# Energy Use and the Grid

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EGI Energy & Geoscience Institute
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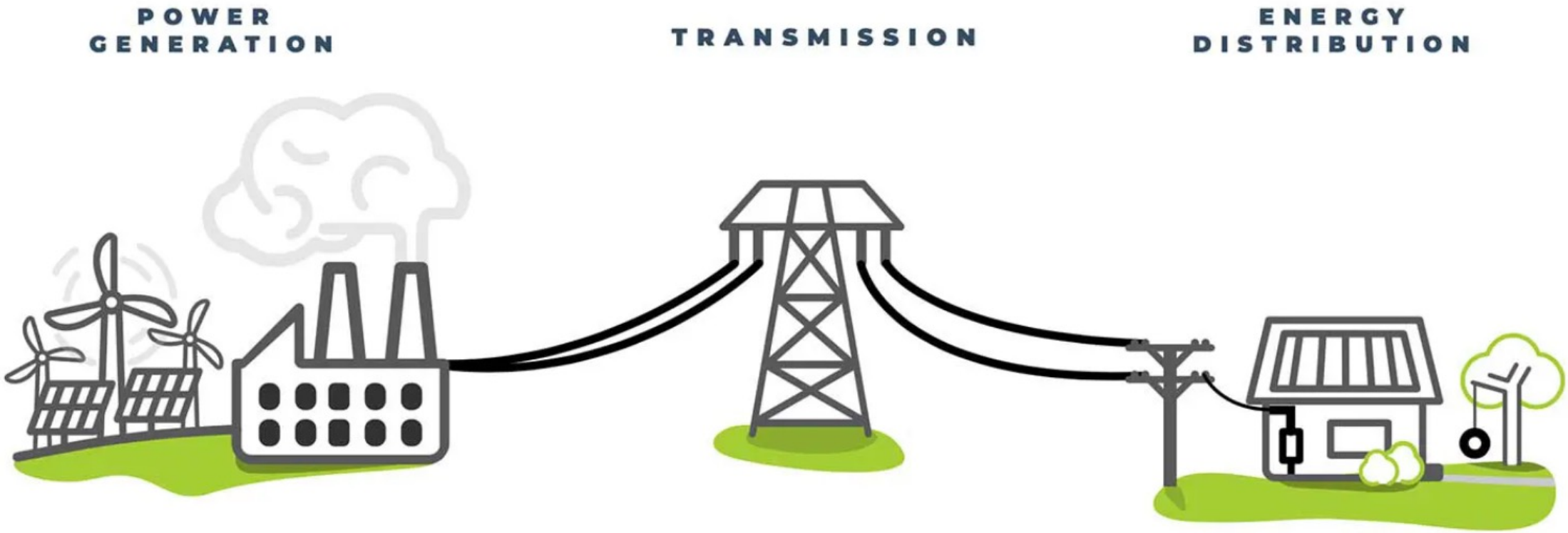


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Source: “Electricity Market”, EnerWisely, https://enerwisely.com/energy-market/


- Historically operated to meet supply
- Operated to be reliable
- Primarily made up of combustible fuels
  - Easy to store
  - Readily available
  - Easy to control



Source: “Electricity Market”, EnerWisely, https://enerwisely.com/energy-market/

- Historically upkept to deliver reliable power to distributors
- Regulated across the country and within states
- Build to transport large amounts of steady energy from power plants



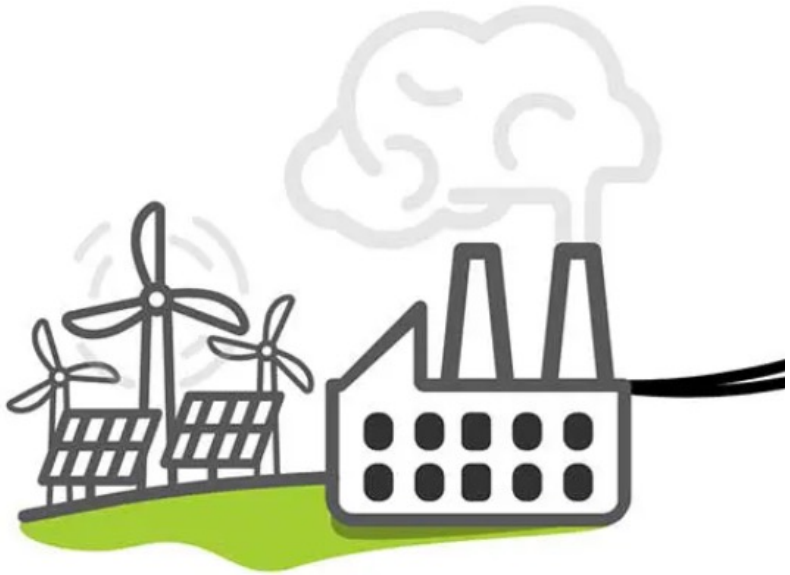

Source: “Electricity Market”, EnerWisely, https://enerwisely.com/energy-market/

- Historically determined the overall electricity demand
- Regulated to prevent monopoly and promote reliability
- Built a culture and reliance on having power when power is needed

ENERGY DISTRIBUTION

Source: “Electricity Market”, EnerWisely, https://enerwisely.com/energy-market/

POWER GENERATION



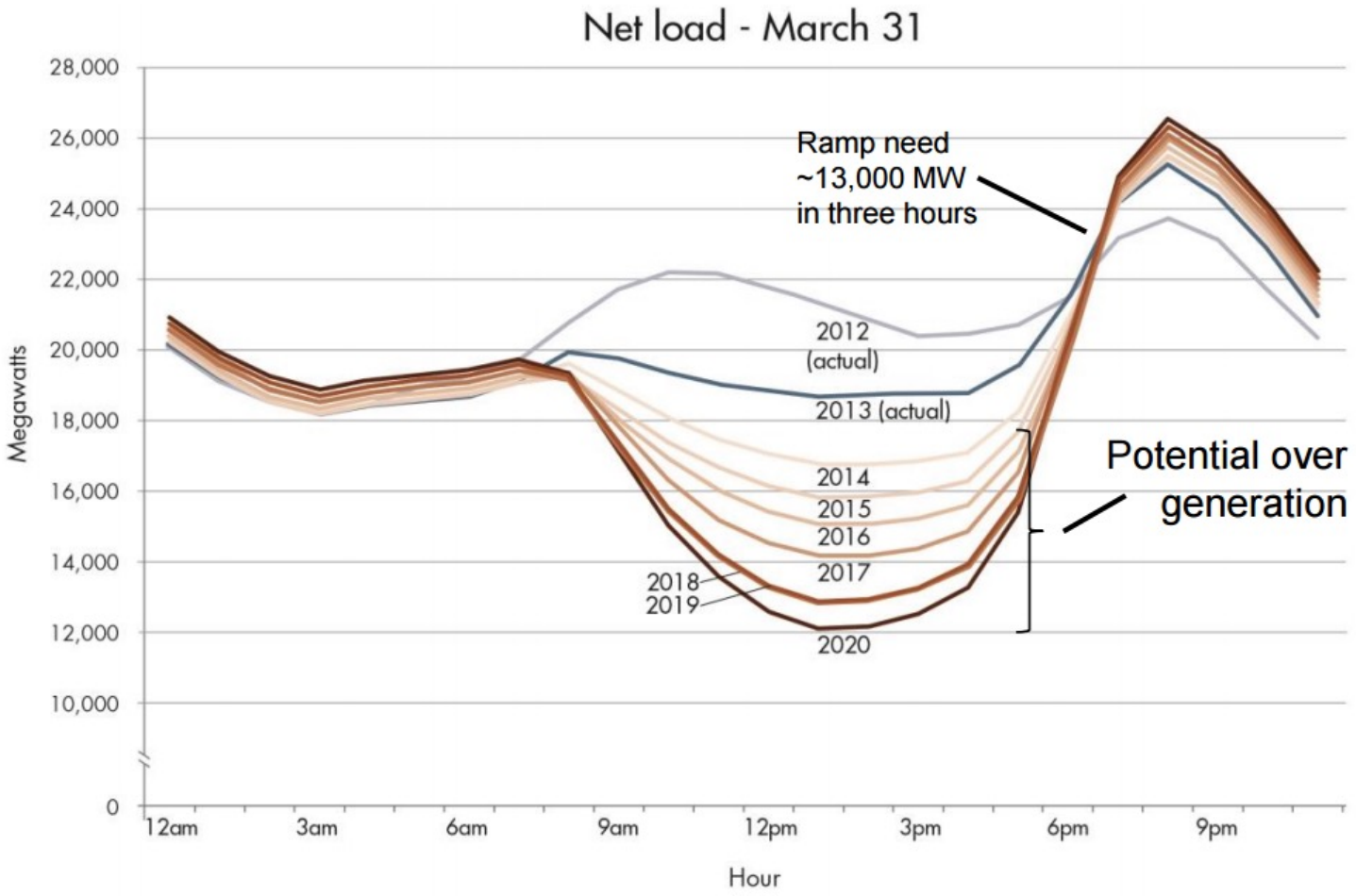
- Relationship between user and producer is changing
- Intermittent renewables have shifted the status quo

ENERGY DISTRIBUTION



Source: “Electricity Market”, EnerWisely, https://enerwisely.com/energy-market/

# The Duck Curve

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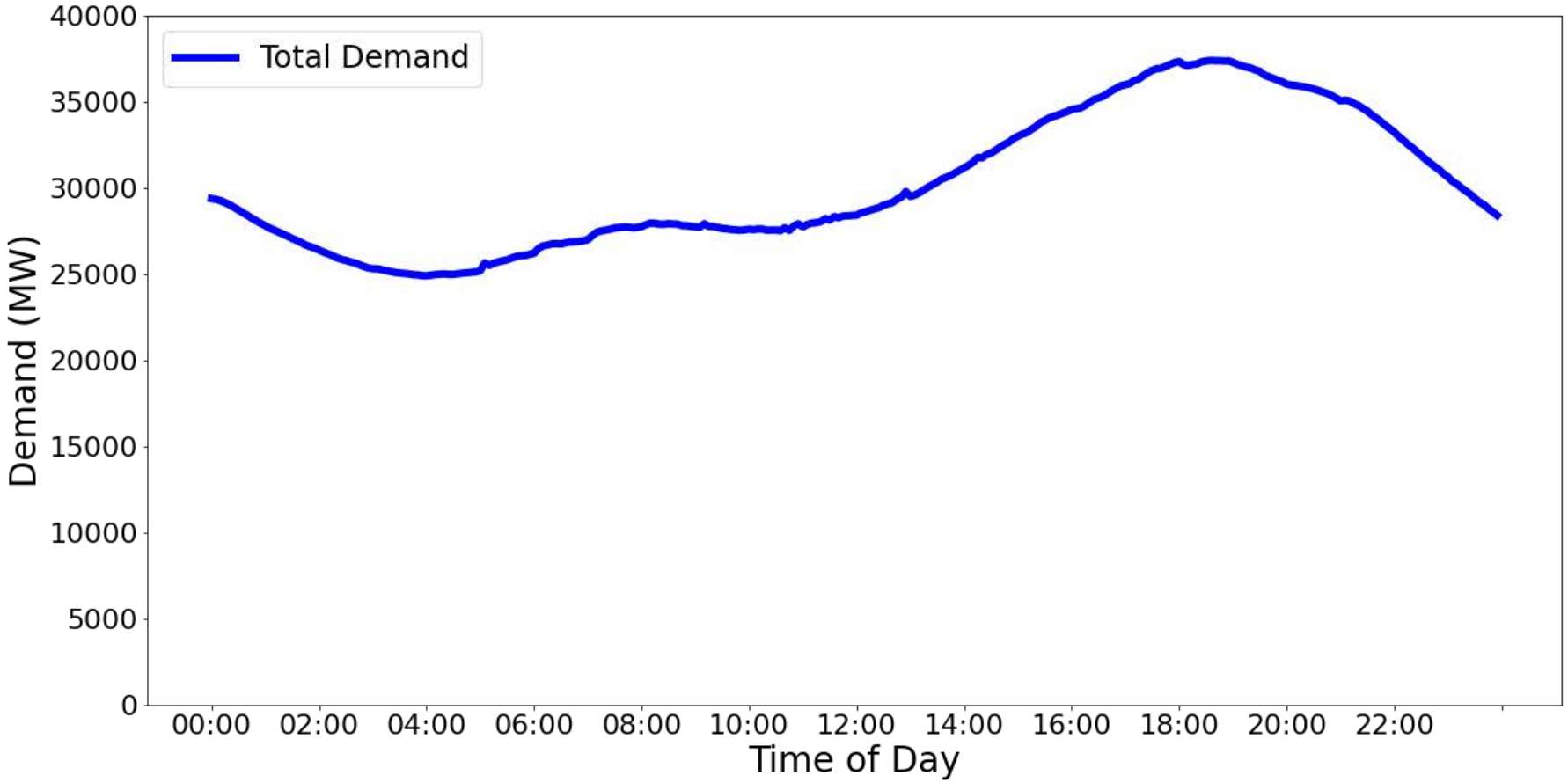
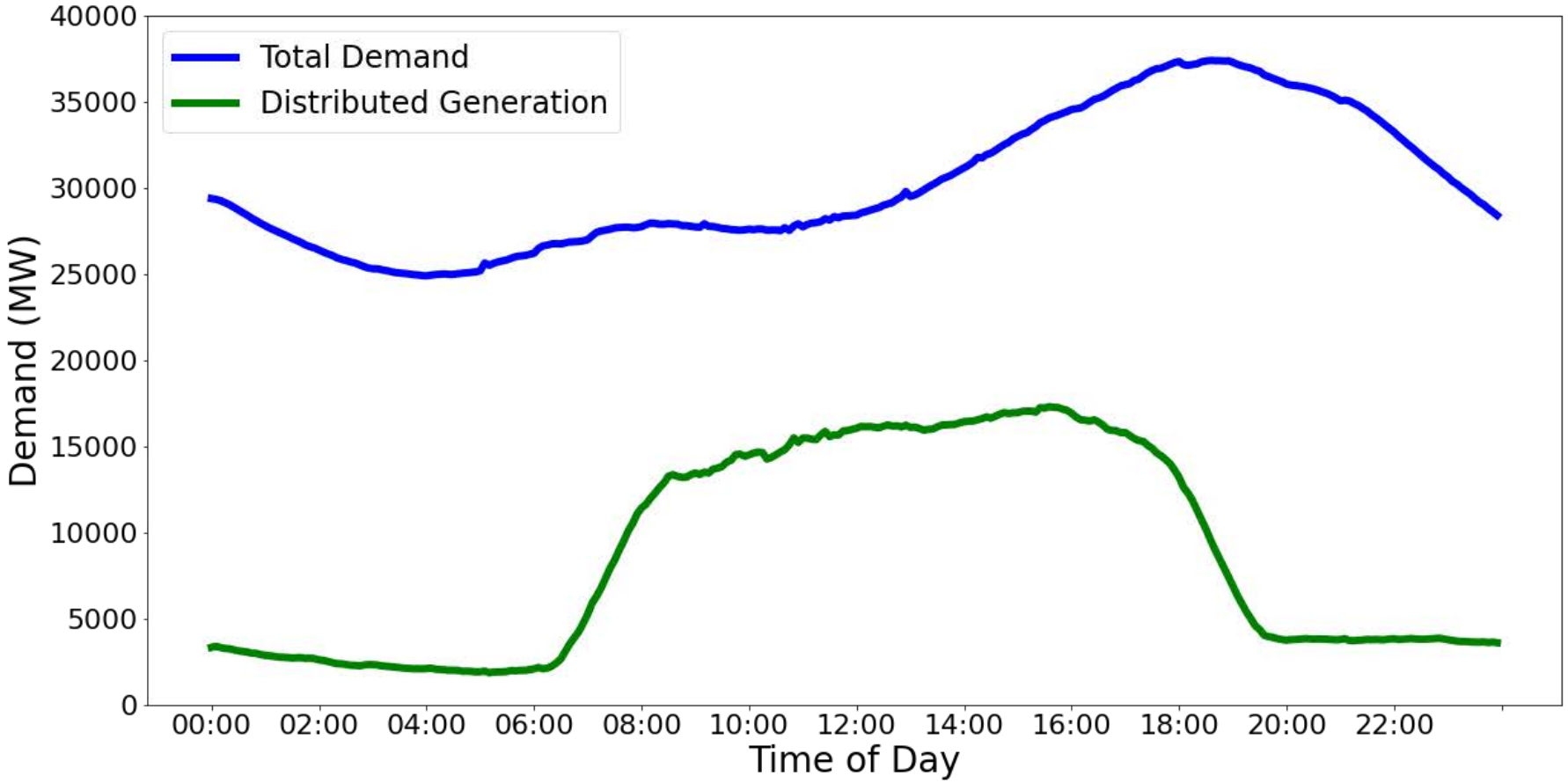
Source: "The Duck Curve", California ISO (CAISO), 2016






