

# How to solve the electrification problem?

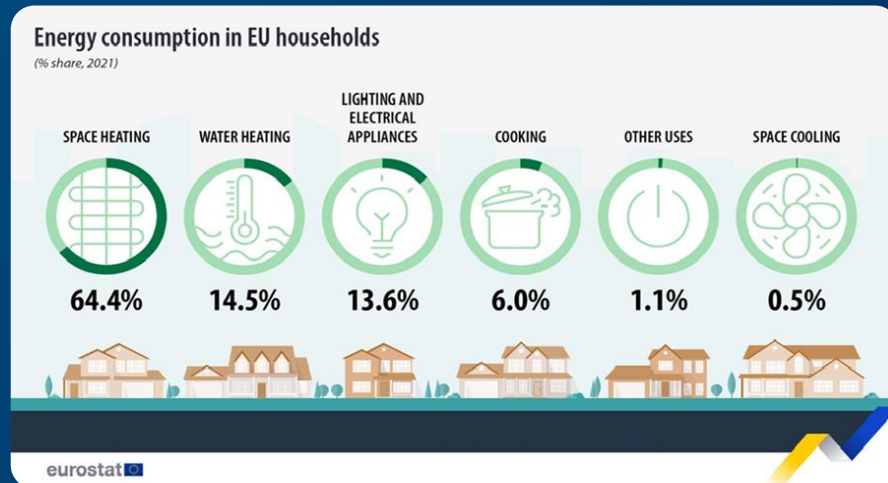
March 2024



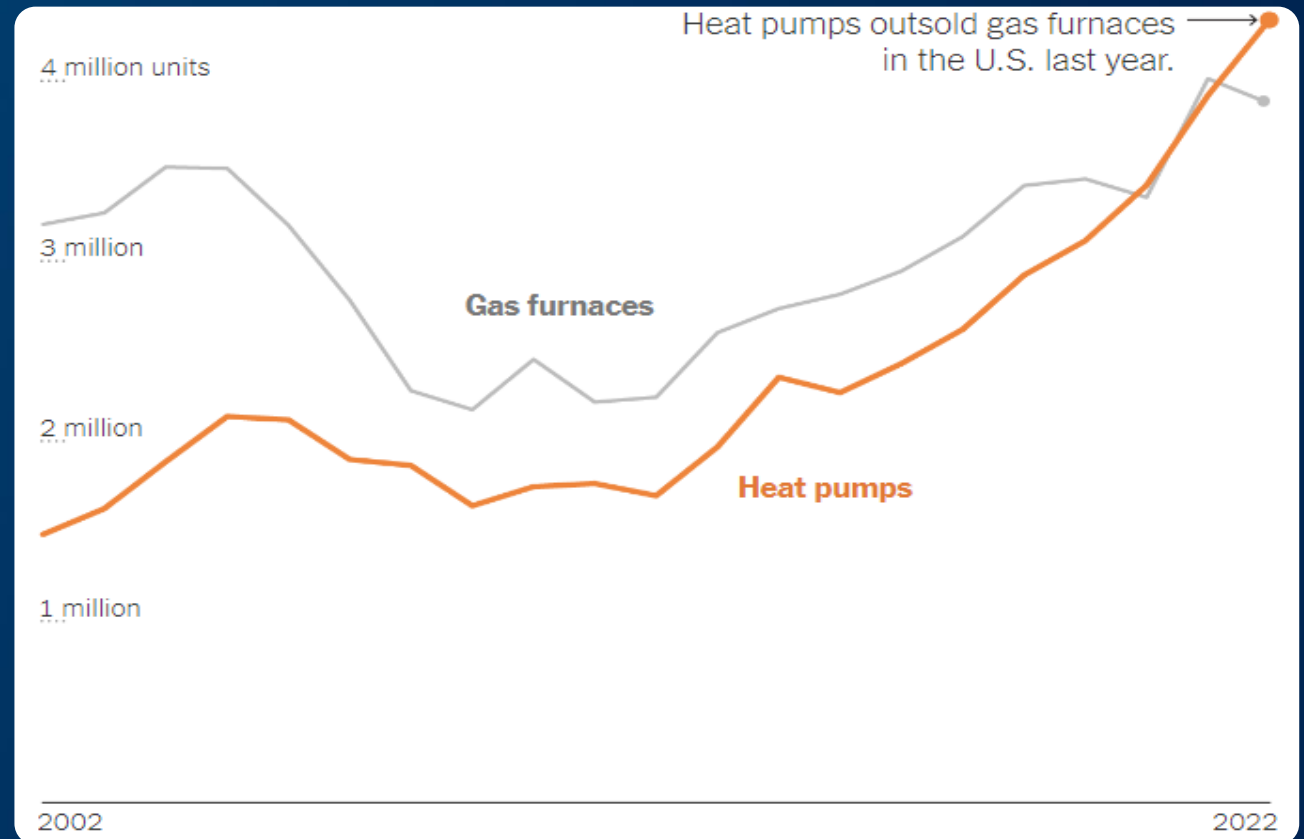
# Electrification of end-user demand

## European household demand

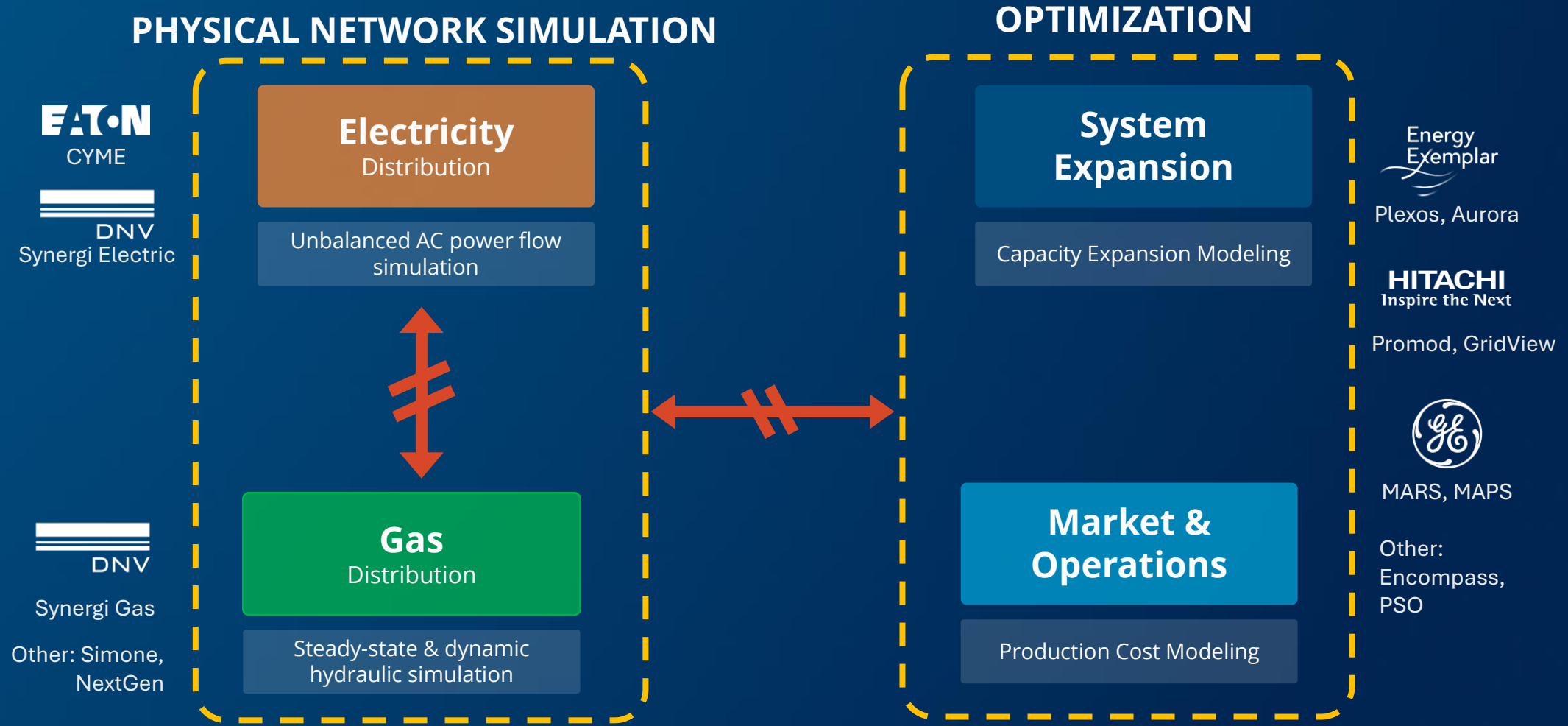
In 2021, EuroStats reported that the residential sector accounts for **27%** of final energy consumption in Europe.



