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PowerSim Modeling – Microgrid Example Problem

Fundamentals of Advanced Microgrid Evaluation, Analysis, and Conceptual Design (Consequence Modeling Module)

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U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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PowerSim Modeling – Microgrid Example Problem

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Outline of Presentation

- Simple basics
- Accessing Data Files – Connections
- Managing Input
  - Creating Switches
  - Creating Sliders
  - Creating Figures and Charts
- Model Creation
- Summary
- Question & Answer Session

Basics

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- PowerSim Studio
- Systems Dynamics Code
- Basic Building Blocks
  - Stocks - A stock is a generic symbol for anything that accumulates or drains. For example, water accumulates in your bathtub. At any point in time, the amount of water in the bathtub reflects the accumulation of what has flowed in from the faucet, minus what has flowed out down the drain. The amount of water in the bathtub is the stock of water.
  - Flows – A flow is the rate of change of a stock. In the bathtub example, the flows are the water coming into the bathtub through the faucet and the water leaving the bathtub through the drain.
  - Variables – Constants or auxiliaries are used to: calculate, make a model readable, prepare an interface.
  - Information Links – Connections/relationship between stocks, flows, and variables.

Basic Building Blocks

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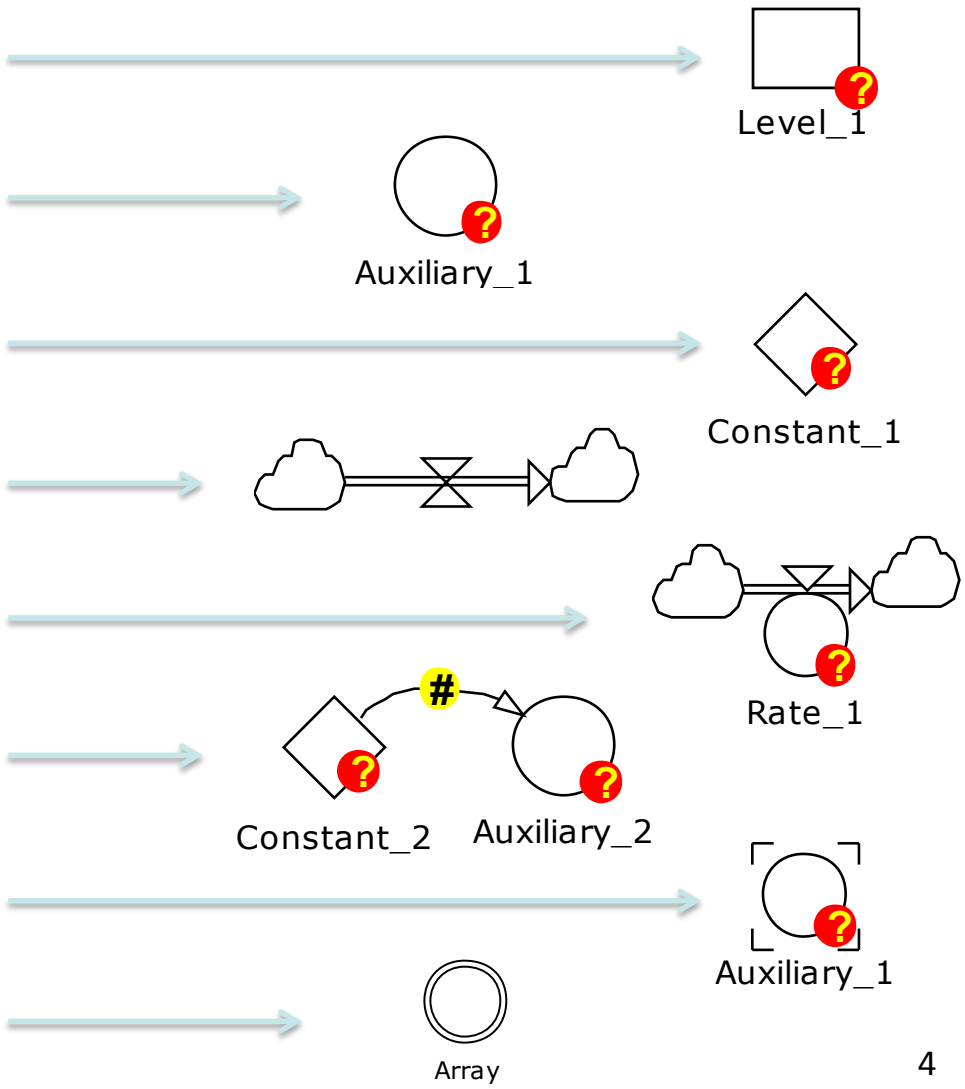
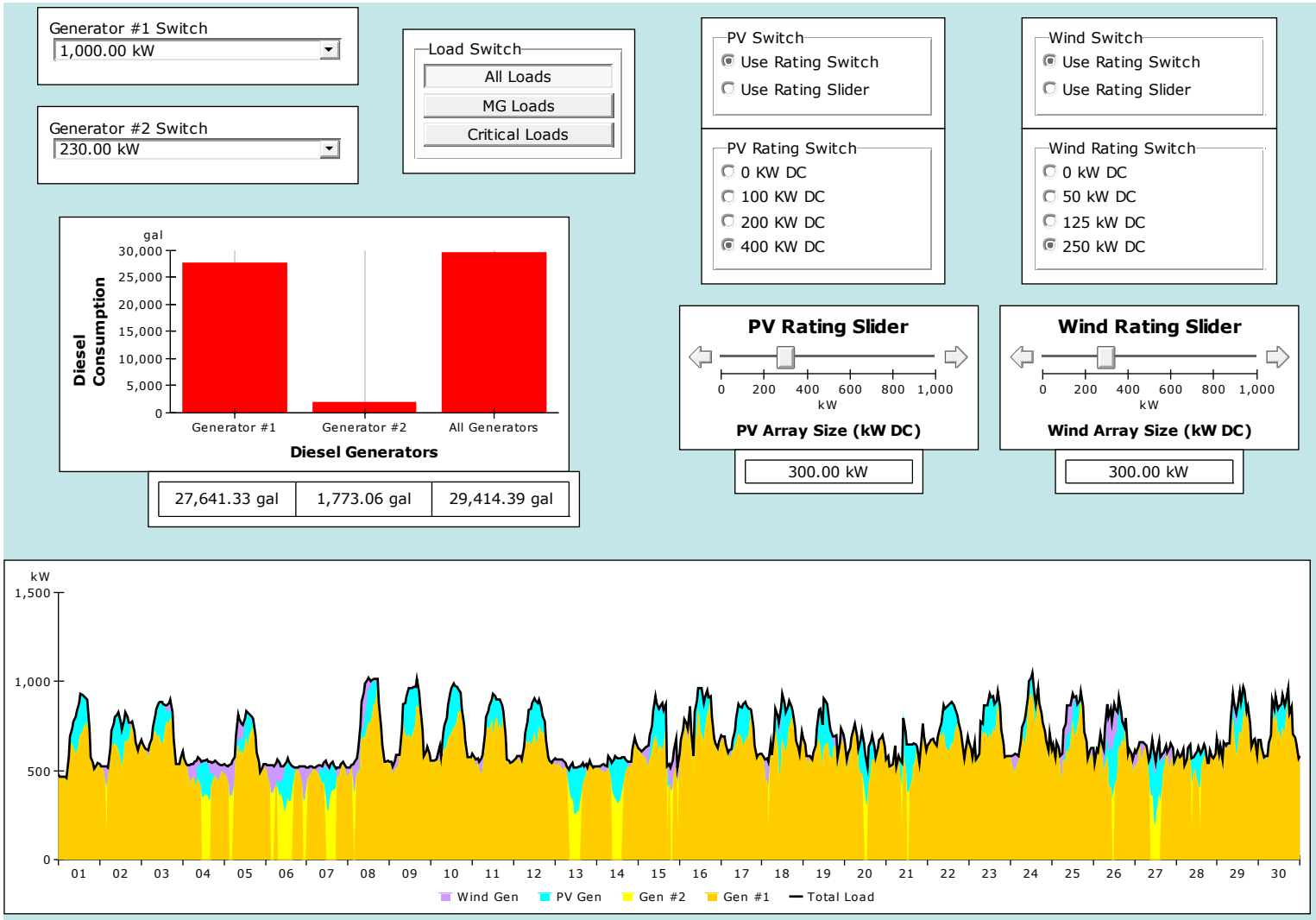
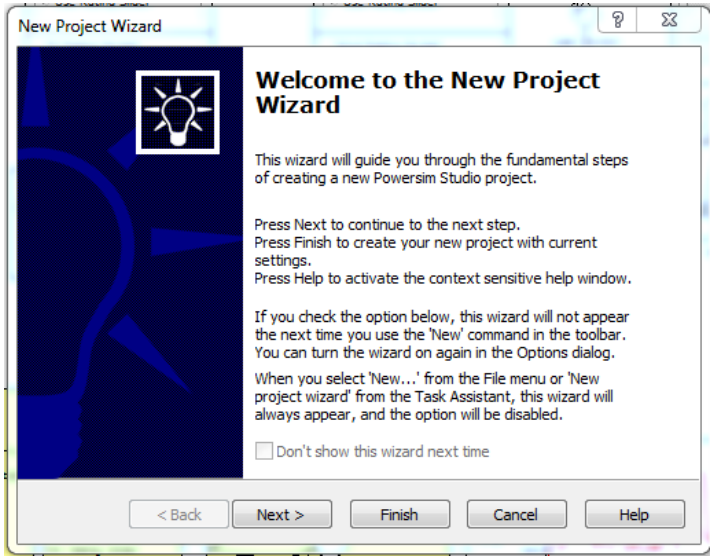
- Level (Stock)
- Auxiliary (Variable)
- Constant (Variable)
- Flow
- Flow w/ Rate
- Link
- Shortcut ("Alias")
- Arrays

