VTA CHURCH STREET REVIEW COMMITTEE
TOWN OF EDGARTOWN

MINUTES OF ZOOM MEETING HELD ON AUGUST 20, 2020
AND
CONTINUED ON AUGUST 25, 2020

Alan Strahler, the chair of the committee, opened the meeting at 12:18 PM.

All members of the committee were present on zoom, as follows:

Keith Chatinover
Jane Chittick
Angie Grant (non-voting member)
Julia Livingston
Sara Piazza
Mark Snider
Alan Strahler
Bill Veno
Doris Ward

The first order of business was public comment from two individuals:

1. Mary Schmidt said on zoom that she is a homeowner and registered voter in Edgartown and is in favor of the project. She said the induction charger project would enable the efficient use of quieter buses and the beautification of Church Street.
2. Bill Connolly sent his comments by email. His email says he is a resident of Edgartown and is in favor of all-electric buses throughout the island, but he also said that he believes this is now a fast-moving and rapidly-changing technology. His concern is that we will tear up the street, permanently alter the landscape and introduce even bigger buses than those which should not have been allowed into this area in the first place, and that we will very soon find that there is a better alternative—whether viewed from the standpoint of VTA operations, from that of public safety or from that of maintaining Edgartown's hard-won historic character. He asks that the committee give full consideration to alternative technologies.

The next order of business was Sara Piazza introducing herself to the committee as she requested because she had been cut short at the previous meeting. She described herself as a lifelong resident of a home near the corner where the buses turn from Pease's Point Way onto Main Street. She feels there are too many buses, and they are too large for in-town use. She believes the induction chargers will guarantee the use of buses that are too large in perpetuity, and that is not ok.

The next order of business was a motion to approve the minutes of the previous meeting. The motion was unanimously approved in a roll call vote.

Next, Alan Strahler described his proposed time limits: 10 minutes for each scheduled presentation, then a question and answer round, with committee members alphabetically having one minute to ask a question or two and the presenter having 3 minutes to answer, and with general discussion after all presentations and question and answer rounds. He agreed that the time limits could be slightly flexible.

The next order of business was a presentation by Alan Strahler using power point slides shared on zoom. Alan described some of the household items (toothbrushes, watches, hearing aids) that use induction charging. He explained that there are two coils with a magnetic charge between them. In the case of Church Street, there would be a coil under the street and a coil

attached to the underside of each electric bus. When a bus is in position above the induction charger in the street, the bus "kneels" so that the two coils are about 4" apart from each other, and the charge starts to flow into the bus battery. Alan said the amount of charge that escapes is minimal and within the established international standards. He said the frequency is different from the frequencies used for pacemakers and cell phones, so there is no interference. He mentioned that Momentum Dynamics and a company called WAVE are both in this business, and he listed a number of places in the U.S. and Europe where the technology has been used successfully over the past 3-5 years. Alan said he spoke to maintenance managers in several locations. He said that an induction charger system was in use in Chattanooga, TN for 5 years, but it had been installed at a depot where the bus drivers took their lunch breaks, not on a bus route, so the system is no longer in use. An induction charger system at a shopping mall in Howard County, MD worked fine for 3 years and is now under repair. Indianapolis, IN is installing a system now. The maintenance manager for the system in Wenatchee, WA reported excellent performance and will be the next presenter at this meeting.

Keith asked whether the induction chargers can be used with buses from different bus manufacturers. Angie said that a receiving coil needs to be installed under each electric bus that will use the induction chargers, and some bus manufacturers have not yet done the engineering necessary to support these coils. She believes more bus manufacturers will eventually do this, and she undertook to find out more.

Jane said that it's difficult to adapt a bus for induction chargers, and the technology has been abandoned in Berlin, Germany.

Sara asked whether the electric buses using induction chargers have to be 8 1/2 feet wide. She agreed to wait on this question until Angie's presentation at this meeting.

Mark described inductive charging as an evolving technology. Alan agreed that the VTA would be an early adopter, but not a pioneer. Mark said there is not much risk because the costs of the project are being paid with grant money. Angie said eventually batteries will be better and on route charging might no longer be necessary. She said the inductive chargers will be supported for the useful lives of the buses the VTA is acquiring. She said overhead on route charging is not an option for the VTA because it requires 500 kW of power as opposed to the 300 kW of power used in the proposed induction chargers. She also prefers the induction technology because it's relatively simple and requires very little maintenance.

Bill asked why some of the systems that have tried inductive charging have stopped using it. Alan repeated some of the material from his presentation summarized above and said he did not have complete information on this point.

Doris asked whether any inductive vehicle chargers had been in use longer than 5 years. Alan said Milan, Italy has had inductive chargers for 13 years. Doris asked whether the systems are safe? Alan said there are a number of studies that say they are.

The next order of business was a presentation by Ed Archer, the maintenance director for the Link transportation system in Wenatchee, WA. Ed says he has been involved with electric buses for 10 years and with Momentum Dynamics induction chargers for 1 1/2 years. He said the induction chargers enable him to run the electric buses for a full uninterrupted 14-16 hour day. The buses charge for 5 minutes every hour or half hour during their natural "dwell time" when they are letting off and taking on passengers. He sends out a bus in the morning with a 100% charge, and at the end of the day it is at 64%. He says the experience with the "generation 1" Momentum Dynamics induction charger has been very successful, so the Link system is now going to install three "generation 2" 300 kW Momentum Dynamics induction chargers. He says the "generation 1" charger transformed how they were able to function

because they could keep an electric bus in service for 24 hours a day, seven days a week. He said the chargers are unobtrusive, with only a 4 x 7 electrical cabinet and no footprint in the street. The Link system chose to paint a logo on the pavement over their induction charger, but this is not required. The chargers are not a problem for snow plows. There is very little maintenance - much less than with the conductive chargers his system tried. The coolant needs to be checked every 6 months, and Momentum Dynamics monitors the system remotely. A few times a year, a breaker needs to be reset. Once, his system needed a new fan, and it arrived and was installed within 24 hours. Ed said Momentum Dynamics was very reliable and very responsive. He said it was some of the best service he's ever seen in transit.

