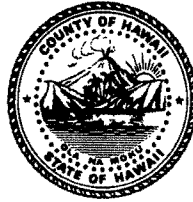


Susan L.K. Lee Loy
Council Member
District 3



Office: (808) 961-8396
Fax: (808) 965-8912
Email: sue.leeloy@hawaiiicounty.gov

HAWAI'I COUNTY COUNCIL

25 Aupuni Street, Hilo, Hawai'i 96720

MEMORANDUM

DATE: September 16, 2019

TO: Aaron Chung, Council Chair; and
Members of the Hawaii County Council

FROM: *SL*
mv Susan L.K. Lee Loy, Council Member

SUBJECT: Regarding Communication No. 424: PowerPoint presentation from BYD Coach & Bus LLC.

2019 SEP 16 AM 8:48
COUNTY CLERK
COUNTY OF HAWAII

Attached is a copy of the PowerPoint presentation from Mr. Justin Scalzi of BYD Coach & Bus LLC for Communication No. 424.

Please distribute this at the Public Works and Mass Transit Committee meeting on September 17, 2019.

SL:so
Att.



COUNTY OF HAWAII
MASS TRANSIT ELECTRIFICATION

Build Your Dreams





COUNTY COUNCIL PRESENTATION

ELECTRIFIED OVERVIEW AND UPDATE

1. Who is BYD?
2. History of Electrified Transportation
3. The future of Electrified Transportation
 - I. Battery Technology
 - II. Benefits of EV adoption
 - III. World Adoption
 - III. US Adoption
4. Quick overview of available models
5. Hele-On as an example



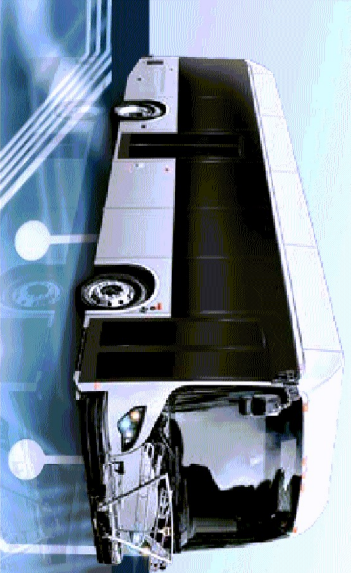
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WHO IS BYD?



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BYD COMPANY PROFILE

- Largest Rechargeable Battery Manufacturer In The World
- Largest EV Bus Manufacturer – 50,000+ units delivered Worldwide
- As of October 2015, Largest Consumer EV Manufacturer
- \$22.7B Revenue In 2018
- 60% Owned By American Investors
- Warren Buffet's Berkshire Hathaway, Single Largest Investor Owning 10%



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BYD IN THE US

BYD in Lancaster, California



- **BYD Coach & Bus and BYD Energy are both located in Lancaster, CA**
- **Executive and Administration office in Downtown Los Angeles**



**JOBS TO MOVE
AMERICA**

BYD is proud to meet and exceed *Buy America* compliance

BYD Coach & Bus facility was expanded to 546,000 square feet in October 2017 and currently employs 840 people.

Lancaster facilities workforce are comprised of 85% minorities

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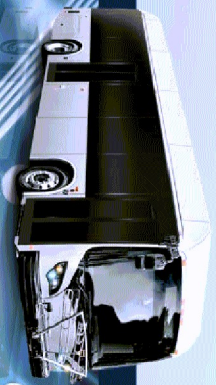
BYD IN HAWAII



BYD Hawaii - Kapolei
Local Inventory, Tech & Engineering Support



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HISTORY OF ELECTRIFIED TRANSPORTATION



102 Years Ago

New York, New York
1917

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HISTORY OF ELECTRIFIED TRANSPORTATION

127 Years Ago

Portland, Oregon
1892



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HISTORY OF ELECTRIFIED TRANSPORTATION

- **A PROVEN TECHNOLOGY FOR MORE THAN 100 YEARS**
- The Electric Drive Trolley Bus has been around since the late 1800's and is the most reliable form of transit in the world
- If you've ever been on a New York Subway, the Chicago "L", BART in San Francisco or any of the dozens of people movers at airports around the world you've experienced this centuries old form of transportation
- Safe reliable and zero emission



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HISTORY OF ELECTRIFIED TRANSPORTATION

