

# APTA 2018 - Nashville

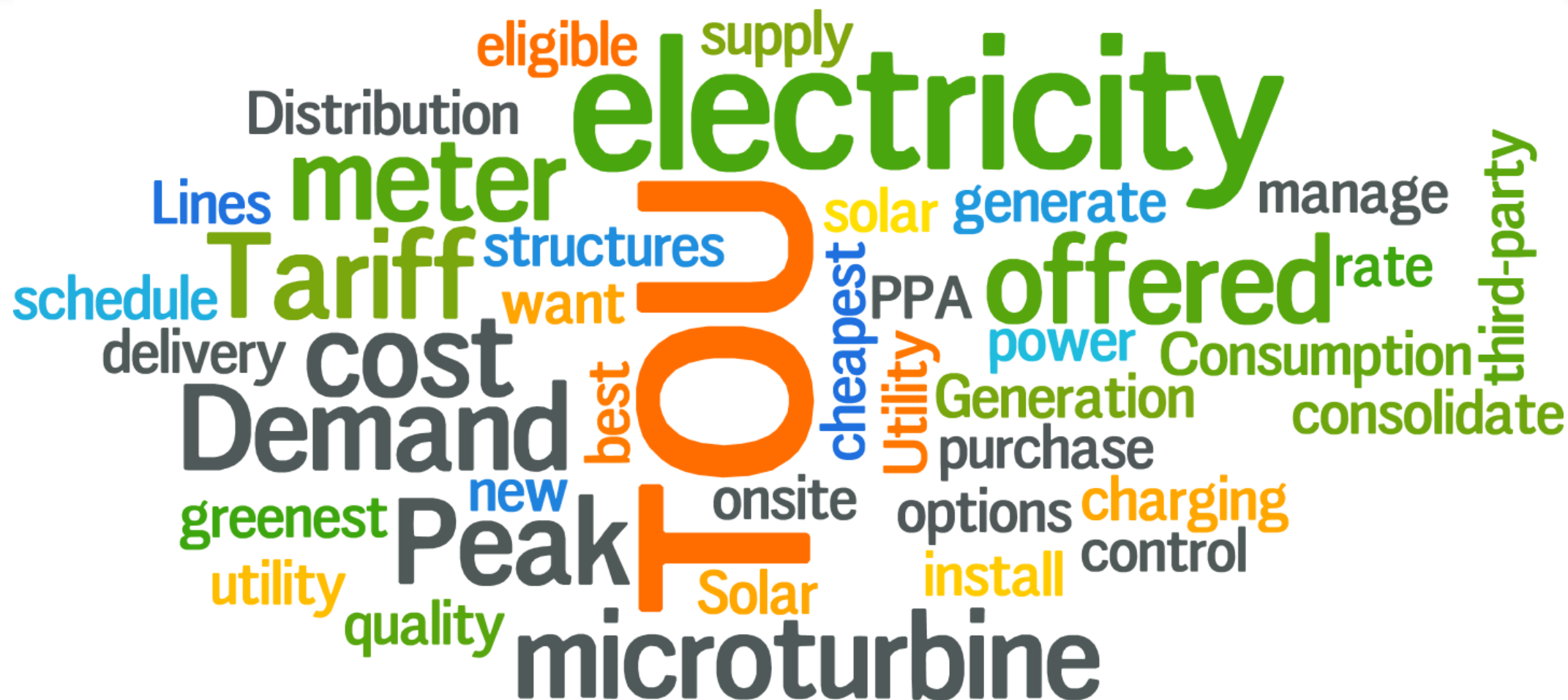
## PLANNING FOR FULL FLEET ELECTRIFICATION

