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Meet the Team



Ian Ragland

Ian Ragland, Randolph-Macon Alumnus, is earning a Masters degree in Product Innovation from VCU's da Vinci Center. He is sustainability-driven, and hopes to use his newfound understanding of human-centered design to create a greener and more autonomous future for the world.



Alan Vollmer

Alan Vollmer is a graduate of VCU's Theatre Department. With his degree in Product Innovation, he hopes to change the culture of communication in corporations around the world.



Ryan Beaver

An alum of the da Vinci Product Innovation program, Ryan has applied his background in Mechanical Engineering to a design centered, well-rounded, and insightful approach at solving problems.



Nikita Moyer

Nikita is a freelance filmmaker turned Director of Administration for VCUarts Cinema. She has worked with Kathleen Kennedy, Kristie Macosko Krieger, Rob Zombie, Angus Macfadyen and hundreds of young filmmakers. She is passionate about creative problem solving and innovations in filmmaking.

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Foreword

The industrial age of energy and transportation is coming to a close.

Innovators around the globe are pushing forward clean technologies such as solar and electric vehicles; the transportation industry stands at the precipice of disruption.

Simultaneously, consumer demand is moving rapidly towards autonomous, frictionless technology. They report growing concern over the state of the environment, but are unsure how to proceed.

As with many issues regarding sustainability, there is a lack of accessible information to help the end user make a choice.

Information in respect to electric vehicles is often obscured by misconception, whether it be their relative simplicity (as opposed to fossil fuel vehicles) or their price points.



Team Prompt

Find ways (business models, products, services, etc.) to enable, incentivize, and/or drive the use of electric transportation and mobility solutions in the Commonwealth of Virginia.

Research

When in doubt...PESTLE

PESTLE analysis is a market research tool designed to facilitate an overall understanding of the trends and possible future movements of an industry. Within six categories: Political, Environmental, Social, Technological, Legal and Economic, this method assists an organization with identifying the external forces that could impact their market and analyze how these areas could directly impact their business.

Firstly, the Basics of Transport Economics were examined. This allowed for a more thorough focus into the follow areas of transportation:

- » The trip purpose
- » The times at which the transportation occurred
- » The transport distance

Building Context

PESTLE provided the insight that travel distance and methods of transport were key pain points among the average commuter. Surveying the customer segment of the metro Richmond area, this led to a focus on last-mile transportation.

Our research also led us to re-examine Richmond's existing transportation infrastructure. However, we found that changes to the existing system to accommodate emerging technologies were unrealistic at this juncture.

The creation of a new transportation infrastructure would be costly and time consuming. This change can only be justified "when the total benefits, calculated over a certain period of usage exceed the total costs." ¹⁰

Dominion then raised additional questions. Primarily, how can the existing infrastructure be optimized to improve social well-being?

Careful observations were made of the public's initial scrutiny of transportation innovations such as the *Pulse* project. Compositing these reactions, in addition the client's purview, the team concluded that incremental innovative solutions were the most realistic use of effort.

The Future of Transportation

Education and Outreach

State Commissions, legislative bodies and utilities must recognize that programs to help educate consumers, stakeholders and related organizations are the next logical conclusion for adoption to move forward. These should include both general awareness programs for consumers, in addition to technical assistance programs for adjacent businesses. This is a critical initiative that should parallel the journey as EVs move away from early adopters to the early majority phase.

Long Term Goals

Petroleum-fueled vehicles and their affiliated infrastructure developed over the course of a century.

These long ingrained habits of the majority of consumers will not change overnight and it will take significant resources over multiple modalities to push this forward.

Broad Stakeholder Process and Collaboration

In order to proceed, all of the aforementioned agencies need to reach a common ground. They need to unify their vested interest in tackling this problem.

Currently, there is a great deal of litigation between these parties which is detrimental to the growth of this new ecosystem, and ultimately slows investments for stakeholders and consumers alike.

Learning from Innovations of the Past

Politics in Action

*“Developing User Scripts in Relation to the Electric Vehicle”*¹¹ echos the collaborative sentiments of the previous article, stating clearly:

