April 7th, 2023

Limited Generation Profile Analysis

An Assessment of How LGP Design Affects Energy Delivery

Data Used for this Analysis

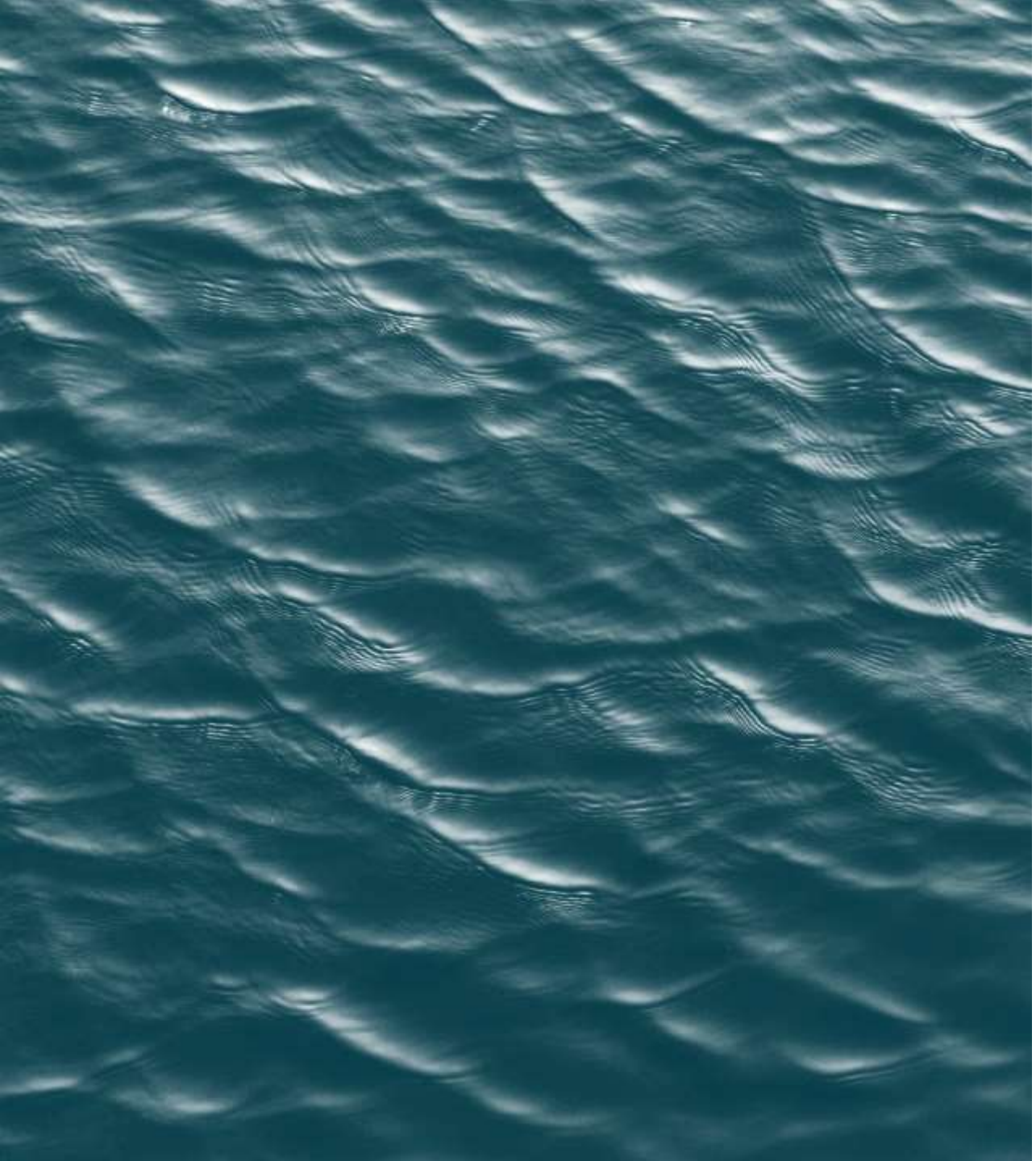
Utility: Southern California Edison
ICA Study: Uniform Generation Static Grid
Load Type: Minimum Load
Circuits Analyzed

- MONROE – 598 Nodes
- ABACUS – 604 Nodes
- CITY CREEK – 511 Nodes
- CLAY – 707 Nodes

