Using the EZMT to Equitably Plan for Electric Vehicle Charging Stations

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January 11, 2022
TODAY’S DISCUSSION

• Introduction
• EZMT mapping content
• EZMT modeling methodology
• EVSE/equity examples
• Demonstration
• Questions

https://ezmt.anl.gov
INTRODUCTION
THE ENERGY ZONES MAPPING TOOL (EZMT) IS A PUBLIC, WEB-BASED MAPPING TOOL

- Funded by the DOE Office of Electricity
- First launched in 2012
- Now updated to help plan new electric vehicle supply equipment (EVSE) locations with an emphasis on equity and environmental justice
- Scope of mapping and analysis capabilities:
  - Energy resources (e.g., wind, solar)
  - Energy infrastructure (e.g., substations, alternative fuel stations)
  - Siting factors (e.g., land use, traffic, population density)
  - Reference data (e.g., boundaries)

Example EZMT modeling results
TODAY THE EZMT IS ALSO BEING USED IN OUR VEHICLE TECHNOLOGIES OFFICE PROJECTS

- Funded by the DOE Office of Energy Efficiency and Renewable Energy, Vehicle Technologies Office
- Mid-Atlantic Electrification Partnership
  - Seeking to advance EV adoption and EVSE network development in Washington DC, Maryland, Virginia, and West Virginia with an emphasis on social equity
- I-80 Mid-America Alternative Fuel Corridor
  - Developing an Alternative Fuels Corridor Deployment Plan for I-80 from Iowa to New Jersey, including EVSE and compressed natural gas stations
- While focused on these projects, EZMT updates have a national extent whenever possible
WHAT QUESTIONS ARE THE EZMT DESIGNED TO ANSWER?

- Where are the current EV corridors and DC Fast charging stations in my area of interest?
- Which electrical service provider owns that substation?
- Where can I obtain a copy of the household transportation energy burden data?
- Where should we prioritize EVSE siting investments to fill gaps along a designated EV corridor?
- What changes if we add equity to the analysis?
- Which of these three potential sites is the best?
- Where might we be able to leverage federal funds to help underserved areas?
- Do the locations we chose meet our equity objectives?
- How much of Ohio’s power generation is from renewable sources?
EV INFRASTRUCTURE AND EQUITY ARE FEDERAL PRIORITIES

“goal to accelerate and deploy electric vehicles and charging stations”


“The Federal Government should pursue a comprehensive approach to advancing equity for all”


Equity has many dimensions. Identifying metrics and how best to serve the needs and interests of underserved communities are being studied. The equity-related examples in this presentation are for illustration purposes only.
EZMT MAPPING CONTENT
EV AND TRANSPORTATION MAPPING LAYERS IN THE EZMT

- Airports
- Alternative Fuel Stations (All categories)
- Average Annual Daily Vehicle Traffic
- Designated Alternative Fuel Corridors (Round 5)
- Electric Vehicle Charging Stations (Tesla/Non-Tesla, DC Fast/Level 2, and Planned)
- Major Roads
- Marine Ports
- Public Transit Stop Density

Mapping layers can be viewed and queried on the map, and downloaded.

Designated EV corridors and EV charging stations in the Washington DC area.
EQUITY MAPPING LAYERS IN THE EZMT

- EPA EJScreen 2020 (includes 28 equity metrics)
- EPA Class I Areas
- Household transportation energy burden
- Households without vehicles
- Housing – Units in multi-unit structures
- Housing – Mobile home units
- HUD opportunity zones
- Low-income percentage
- Minority percentage
- National air quality standard areas (7 types)
- Population density
- Rural areas
- Transit desert index
- Tribal reservation

Household transportation energy burden with EV charging stations and designated EV corridors in the EZMT

Mapping layers can be viewed and queried on the map, and downloaded.
OTHER RELEVANT EZMT MAPPING LAYERS

- Electrical substations
- Electrical transmission lines
- Electric power retail service territories
- Power plants
- Land cover
- National parks
- Schools, colleges, universities, hospitals
- Many others…

