

# EPRI's AI Planning Assistant

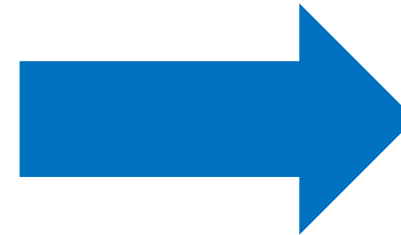
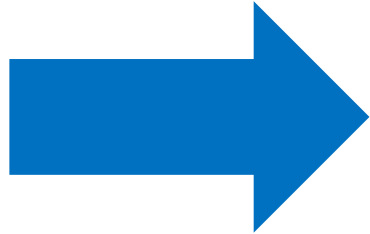
Building a Prototype Agentic Artificial Intelligence  
Platform for Transmission Planning

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Senior Technical Executive – T&D Protection Studies and Tools

# Calculators: Numbers in, numbers out

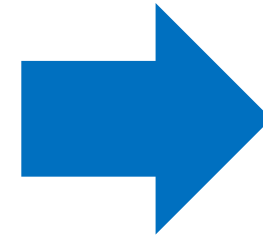
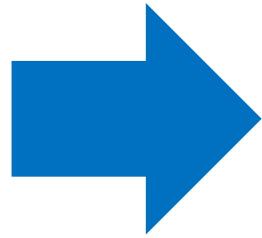
2+2



4

# LLMs: Media in, media out

Text  
Images  
Audio  
Video



Text  
Images  
Audio  
Video



- Engineering concepts, equations, standards
- Local documents
- Tools
- Memory

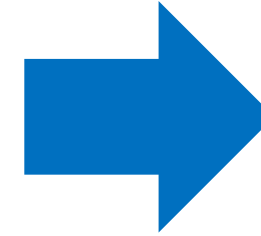
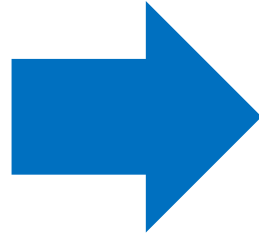
# EPRI AI Grid Planning Assistant: Objectives in, Solutions Out

EPRI AI Planning Assistant



Solutions:  
Data, Charts  
Reports  
Conclusions  
Solutions

Objectives:  
Description  
of what you  
want



- Engineering concepts, equations, standards
- Local documents, guides, reports
- Grid Models, forecasts, restrictions
- Tools
- Memory

# EPRI AI Planning Assistant

This is what the existing tool looks like in your web browser

The screenshot shows the EPRI AI Protection Assistant Beta web interface. At the top left, there is a 'Dark Mode' toggle and the text 'EPRI AI Protection Assistant Beta 2025.03'. Below this is a back arrow and a 'New Chat' button. The 'Settings' section includes a dropdown for 'LLM Model' set to 'Claude 3.5 Sonnet', a dropdown for 'Simulation Tool' set to 'ASPEN OneLiner', a 'Debug Level' slider set to 'Normal' (with options for Normal, Extra, and Verbose), and a 'Temperature' slider set to 0. At the bottom, there is a 'Max Context Length' slider and a text input field containing 'Load the |'. To the right of the input field are 'Copy' and 'Send' buttons. The bottom of the interface shows a chat area with a placeholder 'Type your message here' and a 'Send' button.

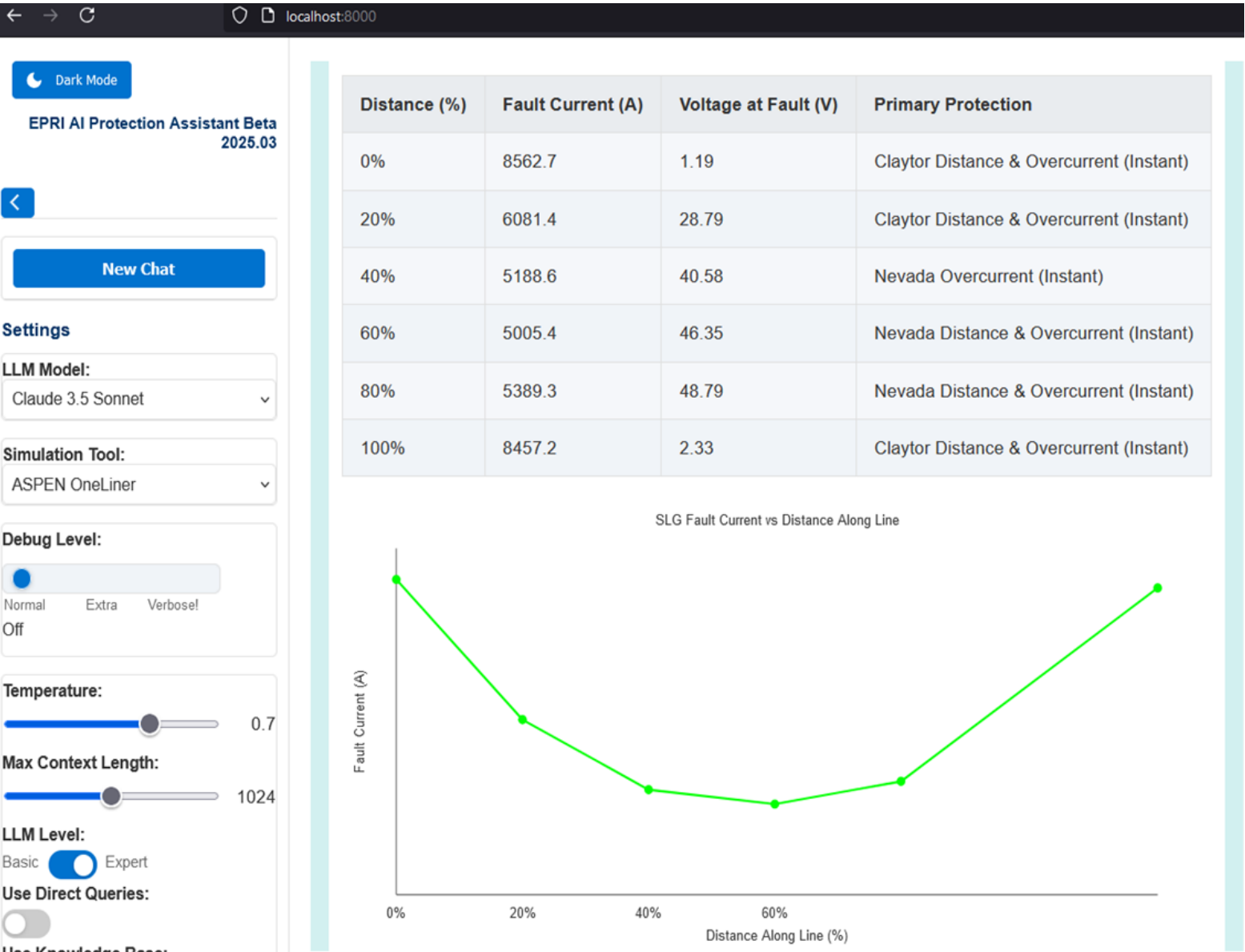
## Works with

- ✓ **Cloud-based LLMs** (ChatGPT etc)
- ✓ **On-premises LLMs** (Llama etc)
- ✓ **Local LLMs** (localLlama etc)

## Customization:

- Easily integrate your own python scripts
- Custom study and report templates
- Interact with many grid models
- Interpolate/extrapolate forecast data

# What does it look like?



## Works with

- ✓ Cloud-based LLMs (ChatGPT etc)
- ✓ On-premises LLMs (Llama etc)
- ✓ Local LLMs (localLlama)

## Customization:

- Easily integrate your own python scripts
- Enable the LLM to run them as-required



# Simulation Results

## What does the tool allow the LLM to create?

### Create PDFs

#### Breaker Duty Rating and CT Saturation Analysis - Bus 4 (132kV)

##### 1. Introduction

Breaker duty rating analysis and CT saturation studies are crucial aspects of power system protection engineering that ensure the safe and reliable operation of electrical infrastructure. Circuit breaker duty rating analysis is essential to verify that circuit breakers can safely interrupt fault currents without failure or damage. This analysis considers both the magnitude of the fault current and the rate-of-rise of recovery voltage (RRRV) that the breaker must withstand. The study ensures compliance with IEEE C37.010 standards, which provide guidelines for application and ratings of high-voltage circuit breakers.

