HNTB

City of Dublin
OHIO, USA

CITY OF DUBLIN, OHIO

DUBLIN EV INFRASTRUCTURE COMPREHENSIVE PLAN

NOVEMBER 2025

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Executive Summary

Dublin, Ohio, aspires to be the most sustainable, most connected and most resilient global City of choice through state-of-the-art infrastructure, convenient transportation and expansive broadband access. With a 100-gigabit fiber network, strategic private and public partnerships, and significant investments in innovation, Dublin is emerging as a global leader providing an ecosystem for companies to beta test new technologies. The City is working to "improve lives, drives and experiences" by embracing the significant shift in the automotive industry towards sustainability. Recognizing the potential of electric vehicles (EVs) to reduce carbon emissions and dependence on fossil fuels, Dublin has actively engaged in fostering the adoption of EVs and the development of necessary charging infrastructure for the City fleet, residents and visitors. In doing so, the City is prioritizing investments in sites that complement market deployments and fill gaps that the market is not solving to ensure a more equitable and effective expansion of EV infrastructure.

This Implementation Plan builds upon the comprehensive analysis of Dublin's current electrification conditions presented in the preceding Existing Conditions Report. It serves as a roadmap for the development and execution of a forward-looking strategy to drive transportation electrification within the City, covering several key areas:

- ***Current EV Infrastructure***: Assessing existing EV charging stations and their usage patterns.
- ***Future Projections***: Forecasting the deployment of Electric Vehicle Supply Equipment (EVSE) to meet anticipated demand.
- ***Municipal Fleet Transition***: Strategies for electrifying the City's vehicle fleet and maintenance equipment.
- ***Policy and Regulation***: Examining relevant policies, regulations, and best practices to support electrification efforts.

The analysis forecasts that Dublin will require an additional 181 public EVSE ports to support the anticipated 5,000 EVs registered in Dublin by 2035. These projections are based on a conservative scenario, considering recent federal policy changes[1] and the high density of single-family homes where most EV drivers can charge at home. To address these needs effectively, the Implementation Plan recommendations have been categorized into seven key areas:

Key Recommendations Overview

1. ***Charging Infrastructure Deployment***: Identifying and prioritizing locations for new EV charging stations, ensuring accessibility and convenience for all users.

[1] https://www.whitehouse.gov/presidential-actions/2025/01/unleashing-american-energy/

2. ***Planning and Zoning Codes, Building Standards***: Updating building standards and zoning codes to facilitate the installation of EV charging infrastructure in new developments and public spaces.
3. ***Partnerships***: Fostering collaborations with local businesses, utility companies, and other stakeholders to expand the EV charging network.
4. ***Education and Outreach***: Developing programs to raise awareness about the benefits of EVs and provide information on available incentives and best practices.
5. ***Dublin Municipal Fleet***: Gradually replacing the City's fleet with EVs, starting with those that have lower duty cycles.
6. ***Funding***: Exploring and securing external grants and incentives to support the expansion and maintenance of EV infrastructure.
7. ***Fee and Law Considerations***: Implementing an enterprise fund, charging fees, idle fees, and legal measures to ensure efficient use of EV charging stations and regularly update policies based on user needs and best practices.

Short-, medium- and long-term recommendations are provided for each recommendation category. While recommendations are given for time periods up to 10 years in the future, it's important to note that EV charging technology, vehicle offerings, and consumer buying are changing rapidly so the plan will be reviewed on regular basis to ensure City resources are being used appropriately.

Impact and Benefits

Implementing this plan will catalyze Dublin's transition to a cleaner, more resilient future by advancing electric vehicle infrastructure and community engagement. The Implementation Plan:

- ***Enhances sustainability and quality of life*** through strategic electrification efforts.
- ***Expands EV charging infrastructure*** and promotes ***electric vehicle adoption*.**
- Leads to a ***significant reduction in greenhouse gas emissions*** and ***improved air quality***.
- ***Decreases dependence on fossil fuels***, boosting energy security and resilience.
- Positions Dublin as a ***forward-thinking city***, attracting ***businesses and residents*** who value innovation and sustainability.
- Fosters ***partnerships and collaborations***, strengthening ***community ties*** and creating economic opportunities.
- Supports ***education and outreach efforts*** to ensure residents are informed about EV benefits.
- Encourages ***increased public support and adoption*** of the City's sustainability goals.
- Addresses ***immediate EV infrastructure needs*** while laying the foundation for a ***sustainable, resilient, and connected future.***

Strategic Considerations and Supporting Analysis

Benchmarking (*See Local EV Trends*)

While statewide progress is only beginning to align with national benchmarks, Dublin's proactive sustainability initiatives and forward-looking policies have resulted in higher EV ownership rates than many comparable municipalities. Dublin should continue to lead the way, leveraging its momentum to

further accelerate EV adoption and serve as a model for peer cities across the state.

Compared to other peer cities in Ohio, the City of Dublin stands out as a frontrunner in EV adoption. Dublin is approaching 10% EV adoption among new vehicle registrations and has reached approximately 4.26% of total vehicles on the road that are electric.

Ownership Models (*See Ownership Models)*

The City of Dublin is exploring multiple ownership and operational models for EV charging infrastructure, including: a City-owned and operated model, a full-service third-party contract model, and a third-party lease and operate model.

The Implementation Plan explores how ownership structures influence capital investment, long-term operations and maintenance costs, and revenue potential. Emphasizing fiscal responsibility and public value, it is recommended that Dublin contract with a third-party vendor for full-service EVSE delivery. This model offers Dublin a balanced approach to infrastructure deployment and reduces the City's capital and operational expenditures while leveraging vendor expertise for installation, maintenance, and customer service.

Although direct revenue may be lower compared to City-owned models, this approach aligns with Dublin's goals of enhancing public amenities and accelerating EV adoption. It also shifts operational risks to specialized providers, allowing City staff to focus on strategic priorities. Partnering with experienced vendors can expedite deployment timelines and ensure high-quality service standards across the network.

Innovative Charging Solutions (*See Innovative Charging Solutions)*

As EV adoption accelerates, cities must explore forward-thinking strategies to support evolving charging needs. While the Implementation Plan explores a range of innovative and unconventional EV charging solutions beyond traditional infrastructure, it is recommended that the City of Dublin prioritize conventional charging approaches in the short term. These solutions are more readily deployable, cost-effective, and better understood by users and operators. Innovative options may be evaluated and piloted in targeted use cases—such as high-density urban areas or locations with limited grid capacity—where they can complement existing infrastructure and align with the City's long-term sustainability goals.

Hydrogen Technology (*See New Technology Risks and Opportunities for a detailed discussion of other technologies, including hydrogen)*

For near-term strategic planning, hydrogen fuel cell technology is best suited for specific use cases—such as transit agencies, freight operators, and specialized commercial fleets—where its technical strengths align with operational demands, rather than for widespread consumer adoption. In contrast, EV technology has matured significantly and is gaining strong market traction, particularly in Ohio, which surpassed 100,000 plug-in EVs, justifying continued infrastructure investment. Given current market trends, technology readiness, and infrastructure limitations, the City of Dublin should refrain from major hydrogen investments at this time, instead maintaining a proactive stance by monitoring technological and market developments to remain adaptable should hydrogen become more viable for widespread consumer adoption in the future.

Electrification of City Fleet and Equipment (See *Dublin Fleet*)

The City should continue deploying battery-electric fleet vehicles including mowing equipment, prioritizing right-sized models where commercially available battery capacities can reliably support daily duty cycles. To maintain operational resilience, electrification of City-owned assets such as fleet vehicles, mowers and off-road equipment should be complemented by retaining a sufficient inventory of gas-powered units. This hybrid approach ensures continuity of essential services during grid outages while supporting long-term sustainability goals.

Financial Analysis (See *Charging Infrastructure Needs*)

The City of Dublin's financial analysis supports a strategic and fiscally responsible approach to expanding EV charging infrastructure. The recommended plan calls for the installation of 36 Level 2 charging ports and two DCFC ports across eight publicly accessible locations by 2035. This expansion is projected to require an estimated investment of approximately $1 million spread over a 10-year period. By leveraging third-party vendor partnerships, the City can optimize upfront and ongoing expenses, shifting capital risk and operational responsibilities while accelerating deployment. The plan also recommends creating an enterprise fund to collect fees and return them to the program to create a sustainable model. This overall financial approach balances the need for robust public charging with fiscal prudence, ensuring Dublin's infrastructure remains adaptable to future technological and market developments.