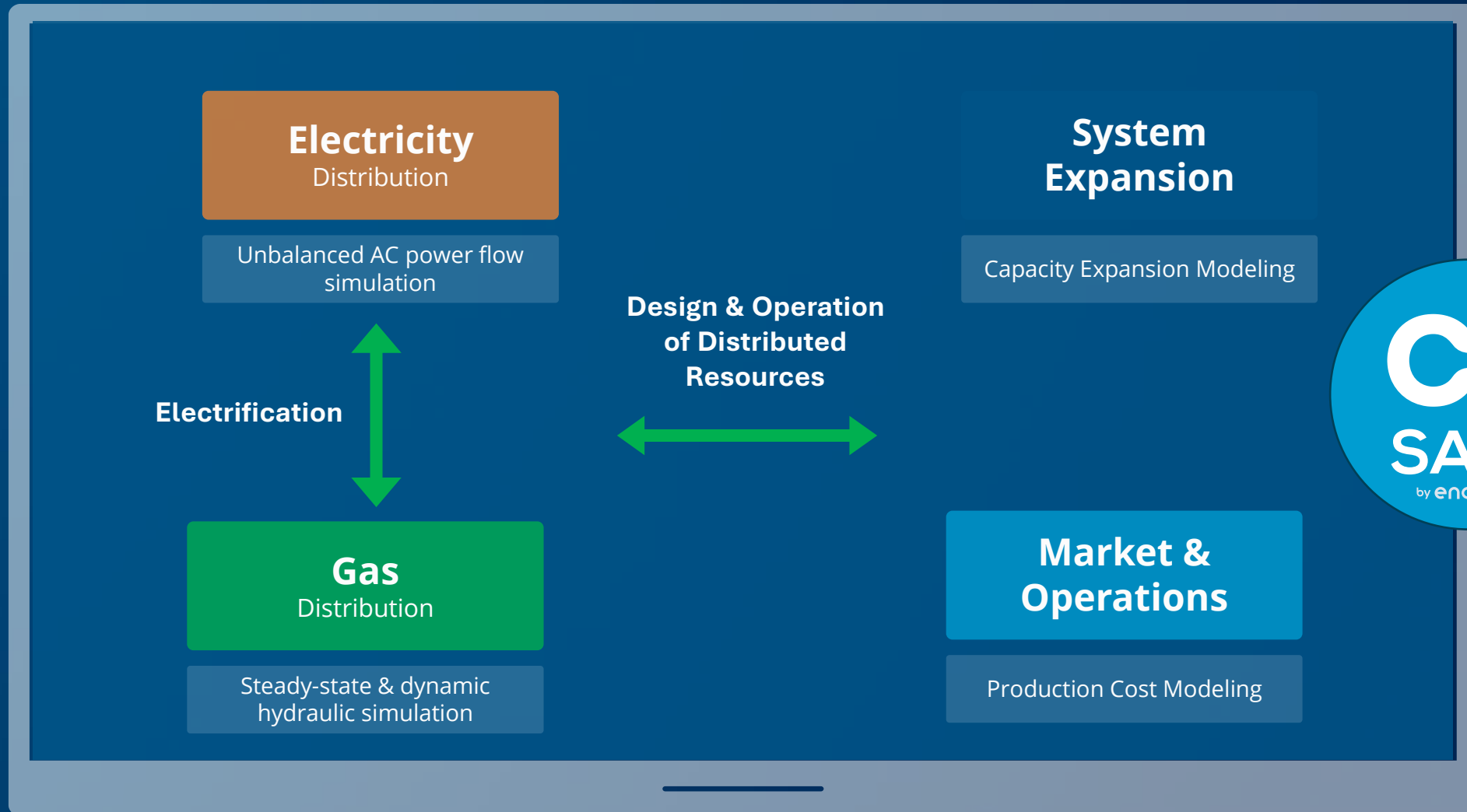
## USA's heat pumps demand



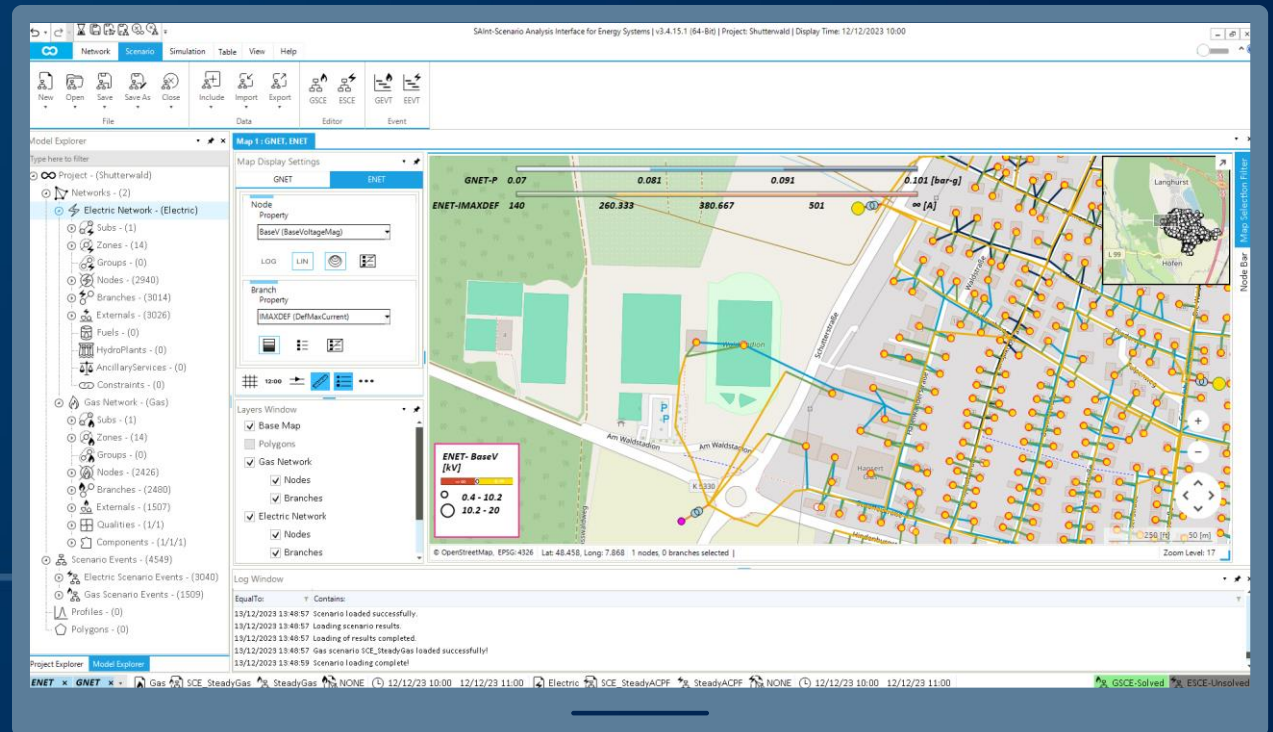
# What is the modelling challenge?



# Our integrated energy planning approach



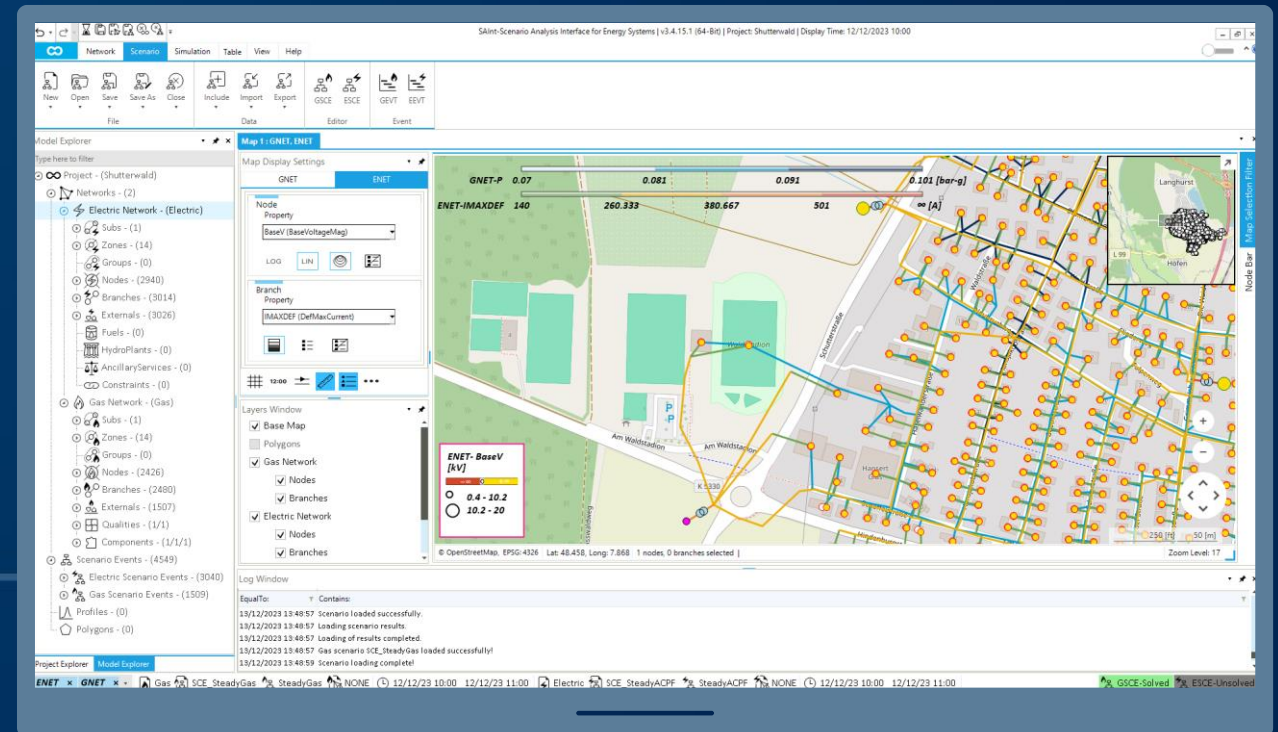
# Real-world use case: Electrification of gas customers



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## Scope of work

A pilot electrification project where roughly **400 gas customers** in the Northeast United States are converted to electric alternatives on **two feeders** served by **one substation transformer**.