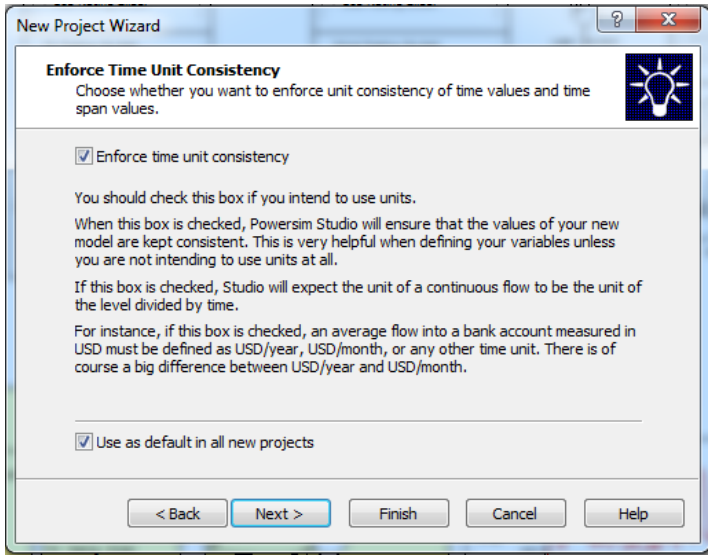


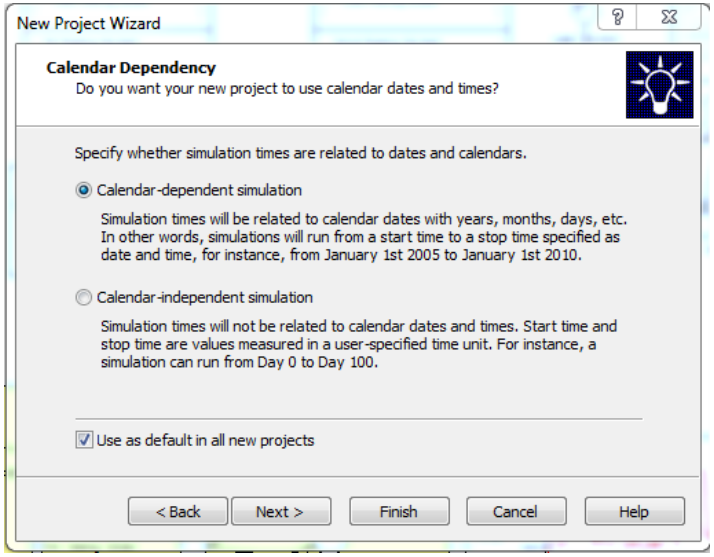
Example MG Model Output



Begin Model Building

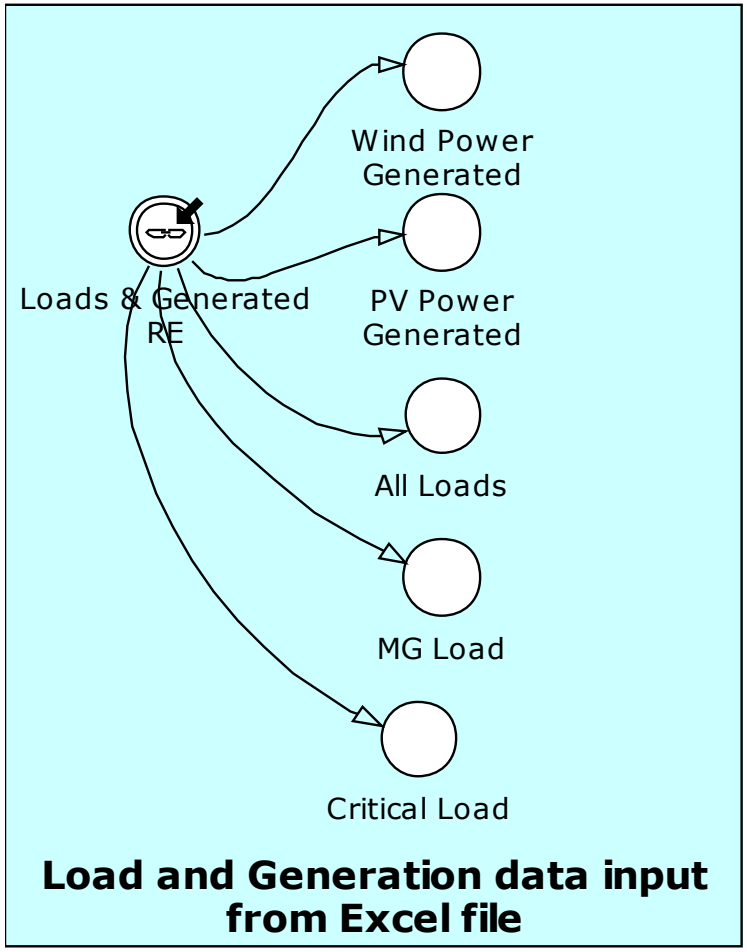






- New Model Wizard
- Step through Wizard

Accessing Data Files – Connections



- Create global dataset
- Add dataset
- Create auxilary
- Create connection
- Create simple reports/ figures

Dataset Creation

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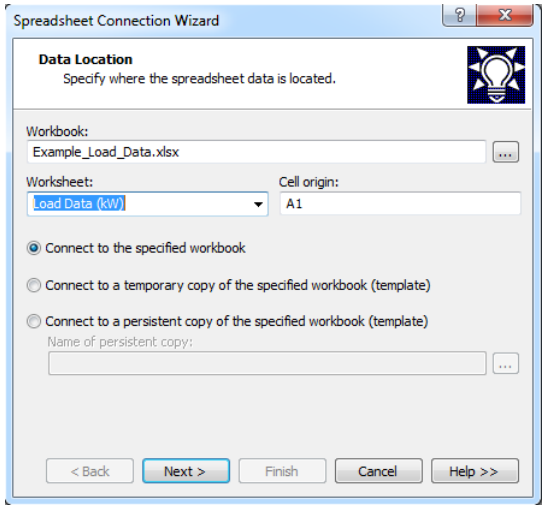
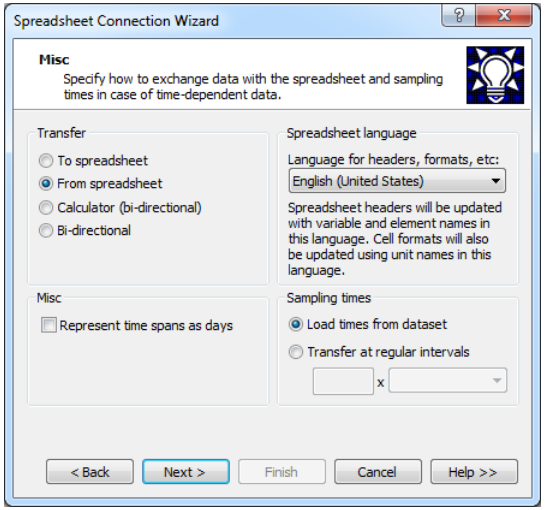
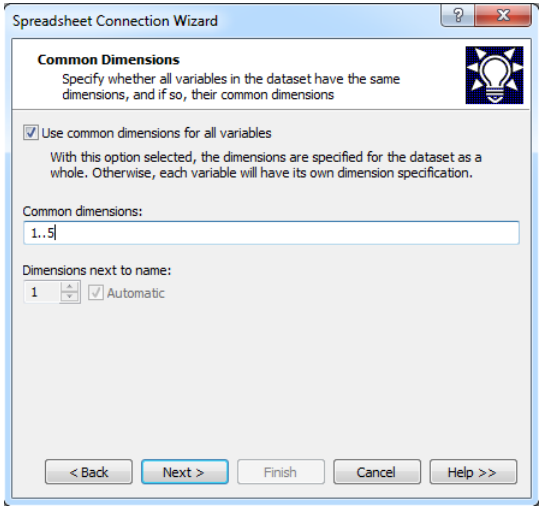
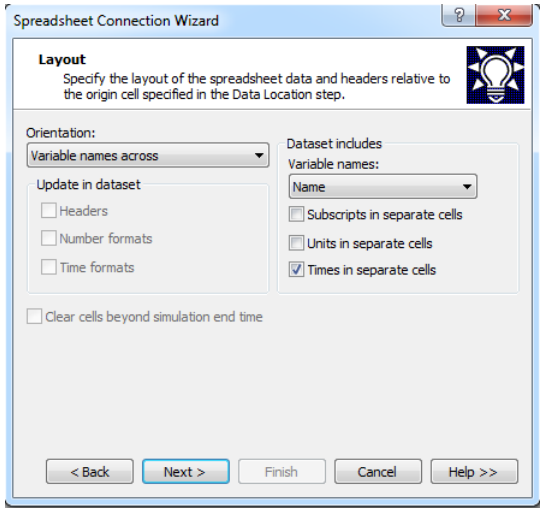
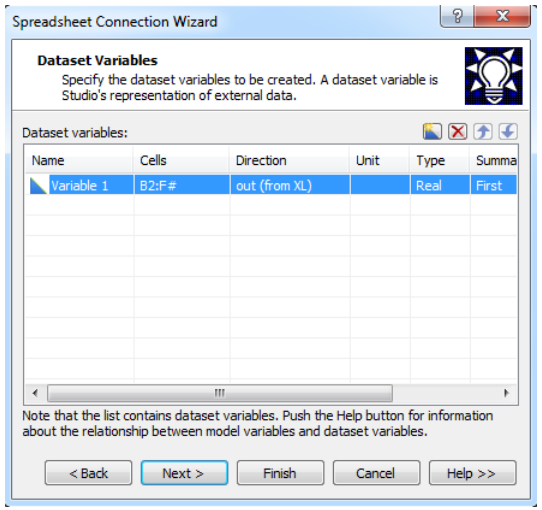
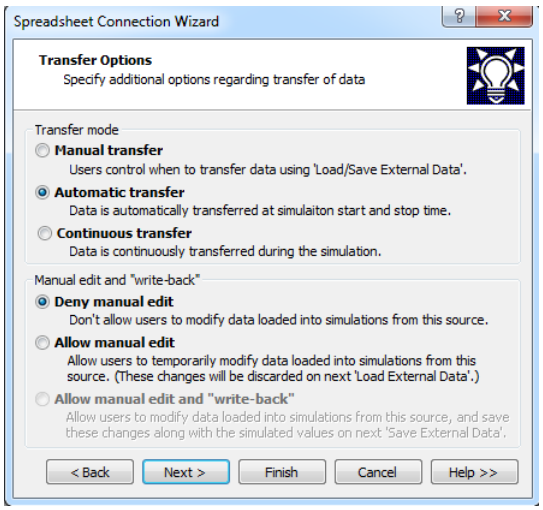