Analysis Procedure

For each node we develop the following four limited generations profiles (LGPs)

- **LGP 1: Maximum 288 profile**
  - No change to ICA 288 profile
- **LGP 2: 12-month profile**
  - Take the minimum value for each month across all hours
- **LGP 3: 24-hour profile**
  - Take the minimum value for each hour across all months.
- **LGP 4: Blocked profile**
  - Divide the year into blocks of 3 months and each day into blocks of 4 hours, and take the minimum value for each block
  - Total of 24 blocks
  - Example Block: July-September; 5pm-9pm



Analysis at the Node Level

For each node and LGP we calculate:

- Annual energy delivered (GWh)
- Utilization rate: % of energy delivered relative to the 288 profile

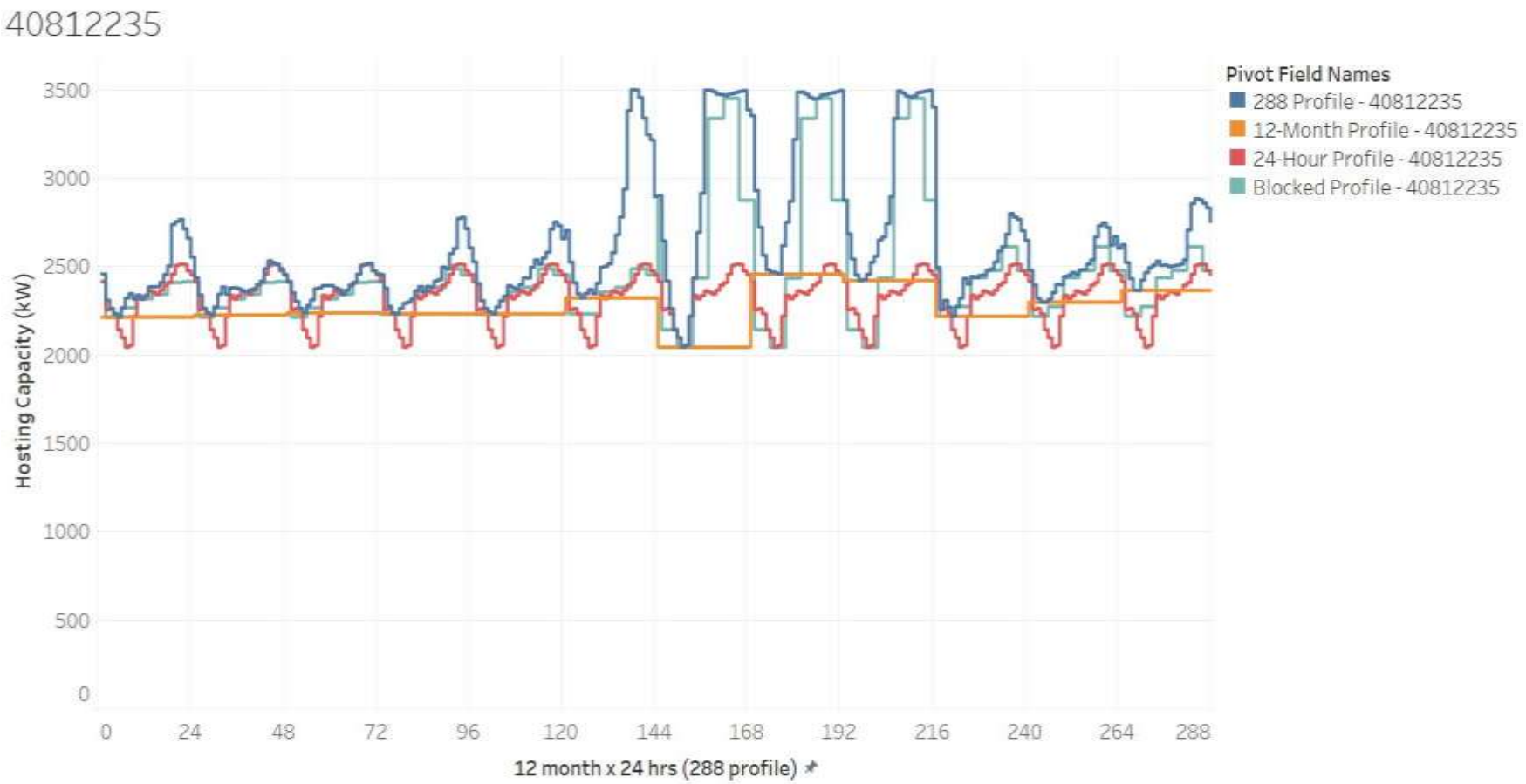
Example Node Analysis

Circuit: CITY CREEK

Node: 40812235

Profile	Annual Energy Delivered (GWh)	*Utilization Rate (%)
288 Profile	23.0	-
12-Month Profile	19.9	87%
24-Hour Profile	20.4	89%
Blocked Profile	21.5	93%