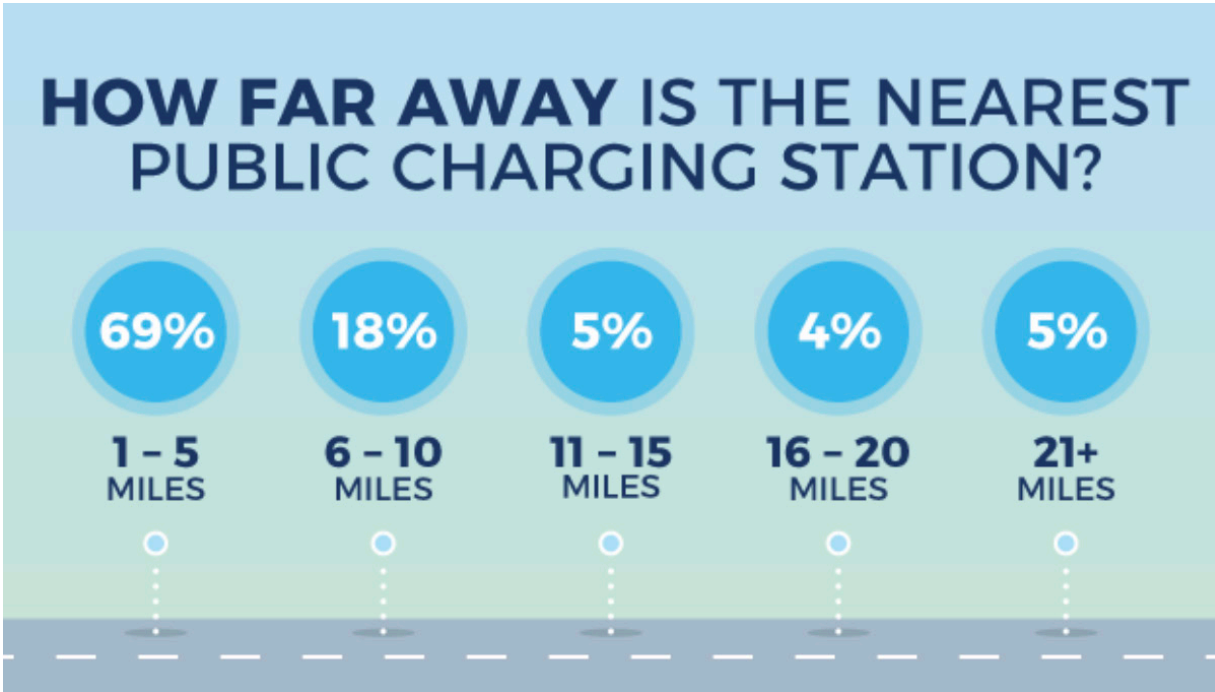
“If relevant companies, proactive city authorities, and various movements join in the organization of social forums or networks in which users and designers meet to exchange scenarios and scripts, or if they get together to launch social experiments in which user participation is explicitly called for, then we might indeed experience the rapid dissemination of EVs in the near future.”

We can look back almost a century to further this point. In the 1970s, the national French electricity company created multiple initiatives to put forward an electric vehicle. Termed “engineer-sociologists”, this group designed an electric vehicle, redesigned their infrastructure around the car, and the scenario in which society would accept this innovation.

They recognized the shift would have to be in concert with many other moving parts. This was a disruption of the industrial age. In the end, there was no collaboration and the catalyst stakeholders were not ready to move into a post-industrial age.

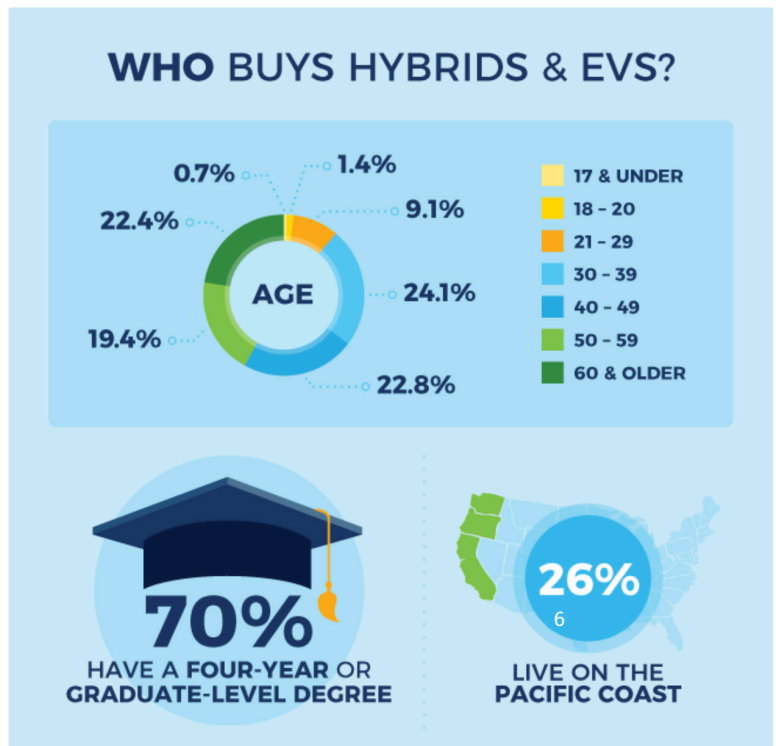
Demonstrating successes in incremental innovation around the field of electric vehicles will help to unify and rally state legislature, utilities, and the public to embrace this technology and move forward with further innovation.

Current Users



A recent CarMax survey proved that EVs are well into the early majority phase, including a wide range of customer demographics.

Lack of awareness is still the primary reason car buyers do not purchase EVs in all areas. Many would-be users are worried about performance in long distance driving. However, the charging infrastructure is fast on the heels of this primary customer fear with roll out plans for both rural and urban areas. No geographic location should curtail the ability to charge a vehicle. Public fast-charging tackles this barrier to ensure that this is no longer an issue.



Understanding Pain Points

Based on research and ideation sessions in our early stages, we identified the last-mile transportation pain-point for a large customer base in the City of Richmond.

Without a way to get around within the city easily, the citizens of Richmond walk.

Further on, we found our interviewees to have surprising misunderstandings about the nature of electric vehicles, even if sustainability was a priority for them. Informing them about the advantages of electric transportation became one of our primary goals.

