

# Xcel's Synergi and DRIVE Demonstration for Hosting Capacity Webinar – June 2, 2020



## TODAY'S AGENDA:

12:00 – 1:30

The first half of the Workshop (12:00 to 1:30) will be a demonstration that provides an in-depth look at how Xcel Energy uses the EPRI DRIVE tool and other software tools for its hosting capacity analysis (HCA).

30-minute Break (1:30 p.m. – 2:00 p.m.)

2:00 – 4:00

The second half of the Workshop will feature a representative from EPRI who will provide an overview of DRIVE and outline the three available methodologies



# Presenters



Luther Miller, Xcel Energy - Distribution Planning Engineer



Matt Rylander, EPRI - Distribution Ops and Planning's Advanced Analytics Project Set Lead

# Synergi and DRIVE Demonstration for Hosting Capacity

June 2, 2020



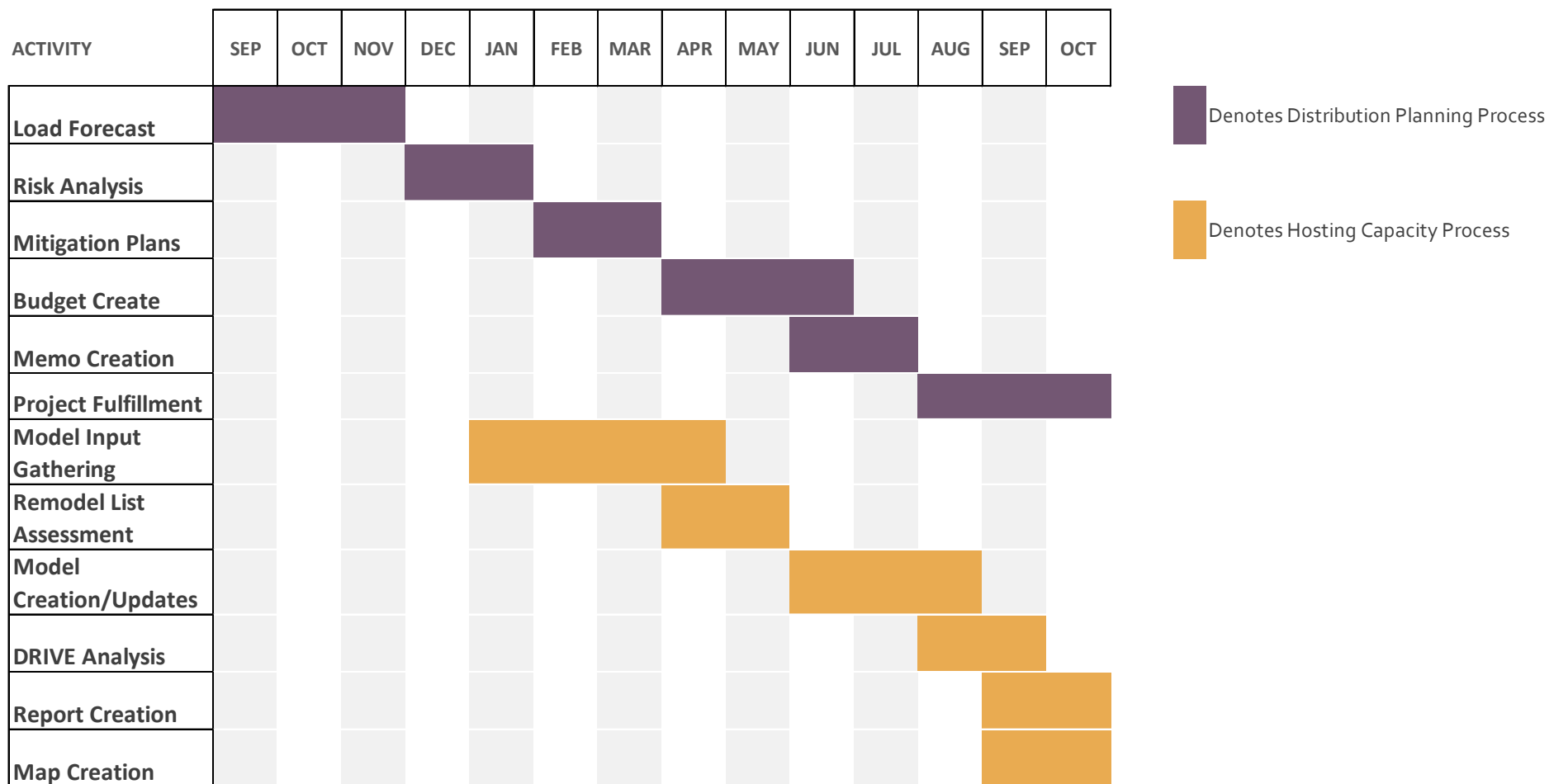
# Hosting Capacity

- Xcel Energy filed its first Hosting Capacity Analysis (HCA) report in December 2016 and has continued to file HCA reports yearly with consistently updated features and accuracy
- The purpose of this demonstration is to provide a practical look at the full HCA process used by Xcel Energy in the Synergi tool and the Electric Power Research Institute (EPRI) Distribution Resource Integration and Value Estimation (DRIVE) tool.

# Objectives

- Provide a practical demonstration of Synergi modeling and DRIVE analysis with respect to Hosting Capacity
- Examine additional functionality of the DRIVE tool

# Distribution Planning and Hosting Capacity Process Timeline



# History of DRIVE Usage and HCA

- 2015
  - Xcel Energy began working with EPRI in 2015 to begin the process of acquiring DRIVE as a tool for HCA
- 2016
  - Xcel Energy's first filed HCA
- 2017
  - Methodology changed to Large Centralized HCA in DRIVE
  - HCA heat map developed and implemented
- 2018
  - Reverse power flow was added as an analysis criteria
- 2019
  - HCA performed with actual daytime minimum loading and power factor information.
  - Unintentional islanding was added as an analysis criteria
  - Popup functionality in HCA map

