FedEx Electrification of Short-Haul Transportation

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FedEx Express

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Evolution-driven Success

Energy Agnostic

No silver bullet: A wide variety of alternative energy applications for both pickup delivery & GSE vehicles

- Compressed natural gas
- Zero emission electric vehicles
- Extended range electric vehicles (eREV) using fuel cells, diesel, or gasoline-powered generators to extend range
- Biofuel

Global Scope: Alt-Fuel Vehicles & GSE

FedEx Alt-Fuel Fleet: 4,049 total

Hybrid & Electric Vehicles: 1,189

Hybrid & Electric GSE: 2,860

Short-Haul (PUD) Focus

FedEx Express Global Vehicle Fleet

44,600 Short-Haul (Pick-Up & Delivery) vs. **4500** OTR Tractors

Nearly

10:1

Ground Support Equipment

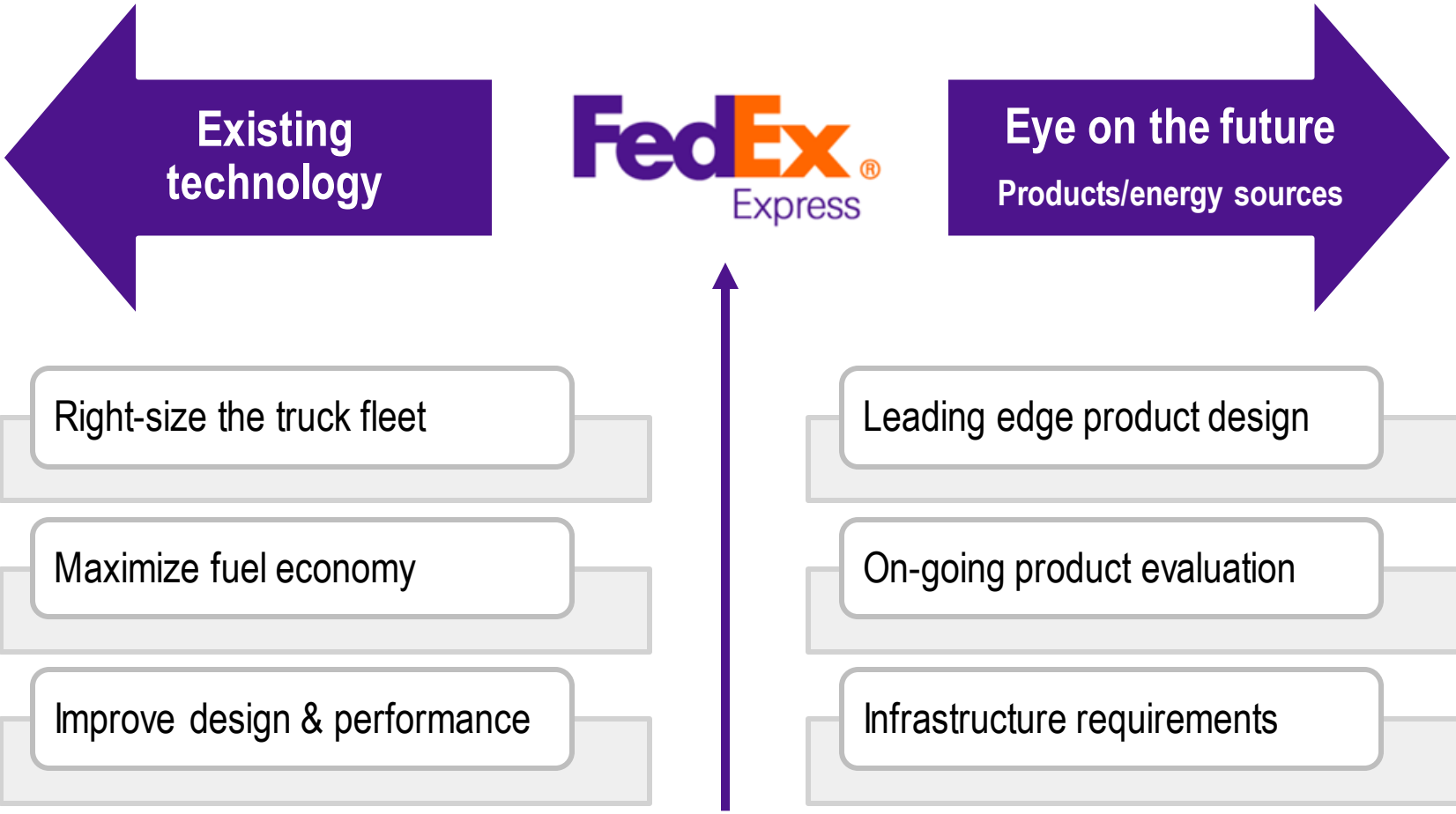
- **Domestic & International**
  - 2,860 hybrid & electric GSE
  - 5% of fleet
- **Electric Loader**
- **Hydrogen Fuel Cell Cargo Tractor**