- So What has changed?.....Superior Battery Technology!
- The advent of high density lithium batteries
- Successive improvements in the technology have increased storage capacity and decreased costs, leading to innovations in electric vehicles
- By unleashing the bus from the fixed overhead system and putting the power supply on board we have given the standard transit bus the same reliability as its steel wheeled counterparts at a fraction of their cost



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SUPERIOR BATTERY TECHNOLOGY

- BYD's proprietary battery technology makes it the safest choice for energy storage.
- Our Iron-Phosphate battery passes every international standard for battery safety testing available
- No other battery manufacturer can equal, let alone beat, this record



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PUNCTURE

OPEN FLAMES

IMPACT

BATTERY TESTING

OVEN

CRUSH

VIBRATE



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BYD IRON PHOSPHATE CHEMISTRY



12
YEAR
BATTERY WARRANTY

FIRST IN THE INDUSTRY

Reliability & Longevity

- BYD batteries have a 40+ year service life
- 70% capacity even after 10,000 cycles = 27 years

Safety

- No propensity for fire or explosion even under the most stressful conditions

Sustainability

- Zero emissions and zero pollution
- 100% Recyclable, no heavy metals or caustic materials



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EV BUS “CRADLE TO GRAVE” TOTAL COST OF OWNERSHIP

Annual Mileage: 45,000 Years in Service: 12		BYD	CNG	DIESEL
Fuel per mile	120 kWh/100km 19.8 MPGe \$0.2 USD/mi	112 L/100km 2.1 MPG \$1.0 USD/mi	45 L/100km 5.23 MPG \$1.0 USD/mi	
Fuel Cost	\$153,905	\$459,410	\$392,605	
Maintenance Cost	\$135,000	\$672,020	\$580,220	
Environmental Cost	\$0	\$50,000	\$100,000	
Initial Bus Cost	\$770,000	\$525,382	\$475,600	
Lifetime Cost	\$1,058,906	\$1,706,812	\$1,548,425	



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Why Go **All-Electric** Reason #1 **ZERO Emissions**

- What are some of the environmental benefits?

ZERO EMISSIONS

- **Carbon dioxide (CO₂)**: a 121-ton reduction per year, per electric bus. Over the anticipated 12 year lifetime of the bus, this equates to 1,452 tons per bus.
- **Nitrogen Oxides (NO_x)**: less 0.5938 tons per year, or 7.1256 tons over the lifetime of the bus.
- **Particulate matter (PM)**: reduced by 0.0274 tons per year, or 0.3288 tons over the 12 year lifespan of each electric bus.
- **Carbon monoxide (CO)**: reduced 0.310 tons annually or 3.72 tons over the lifetime of the bus.
- **Hydrocarbons (HC)**: reduced by 0.0428 tons per year or 0.5136 tons over the 12 year lifespan of each bus.



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Why Go **All-Electric Reason #2 Health Benefits**

- Reduced emissions lead to reduced occurrences of illness.

HEALTH BENEFITS

According to the EPA's Diesel Emissions Quantifier Health Benefits Methodology:

The reduction in particulate matter from just one electric bus is equivalent to about \$55,000 in health benefits savings annually; over the anticipated 12 year lifetime of the bus, health benefit savings are estimated at about \$660,000 per bus.

A fleet of 35 buses on the Big Island would have a direct local health cost savings of \$36,300,000 over the next 12 years.



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Why Go **All-Electric Reason #3 Cost Savings**

- **Cost Savings through reduced maintenance**

Battery electric buses can save upwards of 60-80% in operational cost.

No Hazardous UREA to purchase and store.

No DPF's to clean and no EPA regulated Hazardous Waste such as soot from DPF cleaning, oil and filters to dispose of.

Fewer preventative maintenance inspections means more up time.

