# Algonquin College CHP Microgrid Optimization

## Increasing Project ROI by Optimizing Onsite Campus CHP Units via Advanced Software



usa.siemens.com/microgrid



Max Majkowski / EM DG SWS

# Algonquin College CHP Project Content

- Investment in Sustainability
- Next Step: CHP Investment
- Optimization & Control Software

# Energy Savings Contract (ESCO2)

## Project goals

20-year Energy Savings Contract between Algonquin College and Siemens; focusing on better energy performance with social, economic, and environmental improvements

**Success metrics**

Annual operating cost savings target more than $3.2 million

- Includes electricity, natural gas and water
- Includes over $1.7M from new Energy Centre

More than 1,400 tonnes of CO2 reductions annually

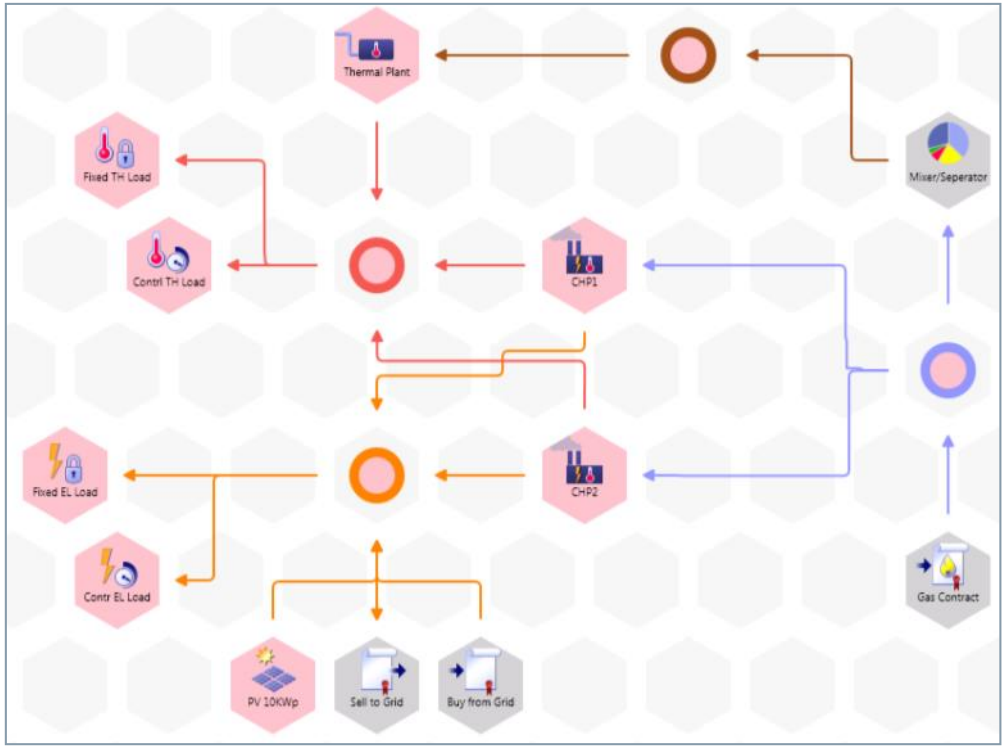
**Investments to date**

- Water efficiency
- HVAC retrofits
- Building automation control optimization
- Cooling plant and chiller optimization
- Lighting controls
- Modernized kitchen equipment
- Central plan improvements