# Real-world use case: Electrification of gas customers

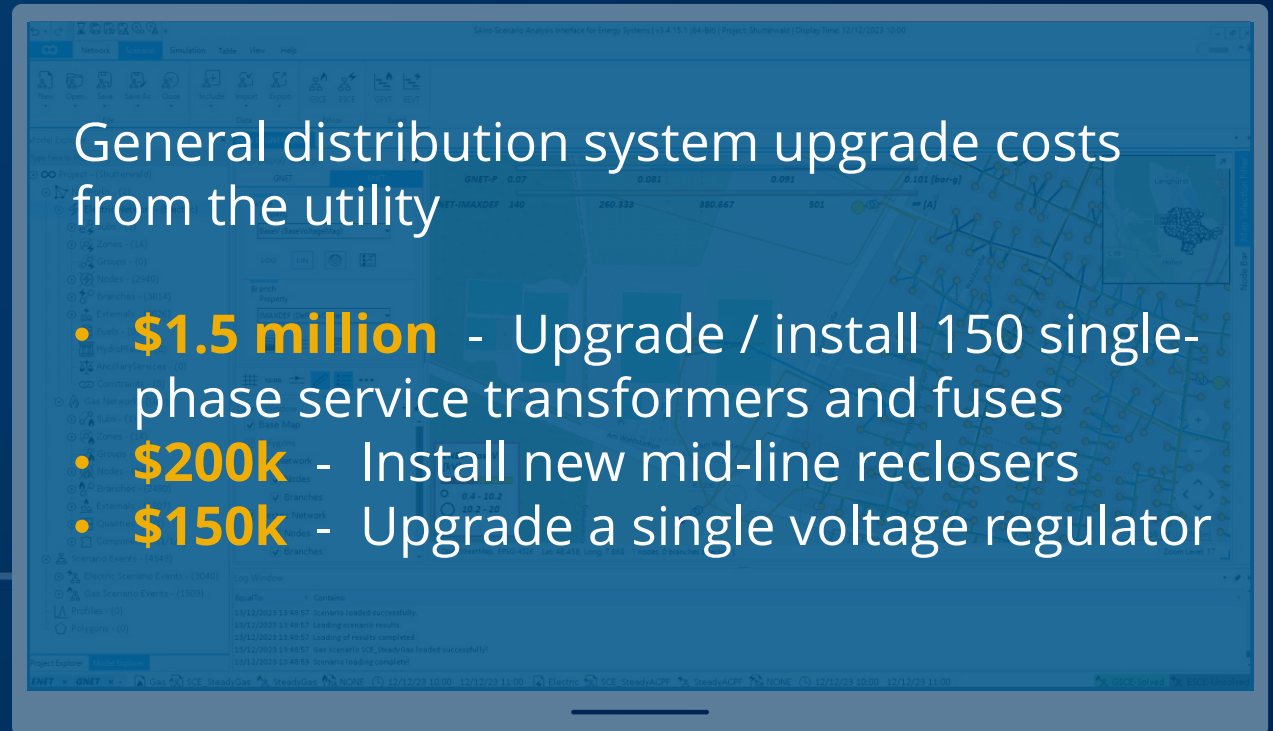
## Planning challenge

After assessing the impacts of this electrification of gas customers, it is estimated that upgrading the substation would cost **over \$ 10 million** to amend system violations.

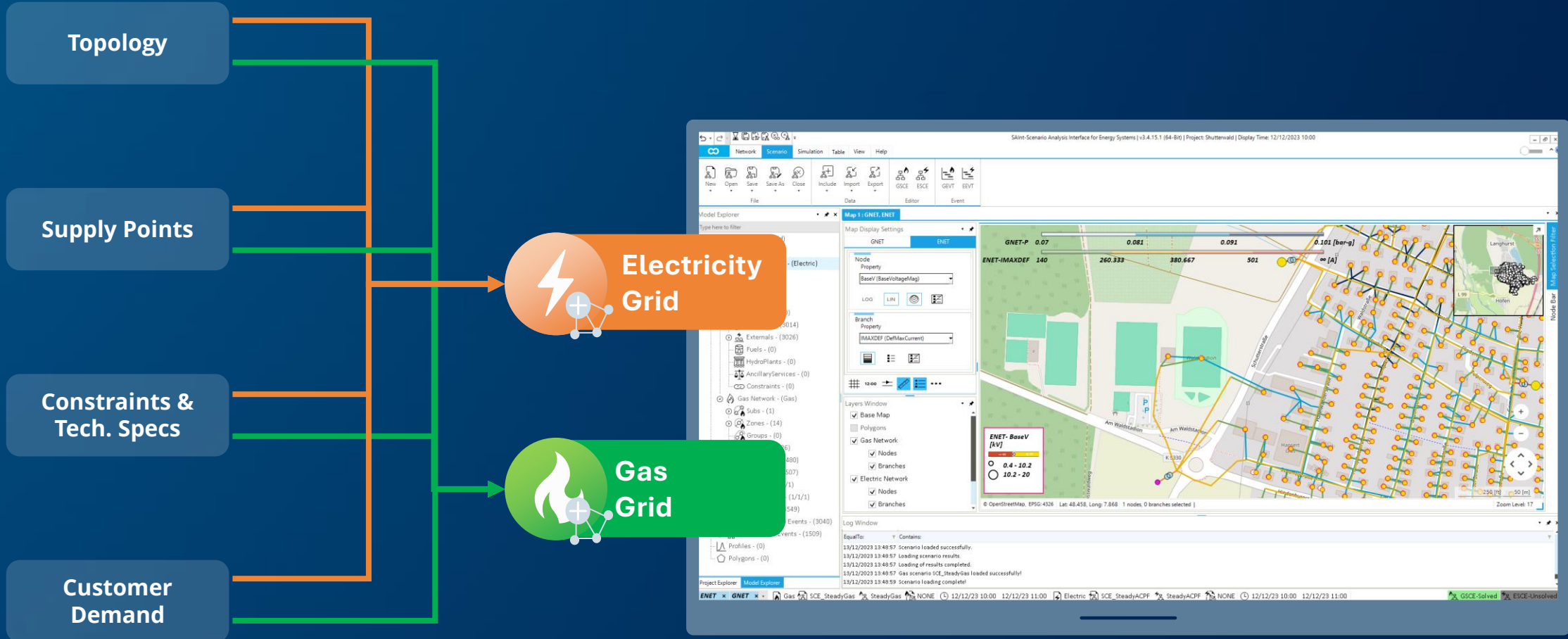
Can **NWA** or **DER** be a **cost-effective** alternative? While increasing system **reliability** and **flexibility**?

General distribution system upgrade costs from the utility

- **\$1.5 million** - Upgrade / install 150 single-phase service transformers and fuses
- **\$200k** - Install new mid-line reclosers
- **\$150k** - Upgrade a single voltage regulator