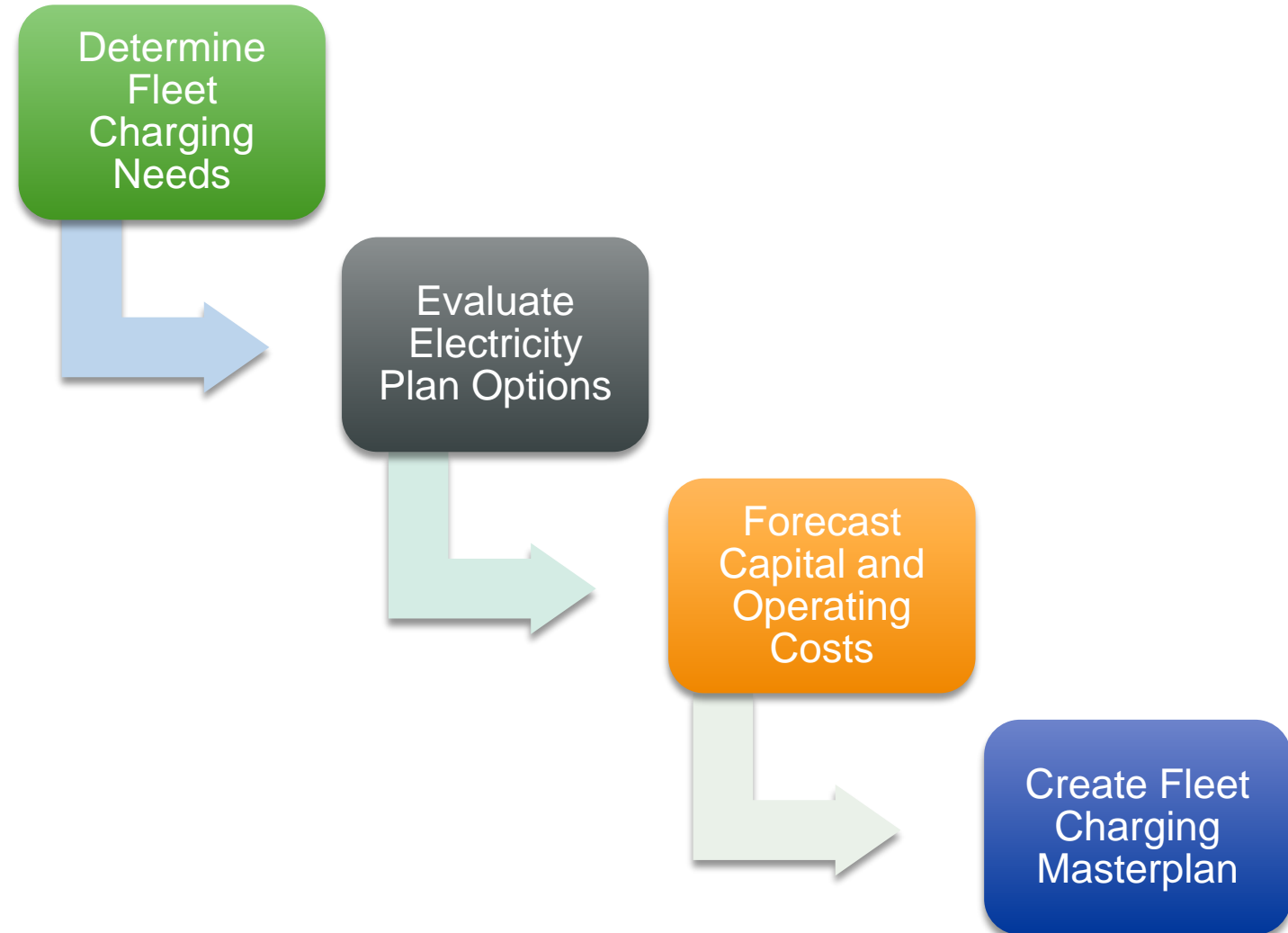


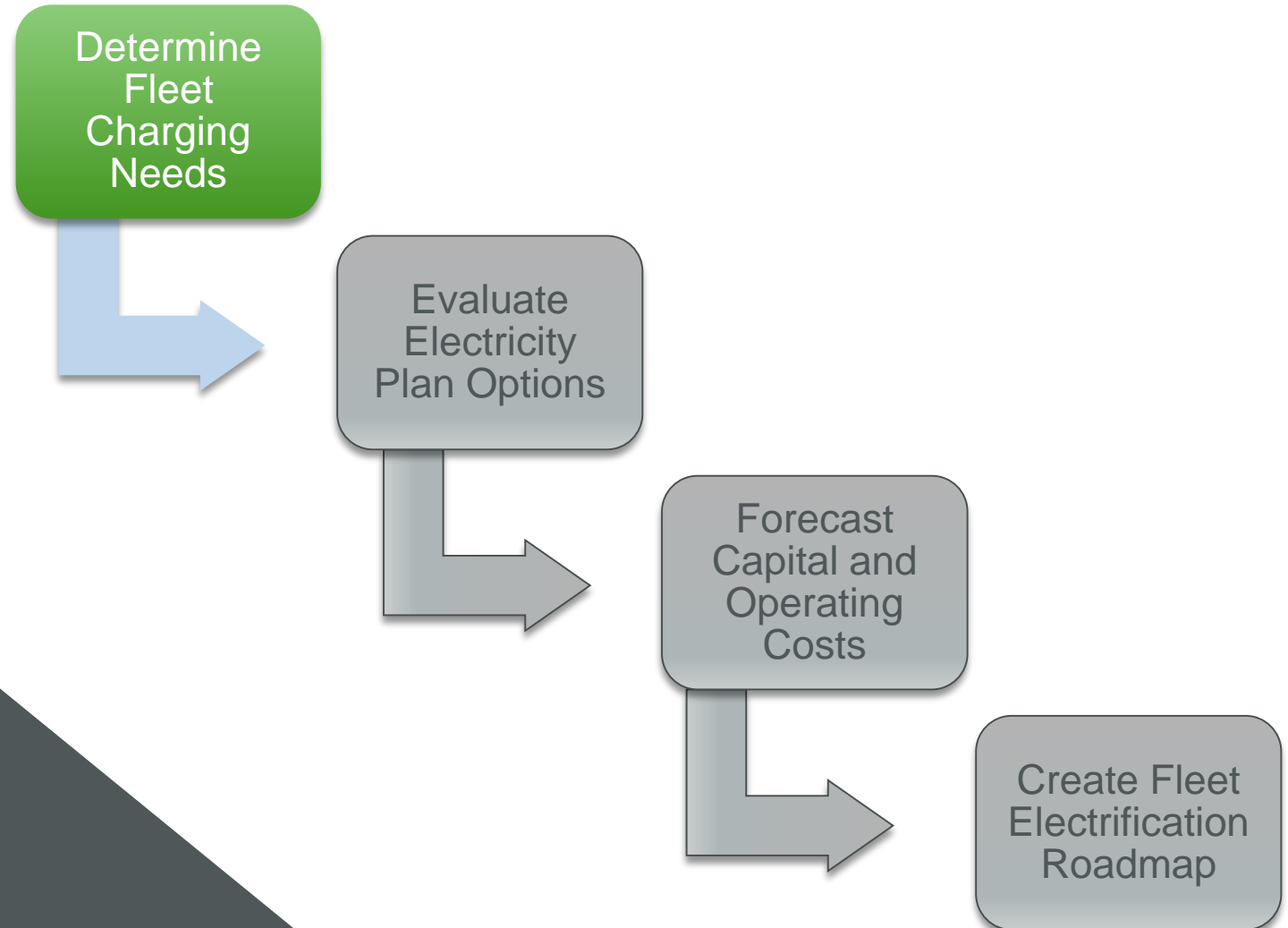
Andre Lalljie

September 25, 2018

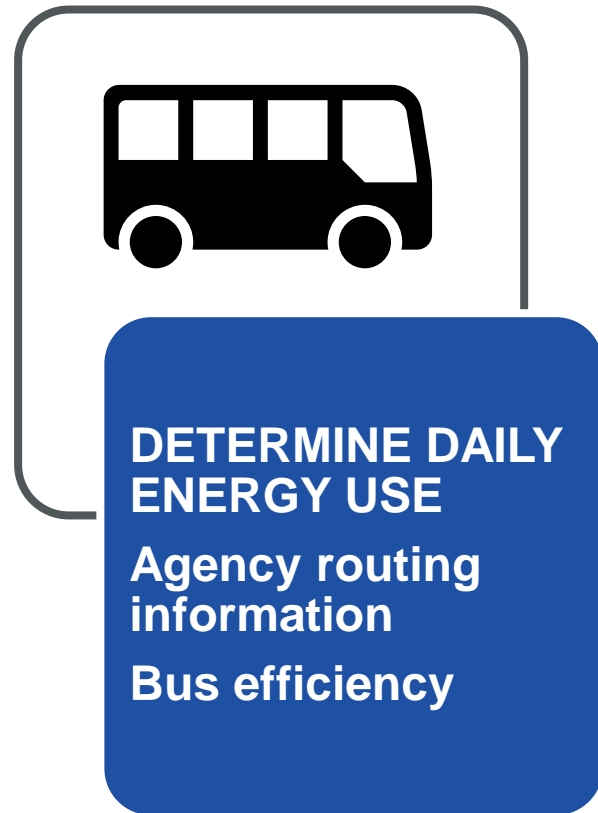




