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Financing EV Charging

SIPA Spring '23 Capstone Project
Final Presentation | April. 20, 2023

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Meet the Team

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Executive Summary

Stage is set for major EV infrastructure investment

In the US, more than 2 million EVs already on the road, and electrification is coming for vehicles of every type and use

Project finance is still a challenge

- Public charging not profitable without subsidies
- Fragmented fleets
- Other issues: grid and incentive delays, broken chargers, high or unpredictable electricity costs

Promising trends

Including strategic partnerships, growing fleet commitments, and development of new revenue models

To access this market, SMBC can look for projects that:

Achieve adequate size by going beyond charging infrastructure

Offtake to partner with loss leader strategies

Take advantage of layers of federal, state and utility policy support

Part 1. The Stage Is Set for Major EV Charging Investment

Current Landscape

Technologies:

Level 1, 2, or 3 technology
Differences in charging speed along with different voltage/wattage/AC/DC

Different plug shapes, charging speed and power, costs, driving application and range

Newer charging tech includes induction (wireless) and battery swapping

Common charging models:

Private passenger vehicles: Public charging stations or home charging

Fleets: Government and commercial fleets, rideshares, school buses, Medium-Duty Vehicle (MDV) and High-Duty Vehicle (HDV): Typically charge at depots

Charging companies:

> 100 charging companies in North America

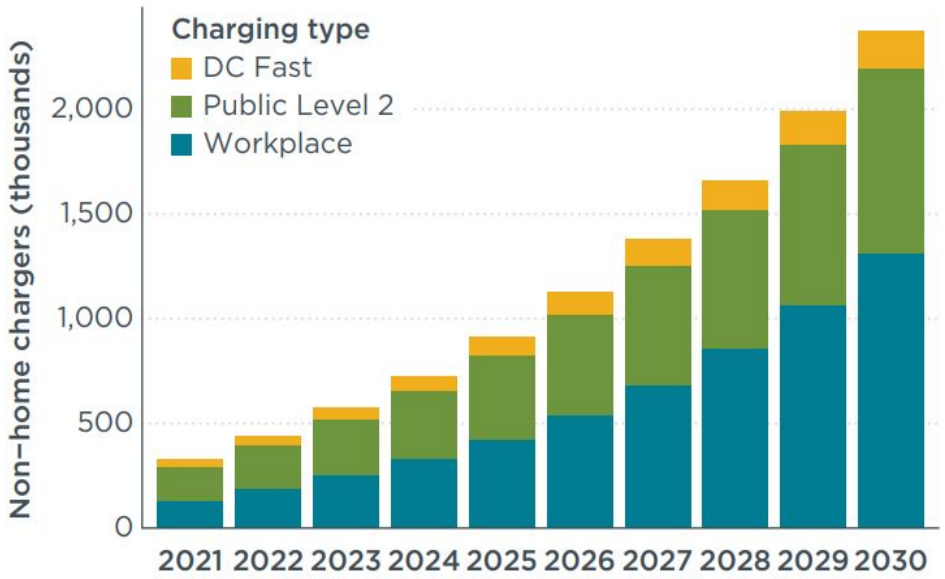
> $2 billion worth of investments into EV charging start-ups*

Increased investment by energy companies (e.g. BP and Shell) and OEMs

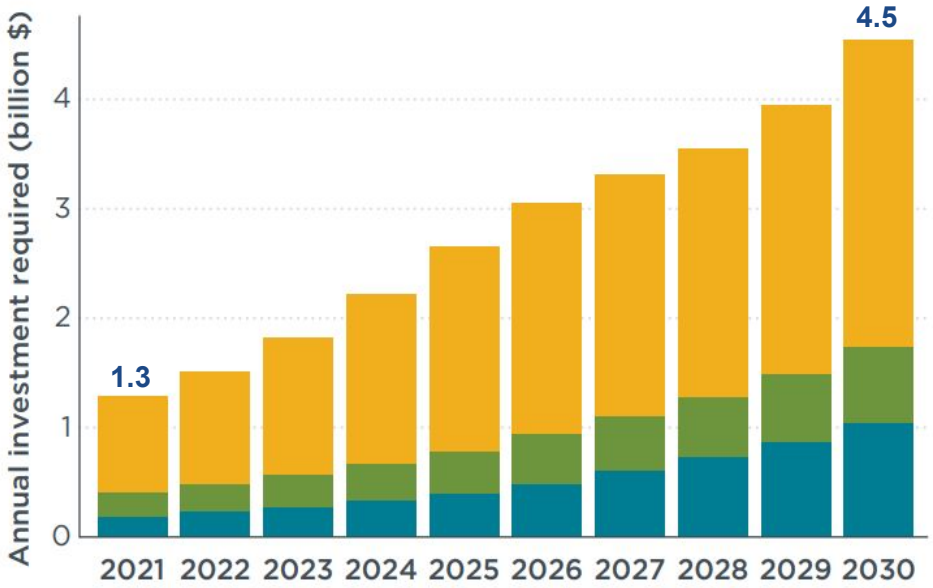
Source: Pitchbook, PwC, various

Projected Charging Stations in the US

Workplace and Level 2 chargers will **dominate** the market share of the EV charging ecosystem.