Source: California ISO (CAISO), 2023

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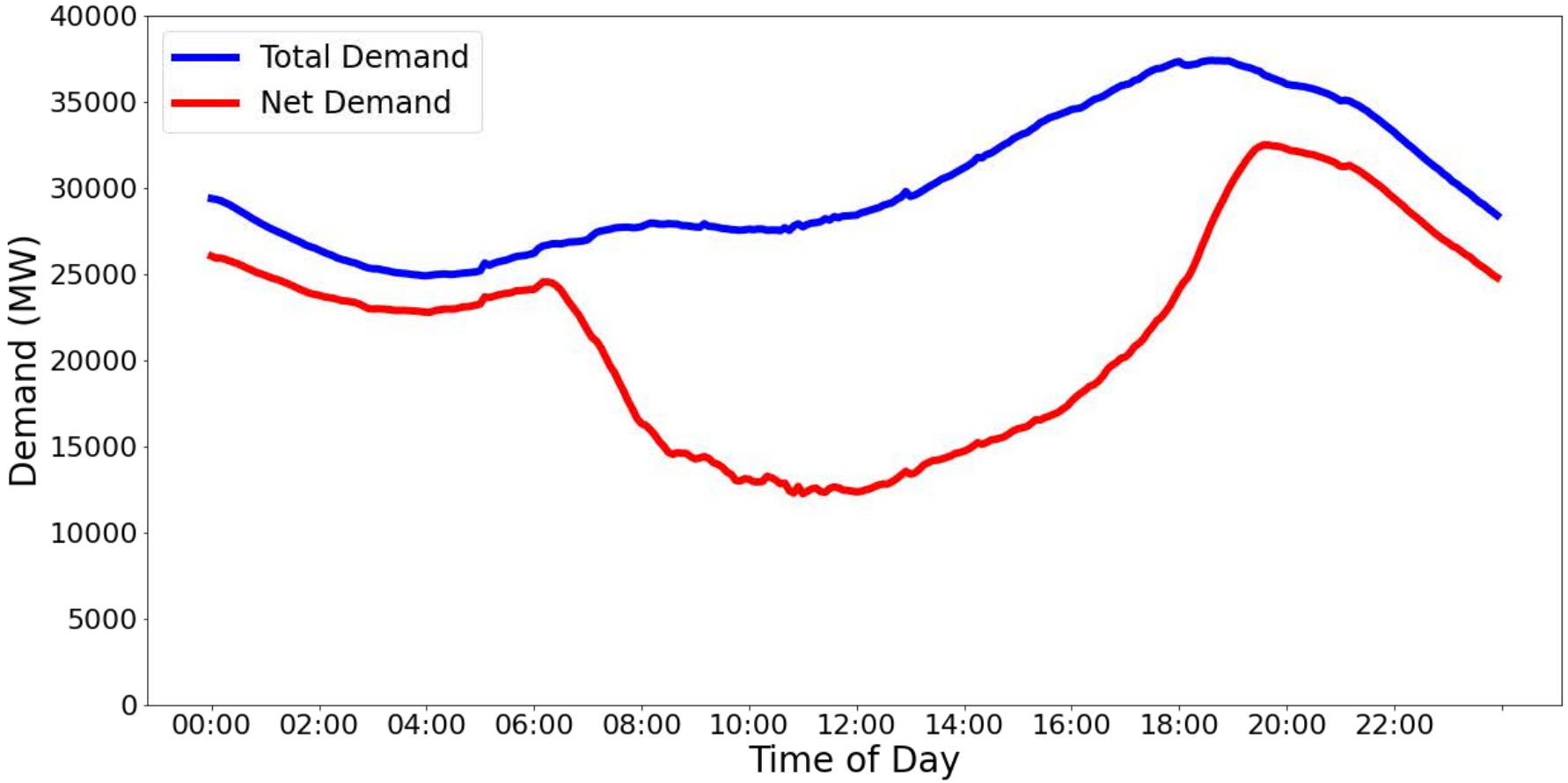
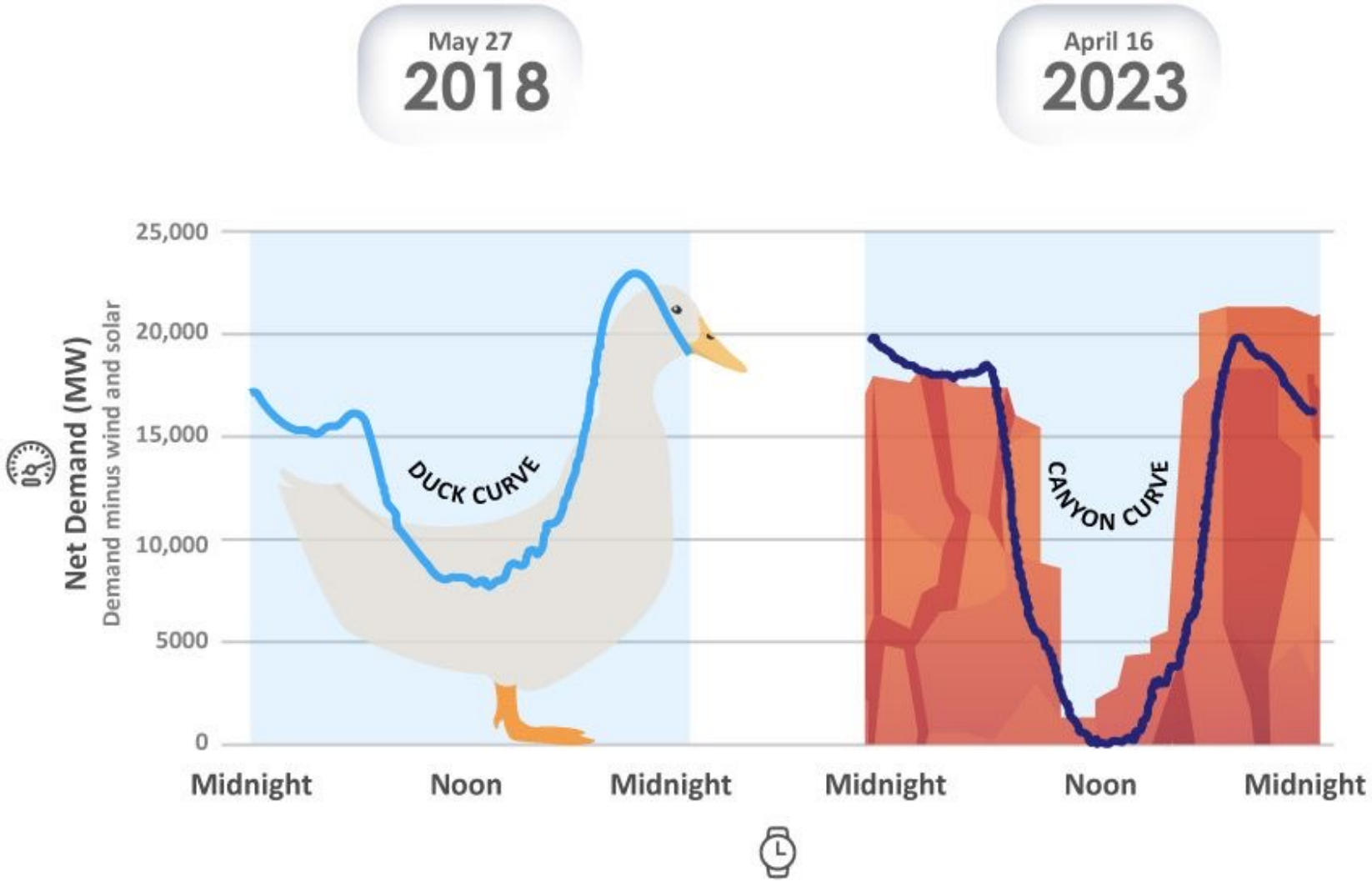
Source: California ISO (CAISO), 2023






Source: California ISO (CAISO), 2023

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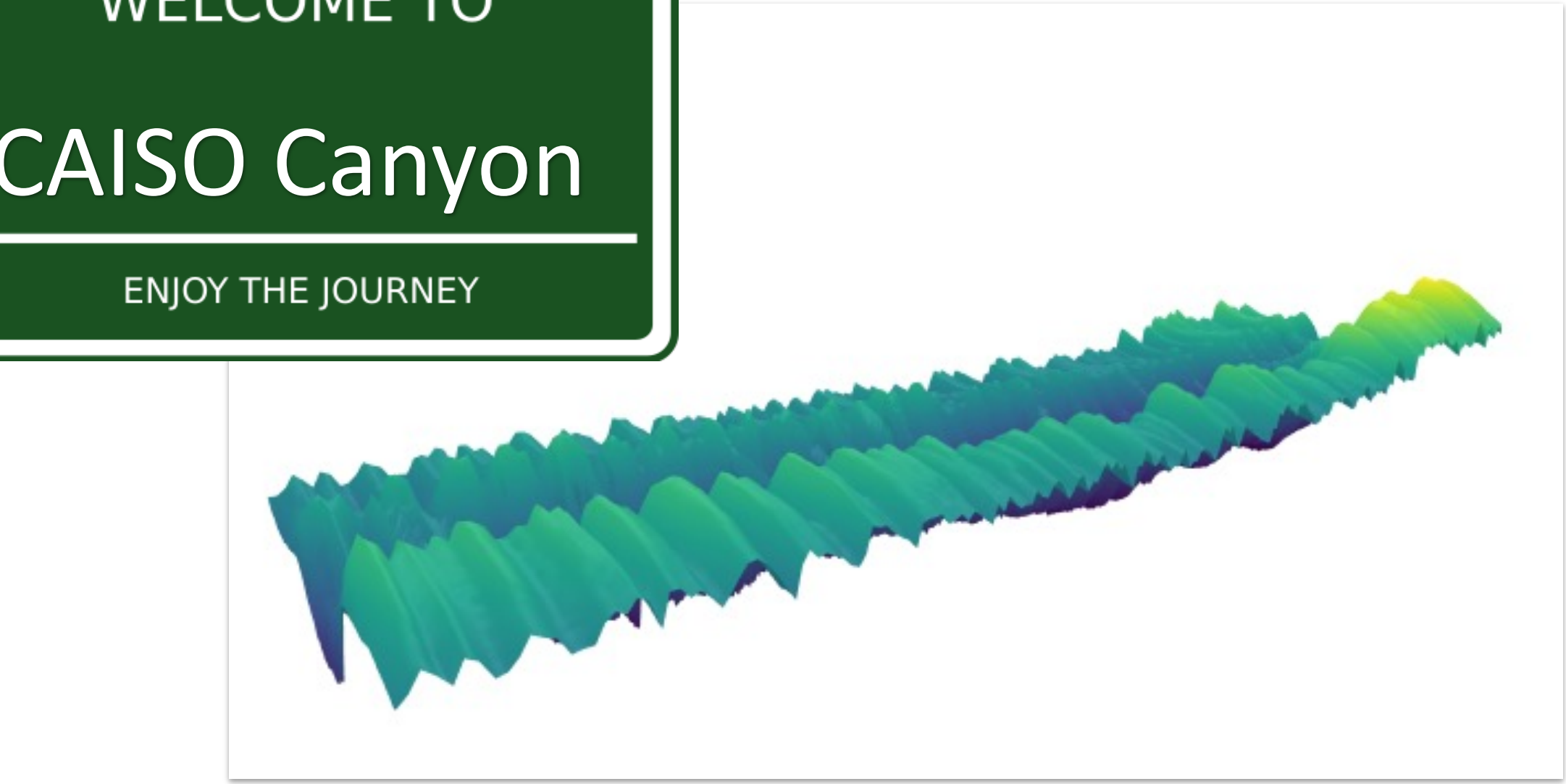
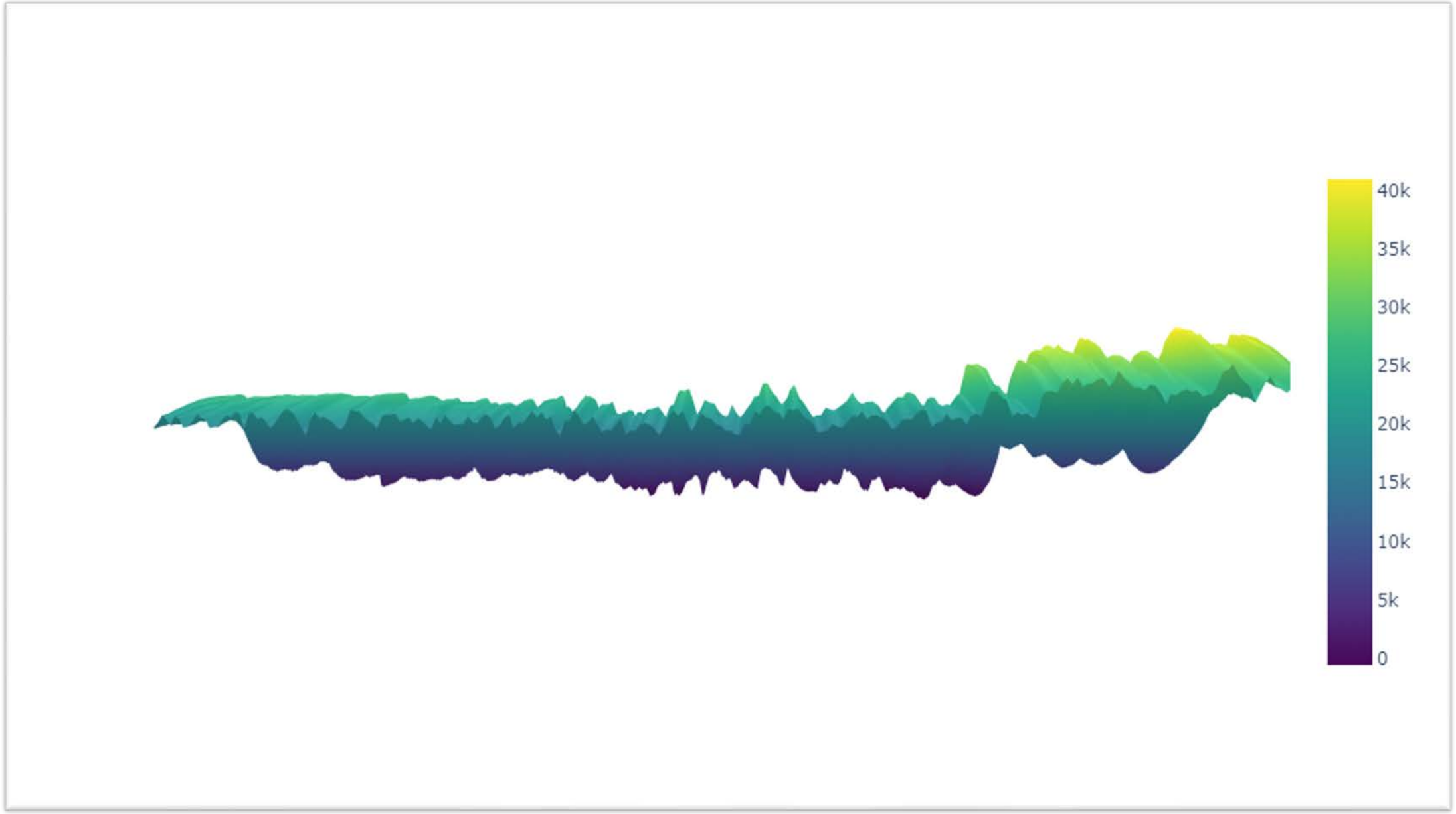
Source: “EPRI Head: Duck Curve Now Looks Like a Canyon”, POWER Magazine, 2023