Electric Loaders

Electric Cargo Tractor

Hydrogen Fuel Cell Cargo Tractor

Taking a Leadership Role



Right-Size the Fleet

Hybrid

15,000–30,000

Composite Body Reach

10,000 – 40,000

Existing W700

up to 20,000

Sprinter Type

10,000–60,000

Panel Van

> 40,000

Improved battery range

eREV

up to 16,000

> 16,000

Range – Speed – Time

Right Technology | Right Duty Cycle

Payload – Stops – Volume

5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000 45,000 50,000 55,000 60,000

Miles per year

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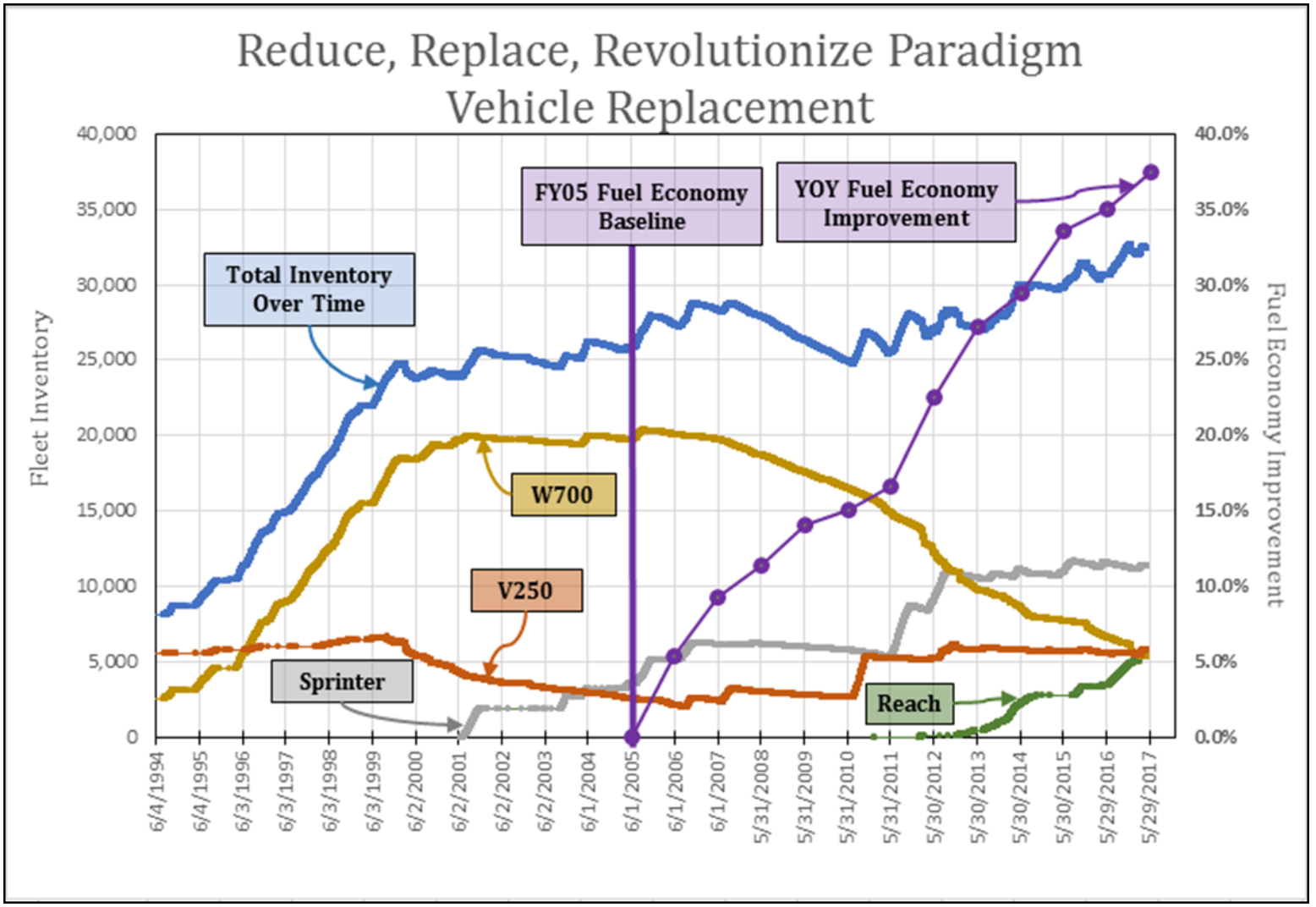
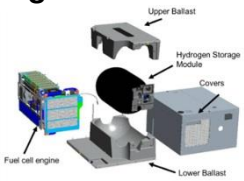
Maximize Fuel Economy