Even our target end user has misconceptions about EVs.

To incentivize the growth of electric transportation, we need to get people's hands on the vehicles. Research has shown that a customer's view of electric transportation is improved through hands-on experience. We kept this in mind as we ideated around our solutions.

EVs are not yet ubiquitous. The average person has not interacted with them.

Changing the culture surrounding electric transportation also became an important goal. We want to excite people into using electric transportation. If we can change the culture we can increase the use of EVs on a grand scale.

Though the benefits are clear, the general public still views EVs as a niche market.

Surveys & Interviews

What would convince you to give up your car and rely on alternative means of transportation?

If it could be actually done logistically and practically in this reality. I've spent hours poring over it. But I would have to, the thing the planners need to understand. The real problem, the real reality is that, it's just not good enough. If it isn't complete, you still need to hang on to your car for your necessity. And when you have it, it becomes cheaper. And that is a problem that needs to be addressed by large scale infrastructure.

How would you tackle this problem of people not adopting electric vehicles?

Apple, am I right? When they first came out their prices were ridiculous. What they gave was an idea. You can't put that on a balance statement, you give people a vision. Not tangible in numbers, but it is tangible - no longer a device or status symbol, it is a way of life -
-How can this product or service integrate into my life? - I need to see it - People who are passionate about a future - massive event that showcases what Richmond will be.

What about electricity as a whole? Do you see changes coming to the grid?

The grid is still going to be required for security. So we can't have the inconsistency of hospitals going down, major institutions going down. Those, I think, would have to remain on a grid, so that in a state of emergency they are more likely to be sustained. So if they are reducing their grid down to that then there's still income. At the same time they can actually cut their production costs if they allow the non-gridded units to sell their energy to the security grid. That could be their future model of the combination of gridded and non-gridded where they are still the brokers of energy.

Where do you see Dominion as part of the future of electric transportation?

If they are looking at transportation specifically, that's going to make them have to look at partnerships with gasoline powered infrastructures and begin to convert them to a standardized electrical refueling station. So if we standardize around Tesla, then we standardize around Tesla, but if we standardize around EvaTran or one of the other companies that Dominion invests in then we can go into active competitions with Tesla and we can figure out who is going to win that. And how you do that is by going to GM, going to all the big automakers and say, this is what we are putting in place. Can you standardize around that?

Can you describe an improvement to alternative transportation that would convince you to give up your car?

Cost, speed, and simplicity are essential. I think what dissuades many people from using the bus system is the time tables and routes "seem" too complex. There's not enough visibility/awareness when it comes to all the variables at play there. Bus delays can also be a big deterrent. Lyft's And Ubers, while cheaper than taxis, are not necessarily a viable option economically speaking for everyday commutes.

A car, for me, equals freedom and privacy. It would need to be replaced by something that provides those. For public transportation to work for me, I would need more options in more directions with more consistent schedules and frequencies.

For the most part, no, I wouldn't be able to give up my car because I need to be able to travel long distances beyond the city.

Given the choice between a pedal-assist bike, combustible car, electric car, and electric scooter, which fits your lifestyle and why?

Hmm, I'd like to say electric car because I don't mind walking or using public transportation, but it would be nice to have an electric car to pick up groceries and travel longer distances whether it's across the city, the state, or the country. This is a personal opinion, but the electric scooters bug me because they're electric and that means they'll have to get their power from an energy company who burns coal as their main source of energy. I realize that an electric car would get its power from the same source, but I feel like if you're gonna ride an electric scooter, you might as well walk, use a kick scooter, or a manually powered bicycle. I know that the electric scooters do move at a faster speed and perhaps they're better for someone with a physical impairment or disability, but in general I feel like they're silly. Sorry, rant over.

Final Insights

Insights derived

- » Students are primarily mid-to-late adopters of new technology
- » The cost of owning an electric vehicle is often incorrectly inflated in the minds of potential buyers
- » Perceived lack of infrastructure for charging electric vehicles has impeded adoption
- » Concern for how electricity is generated often supersedes the perceived benefit in the minds of environmentally conscious individuals

Pain Points Discovered

- » Students need an easier way to get to and from the grocery store or other errands without using a car or costly ride-sharing services
- » Commuters need a way to run errands while at work that doesn't involve getting their car out of the parking deck
- » Electric vehicles are too expensive for most potential buyers
- » Perceived difficulty of using public transportation prevents users from participating
- » Infrastructure of the city does not accommodate bicycle users safely enough
- » Lack of understanding of electric vehicle technology has led to a "wait and see" approach, with people now waiting until the technology is "perfected" despite the technology being usable now

Solution Mapping

Insight Validation

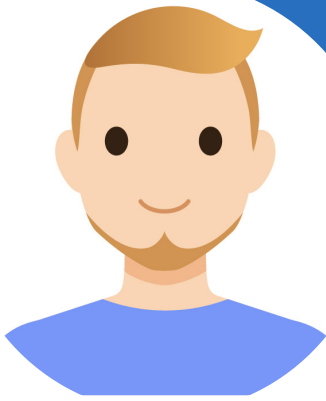
Throughout this process, we ensured that our assumptions and insights were backed by thorough research. Upon entering into our customer survey phase, we were validated in our previous work. Any changes in our insights were consistently confirmed throughout our reiterative market validation. From this, we were able to create accurate user personas.

