CLIMATE
WEEK
AT PENN

EVs at Penn: Possibilities for Our Campus

Robert Graff

Monday, September 20, 2021, 11:30 – 12:30

Quick overview of EVs

Overlapping, sometimes inconsistent usage

- **PEV: Plug-In Electric Vehicle**
  - **BEV: Battery Electric Vehicle**
    - **Also known as All Electric Vehicle (AEV)**
  - **PHEV: Plug-In Hybrid Electric Vehicle**
- **HEV: Hybrid Electric Vehicle**
- **FCEV: Fuel Cell Electric Vehicle, runs on H_2 Fuel Cell**
- **ZEV: Zero Emissions Vehicle**

EV Charging Technologies

Level 1 Charging

Level 2 Charging

DC Fast Charging

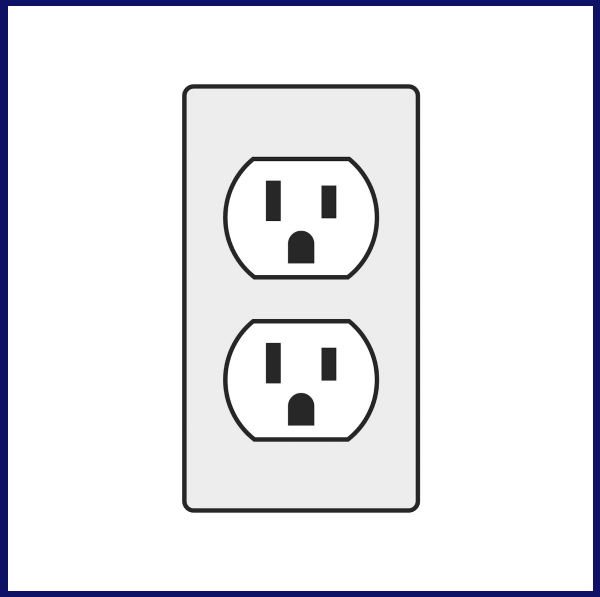
EV Charging Technologies

Level 1 Charging: 120V / 1400W

- About what a powerful hair dryer uses
- Adds 2-5 miles of range in an hour

Level 2 Charging

DC Fast Charging



EV Charging Technologies

Level 1 Charging: 120V / 1400W

Level 2 Charging: 240V / 7700W

- Like an electric stove with all burners and oven on
- Adds 10-20 miles of range in an hour

DC Fast Charging

EV Charging Technologies

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DC Fast Charging: 480+V / 50,000 to 120,000W or more

- Like a commercial building
- Adds 60 to 80 miles of range in 20 minutes

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Note: Gasoline pump adds ~250 mile of range per minute.


INTER-METRO
DC L1-2
PUBLIC IN METRO AREA
AC Level 2, DC Level 1
FLEETS
AC Level 1-2, DC Level 1-2
EMPLOYEES AT WORK
AC Level 1-2
MULTI-FAMILY HOME
AC Level 1-2
SINGLE FAMILY HOME
AC Level 1-2

The EV world is changing fast

New vehicle types: Pickup trucks, SUVs, commercial vans

Battery energy density increasing, price decreasing

- Longer ranges
- Lower prices

More public funding may be coming.

Total Cost of Ownership (TCO) likely to flip to EVs over next few years.

Used vehicles are starting to appear on the market

Many opportunities in goods movement world.

If it's in print, it may already be out of date.

Top opportunities for Penn

- Electrifying Penn's fleet
- Providing charging for faculty, staff, and students who require it

Electrifying Penn's Fleet

- **Excellent Resource: *Electric Vehicle Resource Kit for Municipalities* on DVRPC's website**
  - **Information valid for any fleet**
    - **EVs 101 — Introduction to Electric Vehicles**
    - **Incorporating PEVs Into A Fleet**
    - **Determining the First Vehicle to Replace with a PEV**
    - **Selection and Placement of PEV Chargers**
    - **Resources to Purchase PEVs and Charging Equipment**
    - **Contacts For Assistance**
    - **Fleet PEV and Charging Equipment Case Studies**

Evaluate your fleet!