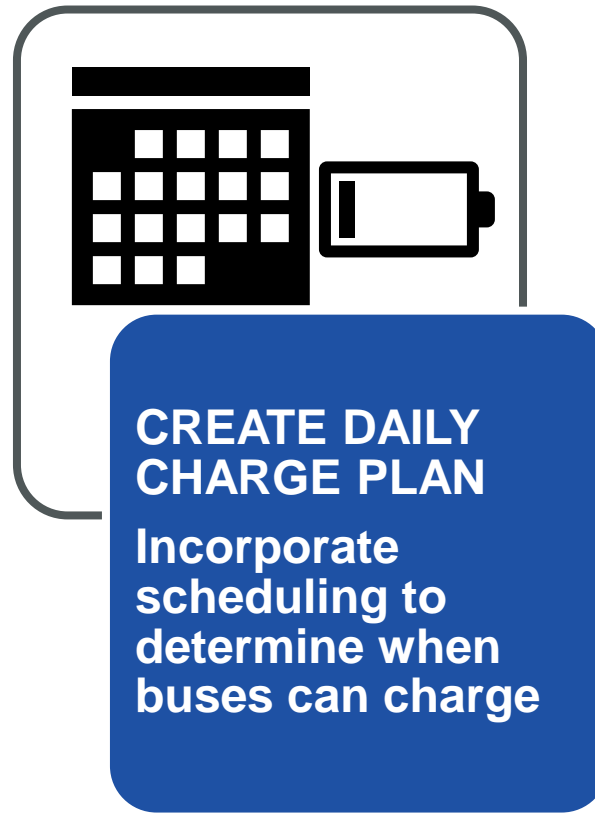




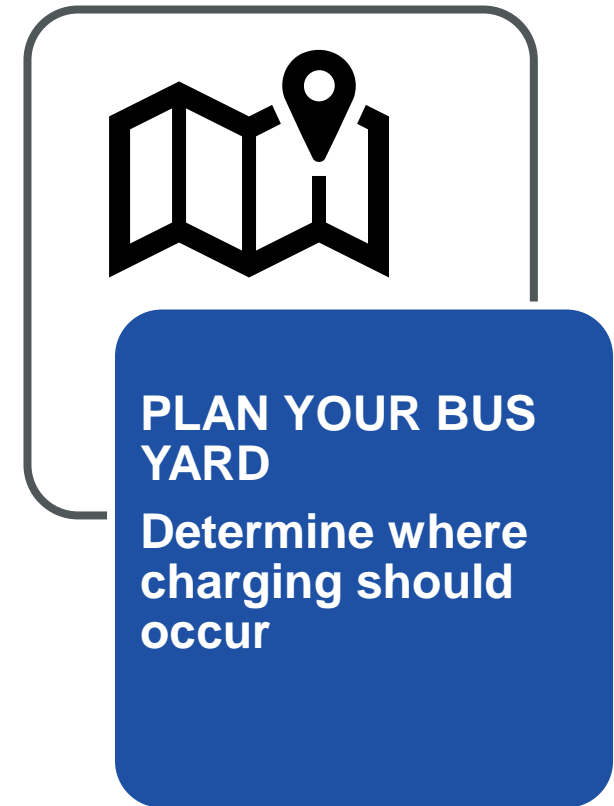
How much charge?



When to charge?