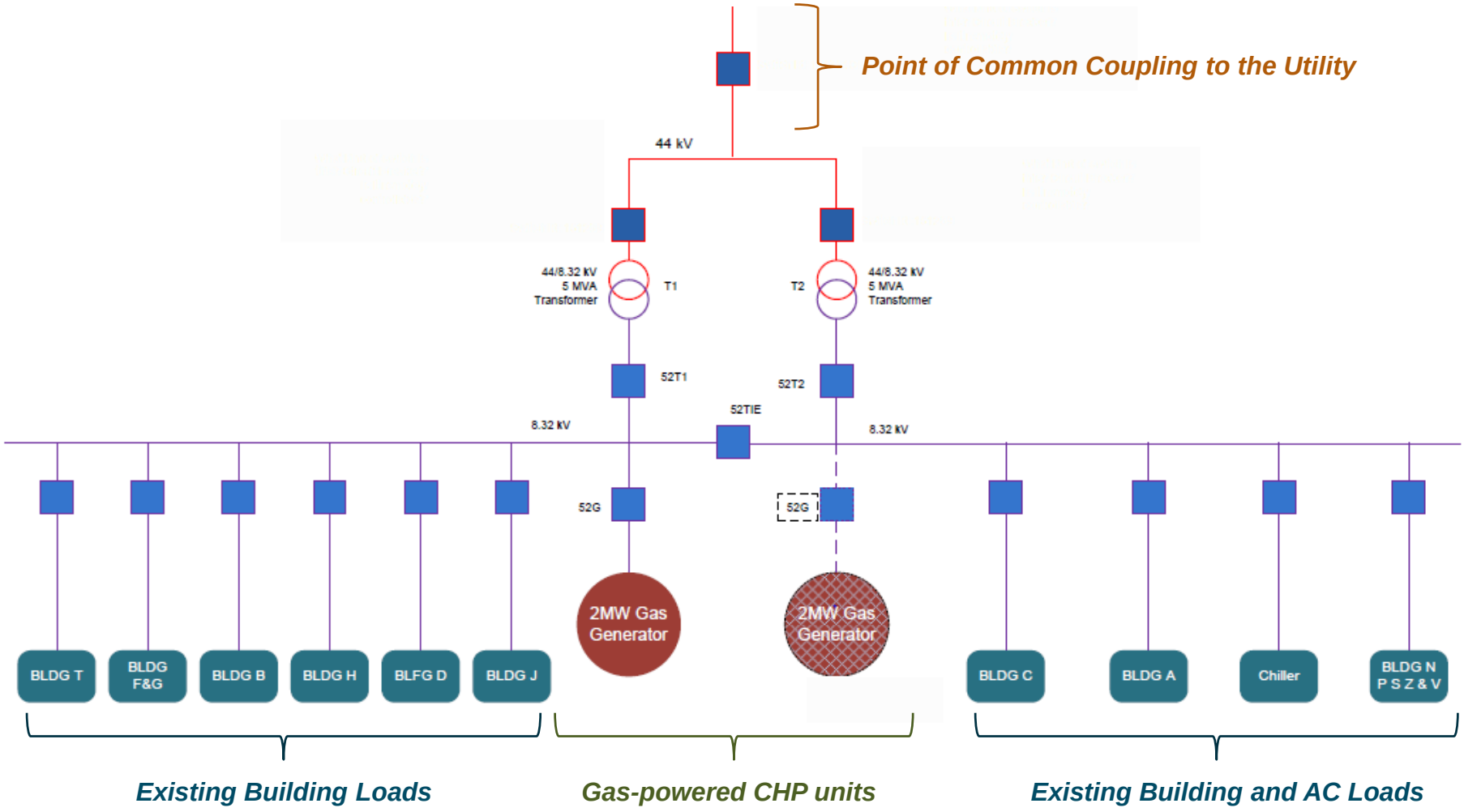
# The Next Step: Microgrid

Algonquin College energy and emission reduction goals include further investment in **on-site electrical** and **thermal power generation**.

- The first step is the installation of on-site **Combined Heat and Power** units
- Future plans include **solar PV generation and energy storage.**



