DISTRIBUTION SYSTEM GUIDELINES FOR

ELECTRIC VEHICLE ADOPTION

A Guidebook for WPPI Energy Member Utilities

WPPI ENERGY

CONTENTS

INTRODUCTION

HOW DID THIS PROJECT COME ABOUT?

Members approached WPPI concerned with how electric vehicle loads would impact local distribution systems.

In 2022-2023, WPPI partnered with Power System Engineering to study the impact of EVs on local distribution systems with a multipronged analysis and answer the following questions:

- When and where are EVs coming?
- How should utilities plan secondaries and transformers?
- How might EVs impact a full distribution system over the next 20 years?

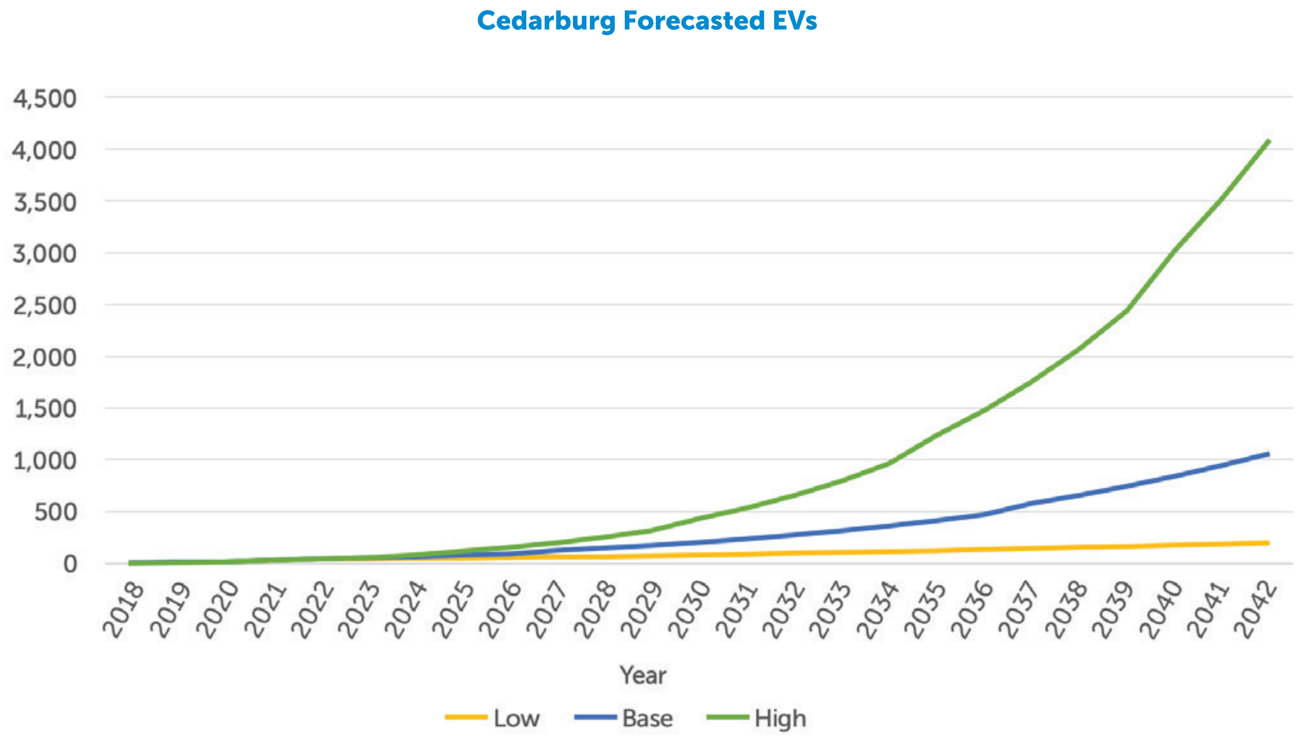
The goal of this guideline is to provide a technical reference for members as they plan their distribution systems, with EV adoption in mind. WPPI's goal is not to tell members what to do, but instead provide information to help members make informed decisions.

This guideline is intended to be a living document, with updates made as additional information becomes available.

