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Holistic Evaluation Methodology for Electric Vehicle Charging Station Location within Utility Service Territory

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Context

- "Annual Electric Vehicle (EV) sales increased globally from 300,000 in 2014 to 500,000 in 2015" *The International Council on Clean Transportation.*
- "Falling battery costs will mean electric vehicles will also be cheaper to buy in the U.S. and Europe as soon as 2025" *Bloomberg New Energy Finance.*
- Subject matter experts' predictions on EV adoption in the next 10 years suggest that we will see this industry emerge.
- The electrification of the transportation industry is expected to directly affect electric grid planning and operation.
- Potential challenges and opportunities are yet to be explored.

EV Infrastructure

To make this a reality, Electric Vehicle (EV) infrastructure is crucial:

- To accommodate EV market growth, ensuring access to power for current and future drivers
- To limit range anxiety (drivers' concern that they might not have a charging station nearby when their battery runs out)

Increased amount of EV charging stations → Direct impact on Distribution System Planning and Operation →

Opportunities for Utilities

- Develop methods to manage addition of new loads
- Develop new services benefiting customers and the grid
- Increase utilization of existing assets

Level 1 Charging	• Typically, 120 VAC, single phase • Around 3-5 miles of drive range per hour
Level 2 Charging	• Typically, 240 VAC, single phase • Around 10-20 miles of drive range per hour
DC Fast Charging	• Typically, 480 VDC • Up to 40 miles of range for 10 minutes of charging

Introduction to the Screening Tool

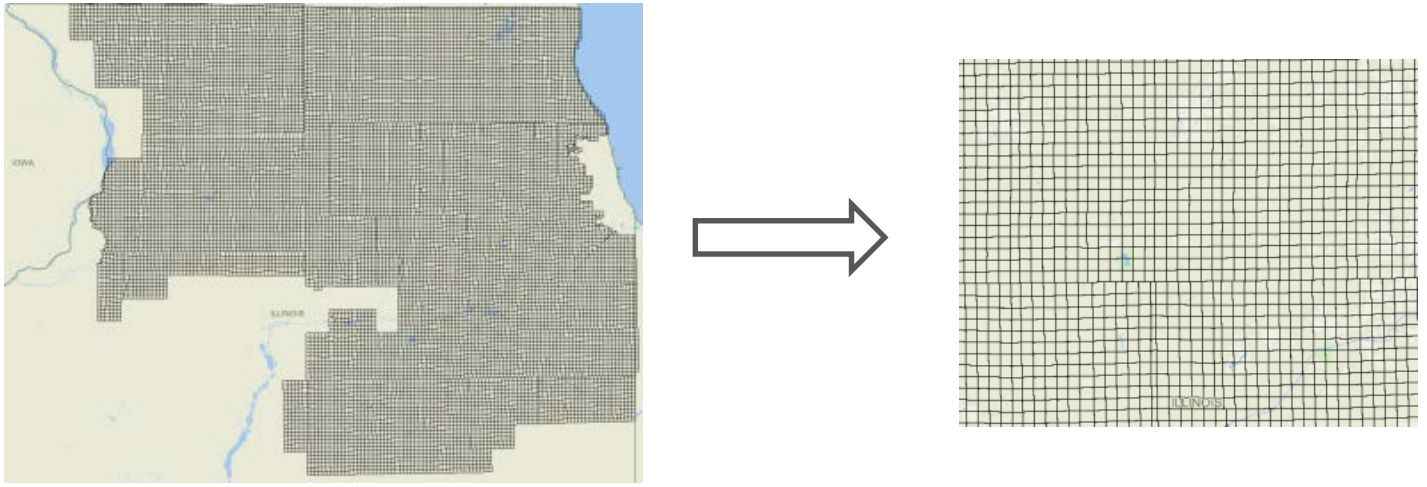
- **Objective:** To develop a flexible tool that allows for the determination of optimal locations for charging stations within the utility's service territory

- **Methodology proposed:** Holistic, data-driven approach that makes it possible to rank different areas in the utility service territory to identify prime locations for EV charging stations
  - Methodology used to develop the tool was adapted from a previously performed evaluation of the utility service territory for a public purpose microgrid installation*

