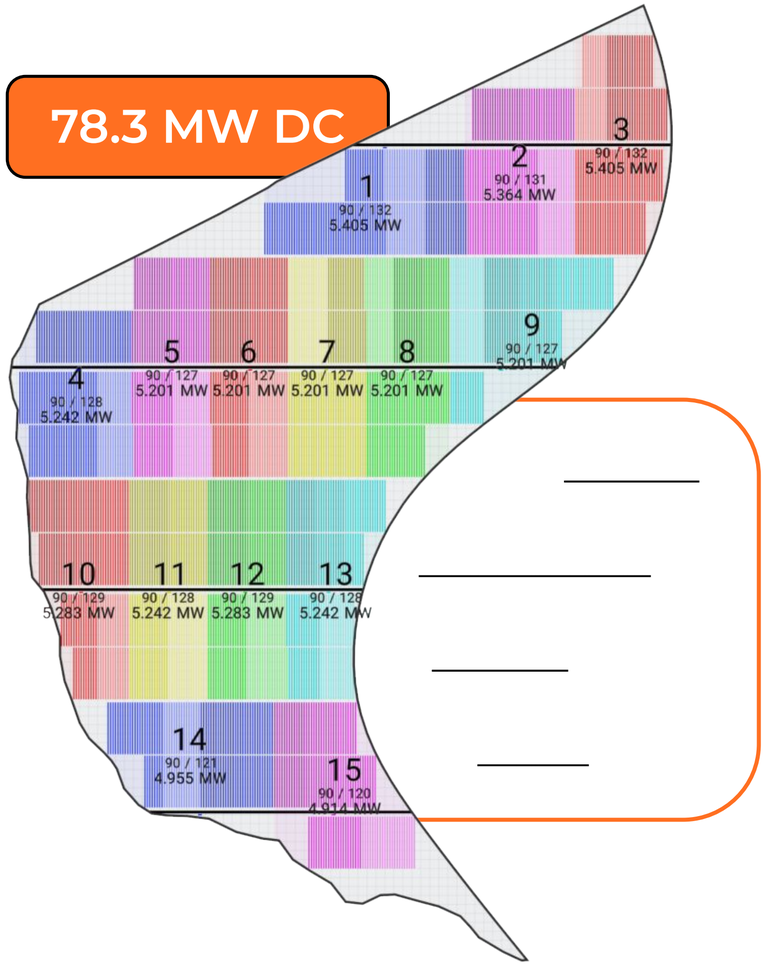


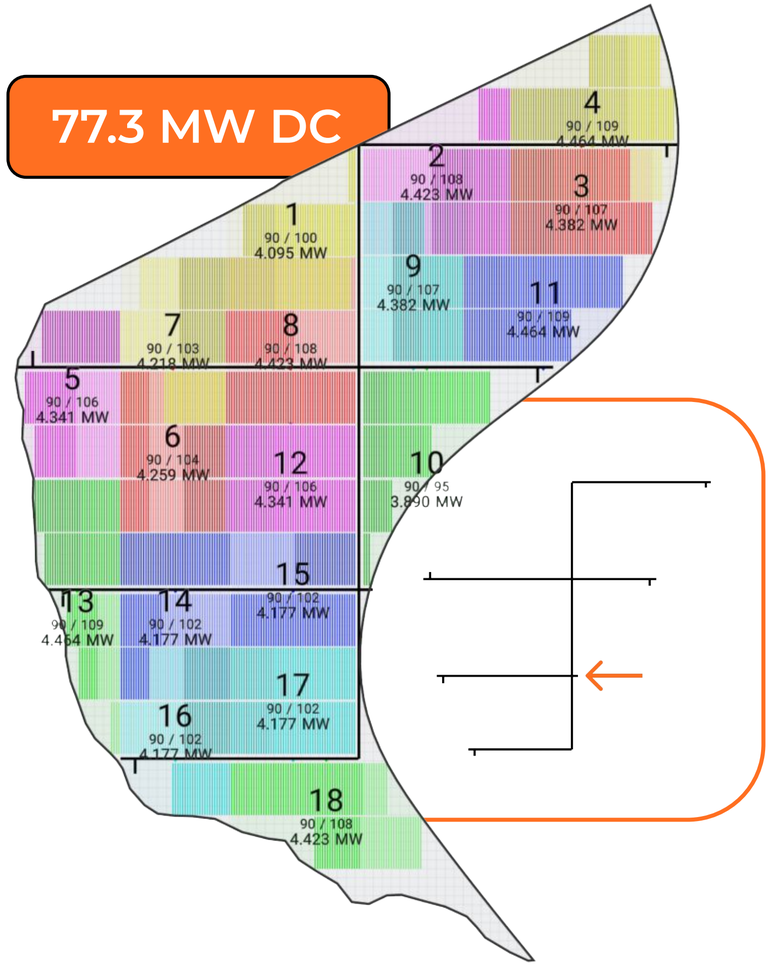


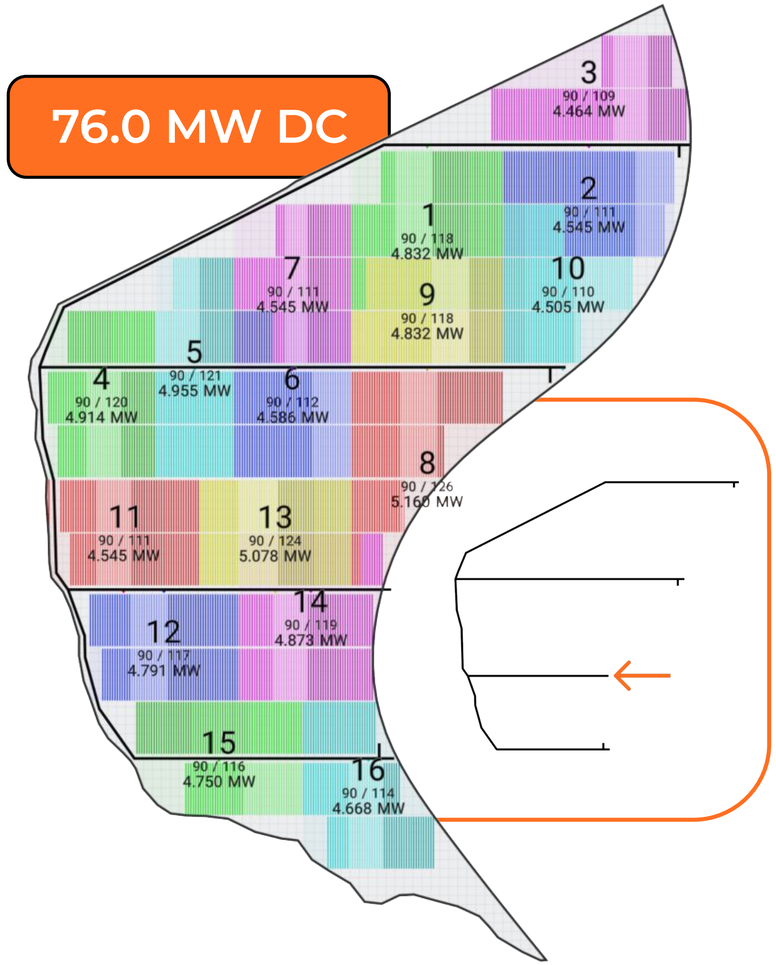


‘Good Enough’ is a Snapshot in Time

A ‘good enough’ layout today is just a step toward a better layout tomorrow







Takeaway: ‘Good Enough’ is Not One Answer

✅ It depends on project goals or what matters most at a given moment

✅ It’s about balancing trade-offs, not perfection

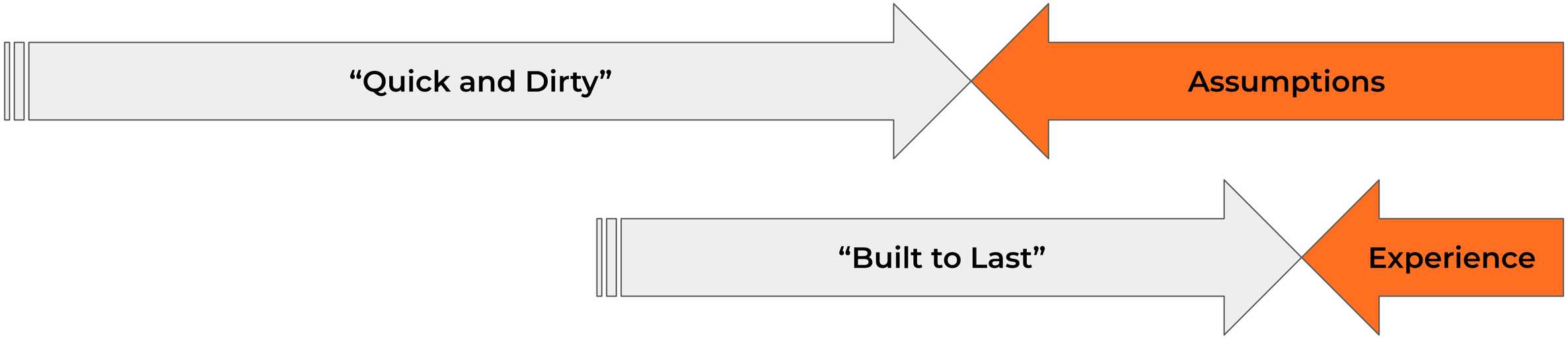
✅ It’s a moving target, shifting with new data, constraints and optimisation goals

Quick & Dirty vs. Built to Last

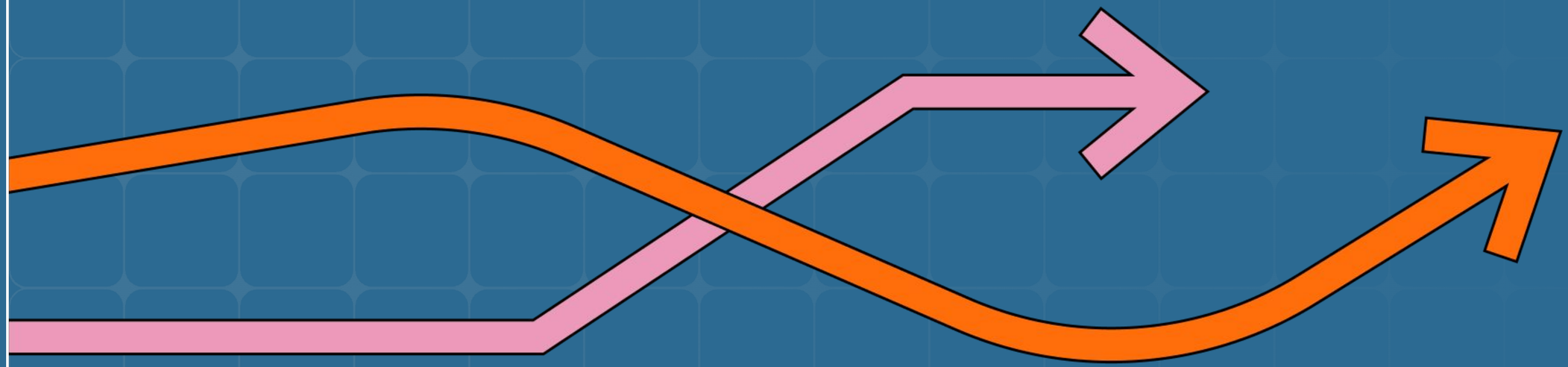
Driven by the data available at each stage, a layout evolves from quick and dirty to buildable, while long-term efficiency considerations transform it into something built to last.

Balancing Insights, Available Data, and Timing

Making ***"Quick and Dirty"*** *good enough is about assumptions and risk management. Making* ***"Built to Last"*** *good enough is about polishing and ensuring buildability and lifecycle optimisation*



Goal Settings & Requirements Gathering	Context & Restrictions Analysis	Exploration: Finding a Feasible Solution	Equipment Selection	Optimization: Iterating Trade-offs	Design: Polishing & Refining	Pre-Construction: Ensuring Constructability	Construction O&M