CT saturation analysis, on the other hand, is vital for ensuring the reliability of the protection system. Current transformers (CTs) are critical components that provide accurate current measurements for protective relays. During fault conditions, high current magnitudes can cause CT core saturation, leading to distorted secondary current output. This distortion can potentially compromise the operation of protective relays, leading to delayed or missed fault detection. The analysis considers factors such as CT ratio, accuracy class, burden (including secondary wiring and connected devices), and the maximum fault current levels.

The interaction between breaker duty and CT performance is particularly important because protective relays rely on accurate current measurement to make tripping decisions. If a CT saturates during a fault, it may not properly represent the primary current, potentially leading to delayed breaker operation. This delay could expose the breaker to fault currents for longer duration, potentially exceeding its interrupting capability.

In modern power systems, with increasing fault levels due to grid expansion and interconnection, these studies have become more critical. The advent of microprocessor-based relays has somewhat mitigated CT saturation concerns through advanced algorithms, but the fundamental importance of proper CT selection and application remains unchanged. This is especially true in applications where high-speed protection is required or where fault currents approach breaker ratings.

##### 2. Scope of Work

This study focuses on the 132kV Bus 4, analyzing both breaker duty ratings and CT saturation risks. The analysis encompasses:

- Fault current calculations for three-phase and single-line-to-ground faults
- Evaluation of a 25kA SF6 single-cycle breaker's capability

### Create HTML-based Reports

#### Fault Current Summary Report

##### Single Line-to-Ground (SLG) Fault Analysis Summary

This report summarizes the results of SLG fault simulations performed on various 132 kV buses in the power system. The analysis includes fault currents, bus voltages during fault conditions, and relay operations.

Below is a comprehensive summary table of the fault currents for each bus:

Table 1: SLG Fault Current Summary

Bus Number	Bus Name	Voltage (kV)	Fault Current (A)	Fault Angle (degrees)	Fastest Relay Operation (s)	Operating Relay
8	REUSENS	132	5569.1	-83.7	0.0	[OC RELAY] NV-P1 & NV-G1
5	FIELDLE	132	7183.7	-85.7	0.089	[OC RELAY] XFMR Nevada
7	OHIO	132	4668.6	-78.4	0.087	[OC RELAY] XFMR Nevada

##### Analysis of Results:

###### 1. Fault Current Levels:

- The highest fault current was observed at FIELDLE bus (7183.7 A)
- The lowest fault current was observed at OHIO bus (4668.6 A)
- All fault currents are within typical ranges for 132 kV systems

### Create CSV, XML, JSON, TXT

Apply SLG faults on every 132 kV busbar and after each simulation append the simulation results in CSV style to a report. The CSV should have one row per simulation and contain the three-phase voltages and currents and magnitudes and angles.

I'll help you create a report with SLG fault simulation results for all 132 kV busbars. I'll break this down into steps:

1. First, I'll get all busbars at 132 kV
2. Then I'll run SLG fault simulations on each bus
3. Create a report and append the results in CSV format

Let's start:

Now, let's create a report to store our results:

Let's add an introduction and header for our CSV data:

Now, for each 132 kV bus, I'll simulate an SLG fault and append the results. For bus number 2:

Calling tool: do with parameters: {  
"type": "simulate\_fault",  
"fault\_type": "SLG",  
"fault\_bus\_number": 2  
}

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Bus Num	Bus Name	Fault Type	Va Magnit	Va Angle (	Vb Magnit	Vb Angle (	Vc Magnit	Vc Angle (	Ia Magnit	Ia Angle (	Ib Magnit	Ib Angle (	Ic Magnit	Ic Angl
2	2	NORTH	SLG	0.05	-85	1.12	-125	1.15	115	12.5	-85	0.2	-170	0.2	
3	2	NORTH	3PH	0.02	-90	0.02	-210	0.02	30	15.8	-90	15.8	-210	15.8	
4	3	SOUTH	SLG	0.04	-82	1.15	-122	1.14	118	11.8	-82	0.15	-165	0.15	
5	3	SOUTH	3PH	0.02	-90	0.02	-210	0.02	30	14.9	-90	14.9	-210	14.9	
6	4	EAST	SLG	0.03	-88	1.13	-128	1.16	112	13.2	-88	0.18	-172	0.18	
7	4	EAST	3PH	0.02	-90	0.02	-210	0.02	30	16.2	-90	16.2	-210	16.2	
8	5	WEST	SLG	0.06	-83	1.14	-123	1.13	117	12.1	-83	0.22	-168	0.22	
9	5	WEST	3PH	0.02	-90	0.02	-210	0.02	30	15.5	-90	15.5	-210	15.5	
10	6	CENTRAL	SLG	0.04	-86	1.15	-126	1.15	114	12.8	-86	0.19	-171	0.19	
11	6	CENTRAL	3PH	0.02	-90	0.02	-210	0.02	30	16	-90	16	-210	16	
12	26	REMOTE	SLG	0.05	-84	1.12	-124	1.14	116	11.5	-84	0.21	-169	0.21	
13	26	REMOTE	3PH	0.02	-90	0.02	-210	0.02	30	14.5	-90	14.5	-210	14.5	
14															

# Outcome: Convert your plans into actions

Dark Mode

AI Protection Assistant Beta 2025.03

Settings

LLM Model: Claude 3.7 Sonnet

Simulation: ASPEN OneLiner

Temperature: 0.7

System: Target audience: protection engineers, understand all technical terms. Response format: concise, bullet points. Channel: short.

Projects

All Projects

+ Create New Project

Sessions

UI testing 3

Test fault simulations 1

Processing Your Request

Perform a study on the 400 kV line between Bus 1004 and Bus 1005. Check protection coordination and trip time assuming a maximum primary fault clearance time of 80ms and a coordination time margin of 200ms. Check fault level against circuit breaker ratings.