# Inputs required for HCA

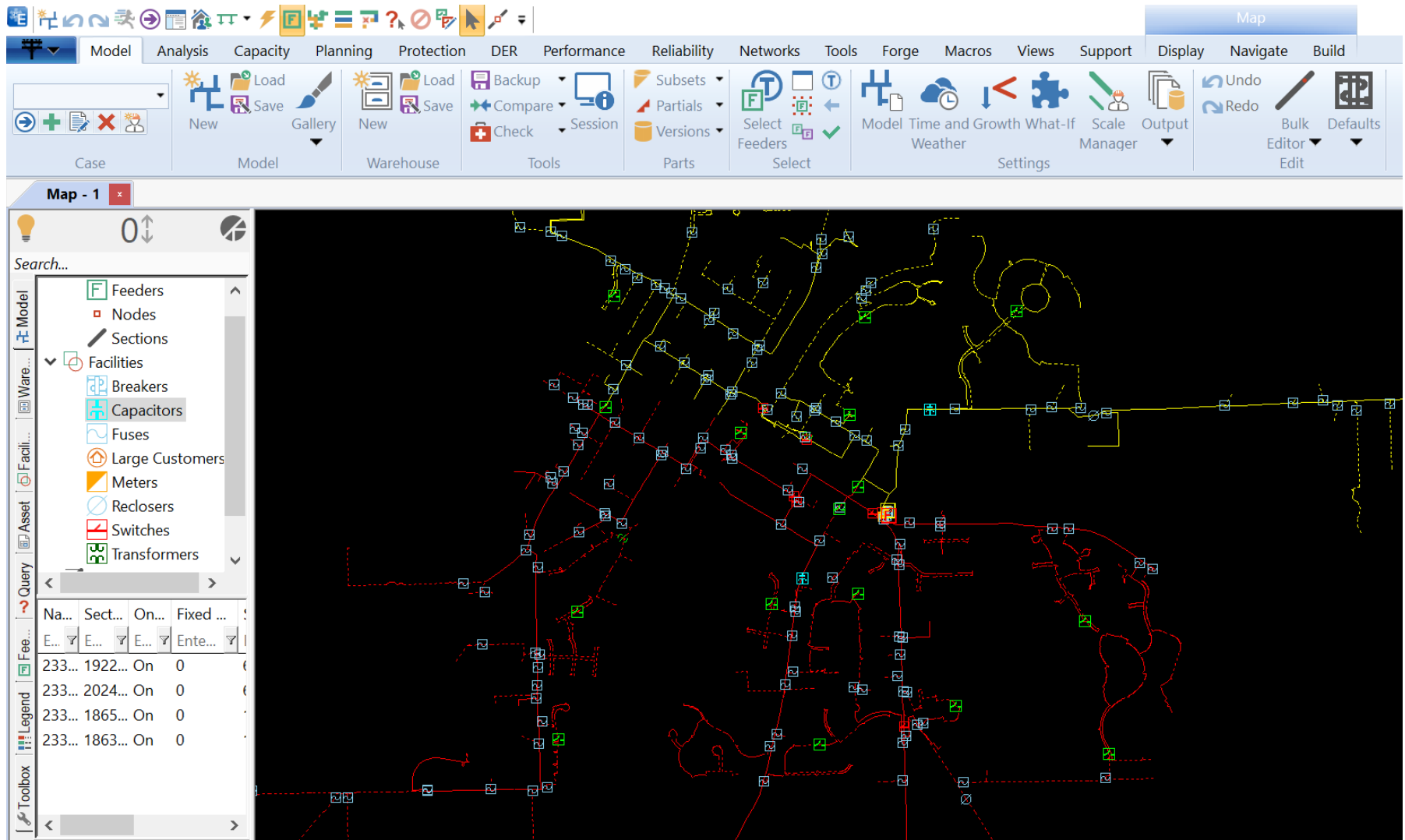
- GIS feeder model
- Forecasted peak load, amp balance and power factor
- Secondary customer billing data
- Primary customer and solar garden information
- Daytime minimum load



# Synergi Model Creation Process

- Import feeder model from GIS
- Perform model cleanup
- Input forecasted loading, head-end impedance
- Import customer billing information and solar garden size/power factor
- Allocate load
- Perform load flow
- QA model

# Model Creation and Cleanup



The screenshot displays the Xcel Energy software interface, specifically the 'Model' tab. The top ribbon includes tabs for Model, Analysis, Capacity, Planning, Protection, DER, Performance, Reliability, Networks, Tools, Forge, Macros, Views, Support, Display, Navigate, and Build. The 'Model' tab is active, showing a toolbar with icons for New, Load, Save, Gallery, Backup, Compare, Check, Session, Subsets, Partials, Versions, Select Feeder, Model Time and Growth Weather, What-If Settings, Scale Manager, Output, Undo, Redo, Bulk Editor, and Defaults.

Below the ribbon, the 'Map - 1' window is visible. On the left, a search bar is present, and a list of model elements is shown:

- Feeder
- Nodes
- Sections
- Facilities
  - Breakers
  - Capacitors
  - Fuses
  - Large Customers
  - Meters
  - Reclosers
  - Switches
  - Transformers

Below the list, a table displays the following data:

Na...	Sect...	On...	Fixed ...
E...	E...	E...	Ente...
233...	1922...	On	0
233...	2024...	On	0
233...	1865...	On	0
233...	1863...	On	0

The main map area shows a complex network of lines and nodes, representing the power distribution system. The map is overlaid with a grid and various colored lines (red, yellow, green) indicating different types of infrastructure or status.

