The Use of Data Modeling and Sensitivity Analysis to Optimize the Use of WPT Charging with Electric Buses

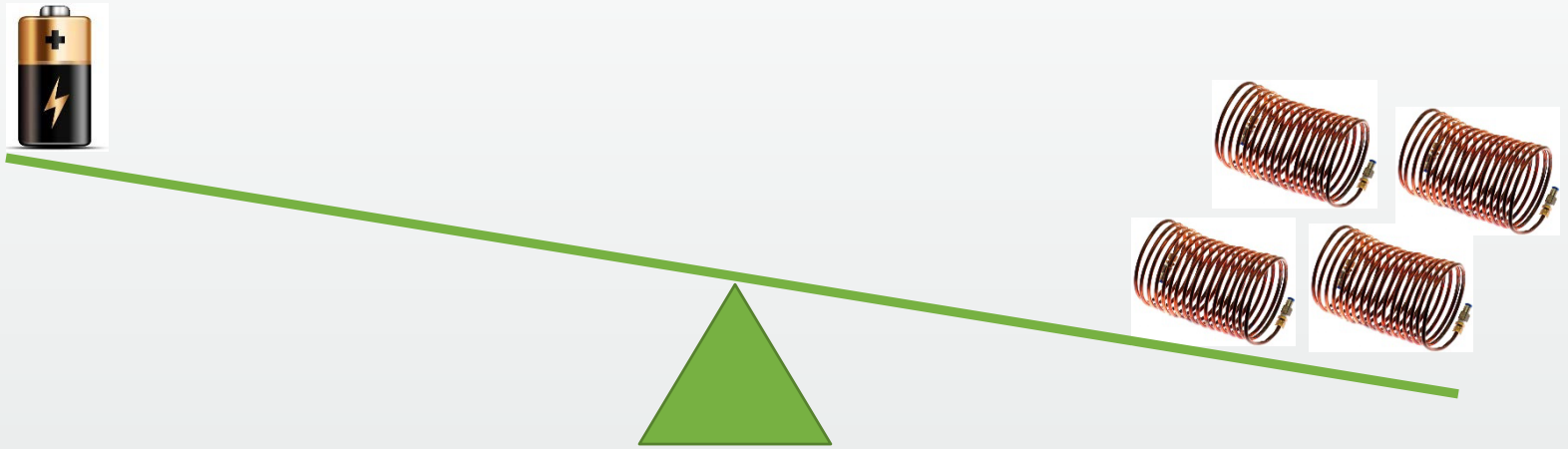
James W. May | May 16, 2016

The Basics

- Economics, energy technology, public policy
- Co-Founder and VP of Business Development for WAVE 2011-2015
- Independent consultant focusing on energy, environment, public transit space
- Interested in how data analysis and modeling can help accelerate the use of emerging technology

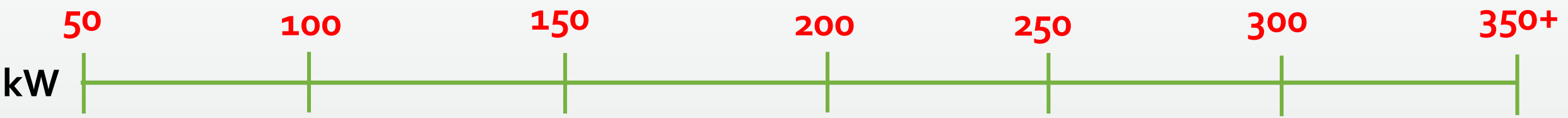
The Questions

- How much wireless charging is the right amount?



The Questions

- What is the right charging level?



FACTORS

$ Cost

Charging Time

Battery Size & Chemistry

R&D Time

Grid Impact

Power Electronics

The Tool

WAVE Public Transit Total Cost of Ownership Comparison 1.3

James W. May

WAVE CHARGE LEVEL	100 kW

Route Inputs	
Length of Route	10.00 miles
Laps per Day	24
Deadhead Miles	6
Daily Hours of Service	12
Number of Buses on Route	5
Recovery Time per Lap	8.0 min
Project Location (State)	Michigan

WAVE Inputs	
Bus Selection	BYD K9
Number of Primary Chargers	1
Electricity Price ($/kWh)	$ 0.13
Electricity Demand Charge	$ -

Bus Output Parameters	
Vehicle Battery Size Pure EV	853.0 kWh
WPT Battery Size	335.7 kWh
Battery Reduction %	61%
Total WAVE Equipment per Bus	$ 122,240
Annual Miles Traveled	89,790
Vehicle Energy Consumption (kWh/m)	2.04