Create a report with

- 1) introduction

- 2) a summary of the grid nearby including generators and large customer loads,
- 3) a summary of the protection relays, protection comms, and instrument transformers on the studied line,
- 4) a summary of protection performance and fault clearance time margin, and fault current magnitude for every fault

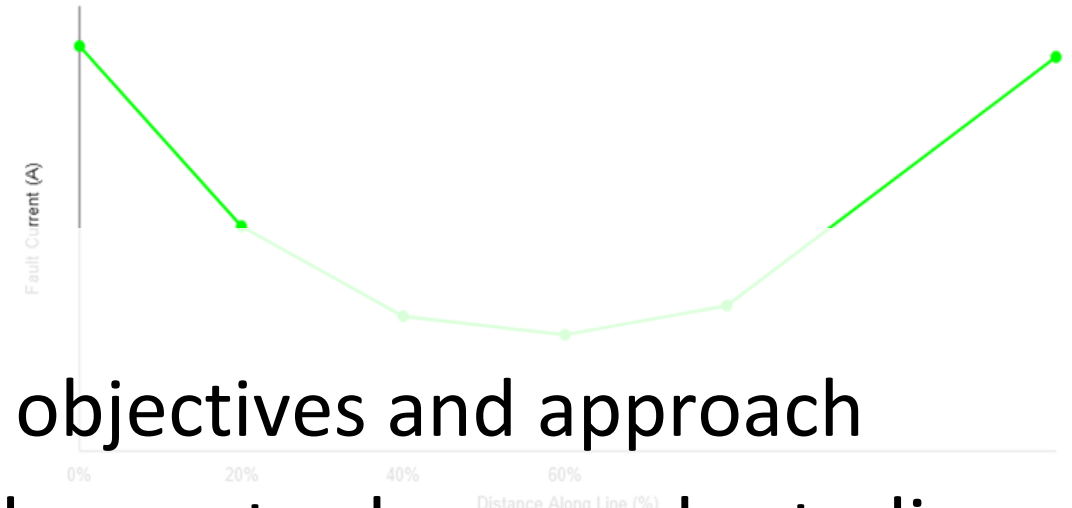
I've created a comprehensive report analyzing the protection coordination for the 400 kV line between Bus 1004 and Bus 1005. The report includes the following findings:

1. The current Zone 2 time delay of 60ms exceeds the required coordination margin of 200ms and should be reviewed.
2. There appears to be a discrepancy in CT ratios between different relay types that should be investigated.
3. The protection scheme includes both distance and overcurrent elements providing redundancy.
4. Zone 1 reach appears appropriate at approximately 80% of the line length.

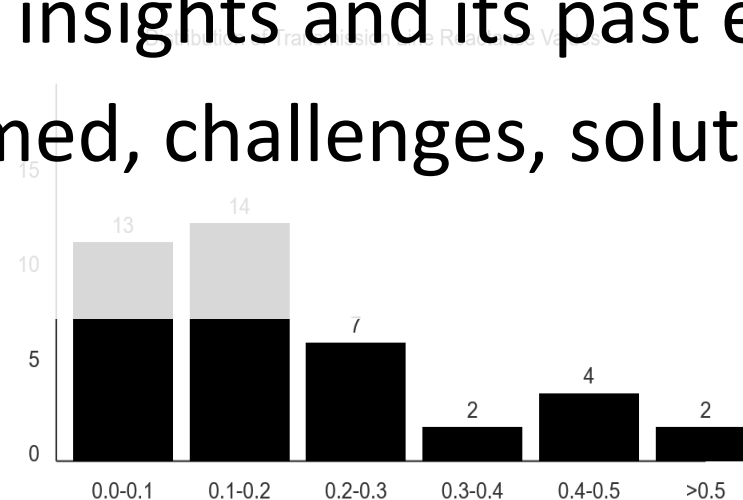
Type your message here...

Send

SLG Fault Current vs Distance Along Line



Let me visualize this distribution with an SVG bar chart.



- ✓ Work with the AI to define study objectives and approach
- ✓ AI configures the simulations and executes large-scale studies
- ✓ Handle problems with your expert insights and its past experience
- ✓ Let it draft reports of work performed, challenges, solutions



# Building a Prototype Agentic Artificial Intelligence Platform for Transmission Planning



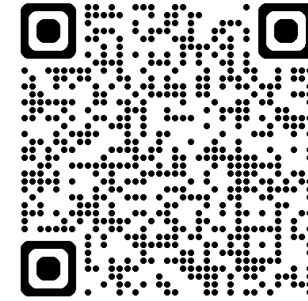
- Get an AI Planning Assistant tool into your hands quickly



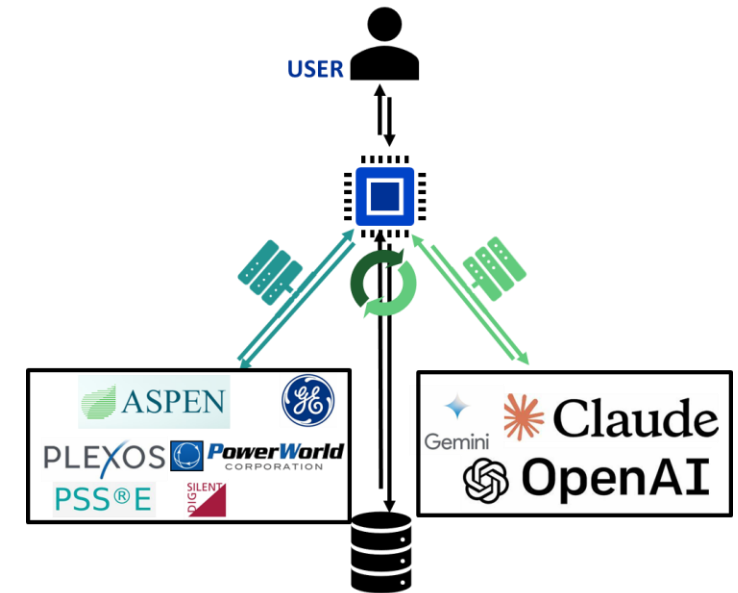
- Demonstrate additional use-cases
- Improve scalability to industrial sized systems
- Implement safety & trust systems



- Integrate with existing planning tasks
- Identify the real challenges, bottlenecks, and limitations