WELCOME TO

# CAISO Canyon

ENJOY THE JOURNEY

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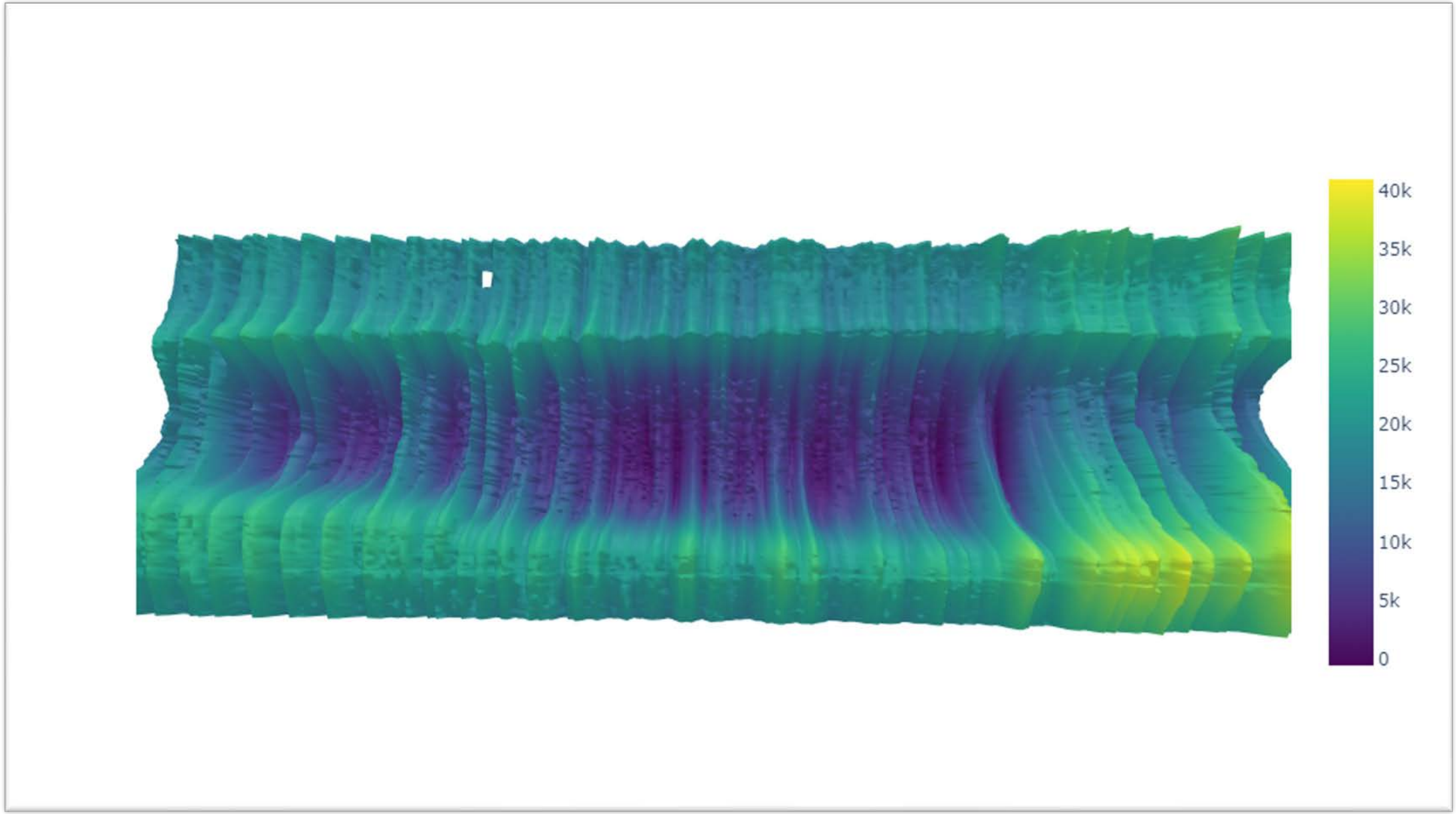
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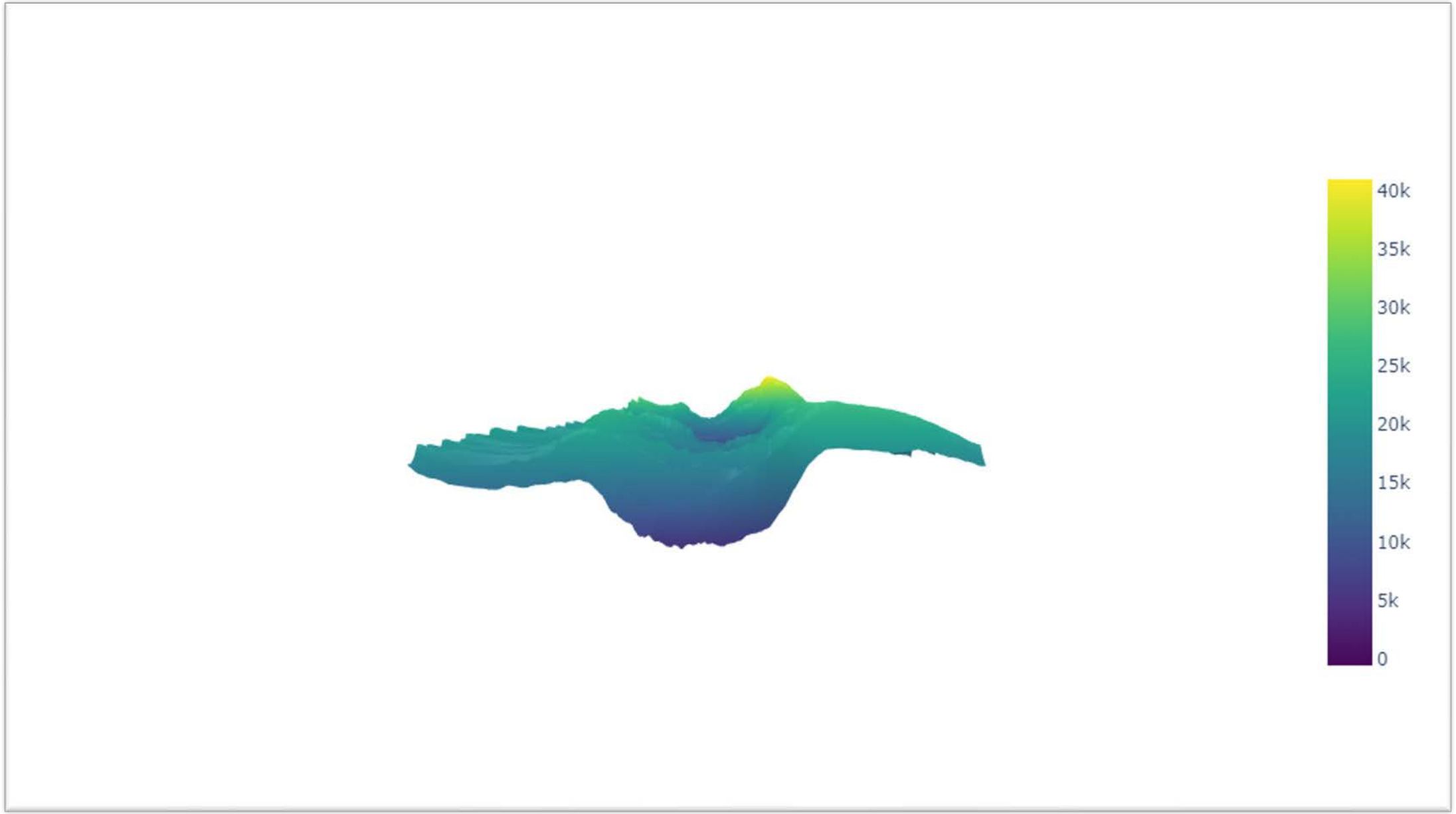
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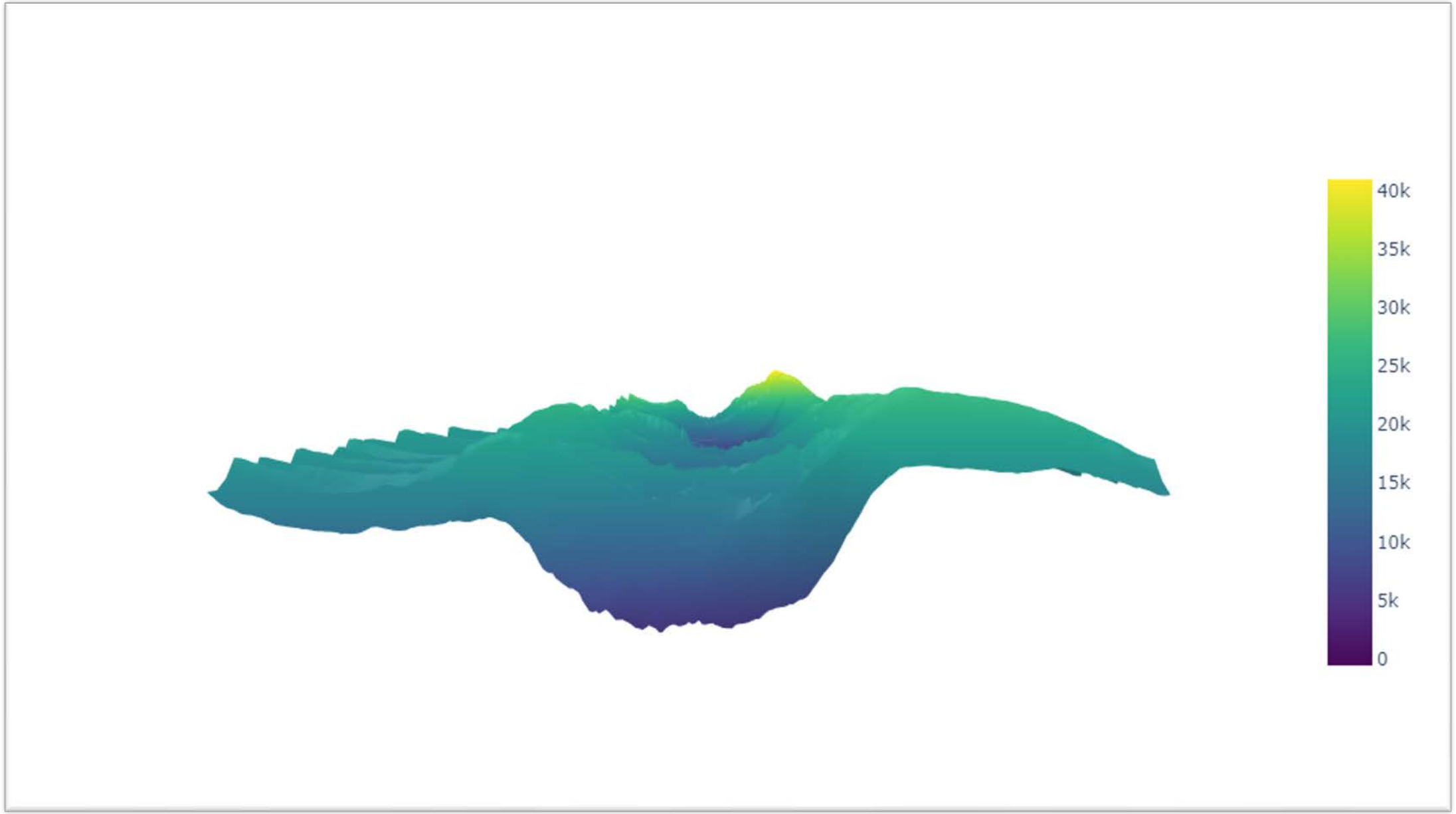
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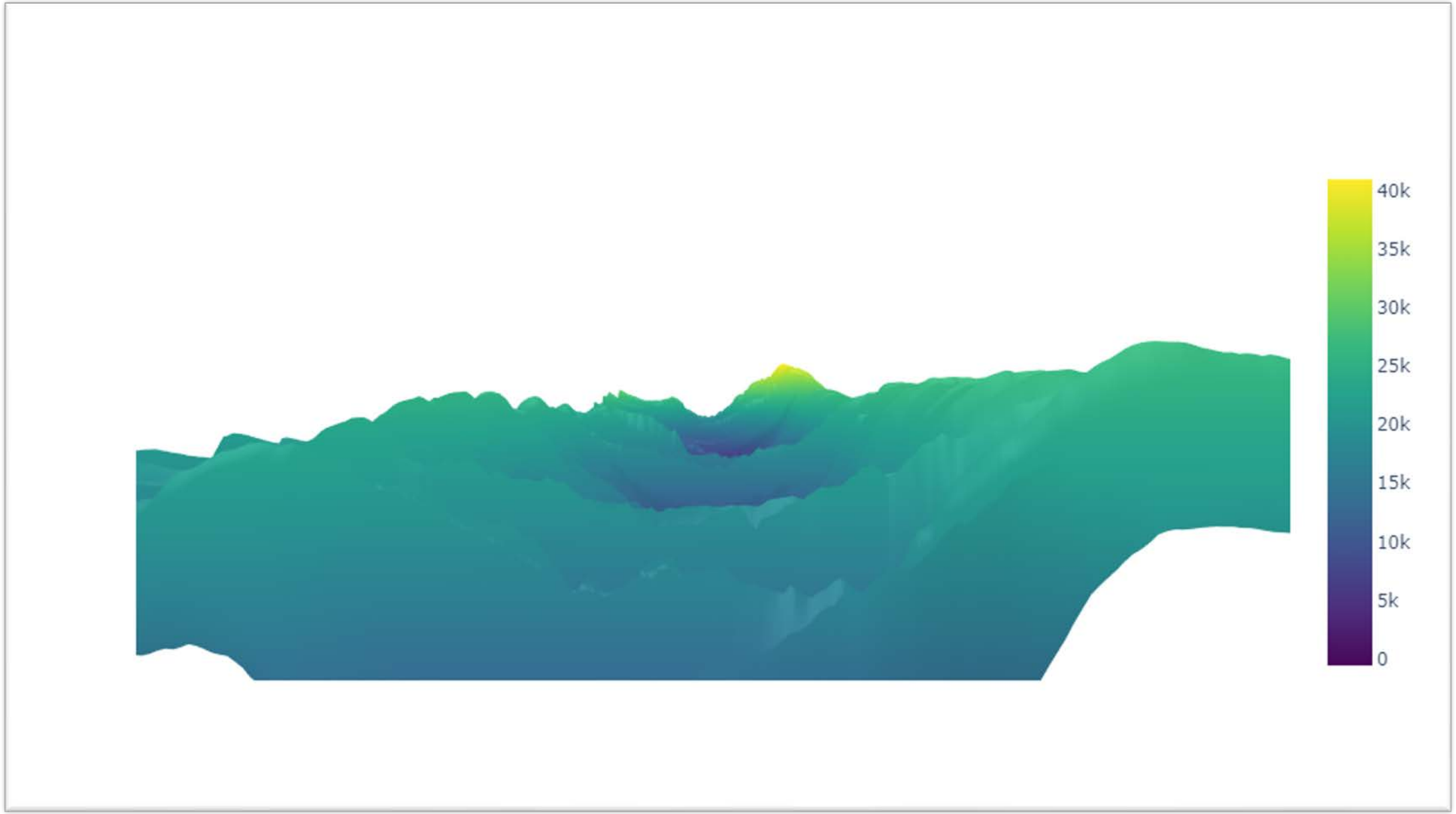