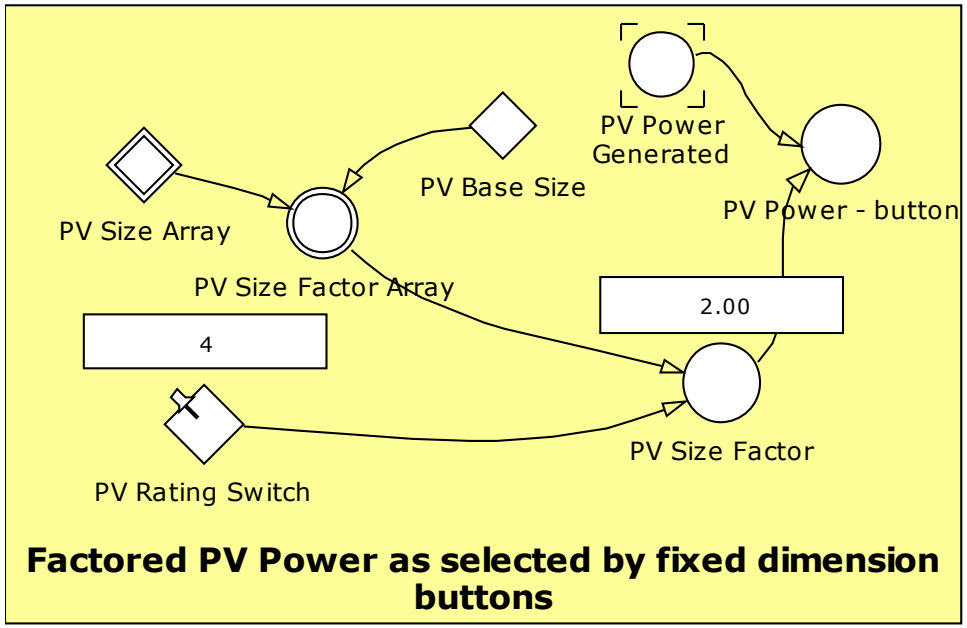




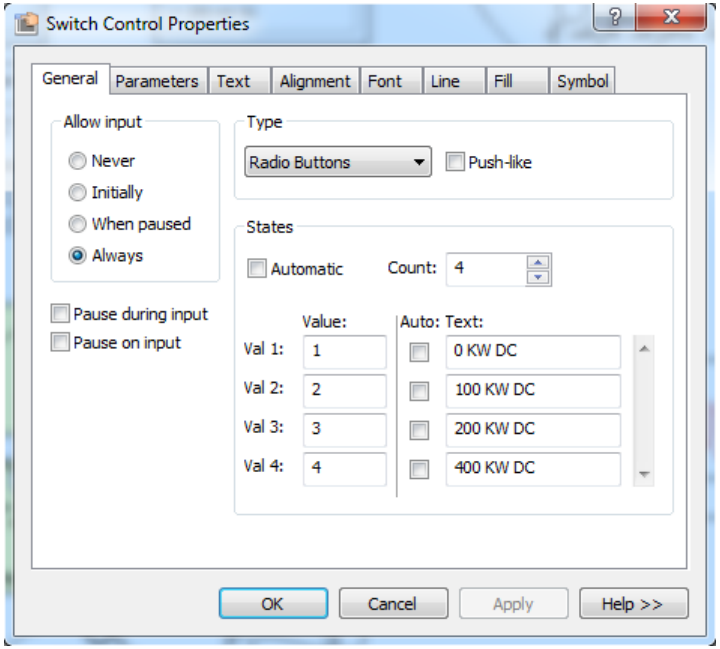


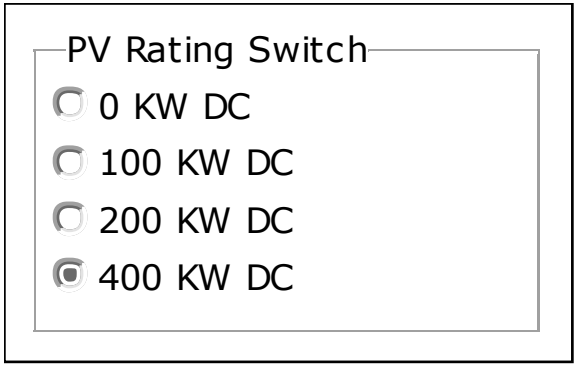


Creating Switches

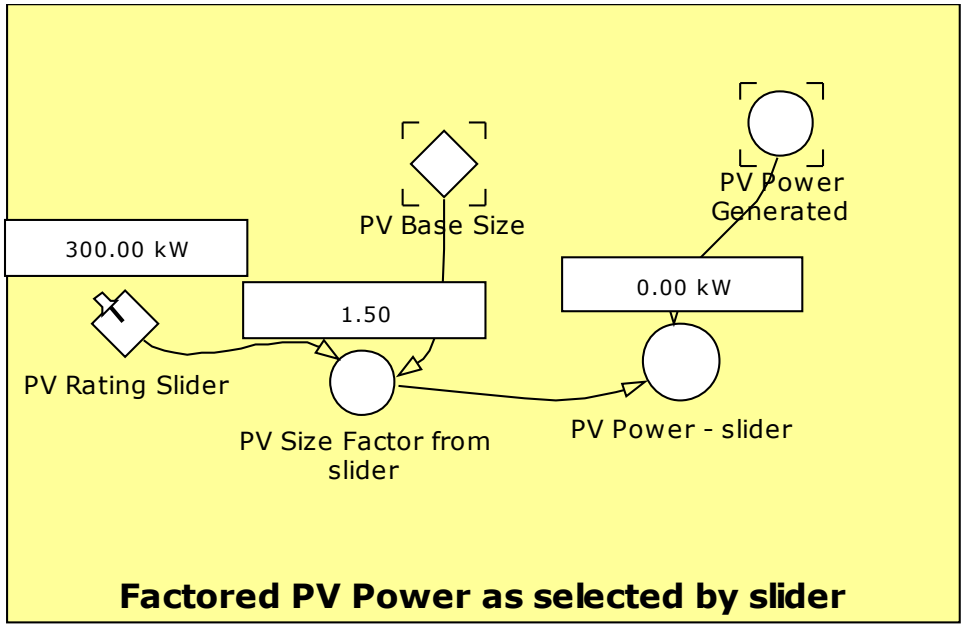


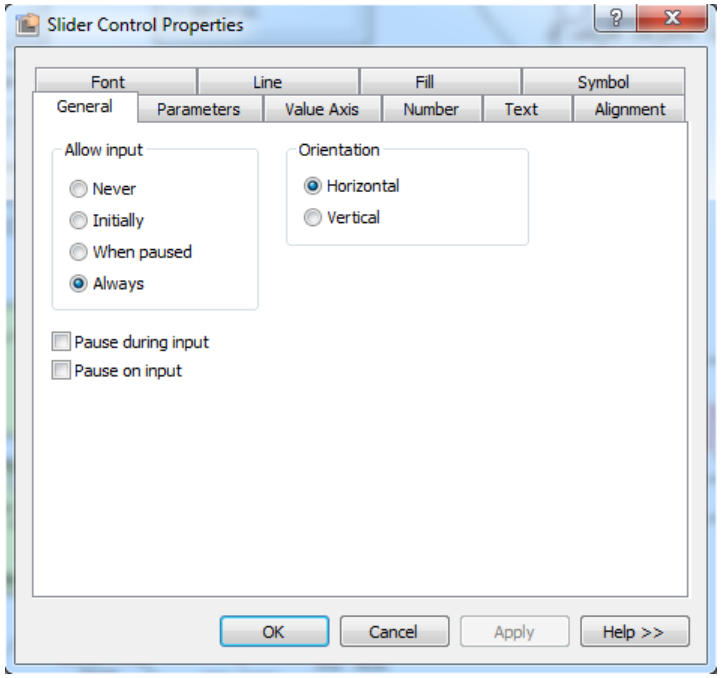
Factored PV Power as selected by fixed dimension buttons