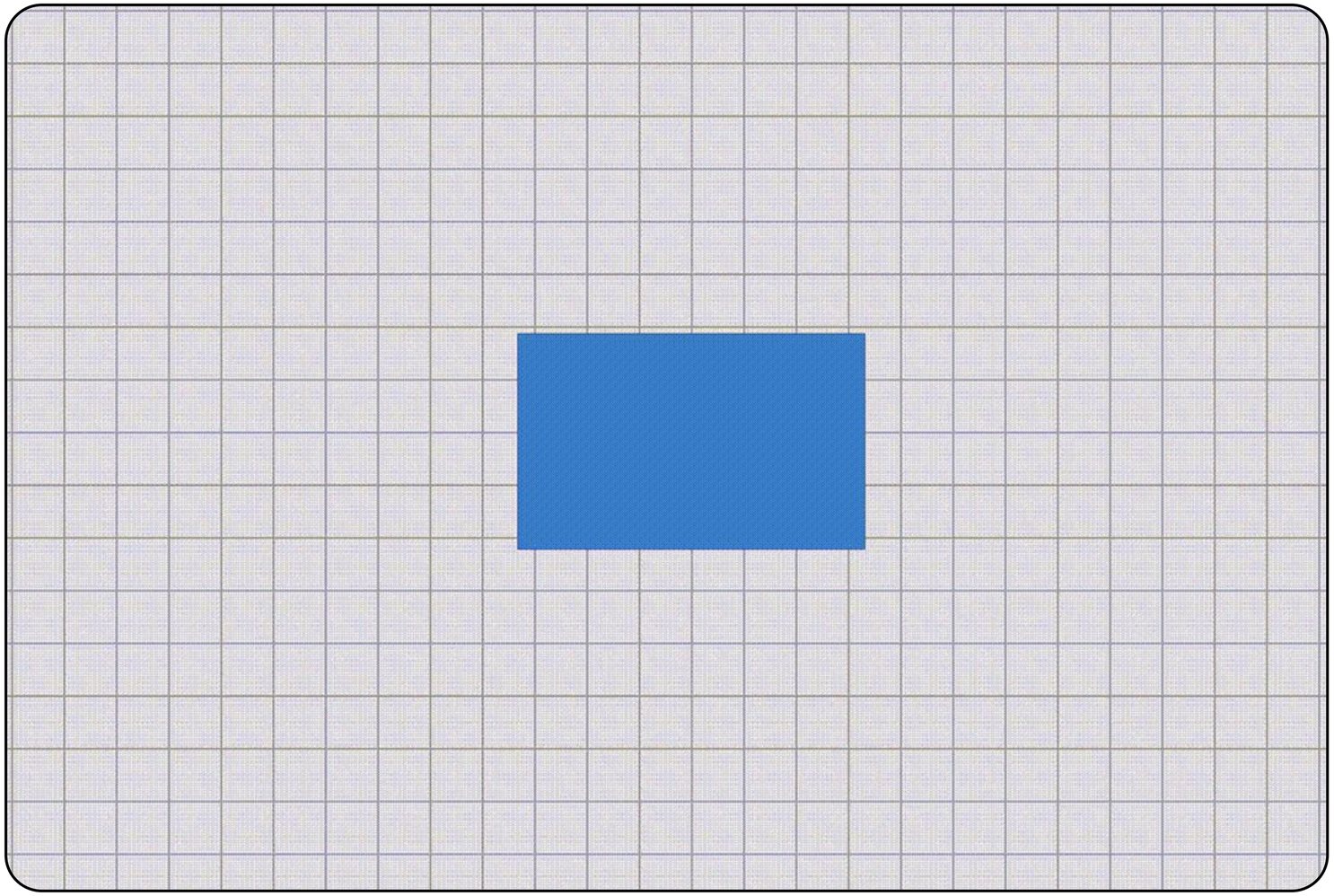
Ways to Design Layout

There's more than one way to do it right — it all depends on the context, including inputs, goals, and constraints

Layout Hierarchy

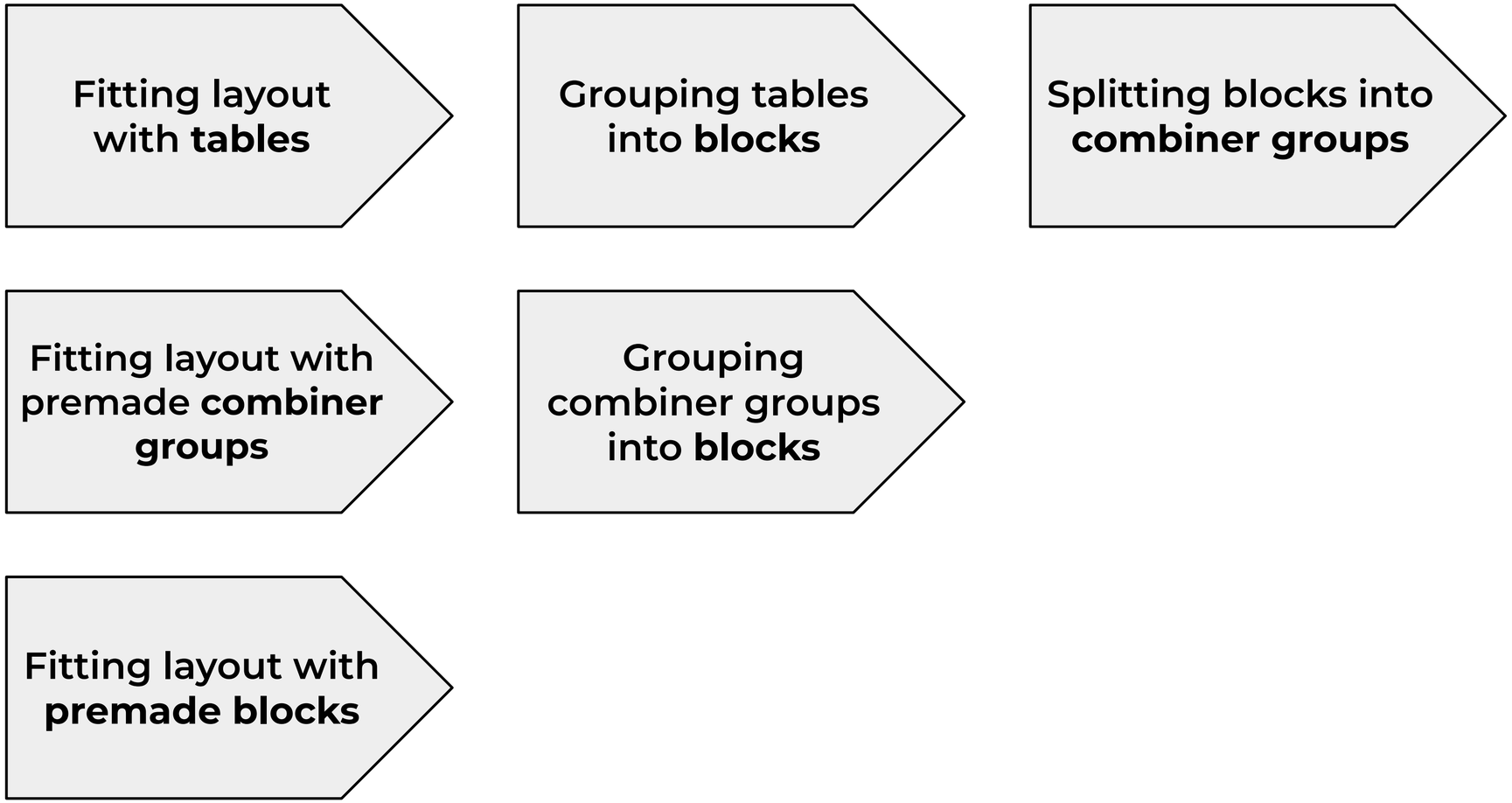
Everything runs in sync, seamlessly connected to generate energy

- → String
  - → Table group
    - → Combiner group
      - → Block
        - → Medium voltage group
          - → Layout