DRVE tool : Dashboard for Rapid Vehicle Electrification

- Free Microsoft Excel-based tool (Excel 2016 or later)
- Easily import all fleet vehicles using VINs
- Compare current fleet with electric vehicle alternatives
- Includes financial and environmental analysis of light-, medium-, and heavy-duty vehicle fleet procurements
- Total cost of ownership basis
- Well-to-wheels emissions for regional electrical grid.
- Easiest way to find: Google “DRVE tool”

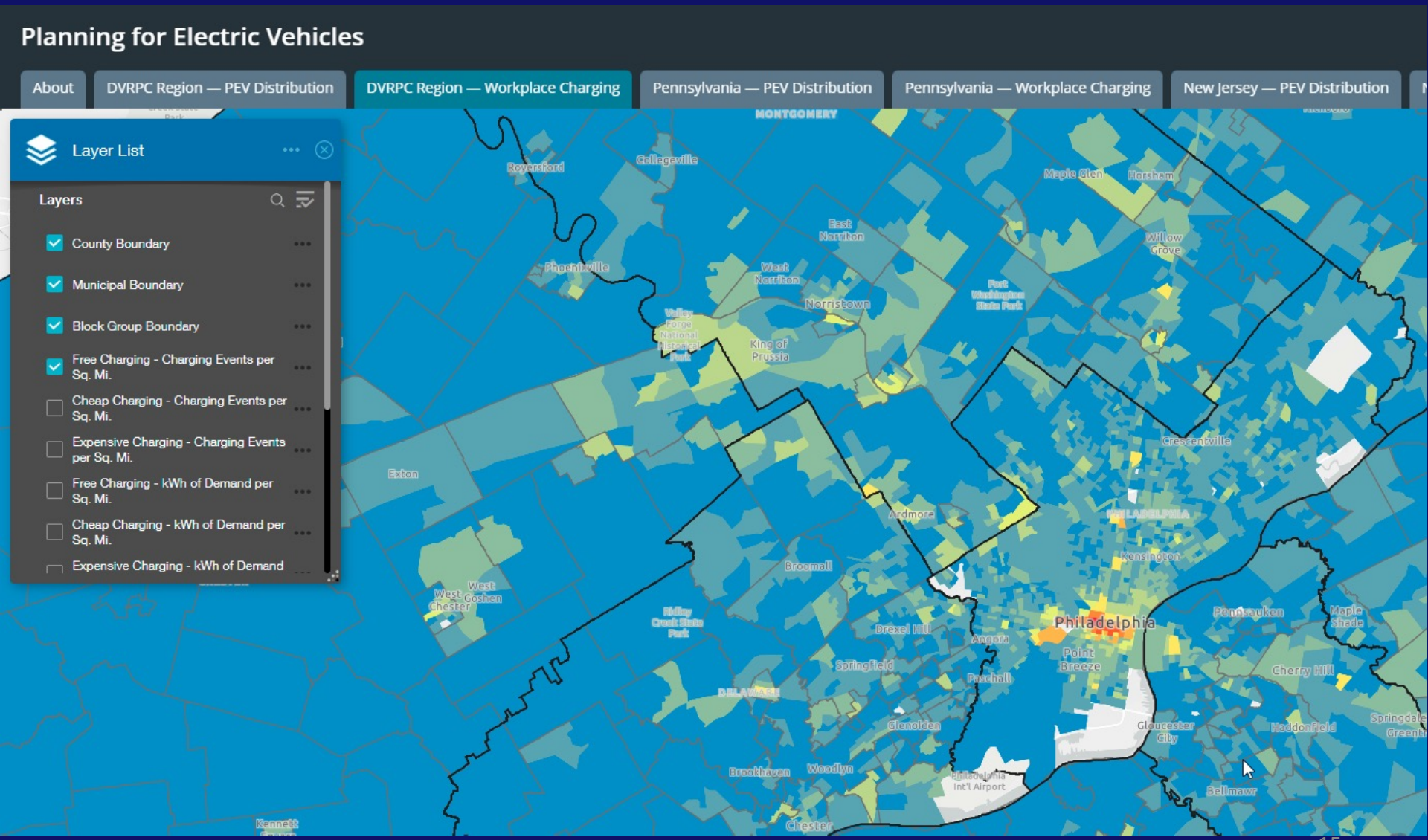
Key Elements of Fleet Analysis

- Good Fleet Management – Effective, cost-efficient fleet.
- Fleet Procurement Analysis – Excellent free tools available.
  - Dashboard for Rapid Vehicle Electrification (DRVE)
- Note: electrification is not the only way to reduce emissions from Penn's fleet!