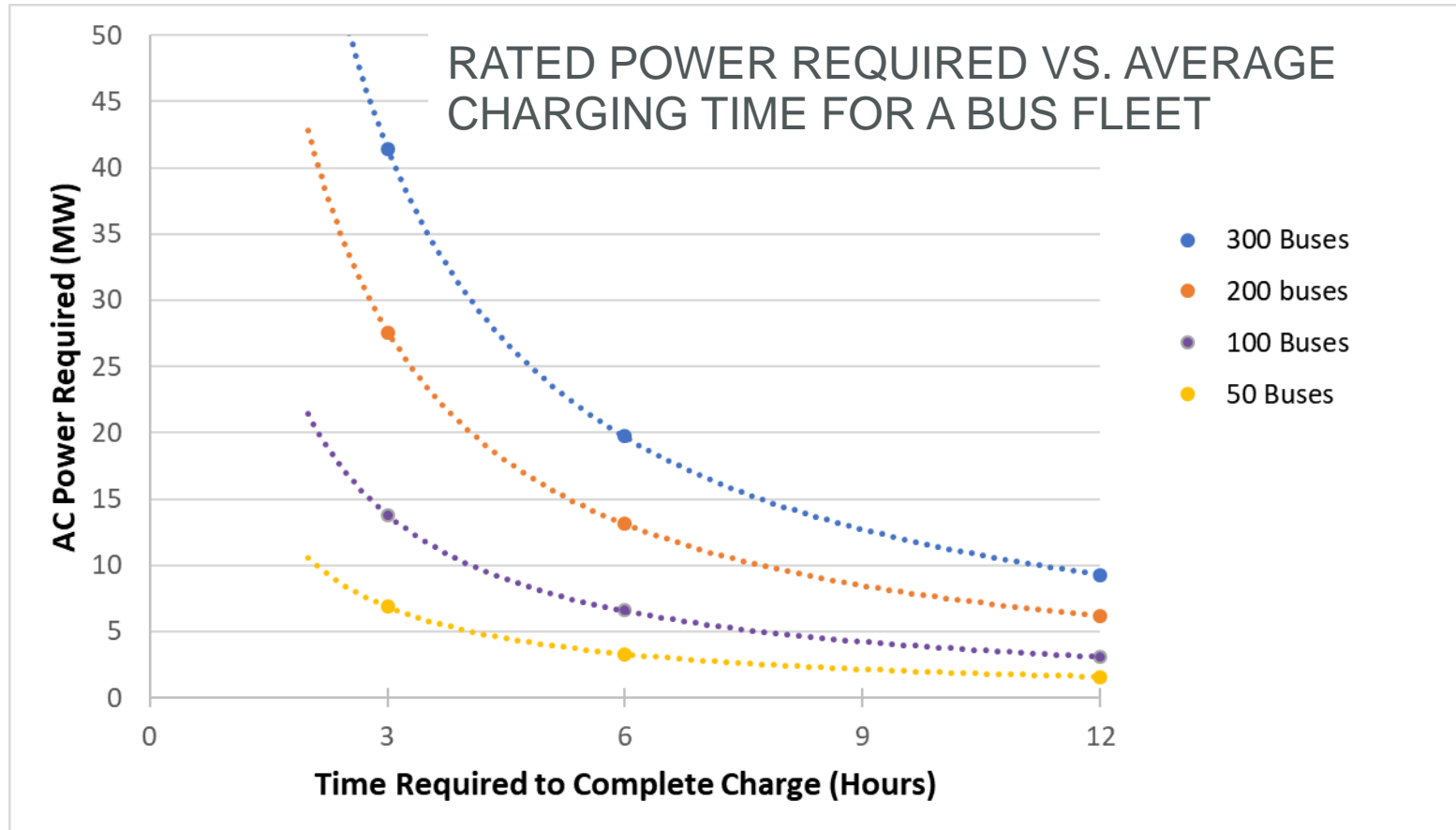


Where to charge?



# DETERMINE FLEET CHARGING NEEDS

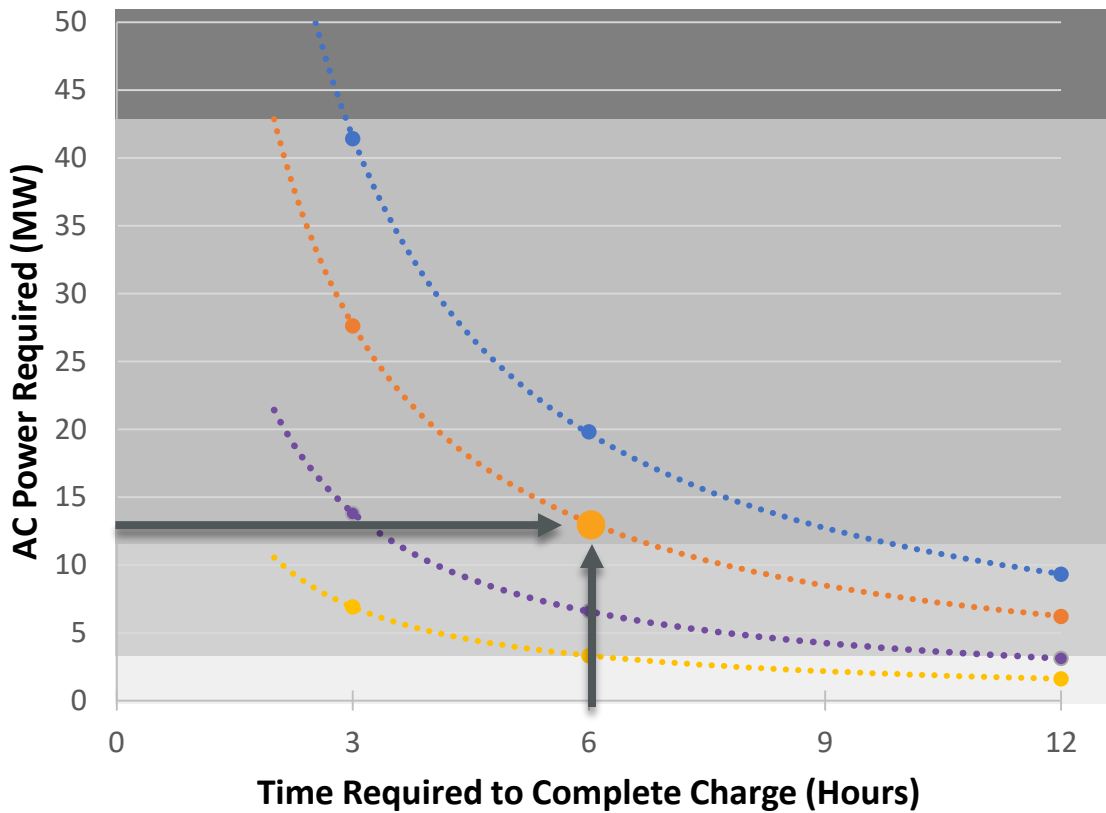
Factors to Consider include: Number of Buses in Fleet, Route Length, and Charge Time Required



# SIGNIFICANT POWER IS REQUIRED FOR FLEET ELECTRIFICATION



Full fleet electrification will require significant power, which means you must work with your utility power provider.



