



Welcome!

Webinar #5. TIME and Annual model

July 12, 2017

Host: Meritt Elmasri (US office)

Presenter: Evgeny Zakharenkov

Agenda

- Introduction
- Snapshot
- Annual model
- What is TIME, when to use TIME
- TIME, power plant sample
- Q & A session

Introduction

Heat balance & equipment design



Cost & labour estimation



Cashflow & investment analysis



Thermoflow
software

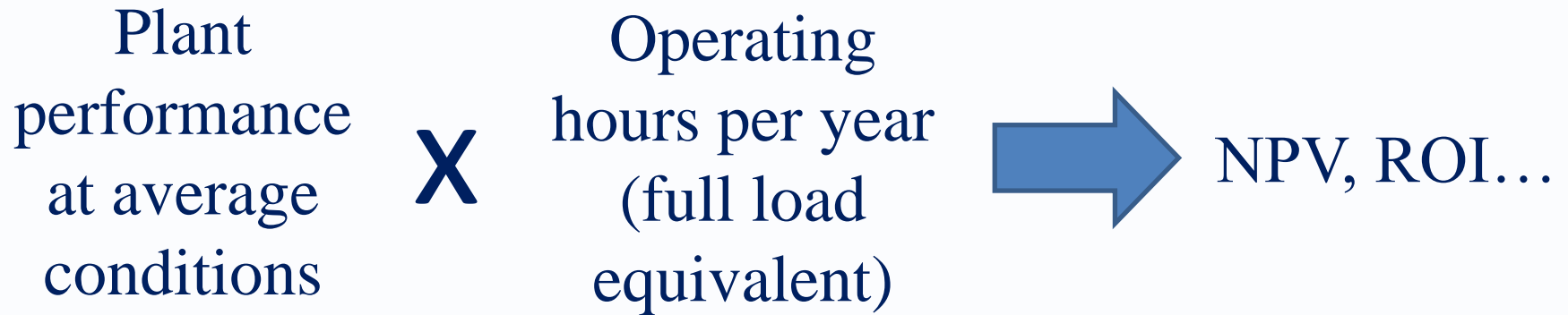
Introduction

Thermodflow Features for Cashflow & Investment Analysis

- Snapshot (GT PRO/MASTER, STEAM PRO/MASTER, THERMOFLEX)
- Annual model (GT PRO/MASTER, STEAM PRO/MASTER)
- TIME - Time Integrated Modeling Economics (GT MASTER)

Snapshot

Snapshot - multiplying plant performance at the average ambient conditions by the number of operating hours per year



Snapshot

- Start Design
- Plant Criteria
- GT Selection
- GT Inputs
- ST-HRSG
- HRSG Inputs
- Water Circuits
- HRSG Layout
- Cooling System
- ST Inputs
- Environment
- Other PEACE
- Economics**
- Gasification
- Desalination
- Compute**

Cashflow Method

Nameplate Data (One representative snapshot)

Annual Model (Multiple GTM runs)

This cashflow calculation is based on current operating condition representative of the plant's annual average.

Import selected Economics menu inputs from another file...

My Plant

<p style="color: red;">GT fuel LHV price</p> <p><input type="text" value="5.687"/> USD/GJ</p> <p style="color: red;">Duct burner fuel LHV price</p> <p><input type="text" value="5.687"/> USD/GJ</p>	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 60%;">First year of plant operation</td><td style="width: 20%;"><input type="text" value="2018"/></td><td style="width: 20%;"></td></tr> <tr><td>Project life in years</td><td><input type="text" value="20"/></td><td></td></tr> <tr><td>Operating hours per year (full-load equivalent)</td><td><input type="text" value="6570"/></td><td></td></tr> <tr><td style="color: magenta;">Straight line depreciation life in years (enter 0 for variable depreciation)</td><td><input type="text" value="15"/></td><td></td></tr> <tr><td style="color: magenta;">Depreciable percentage of total investment</td><td><input type="text" value="90"/></td><td style="text-align: right;">%</td></tr> <tr><td>Debt term in years</td><td><input type="text" value="15"/></td><td></td></tr> <tr><td style="color: magenta;">Debt percentage of total investment</td><td><input type="text" value="70"/></td><td style="text-align: right;">%</td></tr> <tr><td style="color: magenta;">Debt interest rate</td><td><input type="text" value="7"/></td><td style="text-align: right;">%</td></tr> <tr><td>Overall tax rate</td><td><input type="text" value="35"/></td><td style="text-align: right;">%</td></tr> <tr><td>Discount rate for NPV calculation</td><td><input type="text" value="10"/></td><td style="text-align: right;">%</td></tr> </table>	First year of plant operation	<input type="text" value="2018"/>		Project life in years	<input type="text" value="20"/>		Operating hours per year (full-load equivalent)	<input type="text" value="6570"/>		Straight line depreciation life in years (enter 0 for variable depreciation)	<input type="text" value="15"/>		Depreciable percentage of total investment	<input type="text" value="90"/>	%	Debt term in years	<input type="text" value="15"/>		Debt percentage of total investment	<input type="text" value="70"/>	%	Debt interest rate	<input type="text" value="7"/>	%	Overall tax rate	<input type="text" value="35"/>	%	Discount rate for NPV calculation	<input type="text" value="10"/>	%	<p style="color: green;">Electricity price</p> <p><input type="text" value="0.065"/> USD/kWhr</p> <p style="color: green;">Heat export price</p> <p><input type="text" value="4.739"/> USD/GJ</p> <p style="color: green;">Capacity income, USD per net kW per year</p> <p><input type="text" value="0"/> USD</p>
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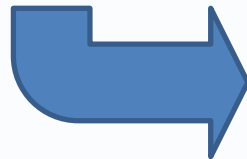
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- quick analysis
- plant operated mainly at base load
- low range of ambient conditions