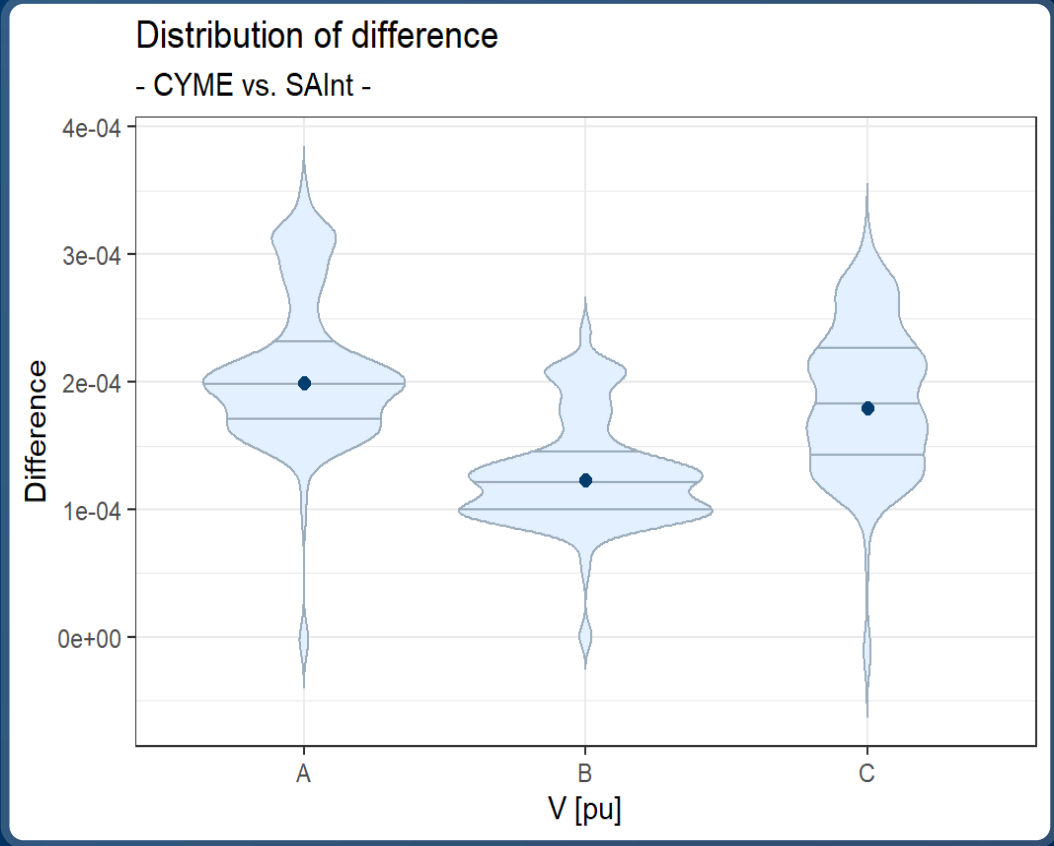
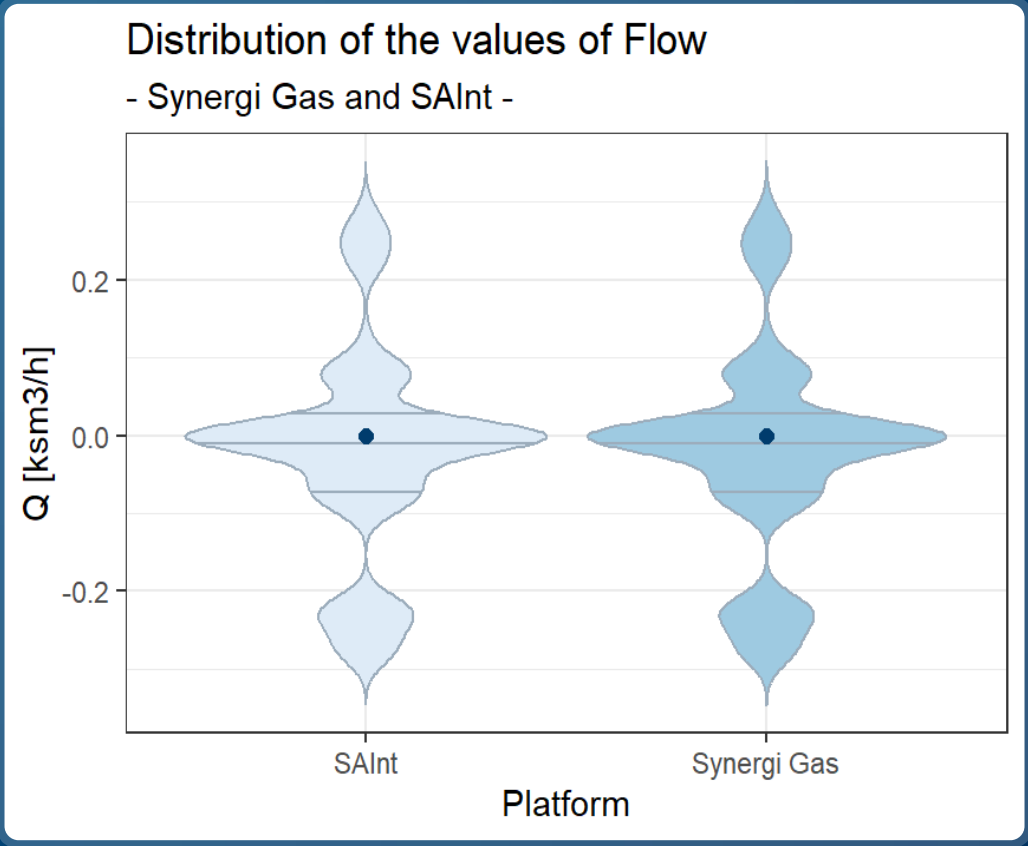


# Step 1: Import data and build network models





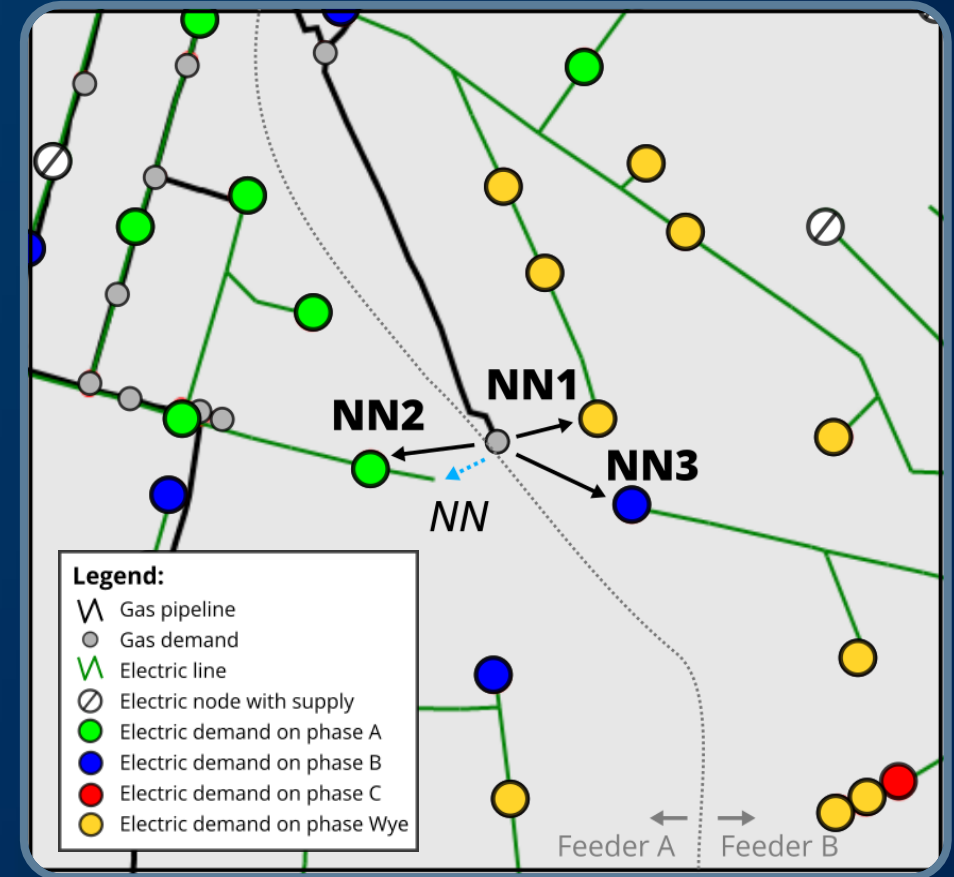
# Step 2: Data validation process



Statistical approaches quickly bestow confidence on numerous quantities of large networks