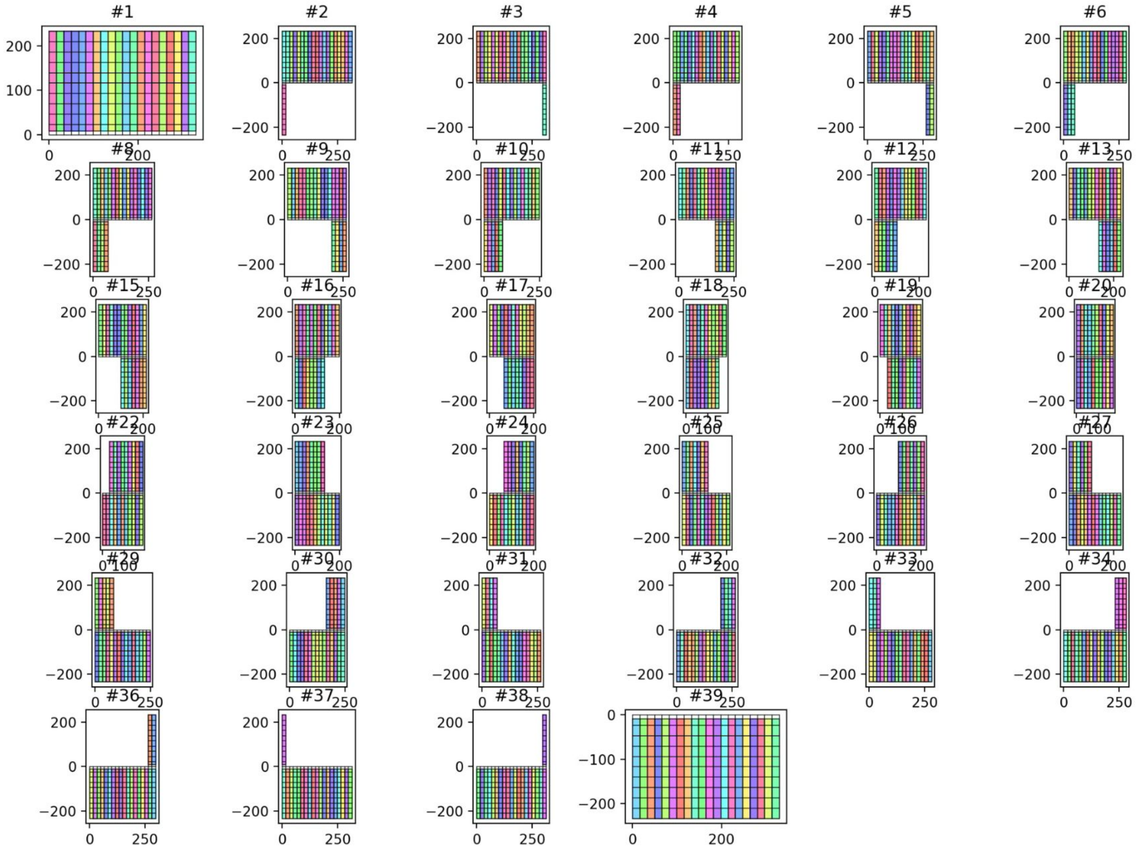


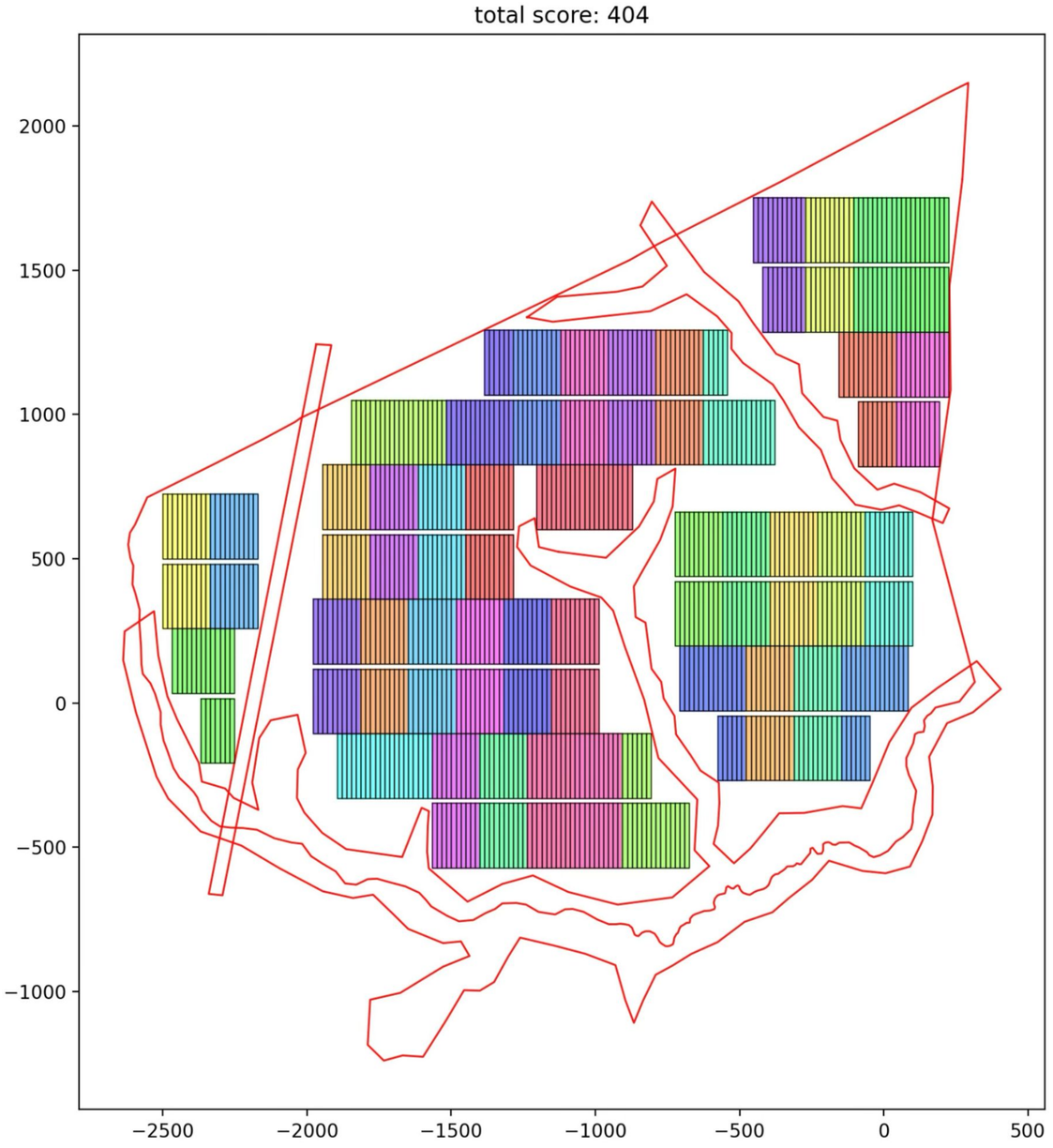
Different Paths to a Layout

The order in which you build defines what you optimize for

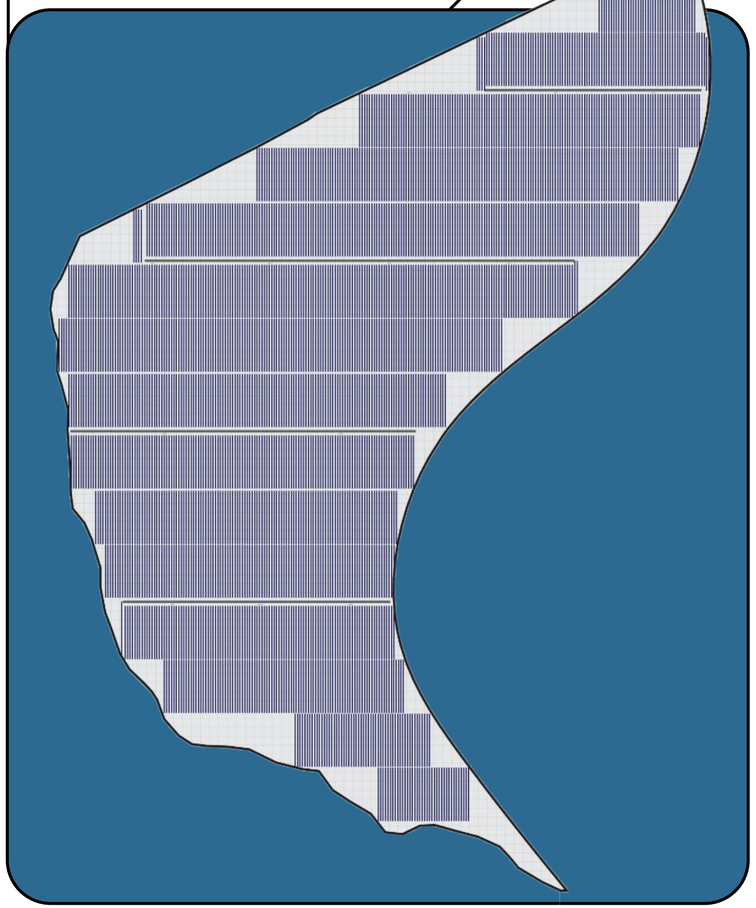


Fitting layout with premade blocks

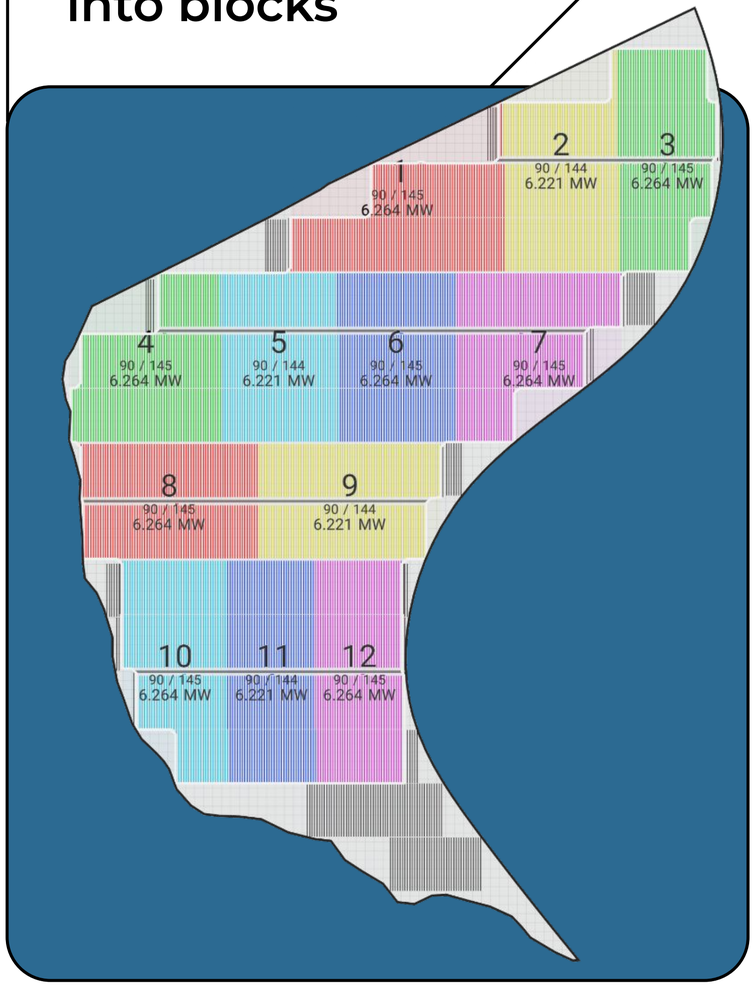




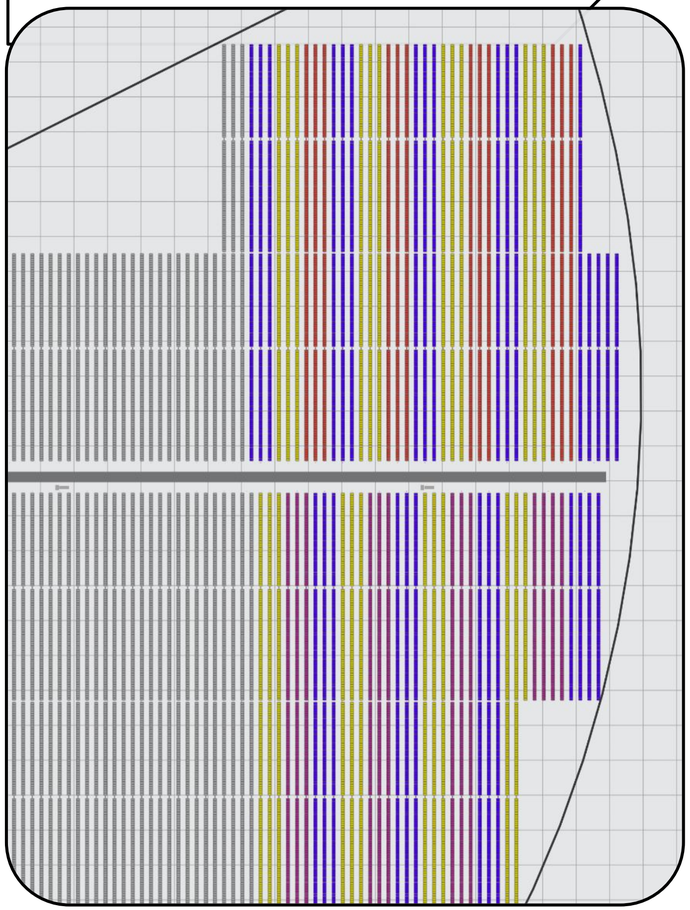