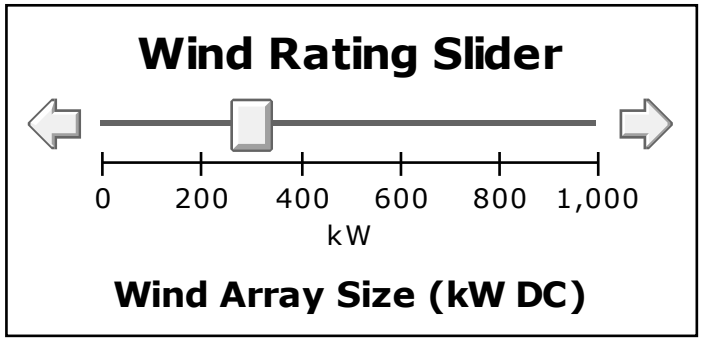




Creating Sliders

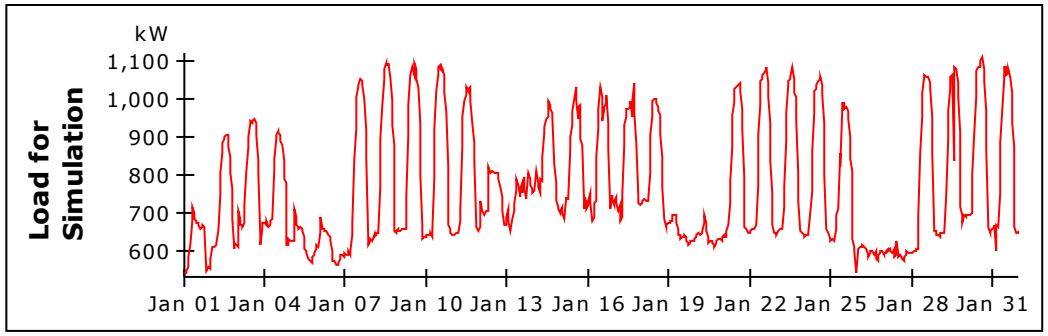


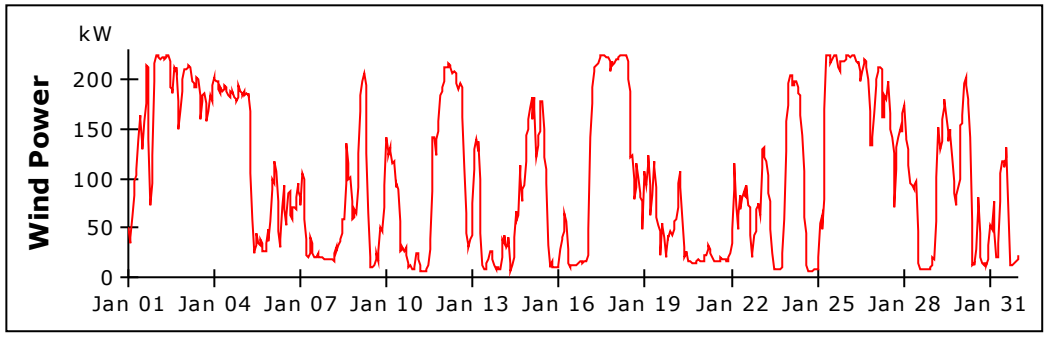


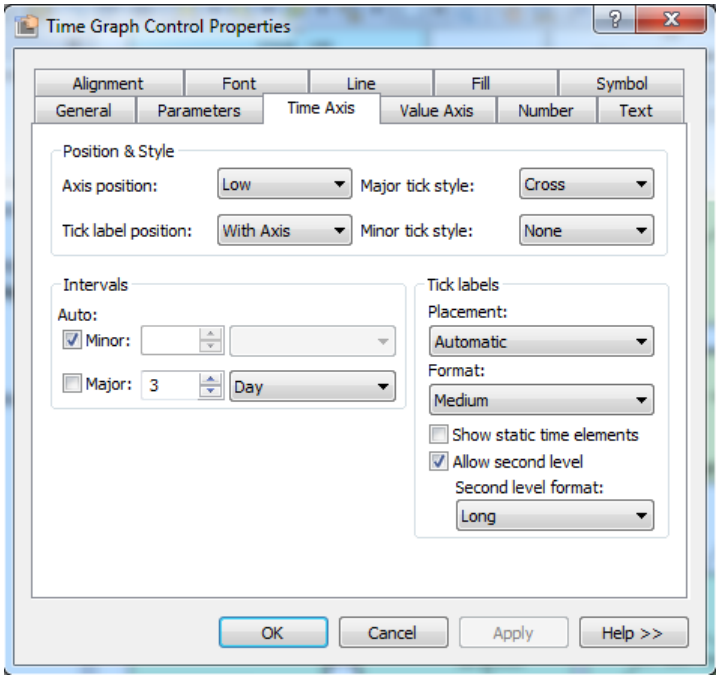


300.00 kW

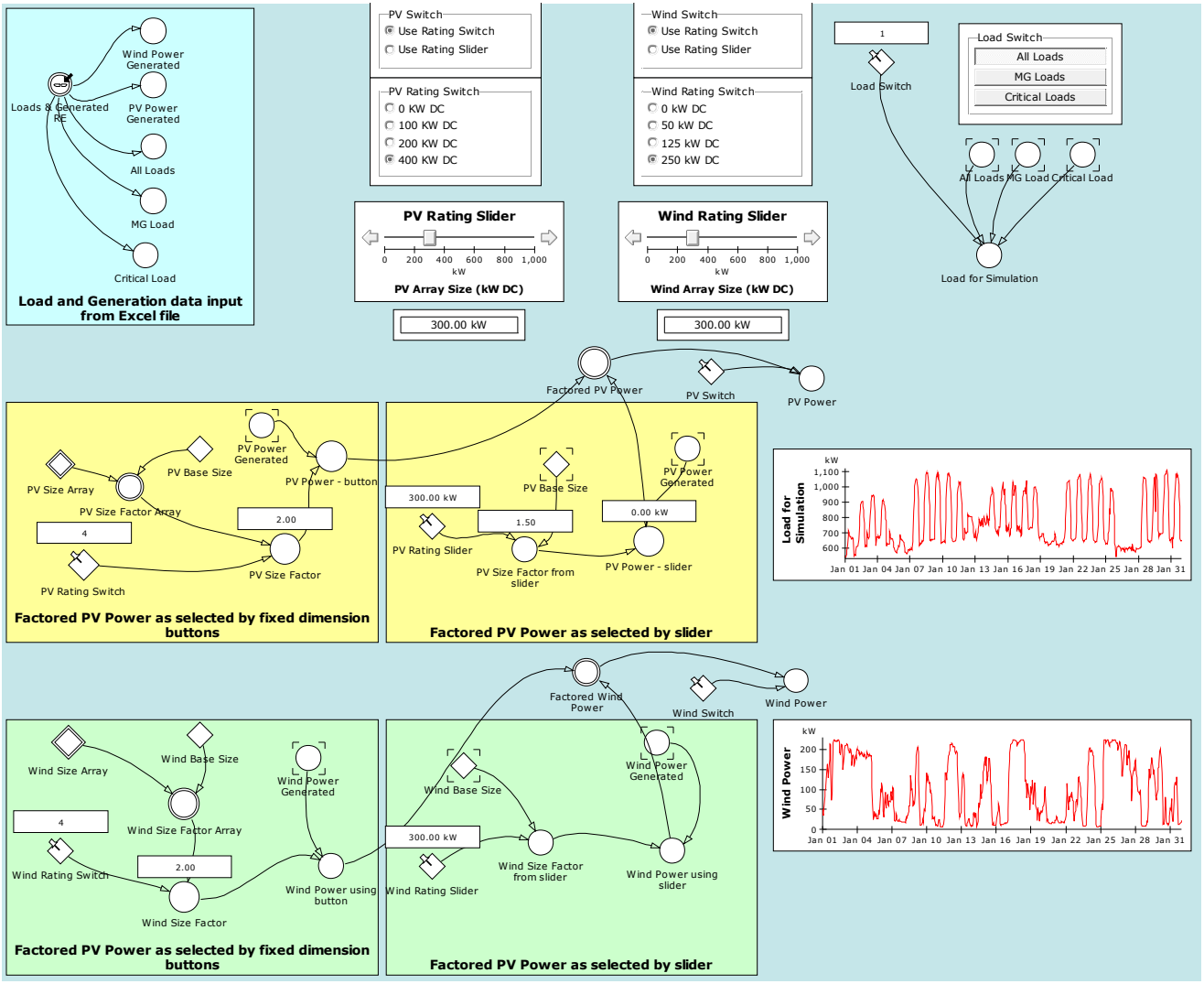
Creating Figures and Charts





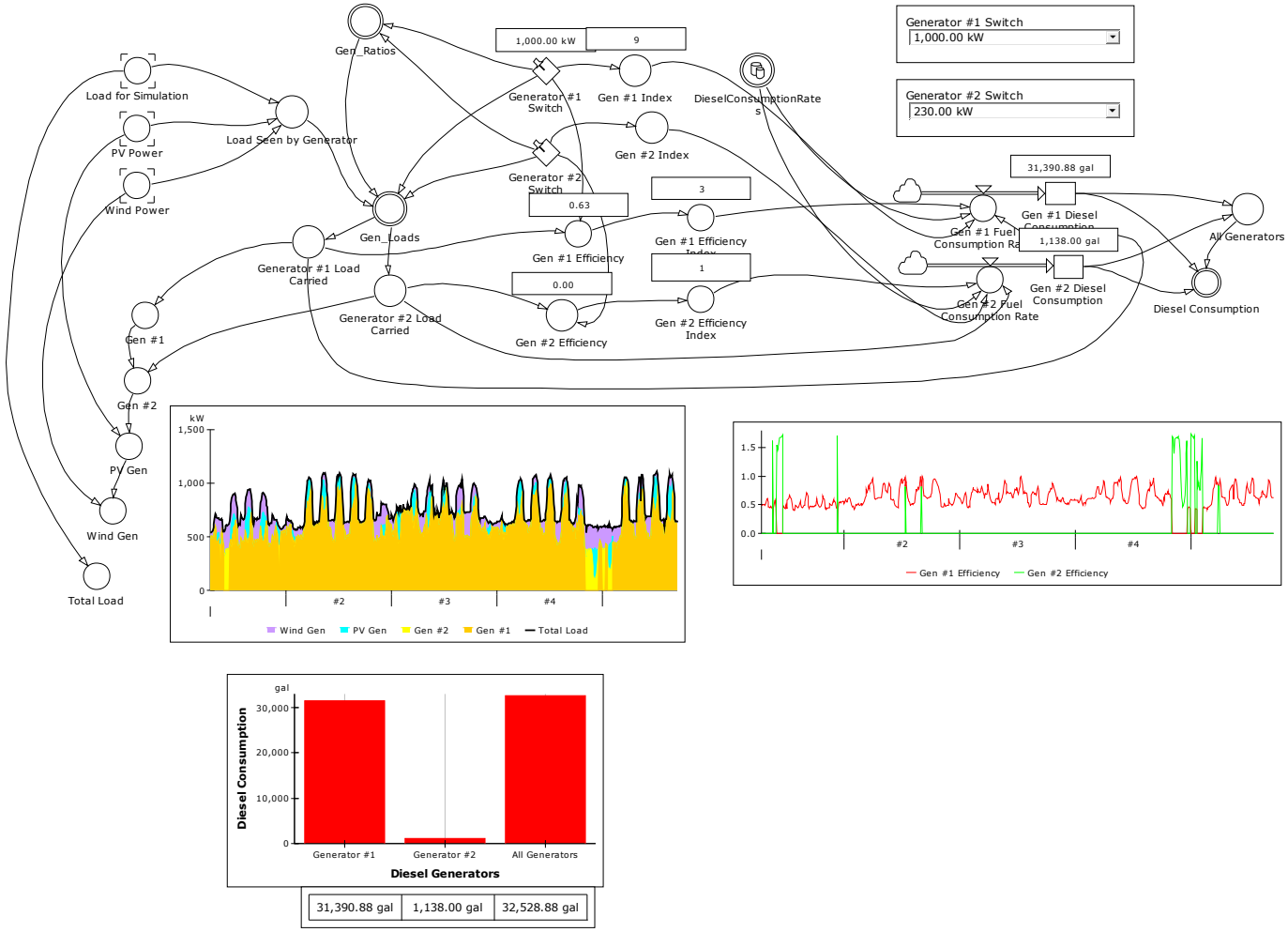


Model Creation



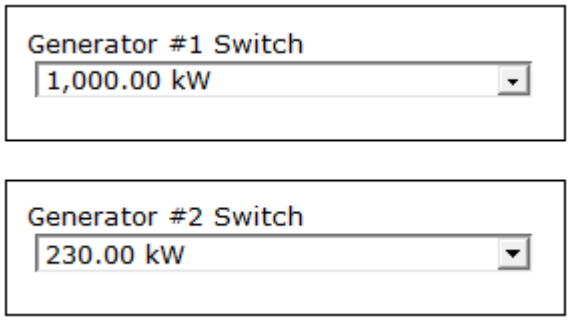
- Create input switches and slider for wind generation
- Create input switch for loads

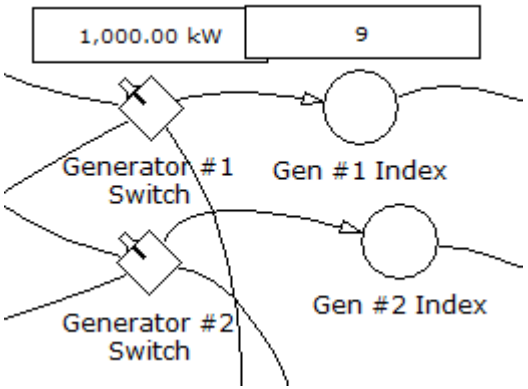
MG Model

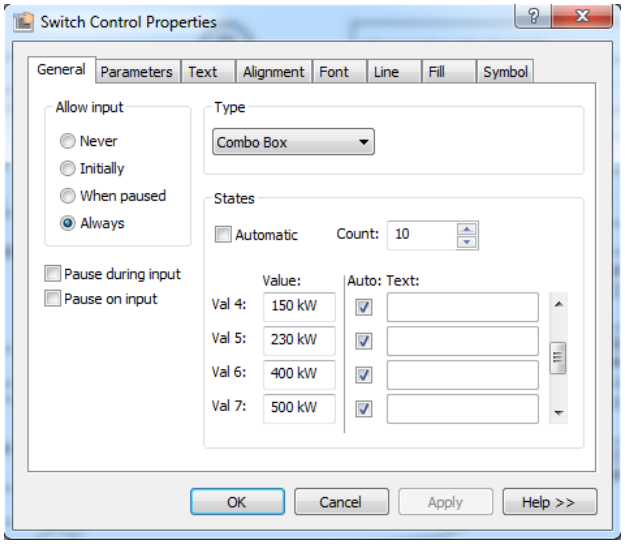

Gen_Ratios
1,000.00 kW
9
Generator #1 Switch
Gen #1 Index
DieselConsumptionRates
Generator #1 Switch
1,000.00 kW
Generator #2 Switch
230.00 kW
Load for Simulation
PV Power
Wind Power
Load Seen by Generator
Gen #2 Index
Generator #2 Switch
31,390.88 gal
3
0.63
Gen_Loads
Gen #1 Diesel Consumption
Gen #1 Fuel Consumption Rate
All Generators
Gen #1 Efficiency
Gen #1 Efficiency Index
1,138.00 gal
Generator #1 Load Carried
1
0.00
Gen #2 Diesel Consumption
Gen #2 Fuel Consumption Rate
Diesel Consumption
Generator #2 Load Carried
Gen #2 Efficiency
Gen #2 Efficiency Index
Gen #1
Gen #2
PV Gen
Wind Gen
Total Load
kW
1,500
1,000
500
0
#2
#3
#4
Wind Gen
PV Gen
Gen #2
Gen #1
Total Load
1.5
1.0
0.5
0.0
#2
#3
#4
Gen #1 Efficiency
Gen #2 Efficiency
gal
30,000
20,000
10,000
0
Diesel Consumption
Generator #1
Generator #2
All Generators
Diesel Generators
31,390.88 gal
1,138.00 gal
32,528.88 gal