Power (MW)	Transmission Line	Above-Ground Installation Cost/mile*	Underground Installation Cost/mile*
>35	115kV	\$800K - \$2.1M	\$4.7M - \$9.5M
11-35	33kV	\$700K - \$800K	\$2.3M - \$3.1M
4-10	12kV	\$600K - \$700K	\$2.4M - \$3.2M
0-3	4kV	\$300K - \$500K	\$700K - \$1.5M

- 300 Buses
- 200 buses
- 100 Buses
- 50 Buses
- 200 buses, 6 hour charge period

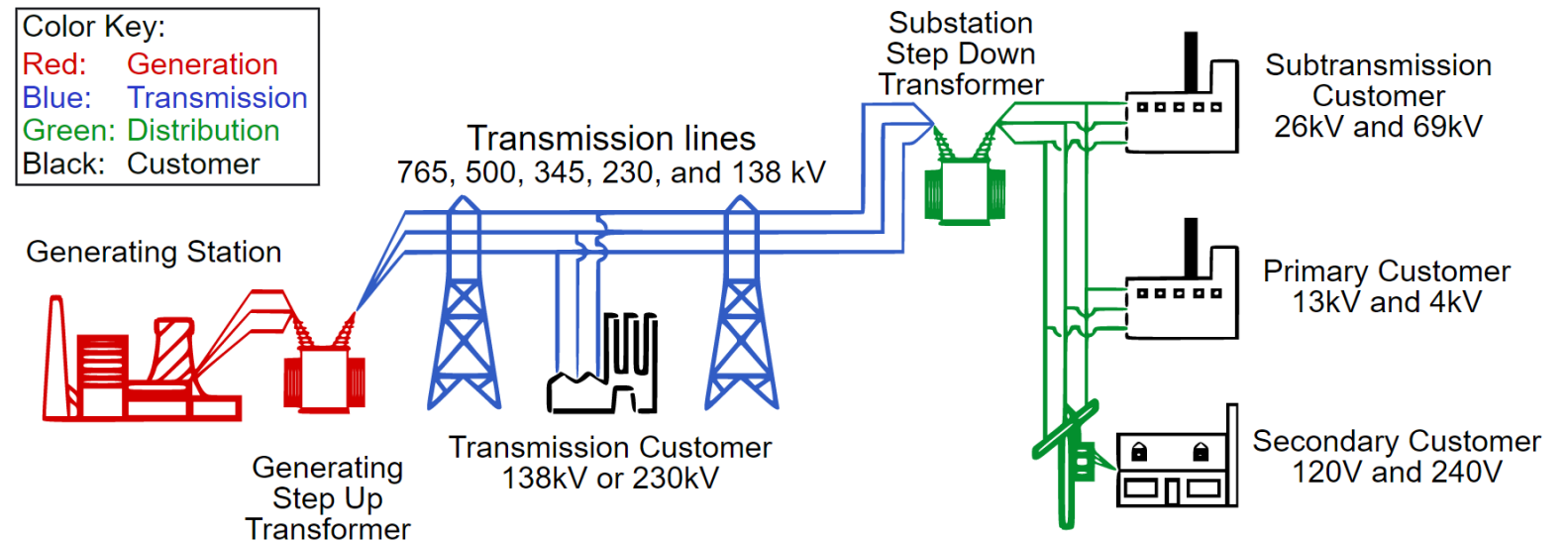


# EVALUATE YOUR ELECTRICITY PLAN OPTIONS

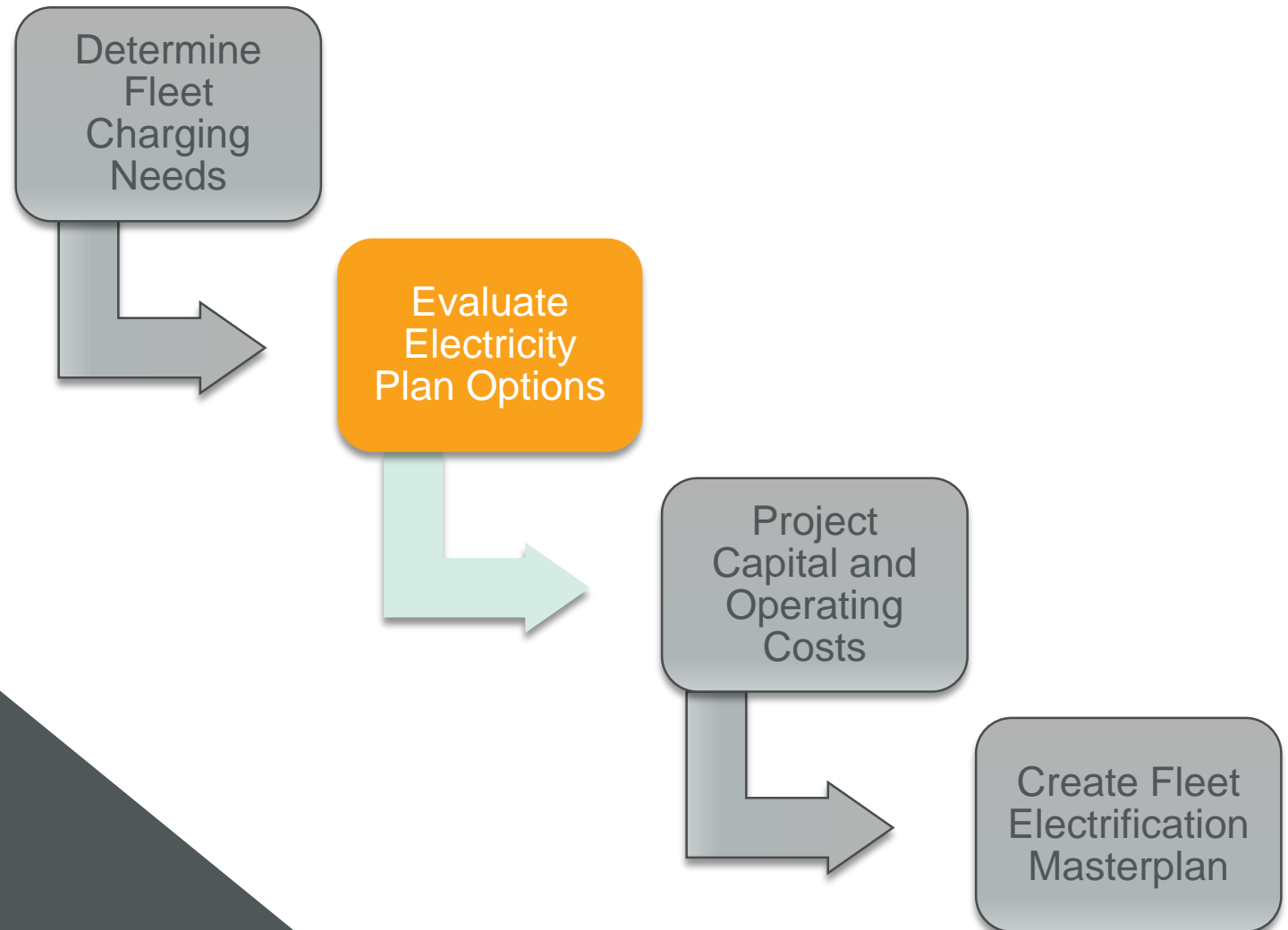
Significant infrastructure is required to get power from the power plant to your bus depot

The grid performs three key functions:

1. **Generation:** Create electricity at a power plant
2. **Transmission:** Move high voltage electricity long distances
3. **Distribution:** Electricity passes from a transformer to individual consumers.