KEY TAKEAWAYS THAT WILL HELP MEMBERS PREPARE FOR RESIDENTIAL EV ADOPTION:

- **EVs are coming** and will impact all electric utilities. EV adoption rates vary by community and depend on factors such as community demographics and advances in EV and EV charger technology. It is possible to quantify these factors through a forecasting tool. (reference *Figure 1*)
- **EV loads can be substantial.** WPPI's 2022–2023 EV Planning Study showed an average EV charger load of 11.5 kilowatts. The addition of an EV could triple a customer's peak demand.
- **Taking a measured approach to existing infrastructure is important.** The report does not encourage utilities to proactively swap out existing distribution equipment to prepare for EV adoption. Instead, utilities should use available data to monitor transformer loads and prioritize equipment upgrades. Data is a valuable tool for utilities as they prepare for customer electrification. The anticipated pace of EV adoption will be manageable.
- **Residential services should be designed with EVs in mind.** When sizing new services, utilities may want to plan for one EV for every four to five residential customers. This assumption varies based on demographics, service area, and a utility's ability to influence charging behavior. Additional insights on transformer sizing are detailed in this guideline.
- **Flexible electric rates benefit customers and utilities.** The need for distribution system upgrades will be dictated by when and how customers charge their EVs. Data shows that residential customers are reactive to price signals, such as time-of-use rates. These rates encourage customers to charge off-peak, resulting in lower power costs for all customers.
- **Existing primary systems may be well equipped for customer electrification.** Based on WPPI's EV Planning Study, an existing 24.9 kV primary distribution system may be well positioned to serve projected EV growth over the next 20 years. However, a 4.16 kV system will be less prepared. This may further justify utility voltage conversion projects.

Figure 1. Sample EV Forecast for WPPI Member



PLANNING FOR AND IDENTIFYING EVS ON EXISTING DISTRIBUTION SYSTEM

When preparing a utility's distribution system for future EV growth, best practices include:

1. Do not proactively replace transformers. Research showed that replacing transformers as needed is adequate. Use the methodologies outlined below to identify when transformers may need to be upgraded.

2. Use available tools to identify overloaded transformers and secondaries.

Utilities with advanced metering infrastructure (AMI) have the following capabilities:

Transformer loading tool
The tool can help determine if a transformer is sized correctly by showing coincident peak demand for the last two years.
Additional information is available in Appendix A.

EV locator tool
This tool can mine AMI data to identify customers with load profiles consistent with EV chargers.
Additional information is available in Appendix B.

Daily AMI Reports
Daily automated reports have the potential to provide alerts on phase voltage dips. A phase voltage dip could be indicative of several issues, one of which signals the overloading of a transformer or secondary wire due to an EV.

Utilities without AMI still have options, including:

Infrared scans
Infrared scanning is a noninvasive inspection technique that uses a thermal imaging camera to detect high levels of heat emitted in the form of infrared radiation.

Regular system inspections
Electric utilities should perform a physical inspection of their distribution system every five years, and WI members are required to per Public Service Commission of Wisconsin requirements. Infrared inspections are complementary and highly encouraged.

System level monitoring to identify overloaded equipment
As part of substation inspections, utilities can monitor feeder level loads using relay information. Some members can monitor substation loading through their SCADA systems. This system level modeling would be most helpful if heavy EV penetration leads to feeder overloading.

Identifying customers with EVs through other means:

1. Track customers who receive rebates for EV chargers.

2. Ask for information about EVs on service applications.
Consider requesting information on the make/model/size of charger, make/model of vehicle, and the number of EVs at the residence.

3. When an EV customer is identified, consider how data will be tracked and updated.
Potential tracking mechanisms include CIS or GIS systems. WPPI intends to consider an optional consistent approach for members that best fits within the current technology suite.

State Level Vehicle Registration Data
WPPI continues to monitor options to obtain vehicle registration data through state agencies in Wisconsin, Iowa, and Michigan.

PLANNING FOR EVS IN NEW RESIDENTIAL DEVELOPMENTS

TRANSFORMER SIZING

It is important to use basic system planning principles. The following table suggests how to size a new transformer for residential services based on the home size and the number of homes on the transformer. This table assumes zero EVs.

> *Note: More homes on a transformer means greater diversity in load. For example, it's unlikely that six homes will all hit their peak at the same time. Therefore, with more homes on a transformer, one may assume a lower number of kilovolt-amps (kVA) per home.*

HOW SHOULD EVS BE CONSIDERED WHEN SIZING A NEW SYSTEM?