In our first round of surveys, we worked with college students (Sally Student persona). Our questions surrounding last-mile transportation were supported with students' reported behavior. The pain point of running errands (without a car) was a recurring theme.

Our second survey, aimed at a wider audience (Commuter Carl, and Eco Eddie), furthered the Build-it-Yourself Event concept. We found that keeping people in the city, giving them an event to attend, and making it about electric transportation would attract those personas.

Within our ethnographic interviews, we attempted to understand the larger misconceptions surrounding electric vehicles. We found broad misconceptions (actual difference in cost of owning an EV compared to a gasoline vehicle), and small misconceptions (concerns with charging infrastructure) that are deterring even the early adopters.

We were constantly 'going back to the drawing board' during this project, and when we circled back, we created insight-based assumptions. Then those were validated in our interviews. This, thankfully, allowed us to move forward with confidence and suggest multiple solutions for a wide-ranging problem statement.



‘Right Now’ Randy

Randy is a VCU Student, age 25, studying Economics/Finance. He operates on the bare minimum, content with his daily regimen. He’s EV-savvy, but a crowd-following nature makes him reluctant to adopt.

Randy wants results *right now*. Life has made him impatient over the years. We’ve pinned him as a mid-to-late adopter, as he likes things to be ironed-out before he fully commits to them. He’s safeguarded; it’s just his nature.

Having access to a parking deck makes his morning commute easier, but he still has to park on the street on days where his schedule deviates, which can make him late. Once parked, he walks for the rest of the day.

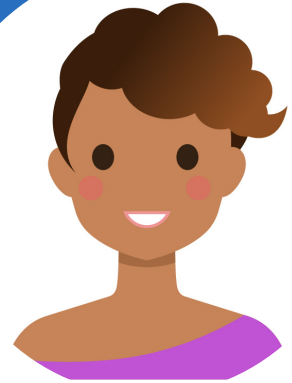
His 25-mile commute to the city is the reason for vehicle dependency. Although he drives a “beater” that requires constant maintenance, he fails to recognize the economic and environmental benefits he’d receive from converting to electric transportation.

Recommendations

-*Bill Contextualization*. Randy responds best to “wake up” moments. This will help put things into a new perspective for him.

-*Build-it-Yourself Electric Vehicle Event*. If incentivized to attend, being exposed to the growing community of EV-enthusiasts could spark a change of heart.

Sally Student



Sally, age 19, is studying Cinema. She's conscious of sustainability and other social causes, but doesn't have time to fully commit to them. Sally works part-time, is a student full-time, and has a car that is not at school with her.

Sally walks all day to her classes and wonders how she can possibly fit something else into her already-busy life. She doesn't have a lot of income and she doesn't want to spend all her money on one thing, so she doesn't buy a car and she doesn't try to be anything more than a student. If it doesn't get assigned to her in a class, she probably isn't going to do it, only because she knows she will have time for it "later on" in life.

She cares, she really does, but when it comes down to fun versus doing the "right" thing, (when the right thing is going out and getting signatures for a petition), she is going to go have fun. She is young and she knows it. She wants to take advantage of this time before it is gone. She can make sustainable choices later. Right now her priorities are focused around grades and school and she doesn't have the bandwidth for anything else.

Recommendations

-*Build-it-Yourself Electric Vehicle Event*. This works with her schedule, could be close to her school, and interests her. She can take friends and make a day of it.

-*ELF Electric Vehicle*. The ELF electric vehicle provides an easy grab-and-go option for quick trips to the grocery or an appointment off-campus.





Commuter Carl

Carl, middle aged, works a full time job in the city. He drives in at least 30 minutes, if not more, every day. He feels like a lot of his time is being lost to his commute. Carl will typically park in a garage downtown and avoid moving his car for the rest of the day.

Carl spends what feels like half of his day in the car. He doesn't like commuting to work, but he loves where he lives. He loves his family and his wife, but he's starting to hate his car. He doesn't take care of it, and he doesn't want to. He resents it because of how much time he spends in it. He wishes he could use that time for something else, so he listens to audiobooks, podcasts, or the radio.

When he does have time for something, he wants it to be for him or his family. He loses so much time to the commute that when he has a weekend or a surprise day off, he isn't going to spend it making his house more energy efficient, he's going to grill on the porch with his friends. He feels as if he can't let go of the car. He can't use public transportation -- the bus doesn't go near his neighborhood. Even if he could he wouldn't want to, he doesn't have much experience with public transportation.

Recommendations:

-*Build-it-Yourself Electric Vehicle Event*. Carl would learn a lot from an event like this and it would be something he could take his kids to.

-*Elf Electric Vehicle*. Carl would have a lot of fun on an ELF like vehicle if they were provided on his corporate campus.

Eco Eddie



34-year old working professional in the creative economy. Invests significant time and energy into sustainable practices. He holds an advanced degree. Eddie is looking for a disruptive, higher-level solution.