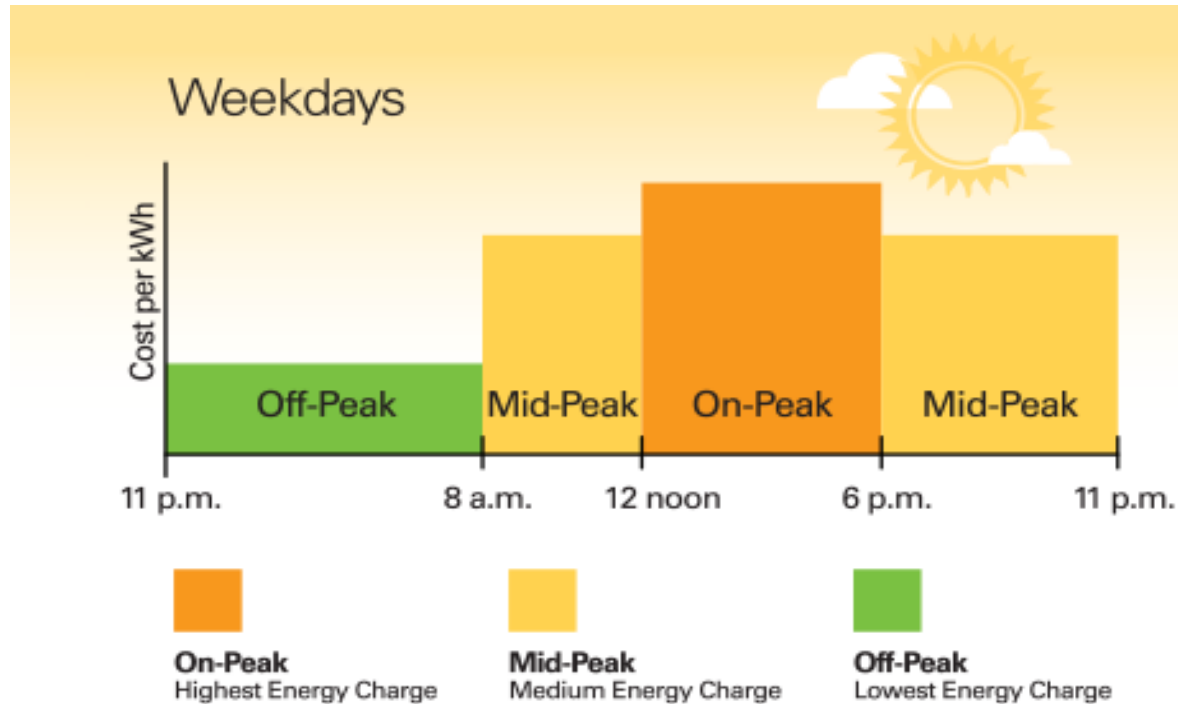






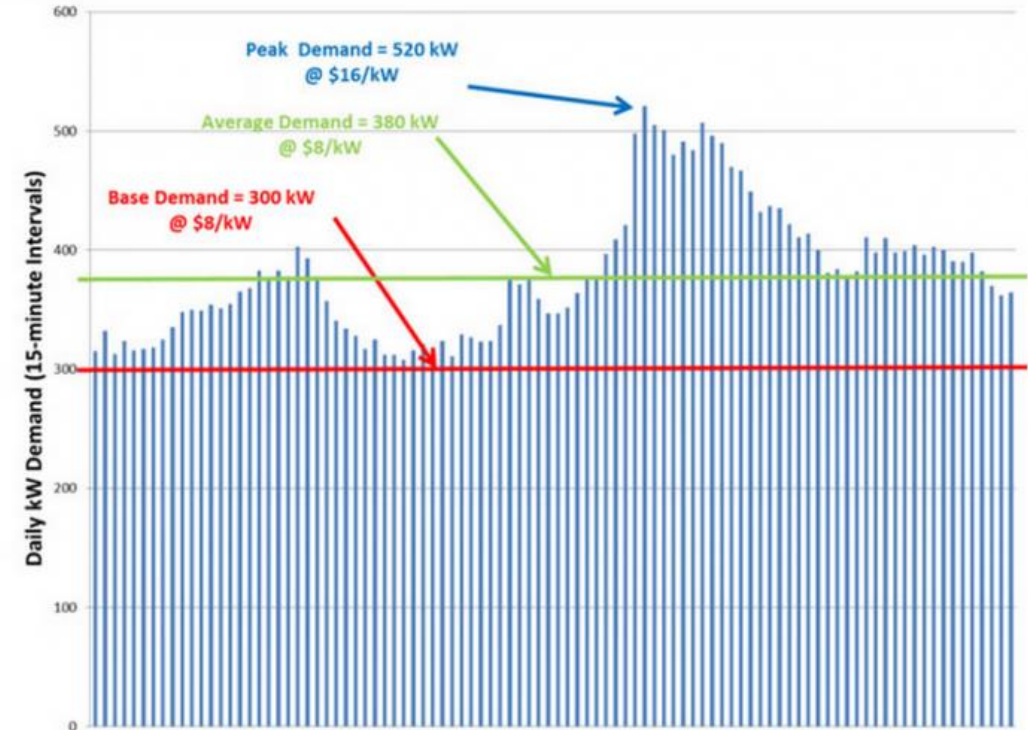
# CONSIDERATIONS: Utility Rate Considerations to Manage Operating Costs