*Utilization Rate = Percent Energy Delivered Relative to 288 Profile (%)



Example Node Analysis at Periods of Peak Load (5pm-9pm)

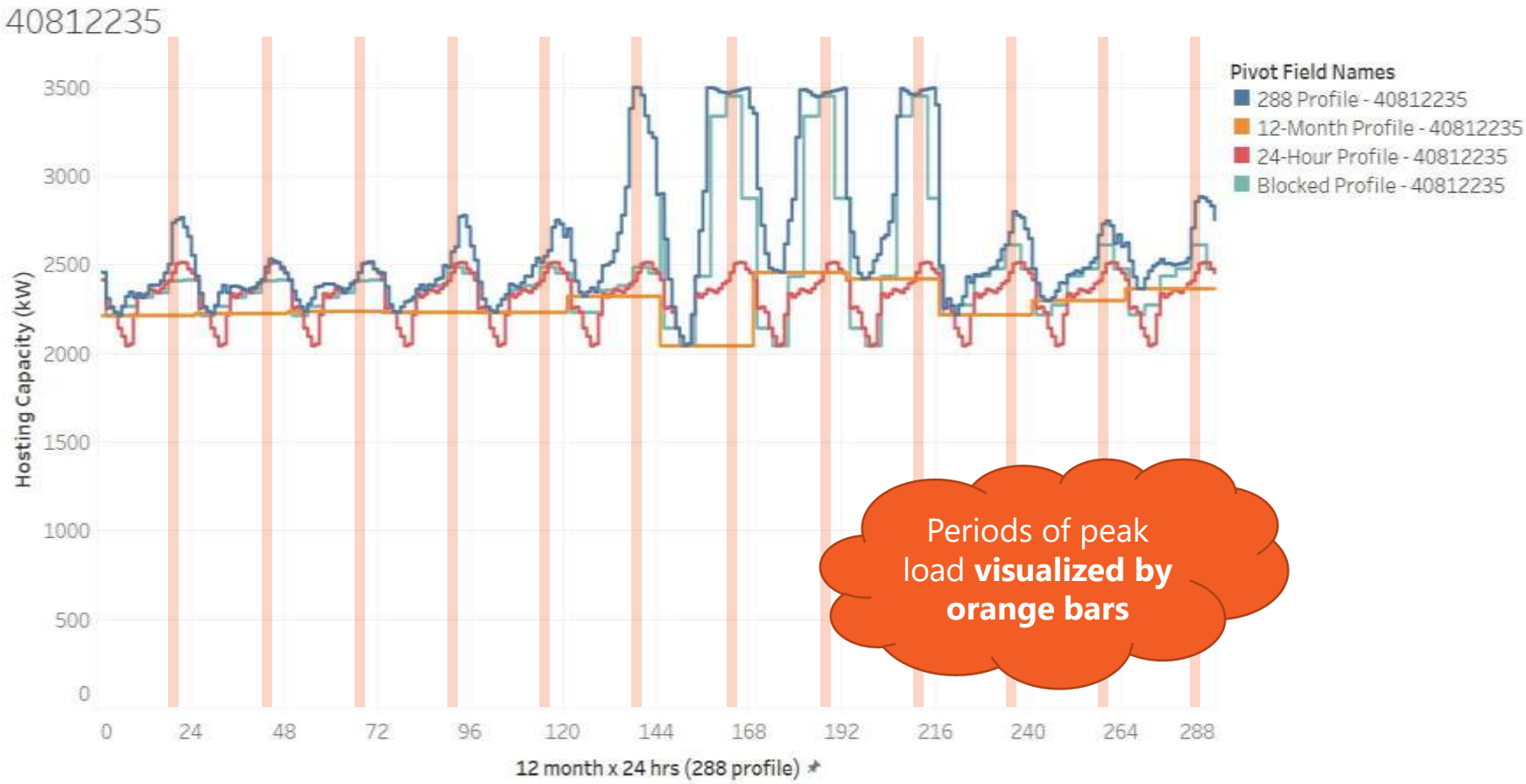
Circuit: CITY CREEK

Node: 40812235

Now only looking at 5pm to 9pm over the entire year

Profile	Annual Energy Delivered (GWh)	*Utilization Rate (%)