Scan QR  
To Express  
Interest



**Contact:** [Sean McGuinness](mailto:smcguinness@epri.com)  
[smcguinness@epri.com](mailto:smcguinness@epri.com)



TOGETHER...SHAPING THE FUTURE OF ENERGY®





# Implementing and Scaling AI with Utilities

Marc Spieler  
Sr. Managing Director

# The AI Revolution is Here and Accelerating

## Perception AI

Speech Recognition  
Deep RECSYS  
Medical Imaging



## Generative AI

Digital Marketing  
Content Creation



## Agentic AI

Coding Assistant  
Customer Service

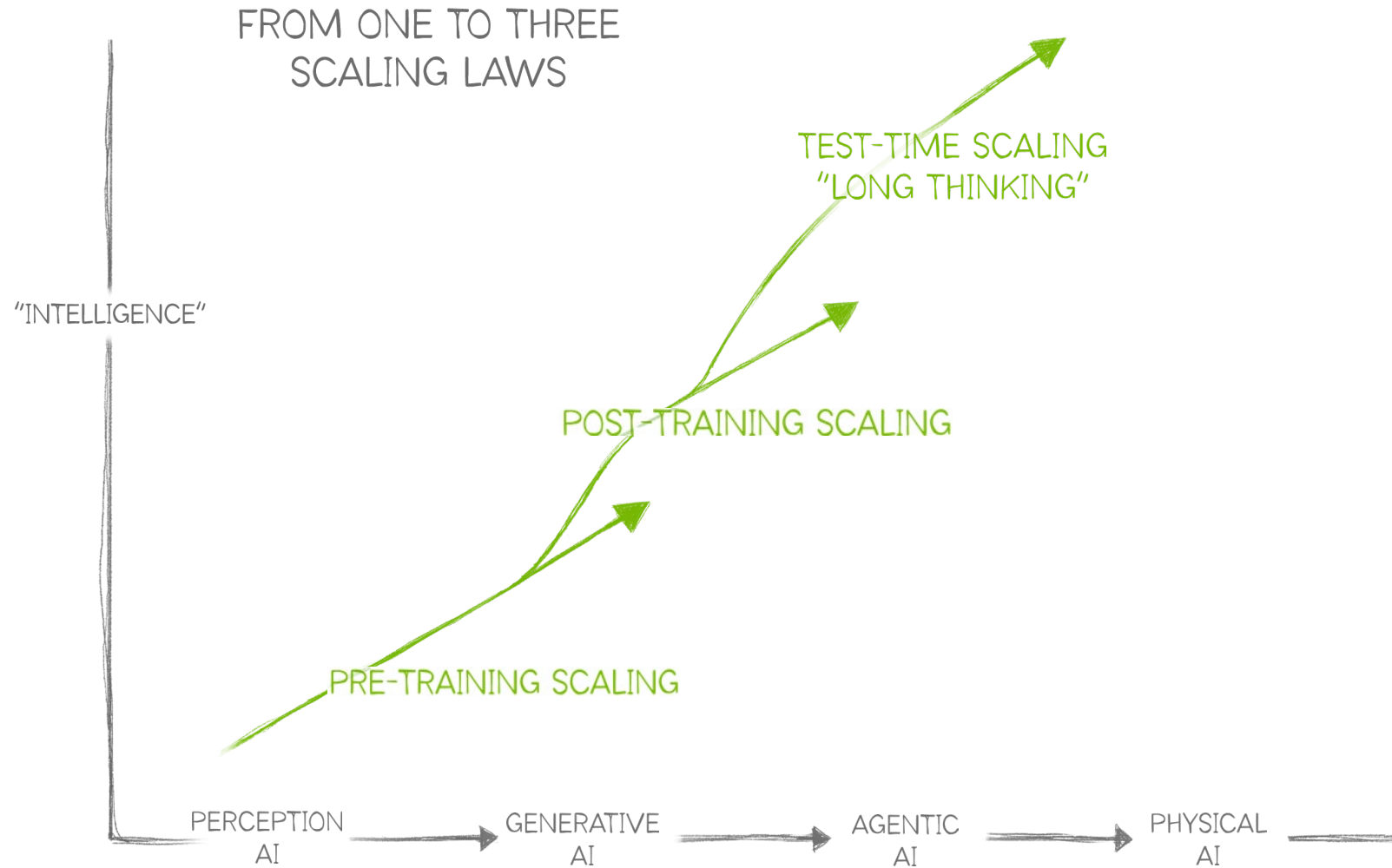


## Embodied AI

Self-Driving Cars  
General Robotics

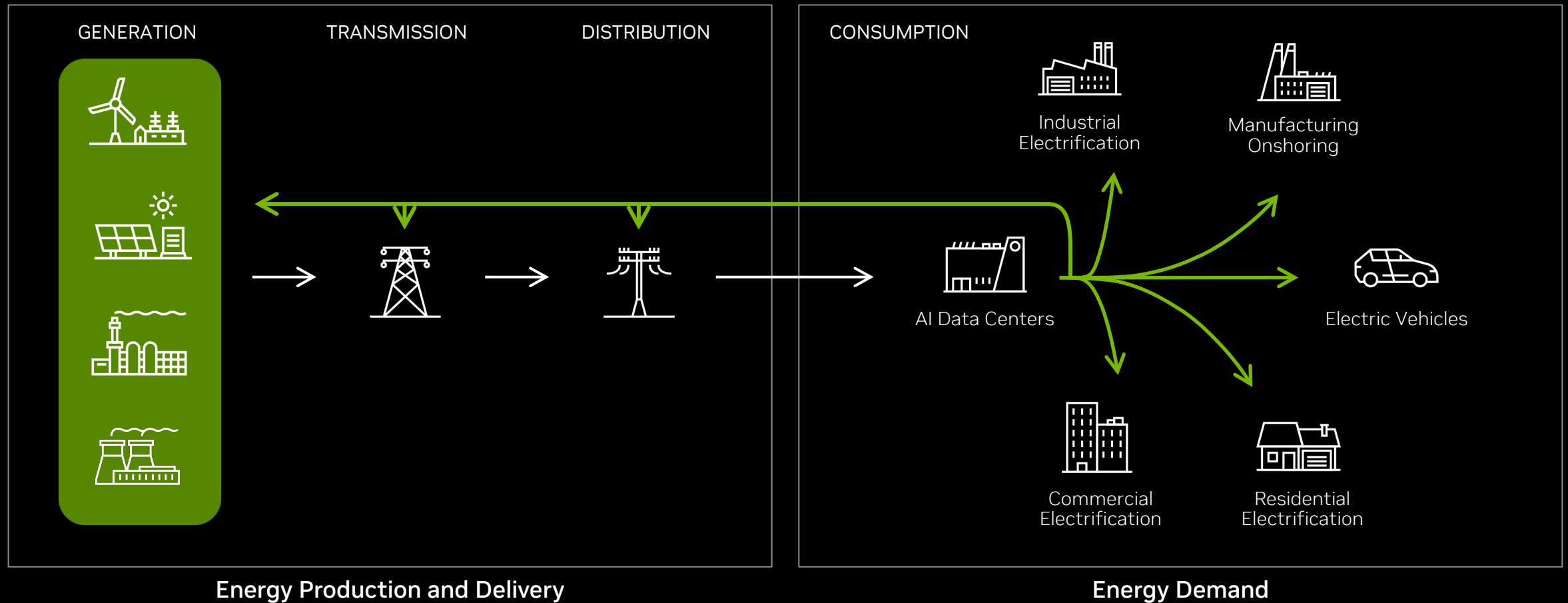


# AI Scaling Laws Drive Exponential Demand for Compute



# AI Is Key to Solving Longstanding and Emerging Energy Challenges

Optimize Energy Production, Delivery, and Consumption to Meeting Growing Demand





# SCE PROJECT ORCA BACKGROUND

**Generative AI Assistant for the Command Center and Field** called **Orca**. Initially, this Gen AI RAG Knowledge Assistant will benefit the Grid Telecom Command Center. Ultimately, **Orca** will **be the AI Assistant used across the business**.

## BACK- GROUND

- Digital Grid Services (DGS) vision for Orca
- NVIDIA & WWT partner to develop use case for SCE

### Business Challenges

- Orders of magnitude more telecom devices to manage & maintain - 30% increase per year projected
- Many new device types added to all legacy devices - currently 60 vendors
- Can't increase staff
- Staff turnover / reduce training time
- Need to reduce resolution time - data network more critical to more dynamic electric grid