## Time of Use Charges (\$/kWh)



[Image Courtesy Southern California Edison - SCE](#)

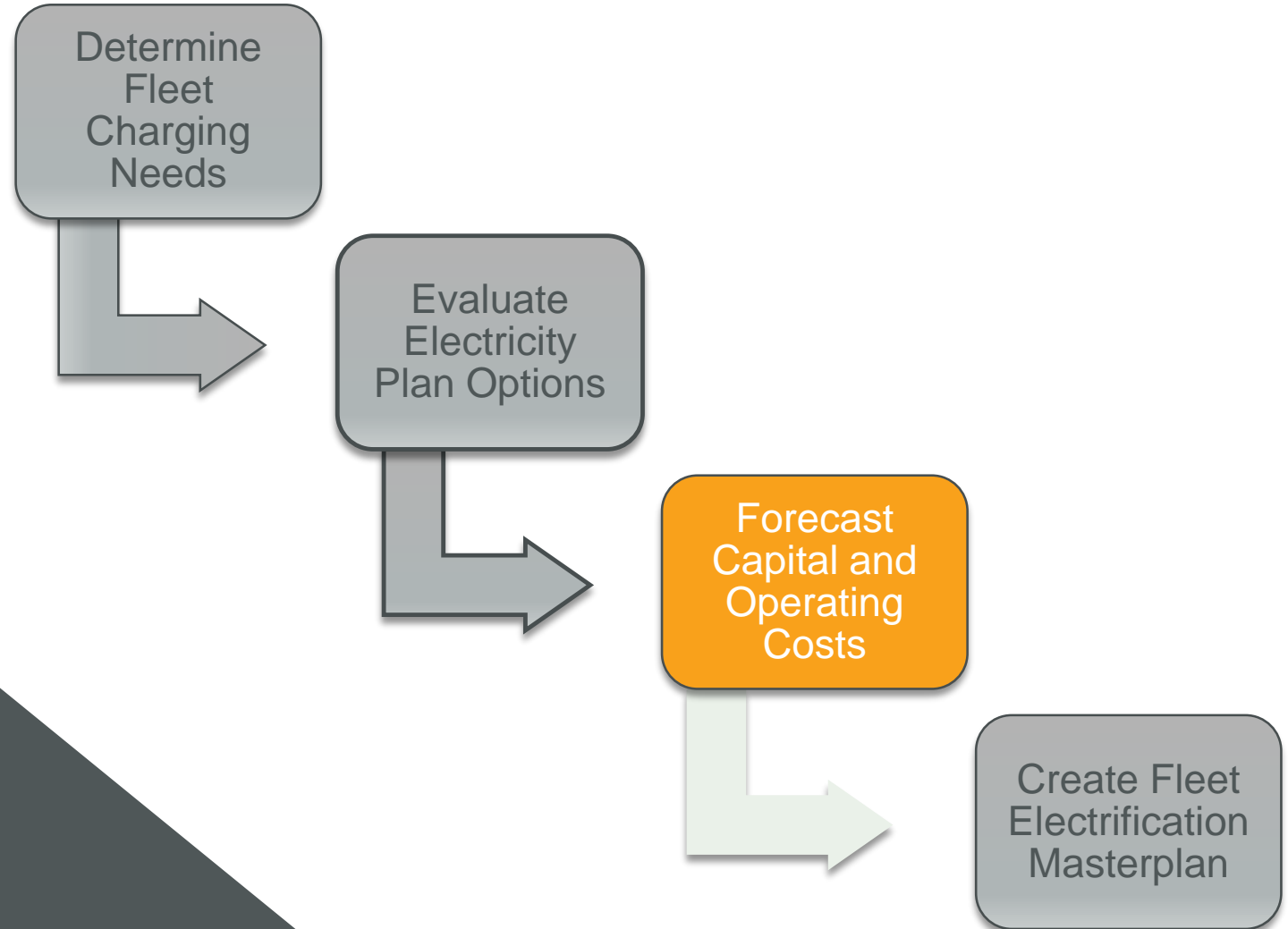
## Demand Charges (\$/kW)