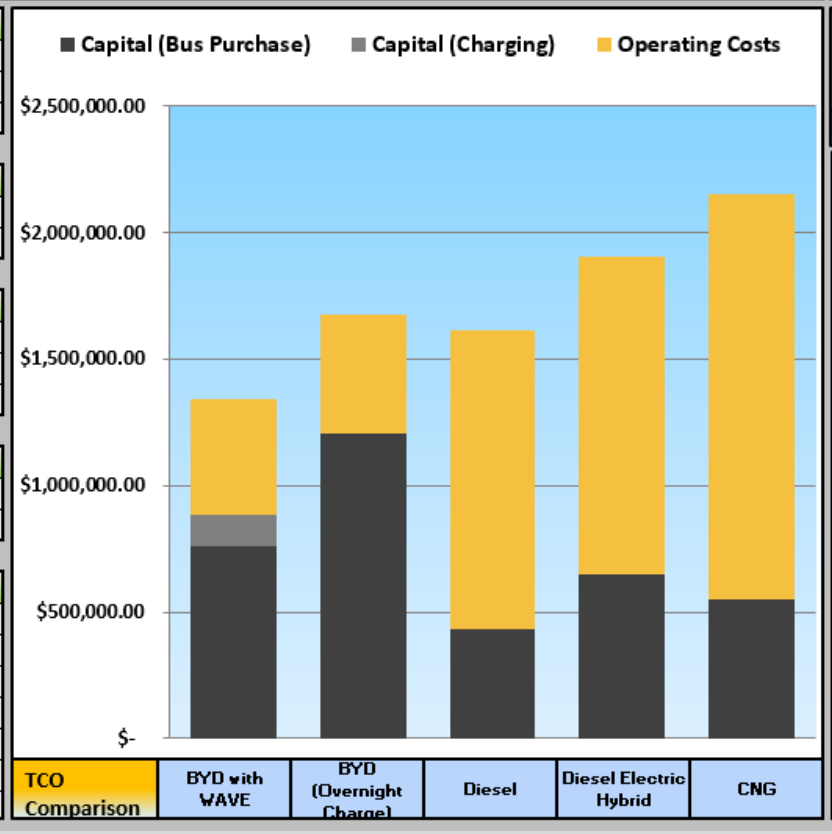
Diesel Bus Inputs	
Bus Purchase Price	$ 430,000
Bus MPG	4.30
Fuel Price ($/gal)	$ 3.60

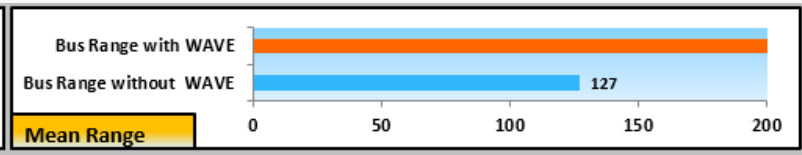
Diesel Electric Hybrid Bus Inputs	
Bus Purchase Price	$ 650,000
Bus MPG	4.80

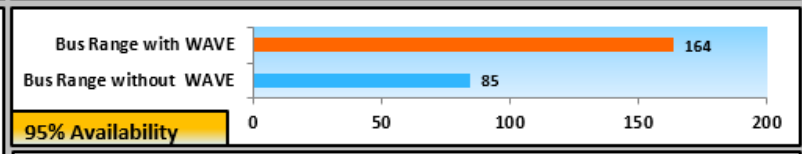
CNG Bus Inputs	
Bus Purchase Price	$ 550,000
Bus MPG	2.76
Fuel Price ($/gal)	$ 2.51

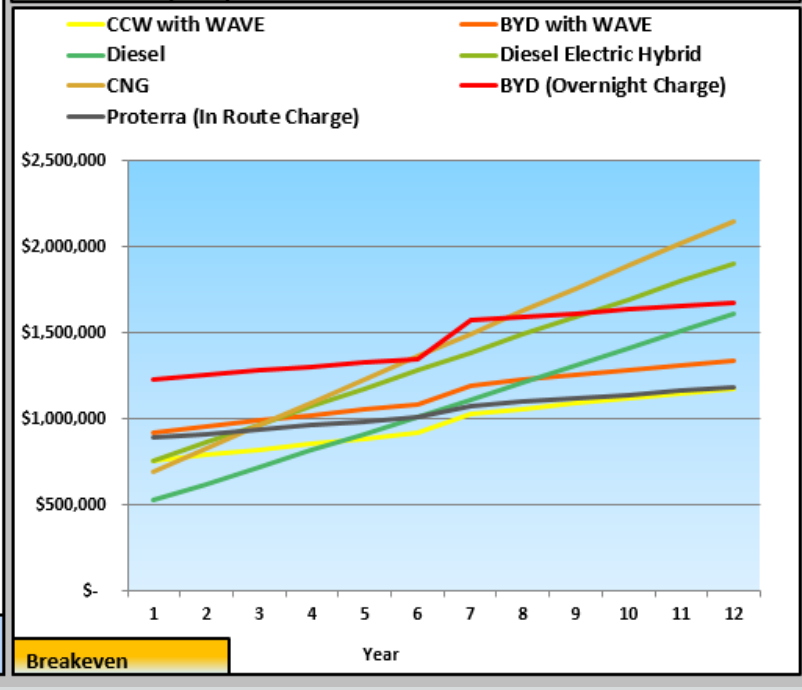
Alternative EV Buses	
BYD Purchase Price	$ 750,000
Proterra Purchase Price	$ 800,000

