Algonquin College Microgrid

Harnessing the full reliability and economics of a college Microgrid through control software

usa.siemens.com/microgrid

Algonquin College Microgrid Content

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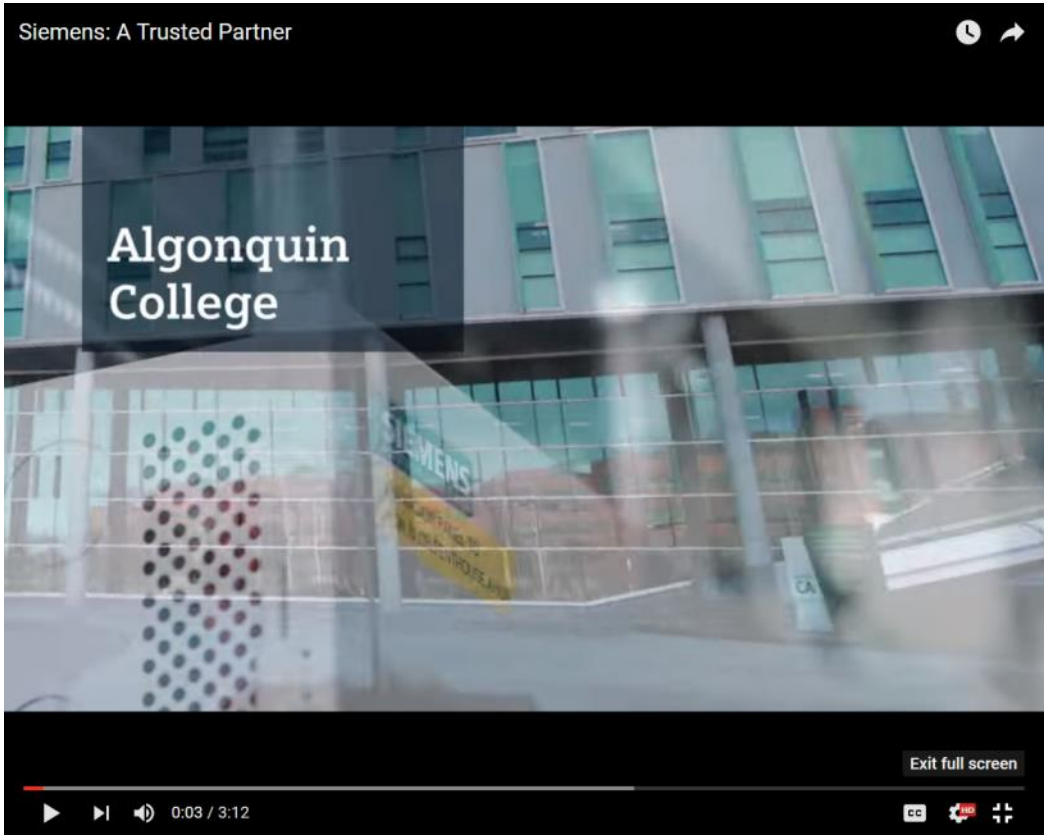
- Investment in Sustainability
- CHP-based Microgrids
- Optimized Control Software