Keith asked for confirmation that, during the 16 hour day, the bus never went back to headquarters. Ed confirmed this. He said, without the on route inductive charging an electric bus could run about 8 hours, but with the on route inductive charging it could run 16 hours. In Wenatchee they have an "intermodal center" which is a hub for a lot of bus routes. That's where their buses have natural on route "dwell time," so that's where they put their inductive chargers, but an intermodal hub with a lot of space is not necessary. Ed said that inductive chargers can be put anywhere a bus pulls off the road to let off and take on passengers, as long as there is also space for the 4 x 7 cabinet. The Wenatchee cabinets are wrapped with informational graphics. He said you get about 1% charge per minute.

Jane asked Ed to confirm that the Link system is getting their "generation 2" chargers for free. Ed said that Momentum Dynamics is swapping the "generation 1" charger for a "generation 2" charger for free, and the Link system is buying two additional "generation 2" chargers. Also they are getting one "generation 2" receiver plate for free, installed on the bus that now has a "generation 1" receiver plate, and they are buying nine "generation 2" receiver plates for the other nine buses that will use the three new "generation 2" induction chargers.

Julia asked how far in the future it would be when bus batteries would improve to the point where a bus could run for 16 hours without needing to be charged. Ed estimated 10 years.

Sara asked whether there are electric buses smaller than 30' x 8.5'. Ed said right now 30' x 8.5' is about as small as it can get, but he thinks there may be a smaller Chinese electric bus, and he has heard through the grapevine that "cutaways" compatible with Momentum Dynamics inductive chargers are likely to be available soon. Angie said the VTA's existing 30' electric buses are 8' wide, not 8.5'. Angie said a "cutaway" is the type of bus used for the park and ride routes.

Mark noted that the Link system induction chargers are at a downtown hub, but we don't have that. Ed said the inductive chargers need to be on the route where the buses go. He said that, if you don't have on route charging, you need one or two additional buses for each route, which is expensive. He said a 35' bus costs $870,000. Angie says the VTA rolls 26 buses each day and would need to double that fleet, maybe more, in order to go all electric without the Church Street induction chargers. Jane said the induction chargers could go in Oak Bluffs. Angie said that won't work for all the routes, so the VTA will need to keep some diesel buses if there are no inductive chargers on Church Street.

Mark asked Ed whether he would invest in inductive chargers now or wait. Ed replied that he would do it now. He said that, right now, because he is between systems, he has to use 10 buses to do the work that was done by 5 buses with the "generation 1" charger. When the "generation 2" chargers are operative he will be able to have 2 of the 10 buses in maintenance while 8 are covering more routes than the 10 buses are covering now.

Bill asked what to look out for. Ed said to think about the bus batteries and consider liquid cooled batteries. Ed said induction chargers are a huge accomplishment and a huge leap forward.

Doris asked if Ed could come to Martha's Vineyard to advise us. Ed said he would need to ask his boss.

At this point, Ed left the zoom call.

Mark said we need the induction chargers for the heavily used routes that run through Edgartown, routes 1 and 13. He noted that the induction chargers will mean that VTA doesn't have to buy more buses and, if it turns out we don't like it, we've lost nothing because we aren't paying for it.

Angie said the VTA cannot go fully electric without the induction chargers on Church Street.

Sara said that allowing the inductive chargers ensures that we can only have big buses in downtown Edgartown.

Angie said, the smaller the bus, the more you need the induction chargers - because the batteries are smaller so the smaller buses have less range.

Keith said we should all bear in mind that, at the town meeting, only 96 people voted to establish this committee to reconsider the induction chargers, and there are almost 4,000 registered voters in Edgartown.

At 1:47 PM, the committee unanimously agreed to recess the meeting and resume on Tuesday, August 25, 2020, from 10:00 AM to 12:00 PM.

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At 10:10 AM on August 25, 2020, the meeting resumed with all committee members on zoom except Sara Piazza who joined later.

The next order of business was a presentation by Angie using power point slides shared on zoom. Angie explained the criteria and the process used to select Momentum Dynamics. The criteria were technical specifications, quality, duration and reliability of installed systems, quality and responsiveness of the proposal, fit with Martha's Vineyard aesthetics, and price. A committee of three studied the responses to the RFP and recommended Momentum Dynamics.

Angie then explained that on route chargers are needed because electric buses do not have enough energy in the summer or the winter to last a full transit day. Currently, the electric buses in the VTA fleet get swapped out mid-day for diesel buses.

Mark noted that West Tisbury will have induction chargers. Angie confirmed that West Tisbury is slated to have two induction chargers, but she said the route 6, 5, 3 bus is the only bus that stops in both Edgartown and West Tisbury, and it does not stop long enough in West Tisbury to do all its on route charging there. Jane suggested it could stop longer in West Tisbury, Angie said it's not that easy because the routes time off each other. Jane said the routes can be changed to accommodate new ideas. Angie said that adding 5 or 6 minutes would change the whole system. She said the VTA has worked hard to maximize its efficiency, and she feels the existing routes and schedules are working well.

