Electric Vehicle Infrastructure for the Future Demand

February 10, 2021

Alabama Power
Key Tech = No Turning Back!
Better – Faster – Smaller - Cheaper

Advanced materials for batteries and other uses

Electric motor advanced technology

Power electronics evolution

Advanced sensors and controls
Current State

Future State
Current State
Commercial Electric Transportation

Rail yard locomotives

Forklifts (indoor & outdoor)

Mining equipment

Airport ground support

Dredging equipment

Seaport cranes

Overland conveyors

Truck refrigeration units
PHEV – Plug-in Hybrid Electric Vehicles
BEV – All-Battery Electric Vehicle

A Car or another Consumer Electronic Device (smart phone, laptop, flat screen, etc.)??????
EV Infrastructure – Drives PEV Adoption

Residential 78%

Workplace 12%

Public 10%
Customer choice will increase: 127 EVs available by 2023
Sampling of Electric Trucks, Crossovers, and SUVs coming to the US

Key questions focus on announcements versus reality and local availability

2020

- Jeep Wrangler PHEV
- Ford Mustang Mach-E BEV
- BMW X5 BEV
- Audi Q5 PHEV
- BMW X3 BEV

2021

- Lincoln Aviator PHEV
- Lincoln Aviator PHEV
- Volvo XC40 Recharge BEV
- Rivian R1T BEV
- Lordstown Endurance PHEV

2022

- Toyota RAV4 Prime PHEV
- Audi Q4 e-tron BEV
- Mercedes EQC BEV
- Tesla Cybertruck BEV
- GM Hummer SUT BEV
- Rivian R1S BEV
- Jeep Grand Wagoneer PHEV
- Porsche Macan BEV
- GM Hummer SUV BEV
- Ford F150 BEV
- Rivian R1S BEV
- Lordstown Endurance PHEV
- Ford F150 BEV
- Rivian R1S BEV
- Lordstown Endurance PHEV
- Ford F150 BEV
Historic Barriers to EV Adoption*:

- More expensive than ICE vehicles
- Not enough places to charge
- Limited range and range anxiety
- Lack of public awareness/education
- Not enough models available

Current and Future Opportunities:

- Light-duty vehicles reaching cost parity
- Opportunity for public and private stakeholders to step in and fill the gap
- Many models available with more than 200 miles of range, several with 300+
- $1 million+ Infrastructure funding from Alabama Legislature 2021
- Models on the market will double to 2025, including many large SUVs and Trucks

*Per Morgan Stanley, 2020
## How Does Alabama Compare to the USA for EV?

### Passenger EV Manufacturing Employment
- State Total (Facility-Level): 4,200
- State Total (EV-specific): 600
- % of National Total (EV-Specific): 1.6%

### EV Sales
- State Total: 3,610 (34th in nation)
- EVs per 1k people: 0.76 (43rd in nation)
- Models available: 21 out of 52

### Passenger EV Manufacturing Investment
- State Total (Facility-level): $6 billion
- State Total (EV-specific): $1 billion
- % of National Total (EV-specific): 5%

### EV Charging Deployment
- State Level 2 Total: 397 ports
- State DCFC Total: 81 ports (35th in nation)
- DCFC per 1k people: 0.02 (47th in nation)

### Utility Investment
- State Total: $0 million
- % of National Total: 0%

### Government Funding for EVs
- State Total: $6.5 million
- % of National Total: <1%

*Source:* “Transportation Electrification in the Southeast: State of Technology Deployment and Investment in Manufacturing” Atlas Public Policy
Home Charging

Connected
Smart App Control
Schedule Charging
Alexa Integration
120 Volt to 20 Amp
240 Volt to 100 Amp
Public Charging – Level 2 (240 Volt)

Can Be:
Connected
Smart App Control
Schedule Charging
Alexa Integration

Circuits:
240/208 Volt to 100 Amp
DC Fast Charging – (480 Volts)
DC Fast Charging – (480 Volts)
DCFC All Shapes & Sizes
Connector Levels

Overview of Charging Levels; Bus/truck use high power DC couplers; CCS, J3105, CharIN, manual/auto.

**Level 1**
- 120V
- 15-20 Amps
- Level 1 chargers use standard 120V electrical outlets. 120V circuits are also used by most home electronics.
- 7-8 miles of i3 range per hour charging
- 1.4 kW power delivery

**Level 2**
- 240V
- Up to 80 Amps
- Level 2 chargers use 240V electrical circuits. 240V circuits are also used by electric dryers & electric stovetops.
- 10 - 26 miles of i3 range per hour charging
- 3.7 - 7.7 kW power delivery

**CCS DC charging**
- 1000kW
- 500 AMPS (800 AMPS)
- CCS can deliver up to around 200Amps with traditional copper cables, while higher currents are delivered via cooled cables.
- Up to 80% of 100kWh battery in less than 20 minutes
- Up to 350kW power delivery, Some units up to 500/800kW