Level 2 EV chargers deliver a charge of between 6.2 and 19.2 kilowatts (kW). The WPPI EV Planning Study analyzed 2022 interval data from a sample Midwestern utility with significant EV penetration, finding the average EV load per charger to be 11.5 kW (11.6 kVA). A 60-amp circuit is common for an EV charger, with 48 amps of draw.

The study suggests that, for now, it is reasonable to plan one EV for every four to five homes. Please note that this is on average, and certain areas will be more concentrated while others will have no EVs.

Figure 2: kVA per Home Based on Home Size.

		Number of Homes					
		1	2	3	4	5	6
Home Size (sq ft)	**1,500**	5.0	4.5	4.3	4.1	3.9	3.9
	1,800	5.5	5.0	4.7	4.5	4.3	4.2
	2,100	7.0	6.3	6.0	5.8	5.5	5.4
	2,400	8.0	7.2	6.8	6.6	6.2	6.2
	3,000	10.0	9.0	8.5	8.2	7.8	7.7

STRATEGIES TO FUTURE-PROOF SECONDARY INSTALLATIONS

Regardless of the transformer selected and installed, utilities can future-proof installations by ensuring that transformers can be easily upgraded. Some ways to support easy upgrades include:

- Considering front easements
- For rear easements, ensure adequate access routes
- Ensure underground secondary sizes are adequate for future growth
- Consider conduit for underground secondaries

THE TIMING OF EV CHARGING IMPACTS TRANSFORMER LOADING

Coincidence Factor is the peak of a system divided by the sum of the peak loads of its individual components. It demonstrates how likely it is for the individual components to peak at the same time. The coincidence factor is always less than one.

The timing of EV charging can be quantified by the "coincidence factor." For the purposes of this guideline, the coincidence factor can be used to measure two different ways that EVs may impact the distribution system:

$CF_{EVMETER}$: How likely it is that EV charging sessions will peak at the same time.

$CF_{EV@SYSPEAK}$: How likely it is that EV charging will peak at the same time as the overall system peak.

What impacts the coincidence factor?

1. When customers choose to charge their EVs. Occupancy patterns and time-of-use (TOU) rates will both influence when a customer chooses to charge their vehicle.

2. The rate at which a customer charges their vehicle. For example, EVs can be programmed to charge more slowly over a longer period of time.

Why does the coincidence factor matter?

The coincidence factor will impact the additional kVA per home when replacing or adding transformers.

As more data is collected utilities may opt to calculate a customized EV related coincidence factor to aid in distribution system planning.

Example: A Conservative Approach

Assumptions:

- Transformer is servicing five 3,000-square-foot homes, including three EV chargers
- EV charger load is 11.6 kVA per charger
- $CF_{EVMETER}$ is 0.70*
- kVA per home is 7.8 based on Figure 3: Conductor Size and Related Ampacity on p.7.

*** Based on the 2022/23 study of a sample midwestern utility with an effective EV TOU rate, one may assume a coincidence factor of 0.70 for EV chargers. It's notable that for this utility, the peak EV demand occurred at midnight. More information is available in Appendix C.**

Transformer Peak kVA =
#Homes * kVA/home + #Chargers * kVA/charger * CF

*Transformer Peak kVA = 5*7.8kVA + 3 * 11.6kVA * 0.70*

Transformer Peak kVA = 53.4kVA

> *Note: This assumes EV peaking will occur at the same time as the system peak. Using tools like TOU rates, managed charging, and customer education will reduce the likelihood of this happening.*

A more detailed discussion of coincidence factor and alternative, less conservative, approaches to determine transformer sizing can be found in Appendices C and D. Appendix E offers information on transformer overloading considerations.

WIRE SIZING

Utilities should ensure the wire size is large enough to handle future growth. Additional consideration should be given to the placement of the wire.

Underground
The recommended service size for a 200-amp service (secondary service to individual homes underground) is 1/0 AL Triplex, direct buried or 4/0 AL Triplex in conduit.

Overhead
If rebuilding overhead, the bare minimum is #2 AL Triplex. The 1/0 Triplex OH is adequate for 200-amp service.