Introduction and Goal

This document outlines the comprehensive plan for the future of vehicle electrification in the City of Dublin, Ohio, incorporating an analysis of existing electrification conditions alongside national and international trends. Its purpose is to serve as a guiding resource for all city departments as they work towards aligning Dublin with the City's vision, sustainability goals and efforts to foster a cutting-edge, connected, and resilient city. This plan helps ensure that the City of Dublin remains at the forefront of sustainable urban mobility. By synthesizing the electrification work done to date, future forecasts, and policy considerations, this plan will lay the foundation for a more efficient and environmentally conscious transportation landscape in Dublin.

Figure 1: City of Dublin Vision

The City of Dublin aspires to be the most **sustainable**, **connected** and **resilient** global city of choice.

Source: City of Dublin

To realize the City of Dublin's vision (**Figure 1**), Dublin established an internal working group with members shown in **Table 1**. The working group met four times over a period of six months, where they discussed topics including EV best practices, strategies, and actionable policies aimed at accelerating Dublin's electrification efforts.

Table 1: Working Group Participants

PARTICIPANT NAME	DIVISION
Bradley Fagrell	Building Standards
Brian Ashford	Facilities & Fleet Management
Christopher Will	Community Planning & Development
Emily Goliver	Office of the City Manager
J.M. Rayburn	Transportation & Mobility
Jean-Ellen Willis	Transportation & Mobility
Jennifer Rauch	Community Planning & Development
Paul Hammersmith	Engineering

Source: City of Dublin

During the initial working group meeting on July 19, 2023, participants worked together to develop goals and examine projection scenarios for EV charging in Dublin. This initial meeting set the foundation for strategic planning and the establishment of key objectives to enhance EV infrastructure across the City. It also laid the groundwork for subsequent meetings, where members discussed the integration of best practices from other cities, engaged in analysis of different policy approaches, and mapped out potential pathways to implement these strategies, including identifying optimal EVSE locations, the associated costs, potential funding resources, as well as policy changes and collaboration opportunities.

SWOT Analysis

The first meeting started with an understanding of where electrification trends are heading and how that will affect Dublin. A brainstorming session was held in the workshop to outline the Strengths, Weaknesses, Opportunities and Threats or SWOT of Dublin as it relates to electrification within the City. **Figure 2** highlights key points of the SWOT analysis used in developing this electrification implementation plan.

Figure 2: SWOT Analysis

Source: City of Dublin

Trends in Electrification

To inform effective policy development and strategic planning for EV charging infrastructure, it is essential to analyze current trends in electrification. This section provides a detailed overview of the evolving landscape of EV infrastructure and associated policies. EV Charging Solutions offers an in-depth review of current and emerging EV charging technologies, emphasizing both established and innovative solutions available in the market. National, state and local trends in EV adoption are then examined, and alternative fuel technologies are evaluated, assessing their level of readiness and the potential risks related to overinvestment in EV infrastructure.

EV Charging Solutions

Conventional Charging Solutions

Plug-in electric vehicle (PEV) charging options are commonly divided into three general types. A detailed comparison of the 3 types of conventional EV charging solutions is presented in **Table 2**. In the United States, approximately 73% of public charging consists of Level 2 chargers, 26% is DC Fast charging, and less than 1% is Level 1 charging.

Table 2: Comparison of Level 2 and DC Fast charging: Types, Sites, and Key Factors

TYPE	CHARGER TYPE FACTORS	SITE PARAMETERS	LOCATIONS	PROS & CONS
Level 1 (L1) 	***Power Level***: ~1.4-1.9 kW ***Range Added:*** ~2-5 miles/hr ***Total Charge Time:*** ~40 hrs to ~80% from empty ***User Fees:*** Typically no fee at home, public L1 often aligns with L2 pricing policies ***Capital Cost:*** ~$0-$900 ***O&M:*** Minimal (periodic outlet inspection; no networking)	-Long-dwell sites -Mostly used to charge at home - overnight -Well-suited to PHEVs	-Residential -Fleet Depots -Micromobility hubs (e-bikes/scooters)	***Pro****: Lowest upfront cost; no special install; ideal for overnight charging and PHEV* ***Con****: Very slow; not practical for high daily mileage; can't be networked*
Level 2 (L2) 	***Power Level***: ~6-19kW/hr ***Range Added:*** ~10-20 miles/hr ***Total Charge Time:*** ~4-12 hours ***User Fees:*** ~$0.09 - $1.00/kWh ***Capital Cost:*** ~$7,500 - $25,000 ***O&M:*** ~$500 - $2,500+ annually	-Long-dwell sites -6–12 hr/day parking stays for average users -Avoid restricted, time-limited or permit only sites	-On-street Public lots -Workplace -Residential Multi-Unit -Long-stay locations	***Pro:*** Low capital and O&M costs; Uses residential power level; Few utility upgrades ***Con:*** Requires multiple hours stay for full charge
DC Fast Charging (DCFC) 	***Power Level:*** ~50–350 kW/hr ***Range Added:*** ~100+miles/30 min ***Total Charge Time:*** ~15 min – 1 hr ***User Fees:*** ~$0.25 - $1.00/kWh ***Capital Cost:*** ~$100,000 - $150,000 ***O&M:*** ~$1,500 - $10,000 annually	-Short-stay sites -High-utilization -Avoid restricted parking sites -Ensure curbside sites have space for equipment	-Retail (Quick Turnover) -Fuel Station -Short stay parking	***Pro:*** Charges in ~30 min or less like gas vehicles ***Con:*** High capital and O&M costs; May require grid or utility upgrades

Source: HNTB

Innovative Charging Solutions

As EVs continue to transform the transportation landscape, the demand for innovative and accessible charging solutions grows. Beyond traditional charging stations, innovative EV charging methods continue emerging to address diverse user needs, urban constraints, and technological advancements.

Table 3 explores these innovative charging types, detailing their functionality and key considerations for implementation. The City of Dublin should consider these alternative approaches in use cases where they align with local infrastructure, community needs, and strategic goals.

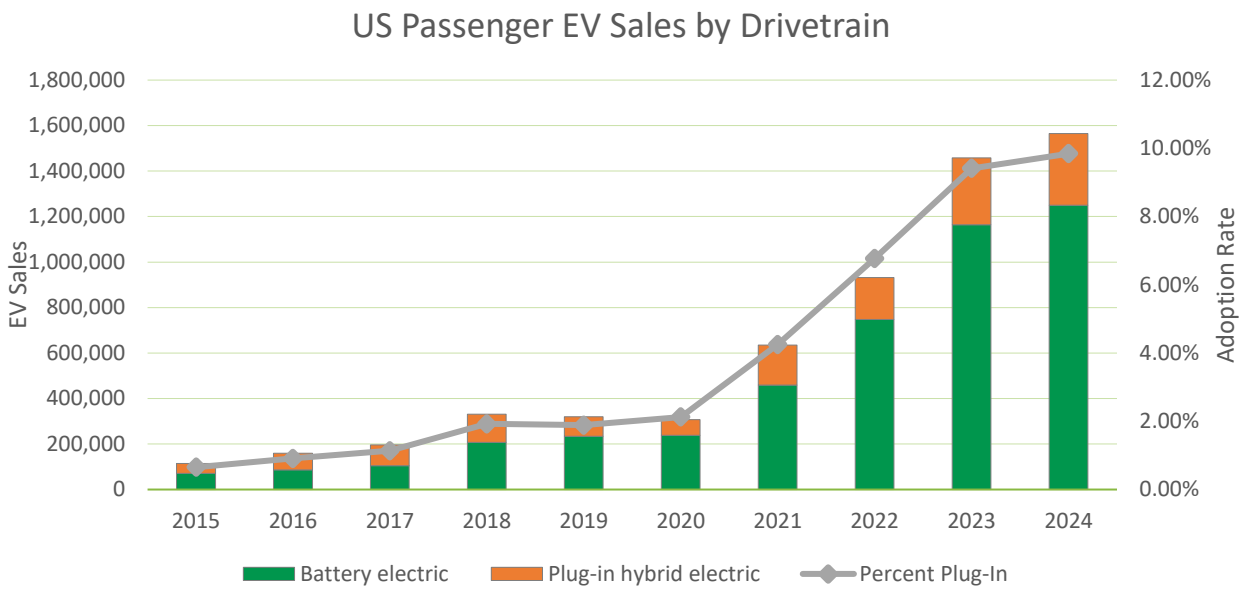
Table 3: Innovative EV Charging Solutions