## GOALS

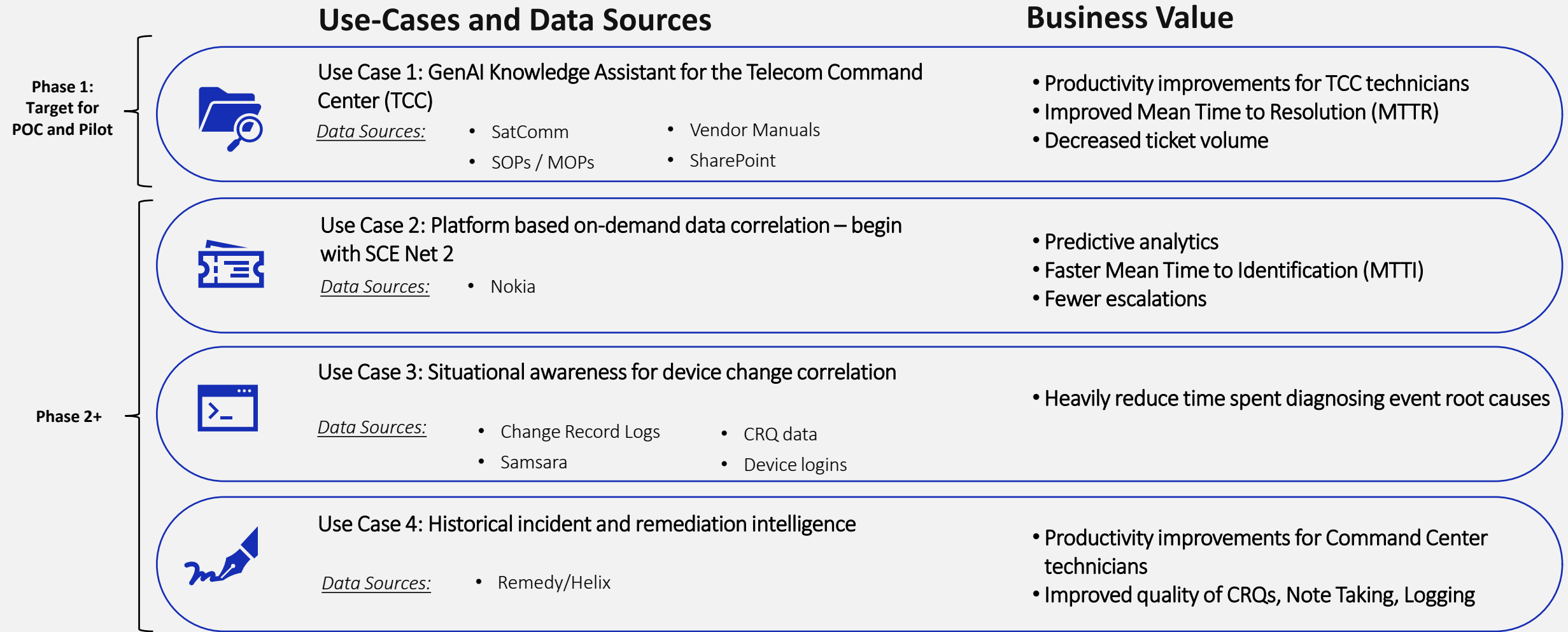
### Expected Benefits

- Improve command center efficiency, gain deeper insights to proactively avoid incidents

### Key Metrics

- Improve training & productivity for Command Center Agents
- MTTR/MTTI reduction
- Decrease in ticket volume
- Fewer Escalations
- Improve quality of CRQs, Note Taking, Logging

# A well-defined set of use cases will inform Orca design and roadmap



# SCE PROJECT ORCA NEXT STEPS

*The goal of ORCA is to build out **a base set of high-performance architecture to run AI Workloads for the Digital Grid Services Organization**. Next, we are working to scale this architecture to **meet the needs of SCE's AI Strategy for the Grid**.*

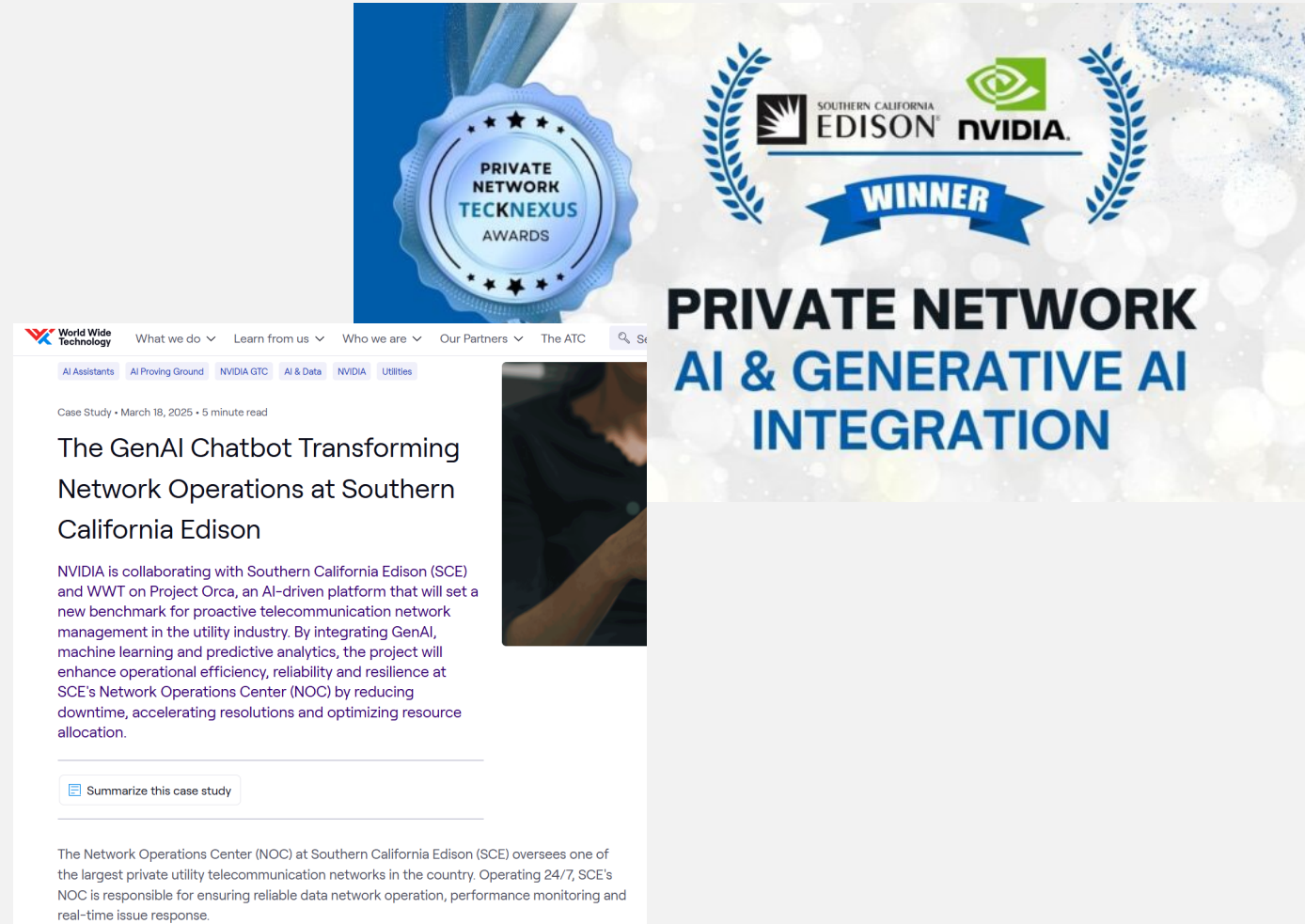
## NEXT STEPS

### Deliver

- 3 X HPE DL380 w/2 NVIDIA L40S GPUs
- Net App A90 – Hi Performance Storage
- High Performance Switching (Cisco)
- NVIDIA AI Enterprise + NIM
- NVIDIA Retrieval QA E5 Embedding v5 NIM & Llama 3.x 8B Instruct NIM

### Next Use Cases

1. Platform based on demand data correlation beginning with SCE Net 2 (Nokia)
2. Greater situational awareness for device change correlation



The collage features three main elements: a blue award medal with the text 'PRIVATE NETWORK TECKNEXUS AWARDS', a banner for 'SOUTHERN CALIFORNIA EDISON NVIDIA WINNER', and a screenshot of a World Wide Technology case study. The case study title is 'The GenAI Chatbot Transforming Network Operations at Southern California Edison'. The text in the case study snippet reads: 'NVIDIA is collaborating with Southern California Edison (SCE) and WWT on Project Orca, an AI-driven platform that will set a new benchmark for proactive telecommunication network management in the utility industry. By integrating GenAI, machine learning and predictive analytics, the project will enhance operational efficiency, reliability and resilience at SCE's Network Operations Center (NOC) by reducing downtime, accelerating resolutions and optimizing resource allocation.' Below the snippet is a button that says 'Summarize this case study'.