# Step 3: Mapping gas demands to electric demands

- Typically, gas demands are aggregated
- No direct link between existing and new electricity demand
- Creates uncertainty on the effect new demand will have upstream and downstream on each phase of the feeder
- Different scenarios are needed to evaluate the best mapping practices to balance the overall load



# Step 4: Add time-series and dynamic data



**Advance  
metering data**



**Gross demand  
estimation**

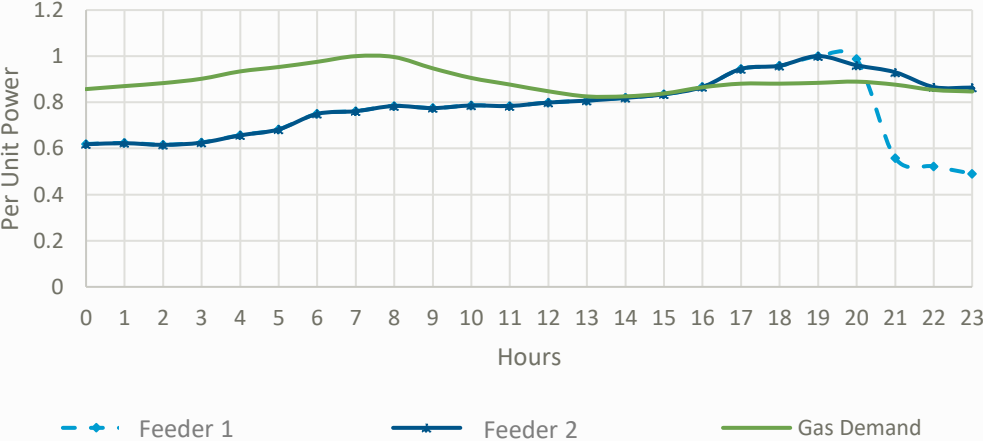


**Weather  
data**

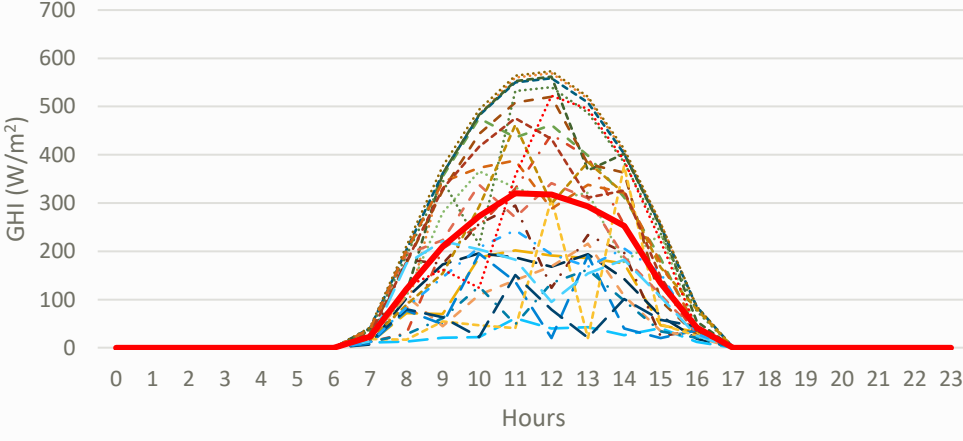


**Warning &  
control system**

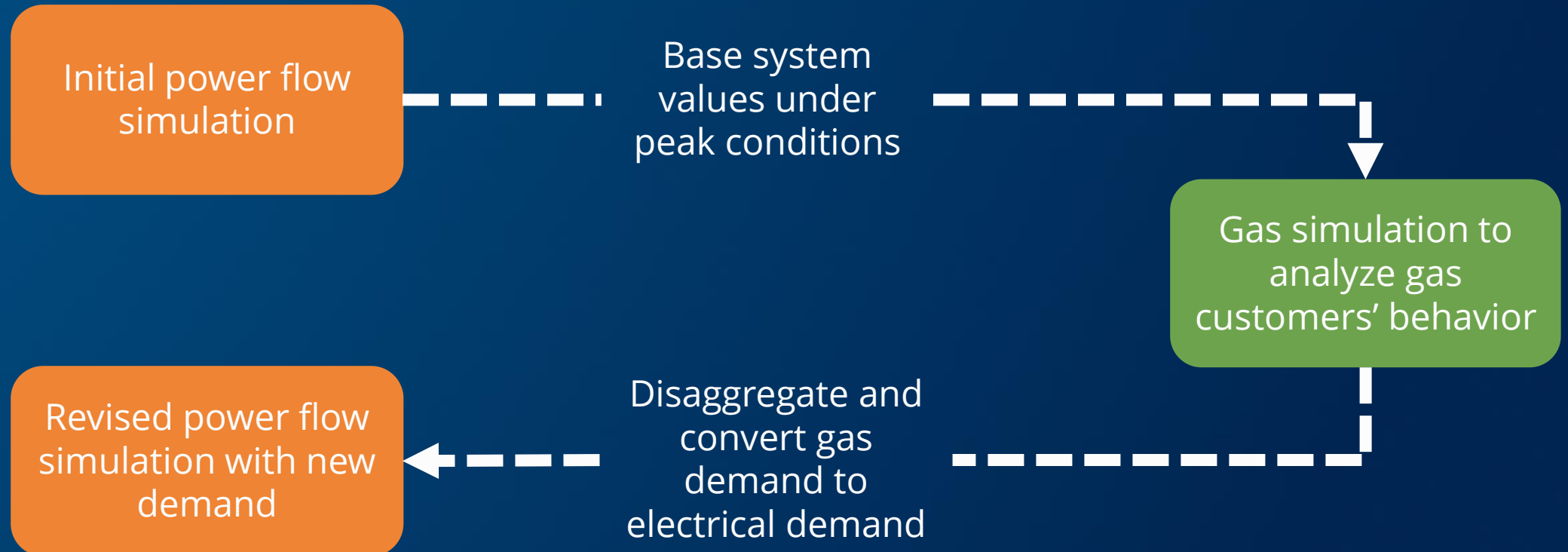
Consumption at Supply Points – Feb. 2, 2023