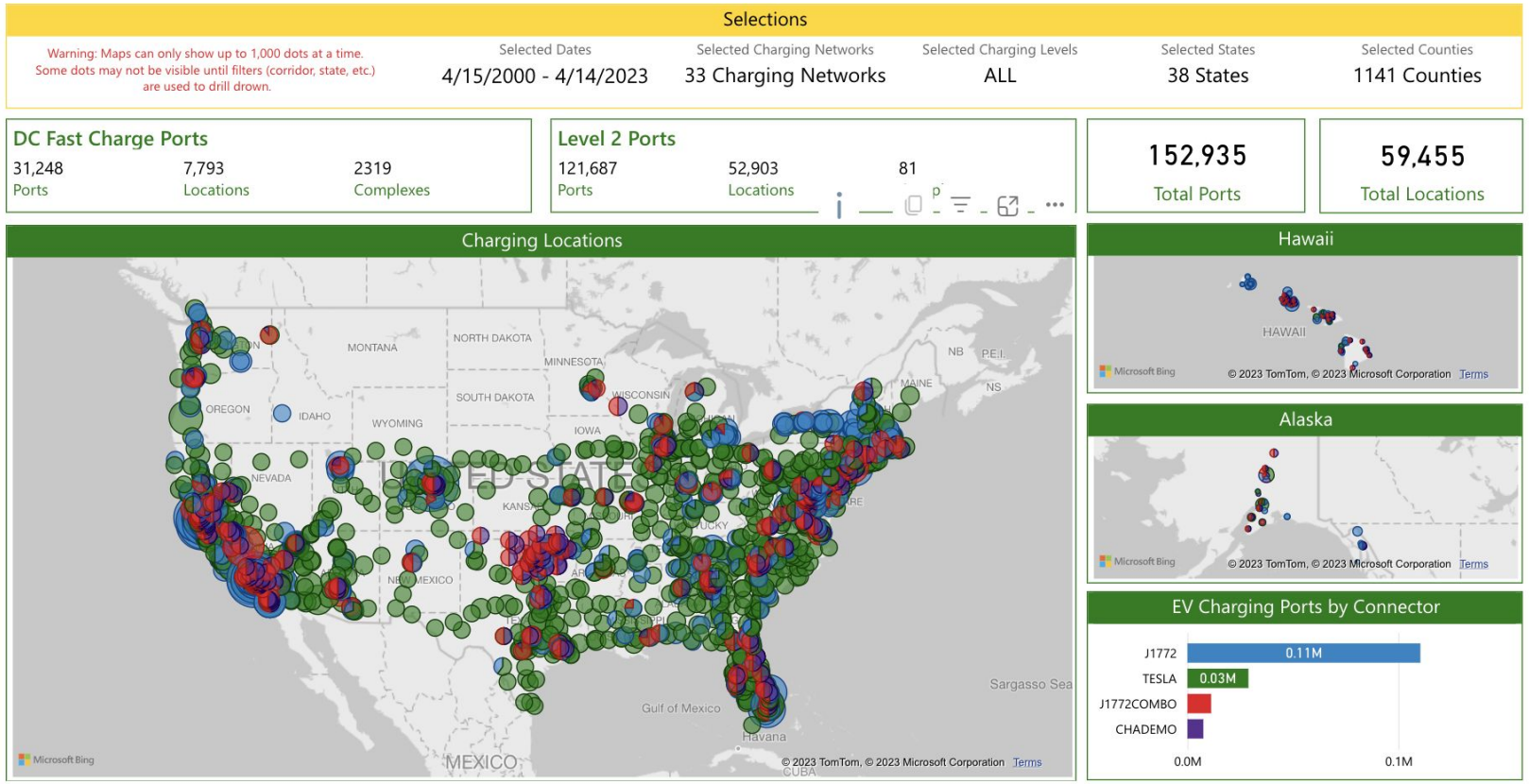
Annual investment required for **charging infrastructure** would have to **triple** by 2030.



Source: International Council of Clean Transportation (ICCT)

Level 2 & Level 3 charging networks across the US

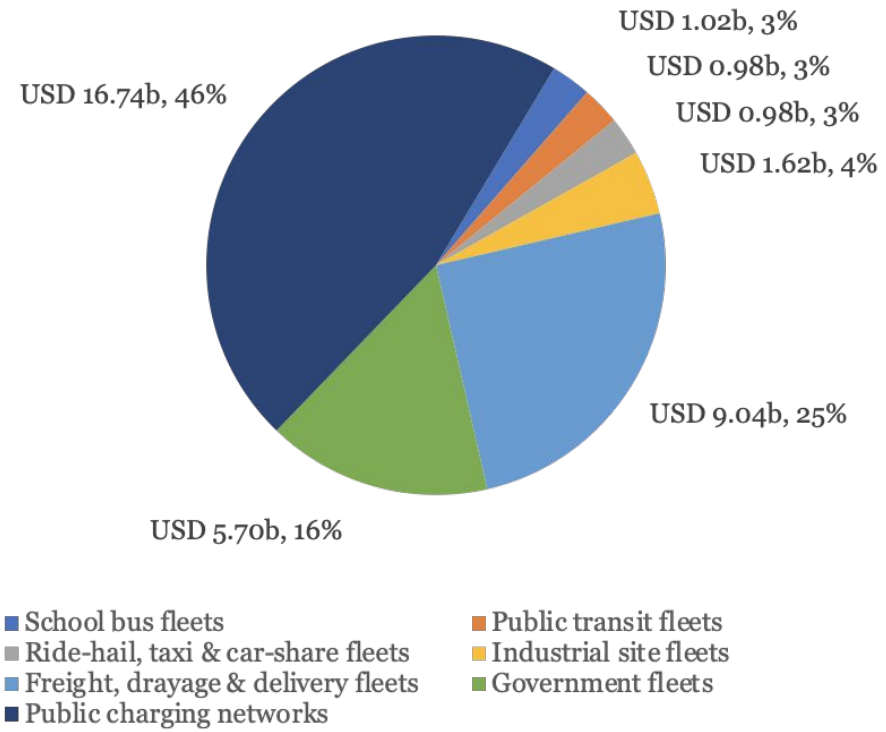
> As of April 2023, there are **152,935** Charging Points, covering **59,455** locations in total in **38** states.



Source: Atlas EV Hub

Charging is Set for Major Expansion

Estimated EV charging market size per business line, 2030 (billion USD)



Source: Team's analysis, various sources

EV charging adoption is seeing significant market share:

$ 36B
worth of market share by 2030

48M
estimated number of EVs in the next 10 years

50%
of all vehicles sold each year be zero emission by 2030

MDV and HDV fleets are on the rise:

14.2K
Global eMDV/eHDV sales (2021)

+66%
Electric transit buses growth past year (2022)

+48%
Electric school buses growth past year (2022)

New major policy support

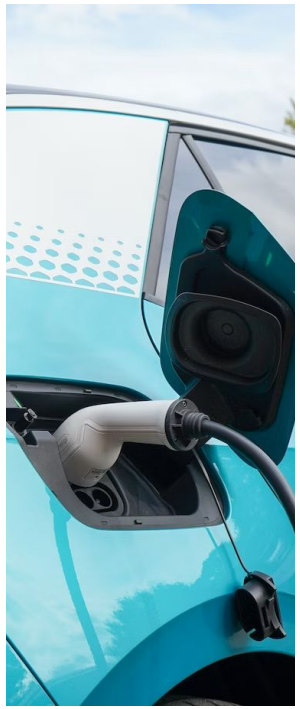
Check Part 10. Appendix - Policy Deep Dive for more details.