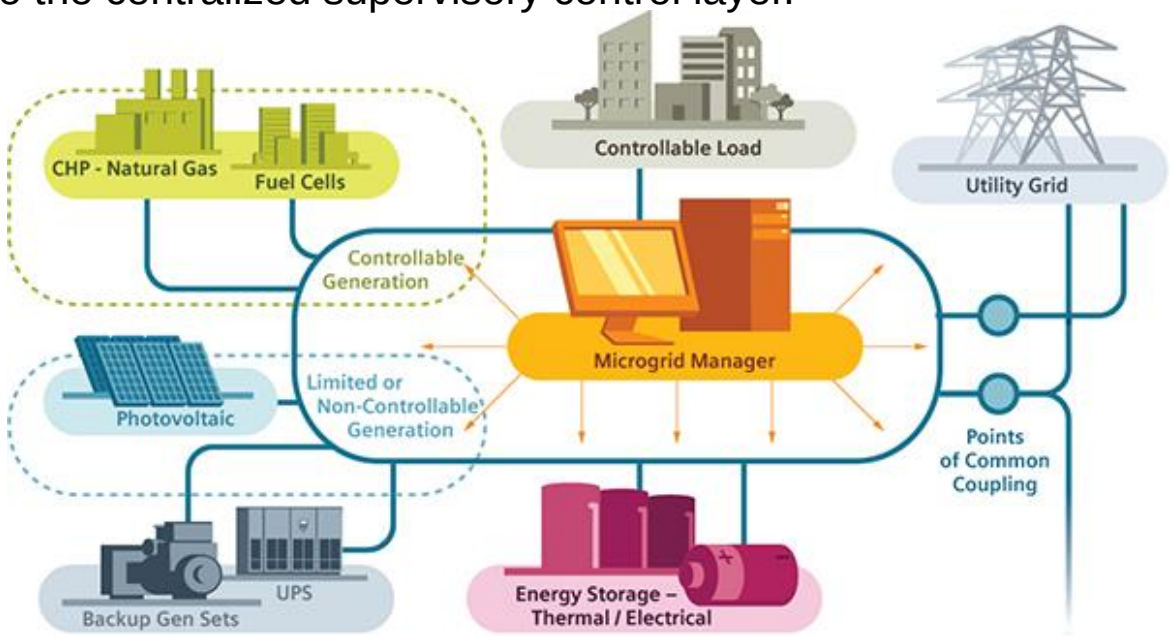
# Microgrid One-Line



# Microgrid Software

## Where does software fit in to this?

Within the campus there is a hierarchy of **data, communications, and control**; from the physical assets or “field layer” through their local control systems, and up to the centralized supervisory control layer.




### Control & supervisory

- Central mgmt. & control comp.
- Operation tool for baselining and decision logic (e.g. weather forecast)

### Communication layer

- IT-communication
- Smart meters, sensors

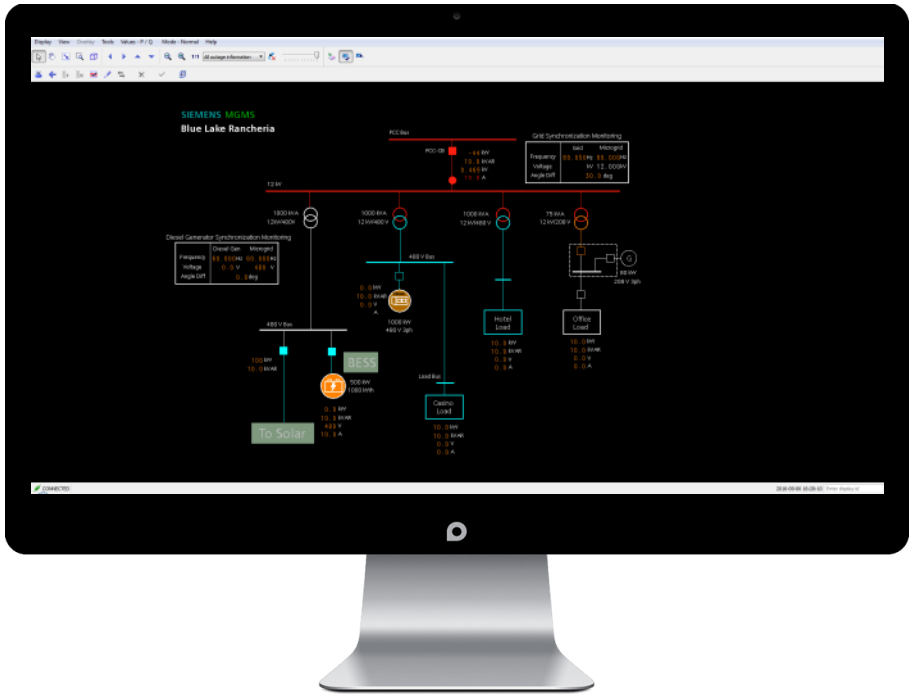
### System layer

- **Power electronics**: Smart inverter, smart connection
- **Smart controller** (DG, storage, loads)