Snapshot

But, it does not work when:

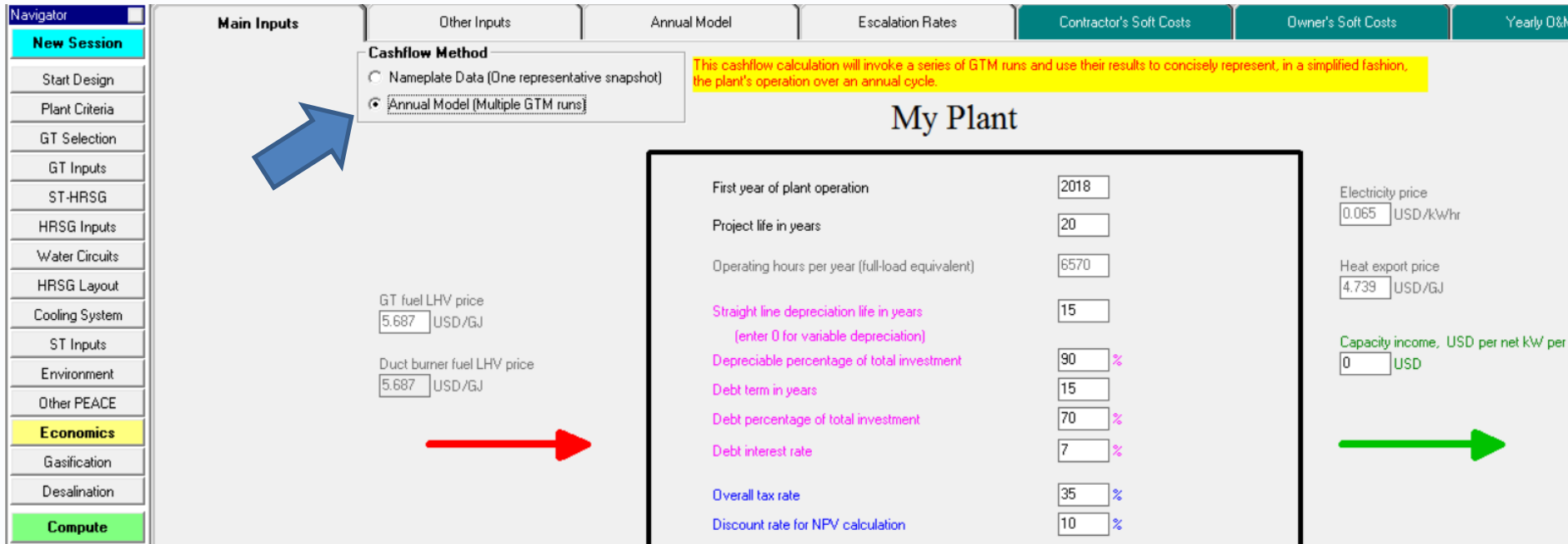
- The plant is started and stopped every day or several times per week
- Duct firing is used to generate more power when the power price is high
- The plant supplies steam to variable demand customer
- ...



Annual model or TIME

Annual model

Annual model is simple, quick and easy method for users who have no time to perform an exhaustive analysis, but who still wish to have a more accurate model, than may be possible with a single point average input (snapshot)



Navigator

- New Session
- Start Design
- Plant Criteria
- GT Selection
- GT Inputs
- ST-HRSG
- HRSG Inputs
- Water Circuits
- HRSG Layout
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Main Inputs

Cashflow Method

- Nameplate Data (One representative snapshot)
- Annual Model (Multiple GTM runs)

This cashflow calculation will invoke a series of GTM runs and use their results to concisely represent, in a simplified fashion, the plant's operation over an annual cycle.