Transition to **EVs is a centerpiece of US climate policy** and is seeing major new policy support:

Source: Atlas EV Hub

Support for EV adoption includes tax incentives, mandates, and lead-by-example policies:

- New EPA rule would require EVs make up two thirds of new cars and one quarter of new trucks by 2032
- **$5 billion** till 2026 to electrify school buses across the country



Direct support for EV charging includes:

- Bipartisan Infrastructure Law **$7.5 billion** for EV charging via NEVI and CFI
- IRA: Strengthened Alternative Fuel Infrastructure Tax Credit (30% of cost or 6% if subject to depreciation, not to exceed $100,000).
- Utilities: **$5 billion** in approved EV spending
- Many state and local programs: 83 state EV policies enacted in last 12 months.
    - i.e., California's Clean Truck and School Bus Program, Clean Miles Standard Regulation

Prospective EV Charging Infrastructure

$7.5 billion of public investment by 2030 in EV charging infrastructure are on the way

Biden's goal to achieve **500,000 EV chargers** by 2030

PwC estimates **$100 billion market** for EV Supply Equipment (EVSE) by 2040*

Transition will touch every piece of US ground transportation:

- The General Services Administration (GSA) expects federal agencies to need **one charging port for every two electric vehicles** acquired
- Giant scale of investment required as US has nearly 300 million registered vehicles and 150,000 gas stations; nearly 1,200 bus transit fleets with more than 66,000 buses
- Growing need for fleet, commercial and industrial vehicles, including forklifts for e-commerce, shipping vans (including USPS EV commitment), drayage, and more

**Note: The four main value pools of the EVSE market include hardware, software, installers and charge point operators (CPOs)*

Source: U.S. Department of Transportation, PwC estimates

Part 2. A Fraught Investment Landscape

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Challenges

- Few proven business models
- Bureaucratic hurdles
- Fragmented fleets

Unpredictable and high electricity prices

High maintenance costs & frequent down time

Grid capacity

Interoperability

Charger utilization impossible to predict

- Difficulty finding bankable charger business model

Uncertainty over future consumer preferences

- Will home charging be dominant model?

Poor performance of EV SPACs

- Underperforming profits and delayed production result in penny stocks

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Challenges

- Few proven business models
- Bureaucratic hurdles
- Fragmented fleets

Lengthy grid interconnection process

Check Part 11. Appendix - Site Visit and Interviews for more details.

Frank Reig
Revel, Co-Founder & CEO

"Permits for Brooklyn Superhub took more than 2 years"

Paul Suhey
Revel, Co-Founder

"It takes 6-18 months to build a fast charging station. It could be a lot quicker if we were able to streamline. The industry needs help"

Slow process and strict requirements for Grants

for getting incentives under NEVI and other programs

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Challenges

- Few proven business models
- Bureaucratic hurdles
- **Fragmented fleets**

Fleets are promising because of guaranteed offtakes. But **the market is fragmented:**

- **Transit:** Different transportation agencies fund infrastructure projects in silos
  - In California agencies are mostly doing it alone, citing differences in service needs and electrification strategies.
- **School Bus:** Different contracts due to variation in land properties ownership, budgeting, priorities, and source of funding across the school districts.
- **Government Fleet:** Use of different technologies and routes lead to the struggle to develop a cohesive and efficient network of charging stations that meets the needs of all users.

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Part 3. Opportunities on the Horizon

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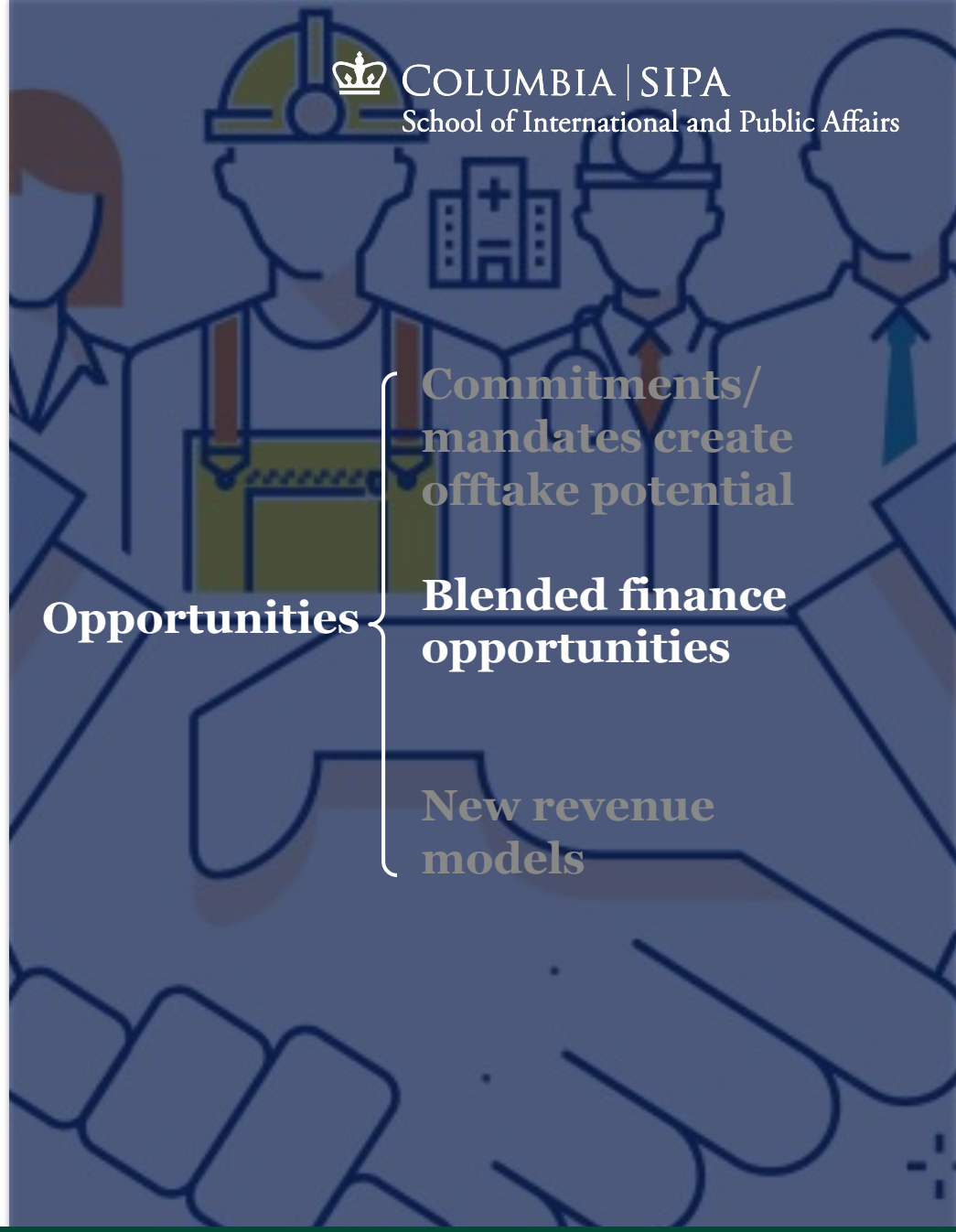
Public and private EV commitments signal potential for large-scale fleet charging offtake agreements