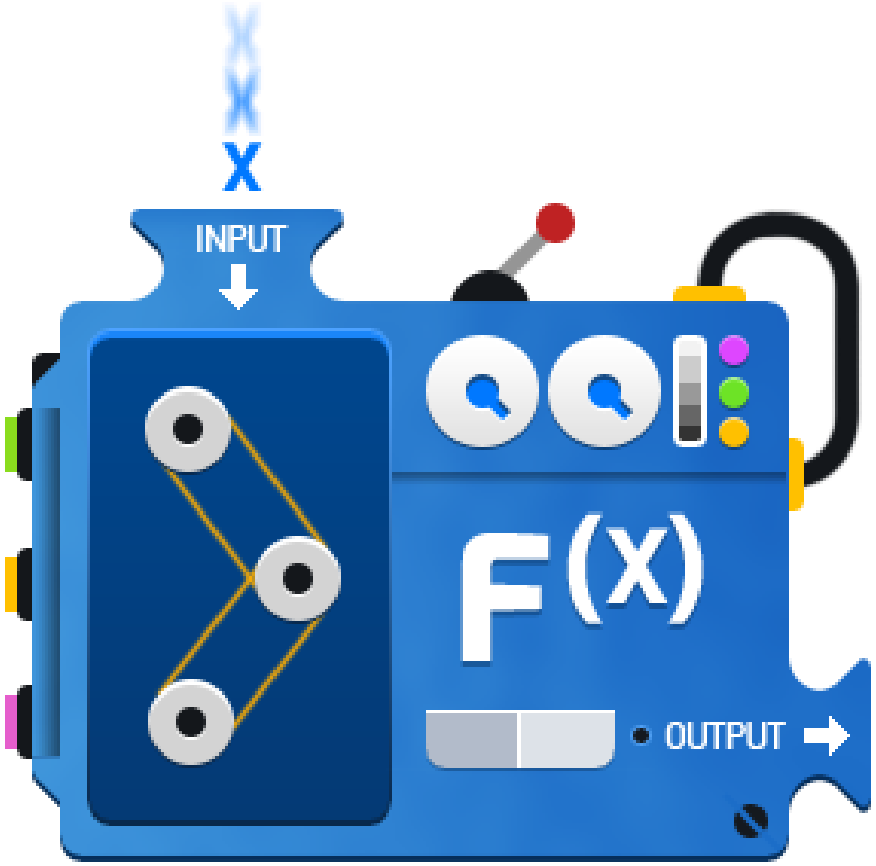
### Field layer

- **DG**: Solar PV, Wind turbine, combustion engine, CHP, CCHP
- **Energy Storage**: Battery, ultra capacitor, flywheel, E-car
- **Grid components**: switchgear, distribution line, transformer, protection
- **Power consumer mgmt.**

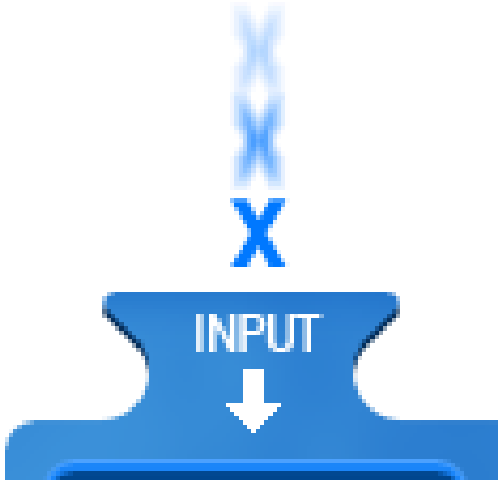
# Siemens MGMS Advanced Control Software


# Optimization Process



# Input into the MGMS Optimization




Demand

## Forecast

- Electric load kWe
- Thermal load kWt

Economics

## Electric Tariff:

- Import power: Electric load
- *Hourly rates from IESO*

## Natural Gas Tariff:

- CHP fuel: Electric + thermal
- Boiler fuel: Thermal
- *Fixed gas rate*

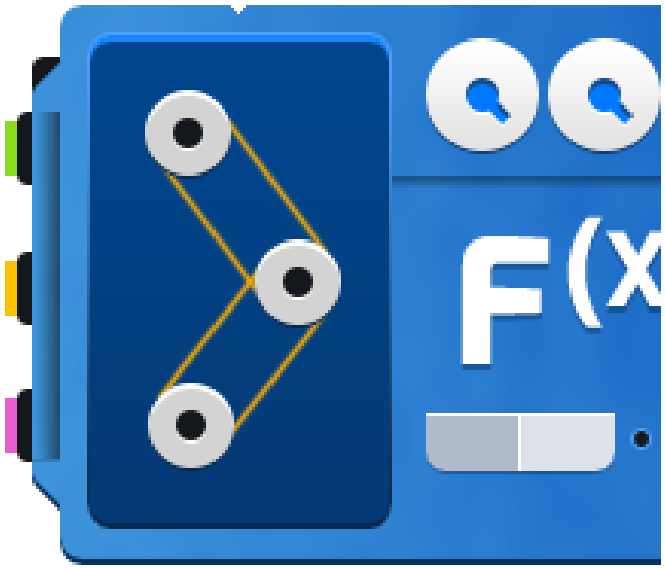
Operational Parameters

## CHP Unit Parameters

- Unit constraints (min on/off time, min/man kW, etc.)
- Unit characteristics (thermal output per electric output)
- Fuel consumption curve (gpm/kW)
- Emission production (CO2, SO2, NOX)
- Initial condition: The current network state