# Model Creation and Cleanup

- Model is imported from GIS Database
- An automated cleanup script performs most of this work, but several facilities require further inspection
  - Conductor validation
  - Capacitor banks
  - Stepdown Transformers

Section: 2027891

Section

Construction

Properties

Load - Dist

Load - Spot

Load - Proj

Load - DTran

Gen - Dist

Zones

Coordinates

Info

Results

Edit conductors and spacing

Construction model

Detailed - same phases

☒ A ☒ B ☒ C ☒ Multi-Gnd

☒ N ☐ Single-Gnd ☐ Earth Ret

Conductor types

All Phases: 2 ACSR

Phase B: 2 ACSR

Phase C: 2 ACSR

Neutral: 4 ACSR

Equivalent spacing and height

Phase to phase: 48.0 in Phase to neutral: 36.0 in Height to ref.: 30.0 Ft

Detailed spacing - configuration and transposition

Config: NSP Horizontal CBA

Duct bank

Instance Unknown Ckt: 1

Apply Cancel

# Loading and Head-end Impedance

- Head-end impedance information is retrieved from an internal substation database
- Forecasted peak load data is gathered for each phase (when available) from Feeder SCADA and entered into the model's meter facility

**F Edit impedance and voltage levels**

**Voltage levels**

☒ Use balanced  
Volts:  (120V)

☐ Use by-phase  
Volts (120V)      Angle (Deg.)

Phase A/AB:	<input type="text" value="125.00"/>	<input type="text" value="0.000"/>
Phase B/BC:	<input type="text" value="125.00"/>	<input type="text" value="-120.000"/>
Phase C/CA:	<input type="text" value="125.00"/>	<input type="text" value="120.000"/>

**Source impedance**

☒ Use minimum (may be overridden by model options)  
☐ Use maximum

	R	X	
Z0 Min:	<input type="text" value="0.0572"/>	<input type="text" value="1.3455"/>	Ohms
Z1 Min:	<input type="text" value="0.1684"/>	<input type="text" value="1.6180"/>	Ohms
Z0 Max:	<input type="text" value="0.0000"/>	<input type="text" value="0.0000"/>	Ohms
Z1 Max:	<input type="text" value="0.0000"/>	<input type="text" value="0.0000"/>	Ohms

**Edit meter demands**

☐ Do not use demands      ☐ Lock downstream loads

**Type**  
☒ Amp      ☐ kVA

**Units**  
☒ kW, kvar      ☐ kva, % pf

**Metered values**

☐ Overridden by upstream meters

	A	B	C	
Amp:	<input type="text" value="131.0"/>	<input type="text" value="122.0"/>	<input type="text" value="118.0"/>	<input type="text" value="123.7"/>
% pf:	<input type="text" value="99.0"/>	<input type="text" value="99.0"/>	<input type="text" value="99.0"/>	<input type="text" value="99.0"/>

# Customer/DER Information

- Customer metering data is imported through Synergi's CMM tool and assigned to the model's nodes/sections
- Primary customer and Solar Garden data is entered manually from Xcel Energy's records

Large Cust: 467604827

Large Cust.  
Load  
**Generation**  
Info  
Results

### Edit generation information

☒ Generation on

Type: PV\_Gen3\_LargeCust

Inverter: Unknown

Review status: Constructed

DERP: NEM

Generation/phase

☒ Specify rating

	A	B	C	Total
Rated kW:	333.3	333.3	333.3	999.9
Pf %:	-94.0	-94.0	-94.0	-94.0
Inverter kVA (as % of kW):				100.0 %
Capacity factor:	1.00			
Voltage setting:				120.0

Generator output

☒ Rated kW output

☐ Specify output % 100

☐ Weather based performance

☐ DER Profile Unknown

☐ Specify pf 90.0 %

Derating factor 1.00

# Load Allocation and Load Flow

- Load is allocated with peak load values entered in the feeder model, and distributed across the feeder based on customer metering information.
- DER is turned off for load allocation
- A load flow is performed to check for any exceptions such as low voltage, overloaded transformers and overloaded conductors
- DER is turned back on and another load flow is performed