TECHNOLOGY	HIGH	USE & DESCRIPTION	PROS	CONS
Streetlight Chargers	***Cost-Effectiveness and Commercial Availability***	***Use:*** L2, space constrained curbsides with streetlights ***Description:*** Chargers integrated into streetlights for EVs parked on city streets	-Reduces installation costs -Blends into cityscapes -Uses existing streetlight network	-Requires grid upgrades -Vulnerable to vandalism -Limited power capacity
Overhead Chargers in Garages		***Use:*** L2, sites where wall space for charging is limited ***Description:*** Ceiling-mounted chargers in garages with retractable cables	-Space-efficient -Clean aesthetic -Suitable for residential & commercial garages	-Higher installation costs -Increased complexity vs. wall-mounted chargers
Pop-up Bollard Chargers		***Use:*** L2, space constrained curbsides and parking lots ***Description:*** Charging points that rise and retract as needed	-Maximizes space -Flexible for parking lots/streets -Aesthetically discreet	-Moving parts increase maintenance -Higher installation and repair costs
Battery Integrated Chargers		***Use:*** DCFC, sites needing high power where grid power is limited ***Description:*** Chargers with integrated battery storage for supplementing grid power	-Reduces grid strain -Enables off-grid charging -Supports peak shaving	-Higher upfront costs -Battery maintenance required -Larger footprint
Mobile, Robotic Chargers		***Use:*** DCFC, space limited sites with high quantities of EVs ***Description:*** Automated systems, such as robotic mobile chargers, that connect to EVs where they are parked	-Enhances user convenience -Supports autonomous EVs -Reduces manual effort	-High costs -Reliability issues in harsh weather -Complex parking scenarios
Inductive Charging in Parking Spots		***Use:*** L2 & DCFC, wireless charging for convenience ***Description:*** Parking spots with wireless charging pads that charge EVs while parked	-Convenient -Cable-free -User-friendly -Seamless parking experience	-Less efficient than wired charging -Requires precise alignment -Costly setup
Wireless Charging In Roads		***Use:*** L2 & DCFC, wireless charging for convenience ***Description:*** Roads with wireless technology charging driving EVs	-Extends range -Reduces battery size -Supports continuous charging	-High infrastructure costs -Efficiency challenges -Still experimental
Source: HNTB	***LOW***			

National EV Trends

Gaining a clear understanding of national trends is essential for anticipating future developments in transportation and effectively guiding strategic decision-making. EV sales in the United States reached a record high, with US plug-in electric vehicle sales surpassing 1.4 million vehicles through 2024, as shown in **Figure 3**. EV demand continues to grow year-over-year, increasing steadily from 4.25% of new light-duty vehicle sales in 2021 to 9.84% in 2024.[2] This growth is largely driven by a combination of factors including technological advancements, increased consumer awareness, and supportive government policies.

Figure 3: US EV Sales from 2015 to 2024



Source: Argonne National Laboratory

The surge in funding for EVs over the past few years has been a major catalyst for sustainability initiatives, accelerating the transition to cleaner transportation. However, as of 2025, the EV sector is navigating a period of heightened uncertainty. This is driven by fluctuating market conditions, supply chain disruptions, and evolving federal policy, incentive, and regulatory frameworks. These factors are reshaping investment strategies and policy alignment within the industry.

This evolving landscape requires the City of Dublin to remain agile and responsive to shifting priorities. By staying flexible and proactive, Dublin can better position itself to leverage available resources and maximize the impact of its sustainability and mobility initiatives.

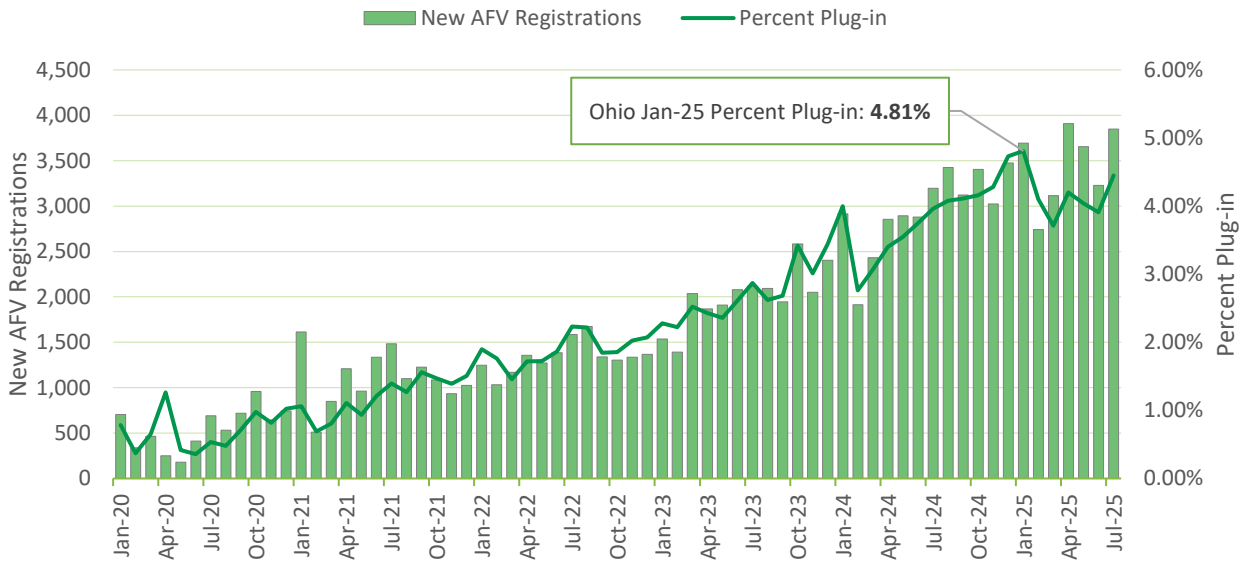
State EV Trends

Compared to states like California and Oregon, Ohio was not an early adopter of electric transportation technologies. However, some of its most populous cities are leading the way in EV adoption. DriveOhio developed the Ohio Alternative Fuel Vehicle Registration Dashboard[3] using data from the Ohio Bureau of Motor Vehicles (BMV) to track the market penetration of all alternative fuel vehicles (AFVs), with a focus on PEVs.

[2] Light Duty Electric Drive Vehicles Monthly Sales Updates - Historical Data | Argonne National Laboratory (anl.gov)
[3] Ohio Alternative Fuel Vehicle Registration Dashboard

Currently in Ohio, PEVs make up 1.12% of all light-duty vehicles on the road. In January 2025, nearly 4.81% of all new vehicle registrations were PEVs, either Battery Electric Vehicles (BEVs) or Plug-in Hybrid Electric Vehicles (PHEVs). This suggests that Ohio is approaching a significant milestone: once 5% of new vehicle sales are PEVs, other countries have observed a rapid acceleration in EV market growth.[4]

Figure 4: Ohio New Alternative Fuel Vehicle (AFV) Registrations

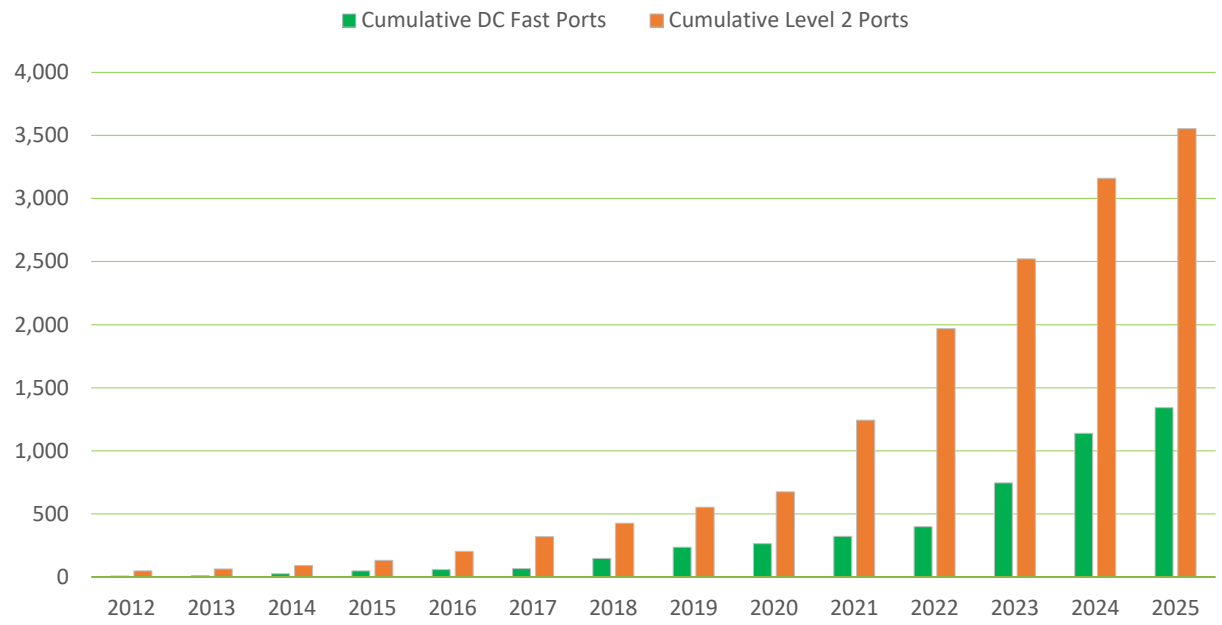


Source: Ohio Alternative Fuel Vehicle Registration Dashboard, as of July 2025

EV charger installations in Ohio saw a significant uptick beginning in the first quarter of 2021 (**Figure 5**), marking a strong push toward expanding EV infrastructure. That momentum has not only continued but is projected to accelerate further. As of July 2025, Ohio has 1,925 publicly accessible charging station locations, including 3,582 level 2 ports and 1,365 DCFC ports.[5]