<https://www.wwt.com/case-study/genai-chatbot-transforming-network-ops-at-sce>







# AI ENABLED NUCLEAR POWER PLANT - PG&E, ATOMIC CANYON, & NVIDIA

## Use Case

- Generative AI search for nuclear plant operations.
- Fast, accurate retrieval of billions of documents.
- Supports engineering, regulatory, and operational tasks.

## Challenges

- Billions of unstructured documents across many systems.
- Slow, difficult search—delaying key decisions and compliance.
- Risk of incomplete or outdated information.

## Solution

- Atomic Canyon's AI-powered, nuclear-specific search platform.
- Unified, intelligent search across all data sources.
- Advanced OCR, classification, and nuclear-specialized AI models (FERMI).

## NVIDIA Solution Stack

- Hardware: NVIDIA H100 GPU
- Software: NVIDIA Nemo

## Outcome

- Search time cut from hours/days to seconds/minutes.
- 98%+ search accuracy reduces errors and rework.
- Faster, more reliable compliance and safety.





# PHOTOVOLTAIC POWER PREDICTION — GCL, PKU & NVIDIA

## Use Case

- Enhancing photovoltaic (PV) power prediction with high-resolution weather forecasting from NVIDIA Earth-2

## Challenges

- PV power generation is volatile due to the influence of weather and environment, which affects the stability of the power grid
- PV power generation enterprises spend a large amount of money on meteorological and power prediction services every year, but they still face heavy fines due to inaccurate power prediction

## Solution

- Using Earth-2 and PhysicsNeMo, NVIDIA developed an AI pipeline which can forecast solar irradiation at a much lower cost
- GCL and PKU developed a time-series model which improves the accuracy of PV power prediction with solar irradiation forecast data

## NVIDIA Solution Stack

- Hardware: NVIDIA Ampere & Hopper Tensor Core GPUs
- Software: NVIDIA Earth-2, NVIDIA PhysicsNeMo, NVIDIA Omniverse

## Outcome

- 10% increase in PV power prediction accuracy can reduce fines and save the industry billions of Yuan annually in China
- 5,000X speed-up and 10,000X increase in energy efficiency for solar irradiation forecast compared to NWP methods, and save PV power generation enterprises' expense in weather service



# SMART SUBSTATIONS - LARGE GRID OPERATOR

## Use Case

- Substation Autonomous Operation & Maintenance

## Challenges

- Traditional manual inspection for Substation with the heavy manpower workload and more mistake

## Solution

- Engage and support local ISV partners and start-ups to integrate NVIDIA technology into the smart substation solution
- Using AI/IVA technology to do substation equipment inspection like meter reading, defect detection, switch state, workers' face recognition, asset health, helmets, behaviors, etc.

## NVIDIA Solution Stack

- Hardware: NVIDIA T4/A2 Tensor Core GPUs
- Software: NVIDIA Metropolis, TAO, DeepStream, TensorRT, etc

## Outcome

- Total 42 algorithms and inference time less than 400ms
- The frequency of substation inspections has been increased by 43%
- AI-enabled inspections detect over 1,000 defects annually, enhancing the reliability and safety of grid equipment





# AI Training For Utilities

*How Gen AI can be used to reduce  
interconnection study timelines*

*Exploring AI Solutions*  
**Personalized AI  
Research Assistants**

# Personalized AI Research Assistants can evaluate interconnection applications without any customization needed.

- ❖ You compile all relevant project documents into one location.
- ❖ AI “reads” all of these documents, then serves as an expert partner.
  - It can flag inconsistencies.
  - It can notify you of missing project details.
  - It can raise concerns about a project, like if it doesn’t have enough land control.
  - It can automatically create questions to send back to a developer.
- ❖ You can improve the assistant overtime by giving it feedback on things it misses or gets wrong.



## Sources

+ Add

Discover

Select all sources

1500V SOLARWARE 2220\_2550\_20170530.pdf

Application Form.pdf

Canadian\_Solar-Datasheet-HiKu\_CS3W-MS\_EN.pdf

Land Agreement.pdf

## Chat

Refresh



## Interconnection Application Project Review

4 sources

Add note

Audio Overview

Mind Map

These are files submitted as part of a grid interconnection application. As the power systems engineer reviewing these documents, point out any important information and prepare questions that I can send back to the developer to ensure the application is complete

I uploaded these project files...

It summarized the documents and flagged that the **inverter datasheet didn't match** the model in the application.

As the power systems engineer reviewing the submitted documents for the Maplewood Solar Project's grid interconnection application, I have identified several key pieces of information and areas that require clarification to ensure the application is complete and accurate.

### Important Information from Submitted Documents

Based on the provided sources, here's a summary of the pertinent details for the Maplewood Solar Project:

- **Project Name and Developer:** The project is named **Maplewood Solar Project** and is being developed by **RenewCo Inc.** <sup>1</sup>. The primary contact is Jane Doe <sup>1</sup>.
- **Project Location:** The project is located at **123 Green Energy Lane, Springfield, USA**, with GPS Coordinates **39.9612° N, 105.2705° W** <sup>1</sup>. It spans two parcel IDs, **04-112-05-01** and **04-112-05-02**, totaling **50 acres** in Springfield County <sup>1</sup> <sup>2</sup>. A Land Lease and Easement Agreement for this property was made as of June 1, 2024, between Landowner LLC and RenewCo Inc. <sup>2</sup> <sup>3</sup>.
- **Proposed Capacity:** The proposed AC capacity for the project is **1.5 MW** <sup>1</sup>.
- **Solar Panel Details:**
  - The panel manufacturer is **Canadian Solar**, and the model number is **CS3W-450MS** <sup>1</sup>.
  - These are **HiKu Super High Power Mono PERC Modules**, with a nominal maximum power (Pmax) of **450 W** under Standard Test Conditions (STC) <sup>4</sup> <sup>5</sup>.
  - The modules have a maximum system voltage of **1500V (IEC/UL)** <sup>5</sup>.
  - They are designed for operation between **-40°C** and **+85°C** <sup>5</sup>.
  - The panels measure **2108 mm X 1048 mm X 40 mm** and weigh **24.9 kg** <sup>6</sup>.
- **Inverter Information (with noted discrepancy):**
  - The **Application Form** specifies the inverter manufacturer as **SolarEdge** and the model number as **SE-1500** <sup>1</sup>.
  - However, the submitted technical documentation includes a datasheet for **TMEIC SOLARWARE 2220/2550 Large Scale PV Inverters (PVH-L2220E and PVH-L2550E)** <sup>7</sup> <sup>8</sup>. These TMEIC inverters have rated powers of **2.22MW (PVH-L2220E)** and **2.55MW (PVH-L2550E)**, which are significantly higher than the project's stated **1.5 MW AC capacity** <sup>1</sup> <sup>...</sup>.
  - The TMEIC inverters can handle a maximum input voltage of **1500Vdc** and operate within an MPPT range of **800 - 1300Vdc** or **915 - 1300Vdc** depending on the model <sup>8</sup>. They also offer **night-time VAR compensation** <sup>7</sup>.