Which Vehicle to Choose as a Pilot?

- Want it to be a success!
- Light-duty Sedan
- More miles, the more savings
  - Balanced, particularly for first vehicle, with criticality as a consideration.
- Used regularly
- Parked at the same location overnight every day
- Parked at a building with easy installation of charger
- BEV vs. PHEV: Lean to BEV to get experience

Assisting Penn-Affiliated EV Owners



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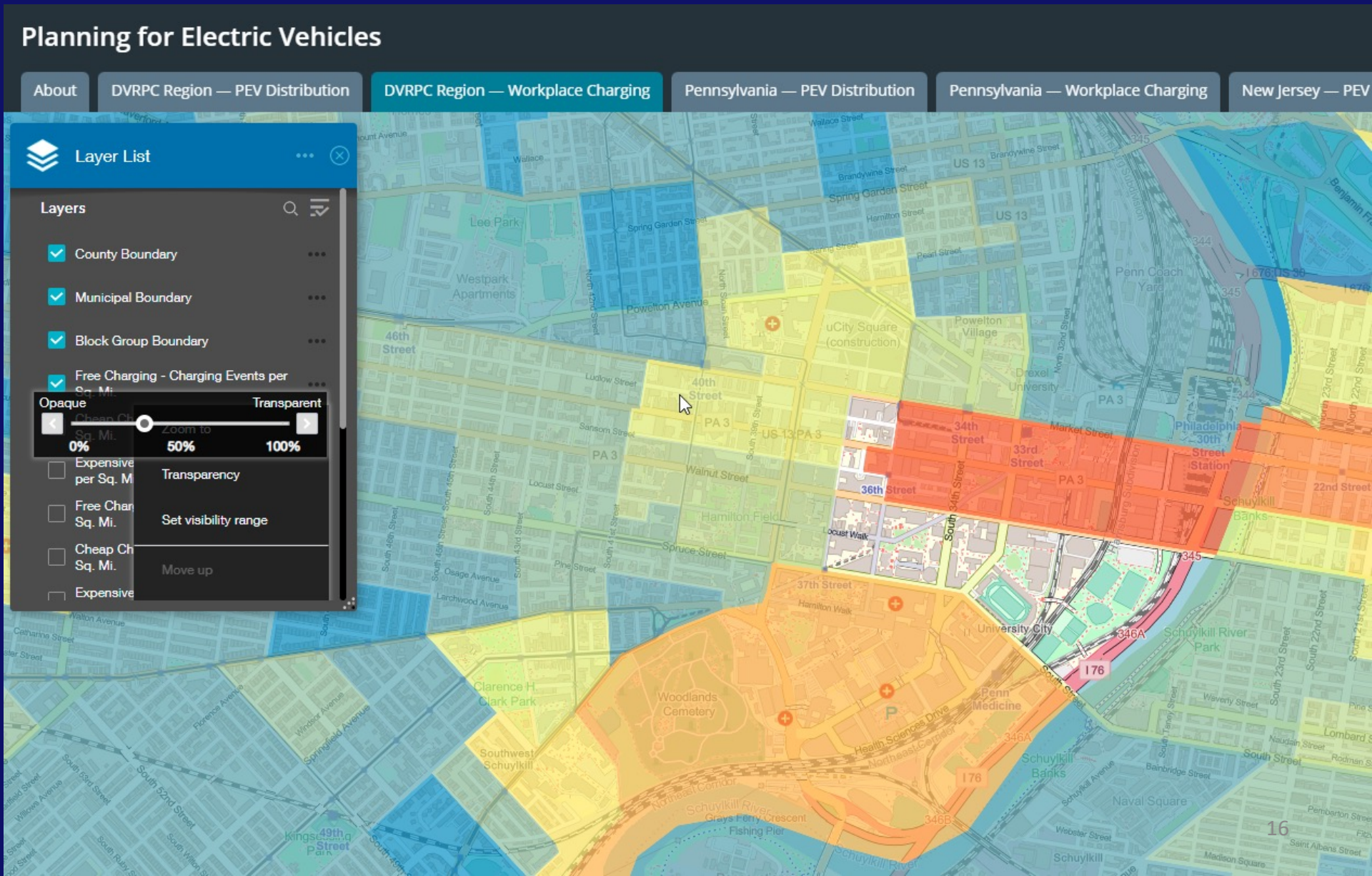