[4] Bloomberg - Electric Car Tipping Point for Mass Adoption
[5] Alternative Fuels Data Center

Figure 5: Public EV Charging Infrastructure in Ohio

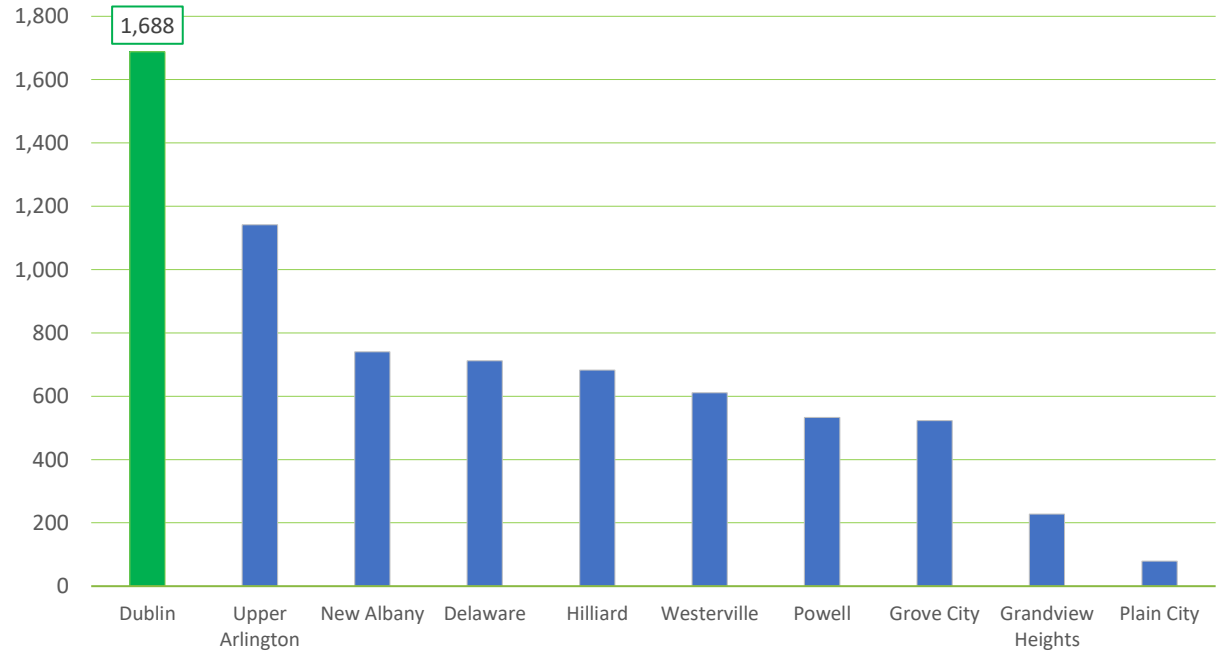


Source: Alternative Fuels Data Center, August 2025

Local EV Trends

Compared to other peer cities in Ohio, the City of Dublin distinguishes itself as a leading adopter of electric vehicles. While the state as a whole has only recently begun to catch up with national leaders, Dublin's commitment to sustainability and forward-thinking policies have resulted in higher rates of EV ownership than many peer cities (**Figure 6**).

Figure 6: Total AFV Registration by City, July 2025



Source: Ohio Alternative Fuel Vehicle Registration Dashboard, as of July 2025

New Technology Risks and Opportunities

Before proceeding with electrification, it is important to be familiar with the various available solutions. As the transportation sector evolves, a diverse array of emerging energy sources are being explored to reduce reliance on traditional petroleum-based fuels. These alternatives—ranging from biodiesel, ethanol, renewable diesel, ammonia, liquefied natural gas (LNG), hydrogen, and electricity—offer unique characteristics that make them suitable for different applications. **Table 4** presents an overview of different energy sources.

Table 4: Energy Sources

FUEL TYPE	DESCRIPTION	PASSENGER VEHICLES	TRUCKS	COMMERCIAL READINESS
Biodiesel	Renewable fuel made from vegetable oils or animal fast.	All diesel models can run on biodiesel blends up to B20.	All diesel truck models can use biodiesel blends. B20 is widely used in fleet trucks.	Widely used: Mature drop-in fuel for diesel engines. Common in fleets (B5-B20 blends) with established supply.
Ethanol (E85)	Renewable alcohol fuel (usually from corn). Currently ethanol is blended with gasoline in low (10%) and high (85%) fuel options.	Very limited – only ~4-6 new 2025 models are Flex Fuel Vehicles that run on high-ethanol fuel blends.	No current medium/heavy duty models run on high-ethanol fuel blends.	Common (light-duty): Mature technology for cars, with E85 available at many Midwest gas stations. Not used in heavy-duty.
Renewable Diesel	Produced from renewable biomass (e.g. plant oils, waste fats).	All diesel vehicles can use renewable diesel.	All diesel trucks can use it. Many fleets have switched to 100% renewable diesel.	Commercially available: Fully drop-in fuel, used by fleets especially on West Coast (growing availability in Midwest).
Ammonia	Carbon-free fuel converted to hydrogen or burned.	No vehicles commercially available.	No vehicles commercially available.	Experimental: Currently in R&D; infrastructure and vehicle technology not yet viable.
Liquid Natural Gas (LNG)	Natural gas cooled to liquid for high energy density.	No passenger vehicles available.	Several heavy-duty truck models (Class 8).	Established (niche): Used for long-haul trucking; limited but stable infrastructure.
Hydrogen	Used in fuel cells; emits only water vapor.	1-3 models in U.S., none in Midwest yet (Honda CR-V SUV in Marysville[6]).	Pilot-stage heavy trucks in limited use; SARTA and OSU CAR have pilot projects.	Pilot Stage: Limited market presence, mostly pilots; Midwest infrastructure lacking.
Electricity (Battery)	Battery-powered electric motors, zero emissions.	70+ models widely available.	Multiple medium- and heavy-duty models (limited range, growing availability).	Widely available (passenger), Emerging (trucks): Well-established passenger market; truck availability expanding rapidly, infrastructure growing.

Source: HNTB

[6] Honda unveils new zero emission hydrogen-electric CR-V at Marysville plant

Considering the evolving market dynamics, both battery electric and hydrogen-powered vehicles play significant roles and are key areas of focus in this discussion.

Balancing Grid Capacity, Technological Diversity, and Policy Flexibility

EV sales in the U.S. reached 372,219 in Q1 2025, marking a 10% increase from the previous year, highlighting continued healthy market growth. This momentum places pressure on policymakers to make informed decisions around grid modernization, technology investments, and regulatory frameworks.

A critical enabler of this growth is the expansion of charging infrastructure, which must be strategically aligned with grid capacity and demand management strategies to prevent system strain, especially as charging behaviors evolve and intersect with existing electrical load profiles.

EVs have reached significant technological maturity. Battery costs have dropped, and improvements in energy density, charging speed, and efficiency have led to price parity with internal combustion vehicles in many markets. Each EV consumes about 25-40 kWh per 100 miles.[7] By 2030, Ohio could see over 5,000 GWh of added demand—enough to power 500,000+ homes. Peak charging may overlap with summer demand peaks, stressing the grid. Ohio utilities expect EV-related electricity demand to grow 15–20x this decade, requiring major upgrades to transformers, substations, and distribution networks.

Is Ohio ready for the New Electric Demand?

The panel discussion titled "Can Ohio Meet its Future Energy Needs"[8] (March, 2025) brought together energy experts, business leaders, and policy advocates to address a pressing question: is Ohio prepared for the surge in electricity demand driven by data centers, electric vehicles, and the retirement of aging power plants?

Panelists agreed that **Ohio is relatively well-positioned** to meet this challenge, thanks to its diverse energy mix, strong transmission infrastructure, and competitive energy markets. However, they also acknowledged that the state is entering an era of rising demand—particularly from AI-driven data centers—and that this growth will require significant upgrades to the grid, smarter demand management, more transparent utility planning, and the attraction of private investment to fund new generation capacity. **Table 5** provides an overview of the challenges and actions being taken to meet the energy demand.