My Plant

First year of plant operation	2018	Electricity price	0.065 USD/kWh
Project life in years	20	Heat export price	4.739 USD/GJ
Operating hours per year (full-load equivalent)	6570	Capacity income, USD per net kW per	0 USD
Straight line depreciation life in years (enter 0 for variable depreciation)	15		
Debt term in years	15		
Debt percentage of total investment	90 %		
Debt interest rate	7 %		
Overall tax rate	35 %		
Discount rate for NPV calculation	10 %		

GT fuel LHV price: 5.687 USD/GJ

Duct burner fuel LHV price: 5.687 USD/GJ

Annual model

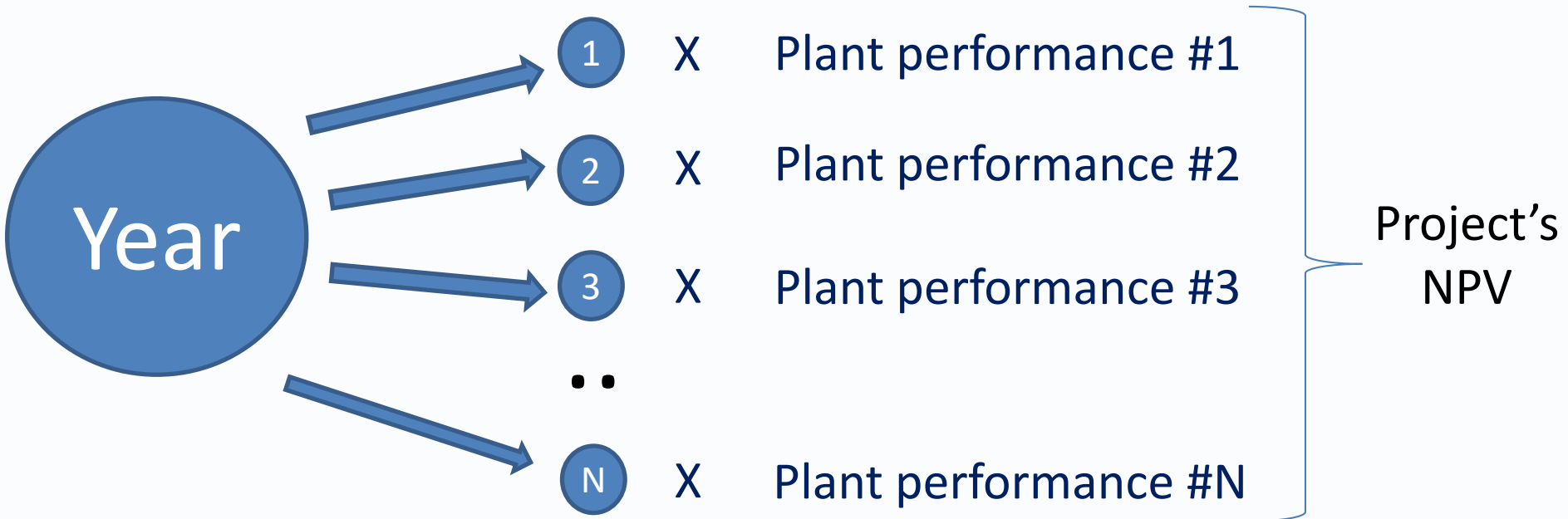
Navigator	Main Inputs	Other Inputs	Annual Model	Escalation Rates	Contractor's Soft Costs	Owner's Soft Costs	Yearly O&M Costs	User-defined Costs																																																																																																		
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TIME

- Tool for GT MASTER (added in version TF24), **Time Integrated Modeling Economics (TIME)**
- It is used when you want to compute plant economics and performance by combining results from a single model at different operating conditions, each applied for a specified period of time.
- TIME helps to compute project's NPV when running with ambient conditions and loads that vary naturally throughout the year.