- Companies with major retail fleets have committed to 100% electric fleets including Amazon, Ikea, Walmart, DHL and FedEx
- California's transit mandate has created funding gaps and financing needs for charging infrastructure
- Uber, Lyft and Revel have made 100% electric commitments, and are considering providing vehicles to their drivers

Government support enables capital deployment with uncertain revenues and to achieve IRR suitable for private investors

Blended Finance Structure: Transit projects present opportunities for creative projects with blended finance

- Philanthropic Foundation/Government/Private Investment
- Bloomberg and Goldman Sachs completed first set of blended-finance investments on innovation across sustainable transport sector in India and Vietnam
- Alphastruxure's "Energy as a Service" offers matching funds for agencies to apply for federal grants



Market and technology trends are unlocking new models

for both public and fleet charging:

- ❑ New technologies are helping retailers integrate charging with business, including advertising displays and location finding
- ❑ Bidirectional charging such as Vehicle-to-Grid (V2G) strengthens demand-response capabilities
- ❑ Projects that provide charging or vehicles as a service are helping increase project sizes
    - International Development Bank invest is the senior loan partner (US$120m) in a project (US$396m) to provide Santiago, Chile, with financing for the 992 electric buses

Part 4. Finding the Right Opportunities

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How Can SMBC Scout for These Projects?

These proposed projects need to consider:

01 **Project size**
Look to bundle services and infrastructure ✓

02 **Finding offtakers**
Look for loss leaders and fleet operators ✓

03 **Pencilling out**
Look for layers of policy support ✓

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Project Size: Look to Bundle Services and Infrastructure

	Explanation	Examples
Additional infra & services	Adding on additional infra and services can increase project size, including: • vehicles • maintenance • charge management	• Highland Electric Fleets provides turnkey solutions to school districts • IDB Invest provides buses to Santiago, Chile • AlphaStruxure provides energy as a service to MCDOT in Maryland (including solar, storage, and full charge management)
Bundling	Bundling can provide access to new revenue sources including: • Grants for vehicles and onsite energy systems • Grid revenue from exporting solar or V2G electricity	

Finding Offtakers: Look for Loss Leaders and Fleet Operators

	Explanation	Examples
Loss leader opportunities	Companies looking for business opportunities created by charger installations: • Vehicle OEMs • Retailers • Utilities are investing in EV charging to increase their rate base and grow investor returns	• Vehicle OEMs: Mercedes/ MN8/ Chargepoint • Retailers: Walmart, Starbucks, and highway gas station markets • Utilities: National Grid
Fleet operators	Private and public entities looking to transition to EVs: • Ride-hail companies • Large industry/ drayage • Transit agencies and school districts	• Ride-hail companies: Uber/ Lyft • Large industry/drayage: TeraWatt Infrastructure • Transit agencies and school districts: Montgomery County Public Schools/ Highland

Pencilling out: Look for Layers of Policy Support

	Explanation	Examples
Government funding sources	Combined state, federal and local sources of capital such as grants, loans and loan guarantees	• Santa Clara's VTA has received federal Low - No funding and state LCTOP funds for electrification
Supportive utility programs	Supportive utility programs include Make-Ready, EV-charging friendly tariffs, and support for V2G and solar/storage energy exports	
Public support	Public support for project development	• California SB 372 provides support for soft financing, interest rate reductions, and investment aggregation

Part 5. Investments in Charging: Illustrative Examples

Using Models to Test Underlying "Opportunities"

We've created **site-level energy & financial models** for 1) public charging and 2) fleet charging to

- Demonstrate drivers for unlevered profitability and thus financeability for these two major categories of business models
- Simulate debt sizing under the assumption that lenders are willing to fund

Model Building Blocks*: Qualitative analysis on business models and outlooks based on desktop research and interviews

	Scenarios	Key operational inputs	Rev & cost structure		
Public charging	1. Med. utilization (14%) site 2. High utilization (20%) site 3. 50% demand charge off 4. Managed fleet offtake 5. Retail spend	• Tariff schedule • Utilization schedule • Price schedule • Retail spend rate • Grants • Installation/maint. costs	**Revenue:** • Charging • Retail (if any)	**Fixed Cost:** • Annual land lease • Installation • Chargers **Variable cost:** • Energy/demand charges • O&M	**DSCR Sculpting Debt sizing assumption:** Interest Rate @6% DSCR = 1.5x Tenor = 5 yrs
Fleet	1. No Incentive 2. No incentive, V2G 3. Incentive 4. 20% fixed cost overrun 5. 20% variable cost overrun 6. Demand charges	• Contract Period • No. of buses • Bus mileage & efficiency • Energy price • Subscription price • Public grant • V2G Energy	**Revenue:** • Subscription • Grant (if any) • V2G (if any)	**Fixed Cost:** • Bus • Chargers **Variable cost:** • O&M • Energy cost/Demand charge (if any)	

Case 1: Public Charging Network Example

Real life case reference - Revel Charging Superhub

Revel has been building DC fast charging "superhubs" for public use (plus their own EV fleet) in NYC. Charging owner-operators like it are targeting high demand locations, partnerships with fleets like Uber/Hertz, and retail revenue opportunities.

- **Technology profile:** 150-250 kW DC Fast Charging System
- **Scale:** 25 DC fast charging points
- **Offtake contract:** Supporting its own EV fleet + future potential for Uber/Hertz
- **Financing**: Raised $126M debt from BlackRock Infra Fund in Nov. '22. Previously raised $34M equity from Ibex Investors in Oct. '19.

Source: Site tour of Revel's charging hub in Bedford-Stuyvent & future charging superhub concept

Frank Reig
Founder & CEO,
Revel

"The way we think about stations is at scale. Revel's not interested in the one charger at a Walgreens. That doesn't do anything for the city, and it doesn't accelerate any transition. The only way to drive EV adoption in cities is with a real network of infrastructure, which does not exist right now. Until a company like Revel builds it all, this EV transition is just a lot of marketing and talk." - TechCrunch, 2022

Case 1: Public Charging Network Example

Output datatable*

(in 1000 USD)

#	Case Name	EBITDA	Total Rev	Total Exp	Unlevered IRR	Debt Size
1	**Medium Utilization (14%) with lower grant**	2,068	28,340	26,272	<0	/
2	**High Utilization (20%)**	6,793	34,471	27,678	8%	983
3	**50% Off Demand Charges**	5,229	28,045	22,816	4%	735
4	**Managed fleet offtake (Revel)**	8,567	32,748	24,181	**12%**	1,393
5	**Retail Spend (BP Pulse)**	2,737	30,064	27,327	<0	/

*only for illustration - based on a single iteration of randomized charging pattern as in public charging projects the charging pattern is inherently slightly random