Angie explained that the 30' electric buses are rated by the federal testing program called "Altoona" to have a range of 150 miles, and the VTA gets an average of 154 miles, but the buses should not go below 20%, so effectively the range is 80% of 154 = 123. The VTA's 35' buses have Altoona ratings of 210 miles, a VTA average of 207, and an effective range of 80% of 207 = 166.

Jane asked who established the stated ranges. Alan asked that questions be saved until the end of the presentation. Angie said she was ok with questions during the presentation as long as she would be allowed to go over the 10 minutes.

Angie reiterated that the stated range is from the federal testing called "Altoona."

Jane said that BYD has an electric bus with a range of 275 miles. Angie said that the BYD buses with longer advertised ranges have not yet gone through the Altoona process, and the VTA cannot buy buses until they have been tested and rated in the Altoona system.

Angie said she has to plan for the worst day. The range of an electric bus is affected by the number of starts and stops, the number and steepness of hills, the temperature, and other factors. She says the worst days are in the winter. She could get more range if the electric buses used diesel heaters, but she does not want to add diesel maintenance costs, and she really wants the VTA to be all electric. Angie said that the electric buses have a useful life of 12 years and come with a battery warranty so that, if the range of the battery degrades to less than 70% of where it started at any time during the 12 years, the bus manufacturer replaces the battery at no charge to the VTA. Angie said that the average run time of the electric buses is 4-5 hours a day in winter and 6-10 hours a day in summer.

Bill asked what is the longest an electric bus is out. Angie said the longest on the power point slide in her presentation was 6:00 AM - 2:00 PM, so about 8 hours.

Jane said the bus could be charged at the airport headquarters at 2:00. Angie agreed, but a full charge would take 4 hours, and it would be expensive to do that at the peak demand rates in the middle of the day.

Mark said that, for the 6, 5, 3 bus Edgartown is an end stop, so the bus can be charged in Edgartown without inconveniencing the passengers, but West Tisbury is a thru stop where longer charging would be passenger unfriendly. Angie agreed. She said the route 2 and 4 buses can do all their on route charging at West Tisbury. She said that on Church Street in Edgartown the planned stops are 7 - 10 minutes, and they are very consistent.

Jane said that all the routes and schedules should be looked at and could change. She said they have not changed for quite a while. Angie said the Massachusetts Department of Transportation looked at the VTA routes and schedules in 2015 and found them to be very efficient.

Angie said she believes the life of the chargers in the ground will probably be 15 years. She said there may come a time when induction charging improves and we may want to swap out the contents of the above ground electrical boxes - or we may at some point in the future be able to get rid of the boxes. The charge receiving plates under the buses will probably have the same 12 year useful life as the buses themselves. If it's longer, they can be removed and installed on replacement buses. Angie said the length of time the VTA will use induction charging depends on battery improvements, and she feels we are a long way from safe long range batteries.

Jane asked how there can be any confidence that the useful life of the underground charging plates will be 15 years. Angie said that's what the due diligence done in the procurement process said.

Jane said the VTA is asking Edgartown to tear up a historic street for something temporary. Angie said "temporary" is a relative thing, and no technology is going to be permanent. She said that, for us to succeed with full fleet electrification, we need on route charging - either inductive or conductive - and conductive chargers are overhead and ugly and require too much electricity. She said there are always some unknowns, and it is her job to deal with problems that come up in the future. A useful life for the chargers of 10-15 years fits with the 12 year useful life of the buses.

Jane said it is this committee's responsibility to assess the whole cost/benefit analysis.

The next subject in Angie's powerpoint was whether the induction chargers affect the choice of the sizes of the buses. Angie said "Not really." She added that smaller buses need on route charging more than larger buses because smaller buses have smaller batteries that have less range.

Angie explained that the VTA is planning to achieve full fleet electrification in 2027, and this cannot be done without on route charging. She said the full cost savings in maintenance and fuel won't be realized until then, but there are already significant improvements in air quality, noise reduction, and reduced fuel and maintenance costs.

Angie said all the capital costs of the project are paid with federal and state grants. Only the operating costs of the VTA system are paid by Edgartown and the other island towns.

A consultant hired by the VTA in 2016 to study alternative fuels recommended sticking with diesel, but Angie said the VTA was not satisfied with that answer because diesel is really not suitable unless the buses can operate at 45 MPH or more for significant uninterrupted runs to clean the diesel particulate filters. Angie feels the diesel buses are just not reliable here on Martha's Vineyard. Other possible fuels might be propane, CNG, or hydrogen, but these have been rejected based on cost or other reasons. Angie said that electricity is the best option, but all technologies have problems. She said that all capital costs of the VTA are paid with federal and state grants, so the VTA needs to do things that will be approved by these funding sources.

Angie reiterated that Church Street is a necessary location for full fleet electrification because Oak Bluffs will only work for route 13, while Church Street will work for routes 1, 6, 8, 11, and 13. She said West Tisbury will have two induction chargers.

As to the sizes of the buses, Angie said the VTA has 7 40' buses, 14 35' buses, and 11 30' buses. The 40' buses are not used in the winter. The VTA needs flexibility in the sizes of the buses depending on changes in the population and passenger loads. The need for social distancing has also become a factor.

Jane asked for the name of the consultants hired in 2016 to study alternative fuels. Angie gave the name and said they were hired in a competitive bid process. Jane said they were not up to par.

Jane asked whether the federal and state grants have been secured, and Angie answered that they have.

Jane asked why the VTA is not considering zero emission battery electric buses. Angie answered that that is exactly what we are talking about.

Jane said Church Street is not the only location that will work. Angie said it is the only location that will work for routes 1, 6, 8 and 11.