The EZMT mapping library currently has over 350 layers

Mapping layers can be viewed and queried on the map, and downloaded
EZMT MODELING METHODOLOGY
(Suitability modeling, or multi-criteria decision analysis)
EZMT MODELING APPROACH
Example Electric Vehicle Corridor Model

Input Modeling Layers

Population Density
Higher suitability in more densely populated areas

Distance to EV Charging Station
Higher suitability in gaps

Distance to Designated EV Corridor
Higher suitability near corridors

Distance to Substation
Higher suitability near substations

Road Traffic Density
Higher suitability for higher traffic areas

Percent Minority*
Higher suitability for higher percentages of minorities

*Equity has many dimensions. Identifying metrics and how best to serve the needs and interests of underserved communities is being studied. The equity-related examples in this presentation are for illustration purposes only.
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EXAMPLE ANALYSIS: WHICH LOCATIONS ARE MOST SUITABLE FOR NEW EVSE INFRASTRUCTURE?

Define model objective and requirements
Identify and rank siting criteria
Configure and run model
Validate/review results for model refinements

Highlight locations in low-income urban areas with concentrations of large multi-family structures, with high traffic, near mass-transit hubs, near a substation, with moderate non-Tesla DC fast charger density.

Socio-economic factors
Transportation factors
Utility/Grid factors
Existing EV/EVSE
EVSE/EQUITY EXAMPLES
EXAMPLE A: URBAN TRANSPORTATION NETWORK COMPANY (TNC) MODEL

Objective

Identify high suitability locations for clusters of (6) 150 kW DCFC plugs and (6) Level 2 plugs within areas having higher numbers of rideshare driver residences, and a high demand for ridesharing, to recharge electric TNC vehicles between assignments and between shifts.
**EXAMPLE A: CHOOSING SITING CRITERIA**

<table>
<thead>
<tr>
<th>EZMT Modeling Layer</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density</td>
<td>↑</td>
</tr>
<tr>
<td>Road Traffic Density</td>
<td>↑</td>
</tr>
<tr>
<td>Land Cover</td>
<td>↑</td>
</tr>
<tr>
<td>Distance (m) to Substation</td>
<td>↓</td>
</tr>
<tr>
<td>Number of Electric Vehicle Chargers within a 10-Mile Radius (Non-Tesla DC Fast)</td>
<td>↓</td>
</tr>
<tr>
<td>Percent minority</td>
<td>↑</td>
</tr>
<tr>
<td>Percent low-income</td>
<td>↑</td>
</tr>
<tr>
<td>Housing Density - Large Multi-family</td>
<td>↑</td>
</tr>
<tr>
<td>Transit Desert Index</td>
<td>↑</td>
</tr>
<tr>
<td>Percent of Zero-Vehicle Households</td>
<td>↑</td>
</tr>
</tbody>
</table>

- **Areas with larger number of drivers and riders**
- **Areas with convenient access to electricity supply**
- **Areas that lack EV charging infrastructures**
- **Areas with more transportation-disadvantaged population and potentially more TNC drivers and riders**

Positive factor for EV charging infrastructure

Negative factor for EV charging infrastructure
EXAMPLE A RESULTS: HIGH-SUITABILITY AREAS

Model Results with Example High-suitability Location.

High-Suitability Area in the Whitcomb Neighborhood of Richmond, Virginia.
EXAMPLE B: RURAL AREAS

Objective

Prioritize rural areas lacking nearby non-proprietary DC Fast charging stations, especially where there is higher traffic and sufficient nearby electrical service.
EXAMPLE B: CHOOSING SITING CRITERIA

<table>
<thead>
<tr>
<th>EZMT Modeling Layer</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density</td>
<td>Identify rural areas by selecting regions with relatively low population density and land development intensity</td>
</tr>
<tr>
<td>Land Cover</td>
<td>Areas with larger traffic volumes</td>
</tr>
<tr>
<td>Road Traffic Density</td>
<td>Areas with convenient access to electricity supply</td>
</tr>
<tr>
<td>Distance (m) to Substation</td>
<td>Areas that lack EV charging infrastructures</td>
</tr>
<tr>
<td>Number of Electric Vehicle Chargers within a 10-Mile Radius (Non-Tesla DC Fast)</td>
<td></td>
</tr>
</tbody>
</table>

Positive factor for EV charging infrastructure

Negative factor for EV charging infrastructure
EXAMPLE B RESULTS: HIGH-SUITABILITY AREAS

Model Results with Example High-suitability Location.