288 Profile	4.26	-
12-Month Profile	3.32	78%
24-Hour Profile	3.60	85%
Blocked Profile	4.00	94%

*Utilization Rate = Percent Energy Delivered Relative to 288 Profile (%)

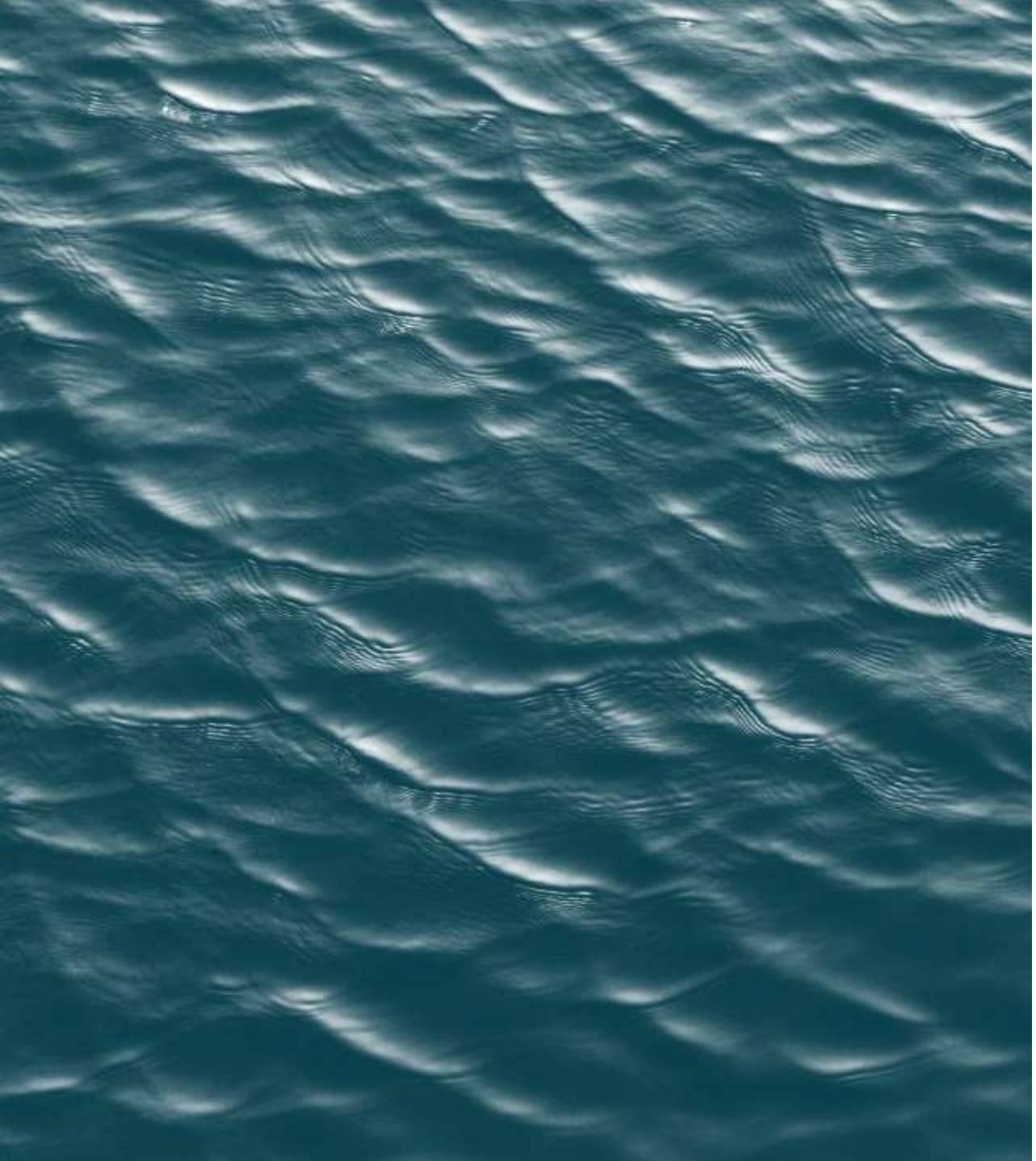


Customizing Your Blocked Profile

The **Light blue** line shows the blocked load profile based on a 5pm to 9pm peak