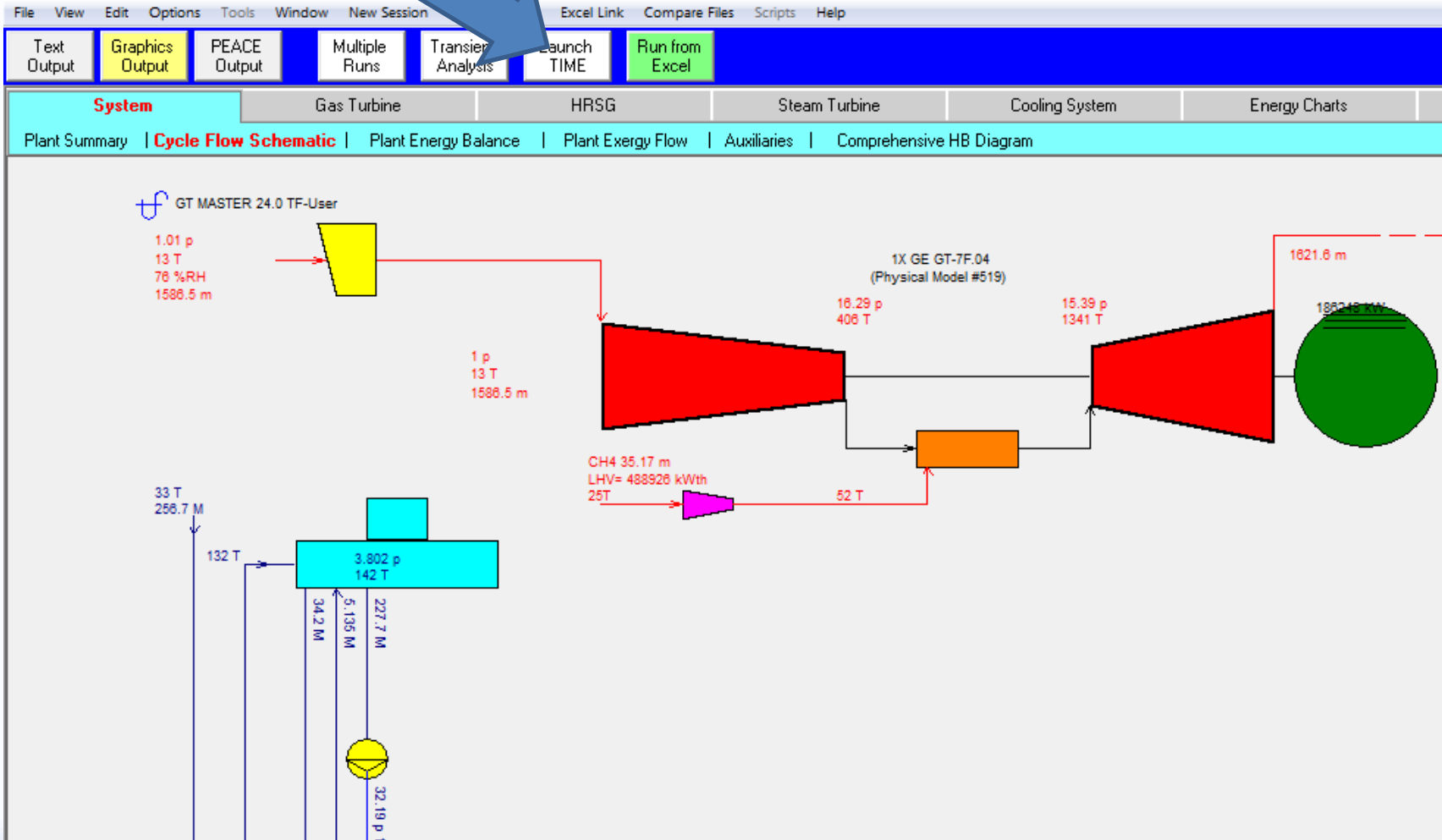
TIME

How does it work?