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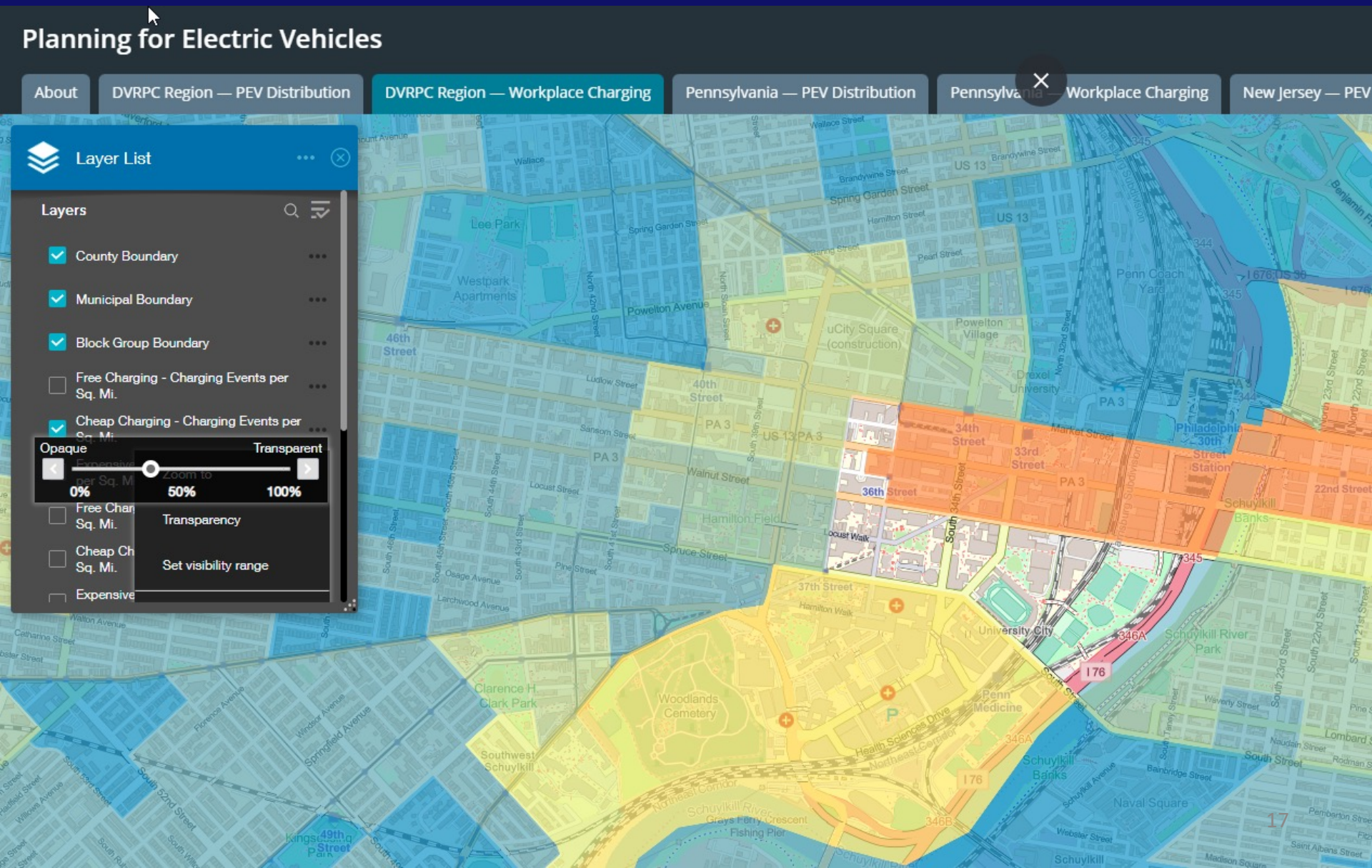