Feeder Summary																						
Source Id	Exception		Pct Ldg		Demand				Amps			Volts	Connected		Load		Loss		Generation			
	Cnt	Emr	Cnt	Emr	kW	kvar	kVA	pf	Max	% lmb	Neut	Avg	c.Cust	c.kVA	kW	kvar	kW	%	Tot kW	PV kW	PV %	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	0	0	25.9	25.9	-1563	2246	2737	-57	113	3.14	12	125.00	1316	14266	-1594	2267	95	6.10	4765	4765	304.8	
	4	4	36.9	36.9	4659	664	4706	99	202	11.11	32	125.00	1105	18454	4569	726	106	2.28	17	17	0.4	
	4	4	N/A	N/A	3096	2910	4249	73	N/A	N/A	N/A	N/A	2421	32720	2976	2994	202	6.52	4782	4782	154.5	

# Additional functions of Synergi as used in HCA and Planning

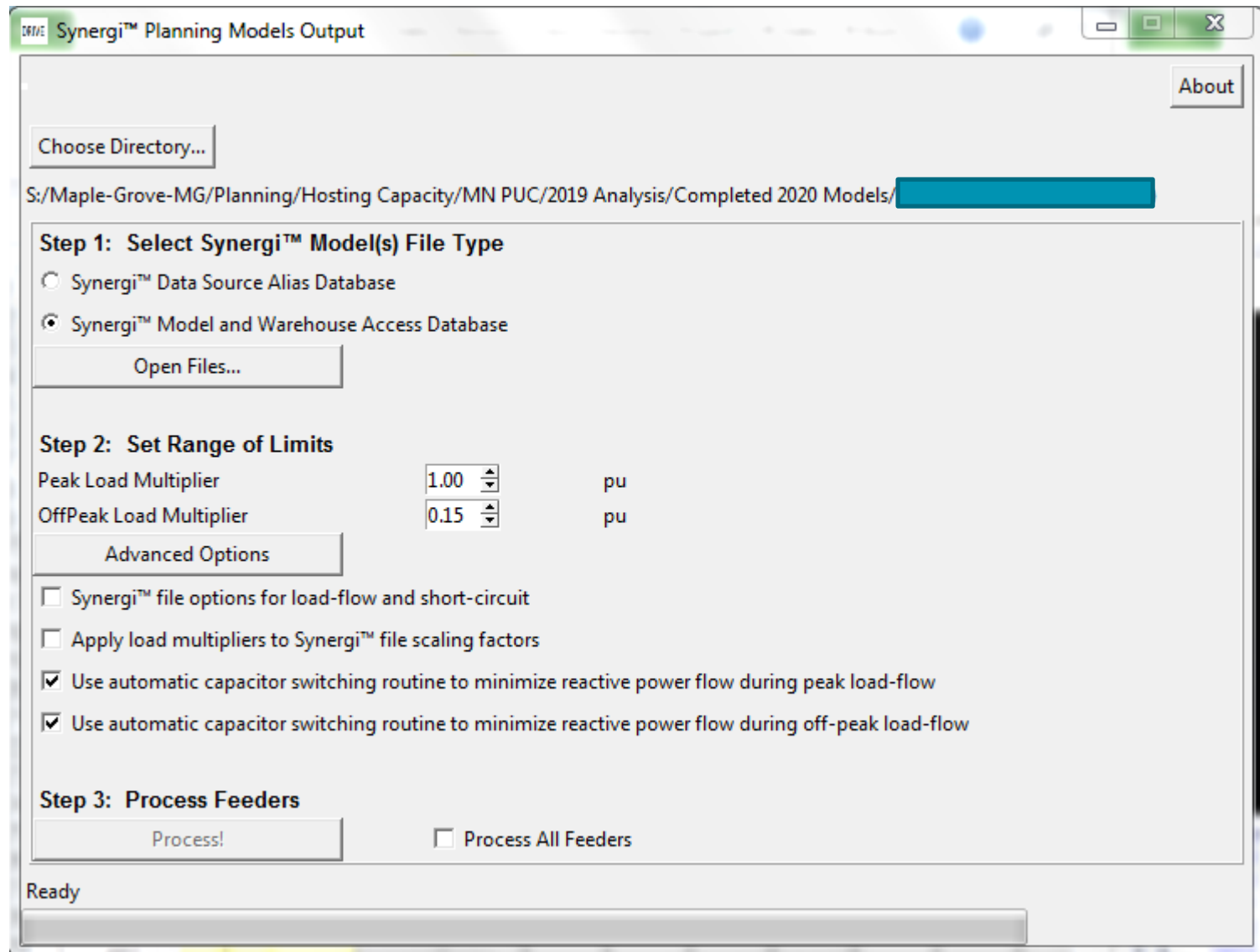
- **Queries**
  - Allow sections of feeder to be highlighted and edited based on conductor type, proximity, etc.
- **Building**
  - Sections of conductor may be built out from an existing feeder, and equipment can be added to new sections
- **Conditional Highlighting**
  - Feeders may be highlighted with multiple color codes based on certain conditions such as loading or conductor type