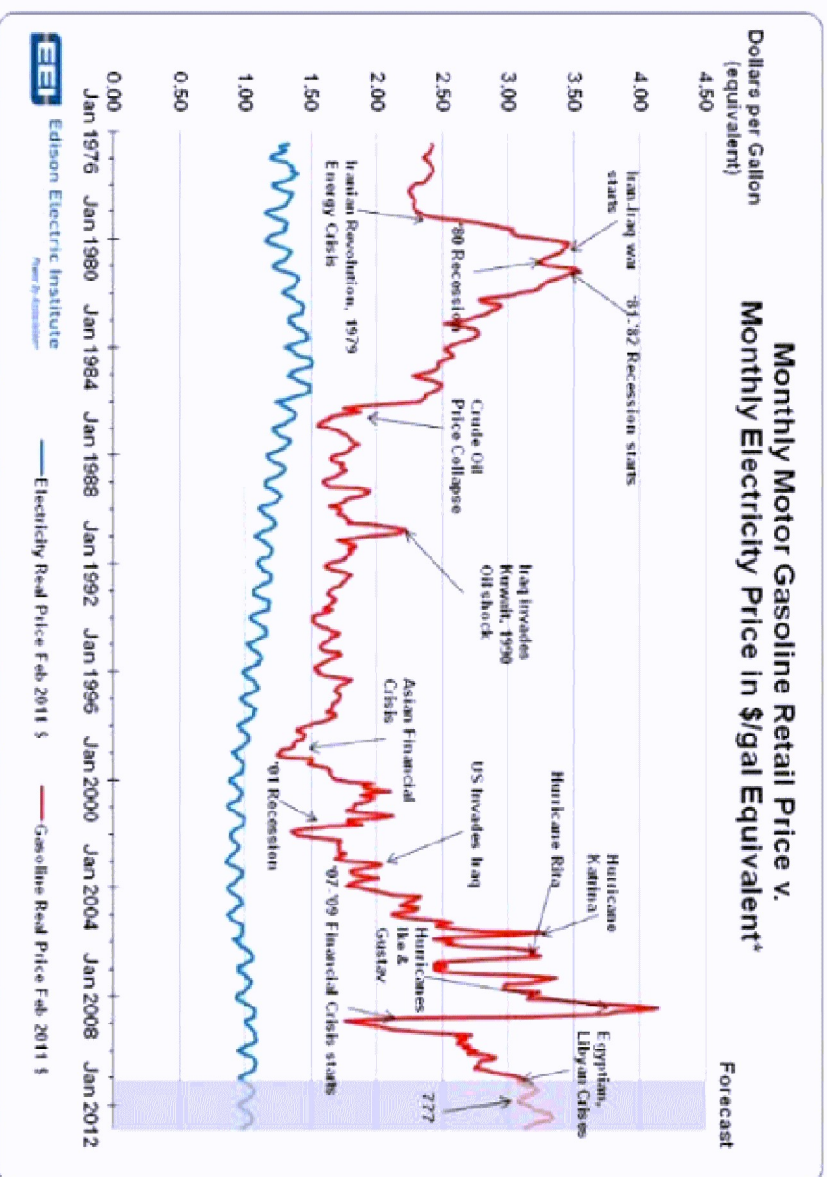


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Why Go All-Electric Reason #4 Energy Cost