Profitability driver

- **Higher utilization**
  14% to 18% util. change boosts EBITDA to >8%
- **Cost structure optimization:**
  - Reduce variable cost **(30%)** from demand charge incentives
  - Reduce variable cost **(16%)** from managed fleet charge schedule
- **Additional revenue source:**
  - $15/hr retail spending leads to ~20% higher unlevered IRR (but that still needs to be complemented on a higher utilization)

Project Finance Opportunity

Check size → Aggregation of sites across highways/cities

Merchant risk shelter → Managed charging with offtaker fleets, demand charge incentives/controls

Pencil out → Target higher utilization sites, complimentary retail revenue spending

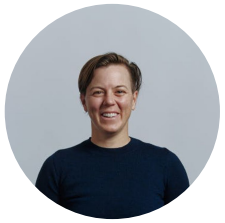
Case 2: Bundled Turnkey Solution Example

Real life case reference - Highland Electric Fleets

Montgomery County Public Schools (MCPS) contracted Highland for their Electrification-as-a-service (EaaS) school bus electrification and building up V2G Bethesda Bus Depot.

- **Technology profile:**60 kW DC Power Charging System
- **Scale:** Total of 25 electric buses & 45 chargers(as of 2022); Total of 326 electric buses (by 2025)
- **Offtake contract:** USD 1.3 million/year contract to Highland (12 year of contract)
- **Financing**: Project as standalone SPV financed by own equity and debt, exploring sale-lease back to engage tax equity investors

Source: Montgomery School District project



Amy McGuire
Director of Market Development, Highland

> "Highland is currently managing over 400+ buses across 15 districts, and keep searching for more sizable project. The company is looking to expand and partner with future lenders and investors. Our pricing will ensure project's pro forma has a satisfactory margin for all parties with embedded risk mitigation."

Case 2: Bundled Turnkey Solution Example

Output datatable*

(in 1000 USD)

#	Case Name	EBITDA	Total Rev	Total Exp	Unlevered IRR	Debt Size
1	**No Incentive**	138	1,457	1,320	/	/
2	**No incentive, V2G**	11,832	13,152	1,320	4%	2,468
3	**Incentive**	9,563	10,882	1,320	**5%**	5,947
4	**20% + fixed cost**	9,563	10,882	1,320	**-11%**	/
5	**20% + variable cost**	9,299	10,882	1,583	3%	5,890
6	**Demand charges**	9,523	10,882	1,360	4%	5,919

*only for illustration

Profitability driver

- **Better Pricing** ($ 3,987.73/year/bus as base input)
- **Cost structure optimization*:**
  - Reduce fixed cost **(88%)** from bulk purchase of bus/charger
  - Reduce variable cost **(16%)** from utility fixed contract, smart scheduling, and economy scale of labor
- **Additional revenue source**
  - Grant (Case #3 creates highest IRR with **$377K/bus** grant that covers per bus cost **$350K on the first year**)*
  - V2G
- **Tax equity** to monetize depreciation/tax credit

Project Finance Opportunity

Check size → Aggregation of project in multiple school districts

Merchant risk shelter → Contracted with reliable counter party, guaranteed offtake

Pencil out → Utilize grant and tax equity; economy of scale for better profitability

*See more in appendix

Part 6. Conclusion

Concluding Thoughts

Additional incentives for SMBC

- Alignment with sustainability efforts
  - By 2030, SMBC aims to "Execute 30 trillion Japanese yen contributed toward sustainability, of which 20 trillion is invested in green finance"
  - Committed "to achieving net zero in their loan and investment portfolio by 2050"

Key recommendations for SMBC

- SMBC can look for projects that:
  - Achieve adequate size by going beyond charging infrastructure
  - Offtake to partner with loss leader strategies
  - Take advantage of layers of federal, state and utility policy support

What's next?

- Emerging landscape of public funding opportunities
- Keep an eye on emerging technologies
  - Hydrogen: attractive due to cheaper production

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Thank You!

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Q & A Session

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Part 7. Appendix: Project Overview

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Client SMBC's need

Understand the current and potential landscape of EV infrastructure including the stakeholders, market participants, and foreseeable partnerships in the United States.

Key research questions

1. What are the biggest barriers and opportunities to the financial viability of EV charging infrastructure?
2. How will the landscape for EV charging change over the next 2-3 years?
3. What are some of the opportunities for an investor like SMBC for EV charging?

Problems to solve

1. Identify opportunities and bottlenecks for various EV infrastructure business models
2. Identify risks of potential EV infrastructure project financing
3. Recommendations for SMBC to be fully engaged and ready for future EV developers/stakeholder who come to SMBC for financing opportunities

Project Methodology

Understand Background/Scope of work

- Overview of SMBC
- Why lending to EV infrastructure is important to SMBC
- SMBC's key competitors and other important stakeholders
- Summary of SMBC's past work in EVs (similar projects financed)
  -> key characteristics of a promising projects (risk profile, ROI, size, timeframe, contractual covenants, DSCR requirements, etc)

Execute and Research

Internal Research

- **Cross-cutting topics**

Policy, International experience, utility relations, Contractual similarities

- **Business model deep dive**

Market sizing, landscape, trends, specific project case studies -> **investment hypothesis**

Question Formulation ⇕ *Industry insight input*

External interviews + Site visit

- Incl. EV Company, researcher, investor
- Site Visit to Revel Charging Hub @BK
- Via Supervisor/ Team's contact leads, and Email/LinkedIn outreach

Final Recommendation

Validate **investment hypothesis** against SMBC's **key characteristics of investment,** and identify the most promising investment opportunities in EV infrastructure, by:

- Defining the financial features/criteria of each business model, taking into account cost, revenue, grant, etc.
- Forecasting future market size and growth rate
- Prioritizing projects developed by certain players/in certain geographies

Hypothesis-driven approach + Periodical updates with clients for validation, feedback and modifications

Key Milestones & Deliverables

Week of April 20, 2023

Final presentation and report for client and SIPA

April 13, 2023

Draft final report and presentation due

March 30, 2023

Client progress slide deck 4: Interviews & case study findings

March 16, 2023

Client progress slide deck 3: Project financing & tangential investments

✓ **Week of March 6, 2023**

Midterm presentation (Feb 28) & report to client and SIPA

March 2, 2023 ✓

Client progress slide deck 2: Demand forecasts, policies & potential case studies