Sara apologized for joining the meeting late, said she did not have questions for Angie, and asked to have time for a comment in the unanticipated topics section of the meeting.

Mark asked whether the VTA could go all electric without the Church Street induction chargers. Angie said that the VTA would have to go back to buying diesel buses in fiscal 2022 if there are not going to be induction chargers on Church Street.

Keith asked whether it's correct that, if we want all electric buses, we need to say yes to this project. Angie agreed and said this has been reinforced by the Martha's Vineyard Commission. She said another way to go all electric would be to acquire 32 extra buses so that electric buses could be swapped out during the day for other electric buses, but this would mean extra capital costs of approximately $25 million and extra annual operating costs of approximately $3 million. She said there would be no governmental grants to help with those costs.

Julia, Alan, Bill and Doris said they had no questions.

The next order of business was a presentation by Jane. She said she had looked at Europe and the U.S., and her question is why we are debating a huge investment in an unproven concept which is less than 10 years old, is intrusive, and will soon be obsolete. She said all the other places using induction charging are large cities with large riderships and large streets. She feels we need additional advice from a real expert. She said that the cities she researched have determined that they are not really going to be all electric by 2030 or 2040. They are not doing induction charging because it's a short term fix while companies work to improve battery range. She provided some specific information about Berlin, Germany, which decided to go hybrid (part electric and part diesel); Madrid, Spain, where they are buying electric buses, but not using induction charging; Italy, where they prefer overnight charging; Genoa and Turin, Italy, where they have mini buses with induction charging, but mostly overhead and nozzle charging; Frederick, Maryland, where they use all plug in "nozzle" charging at their operations base because the cost and the difficulty of getting the required approvals from their historic district commission and others led them to the conclusion that induction chargers were a short term fix and not worth the trouble; Wenatchee, Washington, which is using induction charging because they have cheap hydroelectric power; and Chattanooga, Tennessee where they found the induction chargers took 10 minutes to add 20 miles of range, so they will wait until bus batteries improve to the point that charging during the day is not needed; and Indianapolis, Indiana where a decision was made to use hybrid (part electric and part diesel) buses, not all electric; and Clearwater/Tampa/St. Petersburg, Florida, which is using "zero emission hybrids." Jane asks why we are so convinced of something these large cities are not happy with.

Keith yielded his question time to Angie who said that a hybrid bus has a full diesel set up and does not have zero emissions. She believes there are very serious maintenance issues with hybrid buses. She does not endorse the use of hybrid buses for the VTA. Angie feels that the jurisdictions Jane mentioned are not as concerned about the environment as we are here on Martha's Vineyard. They are making a nod toward the environment, but not a serious effort. She also feels that a lot of jurisdictions are not as concerned as we are here on Martha's Vineyard with how ugly their equipment is; they just want to do something quick and easy.

Jane said she understands how huge the overhead chargers are, and the VTA is free to choose inductive chargers, but the inductive chargers could be put in places other than Church Street.

Angie said we need the chargers on Church Street in order to have a fully electric fleet. She said other systems don't want to be fully electric. She said we are much more progressive than other places, and we want a fully electric fleet. She said that right now no system can buy a hybrid bus with the federal "low/no" grant money. That money is for all electric buses.

Jane said there is a Gillig/WAVE bus that would qualify. Angie said that bus is not a hybrid. She said the Gillig/WAVE technology won't work with the existing VTA electric buses. She said that WAVE bid on the VTA project and was not selected in the RFP process.

Sara asked Jane whether she was saying that inductive chargers are not the end all, be all. Jane said they are a short term fix until bus batteries have longer ranges, and, if they are installed, they should be put in a place that doesn't matter, like the park and ride.

Keith said he objected to the idea that there might be a place to put induction chargers in Edgartown that "doesn't matter." He said the neighbors of the park and ride lot would think that location matters. He also said the park and ride location would only work for route 11. He asked Jane to identify a scenario that's all electric without chargers on Church Street.

Jane suggested that the route 1 and 13 buses could alternate and do both routes, so both could charge in Oak Bluffs.

Keith said that does not answer the question he asked.

Jane said the induction chargers are a short term stop gap measure, and we need a real university transit expert.

Mark asked if the actual visible changes on Church Street are two boxes. Angie said that is correct. She mentioned the utility work under the street, getting rid of the telephone poles, which would result in better ADA access, and putting transformers at the back of the parking lot screened with moveable landscaping. Mark asked how much change is coming to Church Street because of the induction chargers. Jane mentioned the widening of the street, but others said the widening of the street is needed with or without the induction chargers, so that the buses can safely pull out around each other, and is not happening because of the induction chargers.

Mark pointed out that the government would not fund a source of power that makes no sense, and, if the changes are minimal and not unattractive, we can go forward.

Bill said that Jane's research may be correct, but this technology can still be right for our little island. Larger communities may be ok with overhead charging, but we are not. He said inductive charging is the way to go, and he would like to put the issue of the technology to rest. It's not forever, but it works. Let's move on to talk about Church Street.

Julia asked Jane whether she heard that bus batteries would solve the problem sooner than 10 years. Jane said she has heard some experts say it might be 2 or 3 years.

Alan said we are now finished with the technology portion of our deliberations, and next time we will move on to talk about Church Street itself. He requested that members send proposed agenda items to him and to Julia.

Under the heading of unanticipated topics, Sara said she feels the committee is heavily slanted in favor of the induction chargers, and she wants us all to be aware that she and Jane represent a lot of people who are concerned about the size and frequency of the buses and the

fact that they are unsafe for the narrow streets in Edgartown, especially Upper Main Street. She said, if you come up with smaller buses, you can put all the induction chargers you want on Church Street. She said induction chargers guarantee oversize buses in perpetuity. She said this is not a fair and balanced conversation because the concerns about the sizes of the buses are being disqualified.