Time (15 min intervals)

## Many Options to Consider:

- **Utility**
  - Existing and new tariffs
  - PUC influence
- **Generation**
  - Solar
  - Energy Storage
  - Microturbines
- **Third Party Providers and Funding**
  - Power purchase agreements
  - Full service providers



Realistic cost estimates communicate your fleet conversion plans to key decision makers



## CAPITAL COST ESTIMATES:

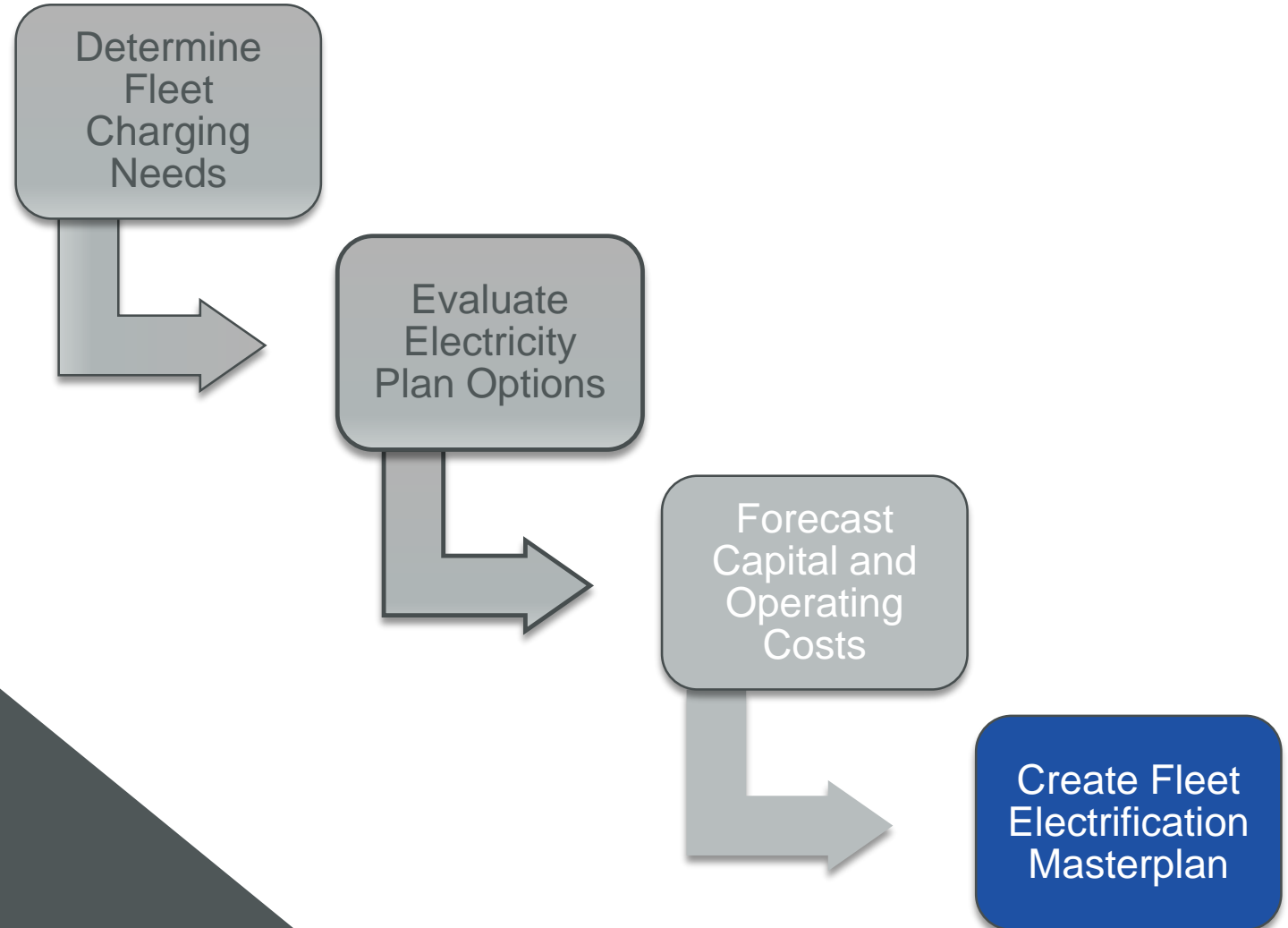
- Perform high level engineering design
- Estimate cost of infrastructure options
- Create rough estimate for infrastructure upgrades **by phase**, based on your fleet electrification plan



## OPERATING COST ESTIMATES:

- Create operating and Total Cost of Ownership calculations based upon:
  - Analysis of your routes and schedules
  - Optimal electricity procurement strategy

**Plan the Infrastructure Costs of Electrification from Today to Full Fleet**



# COMPLETE YOUR FLEET ELECTRIFICATION MASTER PLAN

	Year 1	Year 2	Year 3	Year 4
Pilot Bus(es) Testing				
Operate Pilot Bus(es)				
Full Fleet Electrification Planning				
Utility Infrastructure Implementation – Ph 1				
Yard Infrastructure Implementation – Ph 1				
Fleet Electrification, Phase 1				



THANK YOU.



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