The **Orange** line shows the effect of shifting the block to 6pm to 10pm, increasing export capacity

Shifting blocked profiles based on circuit characteristics can optimize a system's energy delivery while maintaining a set number of LGP changes



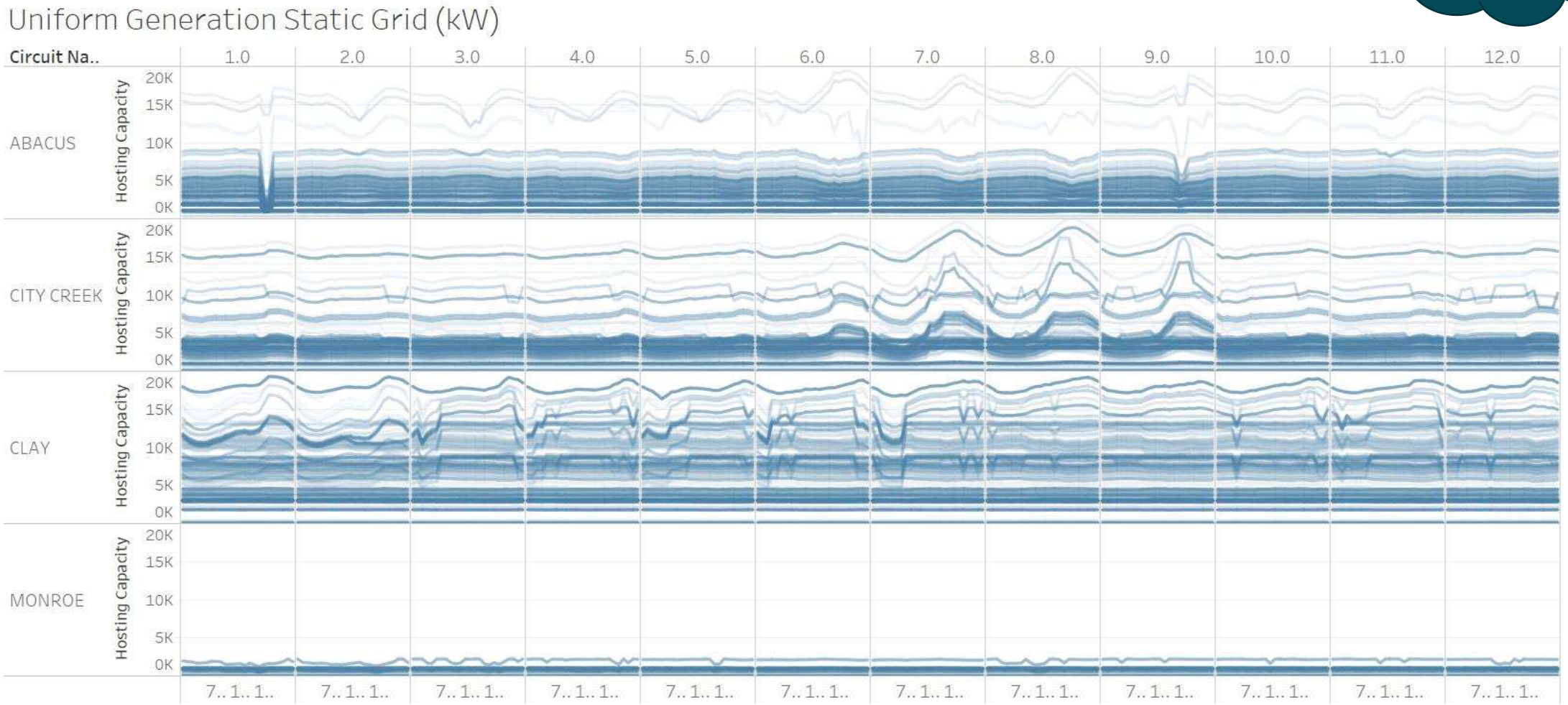
Analysis at the Circuit Level

For each circuit and LGP we compare

- Average annual energy delivered per node (GWh)
- Average utilization rate
- Standard deviation of utilization rate
  - Measures the spread of the data across the mean and susceptibility to outlier values
- Bottom 5th percentile of utilization rate
  - Measures the average utilization rate of the worst preforming nodes