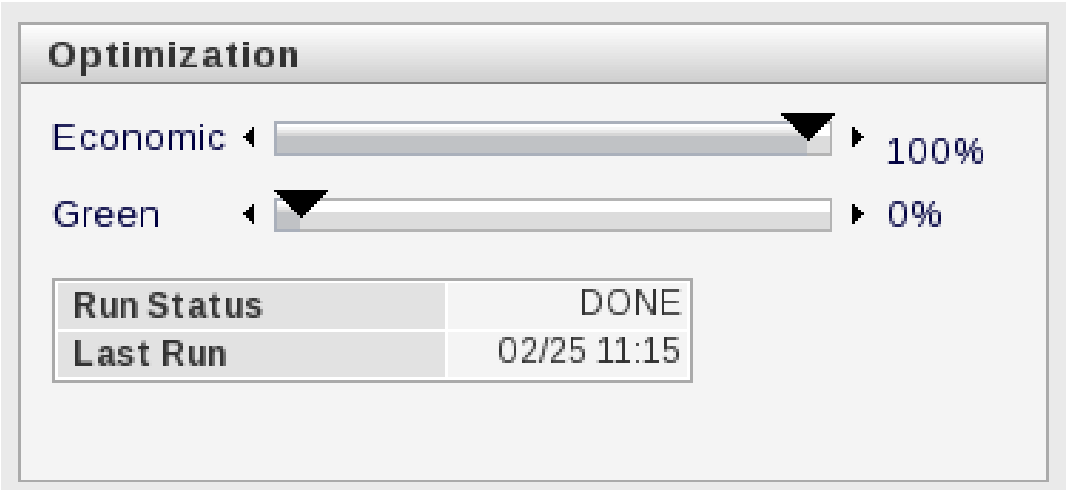
# MGMS Optimization

## Optimization

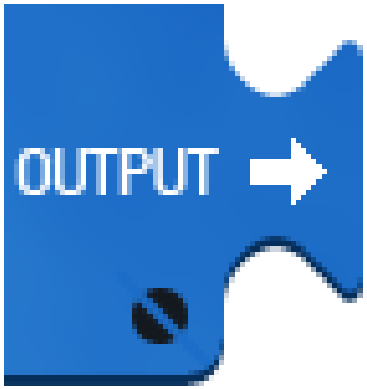


**Minimize $/kWh and lbs of CO2, NOx, SO2**

$$\text{Min } [\ \alpha \sum \text{Cost} + 1 - \alpha \sum \text{Emissions}\ ]$$



# Output of the MGMS Optimization




Resource Statuses

Reporting Data

## Unit Status Schedules

- For each 15-minute increment
- ON/OFF Status

## Unit Output Schedules

- For each 15-minute increment
- If ON: Unit output setpoint

## State of Charge Schedule

- % charge of all network storage

## Cost Schedule

- Operating cost for each 15-minute increment

## Emission Schedule

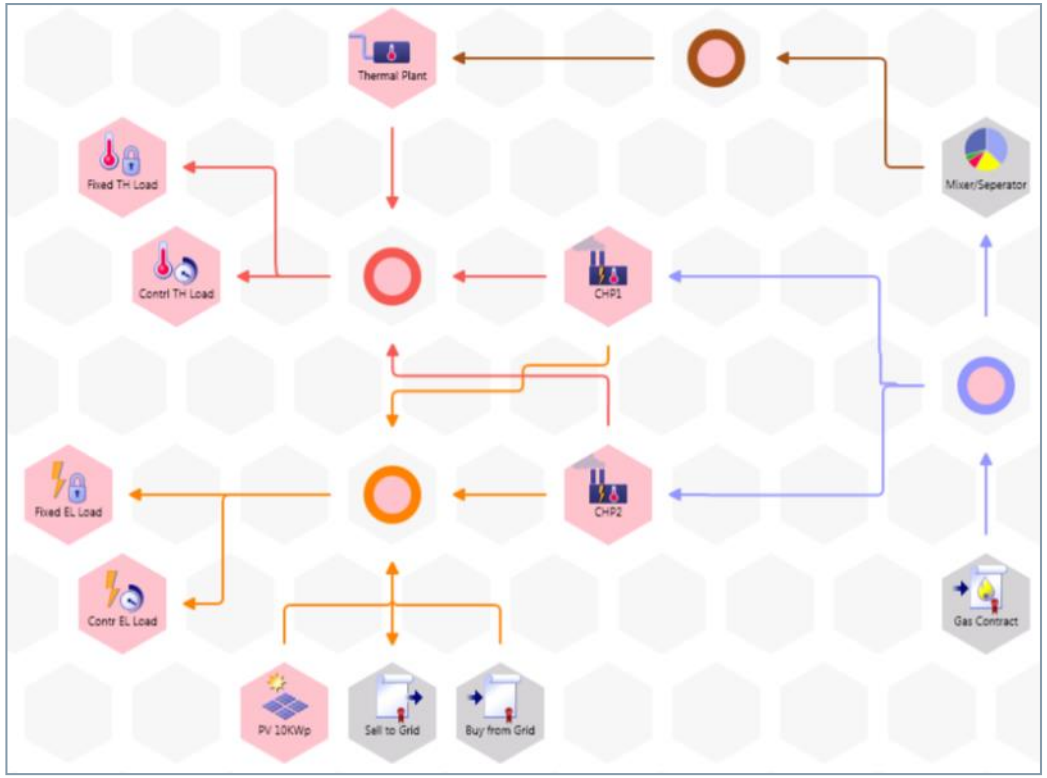
- lbs of CO2, SO2, NOx

# Software Simulation of a Similar Campus

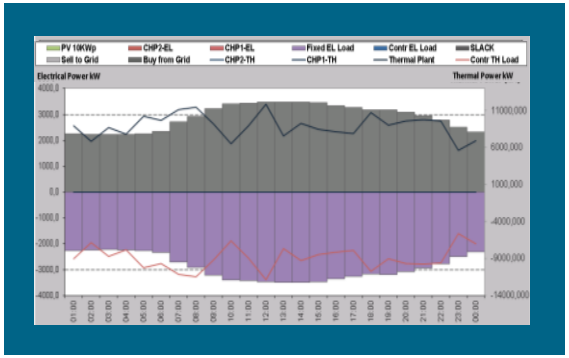
1. Microgrid is modeled based on detailed input data with all of its resources: CHPs, loads and energy contracts, including electrical and thermal elements.

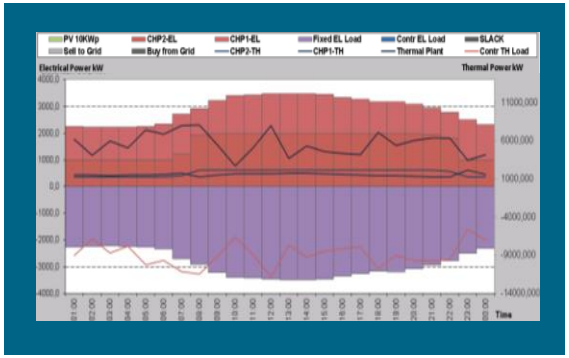