Jane said she wants an expert to say that induction charging is the only way we can have all electric buses.

The committee unanimously agreed that the next meeting would be on zoom on September 8, 2020 from 12:00 PM to 2:00 PM.

At 11:57 AM, there was a motion to adjourn, a second, and a unanimous roll call vote, except that Julia and Sara did not vote.

List of materials presented:

Power Point Presentation to the Committee by Alan Strahler
Power Point Presentation to the Committee by Angie Gompert

POWERPOINT PRESENTATION
TO THE COMMITTEE
BY ALAN STRAHLER

Presentation to VTA Church Street Committee

Alan Strahler

August 20, 2020

Contents

Questions Addressed

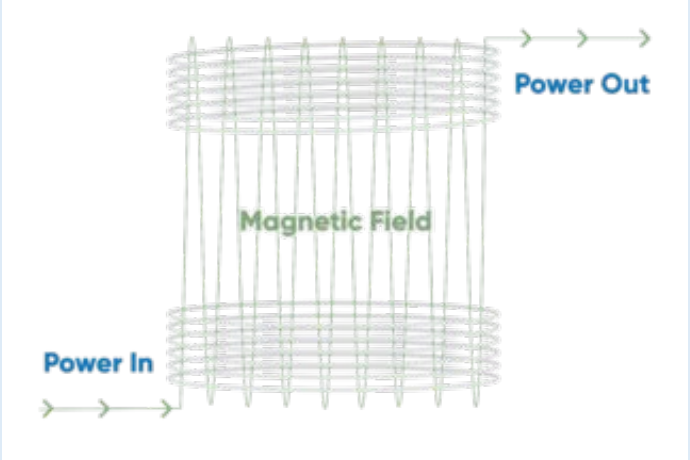
1. How does inductive charging technology work?
4. How does Momentum Dynamics inductive charging work?
3. Is inductive charging safe?
2. Where is inductive bus charging in use?
6. How reliable is Momentum Dynamics technology?

Wireless Inductive Charging

- Wireless power transfer to charge portable devices
- Examples: smartphones, smartwatches, tablets
  - Use Qi (“Chee”) wireless charging standard for consumer electronics
- Others: vehicles, power tools, electric toothbrushes, medical devices

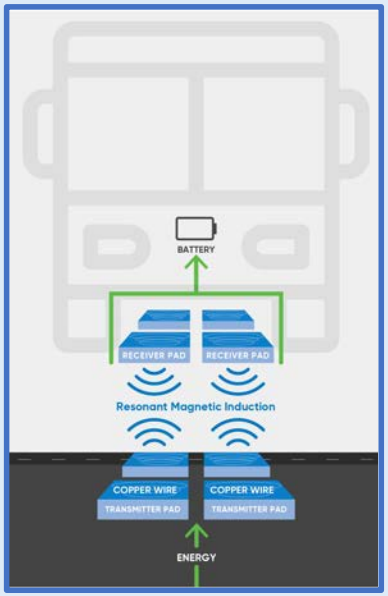
How Wireless Charging Works

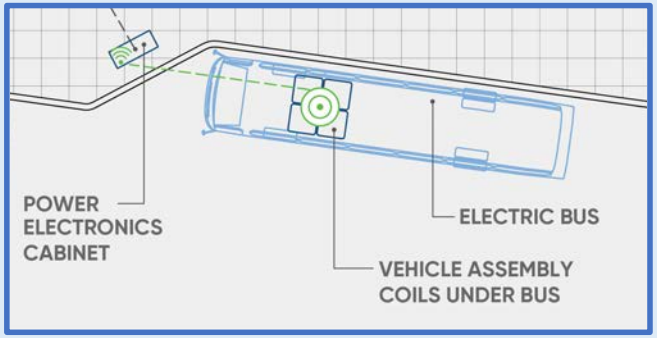
- AC (Alternating Current) power at a particular frequency goes to a resonant transmitting coil
  - Like a radio station sending a signal – 88.7 megahertz for WMVY
  - The current flowing in the coil generates a magnetic field at that frequency
- A resonant receiving coil captures the energy of the magnetic field
  - Like a radio tuned to 88.7 megahertz to receive the WMVY signal
  - This generates an alternating current in the receiving coil
  - The AC current is converted to direct current to charge a battery



Bus Charging

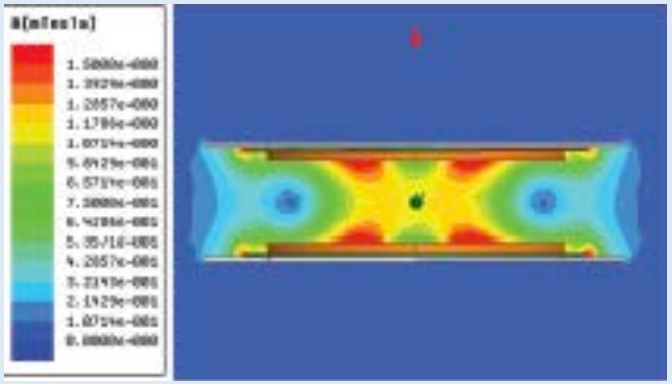
- Momentum Dynamics
  - Generation-1 charger: 50 kW
  - Generation-2 Charger:
  - Four coils in ground
  - Four plates under bus
  - 75 kW per plate, individually controlled, allowing variable power charging
  - In-ground footprint is square