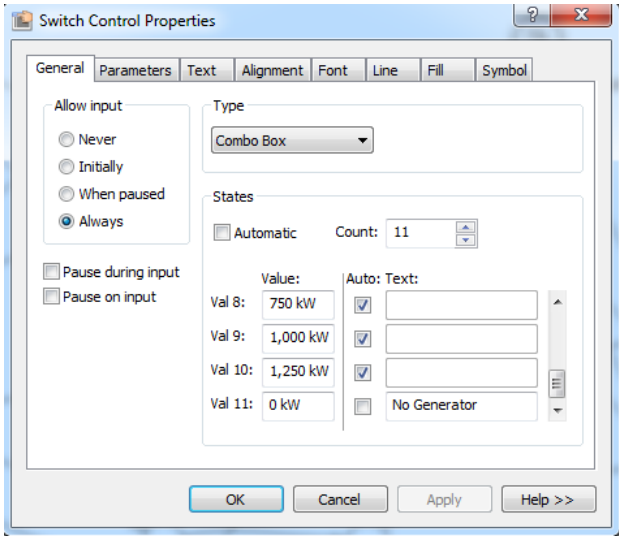
Generator Lists and Switches

- Include pull-down list

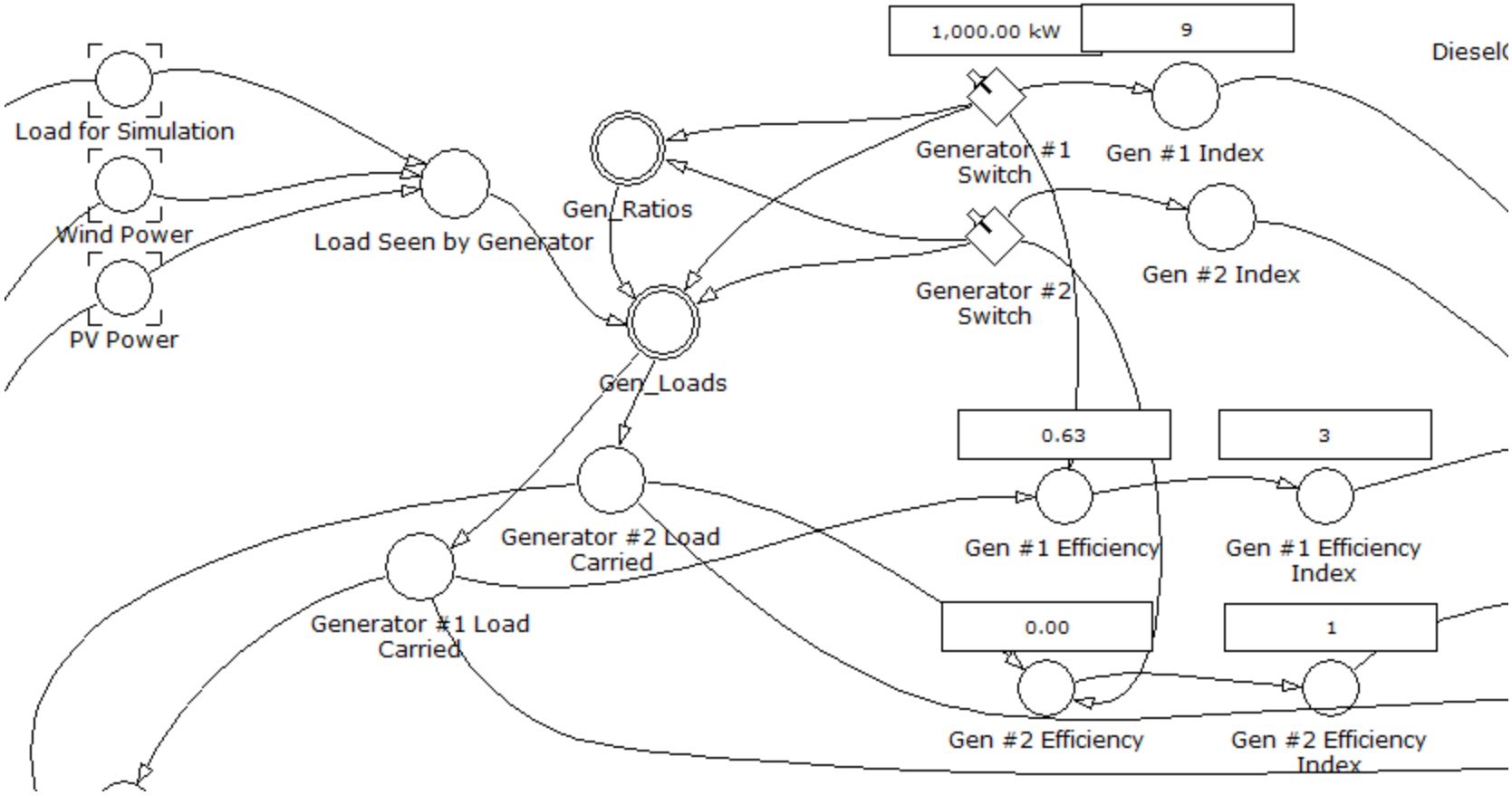




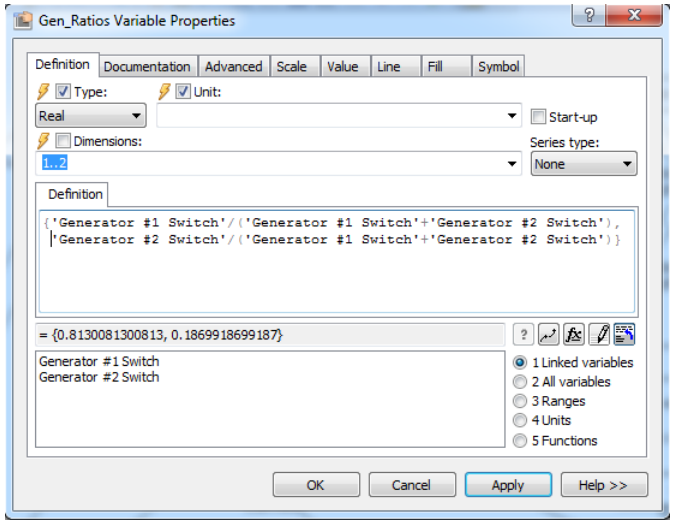


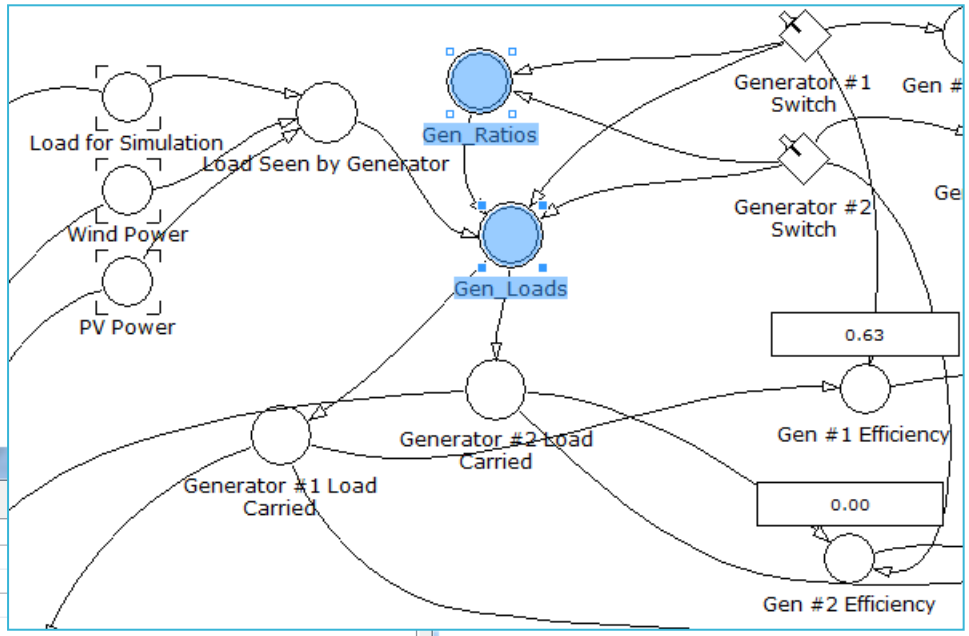


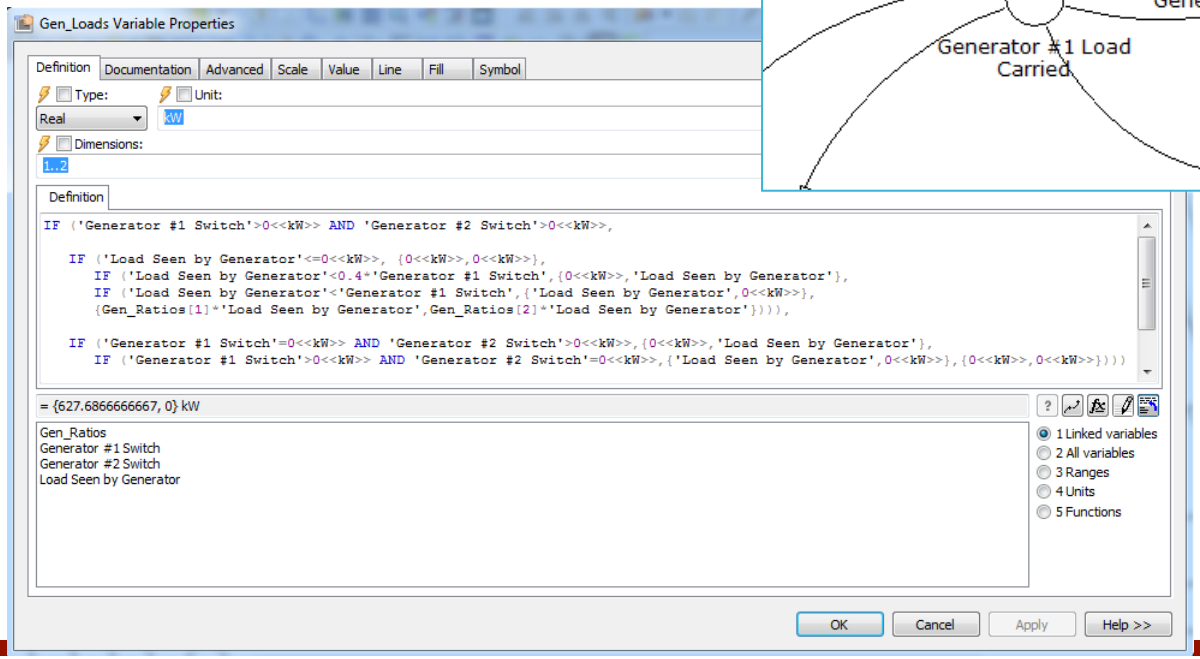
Load Model


1,000.00 kW
9
Diesel(
Load for Simulation
Wind Power
PV Power
Load Seen by Generator
Gen_Ratios
Generator #1 Switch
Gen #1 Index
Generator #2 Switch
Gen #2 Index
Gen_Loads
0.63
3
Generator #2 Load Carried
Gen #1 Efficiency
Gen #1 Efficiency Index
Generator #1 Load Carried
0.00
1
Gen #2 Efficiency
Gen #2 Efficiency Index