# DRIVE Process

- **Model A Interface (DRIVE MAI)**
  - Load Synergi model
  - Assign off-peak load percentage (based on DML)
  - Convert Synergi model to DRIVE input files
- **DRIVE**
  - Select input folder/files
  - Load threshold and analysis settings
  - Perform analysis
  - QA Hosting Capacity Analysis and download summary file



# DRIVE MAI



The screenshot shows a software window titled "Synergi™ Planning Models Output". It features a standard Windows-style title bar with minimize, maximize, and close buttons. An "About" button is located in the top right corner. Below the title bar, there is a "Choose Directory..." button. The current directory path is displayed as "S:/Maple-Grove-MG/Planning/Hosting Capacity/MN PUC/2019 Analysis/Completed 2020 Models/".

**Step 1: Select Synergi™ Model(s) File Type**

☐ Synergi™ Data Source Alias Database

☒ Synergi™ Model and Warehouse Access Database

Open Files...

**Step 2: Set Range of Limits**

Peak Load Multiplier: 1.00 pu

OffPeak Load Multiplier: 0.15 pu

Advanced Options

☐ Synergi™ file options for load-flow and short-circuit

☐ Apply load multipliers to Synergi™ file scaling factors

☒ Use automatic capacitor switching routine to minimize reactive power flow during peak load-flow

☒ Use automatic capacitor switching routine to minimize reactive power flow during off-peak load-flow

**Step 3: Process Feeders**


Process!

☐ Process All Feeders

Ready

# DRIVE Hosting Capacity Interface

Hosting Capacity Analysis

 **EPRI** | ELECTRIC POWER  
RESEARCH INSTITUTE

**Evaluation Criteria Thresholds:**

Primary Over-Voltage	<input type="text" value="1.050"/>	pu
Primary Under-Voltage	<input type="text" value="0.950"/>	pu
Primary Voltage Deviation	<input type="text" value="3.0"/>	%
Regulator Voltage Deviation	<input type="text" value="50"/>	%
Thermal for Load	<input type="text" value="100"/>	%
Thermal for Gen	<input type="text" value="100"/>	%
Reverse Power Flow		100 %
Additional Element Fault Current	<input type="text" value="10"/>	%
Breaker Relay Reduction of Reach	<input type="text" value="10"/>	%
Sympathetic Breaker Relay Tripping	<input type="text" value="150"/>	A
Unintentional Islanding	<input type="text" value="100"/>	%
Operational Flexibility	<input type="text" value="100"/>	%
3V0	<input type="text" value="100"/>	%
Flicker	<input type="text" value="0.35"/>	Pst