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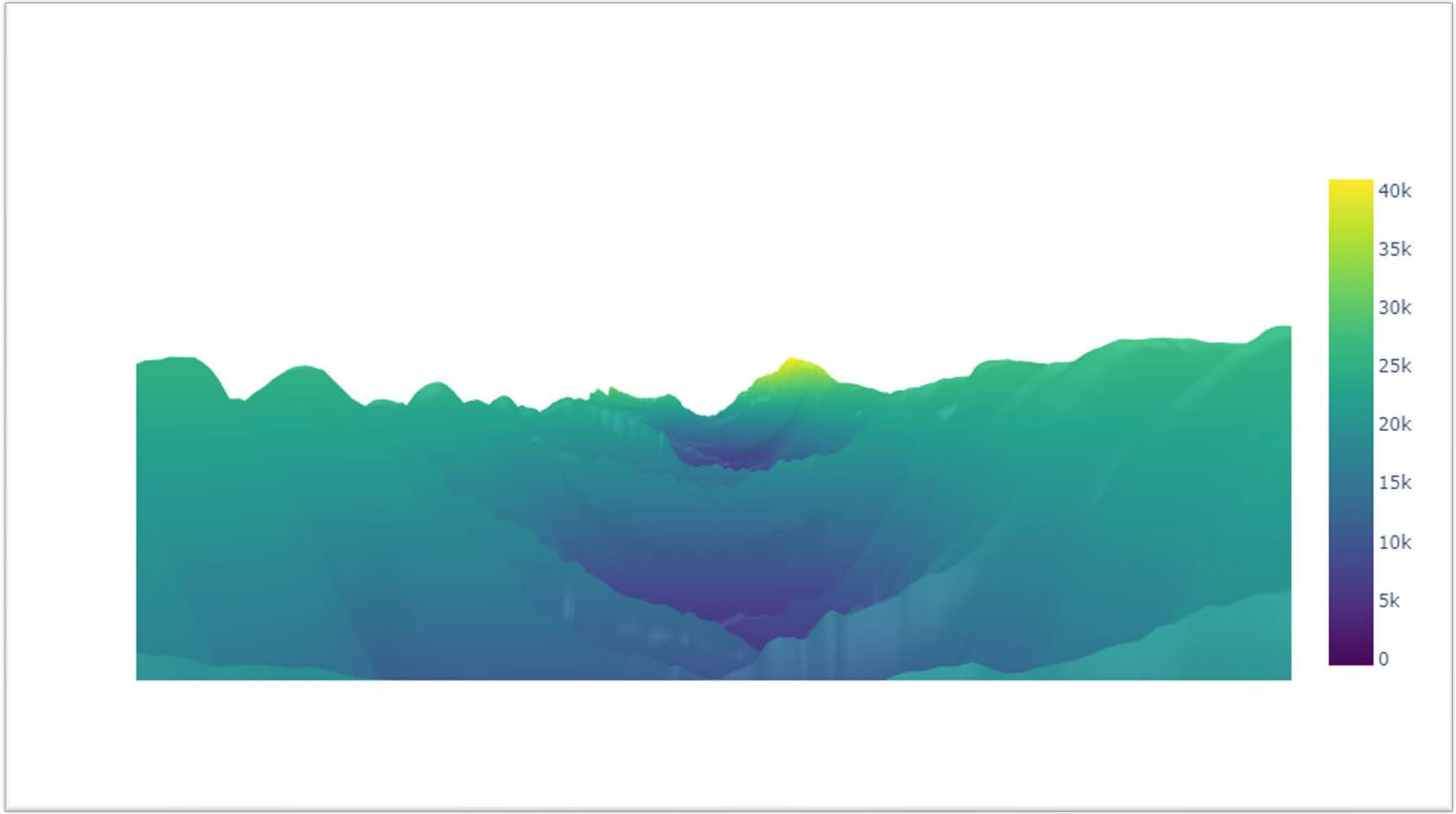
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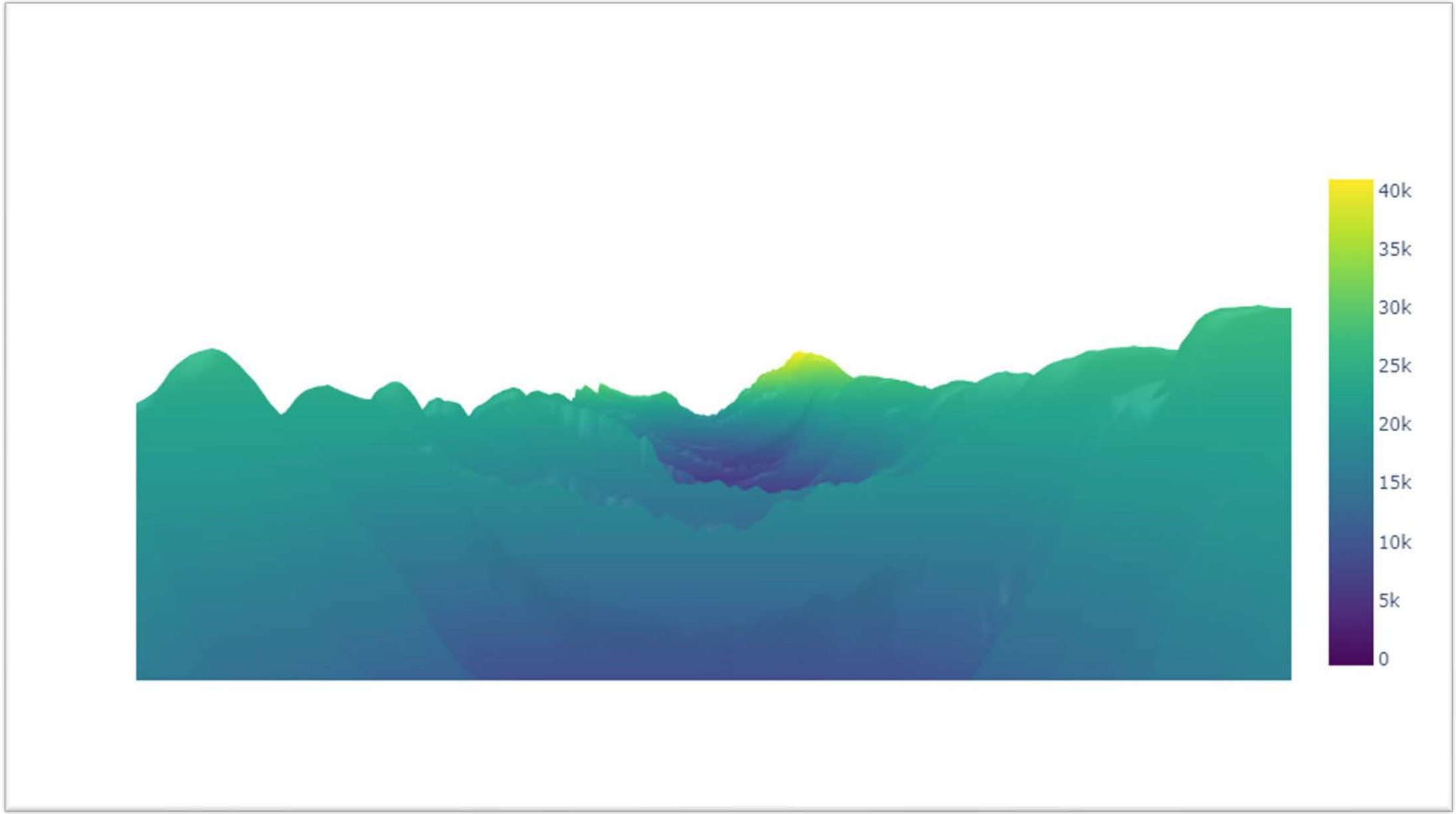
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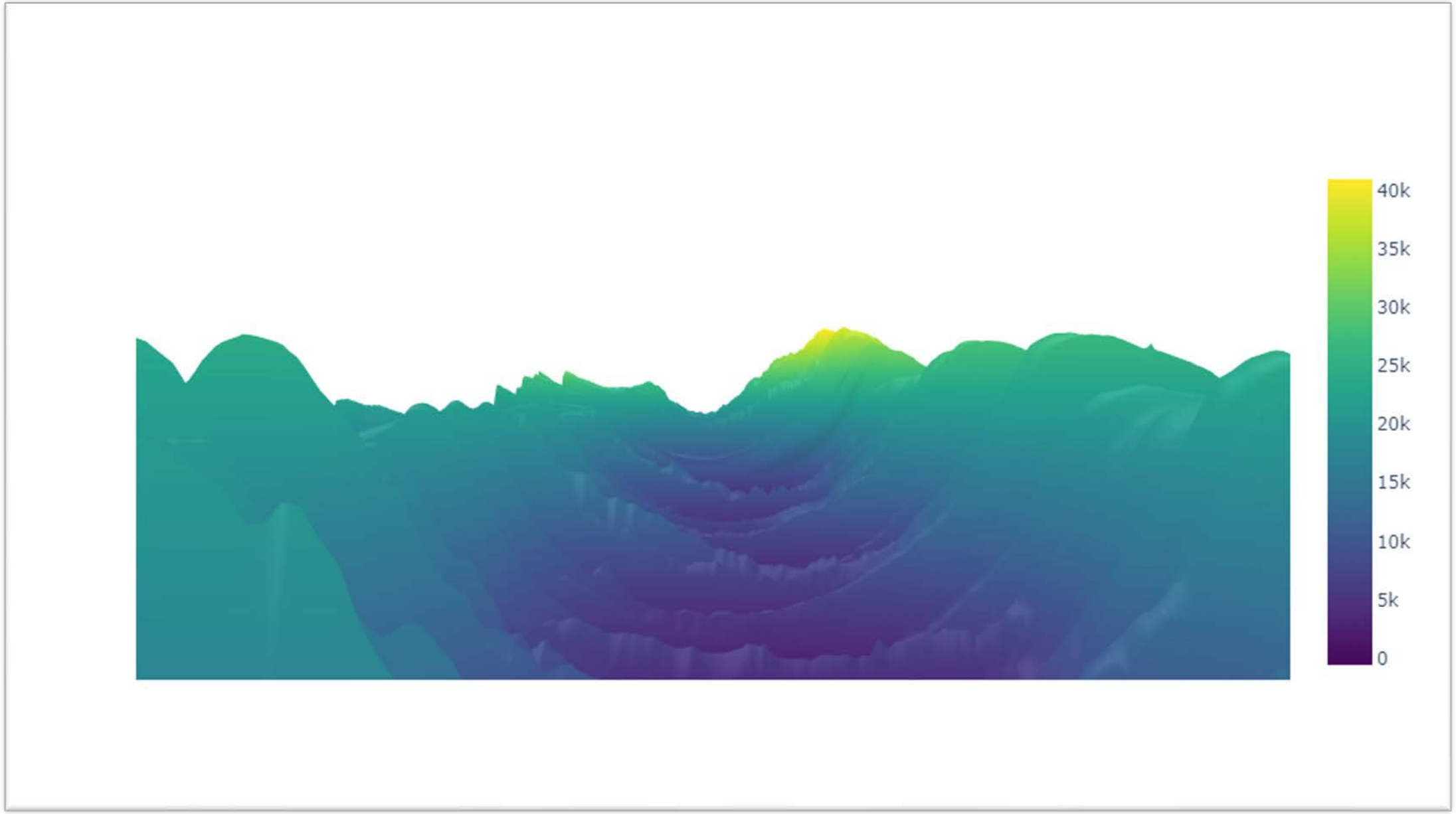
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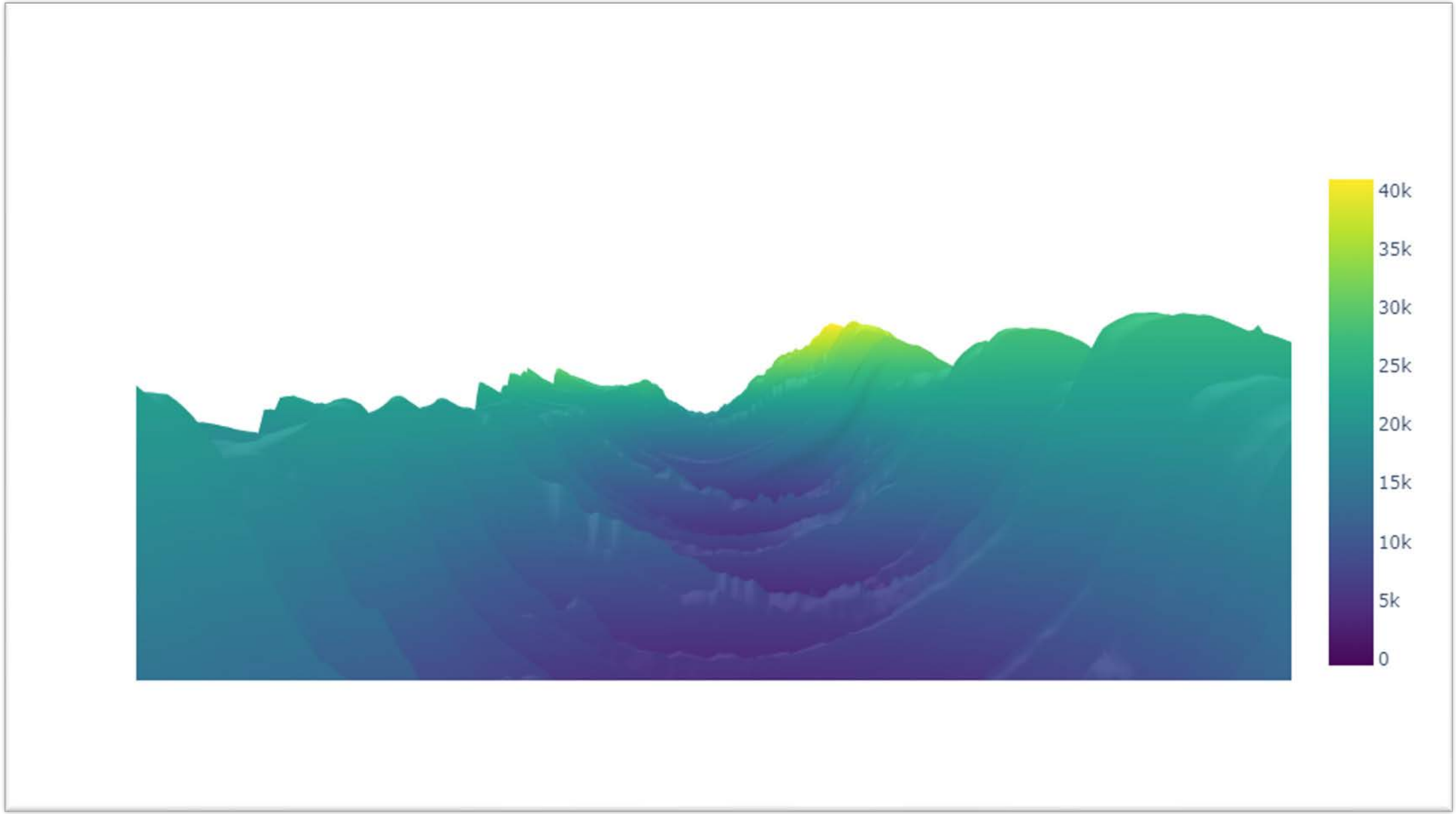
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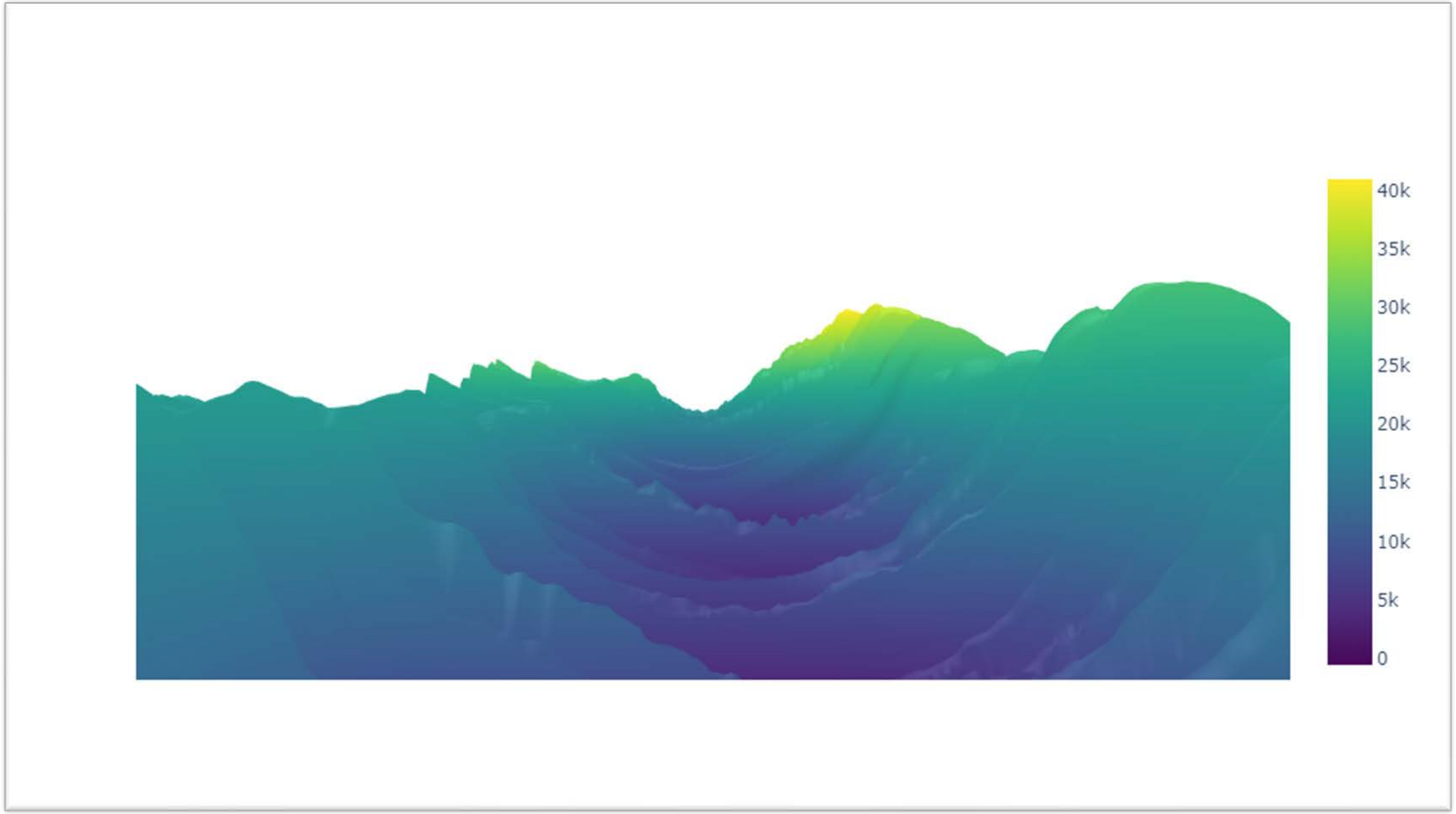