✓ **Feb 16, 2023**

Client progress slide deck 1: Introduction & technology overviews

Feb 9, 2023 ✓

Project work plan finalized with client approval

Part 8: Appendix - Risk and Finance Mitigation Alternatives

Project Finance Risk Characteristics

- A high degree of certainty in terms of **offtake volume**
  - Predictability of charging times (depending on business model, routes) to provide comfort to the utility in terms of rate design and to the developers in terms of charging prices to the offtakers
  - Guaranteed offtakes arrangement
- A high degree of **predictable revenue stream** over offtake period
- Strong **creditworthiness** of the developers and offtakers
- Healthy **financial histories** of the borrowers
- **Proven business model** that have addressed these major project risks:
  - Technological risk
  - Merchant risk
  - Market/revenue risk
  - Regulatory risk

Financial Risk Mitigation Tools to address investment risks

Factors	Risks and challenges							
	Political Risk	Policy and Regulatory Risk	Counterparty Risk (Power Offtake Risk)	Grid Interconnection and Transmission Line Risk	Technology Risk	Currency Risk	Liquidity and Refinancing Risk	Resource Risk
Government Guarantee	✓	✓	✓					
Political Risk Insurance	✓	✓	✓	✓		✓		
Partial Risk/Credit Guarantee	✓	✓	✓	✓	✓			
Currency Risk Hedging Instrument/Guarantee fund						✓		
Internal/External Liquidity Facility					✓		✓	
Liquidity Guarantee / Put Options							✓	
Grant and Convertible Grant								✓
Resource Guarantee Fund / Critical Mineral Exploration Insurance / Portfolio Guarantee								✓

✓ = mitigation tool addresses corresponding investment risk

Source: IRENA

Structured Finance mechanisms and capital markets instruments to scale up investment

Factors	Insufficient Investment Size and High Transaction Costs	Financial Regulators Restraining Illiquid and Riskier Investments
Standardization	✓	
Aggregation	✓	
Securitization	✓	✓
Green bonds	✓	✓
Yieldcos		✓

✓ = said financial mechanism addresses corresponding issue

Financial mechanisms to address **insufficient investment size and high transaction costs, and riskier investments**:

- **Standardisation and Aggregation** of project documentation allow assets to be pooled in larger portfolios.
- **Aggregation** of smaller-scale to scale up volume and reduce diligence costs.
- **Securation** by grouping assets with similar characteristics and selling them to an SPV to protect the assets from outside claims.
- **Green Bonds**
- **Yieldcos**

Source: IRENA

Alternative Risk Management solutions for emerging technologies

Key Rating Driver	Key Concerns	Risk Management
Asset isolation & legal structure	Evaluate whether claims by or against sponsor (e.g.bankruptcy) on underlying assets could influence the overall deal	Create a bankruptcy remote structure that insulates assets from outside claims
Financial structure	Assess the ability of the structure to perform under various market stress scenarios	'Payment priority waterfall' combined with credit enhancements must be sufficient to repay principal in full by the legal maturity date
Credit enhancement	Assess the ability to protect investors from losses arising from defaults in the asset pool	Ensure sufficient credit enhancements are in place to 'withstand default' based on losses in the asset pool under various scenarios
Asset quality	Assess ability of the asset to generate sufficient cash flow	Ensure adequate amount and quality of assets to service obligations without enhancements in the base case scenario.
Originator & servicer quality	Assess if central operational participants can effectively fulfil their roles to support the performance of the asset pool	Evaluate operator and servicer capabilities and processes to establish confidence in the management of all aspects of the asset
Surveillance	Ascertain whether assets are likely to perform as expected and/or whether it is likely that new risks will arise	Detailed and frequent asset reporting and verification of the asset pool

Source: IRENA

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Part 9: Appendix - Case Research

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Battery Swapping Insights

The US market is distant to scaling up investments in battery swapping

- ❑ OEM Uniformization and regulatory designs
  - Other regions (China and EU) have harmonized automotive technical standards and differ from US standards.
  - China's New Infrastructure Initiative incentives battery swapping subsidies
- ❑ Alignment between stakeholders, such as robotic and electric device industries, electrical grid operators (particularly Distribution System Operators) and national authorities, present fuel service station owners, and, consumers.
- ❑ Market development and supply chain constraints
  - Standardization of manufacturers to use same batteries in all cars (reduces market expansion) unless regulation is favorable.
  - Limited availability and cost of raw materials (critical minerals) and policy (recycling)
    - Better Place + Renault failed installed battery market due to high capital costs in EV charging and swapping and incipient market penetration ($850 million investment).

Source: NIO

Charging Models for Logistics

Several business models for charging freight, drayage, and delivery EV fleets:

- **Depot Charging Model:** EVs are charged at a central location, such as a depot or warehouse, where they are parked overnight or during downtime, using Level 2 Chargers or DC Fast Chargers. This model works for the delivery companies and ecommerce platforms that have a centralized location and regular schedules.
- **On-the-Go Charging Model:** EVs are charged at public charging stations or dedicated charging infrastructure located along their delivery routes. This will require planning and coordination to ensure that EVs can get charged on time.
- **Battery Swapping Model:** EVs use interchangeable batteries that can be quickly swapped out for a fully charged battery at a charging station. This requires significant upfront investment in battery swapping infrastructure but is the most time saving option for the fleet.
- **Subscription Charging Model:** EV fleet operators pay a monthly subscription fee to access charging infrastructure and related services.

EV friendly electricity tariffs

As for utility-level incentives, there are evolving tariff rate structures because energy regulators are requiring them to incent EV charging infrastructure. Typically, tariff structures have included: demand (kW) charges, coincidental peak (kW) charges, flat energy (kWh) volumetric charges & time-of-use (TOU) rate schedules. In many utility regions, especially those in California, "performance-based ratemaking" has become a trend where regulators are requiring utilities to achieve certain performance on topics like EV penetration. For example, there might be incentives to alleviate demand charges from an EV changing owner-operator until a certain utilization target for the charger is achieved. Other notable rate designs are emerging that influence EV charging:

- **Xcel Energy (Colorado)** is replacing some demand charges with time-varying energy charges. This includes a critical peak price of $1.50/kWh, which many critics have cited as being a larger burden compared to demand charges for chargers.
- **Pacific Gas & Electric (PG&E)** in California had introduced a rate that combines a subscription charge (i.e., customer subscription to a specific level of peak demand in advance) with a TOU energy charge. This can result in significant savings for CSOs.
- **San Diego Gas & Electric (SDG&E)** in California has introduced a "Power Your Drive" program where EV charging site hosts have two billing options, either to charge a rate to the driver or pay the rate themselves. In this case, drivers have the option to themselves curtail their charging at high priced times.

Rideshare Commitments

- **Uber** has committed to becoming a zero-emission platform in US, Canadian and other major global cities by 2030 and its strategy places heavy emphasis on EV fleets. Uber also hopes to have 100$ of rides globally offered by zero-emission vehicles. The company is making this happen by already helping drivers go electric and by partnering with EV charging companies.
    - For example, Wallbox has partnered with Uber to offer drivers an all-in-one home EV-charging solution and energy management system.
- **Lyft** similarly aims to be 100% electric by 2030 and is leading its strategy with "Express Drive" EV rentals to provide drivers with nearer-term EV access.