Technology Strategy – Eye on the Future

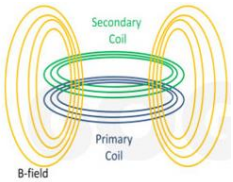
Proof of Concept

Hydrogen Fuel Cells



Ultra Capacitors

Inductive EV Charging



FedEx Improvements

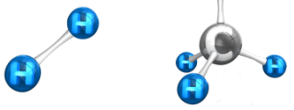
- Anti-idle
- Electric accessories

Validate

Electric Vehicles (EVs)

Extended Range EVs

Other Fuels



Hydrogen Methane

Launch

Isuzu Reach

- Optimize engine size & power
- Lightweight composite panels

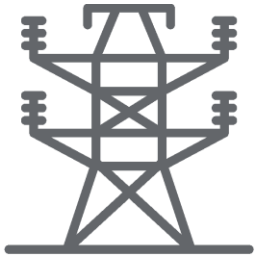
- Adaptive cruise control
- Collision avoidance

European Type

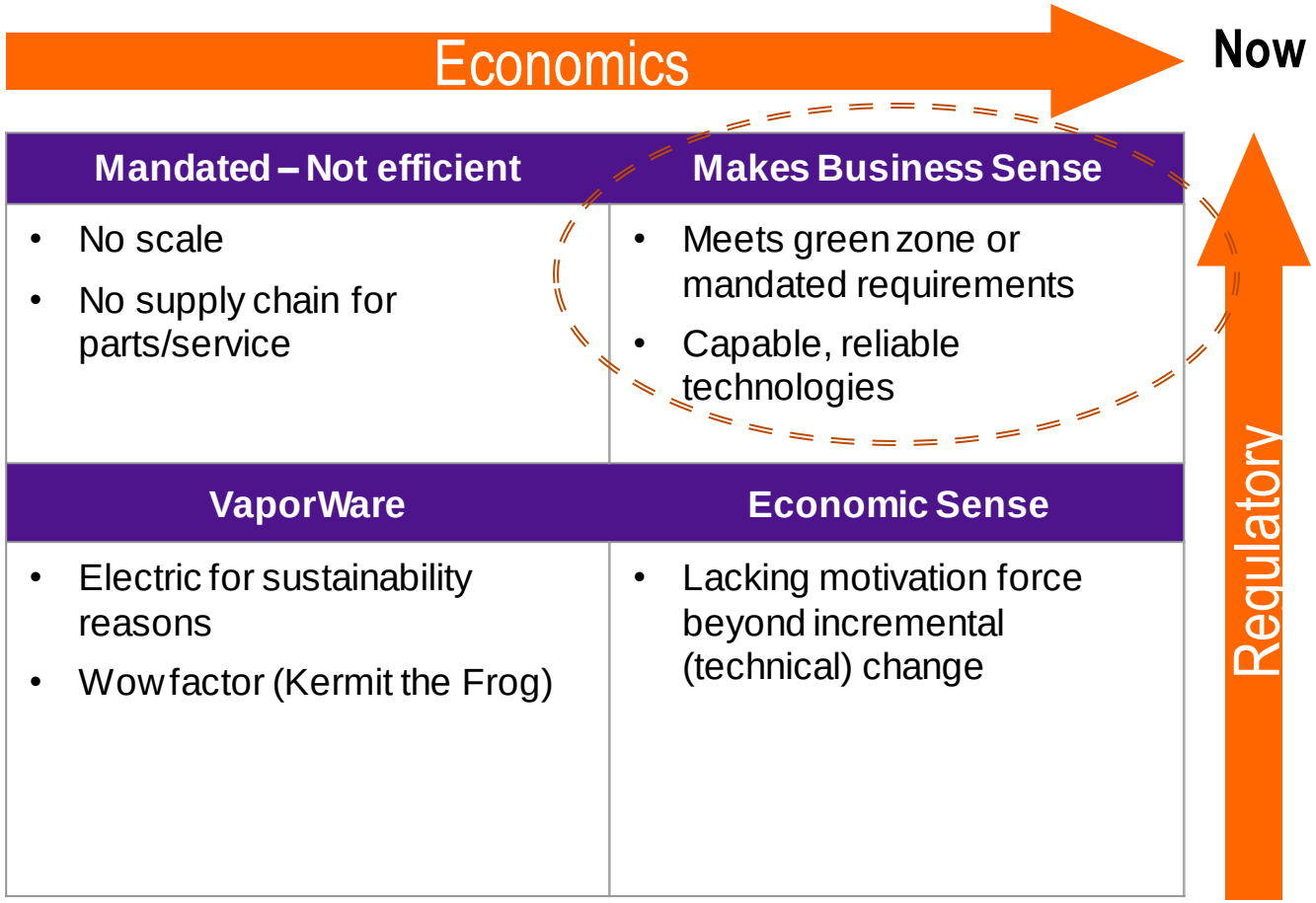
- Optimize engine & trans calibrations
- Tuned shifting