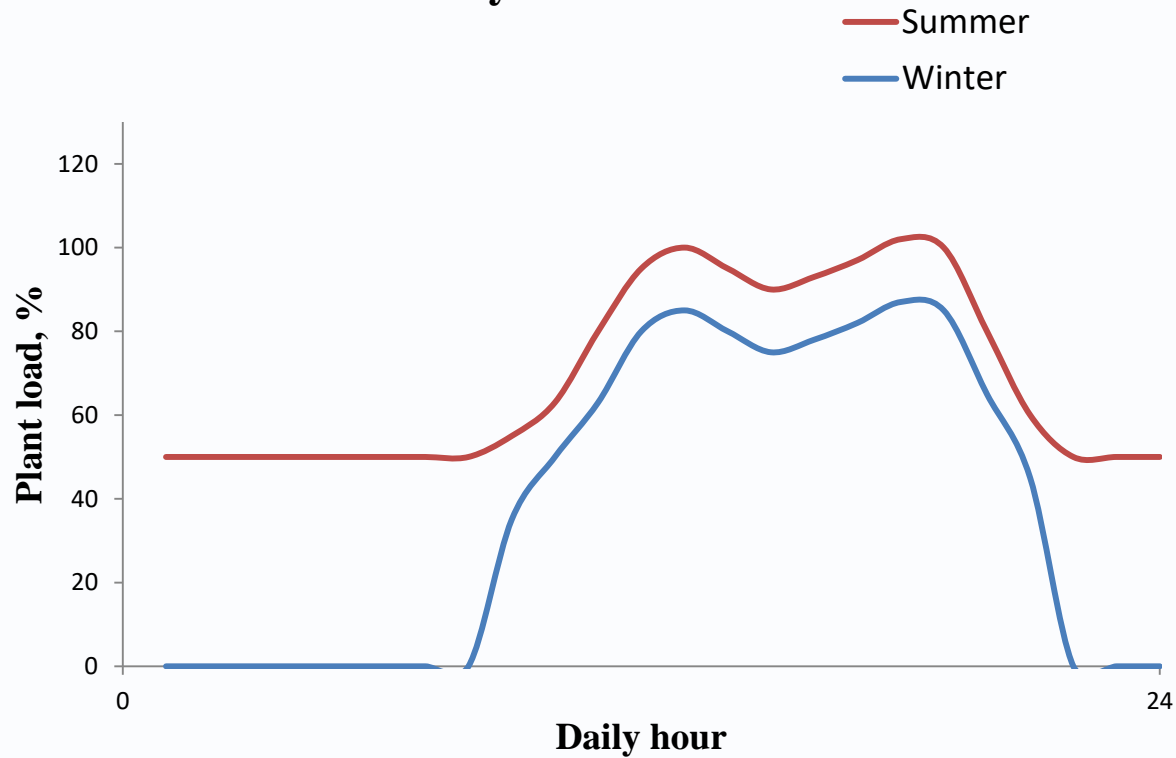
Time bins, representing some number of hours, certain operating and financial conditions

How to launch



This plant is located in Montana, Miles City, TMY (Typical Meteorological Year) ID 742300. It is CCGT based on gas turbine GE GT-7F.04. The power station is operated on the following scenario:

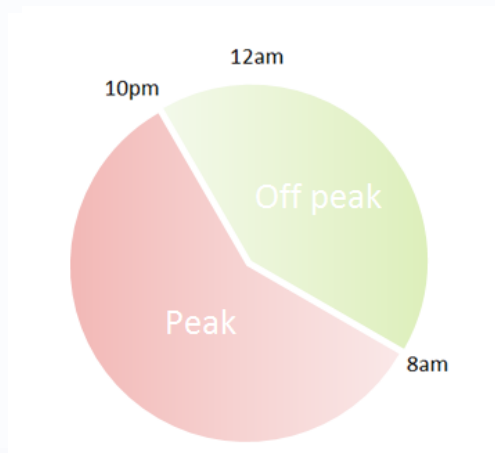
Daily load curve



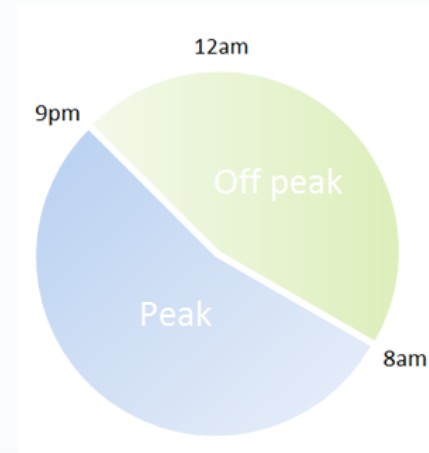
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Electricity price, USD/kWh		
Summer	Peak	0.927
	Off Peak	0.043
Winter	Peak	0.061
	Off Peak	0.039

Summer (May-Oct)



Winter (Nov-Apr)



TIME sample (GT PRO design)

Make the following Inputs:

New Session: Above 200 MW, GT, HRSG and condensing reheat ST

Plant Criteria: 0.921, 8.88 C (year average TMY), RH 56.3 % (year average TMY), 60 Hz, Water cooling with mechanical cooling tower

Plant Criteria-Regional costs: Montana

GT Selection: GE GT-7F.04 (ID 612)

ST-HRSG: Steam superheat/reheat – 579/579 C

Environment: NOx produced 9 ppm, include SCR – 80% effectiveness

Economics: Fuel price - 4.15 USD/GJ, Overall tax rate – 39.39% (Federal – 35%, 6,75% - Montana), Variable O&M costs - 0.0032 USD/kWh.

Q & A session

Please send your questions to the
presenter in the webinar chat!

Thank you!