Safety Issues

- Interaction with cell phones, pacemakers
  - Frequencies are different – like radio vs. TV – so no effects
- Magnetic Field
  - Strong between transmitter coil and receiver coil
  - If coils are close, magnetic field is highly contained
  - Steel in bus floor and frame absorbs magnetic field – passengers shielded
  - Ground absorbs magnetic field reaching ground



- Momentum Dynamics:
  - Buses kneel over charger plate to 4” gap
  - Sensors scan for anything between receiver pad and ground, won’t charge unless clear
  - Magnetic field is safe – measurements of magnetic field at side of bus are within the health standard

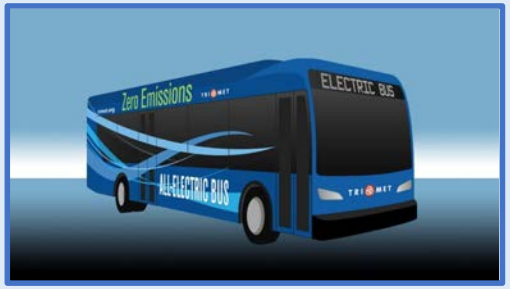
Inductive Bus Charging, Europe

- Turin, Genoa, Italy, since 2002
- Utrecht, Netherlands, since 2010
- Mannheim, Germany, since 2013
- Milton Keynes, England, since 2014
- Madrid, since 2017

Inductive Bus Charging, US

- WAVE: Wireless Advanced Vehicle Electrification (Salt Lake City, UT)
  - Developed at University of Utah
  - Spun off as private company
  - 50 kW and 250 kW charging systems
- Bus Systems
  - U of Utah campus since 2012
  - Long Beach Transit, 2018
  - Antelope Valley, CA, 2018, 2020
  - Grant's Pass, Oregon, 2020

WAVE



Momentum Dynamics – Howard County

- Howard County (MD) Regional Transit Agency (Jim Rippeon)
  - Installed Gen-1 50 kW MD charger at Columbia Mall in 2017 to boost range of three 30’ BYD buses
  - Functioned without issue (3+ yrs) until a few weeks ago – presently being repaired

Momentum Dynamics CARTA

- CARTA – Chattanooga Area Rapid Transit Authority (Ronnie Hendrix)
  - 1 Gen-1 50 kW charger
  - Used for 5 years with 4 BYD buses, worked great
  - Located at bus facility, used for 30 min charging during lunch hour.
  - Buses run 4:30 AM to 1 AM with charge
  - Excellent tech support
  - No longer in service – difficulty in scheduling 30-min turns.

Momentum Dynamics – IndyGo

- IndyGo – Indianapolis Rapid Transit (Thierno Balde)
  - BYD agreed to install two MD Gen-2 chargers to make up for short range, but they were never installed or tested
  - So no information about performance
  - Three Gen-2 300 kW chargers now in installation phase
  - Joint venture with BYD, 31 buses to be powered
  - “Highest capacity system of its kind anywhere in the world” (BYD)

Momentum Dynamics Wenatchee LINK

- Wenatchee, Washington, LINK Transit (Ed Archer)
  - 1 Gen-1 Charger, 50 kW, in 1+ year operation test with 3 BYD buses
  - Excellent performance, system diagnoses itself and alerts manager to any problems.
  - Now installing 3 Gen-2 300 kW chargers, beginning in September 2020.
  - Will use with 10 BYD buses

Thank you

POWERPOINT PRESENTATION
TO THE COMMITTEE
BY ANGIE GOMPERT

VTA Answers to Some Questions Church St Review Committee

What was the criteria used to select Momentum Dynamics?

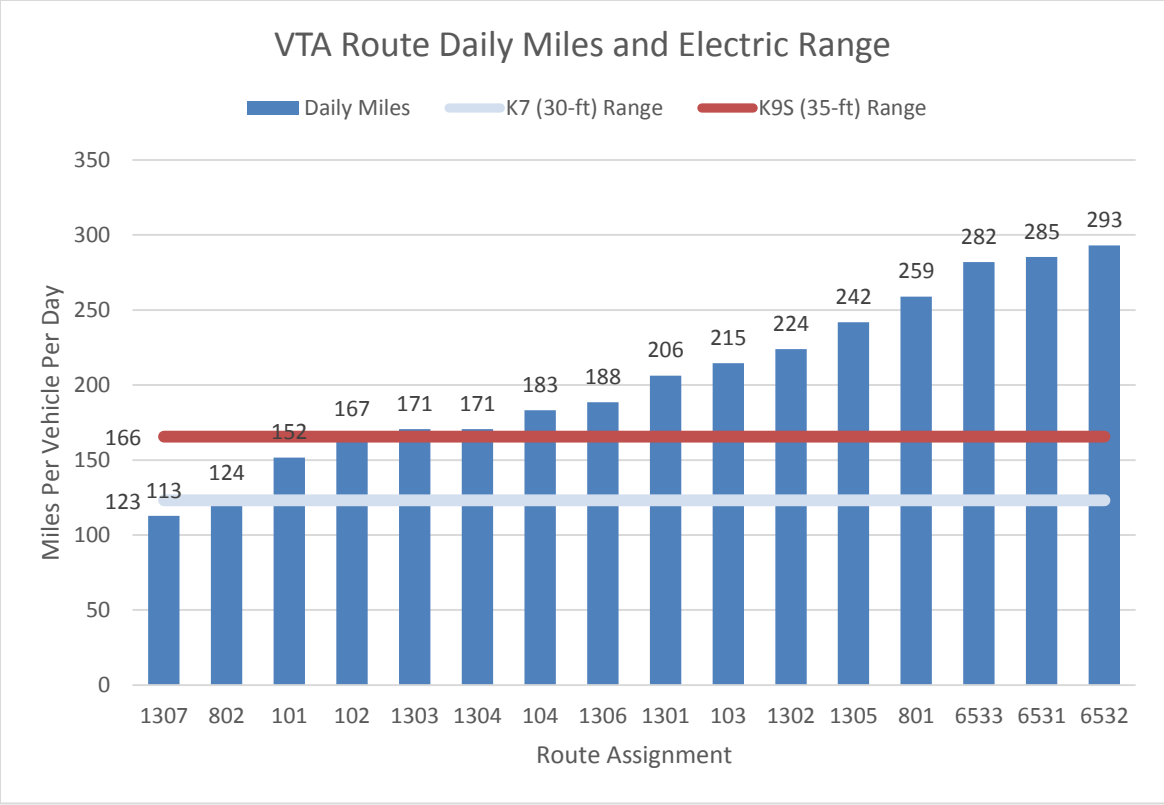
CRITERIA FOR SELECTION (source VTA #2019-03 RFP for Wireless In-Route Charging issued 8/14/2018)