[7] Alternative Fuels Data Center: Electric Vehicle Benefits and Considerations
[8] All Amped Up: Can Ohio Meet Its Future Energy Needs?

Table 5: Challenges and Actions Being Taken to Meet Energy Demand

ASPECT	CURRENT STATUS	ACTIONS BEING TAKEN
Grid Capacity	Adequate but under pressure from rising demand	New legislation to improve transparency and planning (e.g., Senate Bill 2, House Bill 15[9])
Energy Mix	Diverse: gas, coal, nuclear, renewables	Continued investment in renewables and natural gas; calls for fair permitting processes
Demand Management	Underutilized smart meters and demand response programs	Push to reinstate energy efficiency mandates and expand demand-side programs
Affordability & Equity	Rising costs, especially for low-income households	Advocacy for least-cost planning and better cost allocation
Market Structure	Competitive generation market with regulated transmission/distribution	Support for keeping investment risk on private sector, not ratepayers
Innovation & Economic Development	Strong data center growth; AI driving demand	Emphasis on innovation, grid modernization, and leveraging energy as a growth catalyst

Source: HNTB

With Ohio's forward-looking approach to managing rising energy demands and the integration of advanced EV technologies like smart metering, demand response, and vehicle-to-grid (V2G) systems, EVs are positioned to play a key role in creating a sustainable transportation system.

Hydrogen Fuel Cell Technology: Role and Readiness

Hydrogen fuel cell technology offers advantages in specific applications while facing different infrastructure requirements and economic constraints compared to battery electric vehicles. Fuel cell vehicles provide fast refueling capabilities similar to conventional vehicles and extended range potential, making them particularly suitable for heavy-duty transportation, long-haul trucking, and transit applications where battery weight and charging time present operational challenges.

Deploying hydrogen requires distinct infrastructure—production, storage, and distribution—which involves substantial capital investments and technical complexity. Current hydrogen refueling station costs significantly exceed EV charging infrastructure investments. As of August 2025, all public hydrogen refueling stations are located in California[10], which highlights the lack of infrastructure across the rest of the country. This limited availability makes it impractical for the general public to adopt hydrogen fuel cell vehicles as a primary mode of transportation.

Despite the high costs, several Ohio companies including DLZ and Honda[11] are investing in hydrogen fuel cell vehicles, even in the absence of fueling infrastructure. DLZ, for example, has deployed six hydrogen fuel cell cars for its Columbus office. Honda is also producing its first American-made hybrid hydrogen vehicle, the 2025 CR-V e:FCEV, at its Marysville plant.

Should the City of Dublin invest in Hydrogen Technology?

For the near-term strategic planning horizon, hydrogen fuel cell technology appears most viable for targeted applications rather than broad consumer adoption. Transit agencies, freight operators, and specialized commercial fleets represent logical early adoption segments where operational requirements align with hydrogen's technical advantages. The evidence suggests that EV technology has achieved sufficient maturity and market momentum to justify substantial infrastructure investments,

[9] Ohio Advances Major Energy Legislation
[10] Alternative Fueling Station Locator
[11] Why Ohio companies are investing in hydrogen cars despite infrastructure issues

particularly in regions like Ohio where adoption curves indicate significant near-term growth (Ohio has surpassed 100,000 plug-in electric vehicles as of April 2025).

Based on current market dynamics, technology trajectories, and infrastructure constraints, the City of Dublin should not make significant investments in hydrogen technology at this time. Instead, the city can maintain a forward-looking stance by **continuing to monitor advancements in hydrogen technology**, **infrastructure development, and market conditions**. Keeping an open mind while staying informed about its progress will position Dublin to adapt strategically if hydrogen fuel cells become more viable in the future.

Risk Assessment: Technology Diversification vs. Concentration

Concentrating infrastructure investments exclusively on battery electric vehicles presents several strategic risks. Technology lock-in could limit adaptability to future innovations, while grid dependency creates potential vulnerabilities during peak demand periods or supply disruptions. Additionally, EVs may not optimally serve all transportation segments, potentially leaving gaps in decarbonization strategies for heavy-duty and long-distance applications.

More strategic approaches involve identifying limited near-term hydrogen investments focused on pilot programs and demonstration projects rather than broad infrastructure deployment. This strategy allows for technology maturation and cost reduction while preserving flexibility for future expansion if market conditions and technical performance justify broader adoption.

The optimal policy framework combines strong support for battery electric vehicle deployment with strategic flexibility for emerging technologies. Regulatory structures should establish technology-neutral performance standards while providing targeted incentives for early-stage technologies like hydrogen fuel cells in appropriate applications. This approach encourages innovation while avoiding premature commitment to specific technological pathways. Policy mechanisms should include **periodic technology assessments**, **performance benchmarking**, and **adaptive funding allocation** based on market evolution and technical progress.

Electrification Efforts to Date

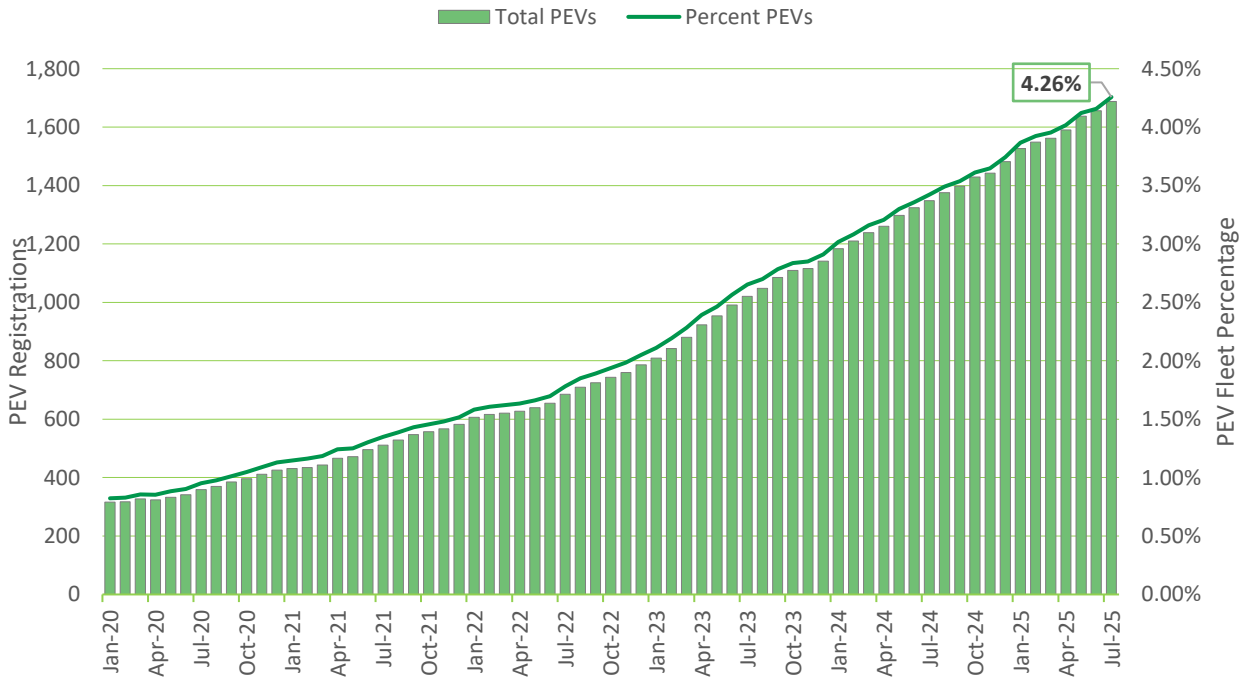
Dublin's history with electrification started with their first public charging station in 2012 at the Dublin Community Recreation Center. The station has two level 2 ports and charging is free for the public. At the time, the Public Utilities Commission of Ohio would not allow non-utilities to sell for electricity to the public. This has since changed and entities who are not Electric Distribution Utilities are allowed to re-sell electricity for EV charging. Dublin has continued to let users of Dublin-operated charging stations charge for free. Dublin's first EV fleet purchase was for four Nissan Leaf BEVs in 2018. Since then, the majority of Dublin's new alternative fuel fleet vehicles have been hybrids and a variety of heavy-duty CNG vehicles.

The City of Dublin fleet was awarded the Leading Public Fleet Award for Green Sustainability at the Advanced Clean Transportation Awards in 2018, having gone beyond what is required to achieve sustainability in their fleet operations. In 2021, the City of Dublin received the Ohio EPA Silver Level Encouraging Environmental Excellence in Communities (E3C) award, which recognizes communities with exceptional achievements in environmental stewardship. Later in 2023, Dublin was one of the first communities to earn the Gold Level award.