Eye on the Future

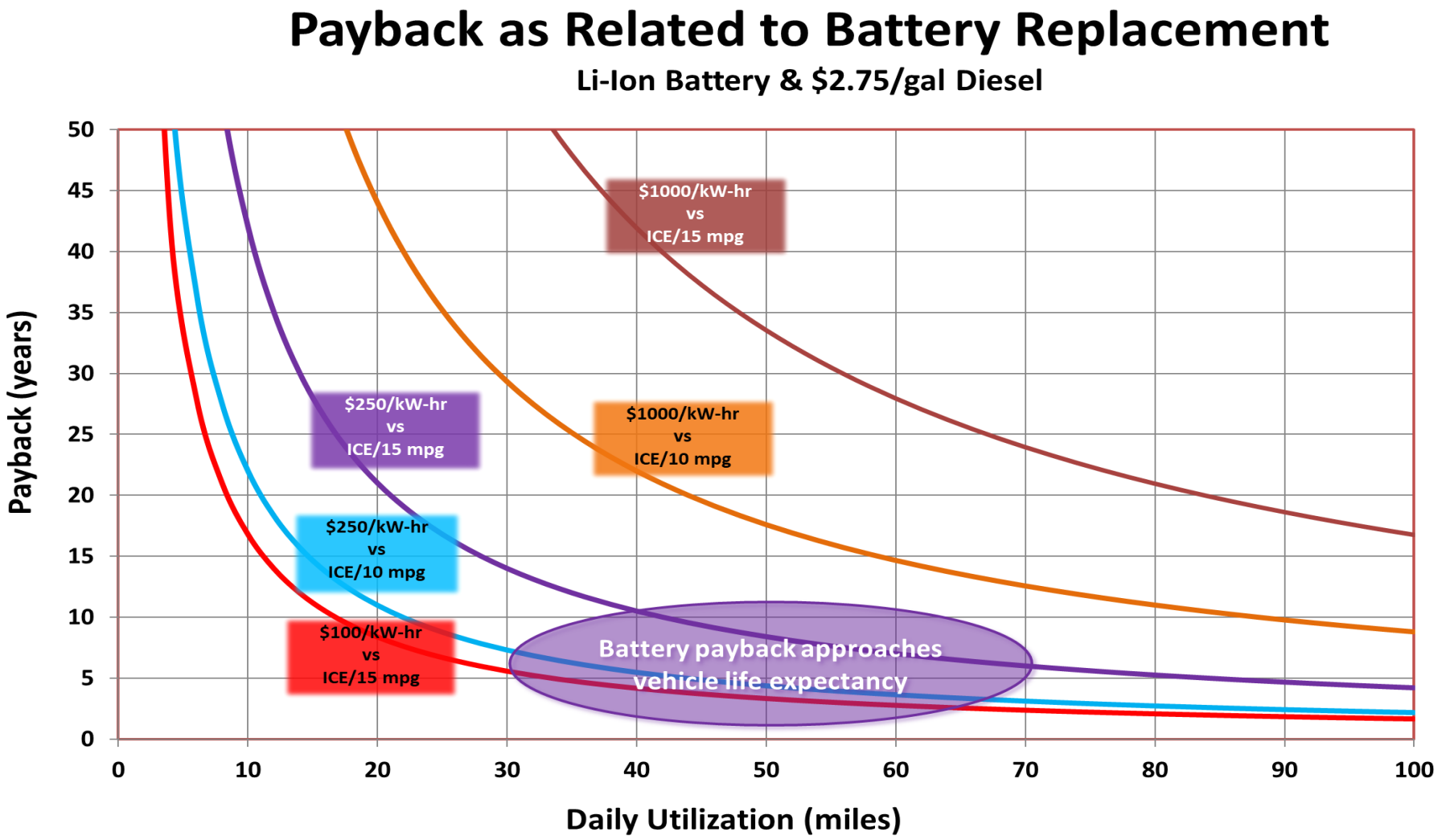
Leading Edge Design	Product Evaluation	Infrastructure Requirements
• Composites • Technology (auto-braking, engine + trans ECU)	• Fuel cells • Capacitors	• Charging capabilities • Municipal utilities



Why now? Why is Electric a Viable Option?