2. Customer-specific scenarios are defined to prove the business case of microgrid controller and additional potential for cost optimization.

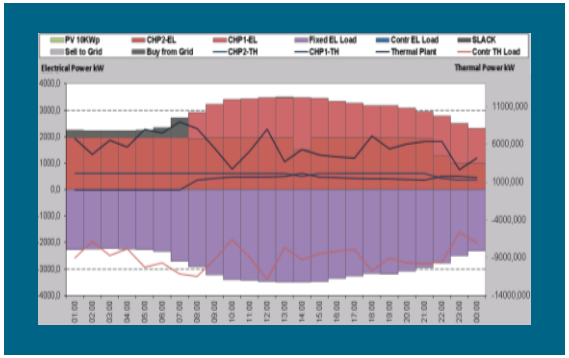
3. Simulations are executed and results analyzed to show the optimization potential.



# Value of Optimization – Similar Campus Simulation







## Scenario 1:
***Base Case***

Simple campus energy model – Entire Campus is supplied from the grid and thermal load is provided by a gas powered plant.

**Energy cost:**
**$3M per year**

## Scenario 2:
***CHP***

Full CHP utilization – Savings through maximum CHP utilization and simple on/off control

**Energy cost: $2.2M per year**
**Savings: $800K per year**

## Scenario 3:
***CHP & MGMS***

Microgrid optimization – Additional savings through optimizing energy intake from either CHPs or grid with the MG manager

**Energy cost: $2M per year**
**Savings: $1M per year**
***$200K additional due to MGMS***

# Contact Page

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