Dublin Trends

Dublin is ahead of the state, with about 4.26% of its registered vehicles being PEV as of July 2025, compared to the State's 1.12%. In the second quarter of 2025, 8% of vehicle sales in Dublin were electric. **Figure 7** shows the steady growth in the percentage of PEVs out of all vehicles registered in Dublin. As of July 2025, 1,688 vehicles out of the 39,648 registered vehicles in Dublin were PEVs.

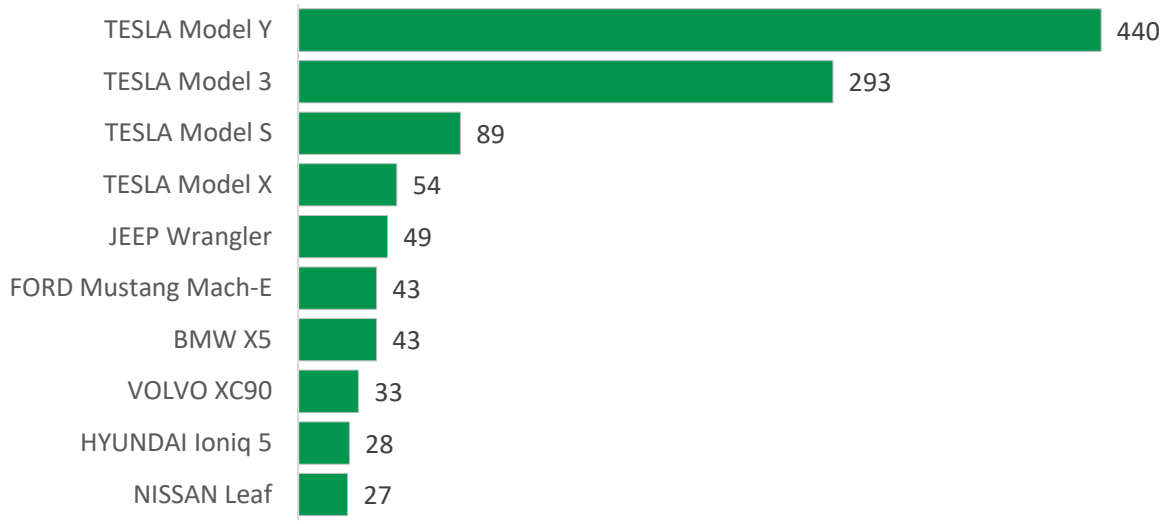
Figure 7: Total PEV Registrations and PEV Fleet Percentage in Dublin



Source: Ohio Alternative Fuel Vehicle Registration Dashboard, as of July 2025

Figure 8 shows the most popular EV makes and models that are registered in Dublin. Tesla is the most popular choice by far, taking four of the top five spots.

Figure 8: Top EV Registrations in Dublin



Source: Ohio Alternative Fuel Vehicle Registration Dashboard, as of July 2025

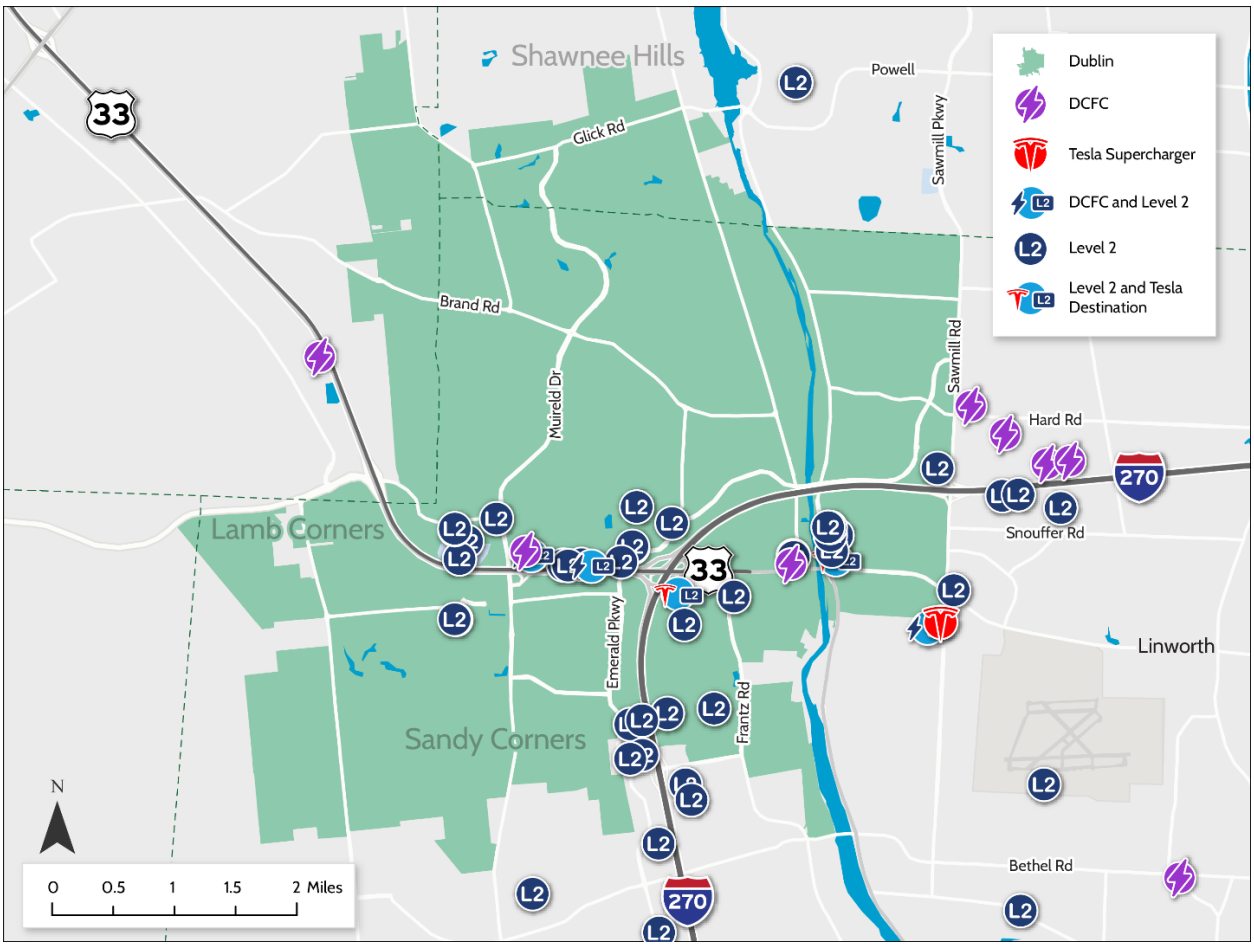
In terms of charging infrastructure, there are 113 publicly accessible level 2 ports and 6 DCFC ports in Dublin as shown in **Table 6**. These chargers are located mainly in proximity to I-270 and US-33, as shown in **Figure 9**.The City of Dublin owns and operates 19 of the level 2 ports and 2 of the DCFC ports as shown in **Figure 10**.

Table 6: Number of Publicly Accessible Ports by Ownership

OWNERSHIP	CHARGER TYPE	NUMBER OF PORTS
City of Dublin	Level 2	19
	DCFC	2
Private Development	Level 2	88
	DCFC	4
	Total	**113**