ROI on Capital for Battery Premium



Note: EVs come with a premium related to battery cost, which can be offset by fuel price and fuel economy

Opportunities & Barriers to Implementation

Internal	Regulatory	Technical
Opportunities		
• Incorporate into our emissions strategy • Increase purchase of hybrids • London congestion charge avoidance (£10 per day per vehicle)	• Hybrids meet expanding local emissions requirements • May aid in compliance with legislated fuel economy target	• Pure electric vehicles available in U.S. • Viable solution to address current & anticipated zero emissions zones globally • Lower development & production costs than plug-in hybrid
Barriers		
• ROI • One-year funding horizon • Large impact on country profit model offshore • Reliability/cost have large impact on contractors	• EPA emissions requirements for diesel engines • PHEV/HEV engine dictated by engine emissions requirements	• Battery technology cost driver • No manufacturer at production scale • PHEV truck engine must meet EPA certification • Limited commercial availability

Next level support for next level evolution

OE Manufacturers

- Genuine OE level of manufacturing & support
- Standardized batteries, chargers, technologies, metrics

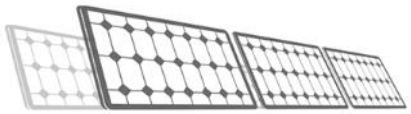
Gov. Agency Infrastructure

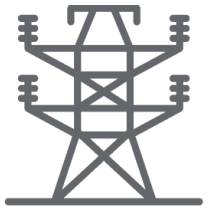
- Grid reliability & capacity
- Increase in overall demand; higher off-peak demand
- Substation upgrades: How to share improvements cost?
- How to increase and/or smooth generation output?

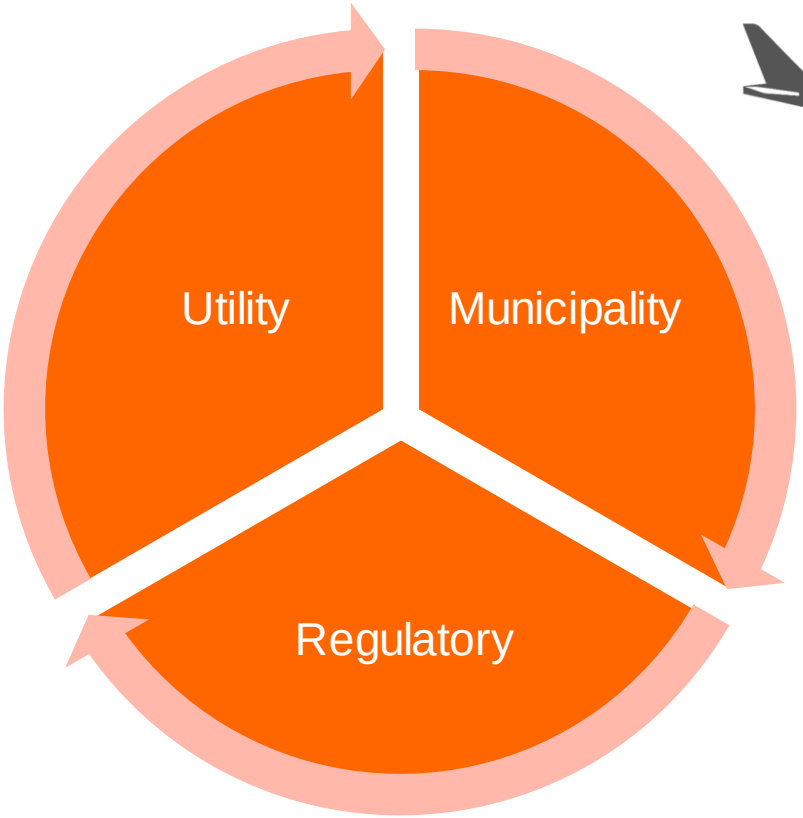
Battery Tech

- Cost / KW-h
- Density
- Charge time & charge process

Develop an Ecosystem, Then Replicate







Questions?

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