Generator Loads

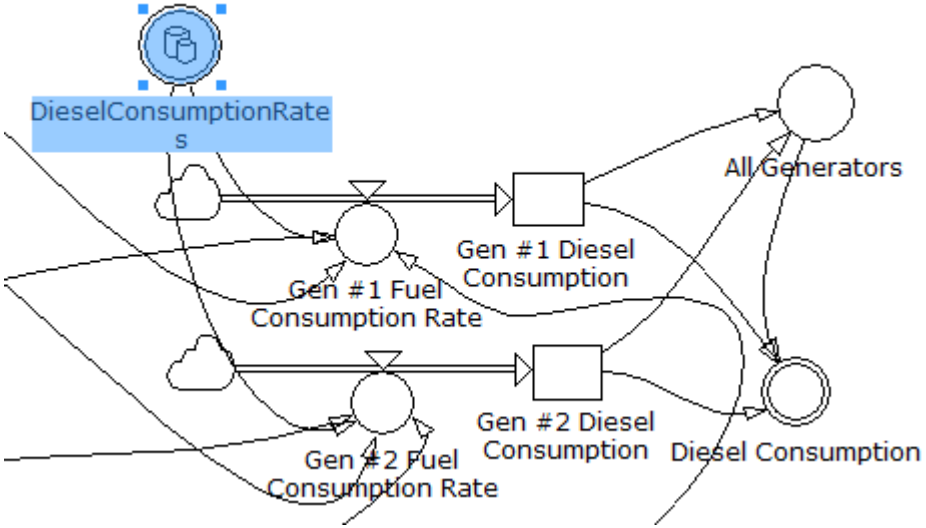


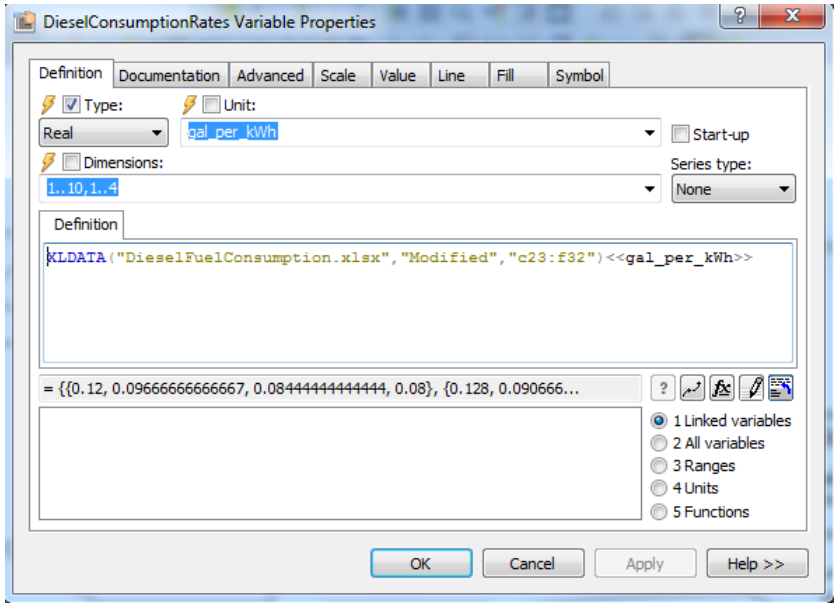




Diesel Consumption Rate

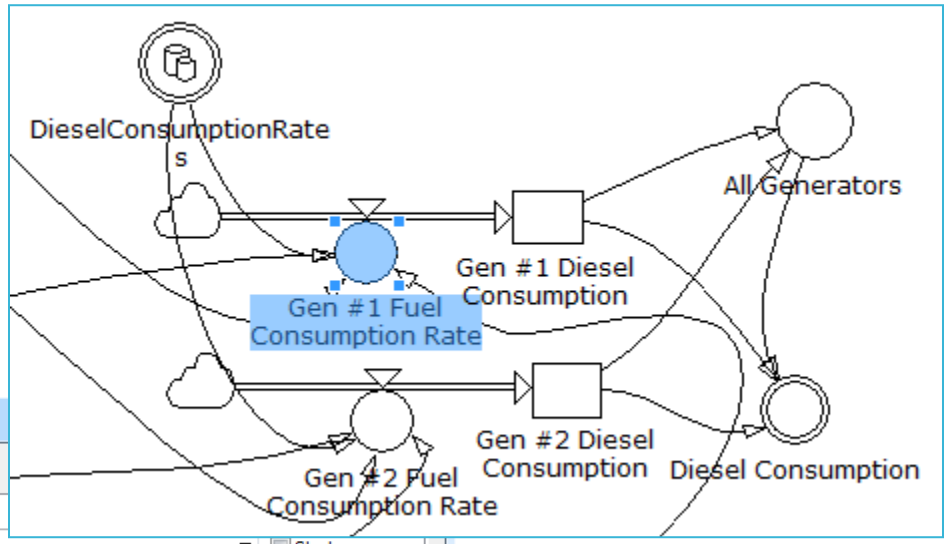
- Adding time independent dataset using direct call to EXCEL file
- Create array variable

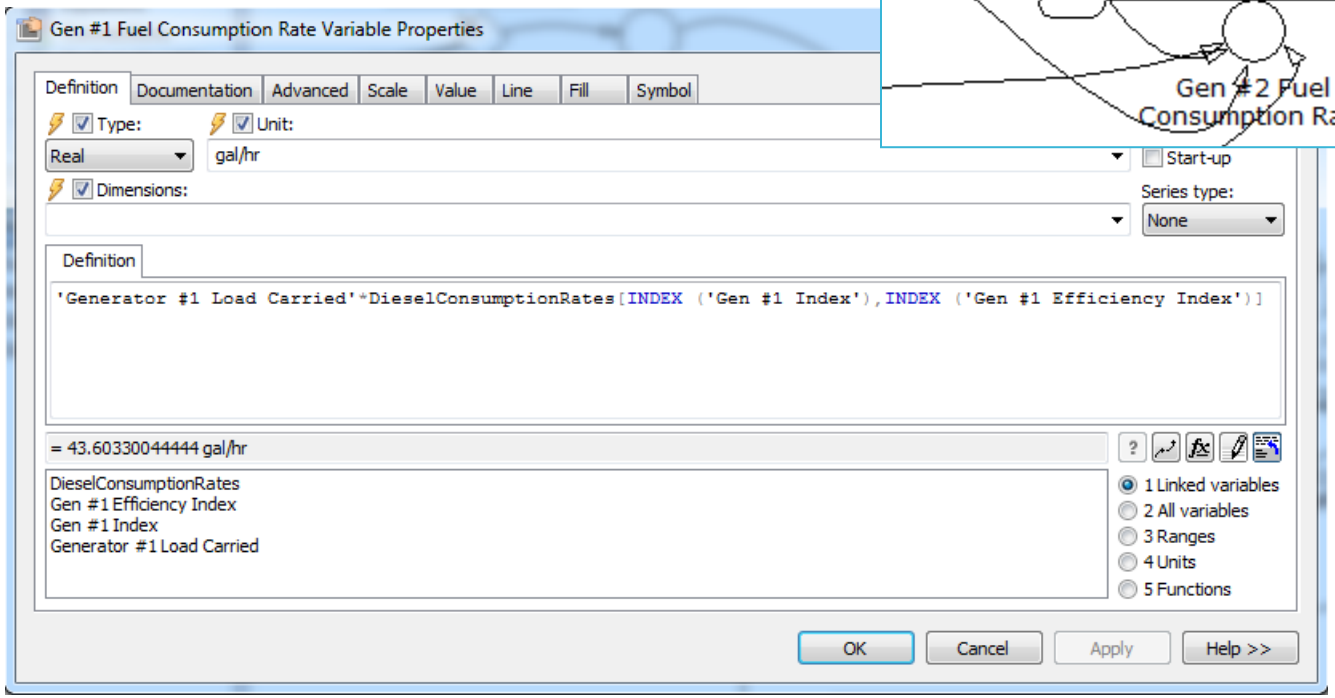




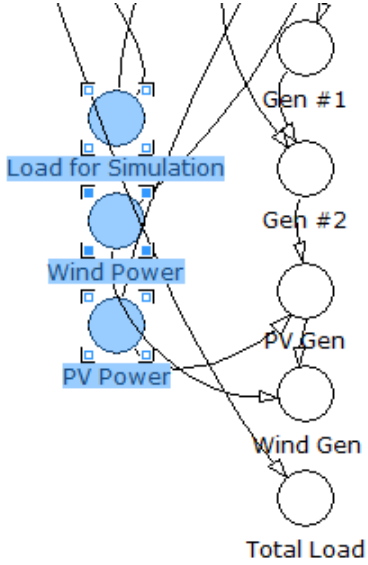
Diesel Consumption

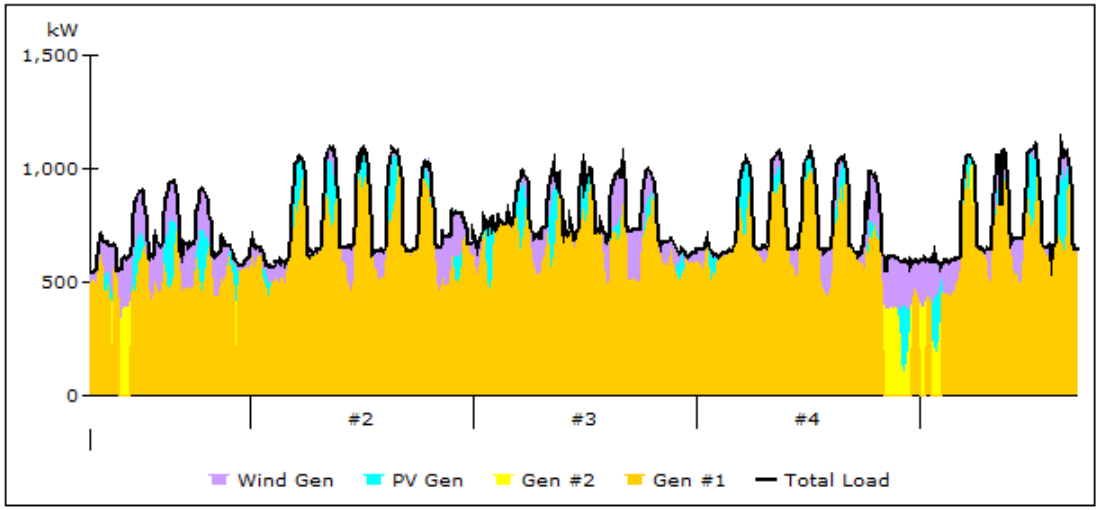
- Link diesel consumption rate to a flow w/ rate to calculate total consumption