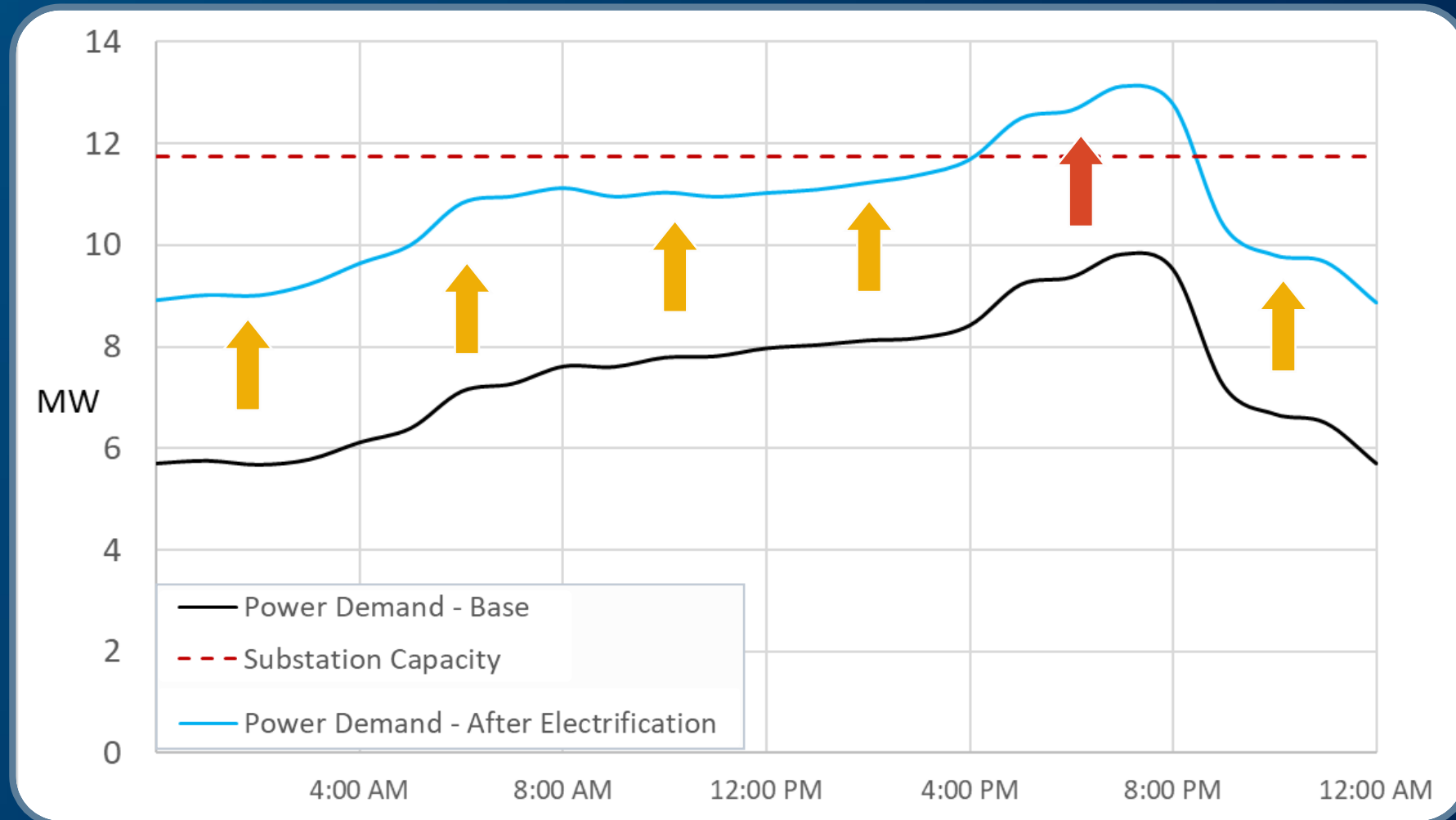
Historical Solar Radiation Feb. 2, 1998 - 2022



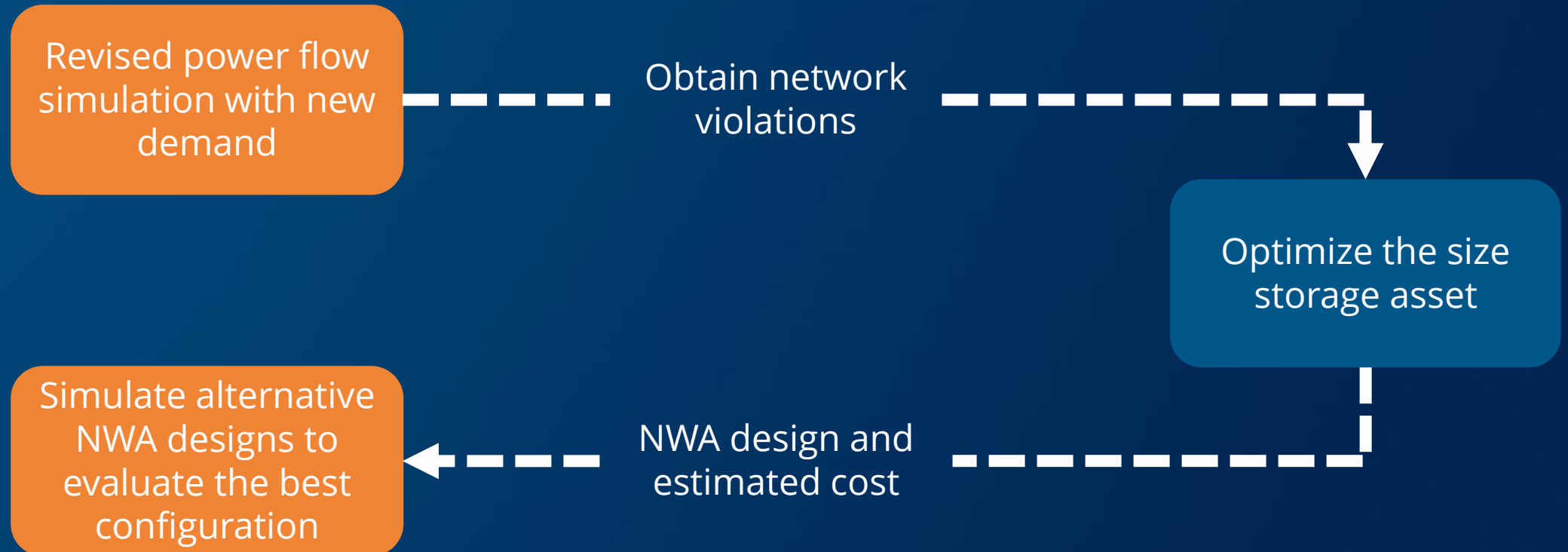
# Step 5: Co-simulation to obtain new system demand