...And asked it to evaluate the application.

#### Questions for the Developer to Ensure Application Completeness

The most critical issue requiring immediate clarification is the discrepancy in the inverter information. Beyond that, further details on system design, interconnection, and auxiliary components are needed.

Here are the questions I recommend sending to RenewCo Inc.:

##### 1. Inverter Specification Clarification:

- The application form lists the inverter manufacturer as SolarEdge with model SE-1500, but the accompanying technical documentation provides specifications for TMEIC SOLARWARE 2220/2550 (PVH-L2220E/PVH-L2550E) inverters **1** **2**. Please clarify which specific inverter model(s) will be installed for the Maplewood Solar Project.
- If the SolarEdge SE-1500 is indeed the chosen inverter, please provide its complete technical datasheet, certifications, and specifications.
- If the TMEIC inverters are intended for use, please confirm this and provide an explanation for the discrepancy with the application form **1** **2**.

##### 2. Proposed Capacity and Inverter Sizing:

- The project's proposed AC capacity is 1.5 MW **1**. The TMEIC inverters provided have rated AC outputs of 2.22 MW and 2.55 MW **7** **8**. If TMEIC inverters are used, how will the 1.5 MW proposed capacity be achieved? Will larger inverters be significantly de-rated, or will only a portion of their capacity be utilized?
- Regardless of the chosen inverter model, please specify the number of inverters that will be installed to achieve the 1.5 MW AC capacity **1**.

##### 3. Solar Array Design Details:

- Given that the panels are Canadian Solar CS3W-450MS **1**, please provide the total number of individual solar panels proposed for installation.
- Please detail the electrical configuration of the solar array, including:
  - The number of modules per string.
  - The number of strings connected to each inverter input.
  - This information is crucial to verify that the string voltage (Voc and Vmp) and current (Isc and Imp) are within the selected inverter's maximum DC input voltage (1500Vdc for TMEIC models) and MPPT operating range (e.g., 800-1300Vdc or 915-1300Vdc for TMEIC models) **5** **8**.
- What is the total nominal DC capacity (kWp) of the PV array? This will help us understand the project's DC-to-AC ratio.

##### 4. Overall System Design and Site Layout:

- Please provide a detailed electrical single-line diagram of the proposed solar facility, showing all major components, including PV arrays, inverters, transformers, switchgear, and the proposed point of interconnection (POI) to the utility grid.
- Please submit a site plan or layout drawing indicating the physical placement of the solar arrays, inverters, control room, substation, access roads, and any other relevant structures within the 50-acre leased premises **2**.

##### 5. Interconnection Point and Grid Impact Analysis:

- Clearly define the proposed point of interconnection (POI) to the utility grid, including voltage level and specific location on the utility's system.
- While the TMEIC inverter supports night-time VAR compensation **7**, please provide a more comprehensive overview of the project's reactive power capabilities and proposed control strategy to ensure grid stability and voltage support.
- Please provide any preliminary analysis or studies conducted on the potential impact of the project on the grid, such as short circuit contribution, flicker, or harmonic distortion.

It also created a list of questions to send the developer.

➤ Fix the inverter discrepancy.

➤ Detail the electrical configuration of the solar array.

➤ Provide missing documents.

##### 6. Protection and Control Philosophy:

- Please detail the proposed protection scheme for the facility, including the types of relays, settings (e.g., overcurrent, over/under voltage, over/under frequency), and coordination with utility protection systems.
- Describe the overall control philosophy for the plant, including how it will interact with the utility's grid operations (e.g., remote control, SCADA integration).

##### 7. Project Schedule:

- While the land agreement is dated June 1, 2024 **3**, please provide a proposed project schedule with key milestones, including anticipated construction start and completion dates, energization date, and commercial operation date.

Providing these additional details and clarifications will allow for a thorough review of the interconnection application.

*Exploring AI Solutions*  
**App Builders**



# AI can build custom Apps for you.

- ❖ If you want something more custom, you can have GenAI build it for you!
- ❖ In under an hour, without writing a single line of code, you can create an App that digests all docs included in an interconnection application (including Single Line Diagrams) and analyzes the project for you.

# AI Interconnection Document Analyzer

A multi-step AI workflow to extract, summarize, and analyze project documents.

## Step 1: Upload Documents

Upload text documents, scans, or image-based PDFs (.txt, .csv, .pdf, .png, .jpg, .svg).



Click to upload or drag and drop  
Upload text, PDF, SVG, PNG, or JPG files

### Uploaded Documents

Land Agreement.pdf	
Grid Impact Study.csv	
Single Line Diagram.svg	
Application Form.pdf	
Canadian_Solar-Datasheet-HiKu_CS3W-MS_EN.pdf	
1500V SOLARWARE 2220_2550_20170530.pdf	

## Step 2: Summarize Files

The AI will process each file individually, performing OCR on images and PDFs as needed.

Summarize Files

### Summaries

#### Land Agreement.pdf

Here's a summary of the key information for a utility engineer:

**Project Overview:**

- Project Type:** Solar energy facility
- Location:** County of Springfield
- Acreage:** Approximately 50 acres (total)
  - Parcel ID: 04-112-05-01 (25 acres)
  - Parcel ID: 04-112-05-02 (25 acres)
- Developer:** RenewCo Inc. ("Tenant")
- Landowner:** Landowner LLC ("Landlord")
- Agreement Date:** June 1, 2024

#### Grid Impact Study.csv

**Grid Impact Study Summary:**

This study assesses the grid impact of an interconnection project. Key findings:

- Voltage Flicker (Pst):** 1.8%, Marginal. Exceeds the 1.5% threshold, requiring further review.
- Power Factor:** 0.99, Pass.
- Short Circuit Current Contribution:** 2500 Amps, Pass. Within breaker duty limits.
- Thermal Loading Impact:** 1.2%, Pass. Minimal impact on existing lines.

\*This document is missing project name, capacity, equipment models, technical specifications, and developer name. The above information represents the summary based on the data provided in the document.\*

#### Single Line Diagram.svg

**Single Line Diagram Summary:**

This single-line diagram depicts a PV system interconnection with the utility grid. Key elements include:

- PV Array:** Connected to an inverter.
- Inverter:** Model SE-1500.
- AC Disconnect:** Located downstream of the inverter.
- Transformer:** Rated at 2.0 MVA.
- Utility Meter:** Installed before the Point of Interconnection (POI) with the Utility Grid.

**Missing Information (Required for complete utility review):**

- Project Name
- Developer Name
- Capacity (DC and AC) - While the transformer is 2MVA, the actual PV system capacity is not defined.
- Specific Technical Specifications - Voltage flicker data, grounding details, protective relay settings, conductor sizes, and other technical parameters are not included.
- Acreage or physical size of the PV Array

**Note:** This summary is based solely on the provided diagram's text descriptions and may be incomplete without additional documentation.

## Step 3: Generate Insights

The AI will perform a cross-document analysis on the summaries.