Fitting layout with tables



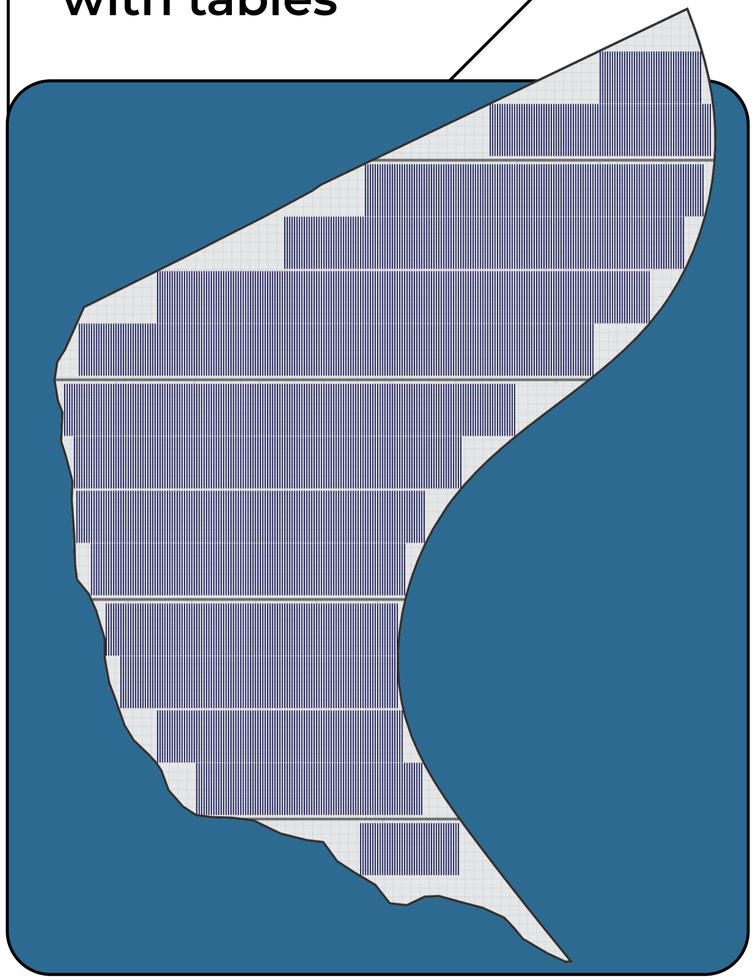
Grouping tables into blocks



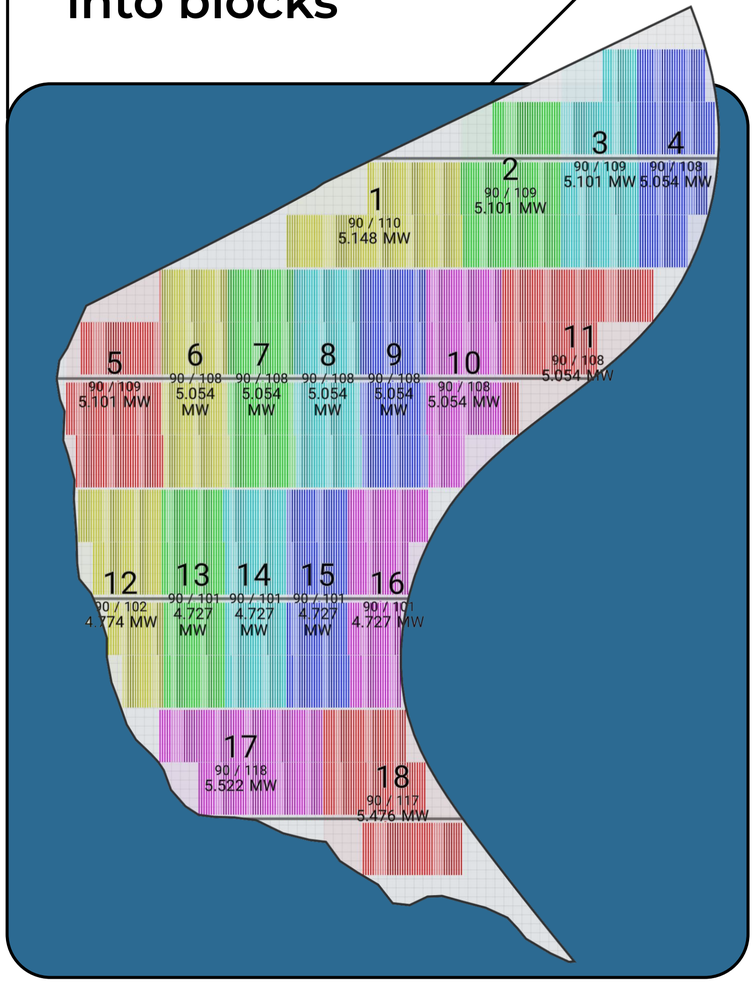
Splitting blocks into combiner groups



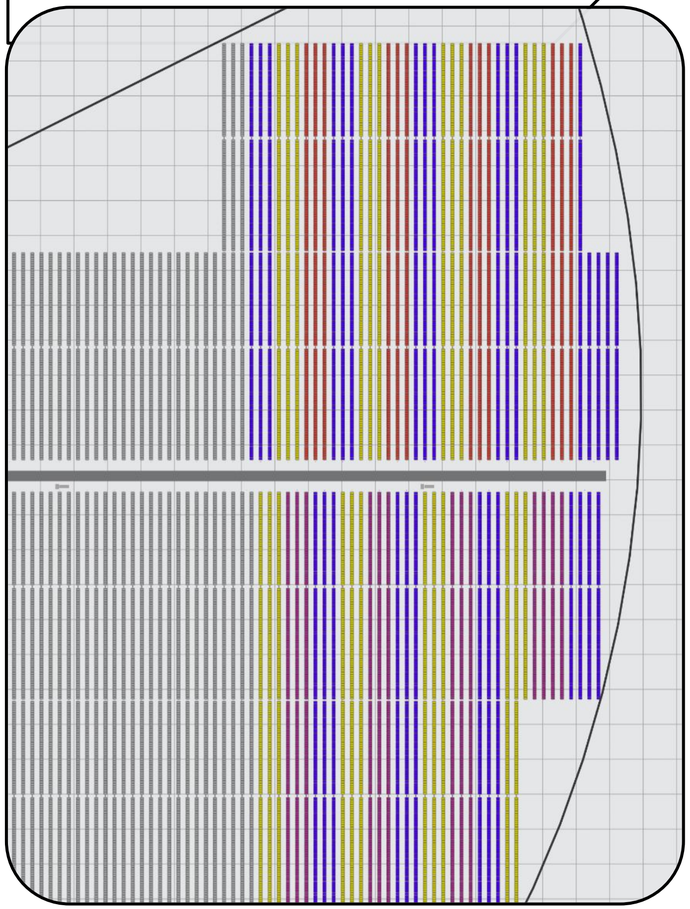
Fitting layout with tables



Grouping tables into blocks



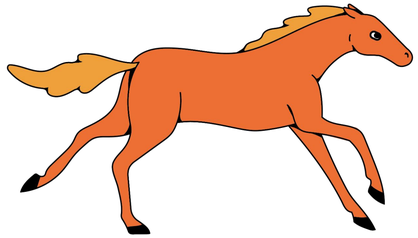