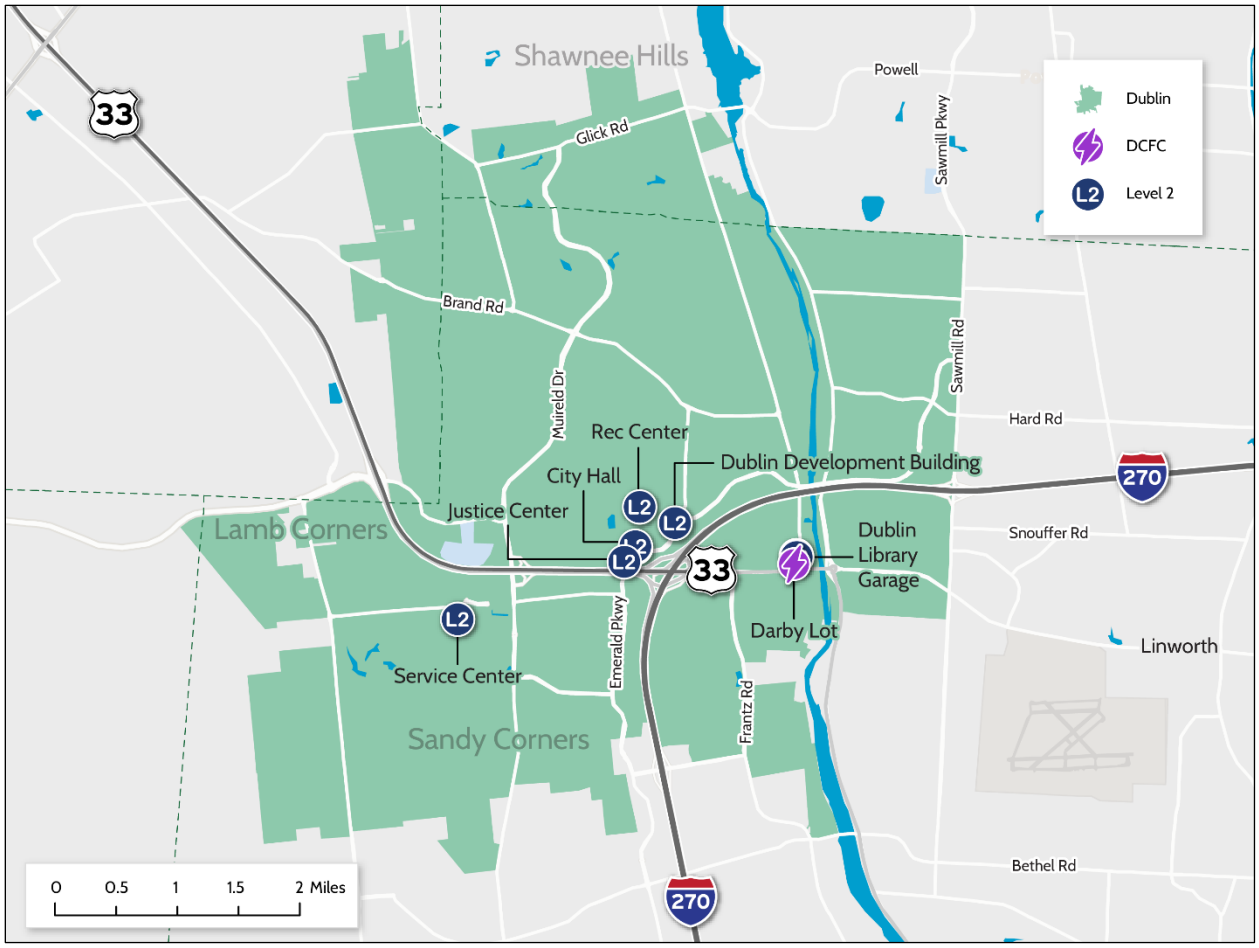
Source: AFDC, PlugShare, August 2025

Figure 9: Existing EV Chargers in and Around Dublin



Source: AFDC and City of Dublin

Figure 10: City of Dublin Owned Existing Chargers



Source: City of Dublin

Dublin Fleet

The Dublin vehicle fleet represents a diverse array of vehicles essential to the City's operations and services with a total of 218 vehicles that serve the municipality. The average model year for all vehicles is 2015 and the low average annual mileage of 5,289 miles reflects a modern and well-maintained fleet.

Table 7 lists the new vehicle purchases in 2023 that replaced existing vehicles, along with their associated costs, which total around a $1.4 million investment in alternatively fueled vehicles.

Table 7: Replacement and New Vehicles CIP 2023

VEHICLE	NUMBER	TOTAL
CNG F150 Ford extended cab trucks ($40,000 each) / CNG upfit ($14,000 each)	2	$108,000
CNG F450 Ford dump trucks ($60,000 each) / CNG upfit ($23,000 each)	2	$170,000
CNG F250 Ford four door trucks ($45,000 each) / CNG upfit ($16,000)	5	$305,000
Police hybrid interceptors ($70,000 each)	3	$210,000
Small police electric SUV	1	$60,000
CNG Freightliner plow trucks ($230,000 each)	2	$460,000
CNG Ford 4 door F350 with utility bed ($80,0000 each) / CNG upfit ($16,000 each)	1	$96,000
Rounding		$1,000
	Total 2023 Investment	**$1,410,000**

Source: City of Dublin

Table 8 lists the proposed vehicle replacements between 2024-2028 along with their associated costs, which total around a $1.3 million investment.

Table 8: Fleet Management Vehicle Request 2024-2028

VEHICLE	YEAR	VEHICLE AND FUEL TYPE TO BE ORDERED	COST
F450 Plow Truck, Used year round	2012	CNG 4x4 F450 Extended Cab Plow	$90,000
F450 Plow Truck, Used year round	2003	CNG 4x4 F450 Extended Cab Plow	$90,000
F450 Parks chipper truck, Used year round	2003	CNG 2x4 F450 Reg. Cab Dump Bed	$75,000
7400 International Snow Plow	2010	CNG Freightliner M2 Snow Plow	$260,000
7400 International Snow Plow	2011	CNG Freightliner M2 Snow Plow	$260,000
7400 International Snow Plow	2011	CNG Freightliner M2 Snow Plow	$260,000
Interceptor Dublin Police Detective Vehicle	2016	TBD	$60,000
Interceptor Police Front line	2014	Ford Hybrid Interceptor	$75,000
Interceptor Police Front line	2016	Ford Hybrid Interceptor	$75,000
Interceptor Police Front line	2016	Ford Hybrid Interceptor	$75,000
		Total 2024-2028	$1,320,000

Source: City of Dublin

Phased Fleet Electrification Approach

Vehicle procurement is aligned with Dublin's sustainability plan which emphasizes reducing or eliminating diesel and standard fuel vehicles from the City's light-duty fleet. This entails establishing and enforcing an EV procurement policy for new vehicles and phasing out non-EV or hybrid units, except in heavier classes where no viable EV alternatives currently exist. As Dublin continues its annual vehicle procurements, specifications should favor models that meet these criteria; for instance, an electric or hydrogen-powered snowplow might become available that allows the City to meet its sustainability

goals. Ford and other manufacturers are also likely to expand electrified police platforms as their lineups continue to electrify. Although the fleet's generally low mileage profiles make electrification operationally feasible, current market offerings tend to emphasize larger—and therefore more expensive—battery packs. Given the pace of technology and product evolution, the City should pursue a pragmatic transition rather than a uniform target: ***a 100% EV fleet is not recommended at this time; a diversified mix of EVs, hybrids, and select ICE vehicles where EV options are not yet viable will best balance sustainability, reliability, and total cost of ownership.***

Electrification of Mowing and other Maintenance Equipment

Dublin is advancing the transition of parks and recreation equipment to battery-powered solutions, building on the success of its autonomous electric mower pilot. The City should continue deploying battery-electric mowing equipment, prioritizing right-sized models where commercially available battery capacities can reliably support daily duty cycles. To maintain operational resilience, electrification of City-owned assets such as mowers and off-road equipment should be complemented by retaining a limited inventory of gas-powered units. This hybrid approach ensures continuity of essential services during grid outages while supporting long-term sustainability goals.

Fleet Charging Infrastructure and Management

Dublin should implement advanced charge management systems and integrate with smart grid technologies to optimize energy use and minimize peak demand costs. These systems enable real-time monitoring, load balancing, and prioritization of fleet charging. As the EV fleet expands, incorporating battery storage can help buffer grid impacts and provide backup power. Pairing this approach with solar-equipped carports will further enhance sustainability and operational resilience. Effective charge management also supports data-driven planning, allowing the City to anticipate infrastructure requirements and avoid costly utility demand charges. The City is already planning ahead, with solar-equipped carports and additional charging stations scheduled to support 32 vehicles by fall 2026.

Dublin-Owned Charger Usage Analysis

Dublin operates 19 level 2 ports across the City (12 of which are available for public use), and two public use DCFCs at the Darby lot in Historic Dublin. A year of charging data from the City's ChargePoint dashboard was examined, covering December 2022 to 2023, to understand usage patterns and help predict future needs. There were 18,907 transactions from 2,233 unique users. Transactions were reviewed to ensure the analysis included quality data. Drivers will sometimes initiate a charging session incorrectly and need to unplug then plug back in. A transaction was deemed unproductive if it lasted less than five minutes and delivered less than 0.15 kWh of energy.[12] This threshold represents a mere 1.8 kW of power, or about 25% of what would be expected of a typical level 2 charger. Of 18,907 transactions, 3,012 were deemed unproductive and not included in the analysis.

[12] Winn, "Electric Vehicle Charging at Work: Understanding Workplace PEV Charging Behavior to Inform Pricing Policy and Investment Decisions." https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/EV_Charging_at_Work.pdf

First, overall utilization of the public facing chargers was reviewed. **Table 9** lays out the active charging utilization rates versus the national utilization average rates. As shown, Dublin's utilization rates are significantly higher than the national average.