**Commercial Vehicle High Power**
- 1500V
- 3000 AMPS
- The High Power Commercial Vehicle charging standard would allow users to recharge their large, commercial vehicles (Classes 6, 7 & 8) in 20-30 minutes.
- Up to 80% of Class 8 truck, carrying 500kWh, in 20 minutes
- Up to 4.5 MW power delivery
Three DC Fast Charge Connectors

- **SAE Combo**
- **CHAdeMO**
- **Tesla**

DC Level 2
DCFC Locations & Networks

480V AC 3P
Up to 350kW
“80% in 30 minutes”
One Vision of Alabama ‘Possible’ DCFC Corridor
Medium & Heavy-Duty Vehicles

• **First Movers** will dictate charging needs

Light Duty urban haul
• Package Delivery
• Food distribution and delivery

Medium Duty Regional haul
• Distribution

Heavy Duty Urban Haul
• Ports
• Terminals
• Distribution Facilities
Future
Solar

Home integration

Canopy Charging

Stand alone off grid applications
Autonomous Charging

**Wireless**

- Less moving parts
- Car aligns itself

**Autonomous**

- Uses existing infrastructure
- Direct connection
High Power DCFC – Micro Grid
Interoperability

Network to Network
Charger to Network
Physical connector
Vehicle to Grid
Thank You

Questions
Electric Vans and Delivery Fleets

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Avg. Size (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-Haul Vans</td>
<td>4.8</td>
</tr>
<tr>
<td>Vans</td>
<td>8.9</td>
</tr>
</tbody>
</table>

Market:

1.2M Class 3-6 vans and trucks total in Alabama Power territory

- Potential solution for “last-mile” delivery and local routes
Medium & Heavy-Duty Truck

Equipment
Medium & Heavy-Duty Truck

DCFC (kW)
150 – 1MW+

Market:

633k class 7-8 trucks in Alabama Power territory

- Customers include food distributors, shipping and logistics providers, etc.
Buses Future Markets

Equipment

Buses

DCFC (kW)

50 – 500+

Market:

Transit
Schools
Universities
Tours/Coach
### Southern Company Charging Stations Summary: Alabama