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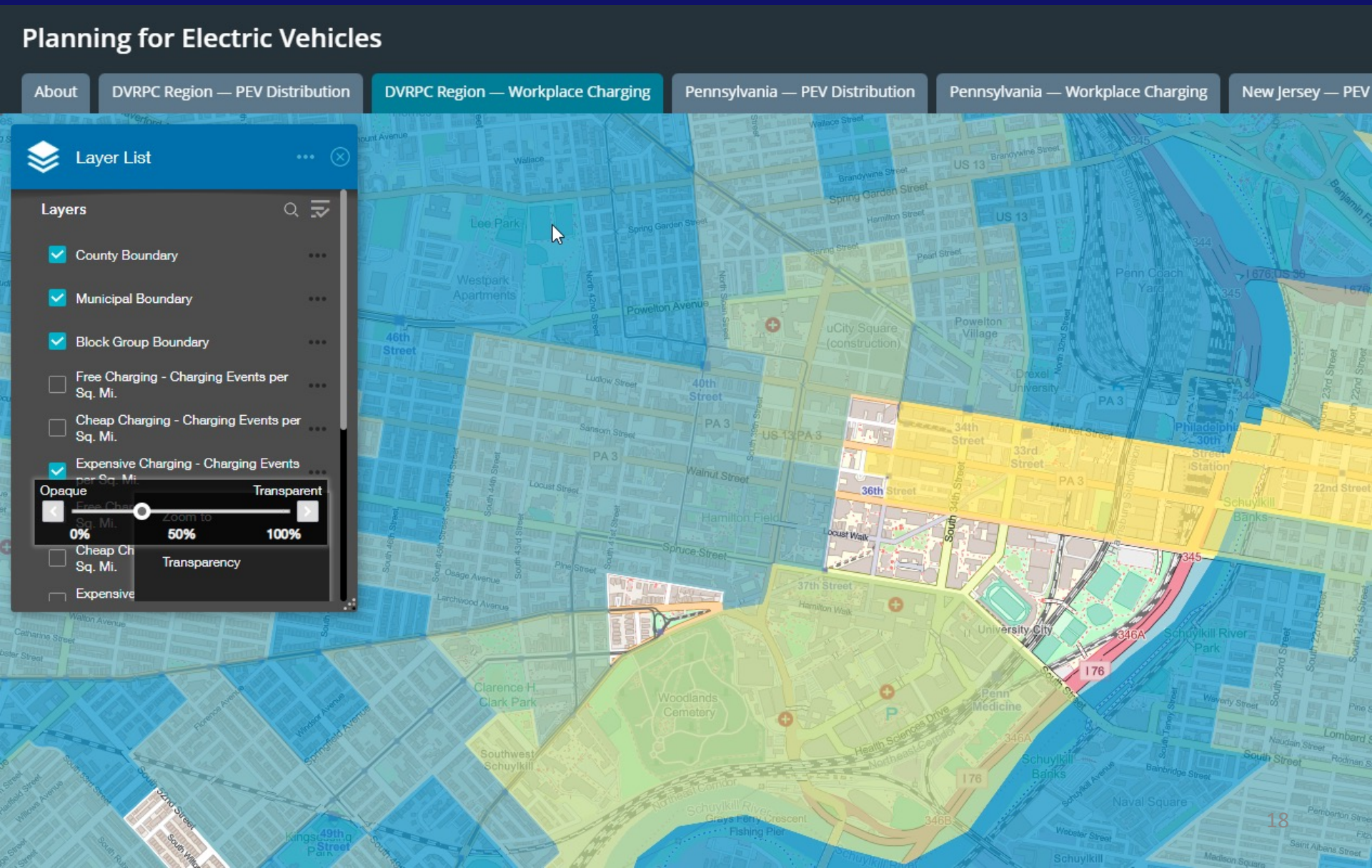