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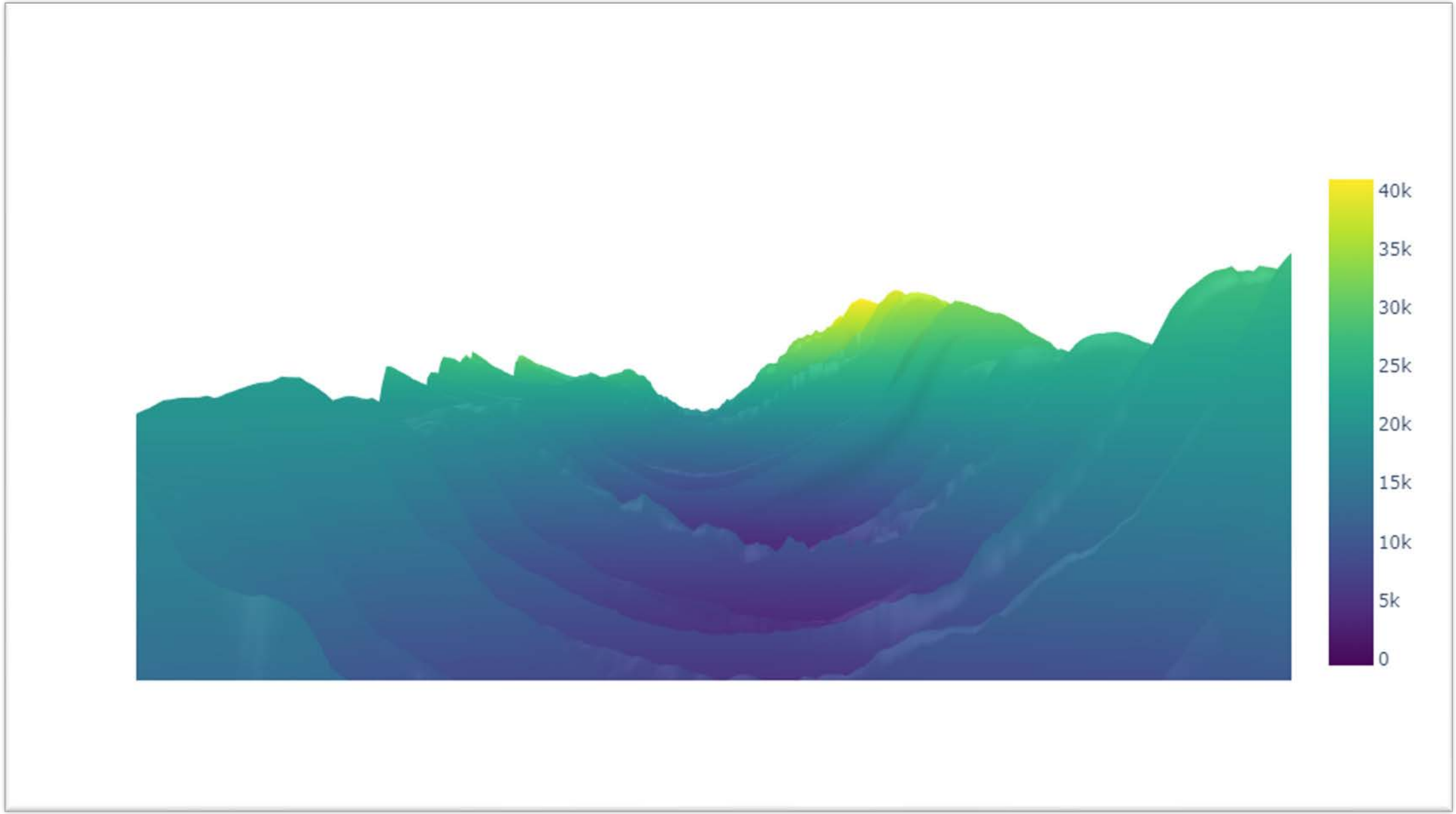
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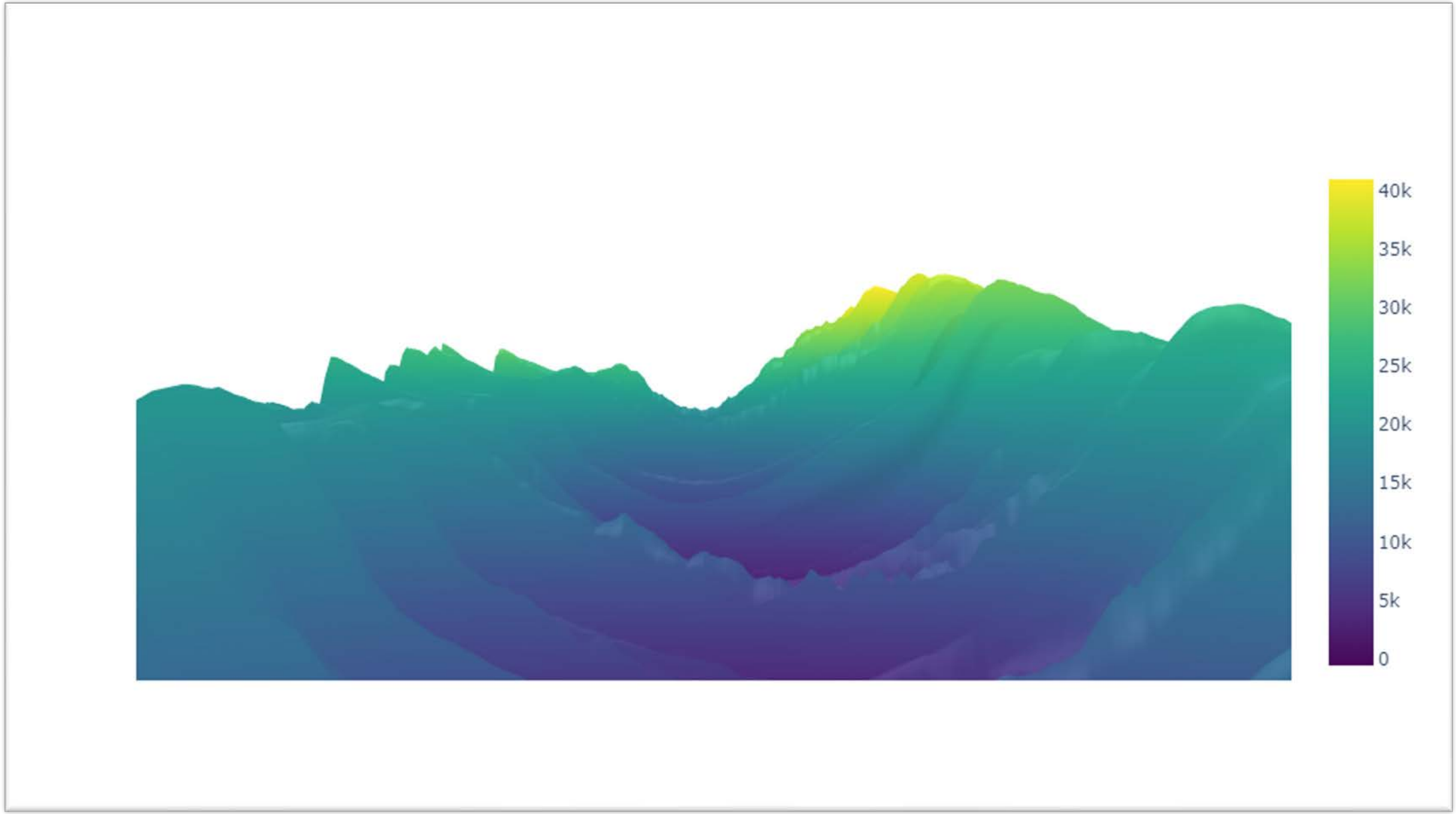
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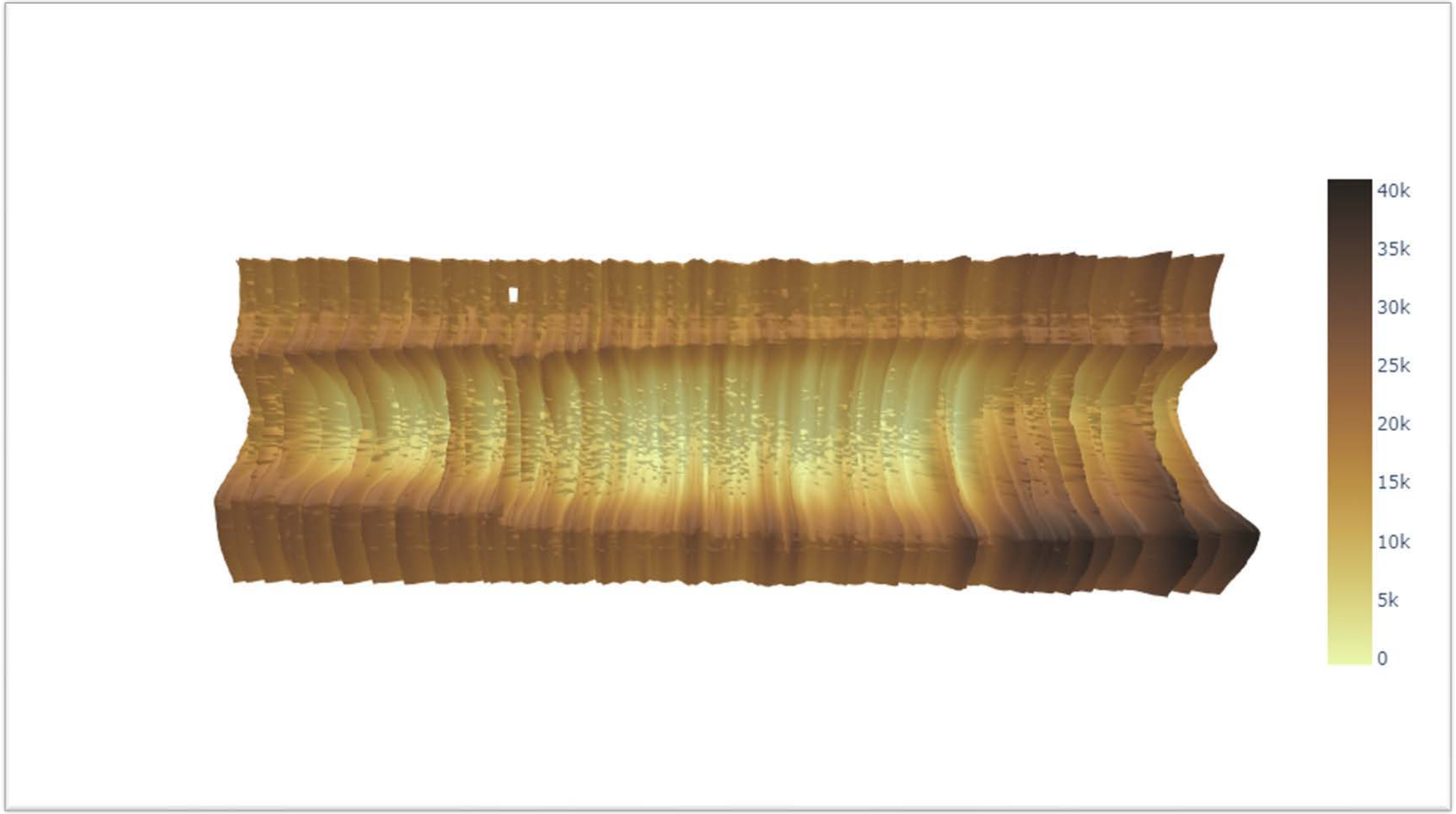
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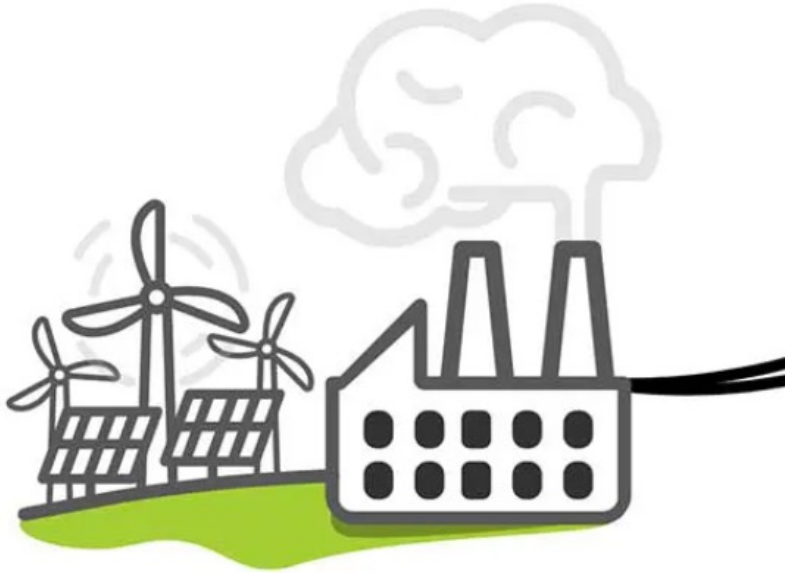
POWER GENERATION