Visualization of Hosting Capacity Data by Circuit

Each blue line represents a node's ICA profile



Circuit Analysis Results

Circuit Name	288 Profile	12-month Profile	24 Hour Profile	Blocked Profile
Average Annual Energy Delivered per Node (GWh)				
ABACUS	27.20	24.82	25.33	26.01
CITY CREEK	33.46	30.59	31.11	31.99
CLAY	55.33	52.29	52.19	53.43
MONROE	2.48	2.25	2.25	2.33
Average Utilization Rate (%)				
ABACUS	N/A	93%	94%	97%
CITY CREEK	N/A	92%	94%	96%
CLAY	N/A	96%	96%	98%
MONROE	N/A	92%	92%	95%
Standard Deviation of Utilization Rate (%)				
ABACUS	N/A	4%	3%	2%
CITY CREEK	N/A	6%	5%	3%
CLAY	N/A	5%	6%	3%
MONROE	N/A	8%	8%	5%
Average Bottom 5th Percentile Utilization Rate (%)				
ABACUS	N/A	89%	91%	94%
CITY CREEK	N/A	84%	86%	92%
CLAY	N/A	84%	81%	89%
MONROE	N/A	N/A, bottom 5th percentile of nodes all have no energy delivered		

Highest utilization rates

Least variation in utilization rates

Circuit Analysis Results - Peak Load Only (5pm – 9pm)

Circuit Name	288 Profile	12-month Profile	24 Hour Profile	Blocked Profile
Average Annual Peak Energy Delivered per Node (GWh)				
ABACUS	4.4	4.1	3.4	3.8
CITY CREEK	6.0	5.1	5.3	5.7
CLAY	9.3	8.7	8.9	9.1
MONROE	0.4	0.4	0.4	0.4
Average Peak Utilization Rate (%)				
ABACUS	N/A	96%	82%	89%
CITY CREEK	N/A	88%	92%	97%
CLAY	N/A	96%	97%	98%
MONROE	N/A	92%	91%	94%
Standard Deviation of Peak Utilization Rate (%)				
ABACUS	N/A	8%	11%	16%
CITY CREEK	N/A	12%	12%	6%
CLAY	N/A	8%	5%	5%
MONROE	N/A	11%	10%	9%
Average Bottom 5th Percentile of Peak Utilization Rate (%)				
ABACUS	N/A	76%	68%	50%
CITY CREEK	N/A	57%	58%	86%
CLAY	N/A	76%	85%	90%
MONROE	N/A	N/A, bottom 5th percentile of nodes all have no energy delivered		

For CITY CREEK, whose ICA data shows pronounced peak hosting capacity periods, the blocked profile significantly increases energy export

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MONROE	0.4	0.4	0.4	0.4
Average Peak Utilization Rate (%)				
ABACUS	N/A	96%	82%	89%
CITY CREEK	N/A	88%	92%	97%
CLAY	N/A	96%	97%	98%
MONROE	N/A	92%	91%	94%
Standard Deviation of Peak Utilization Rate (%)				
ABACUS	N/A	8%	11%	16%
CITY CREEK	N/A	12%	12%	6%
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Average Bottom 5th Percentile of Peak Utilization Rate (%)				
ABACUS	N/A	76%	68%	50%
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CLAY	N/A	76%	85%	90%
MONROE	N/A	N/A, bottom 5th percentile of nodes all have no energy delivered		

The lower utilization rate of the blocked LGP profile at peak load for the ABACUS circuit is driven by outlier ICA data

This shows the benefit of offering customized blocked profiles based on circuit characteristics

Summary of Findings

Benefits of using a custom designed blocked profile

- Higher utilization rates means more energy will be delivered to the grid over the course of the year
- Custom designed of blocked profiles can optimize energy delivery during circuit-specific peak load periods
- Compresses 288 profile into 24 points, while capturing seasonal and daily changes in the grid.