Algonquin College Overview



https://www.youtube.com/watch?v=AIFpgk-W4YI

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

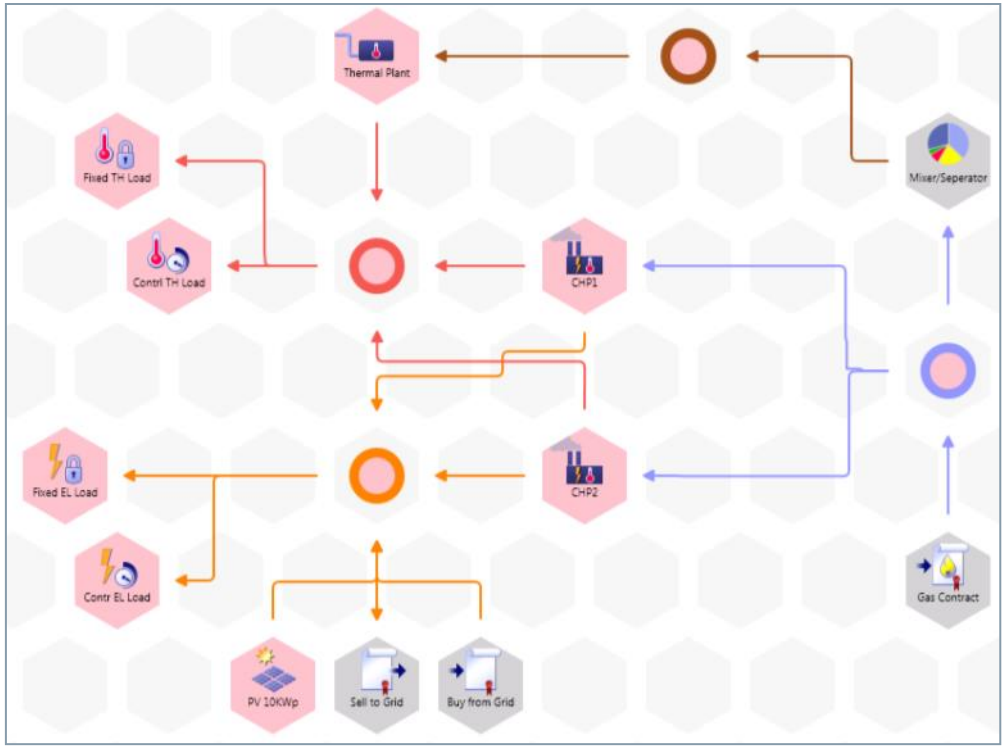
Investments to date

- 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 to leverage the economics and efficiency of electrical and thermal power from a single source.
- Future interests include **solar PV generation and energy storage.**

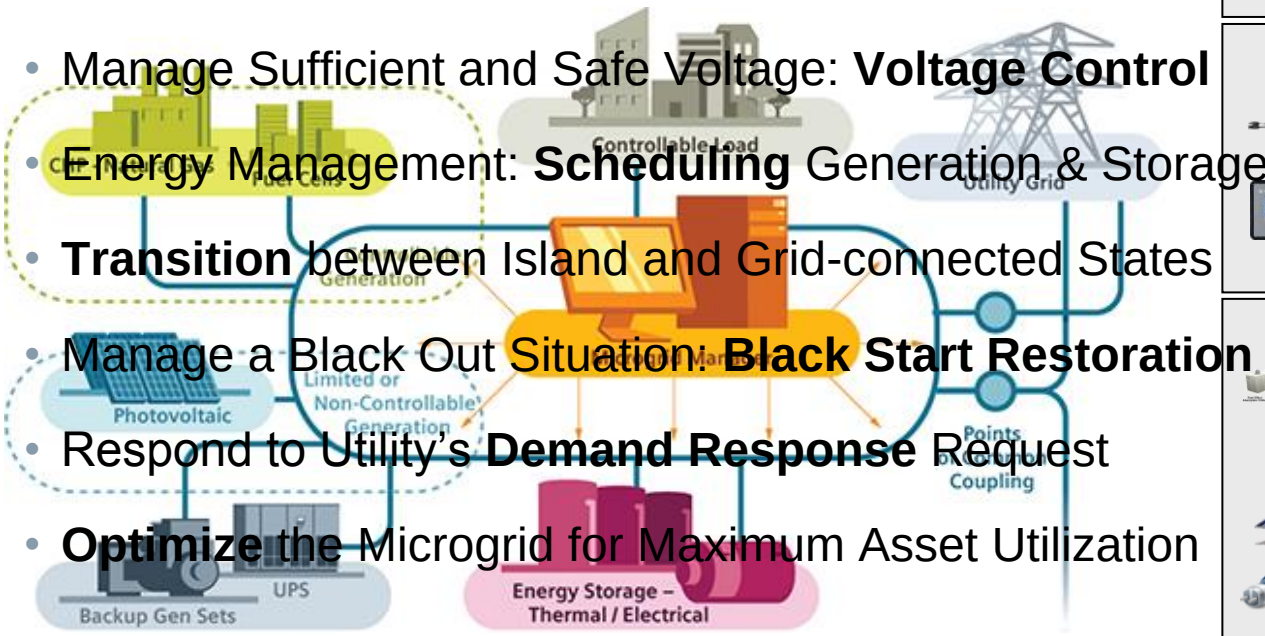


Microgrid Software

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.