Pedestals
The recommended service for a secondary feed to a pedestal is 350 MCM.

The Figure 3 below shows conductor sizes and the related ampacity, broken out by underground and overhead wires.

SECONDARY DESIGN ADDITIONAL CONSIDERATIONS

Pedestals

What not to do
Do not place pedestals in series or the underground wire may become a point of failure. Longer lengths of wire will also lead to an additional voltage drop.

What to do
Carefully consider the use of pedestals, with a preference for transformer-to-home connections. More homes on a pedestal create more risk of conductor overloading.

When installing pedestals, carefully consider the wire size. EVs may add an unknown additional load to one component of the system with buried secondary wires, which can make underground wire the point of failure for pedestals.

Transformer Placement
Place transformers in such a way that they can be easily sized up in the future.

Use of Conduit
Carefully consider the use of conduit. Using conduit allows for easy replacement of wire but limits the wire's ampacity rating without being directly buried.

Figure 3: Conductor Sizes and Related Ampacity

	Conductor Size	Ampacity (direct buried/duct)
Underground	350 MCM	390/255
	350 MCM Quadraplex	390/255
	4/0 AL Triplex UG	350/255
	2/0 Triplex UG	270/170
	1/0 Triplex UG	240/150
	1/0 AL Triplex UG	240/150
	350 Triplex UG	240/150
	#2 AL Triplex UG	185/140
Overhead	4/0 Triplex OH	405
	2/0 Triplex OH	300
	1/0 Triplex OH	260
	#2 AL Triplex OH	195

PLANNING AND PREPARING FOR EV ADOPTION SYSTEMWIDE

As EV adoption increases, it is vital to consider EV load additions during systemwide planning efforts. Two questions to ask include:

1. How many EVs are currently on the system? This question can be assisted by using publicly available data, the EV locator tool, service applications and charger rebates.

2. How many EVs will be on the system in the future? EVs can be allocated to individual feeders and circuits based on:

- Local knowledge
- History
- Housing size or house value. During the current "early adopter" phase, there is a correlation between housing size or housing value and homes with EVs (data from 2022).

Case study

WPPI's EV Planning study analyzed data from a sample Midwestern utility with high EV penetration. The study showed that homes with higher values were more likely to be early adopters of EVs (see Figure 4 below).

Case findings

In 2023, a systemwide planning study, incorporating the future of EV loads, was completed for Cedarburg's distribution system. That study found that the 24.9 kV portion of their system was adequate in most situations, with a few exceptions at feeder exits. If the EV load were reallocated to the 4.16 kV portion of their system, more systemwide issues could be expected.

Whether building a new substation or rebuilding the current distribution system, it is important that EV loads are incorporated into the forecast.

Figure 4: Home Value in Relation to Percentage of Customers with EVs

		Homes with EVs	Homes without EVs	% of Customers with EVs
Home Value	<$250	2	413	**0.5%**
	$250-$400 K	39	4474	**0.9%**
	$400-$700 K	142	5720	**2.4%**
	>$700	14	415	**3.3%**

ADDITIONAL TOOLS FOR CONSIDERATION

Geographical Information System

A detailed Geographical Information System, including secondary cables, transformer sizes, and a field for EV charger locations will be useful in the development of an engineering model. GIS can help with visually benchmarking the system load and system characteristics such as the placement of EV chargers.

Engineering Model

The benefit of including EVs in an engineering model includes accurately modeling distribution equipment, conductors, customers, transformers, secondaries, and loads on the distribution system.

A detailed system model will assist with an assessment of the distribution system, help locate areas of concern, and forecast where possible load may happen.

APPENDICES

A. TRANSFORMER LOADING TOOL

https://wppienergy.org/transformer-loading/

Use to determine if a transformer is sized correctly by showing coincident peak demand for the last two years. Requires advanced metering infrastructure.

There are two ways in which a member may want to consider using the transformer loading tool to support distribution system planning for EVs:

1. Full system analysis: With all accounts assigned to transformers, members can receive a monthly report identifying the loading of each transformer on their system.
2. Partial system analysis: Without all accounts assigned to transformers, members may identify individual customers with EVs. Then, they may run "ad hoc" reports, determining the loading of transformers with known EVs.