Total Cost of Ownership Output	
CCW with WAVE	$ 1,173,469
BYD with WAVE	$ 1,340,819
Diesel	$ 1,614,820
Diesel Electric Hybrid	$ 1,902,567
CNG	$ 2,152,509
BYD (Overnight Charge)	$ 1,675,610
Proterra (In Route Charge)	$ 1,181,496









The Tool

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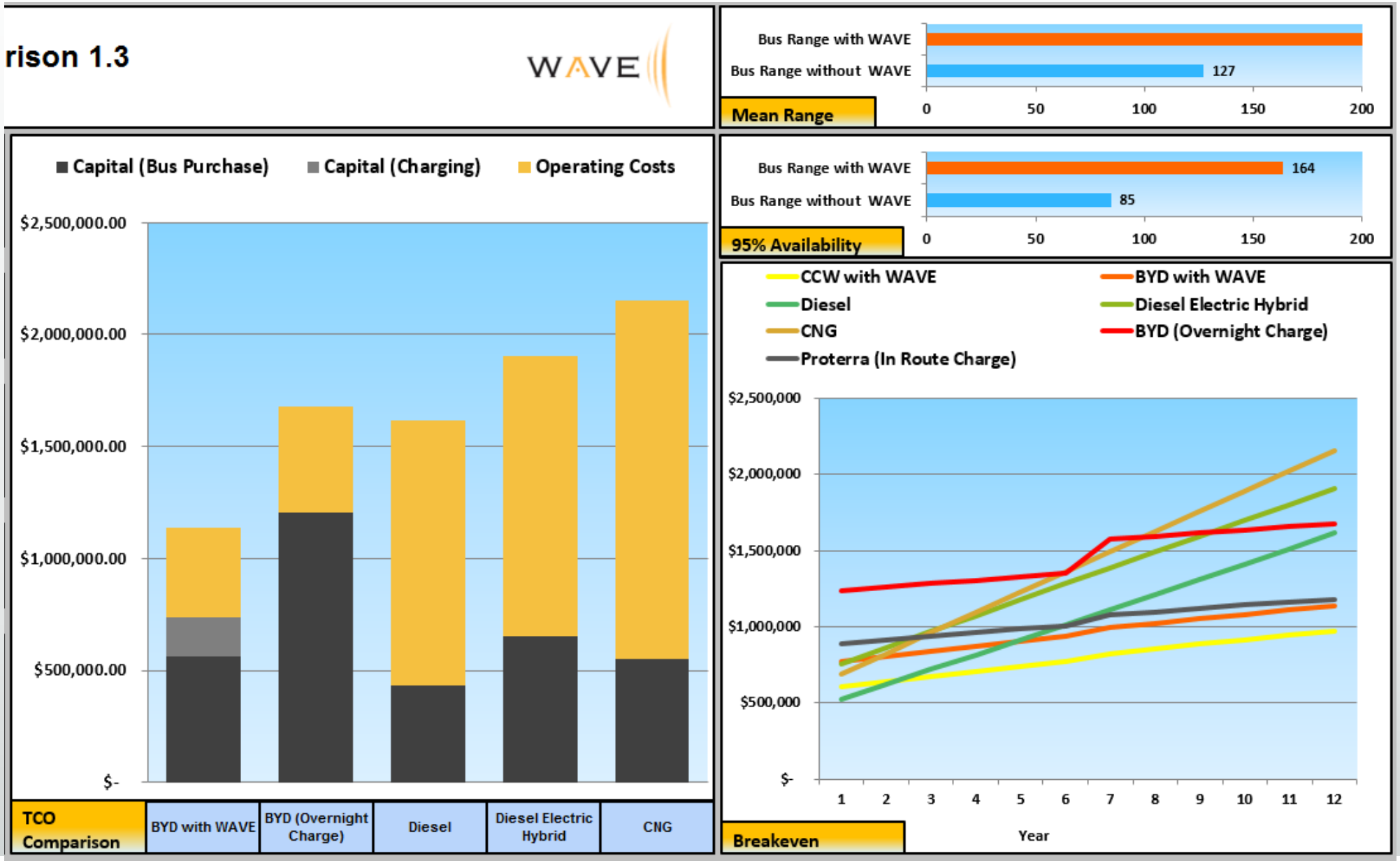
rison 1.3
WAVE
Capital (Bus Purchase)
Capital (Charging)
Operating Costs
$2,500,000.00
$2,000,000.00
$1,500,000.00
$1,000,000.00
$500,000.00
$-
TCO Comparison
BYD with WAVE
BYD (Overnight Charge)
Diesel
Diesel Electric Hybrid
CNG
Bus Range with WAVE
Bus Range without WAVE
127
Mean Range
0
50
100
150
200
Bus Range with WAVE
Bus Range without WAVE
164
85
95% Availability
0
50
100
150
200
CCW with WAVE
BYD with WAVE
Diesel
Diesel Electric Hybrid
CNG
BYD (Overnight Charge)
Proterra (In Route Charge)
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$-
1
2
3
4
5
6
7
8
9
10
11
12
Year
Breakeven

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