VTA may refer all acceptable proposals to its Legal Counsel for review as to compliance with requirements of this solicitation document and upon the results of said review VTA will evaluate all acceptable proposals in accordance with the following Criteria:

A. Technical Specifications of System
B. Quantity, Duration, and Reliability of Installed Systems
C. Quality and Responsiveness of Proposal
D. Ability of System to fit Martha's Vineyard Aesthetic
E. Price

Why are inductive chargers needed?

Simply put, the buses don't have enough energy to last the transit day. Electric buses return to base and get swapped out with diesel buses. If this were a *normal* summer, we would not meet our schedule requirements. Sample of VTA routes below, clearly shows range (this is the battery capacity) is not adequate.



Why are inductive chargers needed? (Slide 2)

Jane's question 4

	Range In Miles	
	K7 (30-ft)	K9S (35-ft)
BYD Advertised Total Range *Tested/verified by Altoona	150	210
Average Actual Range Data from VTA buses through Viriciti	154	207
Average Practical Range in VTA Service (80% of total range)	123	166

These are averages. So the range on the worst days (which the VTA has to plan for) **will be worse than this**. Winter days the buses can use up to 20 miles of range an hour, just in heating. If a bus ran for five hours, in the winter, it could do half of its nominal range before recharging is needed. AC loads are small by comparison.

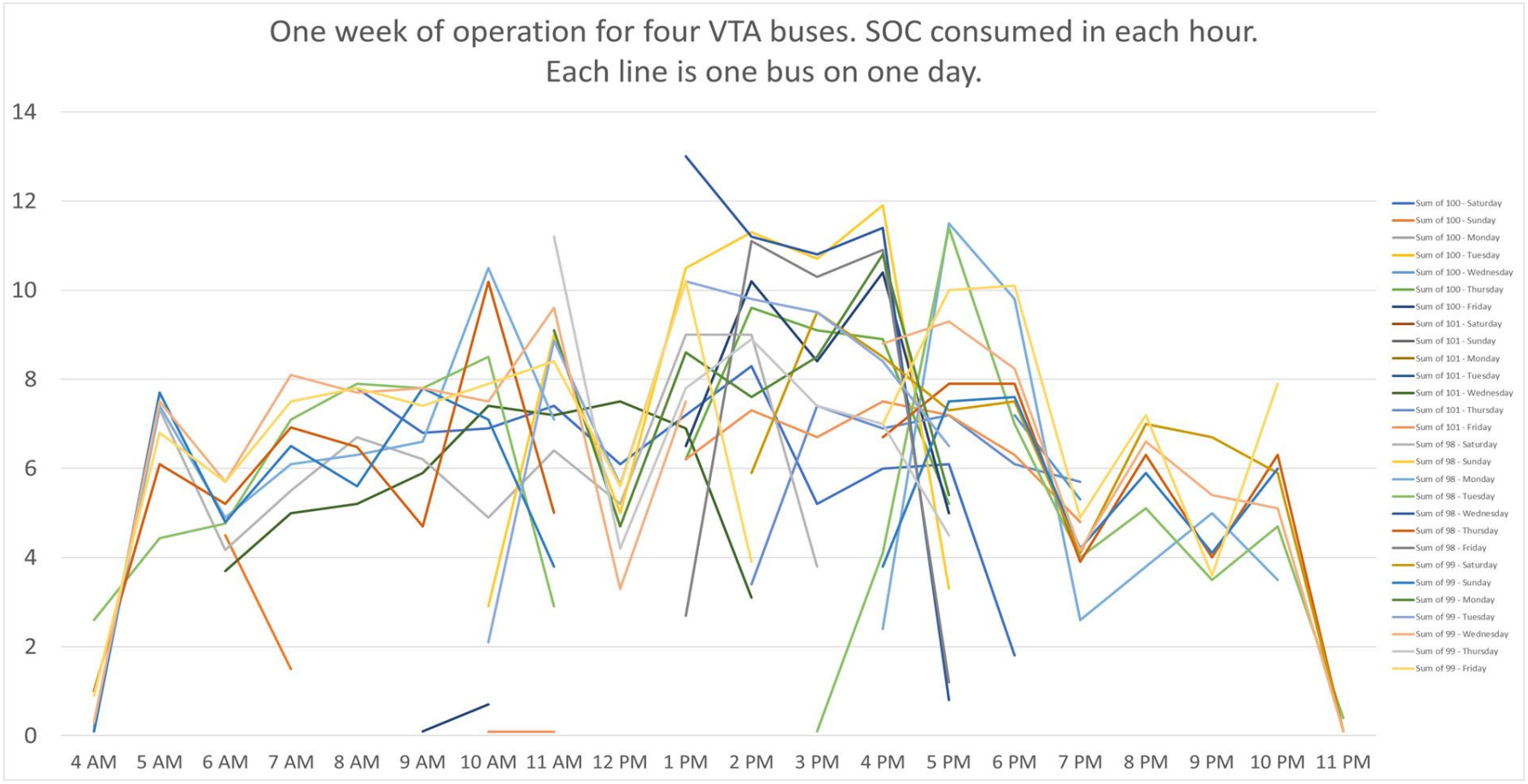
VTA drives very efficiently – we **average about the maximum advertised range**