B. EV LOCATOR TOOL

Use to identify customers with loads that are consistent with electric vehicles. Requires advanced metering infrastructure. Interested members may reach out to Anna Stieve at astieve@wppienergy.org.

C. COINCIDENCE FACTOR (CF)

CF is the ratio of the peak demand of a whole system to the sum of the individual peak demands within that system. The CF will always be between 0 and 1. CF is a critical piece of system design and greatly impacts the results of a planning study.

$$CF = \frac{\text{Systemwide Peak Demand}}{\sum \text{Individual Peak Demands}}$$

For calculation purposes, there are two ways to think about the CF of EV loads:

$CF_{EV@SYSPEAK}$

What are EVs doing when the system peaks?

This was not measured as part of the study but can be evaluated for utilities in the future as more data is collected.

$CF_{EVMETER}$

How likely it is that EVs will peak at the same time as other EVs?

This was measured as part of the WPPI EV Planning Study for a sample Midwest utility that had implemented TOU rates. In this case, there was a 70% summer CF and a 63% winter CF. Note that this occurred at midnight when systemwide loads were otherwise low.

It is most beneficial to look at both factors to determine where the pinch point is for the system.

Data to inform this analysis can come from multiple sources, as detailed in the first section of this report: Planning for And Identifying EVs on Existing Distribution System.

It is also important to consider the time at which EVs are peaking. A single EV on the transformer will have a very different impact on the transformer's load at midnight, when all other customer usage is low, versus at 5 pm on a summer afternoon, when other customer usage is high. Multiple EVs on a transformer change the equation. For example, if three EVs come on at midnight, the transformer may experience a new peak.

> *Note: Cooler weather (i.e. at midnight) allows for greater transformer loading. The cooling effect of the ambient temperature in the winter can then be factored into the selection of a transformer size. If the winter load is greater than 1.25 times the summer load, the winter load should be used to size the transformer. Likewise, ambient temperature impacts the capacity rating of the transformer or the amount of acceptable overload.*

The steps to calculate the coincident factor include:

Normalize the AMI readings to an hourly read (max value at each hour per meter)

Numerator: Sum the kW for the meters with EV chargers across the system and find the peak value/hour in June and January (systemwide coincident peak)

Denominator: Sum the max kW per EV meter (sum of each individual meter's peak)

$$EV\ meter\ Coincident\ Factor = \frac{June\ or\ January\ Peak\ Total\ kW}{Sum\ of\ Max\ kW\ per\ Meter}$$

D. ALTERNATIVE APPROACHES FOR SIZING RESIDENTIAL TRANSFORMERS

With many unknowns, adequately planning for and serving EV loads presents a challenge for utilities. We don't know:

- EV penetration (when & where)
- Rate design
- The impact of TOU rates
- Consumer behavior

There are varied system planning approaches, which can help support utilities. Some utilities may want to design their systems very conservatively. Others may feel more comfortable pushing the limits of transformer loading or sizing systems for today with plans to monitor and upgrade.

The following approaches intend to provide a structured approach to thinking through decision making with many unknowns.

Calculation Examples: Conservative Approach

The following approach is a conservative way to consider how chargers may impact your distribution system.
In this approach, the most conservative CF is applied to EV charger load, then added to the diversified load. This is conservative because with the implementation of EV rates and TOU rates, often EV chargers are not peaking when the system peaks.

In this approach, you take the following steps:

1. Look at the expected kVA/home peak (likely occurs on summer afternoons)
2. Consider the number of EV chargers
3. Determine the coincidence factor of the EV chargers on your system ($CF_{EVMETER}$)
4. In this case, we use a factor of 70%. This is the CF that a sample Midwest utility saw at midnight after implementing effective EV charging rates
5. If $CF_{EV@SYSPEAK}$ * EV Load (kVA) > EV Load (kVA), apply a coincidence factor to the EV charger load. If not, use EV Load (kVA)

kVA/HOME	HOMES WITH EVs					
Home Size (sq ft)	**1**	**2**	**3**	**4**	**5**	**6**
1,500	5.0	4.5	4.3	4.1	3.9	3.9
1,800	5.5	5.0	4.7	4.5	4.3	4.2
2,100	7.0	6.3	6.0	5.8	5.5	5.4
2,400	8.0	7.2	6.8	6.6	6.2	6.2
3,000	10.0	9.0	8.5	8.2	7.8	7.7