- **Objectives for the tool:**
  - Flexible
  - Visual
  - Detailed

*E. A. Paaso, H. Pierce "Geographic Information System (GIS) Based Evaluation of a Utility Service Territory for Public Purpose Microgrid Installations" (CIGRE – US National Committee 2015)

Geographic Analysis



- Service territory divided into more than 50,000 0.25 square mile (0.5 mile x 0.5 mile) quarter sections.
- Each section evaluated and scored from 0 to 4 for each identified factor.
- Each factor contributed towards a composite score calculated as a weighted summation of the individual scores.

Metrics Considered

ComEd gathered data on the above indicators of EV charging station potential

Metric	Description
Feeder Loading	Indicator of the loading condition of the distribution circuits within a specific quarter section
Landmark	Indicator of prime destinations where people frequently travel to spend their time (business facilities, transportation centers, city parking, government buildings, education centers, retail and dining establishments, hotels)
Population Density	Indicator of areas of the service territory where EV owners reside, and potential commuting patterns
Existing Charging Stations	Indicator of areas with existing charging stations, where the installation of new charging stations might be redundant
Distance to Highway	Indicator of proximity to the main transportation corridors in the service territory

Composite Metric

Composite Metric → Weighted sum of the scores from each of the metrics

Metric	L2 Charger Weighting	DCFC Charger Weighting
Feeder Loading	20%	30%
Landmark	40%	20%
Population Density	20%	0%
Existing Charging Stations	20%	20%
Distance to Highway	0%	30%

- Based on engineering experience and recommendations from subject matter experts
- Weightings are modifiable, allowing for different sensitivities to be considered
- Quarter sections were ranked based upon their composite weighted-scored

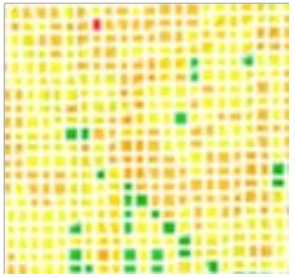
Sample Results

Example of Scoring Methodology for DCFC:

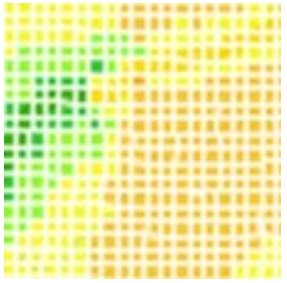
Quarter section	Feeder Loading		Landmarks		Existing Stations		Distance to Highway		Composite Metric
	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	
A	3	0.9	0	0	4	0.8	0	0	1.7
B	4	1.2	1	0.2	4	0.8	4	1.2	3.4
C	2	0.6	0	0	4	0.8	4	1.2	2.6

- Mapping tool leveraged to create heat maps that visualize the composite metric results and individual metric results

Sample of L2 Composite Metric Heatmap:



Sample of DCFC Composite Metric Heatmap:



Results of the Analysis

- Recommended locations for L2 charging stations: aggregated near metropolitan areas, well populated suburban areas and town centers
- Recommended locations for DCFC: mainly along the highways
- Strategy proposed to select deployment locations for L2 charging stations:
  - Quarter sections of the service territory scoring 3.8 to 4 in the composite metric were selected as high scoring
  - To account for adjacencies, reduced granularity of data by looking at townships
    - ✓ High scoring quarter sections distributed along 69 townships out of 376 in the service territory
    - ✓ 69 townships were ranked based on the count of high priority quarter sections within them

Conclusions

- There is need for analysis methodologies to determine the recommended locations where the installation of the charging stations would be beneficial.
- We proposed a strategic screening tool to determine beneficial locations for the placement of L2 and DCFC stations, considering the status of the electric system.
- The tool is flexible and can be easily modified to produce results to meet specific conditions and targets.
- Future work includes:
  - Determining additional factors that could be included in the evaluation
  - Performing a sensitivity analysis to capture the impact on the composite metric
  - Add functionality to the tool to automatically update the data with any new selected location for a charging station to be installed, to avoid redundancies