Eco Eddie makes attempts to be as environmentally conscious as possible. He is willing to go out of his way to make a difference. Eddie tries to use reusable containers and bags, and pays extra on his electricity bill for green energy. He rides a bike or walks as often as possible, and tries to carpool when that isn't practical. Although he is doing as much as he can, Eddie still doesn't understand some of the finer points of reducing his carbon footprint.

He really wants to make every area of his life green, but he is a bit skeptical about electric vehicles. Eddie compares the local transit system to his experiences in Europe and wishes they could be the same. He is willing to adopt and invest in the technology if it becomes available at a reasonable price point.

Recommendations:

-*Build-it-yourself Electric Vehicle event.* Eddie would rally the folks at his current job to participate in any version of these events.

-*Elf Electric Vehicle.* Eddie is open to trying any new EV technology that he can get his hands on.

-*Electric School Bus.* This aligns with Eddie's core values. He is very happy to see a change at this local level.

Problem Statement

From:

“We must find ways to use, incentivise, or grow the use of electric vehicles in the Commonwealth of Virginia”

To:

“How might we incentivise the increased use of Dominion’s services, and gain positive opinions from their customers?”

Market Segmentation

Using human-centered design, we created distinctions between customer segments based on pain-points within each customer segment. Our aim, at the beginning, was to pick a single customer segment and provide a solution to that segment. Within VCU and Richmond city, the ELF solution would appeal to students. In particular, students that felt impeded when going to the grocery store.

Our solutions began to spread further into the Richmond community within our research phase, when our findings led us to a solution centered around the electricity-grid infrastructure. Richmond and its surrounding counties became our target market, with anyone connected to the grid being our market segment. Within that segment market our target would (at the start) be families that could install batteries into their homes to provide relief to the grid during peak hours.

Still attempting to target a similar market share within the Richmond community, the idea for electric school buses would help promote the ideals of sustainability to a younger audience.

Broadening the target market became our greatest challenge.

We wanted to take a solution to our sponsor team that could affect change across Dominion's entire customer segment.

This led us to two possible solutions: a build-it-yourself electric vehicle expo that we could advertise to colleges and like-minded individuals across the state, or a billing-related highlight that showed the translation of actual dollars into miles of electric vehicle output. Based on our surveys and interviews, both of these solutions would perform well within Richmond City and the Commonwealth as a whole.



Cutting Room Floor Round 1

First ideas we floated, but did not pursue

Team Electric City examined the possibility of adopting a micro-grid solution, contained within batteries on each customer's property. In this solution, Dominion would be 'ahead of the curve' and could prevent subversion by a non-company-owned microgrid. Dominion could sustain its business by still being the resource that ties each battery together. After suggesting this solution to Dominion, we were told to steer away from this idea due to regulation and actions already in place by other teams at Dominion.

Starting again, with our research in hand, we held another ideation session.

Solar Light show during a large event at Belle Isle.

Solar farm with an actual farm under the solar panels; a low-cost, mid-profit idea as a standalone business.

Electric VCU "party bus" for special events like basketball games and greek formals.

Electric Ubers that are transparent; shows how engine works.

Mobile charging service: Subscription model or need-based. Company travels the area to charge low EV batteries.

Tours of Richmond City and the James River performed by autonomous, electric cars. A quiet, tranquil, novelty experience.

Autonomous, electric cars that can deliver groceries, supplies, entertainment.

Build-your-own electric car kit branded specifically for the City of Richmond.

Philanthropic Innovation Challenge: Who can use electric and solar technology to develop something that improves the education system in Richmond?

Dominion launches state-wide solar initiative. An initiative aimed at lower-income areas, agricultural areas and schools. Dominion would help break down communication barriers that coincide with new technology.

Cutting Room Floor Round 2

HOW MIGHT WE...



the tech community

...Engage the Tech Community with EV technology?

Investing in a battery research and development contest to find an alternative to lithium-ion.

...Support Community Engagement with sustainable tech in their lives and communities?

Create a green transportation plug-in for Google Maps that would direct people to EVs.



culture

...Foster a sense of sustainability culture in the Commonwealth of Virginia?

Create an eBike to work day with a partner company.

...Make EVs accessible to all businesses?

Dominion Certification in EV tech Education/Outreach program to existing locally own mechanics.



infrastructure

...Create the structural capacity for more EV adoption in the future?

EV battery swap-out services at rest stops, or mobile on demand.

...Use existing industries to push forward analogous technology?

Electricity generating floor panels behind bars and on floors of popular restaurants.

Cutting Room Floor Round 2

HOW MIGHT WE...



dominion culture
& bottom line

...Change Dominion's corporate culture to become an example of the future of transportation?

Corporate Retreat as an EV Road Trip

...Encourage higher usage of electricity?

Make deal with rental companies to incentivize them to replace their fleet with EVs.



electric structure

...Infuse EV tech with foot transportation?

Electricity generating panels on busy streets.

...Better assist with in-city travel to out-of-city residents?

Extend transit line with EVs in fixed routes.



last mile transportation

...Make last mile less stressful?

ELF/Small EV Rental Service for retirement home/people who cannot drive.

...Encourage Commuters to park outside the city and use EV to go the last mile?