Example 1:

Inputs: Two 2,100 square foot homes, one with an EV charger

Calculation: Baseline kVA per home = 6.3 kVA

Baseline loading = 2 * 6.3 = 12.6 kVA

EV charger load = 11.6 kVA

Transformer peak loading = 12.6 + 11.6 = 24.2 kVA

Example 2:

Inputs: Three 1,500 and two 2,400 square foot homes, three with EV chargers

Calculation: Baseline kVA per 1,500 square-foot homes = 3.9 kVA, 2,400 square-foot homes = 6.2 kVA

Baseline loading = 3 * (3.9) + 2 * (6.2) = 24.1 kVA

EV charger load = (11.6 + 11.6 + 11.6) * 0.70 = 24.4 kVA

Transformer peak loading = 24.1 +24.4 = 48.5 kVA

Calculation Examples: A Member Customized Approach

The following approach considers both:

1. What is the likely EV load when residential customer load is peaking?
2. When EVs are peaking, will these EV chargers create a new systemwide peak at a different time?

This approach relies on member-specific analyses. It is most appropriate for members with AMI data, which is required both for the analysis and for ongoing transformer level monitoring.

Step 1: What is the likely EV load when the system is peaking?

1. Look at the expected kVA/home peak (likely occurs on summer afternoons)
2. Consider the number of EV chargers
3. Determine the coincidence factor of the EV chargers when the system is peaking ($CF_{EV@SYSPEAK}$)
4. If $CF_{EV@SYSPEAK}$ * EV Load (kVA) > EV Load (kVA), apply a coincidence factor to the EV charger load. If not, use EV Load (kVA)

Example 1:

Assumptions: $CF_{EV@SYSPEAK}$ = 0.4

Inputs: Two 2,100 square foot homes, one with an EV charger

Calculation: Baseline kVA per home = 6.3 kVA

Baseline loading = 2 * 6.3 = 12.6 kVA

EV charger load = 11.6 kVA

Transformer peak loading = 12.6 + 11.6 = 24.2 kVA

Example 2:

Assumptions: $CF_{EV@SYSPEAK}$ = 0.4

Inputs: Three 1,500 and two 2,400 square foot homes, three with EV chargers

Calculation: Baseline kVA per 1,500 sqft homes = 3.9 kVA, 2,400 sqft homes = 6.2 kVA

Baseline loading = 3 * (3.9) + 2 * (6.2) = 24.1 kVA

EV charger load = (11.6 + 11.6 + 11.6) * 0.40 = 13.9 kVA

Transformer peak loading = 24.1 +13.9 = 38.0 kVA

kVA/HOME	HOMES WITH EVs					
Home Size (sq ft)	1	2	3	4	5	6
1,500	5.0	4.5	4.3	4.1	3.9	3.9
1,800	5.5	5.0	4.7	4.5	4.3	4.2
2,100	7.0	6.3	6.0	5.8	5.5	5.4
2,400	8.0	7.2	6.8	6.6	6.2	6.2
3,000	10.0	9.0	8.5	8.2	7.8	7.7

Step 2: When EVs are peaking, will these EV chargers create a new systemwide peak at a different time?

1. Determine the coincidence factor of the EV chargers on your system ($CF_{EVMETER}$)
   a. In this case, we use a factor of 70%. This is the CF that a sample Midwest utility saw at midnight after implementing effective EV charging rates
2. Look at the expected kVA/home at the times EVs peak (ex. midnight)
3. Consider the number of EV chargers
4. If $CF_{EV@SYSPEAK}$ * EV Load (kVA) > EV Load (kVA), apply a coincidence factor to the EV charger load. If not, use EV Load (kVA)

Example 1:

Assumptions: $CF_{EVMETER}$ = 0.7, occurring at midnight
Baseline kVA per home: 1.5 kVA at midnight
Inputs: Two 2,100 square foot homes, one with an EV charger
Calculation: Baseline loading = 2 * 1.5 = 3 kVA
EV charger load = 11.6 kVA
Transformer peak loading = 3 + 11.6 = 14.6 kVA

Example 2:

Assumptions: $CF_{EVMETER}$ = 0.7, occurring at midnight
Baseline kVA per home: 1.5 kVA at midnight
Inputs: Three 1,500 and two 2,400 square foot homes, three with EV chargers
Calculation: Baseline loading = 5 * 1.5 = 7.5 kVA
EV charger load = (11.6 + 11.6 + 11.6) * 0.7 = 24.4 kVA
Transformer peak loading = 7.5 + 24.4 = 31.9 kVA

Step 3: Determine the system "pinch point"

In the final step, we compare the results of Step 1 and Step 2 to determine when the system may experience the highest loads, given that EVs may peak at a different time than other residential customers.