High-Suitability Area in Milton, Virginia.
Objective

Identify high suitability locations for DC Fast stations within 5 miles of designated EV alternative fuel corridors, in areas of disadvantaged communities, with high traffic volume, in gaps along the corridors or areas with low numbers of existing public non-proprietary DC Fast charging stations.
**EXAMPLE C: CHOOSING SITING CRITERIA**

<table>
<thead>
<tr>
<th>EZMT Modeling Layer</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to Designated Electric Vehicle Corridor</td>
<td>Areas with proximity to EV corridor</td>
</tr>
<tr>
<td>Distance (m) to Substation (&gt;= 100kV)</td>
<td>Areas with convenient access to electricity supply</td>
</tr>
<tr>
<td>Number of Electric Vehicle Chargers within a 10-Mile Radius (Non-Tesla DC Fast)</td>
<td>Areas that lack EV charging stations</td>
</tr>
<tr>
<td>Road Traffic Density</td>
<td>Areas with larger population and traffic volumes</td>
</tr>
<tr>
<td>Population Density</td>
<td>Areas with more transportation-disadvantaged population</td>
</tr>
<tr>
<td>Percent minority</td>
<td></td>
</tr>
</tbody>
</table>

↑ Positive factor for EV charging infrastructure
↓ Negative factor for EV charging infrastructure
EXAMPLE C RESULTS: HIGH-SUITABILITY AREAS

Model Results with Example High-suitability Location.

High-Suitability Area in Cumberland, Maryland.
DEMONSTRATION
Click **Register** at the top right of the [https://ezmt.anl.gov](https://ezmt.anl.gov) home page, then fill out and submit the form.

2. Check for an email confirmation message and **click the link** to confirm your email. (If you do not receive an email confirmation message, check your junk folder, or contact ezmt@anl.gov.)

3. **When the account is enabled** by a site administrator, you will receive an email message. (If you do not receive a response in one working day, contact ezmt@anl.gov.)

4. Return to [https://ezmt.anl.gov](https://ezmt.anl.gov) and click **Launch Tool** on the title bar.
EXAMPLE LIVE DEMONSTRATION CONTENT
LEARNING TOOLS AND RECORDED WEBINARS

About the Tool

The Energy Zones Mapping Tool is a free online mapping tool to identify potential energy resource areas and energy corridors in the United States. This website provides information about the project, background on the energy resources, and details on the data layers used in the tool. There are also links to documents and related links.

See our YouTube Channel for an archive of EZMT webinars and training videos.
Where are the current EV corridors and DC Fast charging stations in my area of interest?

1. Use the Library to add “Designated Alternative Fuels Corridor” and “Electric Vehicle Charging Stations” to the map.
2. Zoom the map to the area of interest.
EXAMPLE LIVE DEMONSTRATION CONTENT

Which electrical service provider owns that substation?
1. Use the Library to add “Electrical Substation” and “Electric Power Retail Service Territories” to the map.
2. Right-click on Electric Power Retail Service Territories in the Table of Contents, choose Properties, and adjust the opacity to about 50%.
3. Use the Identify tool to look up features of interest.
Where can I obtain a copy of the household transportation energy burden data?

1. Use the Library to find “Household Transportation Energy Burden”.
2. Click the Download Data action.
   also optionally…
3. Click the Metadata action to learn more about the data, including a link to the study document.
4. Click the Add to Map action to view it on the map.
Where should we prioritize EVSE siting investments to fill gaps along a designated EV corridor?