- Monitor and Control all Assets: **SCADA**
- Balance Supply and Demand: **Frequency Control**
- Manage Sufficient and Safe Voltage: **Voltage Control**
- Energy Management: **Scheduling** Generation & Storage
- **Transition** between Island and Grid-connected States
- Manage a Black Out Situation: **Black Start Restoration**
- Respond to Utility's **Demand Response** Request
- **Optimize** the Microgrid for Maximum Asset Utilization



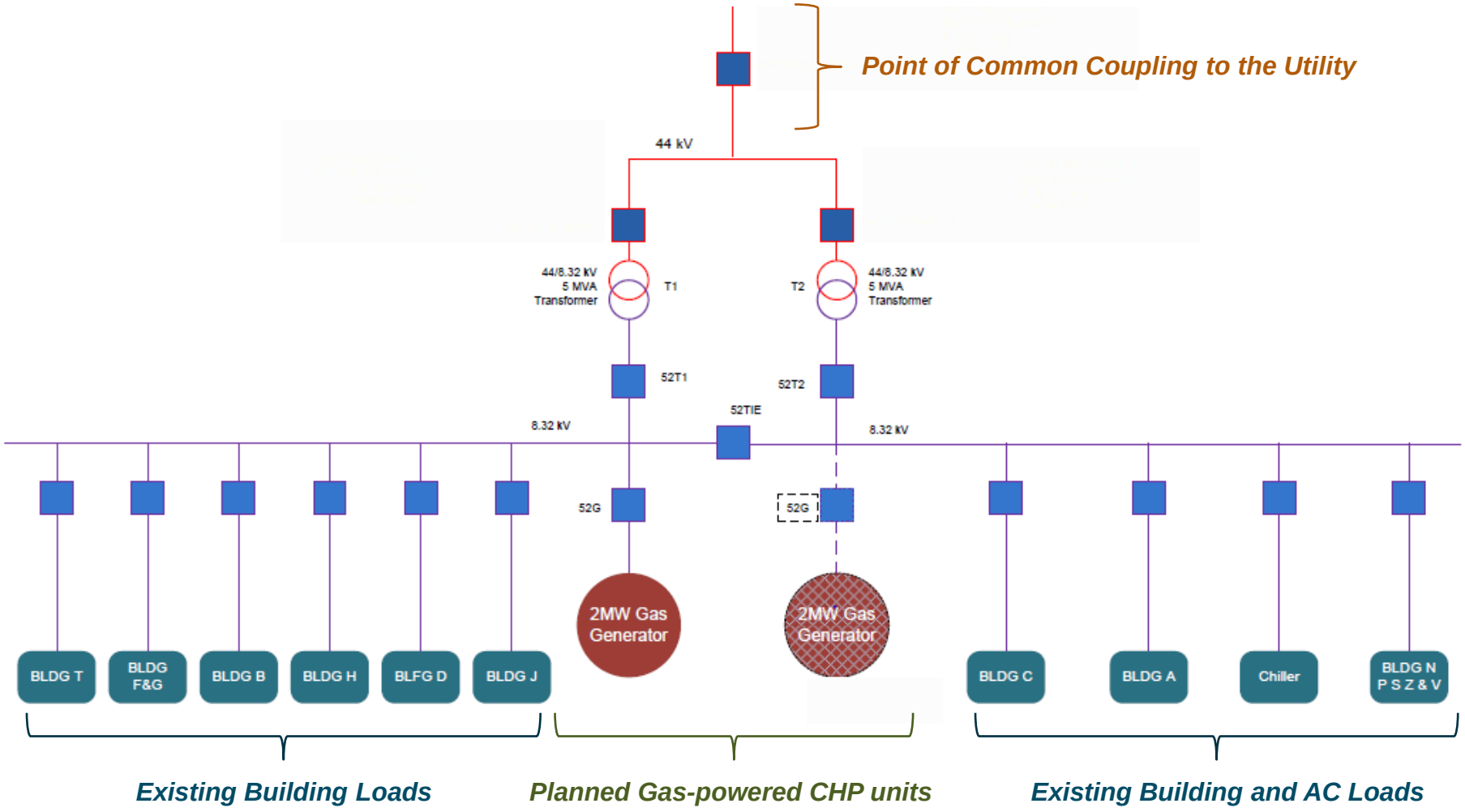
Control & supervisory
- Central mgmt. & control comp.
- Operation tool for baselining and decision logic (e.g. weather forecast)