Example 1:

Inputs: Two 2,100 square foot homes, one with an EV charger
Step 1: What is the impact of EVs during the regular systemwide peak?
Transformer peak loading = 12.6 + 11.6 = 24.2 kVA
Step 2: When are EVs peaking? Will that create a new systemwide peak?
Transformer peak loading = 3 + 11.6 = 14.6 kVA

In this scenario, with low EV penetration, it makes sense to most closely consider how EVs will impact the existing residential systemwide peak.

Example 2:

Inputs: Three 1,500 and two 2,400 square foot homes, three with EV chargers
Step 1: What is the impact of EVs during the regular systemwide peak?
Transformer peak loading = 24.1 +13.92 = 38.0 kVA
Step 2: When are EVs peaking? Will that create a new systemwide peak?
Transformer peak loading = 7.5 + 24.4 = 31.9 kVA

In a scenario with higher EV penetration, EVs impact both on- and off-peak periods.

E. INDUSTRY STANDARDS: TRANSFORMER OVERLOADING

According to ANSI/IEEE Std. C57.91, a transformer with a 4-hour peak overload and preloading of 90% can be loaded to 136% of its nameplate rating in the summer (30°C, 86°F) and nearly 173% of its nameplate rating in the winter (0°C, 32°F) without significant loss of life.

F. EV FORECASTING

An EV forecasting tool was developed in coordination with the 2022-2023 EV Distribution Planning Member Working Group. This tool is used to estimate EV adoption over time per community. Member utilities may contact WPPI if interested in running data for the local community.

The goal of EV forecasting is to estimate how many EVs will be in the community over the next 20 years.

Data sources include:

1. Alternative Fuels Data Center: Number of public chargers
2. Bureau of Economic Analysis: Per capital income
3. Census Data: Population density
4. Dept. of Motor Vehicles: Registered EVs
5. Kelly Book: Price of EV versus ICE vehicle
6. Office of Energy Efficiency & Renewable Energy: Battery range
7. US Energy Information: Price of Gas
8. Utility rates: Price of electricity

As additional data sources become available, WPPI will continue to incorporate those data sources into future models.

G. TRANSFORMER PURCHASING

Utility Service rules outline the standard-sized transformer provided to customers. In some cases, the utility provides the standard sized transformer at no cost to the customer. In other cases, the utility provides the standard sized transformer, up to a size limit (ex. 300 kVA), with the customer paying costs above that limit.

Although WPPI does not recommend changing service rules abruptly, it is in the best interest of the utility's long term financial health to provide the standard-sized transformer at no cost to the customer. Any portion of the transformer the customer pays for is booked by the utility as "contributed plant." Contributed plant is purely an expense to the utility and is not generating a return.

On all plant additions, contributed and utility financed, the utility incurs costs: PILOT, maintenance expense and property insurance expense. However, any portion paid for by the utility is booked as a "utility financed plant." **With a utility financed plant, a utility will recover its capital costs through depreciation expense and earn a return (which provides positive cashflow) on the asset.**

	Portion of transformer cost paid for by utility	Portion of transformer cost paid for by customer
Utility incurs PILOT expenses	x	x
Utility incurs maintenance expenses	x	x
Utility incurs property insurance expenses	x	x
Utility earns a rate of return on asset	x	

Example:

The Public Service Commission of Wisconsin sets the depreciation rate for transformers at 27-34 years.

If one assumes a transformer costs $1,000 (for simplicity), with a 30-year life and 6.2% rate of return, the utility will recover the full $1,000 plus $900 in return.

In conclusion, when utilities choose to have the customer pay for the transformer, the utility is foregoing significant cashflow over the transformer's life.

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