Source: Electrek

Electric forklift market challenges

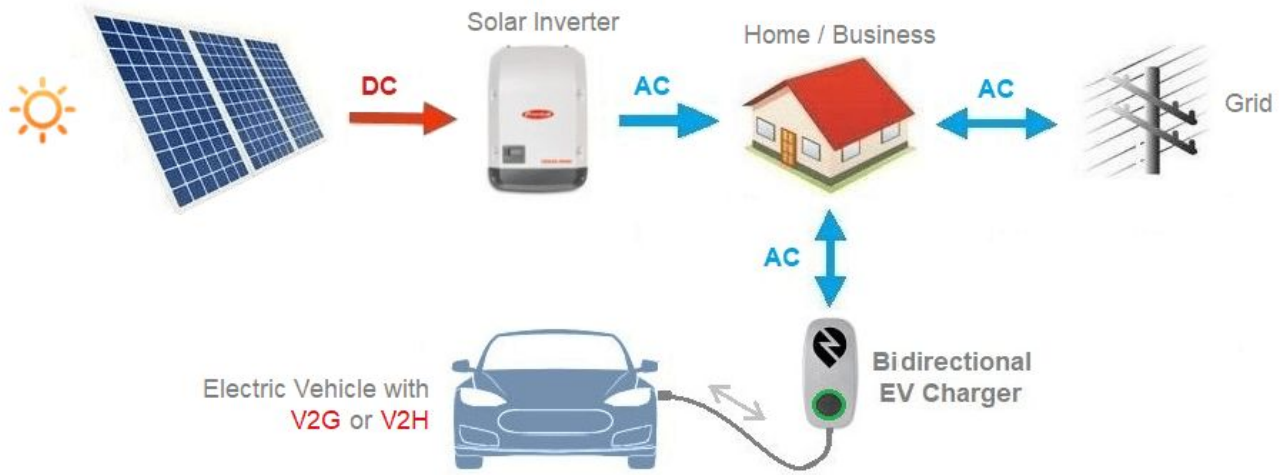
Electric forklifts have several benefits, however there are some challenges to adopting them. One of the main challenges is the higher upfront cost compared to traditional ICE forklifts. “Companies may be reluctant to invest in electric forklifts due to concerns about return on investment and the need to allocate resources to other aspects of their business.” However, it is important to note that in the long-term, lithium electric forklifts have higher cost savings due to lower operating and maintenance expenses. Another challenge for electric forklifts is the need for a charger. The related infrastructure can be a hurdle, especially for smaller businesses with limited space or financial resources. However, smaller chargers for lithium batteries can be installed anywhere, and no charging room is required. The resistance to change and skepticism is the biggest obstacle to the adoption of electric forklifts. Some industry professionals may doubt the capabilities of electric forklifts, particularly in terms of performance, reliability, and durability. “Overcoming these misconceptions will require continued education, demonstration of success stories, and highlighting of the numerous benefits of electric forklifts.”

Investment challenges for other industrial vehicles:

- Rising interest rates crush demand for construction equipment.
- The construction industry consists of residential, non-residential and utilities construction.
- “The two most prominent industries in this sector are residential and non-residential. Due to rising interest rates, financing large expansion projects has become much more costly.”
- Bright spot for the construction market - growing demand for utility construction (expected to grow through 2023.)
- Mining trucks demand lowered due to ESG constraints.
- Mining for minerals, such as coal, has declined due to regulatory pressures and price competition from other energy sources, leading to muted growth among manufacturers.

V2G

- **V2G charging depots with utility partnership** → establishing V2G contract with providers and utilities to secure allowed energy sold to the grid:
  - San Diego Unified School District (SDUSD) V2G Project at Cajon Valley and San Diego Gas & Electric (SDG&E) partnership.
  - Fairfax County Schools in Virginia and Dominion Energy partnership.



Source: Clean Energy Reviews

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Part 10: Appendix - Policy Deep Dive

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EV Charging-Related Sections in IIJA and IRA

Section number	Title	Lead agency	Funding ($ millions)	Funding target
Infrastructure Investment and Jobs Act (H.R. 3684)				
11115	Congestion mitigation and air quality improvement program	DOT	$13,200	MDHD, Charging
11129	Standards	DOT	Not stated	Charging, EVs
11401	Grants for charging and fueling infrastructure	DOT	$2,500	Rural, Underserved Communities, Charging, EVs
40209	Advanced Energy Manufacturing and Recycling Grant Program	DOE	$750	EVs, Batteries, Charging
40541	Grants for Energy Efficiency Improvements and Renewable Energy Improvements at Public School Facilities	DOE	$500	Buses, Charging
Division J	National Electric Vehicle Formula Program	DOT	$5,000	Charging, EVs
NA	Port Infrastructure Development Program	DOT	$2,250	Ports, EVs, Charging
Inflation Reduction Act				
60101	Clean Heavy-Duty Vehicles	EPA	$1,000	ZEV, ZEV Charging
70002	United States Postal Service Clean Fleets	GSA	$3,000	EVs, Charging

Key Federal Level Policy Support

❑ Federal-level

- **Procurement (government fleet):**
  - Under the Clean School Bus Program, enrollment of another 12,000 buses will be funded by the EPA by 2026.
- **Self-procurement (funding for non-government):**
  - Advanced Clean Truck Regulation in California mandates minimum ZEV sales targets. In 2021, other states such as New York, Washington, Oregon, New Jersey, and Massachusetts adopted similar policies. California has unveiled a blueprint in 2022 that allocates USD 6.1 billion for ZEV initiatives within the state, which includes provisions for the electrification of heavy-duty trucks.
  - Inflation Reduction Act (IRA): both light- and medium-duty vehicles are eligible for tax credits of up to $7,500, while heavy-duty trucks may qualify for tax credits of up to $40,000.
- **Utility - Tariff support:**
  - State utility commissions are pushing utilities to offer EV-friendly retail electricity tariffs.
- **Battery Swapping:**
  - Federal government NEVI funding covers up to 80% of a project's eligible costs, and the remaining 20% is likely to come from public or private sources. As the first round of NEVI funding rolls out, a web of e-mobility stakeholders is seeking to influence electric vehicle supply equipment (EVSE) and related infrastructure deployment.