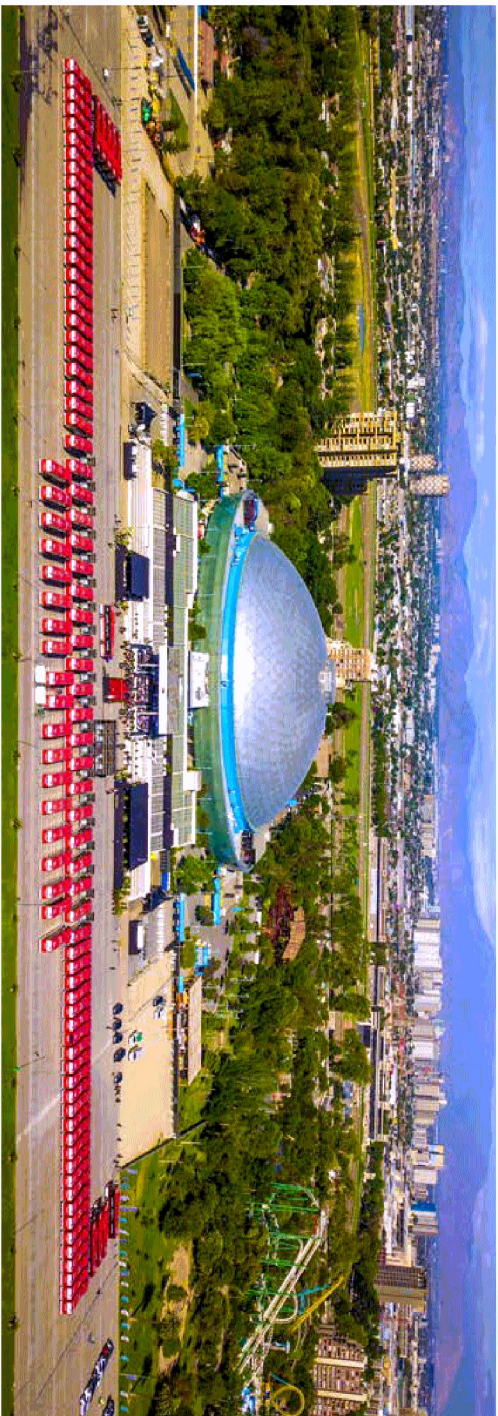
Benefits of Electricity

- Stable Pricing
- Average 20% the cost of crude products
- Easier to forecast annually





Public Transportation Buses are Moving to 100% Zero Emission Globally



Chile is operating 200 electric buses in its Capital of Santiago.

During a recent visit to China, The President of Chile, officially announced to double the number of EV Buses in Santiago in 2020.



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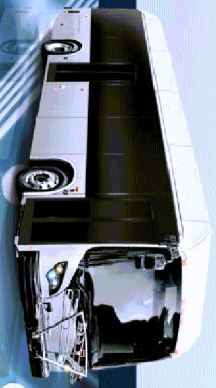
Public Transportation Buses are Moving to 100% Zero Emission Globally

100% of Shenzhen City buses have been electrified since 2017.

China has officially announced, all city buses will be zero emission in 10 years.



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Local Adoption - 100% Zero Emission

CUSTOMER MAP			
			
			
			
			
			
			
			
			
			
			
			
			
			
			
			
			
			

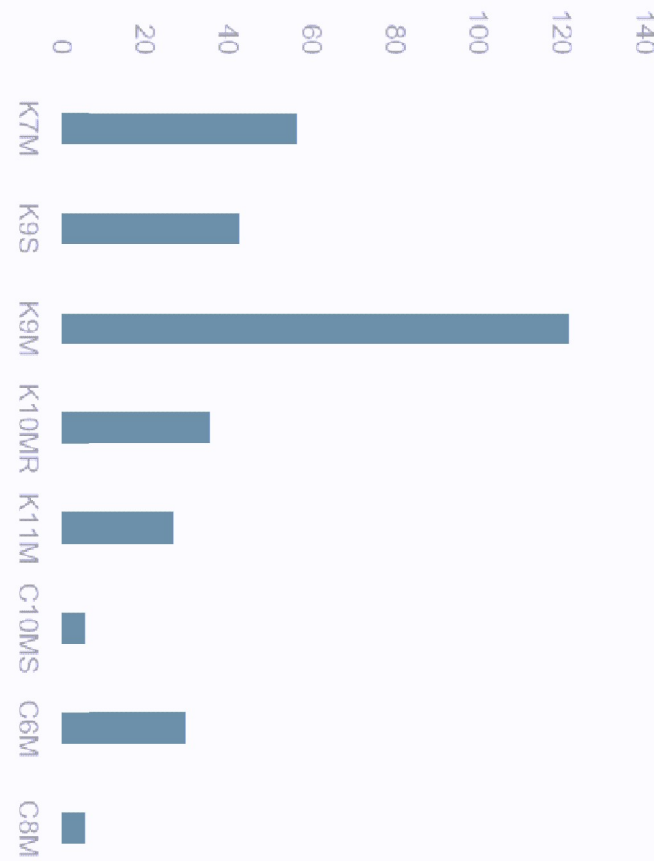
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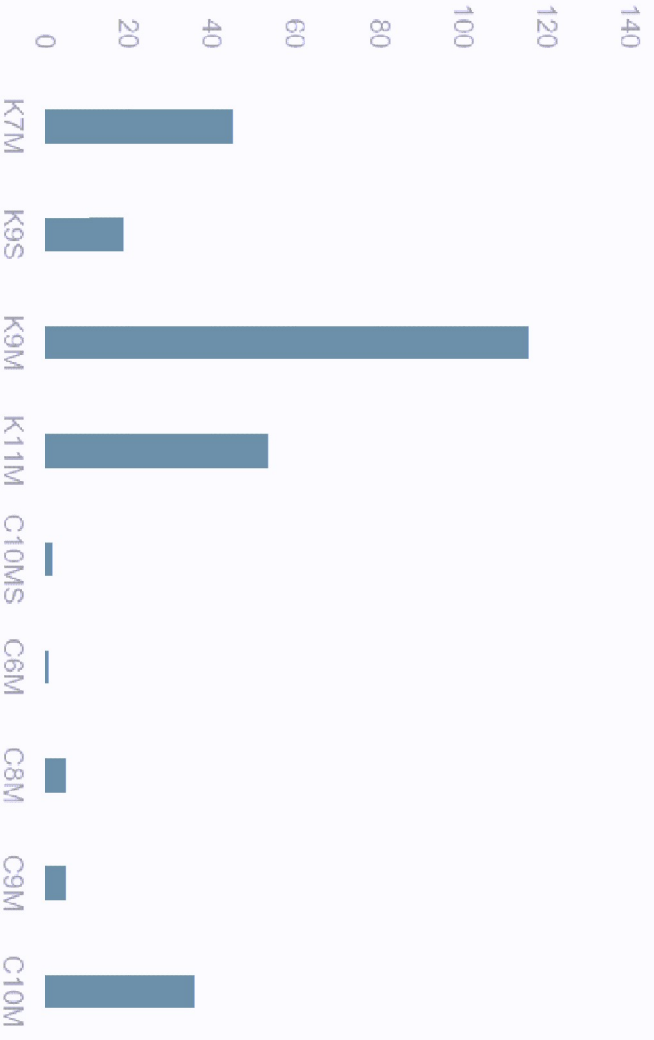