**January, 2021 Update**

<table>
<thead>
<tr>
<th>CITY</th>
<th>STREET</th>
<th>LOCATION</th>
<th>40 AMP 62.5kW DCFC</th>
<th>100 AMP</th>
<th>40</th>
<th>62.5</th>
<th>100</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Anniston</td>
<td>435 Quintard Avenue</td>
<td>Eastern Division Office</td>
<td>40A/100A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Athens</td>
<td>363 East Church Street</td>
<td>Athens</td>
<td>300A</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Auburn</td>
<td>1169 E College Street</td>
<td>Auburn</td>
<td>300A</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Bay Minette</td>
<td>600 Delave Street</td>
<td>Bay Minette</td>
<td>300A</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Birmingham</td>
<td>400 North 10th Street</td>
<td>APL, Corporate HQ</td>
<td>40A/100A</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>6.</td>
<td>Birmingham</td>
<td>1200 4th Avenue North</td>
<td>Birmingham Civic HQ</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Birmingham</td>
<td>1630 4th Avenue North</td>
<td>Birmingham Garage</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Birmingham</td>
<td>3333 Colonnade Pkwy</td>
<td>Birmingham</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>Birmingham</td>
<td>4001 Lakeview Blvd</td>
<td>System Air Hanger</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Calera</td>
<td>674 Highway 67</td>
<td>G.C. Complex Bus #3</td>
<td>40A/100A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>11.</td>
<td>Calera</td>
<td>764 Highway 67</td>
<td>G.C. Complex Bus #9</td>
<td>40A/100A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>12.</td>
<td>Calera</td>
<td>744 Highway 87</td>
<td>G.C. Complex Bus #4</td>
<td>40A/100A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>13.</td>
<td>Calera</td>
<td>744 Highway 87</td>
<td>G.C. Complex Bus #5</td>
<td>40A/100A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>14.</td>
<td>Chelsea</td>
<td>2320 3rd Street S</td>
<td>Chelsea</td>
<td>300A</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>15.</td>
<td>Columbia</td>
<td>7383 W State Highway 95</td>
<td>Plant Finley</td>
<td>40A</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>16.</td>
<td>Demopolis</td>
<td>1000 4th Avenue 15 S</td>
<td>Demopolis Garage</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>17.</td>
<td>Enterprise</td>
<td>798 Glover Avenue</td>
<td>Enterprise</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>18.</td>
<td>Fultondale</td>
<td>400 State Street Road</td>
<td>Fultondale</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>19.</td>
<td>Fultondale</td>
<td>360 East Bessemer Street</td>
<td>South East Division Office</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>20.</td>
<td>Gadsden</td>
<td>1050 Temple Avenue North</td>
<td>Gadsden</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>21.</td>
<td>Gadsden</td>
<td>700 Forrest Avenue</td>
<td>Gadsden</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>22.</td>
<td>Gadsden</td>
<td>700 Forrest Avenue</td>
<td>Gadsden</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>23.</td>
<td>Gadsden</td>
<td>700 Forrest Avenue</td>
<td>Gadsden</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>24.</td>
<td>Hartselle</td>
<td>3031 5th Avenue</td>
<td>Hartselle</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25.</td>
<td>Haysbey</td>
<td>3031 5th Avenue</td>
<td>Haysbey</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>26.</td>
<td>Jackson</td>
<td>1190 College Avenue</td>
<td>Jackson</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>27.</td>
<td>Jasper</td>
<td>111 East 10th Street</td>
<td>Jasper</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>28.</td>
<td>Jasper</td>
<td>2000 Highway 78 West</td>
<td>Jasper</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>29.</td>
<td>Le Roy</td>
<td>351 1st Street</td>
<td>Le Roy</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>30.</td>
<td>Mobile</td>
<td>170 Jack C. Montgomery Boulevard</td>
<td>Mobile Division Office</td>
<td>40A/100A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>31.</td>
<td>Mobile</td>
<td>3701 Elmore Road</td>
<td>Mobile Division Office</td>
<td>40A/100A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>32.</td>
<td>Mobile</td>
<td>3701 Elmore Road</td>
<td>Mobile Division Office</td>
<td>40A/100A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>33.</td>
<td>Montgomery</td>
<td>2424 Gannet Drive East</td>
<td>Montgomery Civic HQ</td>
<td>40A/100A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>34.</td>
<td>Montgomery</td>
<td>1033 Congress Avenue</td>
<td>Southern Division Office</td>
<td>40A/100A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>35.</td>
<td>Montgomery</td>
<td>203 South 17th Street</td>
<td>Southern Division Office</td>
<td>40A/100A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>36.</td>
<td>Oak Grove</td>
<td>38/01 US Highway 280</td>
<td>Oak Grove</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>37.</td>
<td>Pelham</td>
<td>1300 Industrial Park Drive</td>
<td>Pelham</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>38.</td>
<td>Pell City</td>
<td>700 South Martin Street</td>
<td>Pell City</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>39.</td>
<td>Phelan City</td>
<td>1300 2nd Street</td>
<td>Phelan City</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>40.</td>
<td>Prattville</td>
<td>1815 E Main Street</td>
<td>Prattville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>41.</td>
<td>Prattville</td>
<td>1815 E Main Street</td>
<td>Prattville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>42.</td>
<td>Prattville</td>
<td>1815 E Main Street</td>
<td>Prattville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>43.</td>
<td>Prattville</td>
<td>1815 E Main Street</td>
<td>Prattville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>44.</td>
<td>Quinton</td>
<td>4050 Porter Road S.W.</td>
<td>Quinton</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>45.</td>
<td>Quinton</td>
<td>4050 Porter Road S.W.</td>
<td>Quinton</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>46.</td>
<td>Rainsville</td>
<td>365 Main Street</td>
<td>Rainsville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>47.</td>
<td>Rainsville</td>
<td>365 Main Street</td>
<td>Rainsville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>48.</td>
<td>Rainsville</td>
<td>365 Main Street</td>
<td>Rainsville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>49.</td>
<td>Hartselle</td>
<td>577 Church Street</td>
<td>Hartselle</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>50.</td>
<td>Hartselle</td>
<td>577 Church Street</td>
<td>Hartselle</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>51.</td>
<td>Hartselle</td>
<td>577 Church Street</td>
<td>Hartselle</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>52.</td>
<td>Tuscaloosa</td>
<td>1931 Stotes Mill Avenue</td>
<td>Tuscaloosa</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>53.</td>
<td>Tuscaloosa</td>
<td>1931 Stotes Mill Avenue</td>
<td>Tuscaloosa</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>54.</td>
<td>Tuscaloosa</td>
<td>1931 Stotes Mill Avenue</td>
<td>Tuscaloosa</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>55.</td>
<td>Tuscaloosa</td>
<td>1931 Stotes Mill Avenue</td>
<td>Tuscaloosa</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>56.</td>
<td>Waterville</td>
<td>1100 South Main Street</td>
<td>Waterville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>57.</td>
<td>Waterville</td>
<td>1100 South Main Street</td>
<td>Waterville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>58.</td>
<td>Waterville</td>
<td>1100 South Main Street</td>
<td>Waterville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>59.</td>
<td>Wilsonville</td>
<td>39172 Highway 25</td>
<td>Wilsonville</td>
<td>40A</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Approximate miles per charging hour:**

- 40 kW: 10 miles per hour
- 62.5 kW: 5 miles per hour
- 100 kW: 3 miles per hour

(Travel times are calculated for ideal charging conditions, and may vary based on actual charging times and circumstances.)