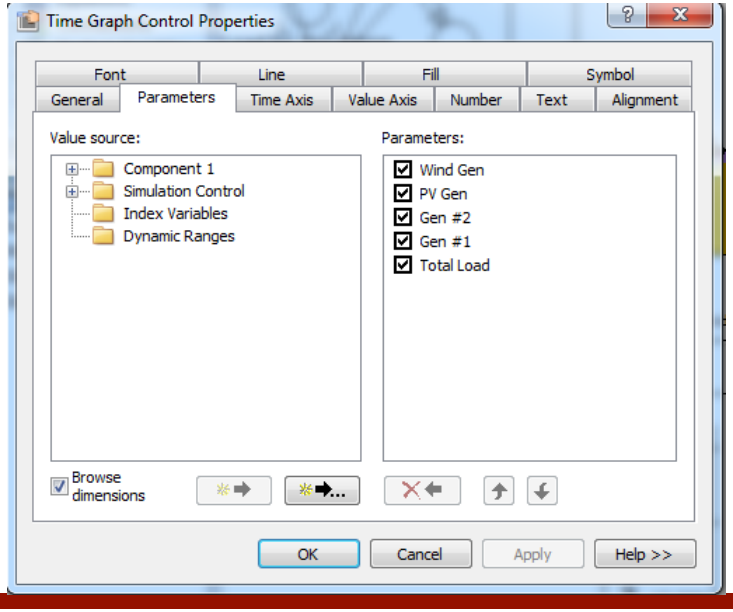


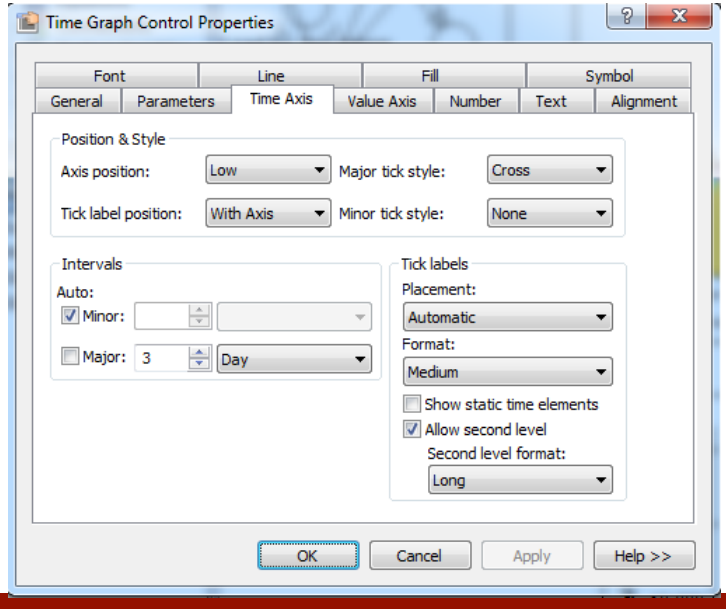


Create Output Figure



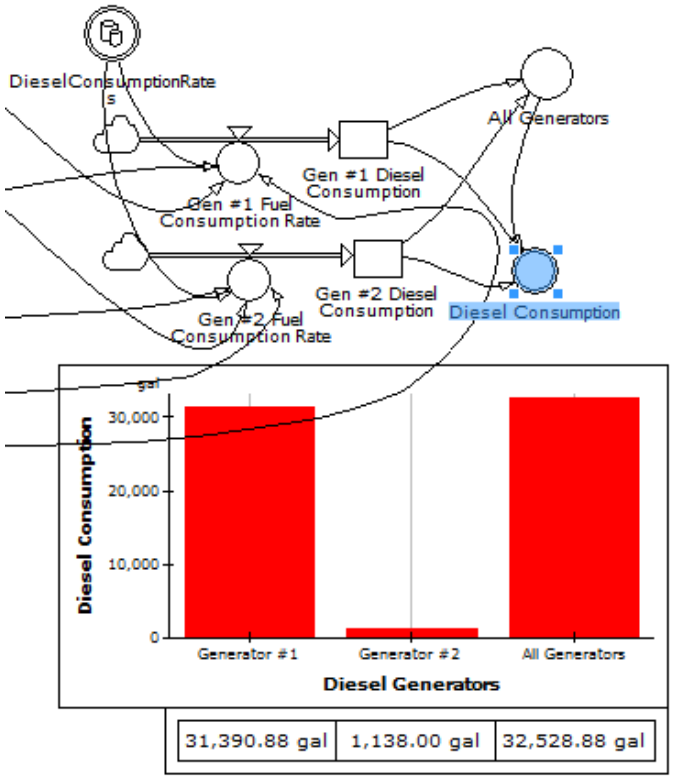


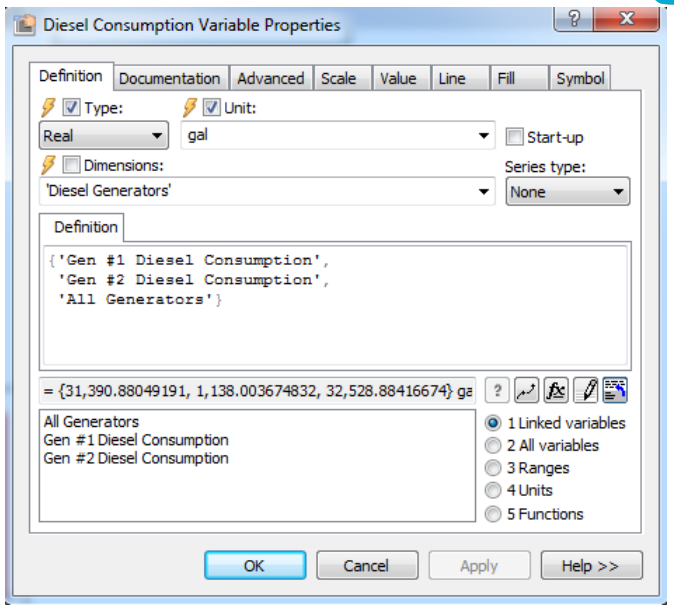


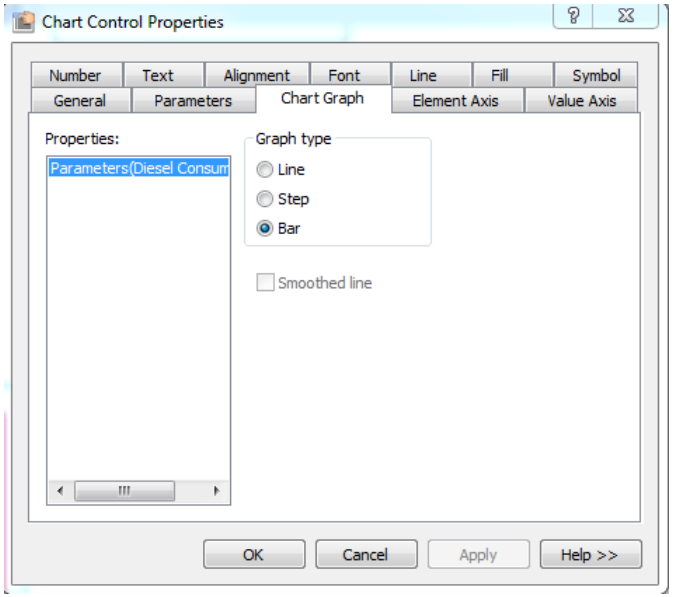


Create Bar Graph

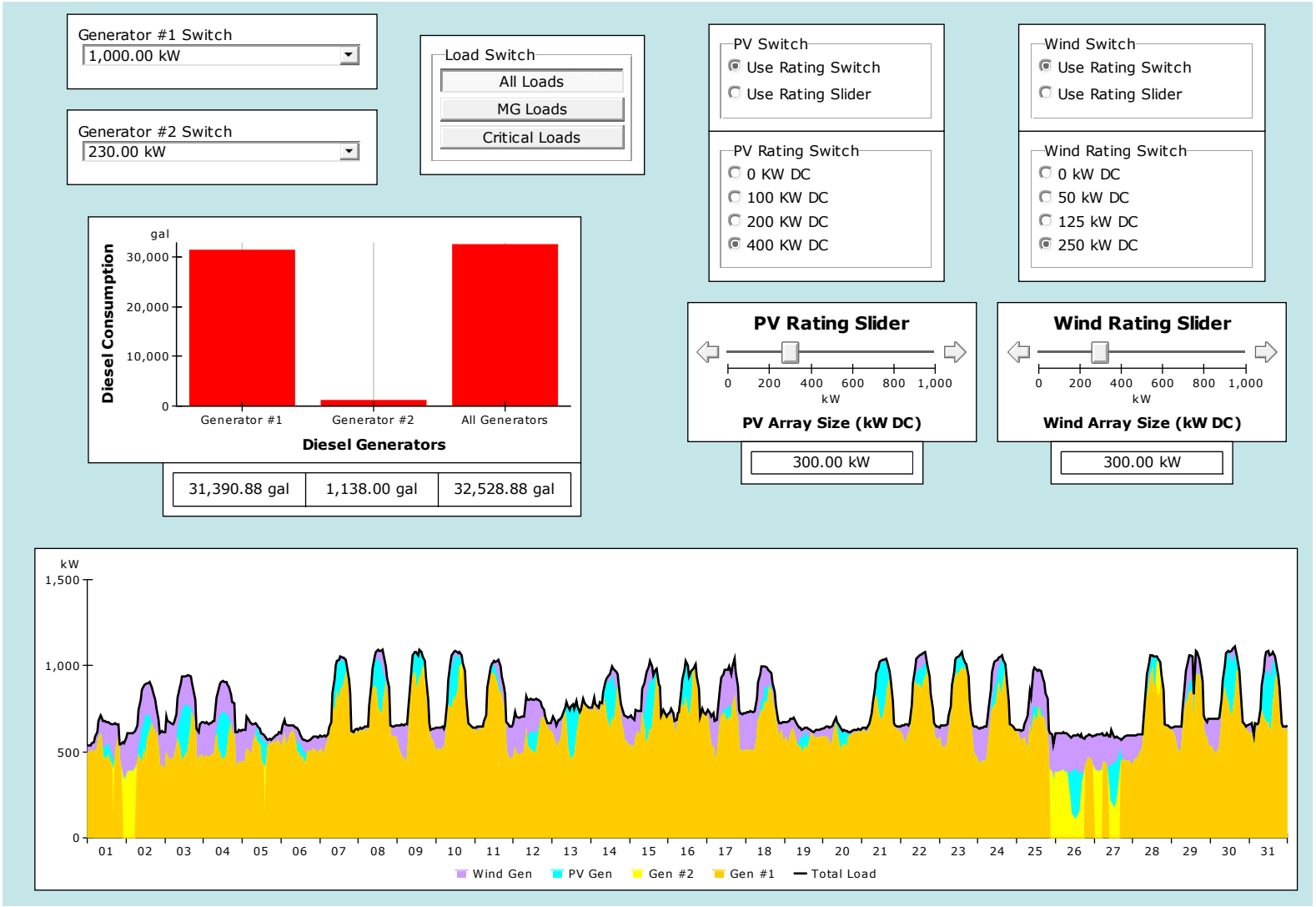
- Create array of “Diesel Consumption”
- Create bar graph of array







Create Input/Output Diagram



PowerSim Modeling – Microgrid Example Problem

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QUESTIONS & ANSWERS

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