BYD Bus Sales & Delivery

Bus Delivery of Each Model



Bus on Order of Each Model



K7M	K9S	K9M	K10MR	K11M	C10MS	C6M	C8M
57	49	125	36	45	10	33	6

K7M	K9S	K9M	K11M	C10MS	C6M	C8M	C9M	C10M
45	19	116	54	2	1	5	5	36

* 252 options

361 DELIVERED

283 ON ORDER



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MASS TRANSIT TODAY

MTA budget in FY17-18 was \$14,031,908. This amount covers operating cost of bus drivers, the shared ride taxi program, fuel, insurance, salary and wages for eleven MTA employees and capital expenses.

Today, Hele-On's fleet consists of **11 operational vehicles** and a number of older buses which are too old and not mechanically sound enough to continue operation.

In order to meet the 14 routes in Mass Transits operation 13 to 15 vehicles are chartered everyday to make service requirements.



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COUNTY OF HAWAII

TRANSIT AND MULTI-MODAL TRANSPORTATION MASTER PLAN

AUGUST 2018 FINAL VERSION



Build Your Dreams





VISION

Create a high quality multi-modal transportation system that provides **safe, reliable, convenient** mobility choices that meet the commuting, social service, and other needs of our residents and visitors.

The multi-modal system should be **environmentally responsible and cost effective**.

TRANSIT FLEET

Transit Fleet Far and away the most important capital need for the current transit program is to get a **reliable fleet**, replacing the current vehicles, and expanding to a fleet that is **dependable** and suited to the type of services being provided.

Vehicle availability and reliability effects service, rider confidence, and MTA pride.



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IMMEDIATE PRIORITIES

(next two years)

- 1) Restore service reliability and get ridership back to previous levels
- 2) Acquire up to 14 buses/vans using previous grants and new capital funds to bring the fleet to 25.
- 3) Once fleet size is enlarged and reliability can be restored, continue to add additional service hours and routes to create a hub and spoke pattern
- 4) Start Hilo to Kona service using Saddle Road

(2020-2025)

- 1) Acquire 5-6 new and replacement vehicles per year to bring the fleet to 40
- 2) Increase service to have all proposed circulators in place
- 3) Plan, design, and build the Kona hub. Consider options to provide light service on Kona side.