Battery degradation: the worst bus has **lost up to 10%** of its original range. (typically battery degradation is faster at first then slows down)

* Advertised range is tested at Altoona, with the vehicles GVWR (loaded) but without heat or AC running. While battery capacity on buses may and have increased, the battery efficiency has not.

Why are inductive chargers needed? (Slide 3)

This chart shows the state of charge used each hour, for each bus, on each day. Generally, it gives an idea of when the buses tend to be out the most, and how much SOC per hour they're using. Generally 8-12% per hour, which means they've got 6 to 10 hours available to run per day.



Expected Life of the Chargers in ground and on bus?

At least 10 to 12 years for each. Likely the in ground units will be in service for 15 years. Depending on battery technology advancements, reliance on chargers could decrease. Should technology change above ground electrical cabinets can be swapped out, have the interior components swapped out or simply just taken out and replaced with landscaping.
On the buses, if the technology is still current we will remove the plates from the buses at the end of their useful life and put them on replacement buses. The technology is no longer current or needed, the plates would likely be disposed of with the bus as surplus equipment.

Does inductive charging affect the choice of the size of electric buses?

Not really, however the speed of charge is impacted by the size of the bus. Smaller buses would not be able to accept a fast charge due to cooling required to cool batteries. In general, the larger the vehicle the faster the charging speed the bus can handle. Smaller buses have less battery storage and require more access to in route charging to meet the VTA's transit day. VTA buses would only charge at 150kWh in order to reduce necessary infrastructure.

What improvements in bus service are expected and when?

Four more electric buses will be delivered in 2021, hopefully June. Full bus fleet electrification is planned to be complete in 2027. Improvements in air quality and noise reduction are already happening. Full fleet electrification can NOT be achieved without in route charging. The true cost saving in maintenance and fuel, won't be completely recognized until/if the entire fleet is converted. To date the VTA has saved over 2M pounds in GHG emissions and $35,000 in fuel and maintenance costs.

How will costs to the town be affected?

There is no cost to the Town for the inductive chargers, any of the upgrades to Church St. or any cost for any VTA capital acquisition. The Town of Edgartown pays approximately $254,556 (FY 21 assessment) to the VTA through the Cherry Sheet, for VTA operations cost. The VTA operating budget is just short of $6.4M.

Are alternate technologies within reach that could obviate inductive charging?

I wish! The VTA hired a consultant in 2016 to perform an alternative fuels study. The results of the study said stick with diesel, the VTA was not satisfied with that answer. I felt strongly that we needed adopt an alternative fuel, as diesel was not working for us. EPA restrictions and fuel changes for cleaner air, make the engines less reliable in our operating environment. Diesel buses need to get hot and maintain speeds of 45mph+ to clean out the DPF.
-Propane buses don't have the range, and no propane powered large bus engines
-CNG would have worked, but getting it here or bringing LPG here and making our own was going to cost $3.5M for infrastructure alone.
- Hydrogen fueled vehicles are also problematic in terms of making the hydrogen and enough range.
I am happy to discuss other technologies and why we didn't choose those, at another time-if someone is interested.

Other important things to know about the VTA doing business:

When purchasing a vehicle with Federal Funds, the vendor must be on approved Transit Vehicle Manufactures List. This means not all vehicles on the market can be purchased with federal funds. The State provides the remaining funds for all VTA Capital Projects.

Total Cost of the Church St. Infrastructure:

All costs are the responsibility of the VTA. VTA is paying for this project with Federal (Low & No emissions grant for $1.75M) and State RTACAP funds
There is zero subsidy from BYD or Momentum Dynamics

Estimates for Church St Construction are approximately $1.5M (Federal & State Funding) plus contingency

- **Utility work $600,000 (Eversource, water line, sewer connection)**
- **Momentum Equipment and installation $550,000**
- **29 Church St site work, improvements, ESS, electrical $350,000**
- **Contingency 10% $150,000**

Charging plates for each bus are not included in above pricing.

- **Installed cost per bus approximately $45,000 (Federal & State Funding)**

Church Street location is necessary for full VTA fleet electrification.

Even IF the VTA pursues putting a charging station in Oak Bluffs, that would only eliminate the need to charge route #13 buses on Church St. Routes 1, 8, 6 and 11 (through vehicle swap) would STILL need to charge on Church St or be diesel buses.

- **Route 1 – 4 buses daily (translates into buses/hour – roughly)**
- **Route 6 – 3 buses daily**
- **Route 8 – 2 buses daily**
- **Route 11 – 1 bus daily**
- **Route 13 – 6 to 8 buses daily**

West Tisbury is slated to have two inductive charging units installed.

Jane's question #5:

VTA does not assign specific vehicle numbers to certain routes, we need flexibility due to the changes in population and passenger loads. However, we do have restrictions on some routes by the size of the vehicle. 30' buses only on Route #4. 40' buses come off the road in the winter.