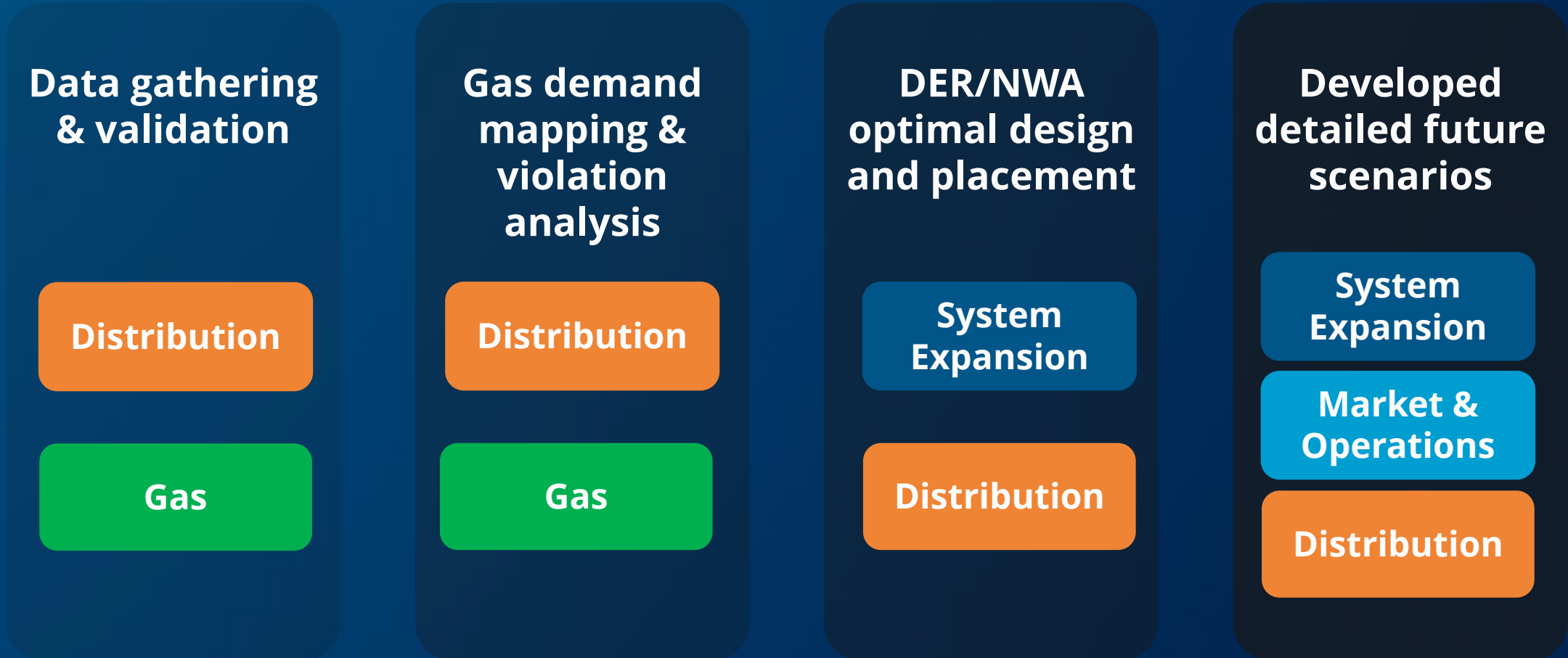
# Step 6: Analyze substation violations



# Step 7: Co-simulation to design energy storage NWA



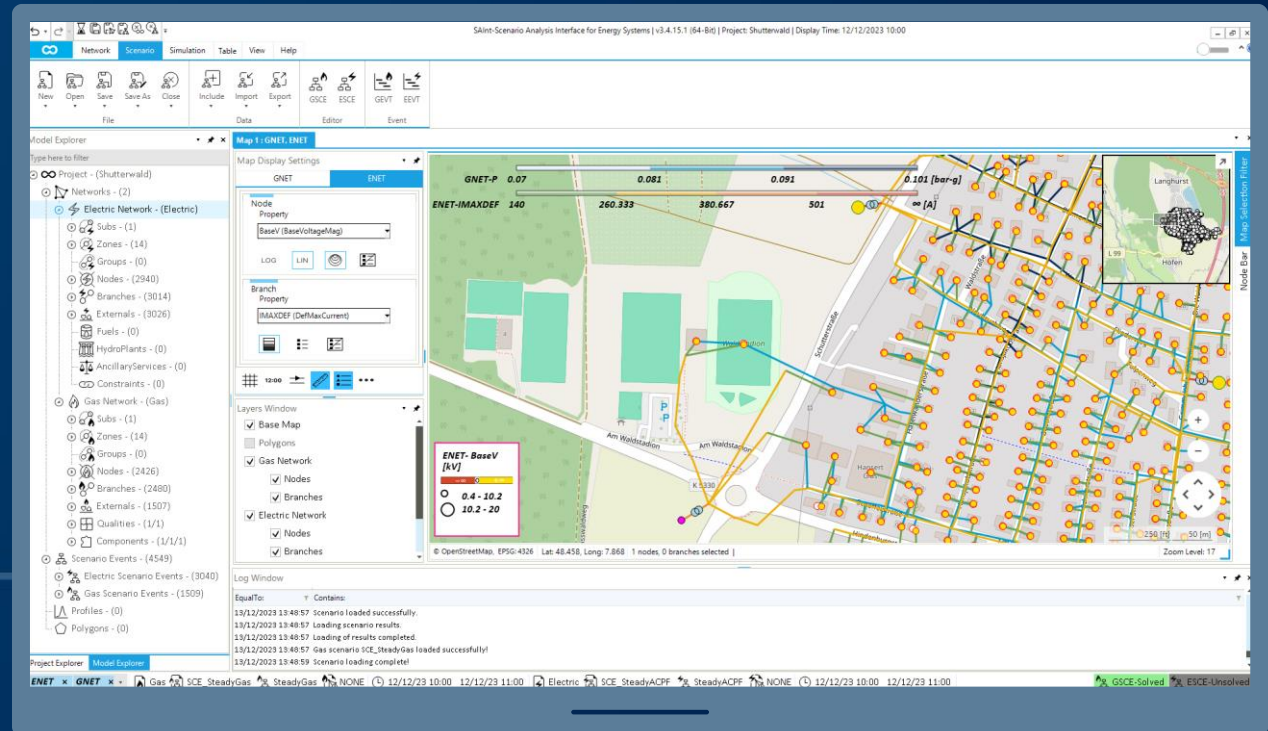
# Electrification of gas customers workflow overview



# Real-world use case: Electrification of gas customers

## Key takeaways

- Electrification requires a **systematic** and **integrated approach**
- **Need for innovative** optimization tools
  - Gas demand disaggregation
  - NWA/ DER design and placement
  - Economic feasibility in future scenarios





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