As this changes,

Is it beneficial to also change this?

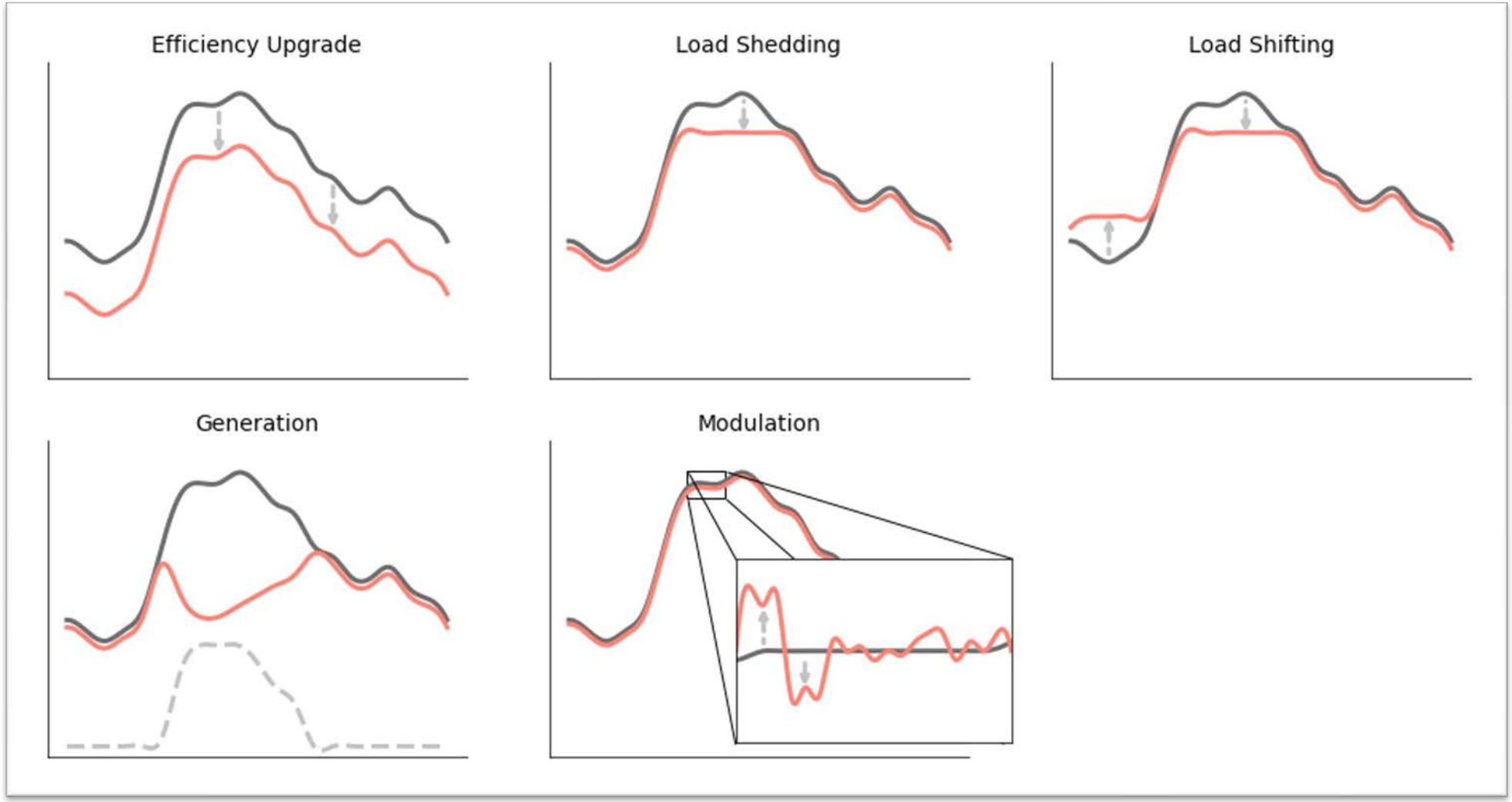
ENERGY DISTRIBUTION

Specifically how we use electricity.



Source: “Electricity Market”, EnerWisely, https://enerwisely.com/energy-market/

# Ways to change electricity demand






Billings, B.W. and Powell, K.M. (2022), Grid-Responsive Smart Manufacturing: A Perspective for an Interconnected Energy Future in the Industrial Sector. AIChE J. Accepted Author Manuscript e17920. https://doi.org/10.1002/aic.17920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MANUFACTURING
RESIDENTAL
MANUFACTURING

# Grid-responsive smart manufacturing

- Can change, adapt, and optimize from signals from the grid
- Utilizes data, forecasting, optimization and algorithms to maintain production
- Utilizes the large potential in the industrial sector



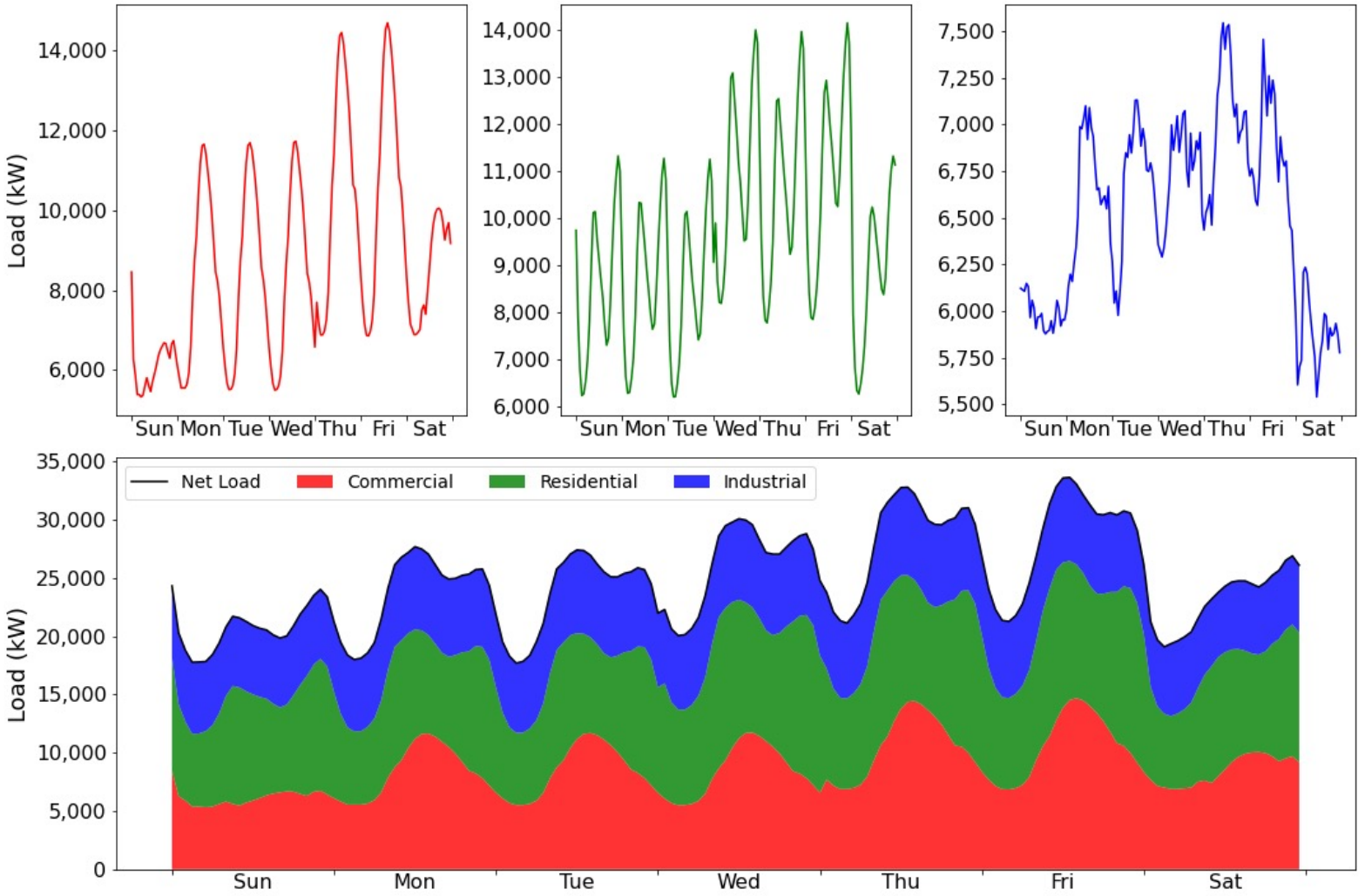
Referenced work: *Billings, BW, Powell, KM. Grid-responsive smart manufacturing: A perspective for an interconnected energy future in the industrial sector. AIChE J. 2022; 68( 12):e17920. doi:10.1002/aic.17920*