1. Click Analyze, scroll the top section to dialog to the “Electric Vehicle Charging Station – Corridor” model, then click the gear icon.
2. Inspect the default model settings in the Model Launcher Dialog, revise if desired, then click Launch.

...
EXAMPLE LIVE DEMONSTRATION CONTENT

Where should we prioritize EVSE siting investments to fill gaps along a designated EV corridor?

... 3. Click “Results” When the model is finished running, click the Add results to map Action.
4. Inspect the model results on the map, especially in higher suitability areas, to look for opportunities for EVSE sites.
EXAMPLE LIVE DEMONSTRATION CONTENT

What changes if we add equity to the analysis? (Comparing two models)
(The previous example included equity measures. Here we’ll run the same model without the equity criteria.) Continuing from that example…

1. Click on Results, then click the gear icon for the prior run of the corridor model.
2. Use the Remove layer action to remove the Minority criteria from the model, update the name and notes, and click Launch (this runs a new copy of the model without changing the prior one).

…
What changes if we add equity to the analysis? (Comparing two models)

3. Add both versions of the model to the map (see previous example for steps)
4. Toggle the top model results on and off on the map, looking for differences.
   (Focus on comparing which areas have high suitability. Models are not comparable quantitatively)
EXAMPLE LIVE DEMONSTRATION CONTENT

Which of these three potential sites is the best? or
Do the locations we chose meet our equity objectives?

1. Locate the sites to compare on the map. One way is to map them as analysis areas: Click “Areas”, then New Analysis Area, then Draw to sketch each area on the map).
2. Make sure “My Analysis Areas” is toggled on in the Table of Contents to display the areas, and in the Analysis Areas dialog, make sure the areas are shown on the map with the show/hide action.
   …
EXAMPLE LIVE DEMONSTRATION CONTENT

Which of these three potential sites is the best?

3. Decide on metrics for comparison – mapping layers, modeling layers, or model results.
4. Add the layers to the map, (see prior example) all displayed at the same time.
5. Zoom to each analysis area and click the map with the Identify tool (see prior example). The dialog will show data from each layer at the click point.
6. The map can be moved rapidly to the sites being compared with the Analysis Areas “Zoom To” action.
Where might we be able to leverage federal funds to help underserved areas?
1. Use the Library to add “Electrical Substation” and “Electric Power Retail Service Territories” to the map.
2. Adjust the opacity to about 50% (see prior example)
3. Examine the map for areas of interest within the opportunity zones.
EXAMPLE LIVE DEMONSTRATION CONTENT

How much of Ohio’s power generation is from renewable sources?

1. Click Analyze, scroll the lower panel to “Power Plants”, and click the “Run this report” action
2. In the Report Run Launcher, choose State as the type, then Ohio from the state list.
3. Click Launch Report.

…
How much of Ohio’s power generation is from renewable sources?

4. Click “Results” The report run will be listed.
5. When the report is complete, click the “Display the generated report” action. It will open in a new tab.
6. Review the report to find that Ohio has 153.6 MW capacity from biomass, 31.7 from hydro, 98.3 from solar and 718.4 from wind, of the total capacity of 28,337.2 MW. About 3.5% of Ohio’s capacity is renewable.
7. Click the link below the table to learn about the data the report is based on.
THANK YOU!

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Questions?

This work is supported by the Vehicle Integration Program in the USDOE’s Office of Energy Efficiency and Renewable Energy, and the USDOE Office of Electricity, under Contract DE-AC02-06CH11357.
The Energy Zones Mapping Tool (EZMT) has been updated for electric vehicle (EV) charging station mapping and modeling, including an emphasis on equity.

Join Argonne’s Jim Kuiper as he will highlight the new mapping data, and how to use the new models to help identify potential locations for EV charging stations.

Equity data, such as percent low-income, percent minority, household transportation energy burden, multi-family housing density, manufactured housing density, and many others can be included in the EV analysis or any of the other suitability models in the system.