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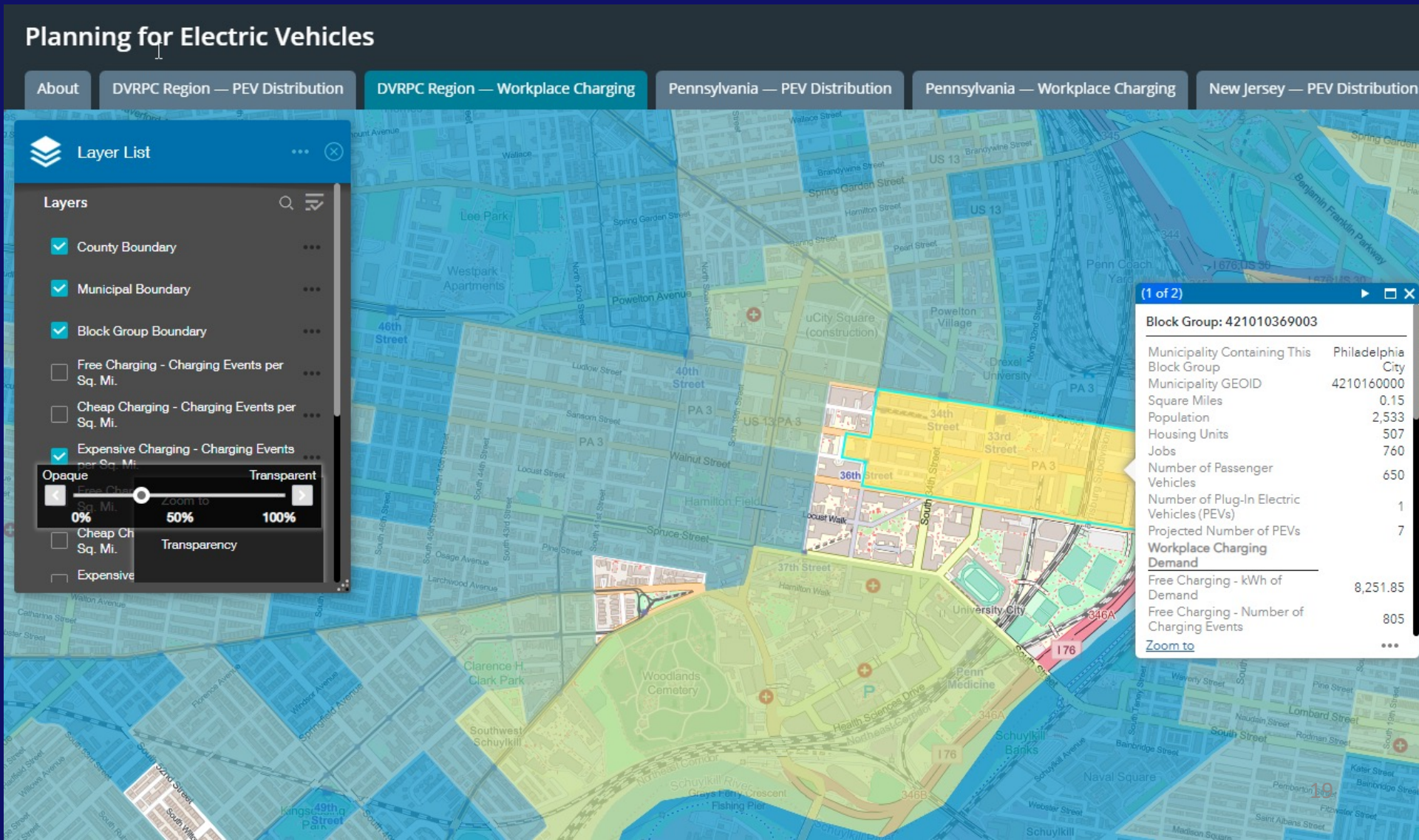

Workplace Charging Demand

- Free Charging
  - 8,252 kWh of Demand
  - 805 Charging Events
- Cheap Charging – Same as at home
  - 2,788 kWh of Demand
  - 408 Charging Events
- Expensive Charging – Twice the cost at home
  - 859 kWh of Demand
  - 114 Charging Events

Lessons for Providing Charging

- Giving away charging may simply displace home charging.
- To be financially sustainable, any charging infrastructure should charge enough to pay for itself, including capital, operations, and maintenance.
- Lots of equity issues in providing chargers, as – currently – EV owners tend to be higher income.

Final thoughts

- Electric vehicles are much cleaner, but they still take up space on the roads, crash with bicycles and pedestrians, enable sprawl, and are not fully enviromentally benign.
- SEPTA's MFL, Regional Rail, and increasing number of buses are electric vehicles.
- Opportunities to expand bicycles in Penn's fleet.

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