(2025-2030)

- 1) Continue to acquire 5-6 buses per year to achieve a fleet size of 55



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COST OF CHARTERING FOR DAILY SERVICE

Qty of Daily Charters	Hourly Cost	8 hr	10 hr	12hr	Average Daily	Average Monthly	Average Annually
13	\$ 200.00	\$ 20,800.00	\$ 26,000.00	\$ 31,200.00	\$ 26,000.00	\$ 780,000.00	\$ 9,360,000.00
14	\$ 200.00	\$ 22,400.00	\$ 28,000.00	\$ 33,600.00	\$ 28,000.00	\$ 840,000.00	\$ 10,080,000.00
15	\$ 200.00	\$ 24,000.00	\$ 30,000.00	\$ 36,000.00	\$ 30,000.00	\$ 900,000.00	\$ 10,800,000.00

MTA budget in FY17-18 was \$14,031,908

The cost of chartering 50+% of the fleet is in excess of 60% of annual budget





CAPITAL LEASE

In order to expedite the The Master Transportation Plan, the County may wish to explore the possibility of acquiring vehicles through a capital lease-to-own program.

This option allows for a phased program to be implemented by the private sector and possibly making vehicles available sooner with a fixed payment over time.

- TELP
 - Tax Exempt Lease Purchase
 - Title Vests With Hawai'i County
 - No Voter Requirement
 - Pre-Payable at Any Time
 - \$1 End of Term Purchase Option
 - Payments Can Be Sculpted
 - To your budget, calendar, etc.
 - Cancellable Annually for Non-Appropriation
 - Existing Statutory Authority¹
 - Low Tax Exempt Interest Rates





TAX EXEMPT MUNICIPAL LEASE

Tax Exempt Muni Lease – County of Hawaii

This model assumes the County is the borrower as they are tax-exempt; the leases by law all have a \$1 purchase option. For example purposes we will choose a 6 year option but the lease could be extended or shortened based on availability of funds.

\$	520,000.00	Equipment Cost	K7M
Payment Type:	Arrears		
	Level Payment		
Term in Years	Monthly Payment	Mode	
2	\$ 22,832.44	Monthly	
3	\$ 15,459.76	Monthly	
4	\$ 11,786.99	Monthly	
5	\$ 9,589.63	Monthly	
6	\$ 8,130.11	Monthly	
7	\$ 7,092.31	Monthly	
8	\$ 6,318.20	Monthly	
9	\$ 5,719.95	Monthly	
10	\$ 5,244.91	Monthly	
11	\$ 4,859.53	Monthly	
12	\$ 4,541.48	Monthly	





PROFORMA – ESTIMATED COST

BYD Model	K7M	K7M-ER	K9S-ER	C6M-ADA	C9M-ADA		
Single Charge Range in Miles	143	185	215	125	200		
Battery Size in kWh	215	266	352	121	352		
BYD Vehicle Lease Rate (6 Year Term)	\$ 8,130.11	\$ 9,068.20	\$ 11,257.07	\$ 5,081.32	\$ 9,928.11		
Monthly Energy Cost (.35/kWh)	\$ 2,257.50	\$ 2,793.00	\$ 3,696.00	\$ 1,270.50	\$ 3,696.00		
Monthly Maintenance Cost (.40/mile)	\$ 1,716.00	\$ 2,220.00	\$ 2,580.00	\$ 1,500.00	\$ 2,400.00		
Insurance Monthly	\$ 445.00	\$ 445.00	\$ 445.00	\$ 445.00	\$ 445.00		
Smart Tech Monthly Fees	\$ 300.00	\$ 300.00	\$ 300.00	\$ 300.00	\$ 300.00		
Driver County Employee							
Total Monthly Vehicle Expense	\$ 12,848.61	\$ 14,826.20	\$ 18,278.07	\$ 8,596.82	\$ 16,769.11		
Replace Daily Charters Only	10	5				Monthly	Annually
	\$ 148,262.00	\$ 91,390.35				Total New Buses	15
						\$ 239,652.35	\$ 2,875,828.20
Replace Daily Charters with 20% spare	12	6				Total New Buses	18
	\$ 177,914.40	\$ 109,668.42				\$ 287,582.82	\$ 3,450,993.84
Replace Charter/20% spare + add Saddle Express	12	6				Total New Buses	22
	\$ 177,914.40	\$ 109,668.42				\$ 67,076.44	\$ 4,255,911.12
Complete Fleet Replacement	10	15	10	10	10	Total New Buses	55
	\$ 128,486.10	\$ 222,393.00	\$ 182,780.70	\$ 85,968.20	\$ 167,691.10	\$ 787,319.10	\$ 9,447,829.20