Communication layer
- IT-communication
- Smart meters, sensors

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

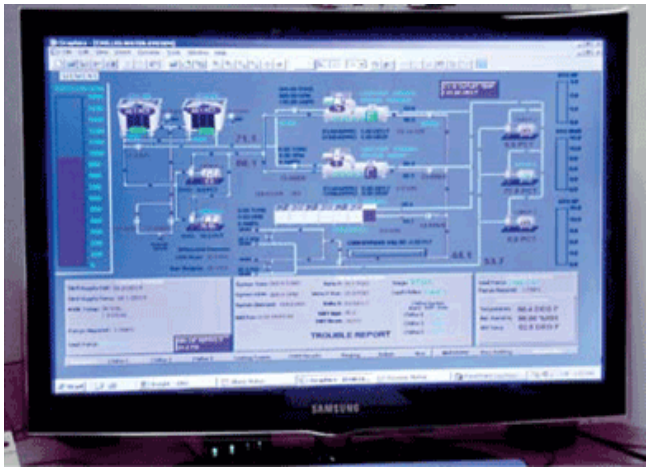
Field layer
- **DG**: Solar PV, Wind turbine, combustion engine, CHP, CCHP
- **Energy Storage**: Battery, ultra capacitor, flywheel, E-car
- **Grid components**: switchgear, distribution line, transformer, protection
- **Power consumer mgmt.**

Microgrid One-Line



Building Automation for Microgrid Loads

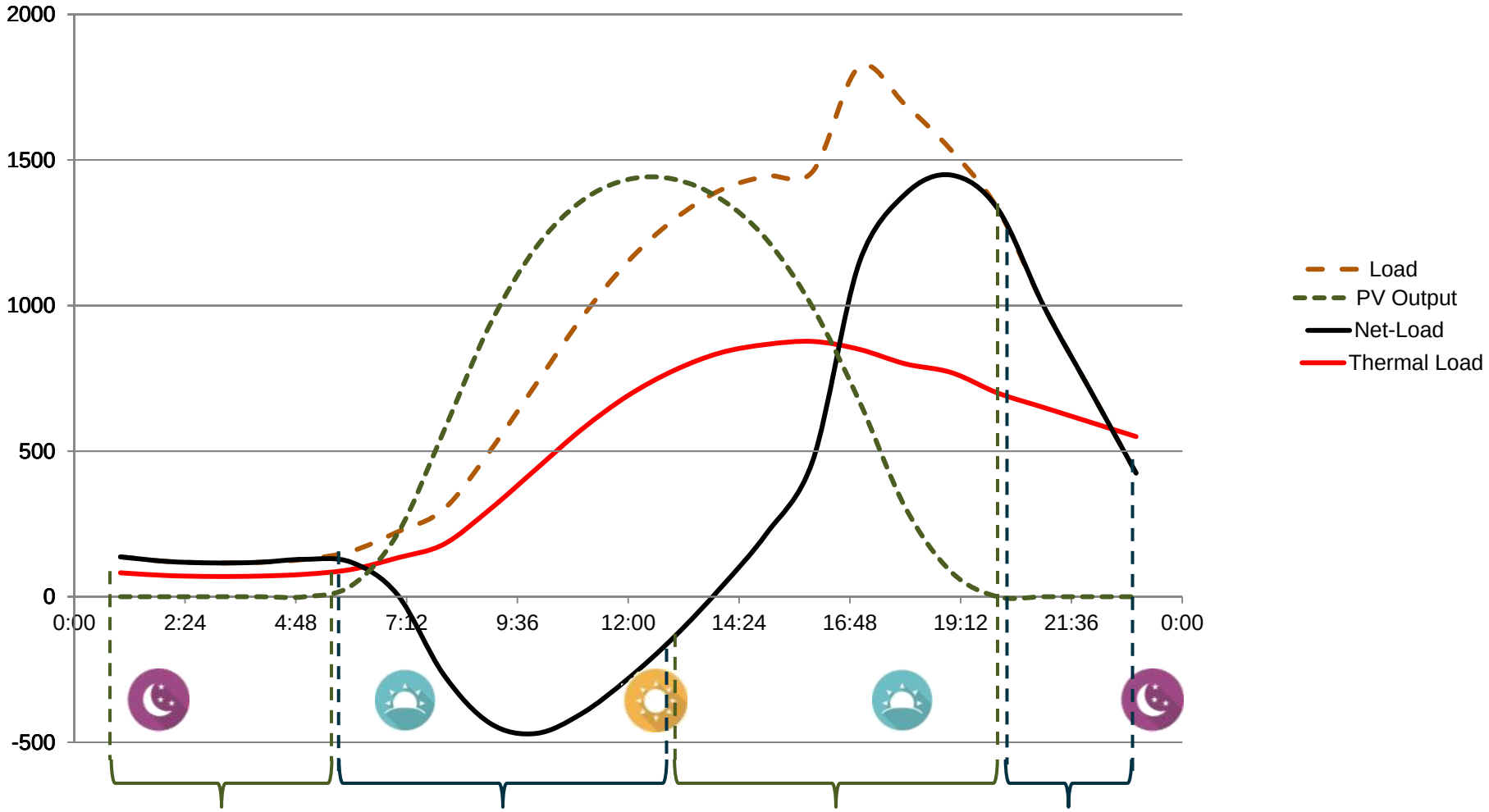
- As part of the ESCO2 project goals, the Algonquin campus has been outfitted with building automation systems to help reduce the total electrical consumption of the Microgrid campus.
- This is done through automated intelligent control of lighting loads and HVAC.
- The automation system oversees all building loads and can be used as a gateway if necessary to shed load when needed.