Splitting blocks into combiner groups



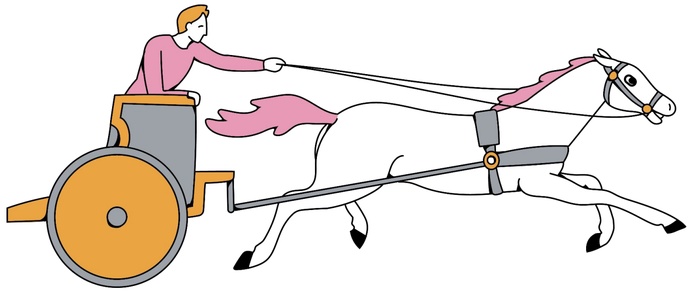
Layout Design Workflows

Ranging from fully automated solutions to expert-driven refinement

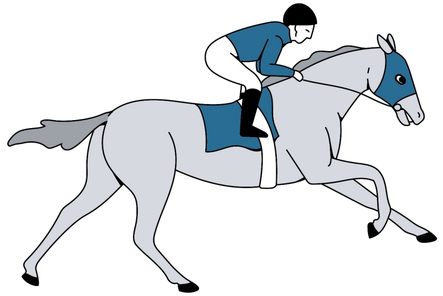
Advanced Automation



Fancy Expert Workflows

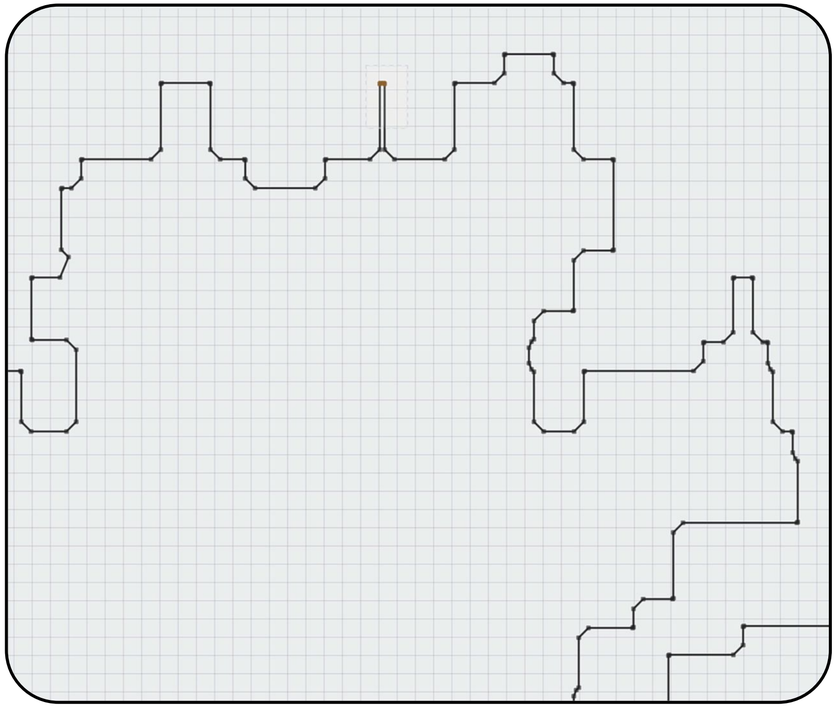