Gamify Parking outside the city

Final Recommendations

Electric School Bus

Smallest Market Segment, Small Investment

ELF Electric Vehicle

Small Market Segment, Medium Investment

Build-it-Yourself Event

Medium Market Segment, Varied Investment

Bill Dollar Context

Largest Market Segment, Small Investment

Electric School Bus



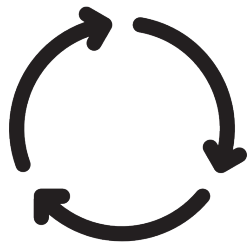
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BUSES IN FLEET



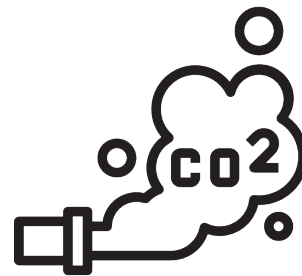
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MAINTENANCE



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YEAR CYCLE



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EMISSIONS

A cultural shift in excitement about EVs has to start somewhere. Why not with youth? Purchasing, leasing or selling school buses to Henrico County will invest in the future of EV users. By supporting Henrico, Dominion will be seen as an local, community-investor and a catalyst for cultural change.

ELF

Organic Transit

Above all, it's important to note that the ELF innovation has already had preliminary validation and integration within the infrastructure of another significant college community: Duke University. The company has plans to roll out more vehicles in that area based on the demand they recognize; however, they face a supply constraint at the moment.

Through the lens of human-centered design, we concluded this to be a trifecta of potential served value. The ELF caters to 'outdoorsy' citizens, environmentally conscious individuals, working professionals, students, exercise-enthusiasts, and retirees.

A partnership with this newly emerging favorite could be mutually beneficial.

As ELF struggles to meet manufacturing quotas, Dominion could provide the resources to jumpstart ELF's production. In return, ELF would make their technology available to Richmond City on a ride-sharing or rental basis with Dominion responsible for overseeing all operations on their end of the contract.

This is one of our team's favorite solutions because of the many pain points that are solved by it. The market clearly shows a last-mile, recreational, and errand-based need for this new wave of mobility. With proper execution, this could be the next big thing.



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Build-it-Yourself EV Race

Based on our research, consumers are largely misinformed when it comes to electric vehicles. This is the greatest hurdle for early majority adoption.

3 of the most common misconceptions regarding electric vehicles are:

- » EVs are complex, more than a fossil fuel vehicle.
- » EVs are too expensive.
- » EVs are unable to travel long distances.

To combat this, we propose to tackle each of these misconceptions head on. We recommend that Dominion host a Build-it-Yourself EV Event to take place in Richmond.

We believe that hosting such an event will increase the public's awareness of electric vehicles which will lead to an faster adoption of the technology.

We also believe that based on the success of these events, Dominion can leverage public interest to local and state governing bodies. This can begin what we hope will be a successful collaboration of key stakeholders to push forward legislation that would encourage the adoption of electric vehicles on a larger scale.

This event can be tailored to reach (3) different market sizes and can run in concert or on their own.

Logistics



RICHMOND METRO AREA

Small Scale Charity Event

Involved parties/sponsors build out batteries and small electric vehicles.

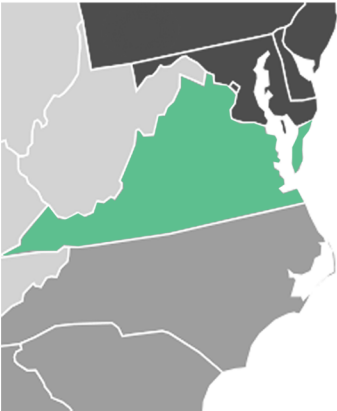
Potential Sponsors: Science Museum/VCU Engineering/Capital One/Tesla or EV companies
Location: Science Museum of Virginia

DAY OF EVENT: Vehicles are parked in the Science Museum parking lot and mounted on stands, running until batteries are depleted. For each mile, Dominion is to donate an agreed upon amount of money to charity of sponsors choosing.

LOGISTICS:

Rental of Science Museum for Event
Marketing Push to Attract Interested Parties
Dominion to Provide Donation Funds
Selection of Battery Materials to be Displayed on Dominion Website

Approximate Cost: \$10,000-\$15,000
Timeline: 6 months



VIRGINIA

Collegiate EV Competition

Dominion to sponsor a class for each institution that follows the process of building a small EV. Classes culminate in a competition to discern the superior vehicle.

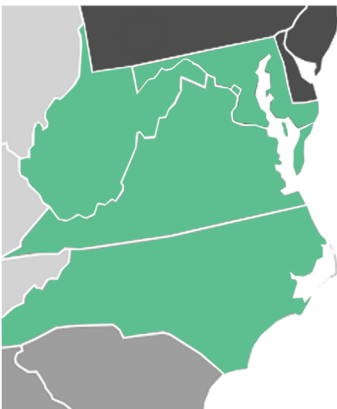
Potential Sponsors: Virginia Tech, UVA, JMU, VCU & CNU
Location: VCU Campus

DAY OF EVENT: College teams to converge on VCU campus to display vehicles. Vehicles are either mounted on stands and run until the batteries are depleted or to be raced. Winning vehicle team to receive award.