CHP for a Campus Microgrid

- A large portion of local power systems/microgrids have centralized thermal loads – this, along with state and federal incentives, make Combined Heat and Power (CHP) a great investment
- CHP is the process of generating electrical power and thermal energy from a single unit
- The thermal by-product can be used to serve building/campus heating needs in conjunction with the boiler, and to serve cooling needs through an absorption chiller
- Today, Algonquin College is serving its thermal needs via a gas-fired boiler – the CHP will work in parallel to this

Microgrid Software

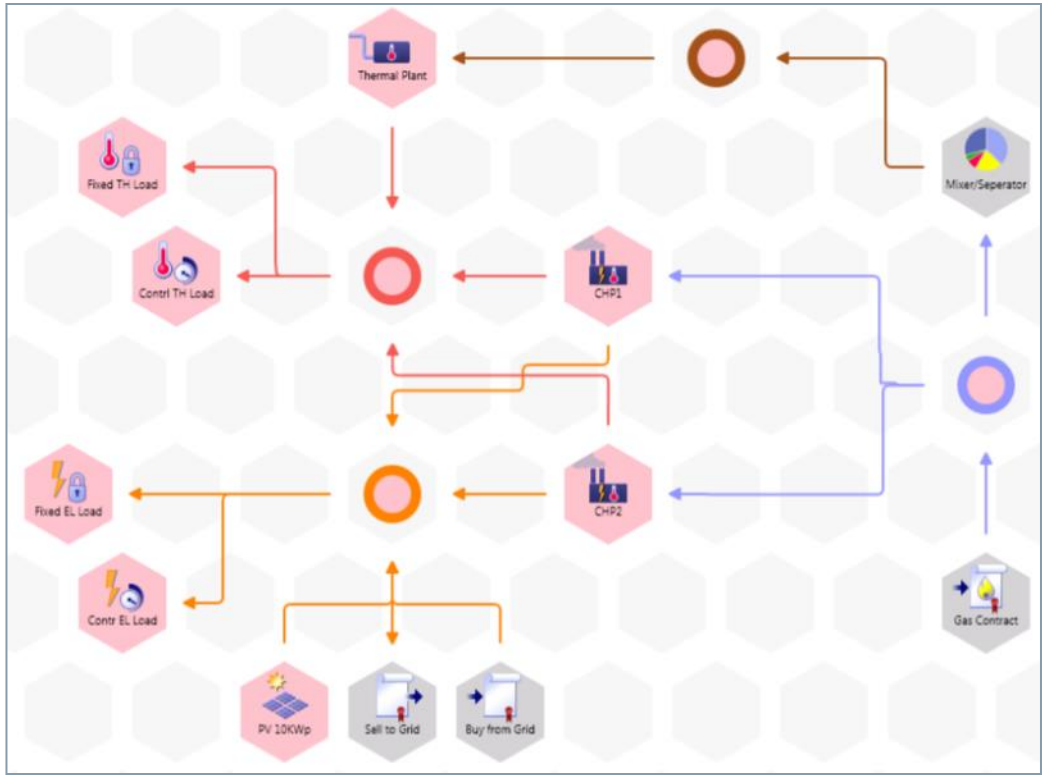


Software Simulation of a Similar Campus

1. Microgrid is modeled based on detailed input data with all of its resources: CHPs, generators, 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.



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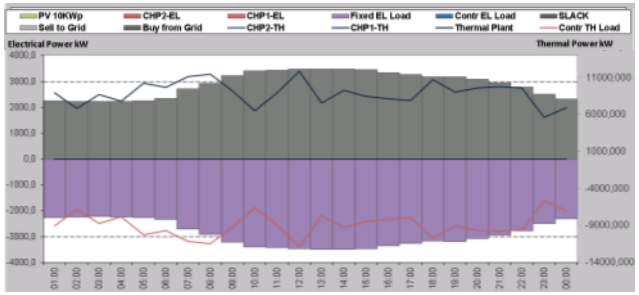
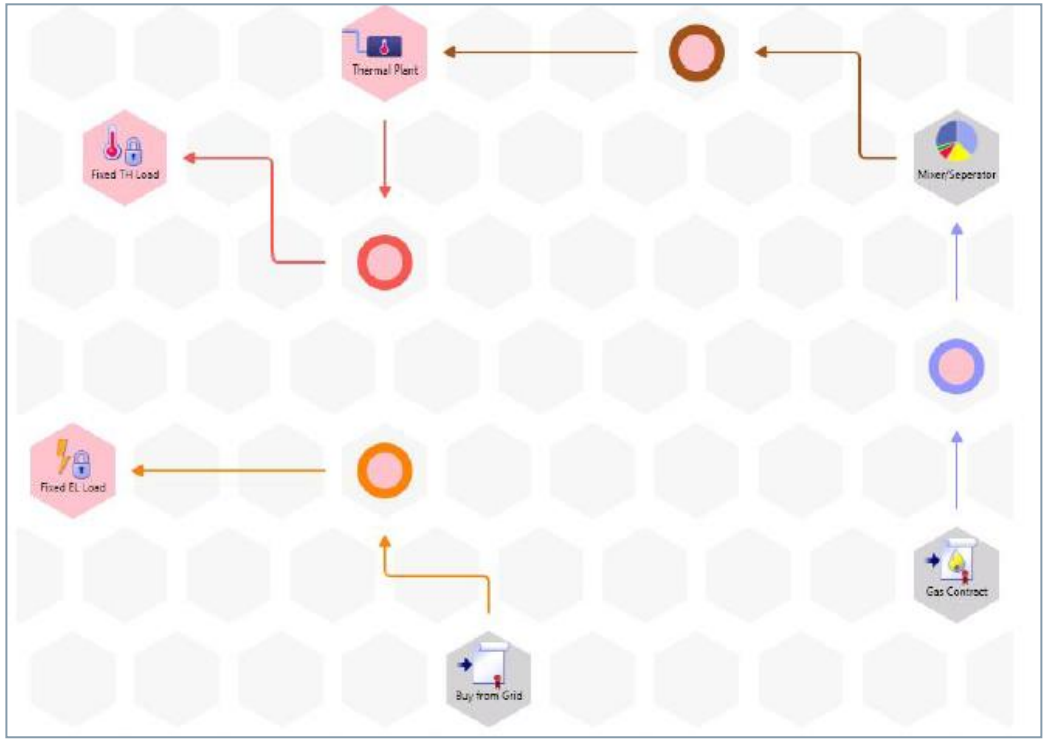


Scenario 1 – Simple campus energy model
Entire Campus is supplied from the grid and heating is provided by a gas-powered thermal plant.