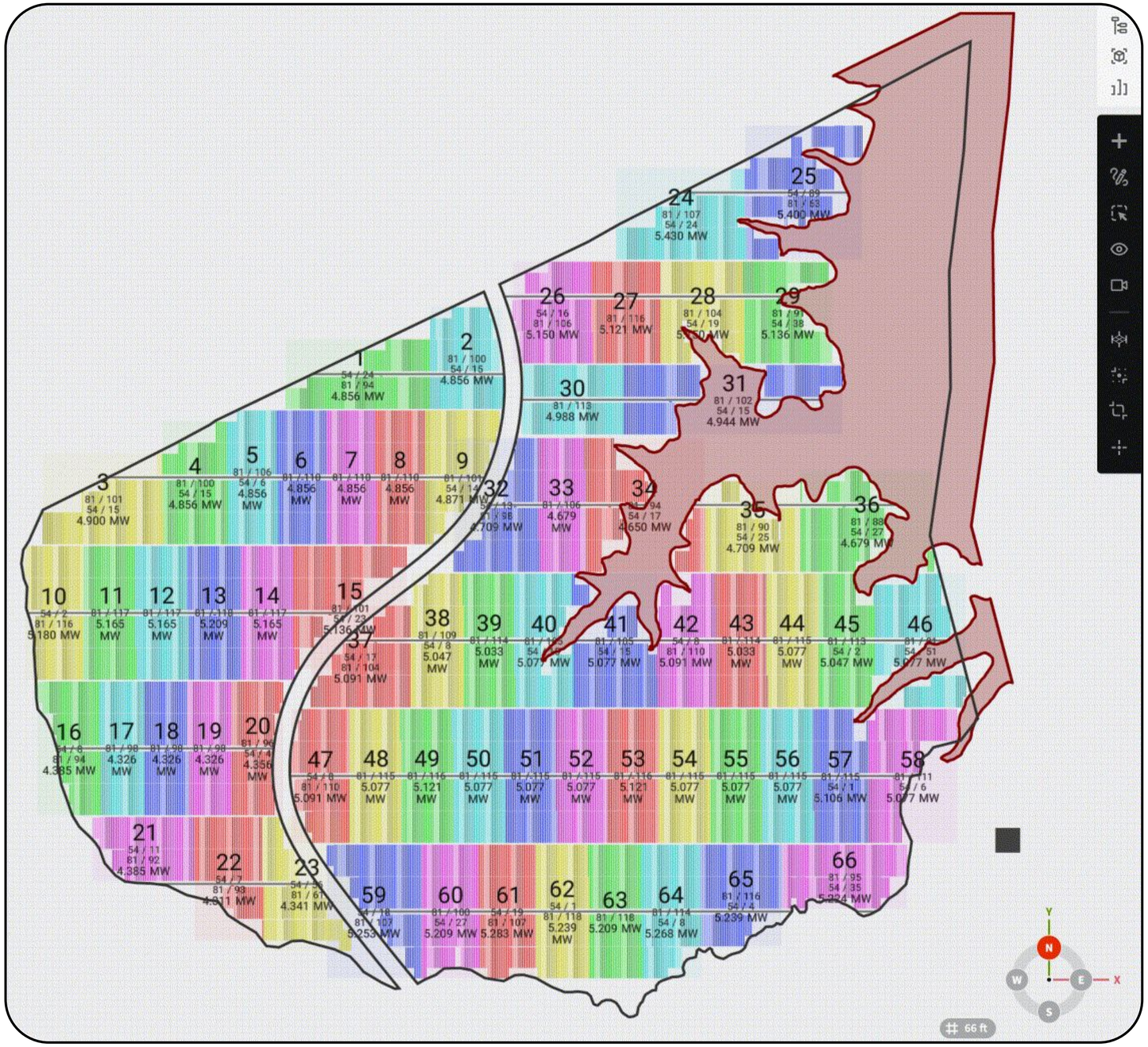
Human Craftsmanship



Advanced Automation

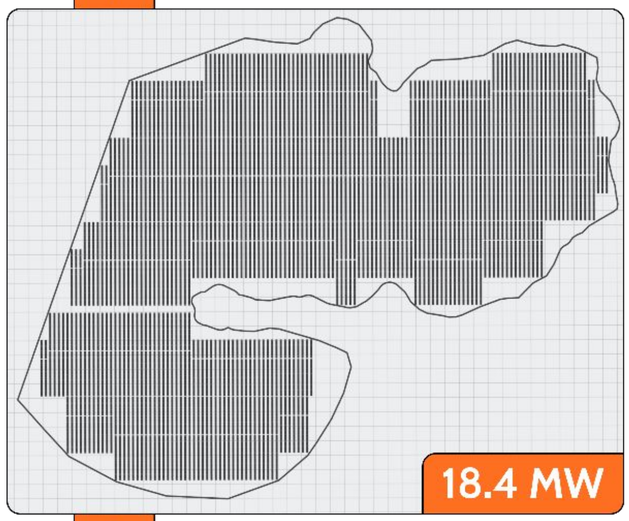
Fancy Expert Workflows

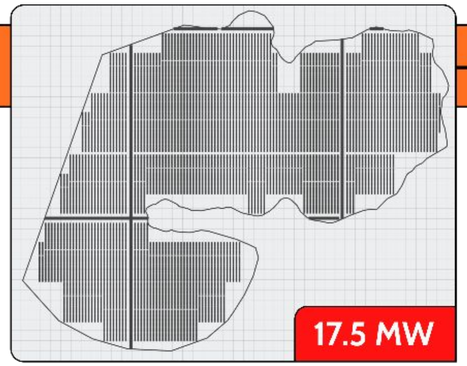


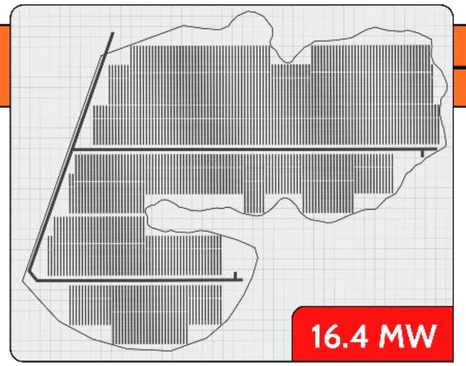


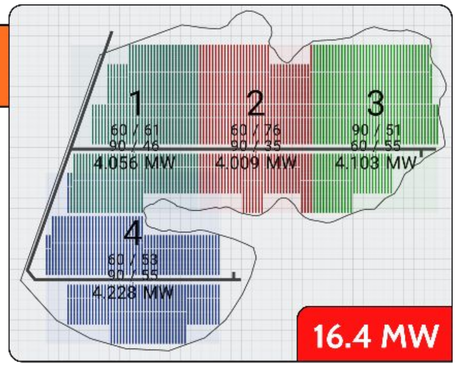
Fancy Expert Workflows *(Roads vs Blocking)*