Process All

Process Individual Feeder

Analysis Options

Future Resource Options

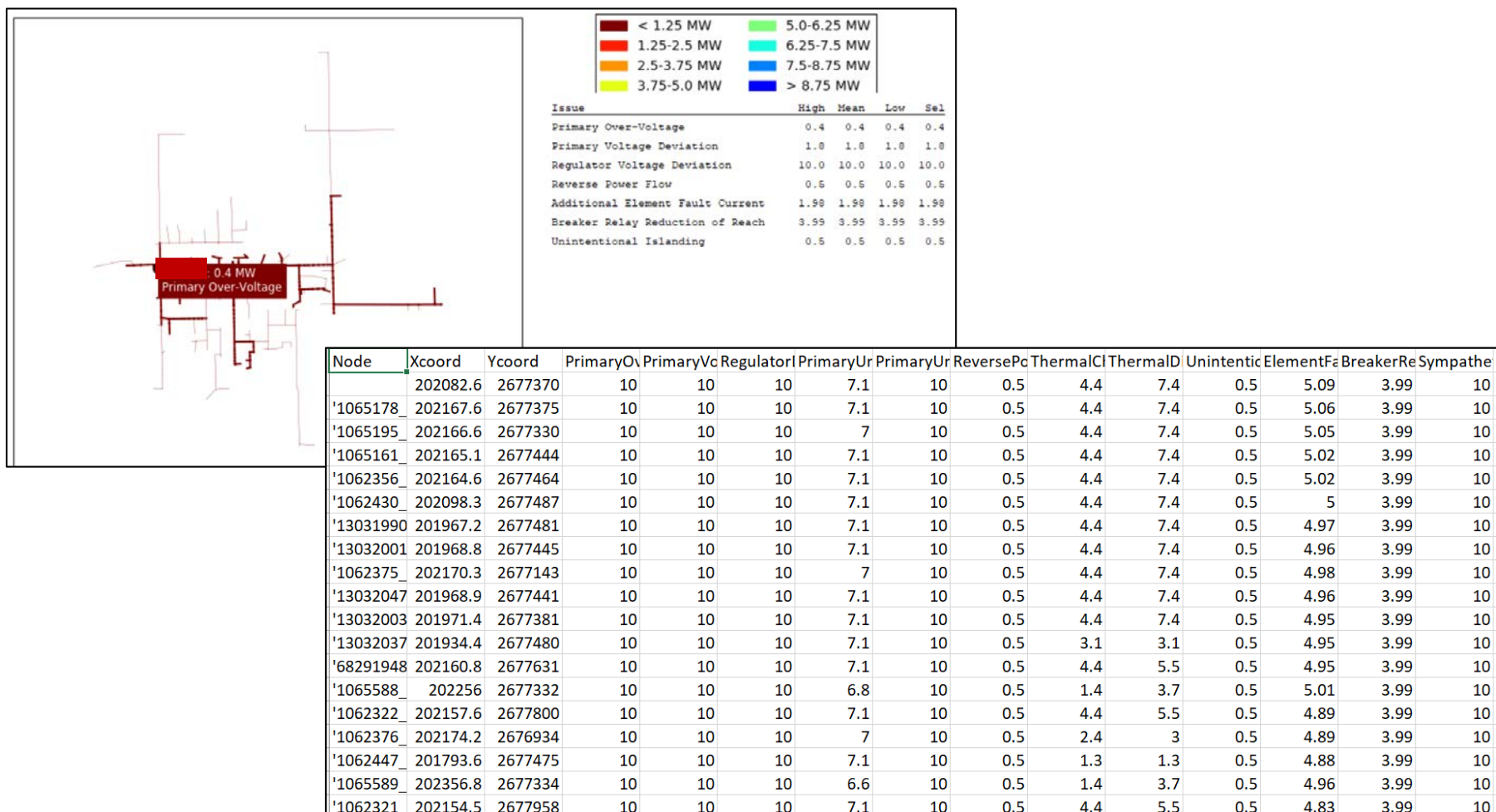
Save Settings

Load Settings

**Progress Details:**

Ready

# DRIVE Hosting Capacity Results



# Functions of DRIVE

- Hosting Capacity for Load or Generation
- Hosting Capacity Analysis with Autonomous Smart Inverters
- Hosting Capacity with N-1 switching
- Mitigation Assessment

**Thank you for  
listening.**

**Are there any  
Questions?**

# **30-MINUTE BREAK**

**1:25 p.m. – 1:55 p.m.**