LOGISTICS:

Rental of VCU Space for Event
Marketing Push to Attract Interested Parties
Dominion to Provide Funds For Adjunct Professors, Team Budgets and Award

Approximate Cost: \$10,000-\$20,000
Timeline: 6-8 months



VIRGINIA AND SURROUNDING STATES

EV Drag Race

Interested parties to purchase materials to build batteries from Dominion and form teams. Teams to create unique EVs and document progress on social media.

Potential Sponsors: Science Museum, VCU Engineering, Tesla/EV companies, Capital One, VT, UVA, JMU, VCU, CNU, and the public
Location: VCU Campus

DAY OF EVENT: Dominion to shut down a street in Richmond, VA to hold a drag race and affiliated event. Related vendors invited to attend. Live music and food trucks arranged. Winning team to receive award donated to charity of their choosing.

LOGISTICS:

Street Closure
Marketing Push to Attract Interested Parties
Live Entertainment and Related Expenditures
Volunteer Staff Coordinator Stipend

Approximate Cost: \$50,000-\$300,000
Timeline: 1 year

Dominion Bill Contextualization

Dominion Power has more than 6 million utility and retail energy customers receiving a bill each month. What better way to engage the entire community of customers than through their bill?

Total Draft Amount:	\$	277.84
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Previous Amount Due: \$ 0.00
 Payments as of Feb 02: \$ 0.00

*For service emergencies and power outages please call
 1-866-DOM-HELP (1-866-366-4357). Visit us at www.dom.com.*

Meter and Usage

Current Billing Days: 32

Billable Usage

Schedule 1 12/29-01/30
 Total kWh 1999

Measured Usage

Meter: 0200050076 12/29-12/31
 Current Reading 3270
 Previous Reading 3204
 Total kWh 66
 Current Reading 5.81
 Demand 5.81

Meter: 0200050076 12/31-01/30
 Current Reading 5203
 Previous Reading 3270
 Total kWh 1933
 Current Reading 7.37
 Demand 7.37

Usage History

Mo	Yr	kWh
Jan	15	1999

Previous Balance 0.00
 Payment Received 0.00
Balance Forward 0.00

Residential Service (Schedule 1) 12/29-01/30
 Distribution Service 41.71
 Electricity Supply Svc (ESS)
 Generation 85.41
 Transmission 18.85
 Fuel 60.33
 Sales and Use Surcharge 1.50
 Deposit Installment 49.00

State/Local Consumption Tax 3.04
 ARLINGTON Utility Tax 3.00
 Service Initiation Chg 15.00
Total Current Charges 277.84

Total Account Balance 277.84

*View payment options, request service changes and enroll in eBill at
www.dom.com, search: Manage Your Account*

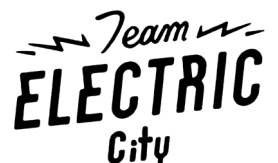
With this much electricity, an EV could have traveled from Richmond to Los Angeles **and back again**. That would cost \$572.33 in a gas-powered vehicle!

With this much electricity, an EV could have traveled from Richmond to New York over 5 times! That would cost \$180.37 in a gas-powered vehicle.

Concluding Thoughts

Human-centered design does not have a linear progression. We make decisions based on the information we have at the time, and it is easy to cross something off the list and consider it a failure. It is when we allow those “failures” to remain on the cutting room floor that we fail in the truest sense. We learned to not let anything go to the furnace entirely. We held as many options in the air as we could until, inevitably, some of them fell away.

We have had amazing support from our sponsor team and our mentor along the way. Dominion’s team welcomed us into their space and we thank them for it. Matt kept us aligned with our true customer base throughout the process. Allison allowed us our blunders and then built our confidence back. This process allowed us to grapple with a large-scale problem and feel what it is like finding specific pain-points in a vast ocean of personas.



Flash to the Future

In the post-Industrial world of rapidly advancing technologies, corporate powerhouses often struggle to calculate human needs into their innovations. This is why human-centered design is a crucial consideration moving into a new age. Understanding a person's pain-points is not only a true artform, but also a critical component of the Design Thinking Process. Dominion has already begun implementing such methods, and soon, many others alike should start to follow their lead.

Using communication as a process, researchers can tap into the roots of human desire and unlock solutions to retrogressive problems world-wide. This is the beginning of a universal mindset shift.

Sustainable development; that's what fuels us. The increased use of electric alternatives is what we should all be striving for. Learning from the failures of our past will be the catalyst which moves us forward. Adjusting outdated systems and infrastructures to coincide with the need-criteria of the future is just one of many ways to prolong the life of this planet.

While fossil fuels are steadily depleting, consumerist intuitions globally are only becoming more unattuned to important topics of ecological preservation through all the noise they encounter on any given day. A change needs to occur. Executive decisions need to be made in respect to environmental status and human necessity.

We believe harnessing electricity and other comparably efficient natural resources will propel us into an astonishing new age. For issues this unfathomable, everyone must play an equal part. We must adopt new technologies, opt-in to impactful services, and continuously strive to mitigate the long history of carbon footprints that have daunted the world we live in.



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Appendix

Research Documents

1. Yang, David. “What’s in Store for Electric Vehicle Manufacturing?” SME Website, 1 June 2013, www.sme.org/MEMagazine/Article.aspx?id=73509.