Public Procurement Plans

- **Government Procurement:** The federal government provided nearly $2 billion for clean buses in 2022 alone. In 2019, California set a statewide target for 100% ZEV bus acquisition by 2029, with a full transition by 2040. Many cities, including New York City and Chicago set similar commitments, and some small agencies have already achieved full electrification.
  - Biden Executive Order requires most federal vehicle purchases to be zero-emission vehicles by 2035. This order affects about 380,000 federal vehicles as they need to be replaced. Federal government may need over 200,000 charging ports to provide power to the vehicle.
  - California has set a goal of having 250,000 EV charging stations by 2025, while New York has committed to building 10,000 charging stations by the end of 2021.
- **Service Vehicle Procurement:** The EPA's Clean School Bus Program, created and funded by the Infrastructure Investment Jobs Act (IIJA) grants a total of $5 billion in the next five years to school districts to replace and electrify old school buses with zero-emission and lower emission models.
- **Industry Vermont Public Power Supply Authority** → $2,500 rebates available for purchase of electric forklift and other equipment.

Part 11: Appendix - Site Visit and Interviews

Site visits: Revel Superhub,Brooklyn

- Fastest expanding charging infrastructure in NYC
- Technology profile: Level 3 charging (100 miles under 20 mins, at least 150 kW) for all EV brands
  - 7MW nameplate capacity at the charging superhub
  - Superhub does not use more than 1.5-2MW at any time to avoid demand charges and manages charging schedule to reduce this
- Scale/Users: Hosts 25 fast chargers in Bed-Stuy, BK (largest fast charging depot in North America)
  - Building 5 more superhubs in NYC, total of 160 stalls, equal to 80% of NYC charging stalls

Source: Columbia SIPA Capstone Team

Site visits: Revel Superhub,Brooklyn

- **Revenue/financing model:** VC arm is Toyota Ventures
  - Revenue is ~39 cents/kWh electricity sold to general customers, Revel's Tesla rideshare fleet, third-party rideshare operators, and light-duty delivery vehicles
  - Drivers pay only for charge, not access to the superhub
  - Electricity costs ~20c/kWh
- **Investment size/project cost:**
  - Raised $126M from BlackRock in Nov. '22, $34M from Ibex Investors in Oct. '19
  - Capex ~60-200k/charger
- **Relevant policy/market trends:**
  - EV chargers in NYC have to join the same power upgrade cue as other users
  - Permitting makes self-gen difficult
  - Few fleets right now but more expected in future (fleets = guaranteed offtake)

Source: Columbia SIPA Capstone Team

Interview Summary

Think Tanks

Pierpaolo Cazzola, Transportation Export, CGEP
Corey Cantor, EV Expert, BloombergNEF
Nick Nigro, Founder, Atlas Public Policy

EV & Charging Companies

Frank Reig, Revel CEO & Co-founder
Levi Tillemann, Vice President, Ample
Yunqiu Deng, Strategy Director, NIO
Hasan Nazar, Policy Director at Tesla
Amy McGuire, Director of Market Development, Highland Electric Fleets
Birgit Dargel, Head of Sales EU, Siemens e-Mobility
Pasquale Romano, Chargepoint CEO

Public Sector & Utilities

Rachel Flynn-Kasuba, Vice President, National Grid
Adam Burger, Head of Zero Emission Planning, Santa Clara Valley DOT

Financial Institutions

Nick Albanese, Director of Research, The Westly Group (Venture Capital)
Andrew Catania Principal, Aligned Climate Capital
Richard Stuebi, Founder and President, Future Energy Advisors

Interview: ChargePoint

Pasquale Romano, CEO

- **CP's "no ownership" business model:**
  - taken in capital light tech business model to be the tech provider, developer, O&M provider, which can access the bigger segments of the market

- **CP's strategy on software R&D**
  - Bleeding for R&D to tap more TAM and spend to get into every vertical
  - Hopeful about future breakeven, and high margin

- **CP-MN8-Mercedez Partnership**
  - **The partnership:** Drive Co (Mercedez subsidiary) to collect revenue and own the meters that are fed from local utility + Asset Co (co-owned) to own the chargers and collect fixed fee for the charger and the solar energy party as a minimum guarantee
  - **Mercedez:** brand ability tied with amenity brands, preferential access to these stations
  - **MN8:** better return compared to renewables, get cushioned by an OEM - willing to take utilization risks but still very sensitive

- **PF for charging infra:**
  - Project finance / infra fund is looking for: big check, low risk, low return
  - Infra funds have started to step in the game, banks maybe later
  - But for charging has lots of barriers:
    - small or medium sized check upfront
    - not so sure when the returns going to hit the hurdle rate
    - only a subset of chargers will ever cancel
  - What makes public charging infra attractive is the "attribution amenity value" (e.g. retailers ingratiating customers / employers - employees)
    - Pure play charger owners won't be making money because they are competing with these retailer distorted pricings/blended returns
    - The future business model: blend! integrated POS system on the chargers; Better safety, security, additional amenities
  - Fleet electrification not really feasible
    - A fully wrapped energy contact would make it financiable but it's not easy to realize in US regulatory markets depending on jurisdictions (for example in Texas you can select distribution services from other non-local markets)
  - Not hopeful about V2G: conservative utilities / technical difficulty /Battery storage matures more quickly

Interview: Highland Electric Fleets

Amy McGuire, Director of Market Development

- Focus on regional fleet electrification service provider
  - raised capital, balance equity/loan structures, recapture period with the contract they signed
  - land ownership varies, although PP&E remains with Highland
  - school bus depots are not publicly accessible, however co-sharing can be possible through charge management
- See huge fragmentation of the market
  - currently managing over 400+ buses across 15 districts, and keep searching for more sizable projects
  - segment of government fleets, buses, and technology add up the cost of expanding
  - looking to engage with adjacent school districts in bundling
- The company is looking to expand and partner with future lenders and investors
  - usually set up SPV for each project, and a program agreement that includes pricing (depending on the school districts, pricing can be in a form of annual subscription fee)
  - ensure project's pro forma has a satisfactory margin for all parties with embedded risk mitigation

Source: Montgomery School District project

Interview: National Grid

Rachel Flynn-Kasuba, Vice President

- **National Grid's EV strategy**
  - Matching the EV growth predictions with infrastructure building projections (2, 5 & 10 years).
  - Updating all the infrastructure at the point of charging station to get EV sites ready.
  - ConnectedSolutions Program in Massachusetts and New York: demand response preparation.
- **Applicable rate structure:** Electric Vehicle Charging Station Programs. No EV specific rate; based on residential, small business, large commercial or industrial customers categories; flexible waiving mechanism to incentivize the adoption of EV.
- **Request for EV charging station construction:** ~$400 million to fund EV charging. Apply online ⇒ customers submit site/time/number of chargers and relevant fees ⇒National Grid review ⇒ one-time funding.
- **Charging station investment:** No expertise/capacity.

Source: National Grid

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