# Net Load Profiles

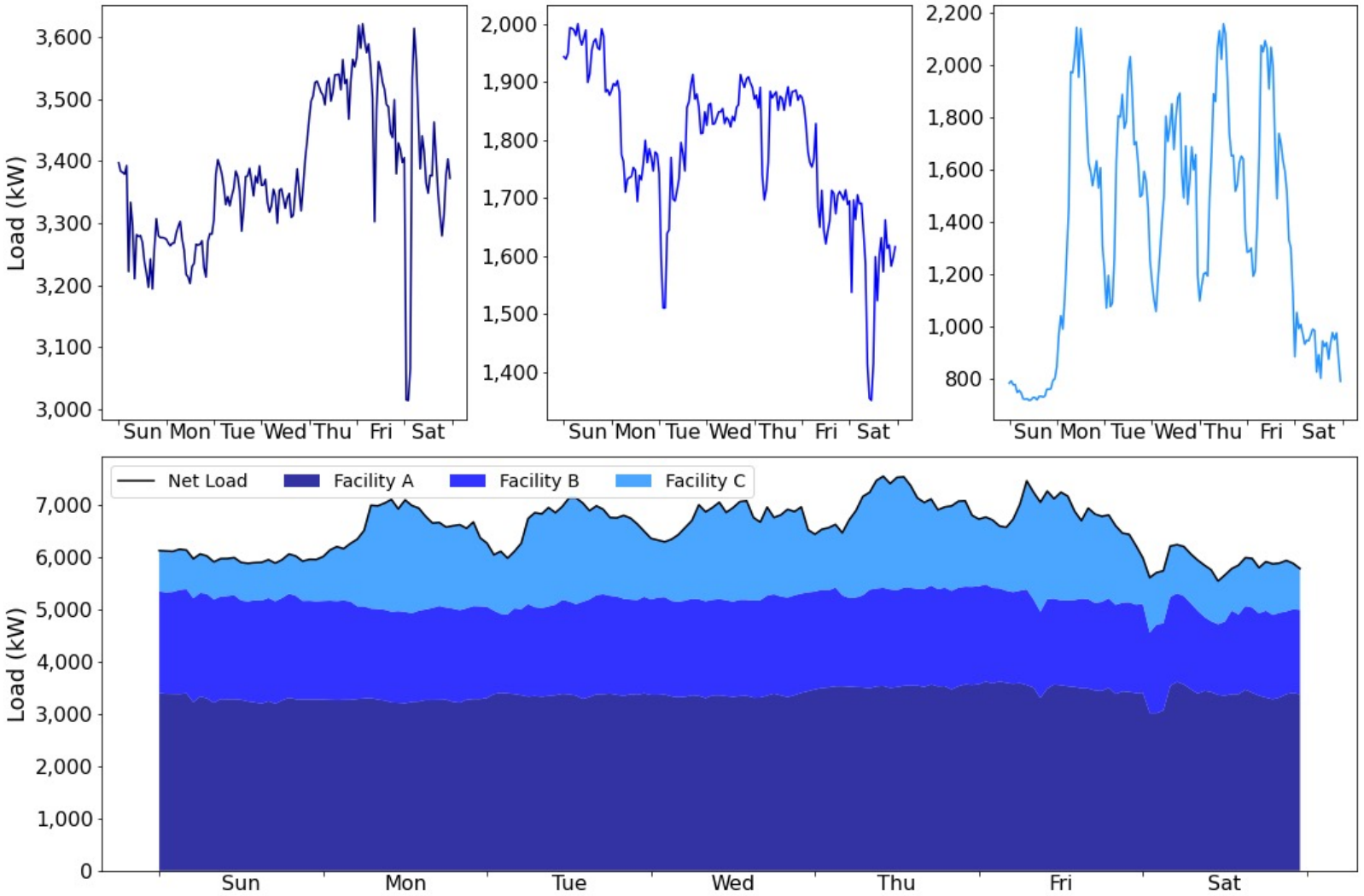
ComStock

ResStock

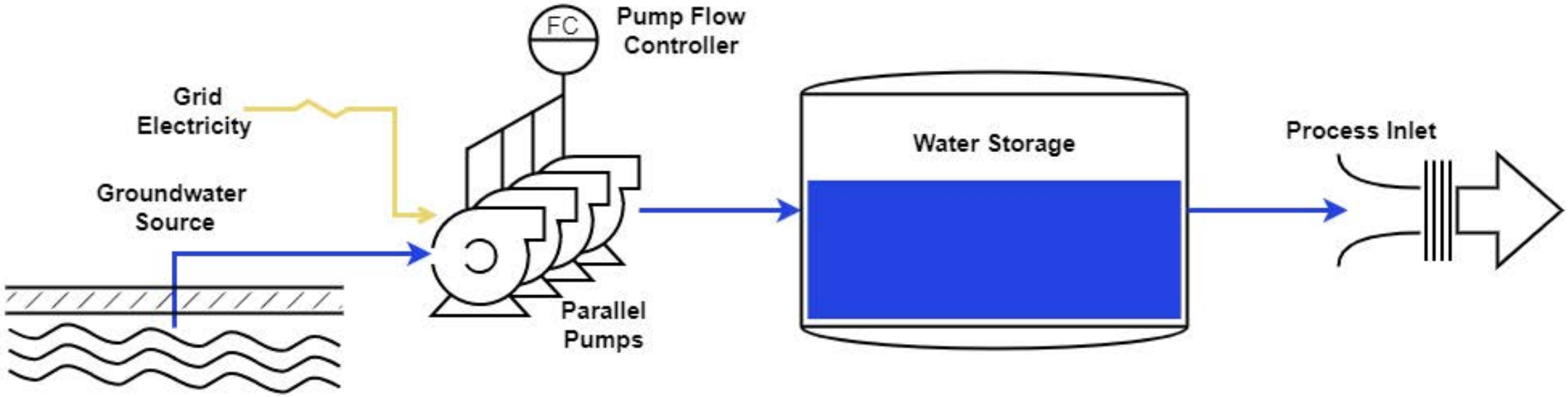
eia



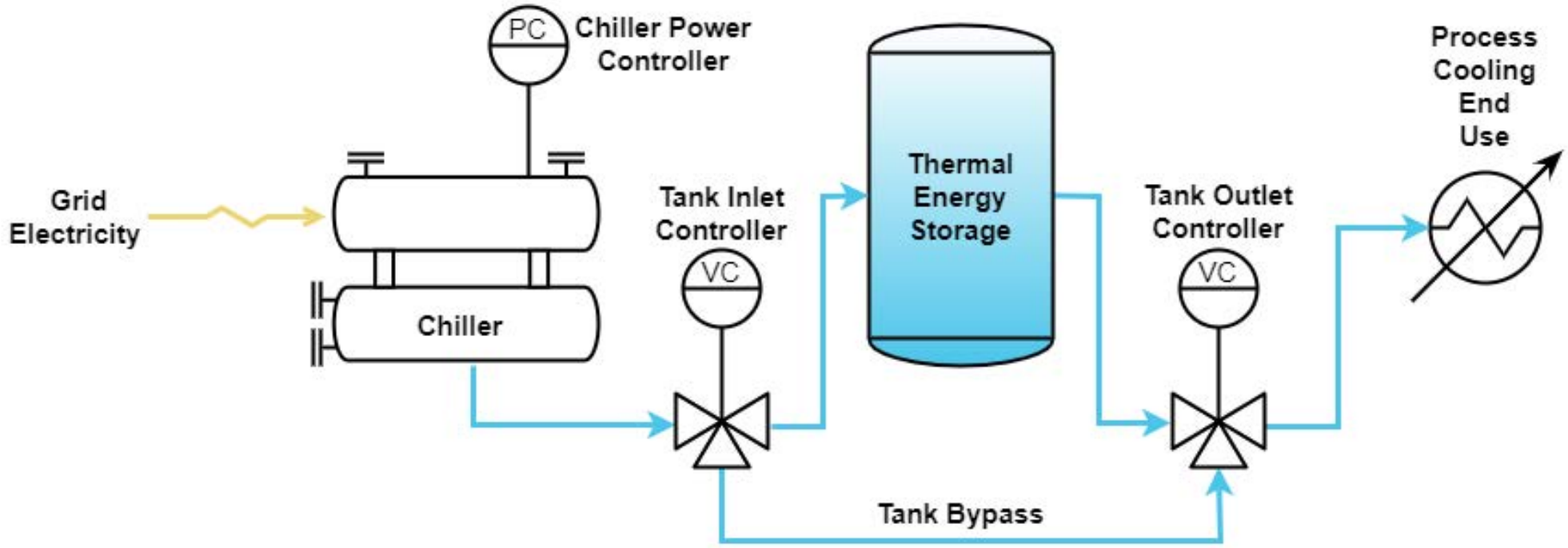
# Aggregated Industrial Loads



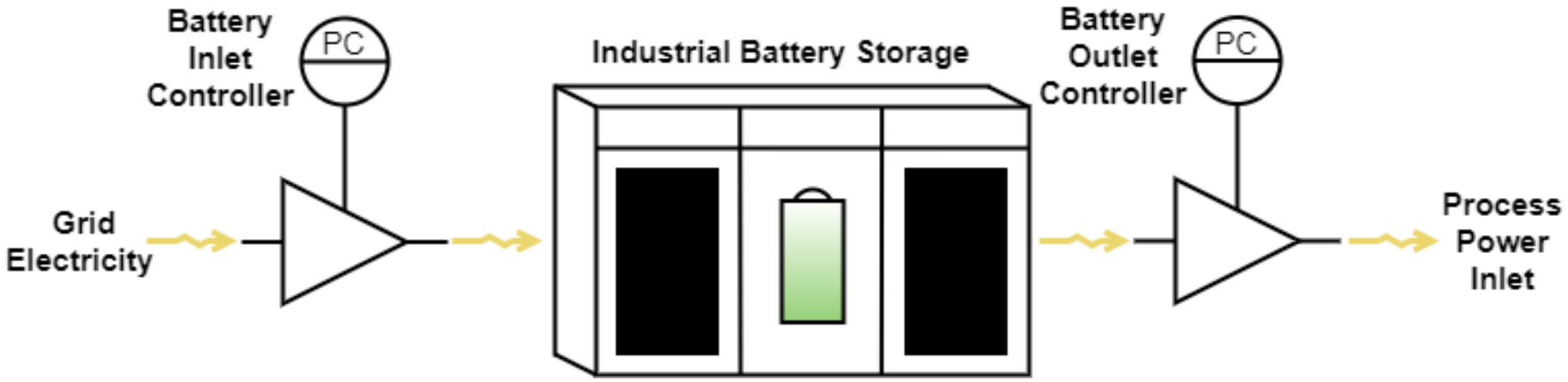
# Facility A Response Mechanism



# Facility B Response Mechanism



# Facility C Response Mechanism

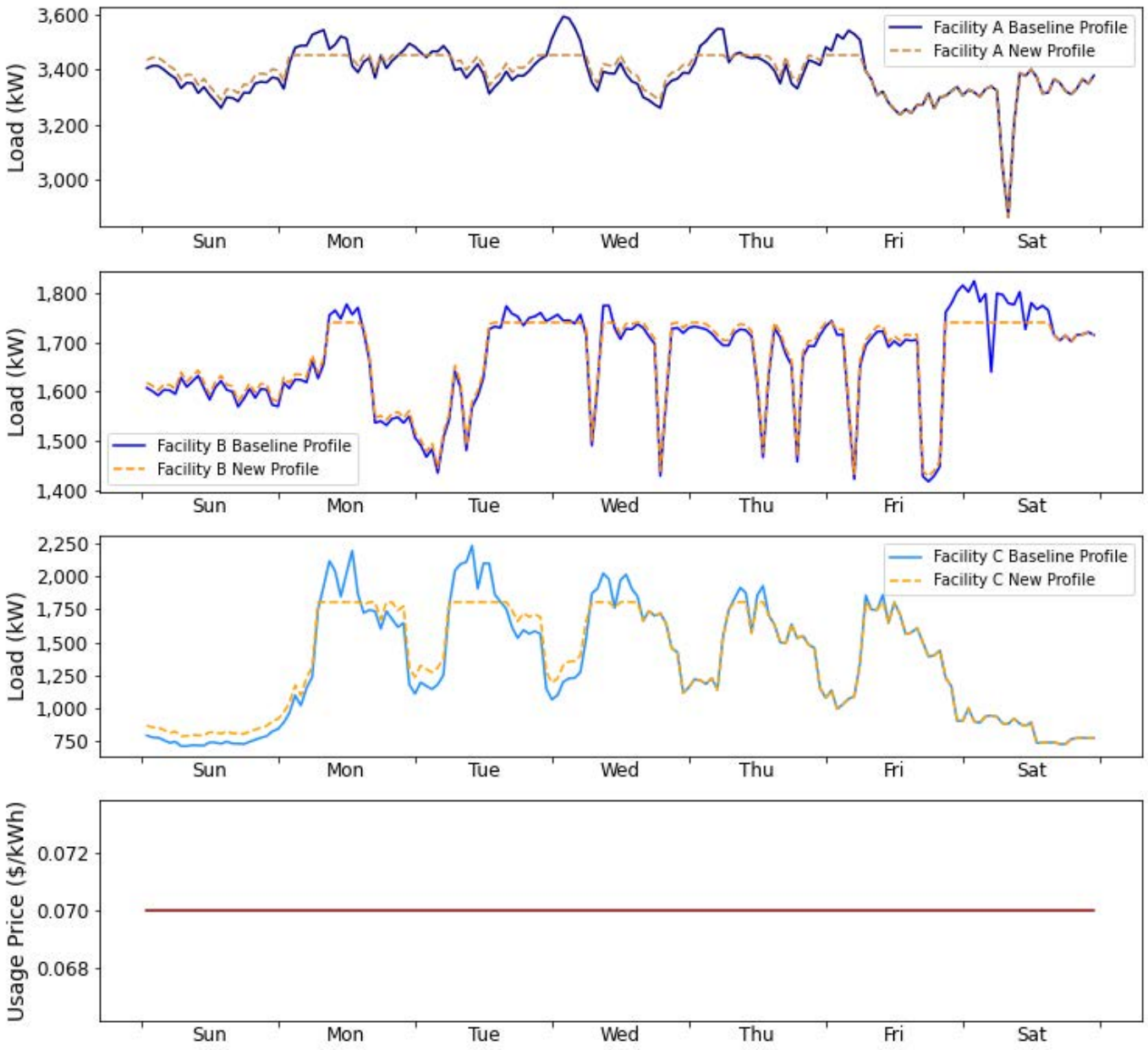


# Results - Fixed Schedule

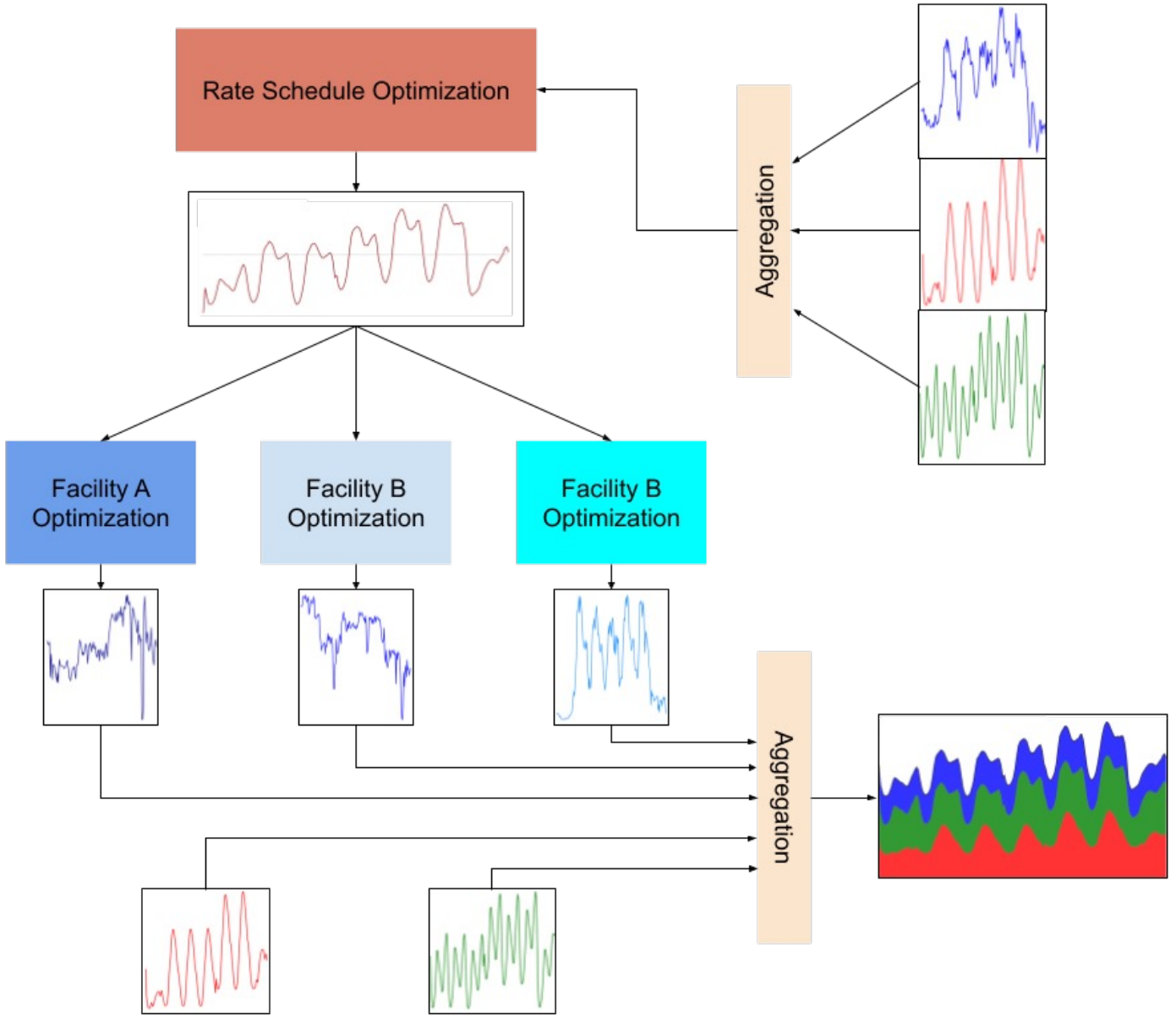
Example profile:

Usage rate: $0.07/kWh

Demand rate: $16.00/kW



- Two levels of optimization
  1. Rate schedule optimization – using week before data
  2. Facility optimization – using test week data