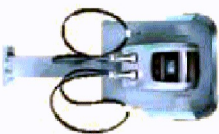
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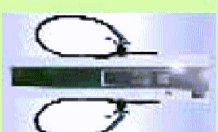
The Big Question Infrastructure



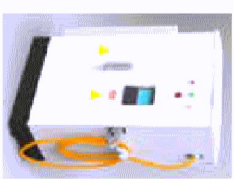
AC 40kW



AC 40kW*2



AC 100kW*2



DC 150kW

The Answer Amplify Power PPA



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Current Transit Offerings



* 2019 EPA Est. Range

Bus Model	2019 Q2	2019 Q3	2019 Q4	2020
 K7M		150 miles 215 kWh (Standard Pack Battery)		
 K7M-ER		185 miles 266 kWh (Standard Pack Battery)		
 K9S		145 miles 266 kWh (Standard Pack Battery)		
 K9S-ER		215 miles 352 kWh (Standard Pack Battery)		
 K9M		156 miles 324 kWh (Standard Pack Battery)		
 K9MD				200 miles 352kWh (Standard Pack Battery)
 K11M-Low Capacity		220 miles 578 kWh (Standard Pack Battery)		
 K11M		220 miles 578 kWh (Standard Pack Battery)		

Note: 1. Calculated with Orange County Road Profile. (Load: curb weight plus weight for half of designed passenger seating positions and for the driver. A/C off)
 2. Operating range varies with route conditions and driver behavior.

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Current Motor Coach Offerings

	Bus Model	2019 Q2	2019 Q3	2019 Q4	2020 Q1
	C6M	125 miles 121 kWh (Modularized Battery)	140 miles 140 kWh (Standard Pack Battery)		
	C8M	200 miles 313 kWh (Standard Pack Battery)			
	C9M	200 miles 352 kWh (Standard Pack Battery)			
	C10M	230 miles 446 kWh (Standard Pack Battery)			
	C8MS		170 miles 313 kWh (Standard Pack Battery)		
	C10MS	230 miles 466 kWh (Standard Pack Battery)			

Note: 1. Calculated with Highway Road Profile. (Load: curb weight plus weight for half of designed passenger seating positions and for the driver, A/C off, Speed: 50 mph)
2. Operating range varies with route conditions and driver behavior.



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Opportunity Charging Introduction

Overhead Charging

Overhead charging system has charging equipment on both bus roof and station mast. It allows electric vehicle to communicate with charger and charge automatically.

- Allow high power charging
- Significantly reduce vehicle weight and cost
- Interoperable en-route and in-depot charging stations
- SAFE-all charging equipment on the roof
- High energy transfer efficiency, extending operation range



Figure 1. BYD Bus up overhead charging



Figure 2. Bus up partograph

Inductive Charging

The Inductive charging system designed for all types of electric vehicles.

- Automatic charging system during bus operation
- Power levels from 50 to over 300kW, Interoperable en-route and in-depot charging stations
- Work in all kinds of weather. Low total cost of ownership
- Simple to use, easy to install and safe with no moving parts

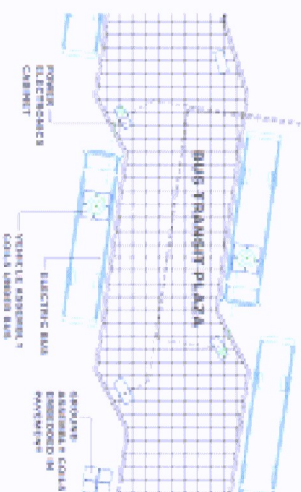


Figure 1. Inductive Charging Layout

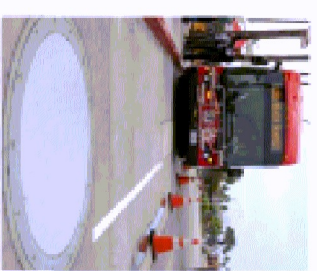


Figure 2. IBT Inductive Charging

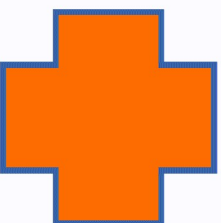
<https://vimeo.com/337273961>





Next Opportunity: Harness Hawaii's Natural Resources for a Self-Sustaining Transportation Solution Supported with Energy Storage.

Large-Scale Solar Power



Energy Storage



Electric Transit Buses



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Thank you



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