Generate Insights

### Final Analysis Complete

#### Consolidated Data

Data Point	Value	Source
Project Name	Maplewood Solar Project	Applic
Developer	RenewCo Inc.	Applic
Project Capacity (MW)	1.5 MW	Applic
Location	123 Green Energy Lane, Springfield, USA; GPS: 39.9612° N, 105.2705° W	Applic
Total Acreage	50 acres	Land /
Inverter Manufacturer & Model	SolarEdge, Model SE-1500	Applic
Panel Manufacturer & Model	Canadian Solar, Model CS3W-450MS	Applic
Inverter Model	SE-1500	Single
Transformer Rating	2.0 MVA	Single
Voltage Flicker	1.8%	Grid in
Panel Model	CS3W-430(435)(440)(445)(450)(455MS	Canad

#### AI-Generated Insights


- Application Form lists Inverter Model SolarEdge SE-1500, but Single Line Diagram lists Model SE-1500, and SolarWare datasheet is for models PVH-L2220E and PVH-L2550E. This is a mismatch.
- Application Form lists Panel Model CS3W-450MS, and the Canadian Solar datasheet includes models CS3W-430(435)(440)(445)(450)(455MS, indicating a match within the product family.
- The project capacity is 1.5 MW and the site acreage is 50 acres. Based on a land use rate of 8 acres per MW, the project requires 1.875 acres. 50 acres / 1.875 acres/MW = 26.67 acres. The site acreage of 50 acres is sufficient.
- Voltage Flicker is 1.8%, which exceeds the threshold of 1.5%.
- The Canadian Solar panel's nominal max power is between 430 W and 455 W, depending on the specific model.
- The SolarWare inverter's peak efficiency is 98.7-98.8%.

Screenshots of an application screening app built w/ Canvas.

➤ Here's a simplified [demo app](#) built with a single Canvas prompt.

*Exploring AI Solutions*  
**Cleaning Data**

AI can pull data with  
inconsistent formats  
and units from  
screenshots, PDFs,  
and Excel Files into  
one clean table.



Shinson-Fl...-450W-60CW PDF

\_Solar Pan...ions Table XLSX

Create a table showing important information from each of these solar panel datasheets

Show thinking ▾

Of course. Here is a consolidated table showing the important specifications from each of the solar panel datasheets you have provided.

To provide a clear comparison, the table uses the highest power rating available from datasheets that listed a range of models.

### Solar Panel Specification Comparison

Feature	Tech Wise Solar	Gamko Energy	Sunket (BIPV)	Sunket (Bifacial)	MY Series	Shinson (Flexible)
Model	TW-630HD-1	GKA157M60-340W	SKT390M10	SKT430M10-108D4	MY-M12/144-700	SSL-450W-60CW
Max Power (Pmax)	630 W	340 W	390 W	430 W	700 W	450 W
Module Efficiency	23.3%	20.90%	19.97%	22.00%	22.3%	20.8%

Ask Gemini

+ Video Deep Research Canvas Search

*Exploring AI Solutions*  
**Analyzing Data**

AI can serve as your own  
personal data scientist.

It will analyze data for insights,  
run models, create charts / tables,  
and suggest next steps.



# AI can analyze PLEXOS outputs\* to find transmission congestion issues...

\*Note, PLEXOS outputs were combined into a CSV w/ a Python script to be imported into Gemini.



Yes, based on the price separation between major trading hubs in your results, **the model clearly shows significant transmission congestion issues.**

I analyzed the `wecc_results.csv` file for price data and found monthly average prices for five key hubs in the Western Interconnection (WECC). The differences in these prices are a direct indicator of congestion, as it means cheaper power from one area cannot flow freely to a more expensive area.

Here are the key findings from the analysis, which are also shown in the plot below:

## Evidence of Congestion

- Consistent North-to-South Price Separation:** There is a persistent and significant price difference between the **Mid-C** (Mid-Columbia) hub in the Pacific Northwest and the California hubs (**NP15** and **SP15**). For example, Mid-C prices are frequently much lower than prices in California, which is classic evidence of congestion on the transmission paths flowing south from the hydro-rich Pacific Northwest.
- California Internal Congestion:** There are also noticeable price differences between **NP15** (Northern California) and **SP15** (Southern California). While they track each other more closely than they do with Mid-C, the separation indicates that there are limitations on the transmission capacity *within* California.
- Southwest Price Spikes:** The **Palo Verde** hub in Arizona shows the highest volatility and the highest peak prices, reaching over  $140/\text{MWh}$  in one month. This indicates periods where the Southwest is "walled off" by congestion and must rely on more expensive local generation to meet demand.

```
!["WECC Hub Prices"]()
```

```
### Summary of Average Prices
```

Here is a summary of the average monthly prices across the hubs, which quantifies the congestion:

```
| Hub | Average Price (/MWh) |
```

```
| :--- | :--- |
```

```
| Mid-C | $24.16 |
```

```
| Four Corners | $37.49 |
```

```
| SP15 | $38.50 |
```

```
| NP15 | $40.04 |
```

```
| Palo Verde | $49.41 |
```

In an uncongested grid, these prices would be nearly identical. The wide spread in these average prices is a clear sign that the model is resolving transmission constraints that prevent the free flow of power.

...And then recommend solutions.

What would be the best actions to eliminate these congestion issues?



Show thinking ▾

Excellent question. This is the core of transmission planning and grid modernization. Based on the congestion patterns we identified—primarily North-to-South limitations and local "load pockets" in California and the Southwest—here are the best actions a utility or grid operator would consider to alleviate these issues, broken down into two main categories.

There is no single "best" solution; the optimal approach is always a portfolio combining several of these options, guided by detailed engineering and economic analysis.

#### Category 1: Transmission Infrastructure Solutions ("More or Bigger Wires")

These are traditional, capital-intensive projects focused on physically increasing the grid's transfer capacity. They are highly effective but have long lead times and can be difficult to permit.

1. **Build New Transmission Lines:** This is the most direct solution. Based on the price separation, key corridors would be:
  - **A new major Path from the Pacific Northwest (Mid-C) to California (NP15/SP15):** To move more low-cost hydro and wind power south.
  - **A new East-to-West Path from the Desert Southwest (Palo Verde/Four Corners) into Southern California:** To bring large-scale solar and wind resources to the coastal load centers.

#### The Engineering Path Forward

To determine the *best* course of action, a transmission planner would:

1. **Run Detailed Simulations:** Use a production cost model (like the PLEXOS model that generated your results) to create a "business-as-usual" base case.
2. **Model "What-If" Scenarios:** Create new scenarios for each potential solution (e.g., a case with a new transmission line, a case with 1,000 MW of new batteries in SP15, etc.).
3. **Perform a Cost-Benefit Analysis:** Compare the total system production cost (mostly fuel and operational costs) in each scenario. The reduction in cost compared to the base case is the "congestion savings" or annual benefit.
4. **Compare Benefits to Costs:** Compare the annual savings of each solution to its upfront capital cost. The most cost-effective solution or portfolio of solutions is the one that provides the highest benefit for the lowest cost over its lifetime.

*It gives specific T-line suggestions!*

*How to get the most  
out of AI*

# Treat AI like a partner, not a tool.

- ❖ Instead of coming up with the perfect prompt, ask AI to prompt itself.
  - Instead of “Would this be a good project to submit for an interconnection application?”
  - Try “I want you to determine if this project would be a good interconnection application submittal. What information do you need from me to evaluate this?”
- ❖ When you get mediocre results, give it feedback on how it can improve.
  - “These results weren’t great... Your evaluation of this project was too vague. What information do you need from me to give me a more detailed response?”
- ❖ Let AI troubleshoot problems for you.
  - If you get an error, feed it to AI, and it can solve it on its own.
- ❖ Build up trust over time.
  - Instead of asking AI to approve an application, ask it to flag any problems to speed up your screening.
  - Automated braking can offer a lot of value before you’re okay riding in a fully autonomous vehicle.

# Appendix