Electric vehicle manufacturing can occur on the same assembly lines as current production. There are government incentives going on right now to encourage production of EVs. Also, these same incentives are being credited as the driving force behind initial growth of EV adoption. Under the baseline scenario, the total cost of ownership over a six-year period for HEVs is estimated as 2.7% higher than conventional vehicles in 2013. During the next five years, the cost differential will decrease at an annualized rate of 5.7–2.0% in 2018, signaling improved competitiveness for HEVs.

2. Jones, Philip B., et al. “The Future of Transportation Electrification: Utility, Industry and Consumer Perspectives.” Sept. 2018, doi:10.2172/1464173.

Utility investment should be deployed in ways that will maximize the societal benefits of these other investment sources. The equitable allocation of resources to benefit low-income communities, communities with environmental justice concerns, and other vulnerable communities could be accelerated by combining utility resources and private resources with these other sources of support.

3. U.S. National Electrification Assessment. Electric Power Research Institute. April 2018.

While some of this load growth will be customer-supplied, utilities in most cases will supply capacity to ensure reliability. By comparison, annual load growth from 1990–2000 was 2.7%, dropping to 0.82%, on average from 2000–2010. For electric companies, such slow but steady growth can moderate potential rate impacts of investments for environmental compliance or grid modernization. Moreover, if guided, new flexible loads can improve grid efficiency and performance.

4. Norris, Cecilia. “What Do Those New Regulations Mean for The Future of Electric Vehicles?” EZ-EV, 11 June 2018, ez-ev.com/tips/new-electric-vehicle-regulations.

In order to remain competitive, the US has to compete with the carbon-emission regulated China and Europe. Krieb states that “these are global automakers who see the rest of the world marching in a different direction. To play in other markets, they must meet the standards of other countries, most notably China, the biggest car market in the world, which is demanding cleaner vehicles

5. Cattaneo, Lia. Plug-In Electric Vehicles: Evaluating the Effectiveness of State Policies for Increasing Deployment. Center for American Progress, 2018, pp. 9–13, Plug-In Electric Vehicles: Evaluating the Effectiveness of State Policies for Increasing Deployment.

In a survey of drivers in California and nine Northeast states, consumers cited—in rank order—lower purchase price and being able to drive 200 miles on a fully charged battery as the top two attributes that would make them more likely to consider purchasing or leasing a PEV.

6. Office of Energy Efficiency and Renewable Energy “Plug-In Electric Vehicles and batteries” www.energy.gov/eere/vehicles/plug-electric-vehicles-and-batteries Lewis M. Fulton, et al.

With their immense potential for increasing the country’s energy security, economic vitality, and quality of life, plug-in electric vehicles (PEVs, including plug-in hybrid electric and all-electric) will play a key role in the country’s transportation future.

7. Heidi Gjoen, et al. “Cultural Politics in Action: Developing User Scripts in Relation to the Electric Vehicle” Norwegian University of Science and Technology. Sept. 2018

EV drivers claimed that they have become more ‘careful and conscious’ compared to when driving internal combustion cars. “My attitude towards road traffic has changed significantly since I am driving the EV, mainly my driving style got less aggressive and more quiet,” one informant stated. [Austrian] users have allegedly become more ‘defensive,’ while communicating better with fellow road users.

8. Surya Santoso, Ph.D.; H. Wayne Beaty: Standard Handbook for Electrical Engineers, Seventeenth Edition. Utility Application of Power Electronics, Chapter (McGraw-Hill Professional, 2018), [AccessEngineering](#).

Multilevel converters are attractive for two major reasons, the ability to increase the operating voltages and an improved ac waveform quality. Among many different types of multilevel converter topologies, MMC is a relatively new family member. It has gained its popularity quickly because of its advantages such as distributed location of capacitive energy storages, modular and scalable design, low switching frequency, transformer/inductor-less grid connection, and the availability of a common dc link which is very useful for HVDC transmission system application.

9. “Electric Vehicles: Technology Brief” International Renewable Energy Agency. February 2017

EV deployment depends on four concurrent strategies to ensure maximum benefits: electrification of vehicles; Provision of sufficient charging equipment; Decarbonisation of power generation; and EV integration with the grid.

10. Immers, L H. “The Basics of Transport Economics.” KATHOLIEKE UNIVERSITEIT LEUVEN, 2007, www.mech.kuleuven.be/cib/verkeer/dwn/H111part4.pdf

A dense appraisal of foundational transport economics that creates a potential for innovat

11. Seba, Tony. “Keynote - 100% Electric Transportation and 100% Solar by 2030 - AltCars Expo.” YouTube. November 08, 2014. <https://www.youtube.com/watch?v=RBkND76J91k>.

Tony Seba shares his predictions and research regarding the end of transportations industrial age. He speaks at length about the simplicity of the electric vehicle design. This keynote asserts that by 2030: All new mass-market vehicles will be electric. All of these vehicles will be autonomous (self-driving). Up to 80 per cent of parking spaces and highways will be redundant. Taxis as we know them will be obsolete. The concept of car ownership will be obsolete. Oil will be obsolete. All new energy will be provided by solar (and wind).