Total cost: $3 million



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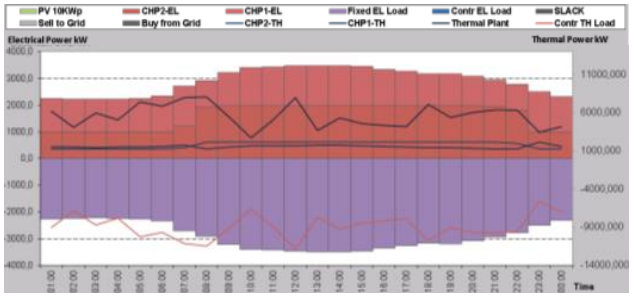
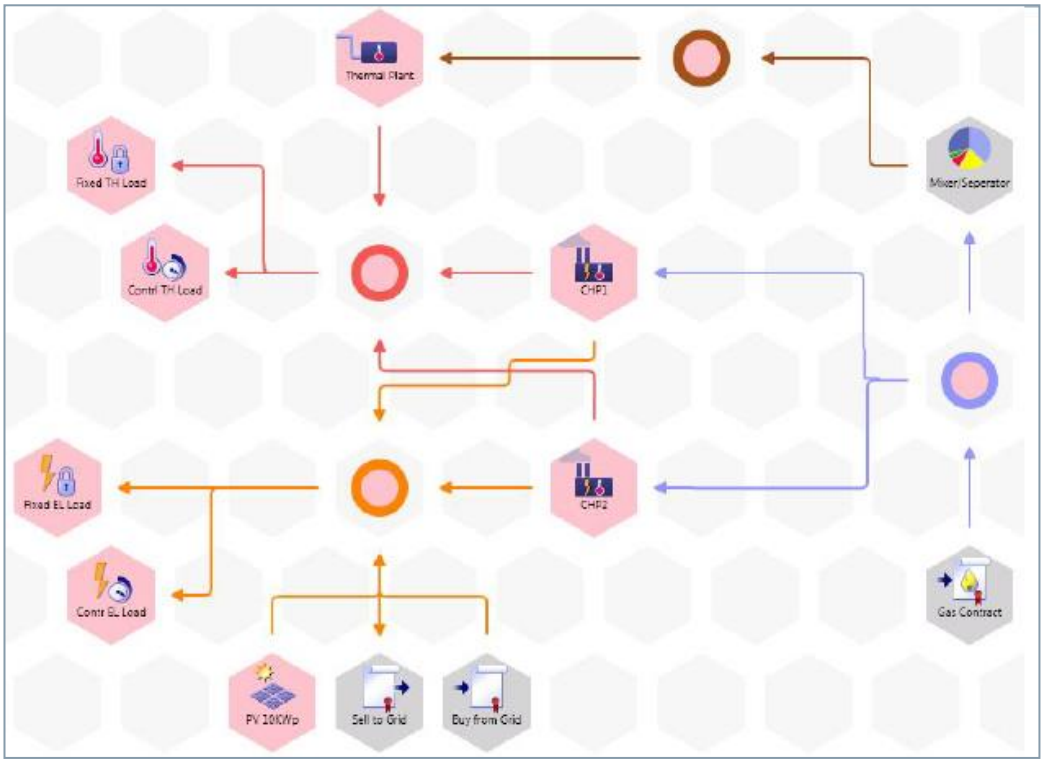


Scenario 2 – Full CHP utilization
Savings are made through maximum CHP utilization and simple MG controller without optimization.