ROADS FIRST



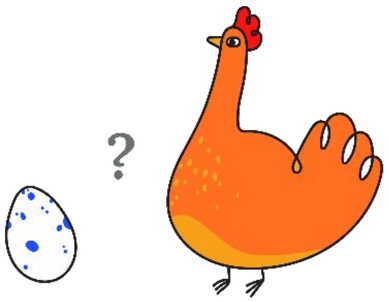




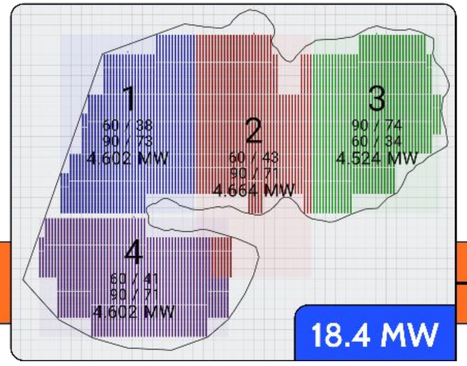


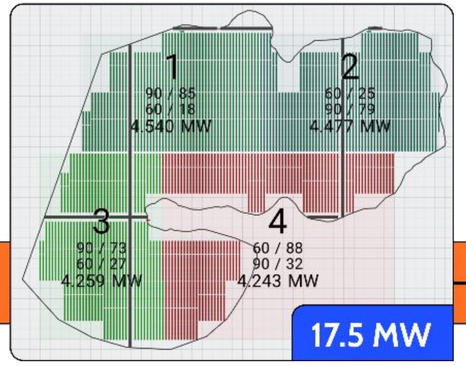
Layout Design Paradox

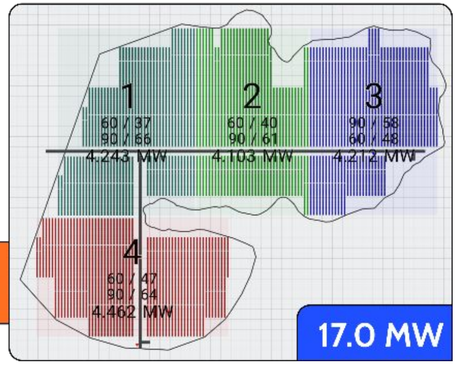
Which comes first,
the *roads* or the *blocking*?



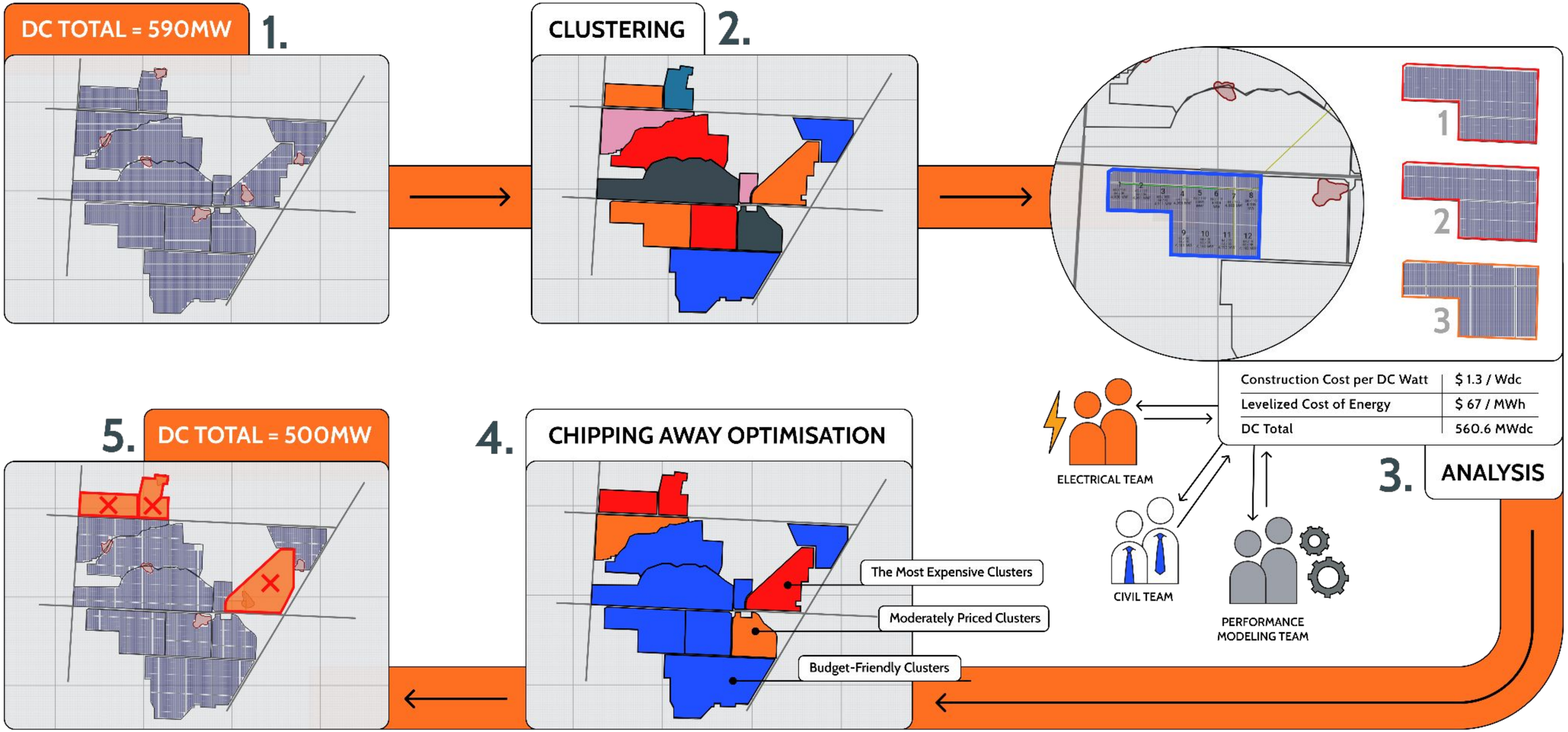
BLOCKING FIRST



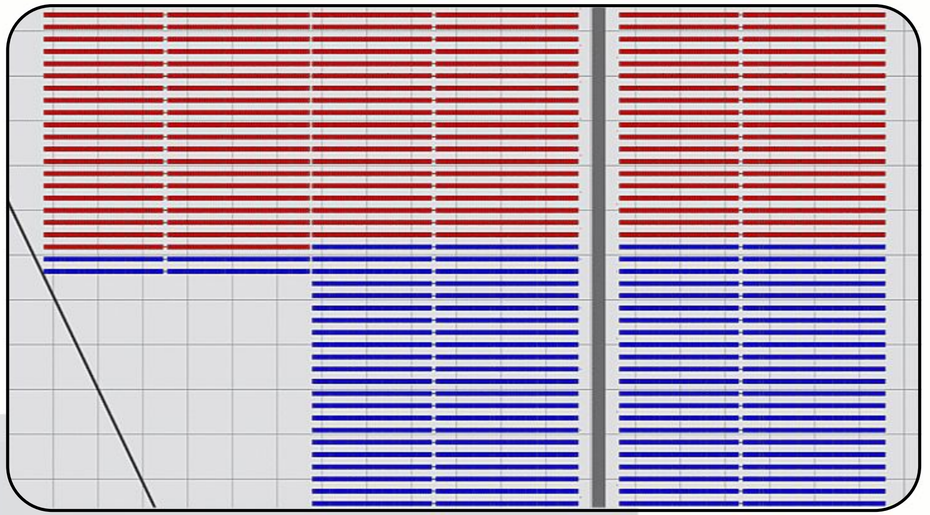




Fancy Expert Workflows *(Chipping Away Optimisation)*



Human Craftsmanship



Thank you!

Any questions?

PVFARM