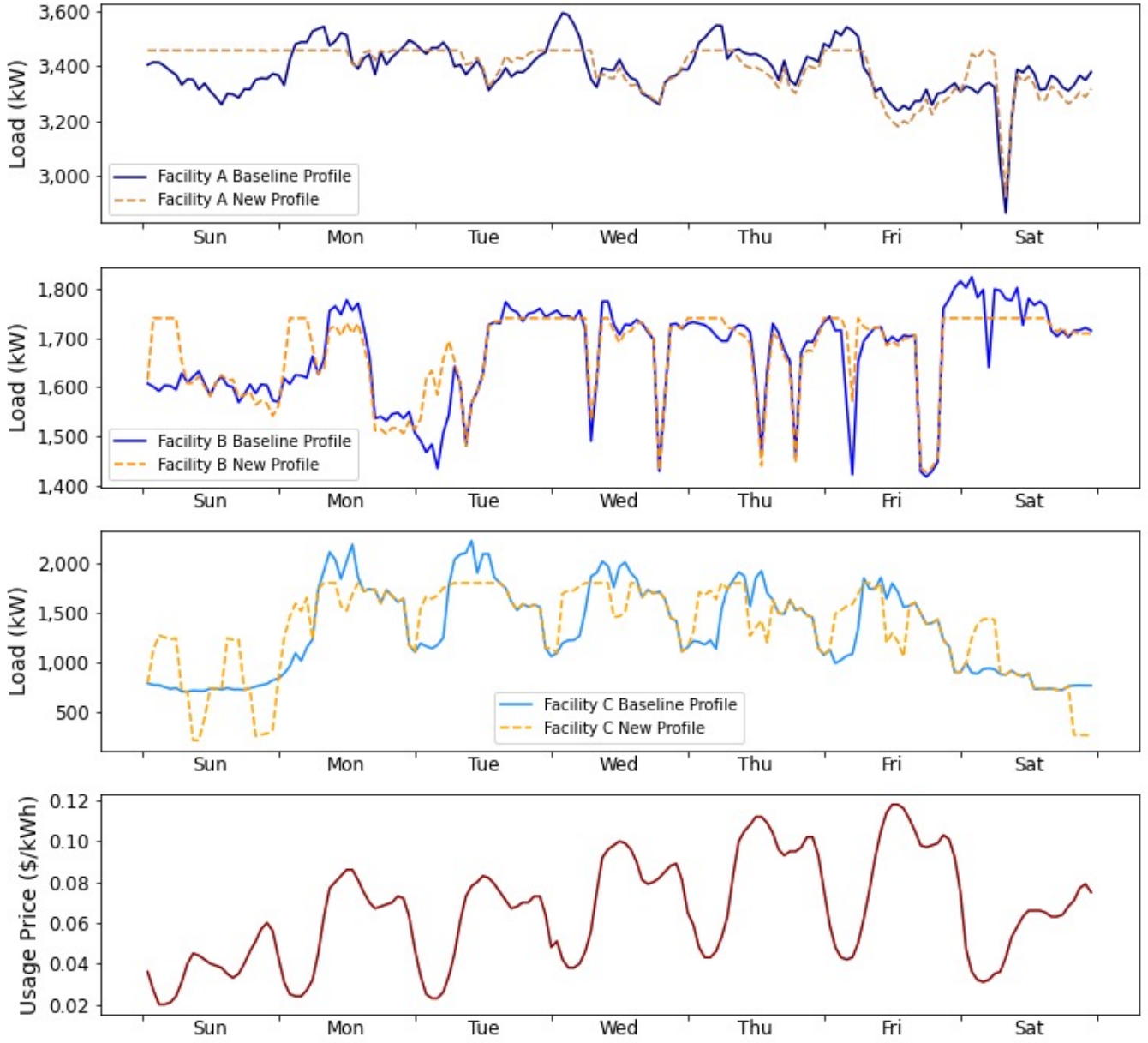


# Results - Dynamic Schedule

Example profile:

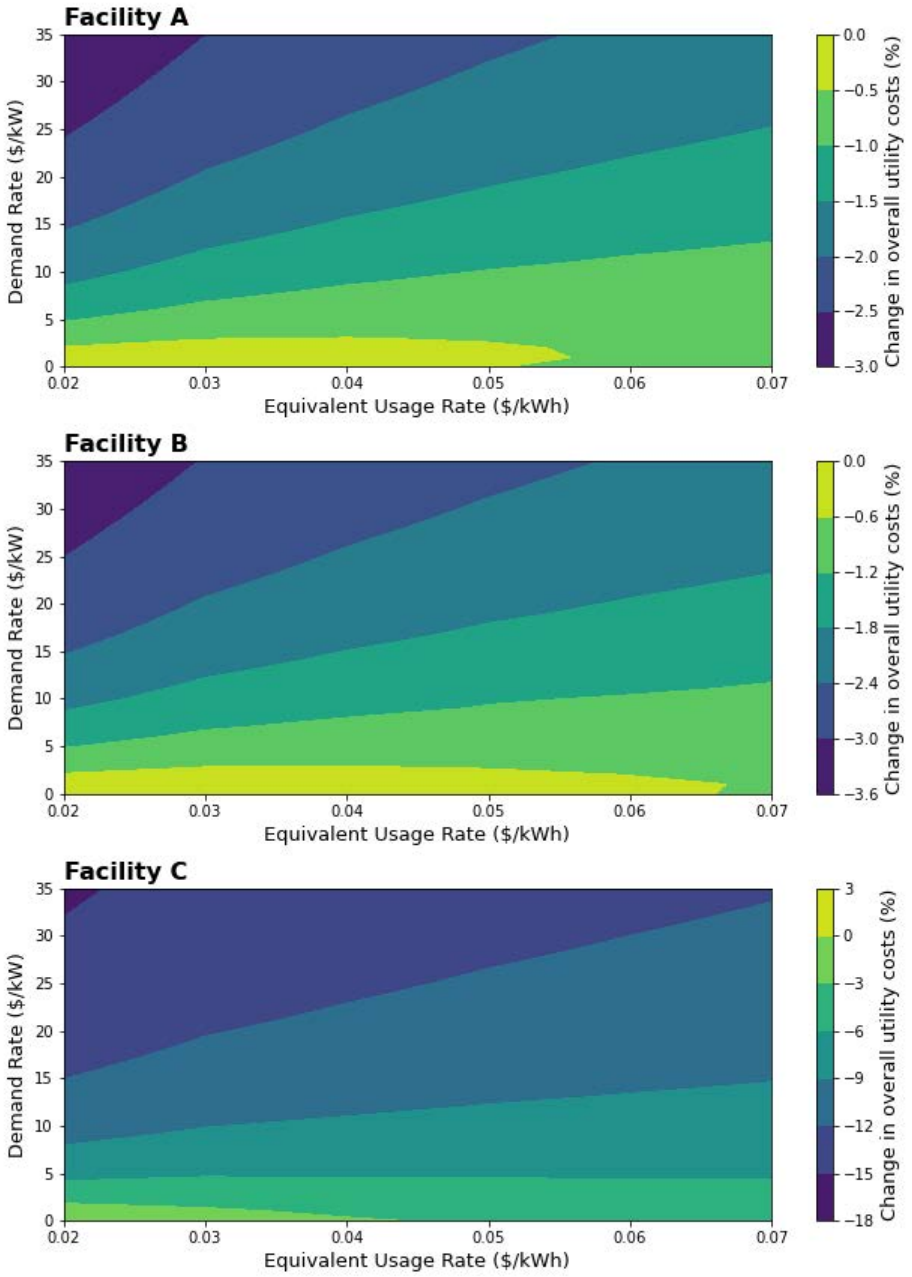
Equivalent Usage rate: $0.07/kWh

Demand rate: $16.00/kW



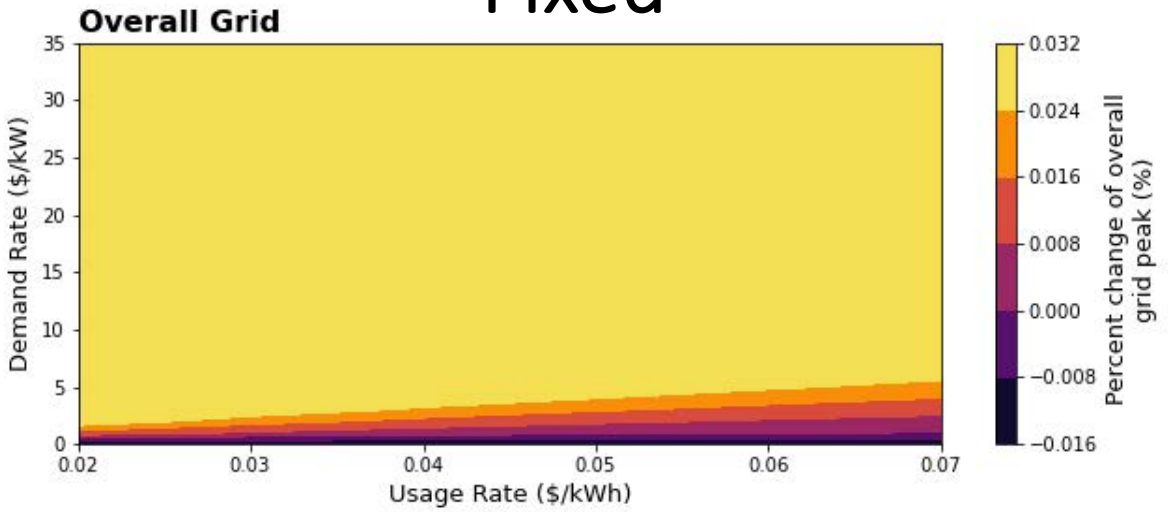
# Results - Facility Savings

- All fixed rates saw an decrease in total overall charges

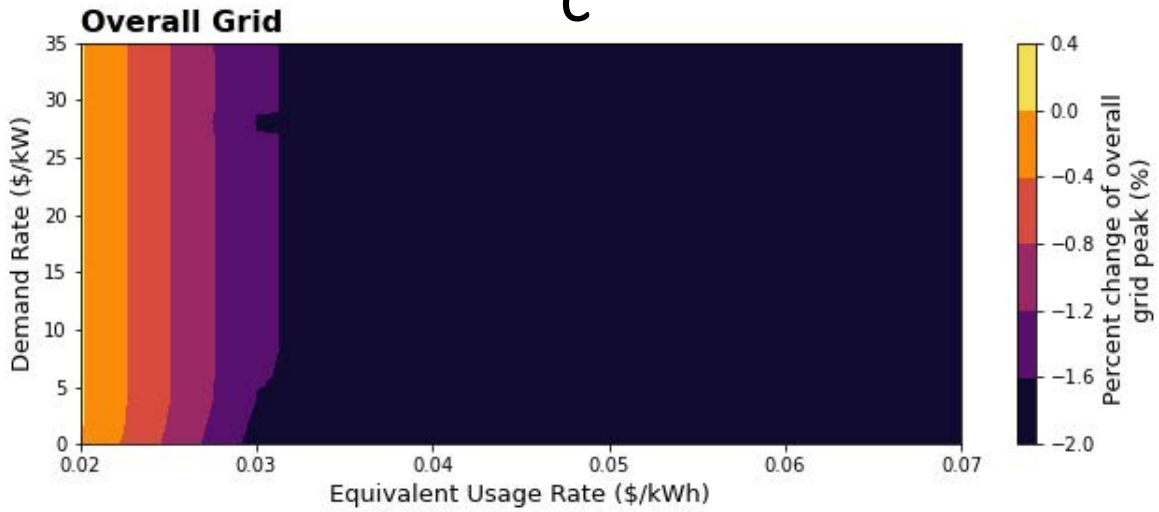


# Grid Peak Demand Reduction

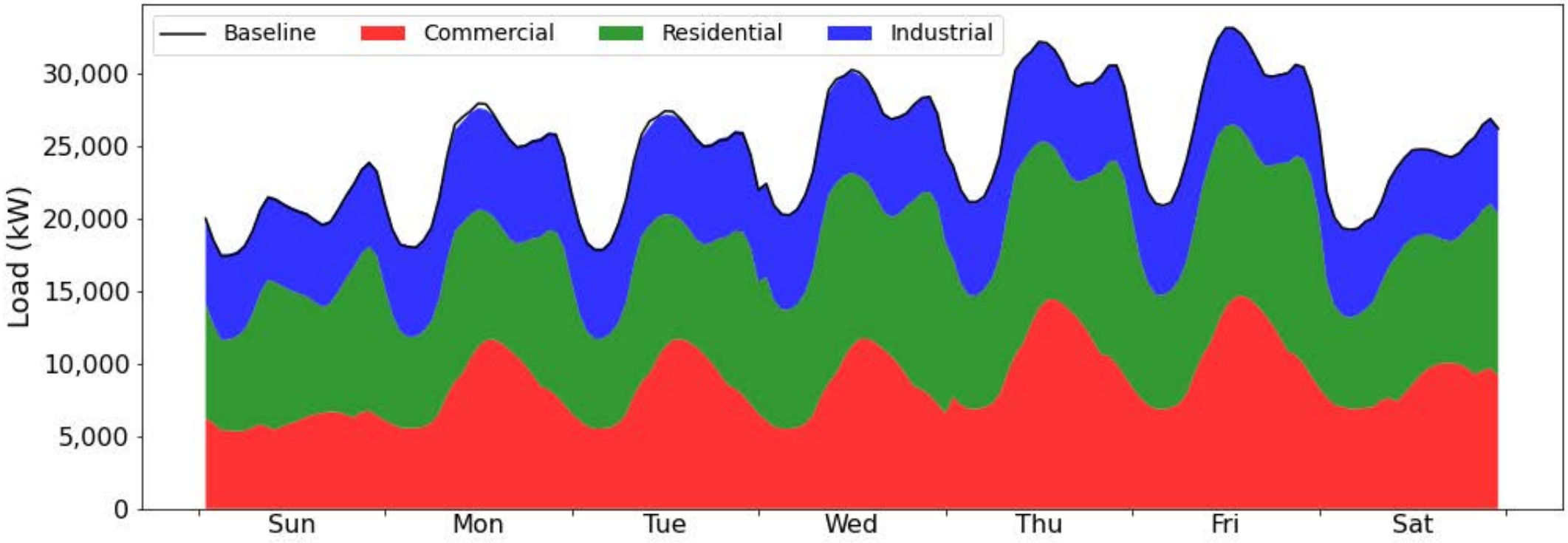
Fixed



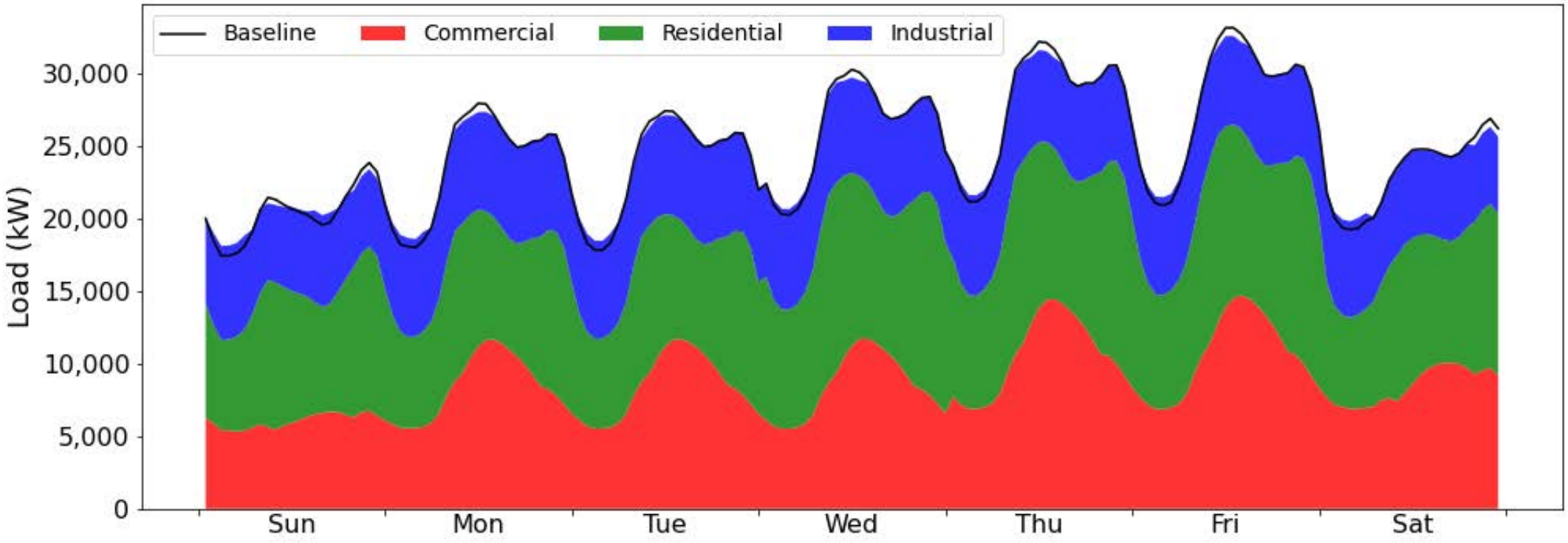

Dynamic



# Grid Results – Fixed Schedule



# Grid Results – Dynamic Schedule

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