Total cost: $2.2 million
Savings: $800K



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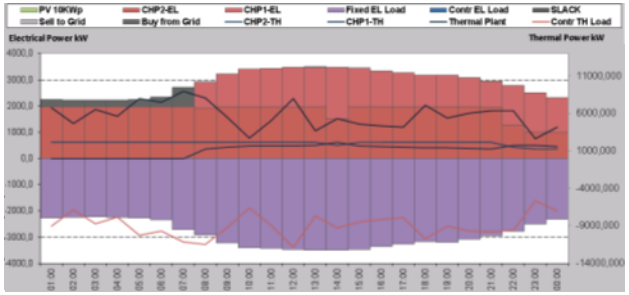
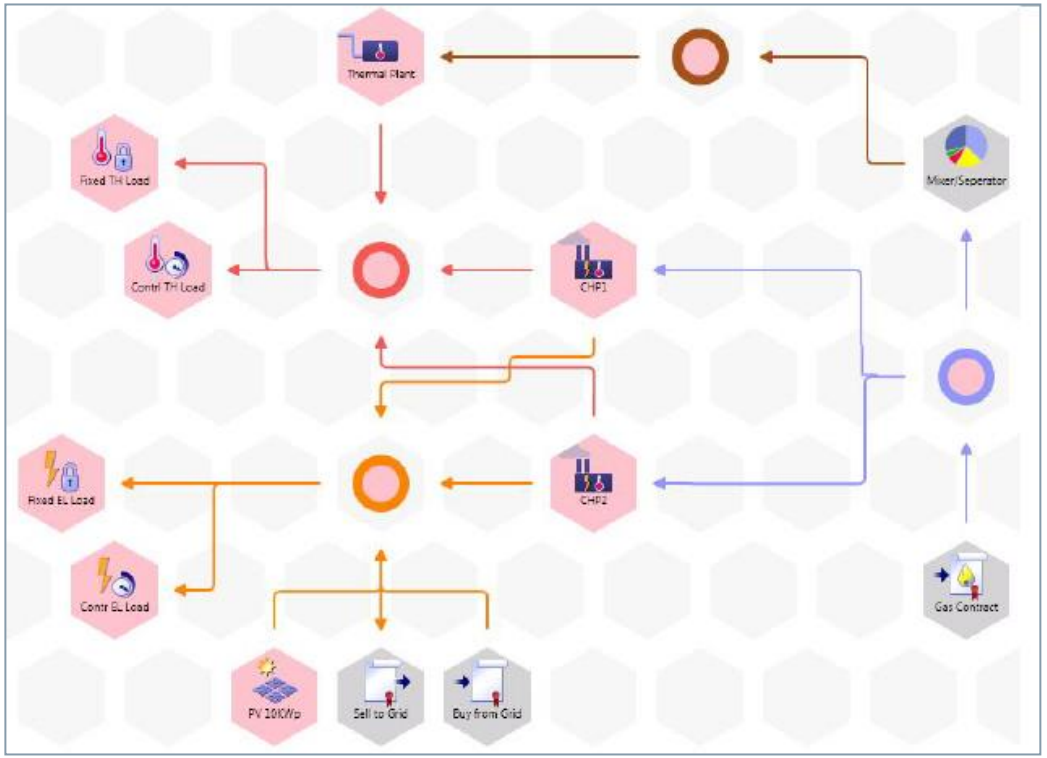


Scenario 3 – Microgrid optimization
Additional savings are made through optimizing energy intake from either CHPs or Grid with the MG manager.

Total cost: $2.0 million
Savings: $200K

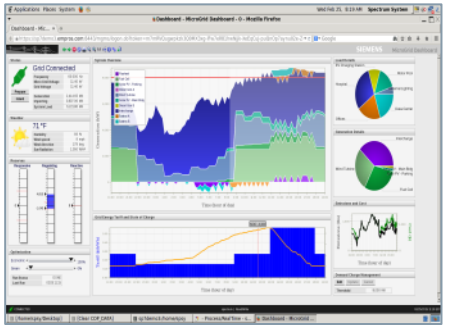


Successfully Leveraging the Microgrid Investment – via Advanced Software

- In alignment with the overall project goals, microgrid control software plays an important role:
  - Reducing energy consumption
  - Increasing operational economics
  - Maximizing energy efficiency

- Within the energy roadmap of the overall microgrid, the control software will seamlessly coordinate with:
  - Existing building automation system
  - Gas-powered CHP units
  - Gas-powered boiler

- Leverage modern software intelligence to ensure all project objectives are met now and into the campus's energy future



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