Table 9: Dublin Charger Utilization and National Averages

STATION NAME	# UNIQUE USERS / # SESSIONS	AVERAGE # OF SESSIONS PER PORT PER DAY	ACTIVE CHARGING UTILIZATION (2024)*	NATIONAL UTILIZATION AVERAGE (2024)**
Rec Center (Level 2)	148 / 925	5.2	**35%**	14.5%
City Hall (Level 2)	78 / 471	1.3	**23%**	14.5%
Dublin Library (Level 2)	617 / 1,696	3.1	**26%**	14.5%
Darby Lot #1 (DCFC)	285 / 1,061	11.8	**40%**	17.1%
Darby Lot #2 (DCFC)	312 / 1,112	12.4	**41%**	17.1%

**Active Charging Utilization describes when at least one charging port at the facility is delivering power and does not include idle time.*

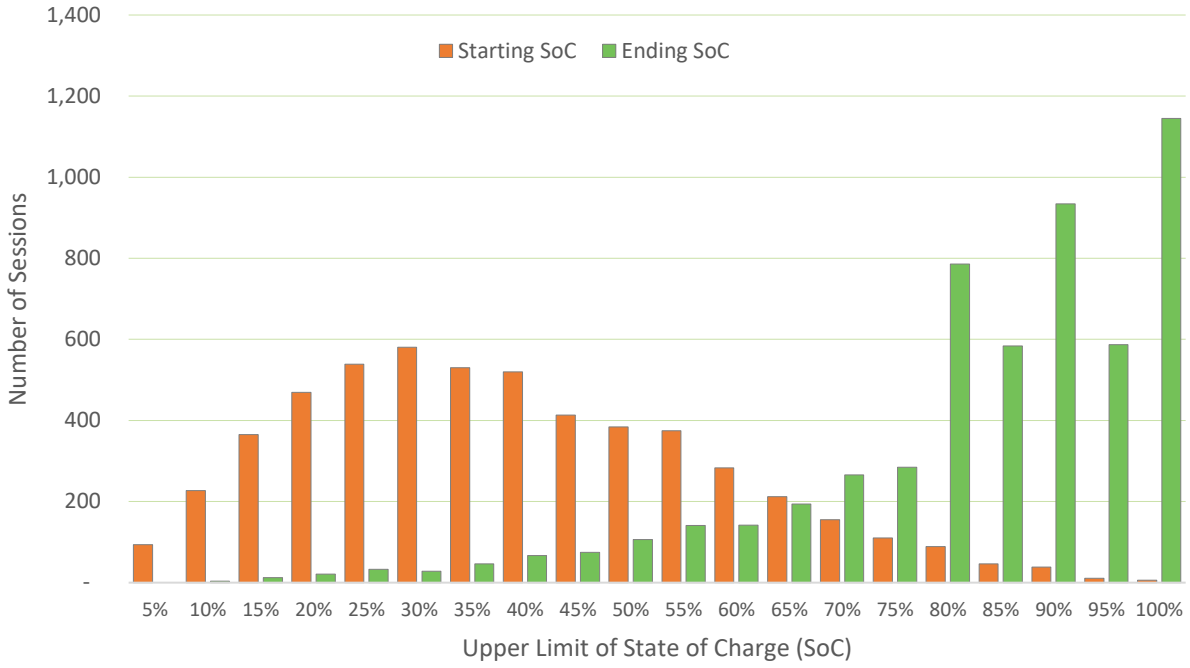
***National and Ohio utilization is defined as the % of time in a 24-hour day that each charger is plugged into a vehicle, regardless of whether that charger is actively dispensing power.*

Sources: Dublin Data from ChargePoint Dashboard, Feb 1 – April 30, 2024 and National and Ohio data from Stable: https://stable.auto/insights/electric-vehicle-charger-utilization-by-month.

Based on Dublin's ChargePoint data, utilization from February to April of 2024 is up approximately 100% from 2023 utilization. Industry opinion on what charger utilization rate threshold should trigger a discussion on adding additional chargers varies. For Dublin, a charger utilization rate reaching 30% or higher for three months is suggested as the time to discuss whether an expansion is necessary. Other factors helping to make that decision would be whether the three months were a spike due to a specific event or whether other stations are already planned to be built in the area to displace the need.

The starting and ending State of Charge (SoC) were examined for DCFCs (**Figure 11**). SoC is less critical for level 2s – it is commonly considered poor charging etiquette to leave a vehicle plugged into a DCFC beyond 80% SoC, but the expectation for level 2 chargers is that the vehicle will remain plugged in until it is full, which can take anywhere from a few hours to over a day, depending on the SoC, battery size, and power level. Charge speed on a DCFC falls off dramatically once 80% SoC has been reached. Charging over 80% can also harm the battery long-term. The data reveals that while many users plug in around 30% SoC, 60% of users remain plugged in beyond 80% SoC.

Figure 11: Starting and Ending State of Charge for DCFC Sessions



Source: City of Dublin ChargePoint Dashboard

Next, idle times by charger type were examined (**Table 10**). A vehicle is considered idling when it has stopped charging but remains connected to the charging station. One key limitation of idle time data is that the session ends when the vehicle is unplugged. This means users may have unplugged their vehicles but remained blocking the space. Interestingly, in contrast to the SoC analysis, most idle times are very short, especially for the DCFCs. 88% of DCFC sessions and 52% of level 2 sessions end within five minutes of charging completion. However, some vehicles, especially on the level 2 chargers, remain plugged in for a very long time after charging has finished.

Table 10: Idle Time by Charger Type

CHARGER TYPE	NUMBER OF SESSIONS	IDLE TIME
DCFC	4,802	<5 mins
	543	5-60 mins
	135	>60 mins
Level 2	5,370	<5 mins
	3,838	5-60 mins
	1,207	>60 mins

Source: City of Dublin ChargePoint Dashboard

Given the idle times, ending SoC, and lack of any fees for charging, Dublin should consider implementing fees for EV chargers. Fees will allow for an opportunity to offset the cost of electricity and instill better EV charging etiquette among users. Fees for charging are discussed further in Fees for EV Charger Use.

The Dublin City Council has adopted the 2024-2028 Five-Year Capital Improvements Program (CIP), which allocates $256 million dollars for new and existing infrastructure in the City. The 2024-2028 CIP includes $475k funding[13] for EV Charging Station Infrastructure for the City's growing fleet of EVs. The design for the EV charging stations was completed in 2023 and includes carport structures equipped

[13] https://city-dublin-oh-budget-book.cleargov.com/12774/capital-request/71042/view

with solar panels which protect the stations from snow and ice while also providing a renewable energy source for the chargers.

Additional CIP funding is proposed each year to support electric vehicle fleet purchases and the future buildout of EV charging stations both for Dublin's fleet and the public. Dublin has also dedicated significant personnel resources to furthering electrification efforts.

Fees for EV Charger Use

When EVs were first introduced, charging stations were often free to use and readily available as needed. However, as EVs become more common, this is changing. Chargers, especially DCFC in popular areas and during high travel periods, can be busy and require a driver to wait their turn. This is also common for gas pumps during high travel times but the turnover is much faster. Chargers can also be unavailable when EV drivers seek to charge their vehicle to 100%, as the last 10-15% charge can take a much longer time to complete. Charging to 100%, especially routinely on a DC fast charger, is also not recommended by vehicle manufacturers, as routinely charging to 100% can damage the battery through overcharging and overheating.

Charging fees can be based on the amount of energy used [measured in kilowatt-hours (kWh)], the time spent charging (measured in minutes), the time spent idling after charging, or a combination of all three. An informal survey of the Electrify America app for chargers in Ohio revealed a pricing structure based on energy usage. This typically includes additional fees if the vehicle remains connected after charging, known as idle fees. The cost per kWh ranged from $0.48 to $0.64, while idle fees were either waived or charged at $0.40 per minute after a 10-minute grace period.

The City of Bexley, Ohio charges an idle fee of $0.10 per minute after two hours of charging for the chargers near their city hall. However, most private companies charge at the higher end of the scale. If the fees are set too low, it may not deter drivers from occupying the charging stations longer than necessary.

Tesla also has a congestion fee of $1 per minute that is charged when a vehicle reaches 90% SoC. This is another tactic to turn over parking spots to the next vehicle. It's worth noting that EV drivers, particularly those who are accustomed to using public charging stations from well-known brands, are likely accustomed to these energy-based, idle and congestion fees.

Dublin's first chargers went live before state law changed to allow non-utilities to charge for electricity so they could only be provided free of charge. Not charging fees can also be a draw for employees and tourists. As the City expands its charger offerings and to respond to the congestion that could occur with more EVs on the road needing charging, **it is recommended that fees be considered for both energy usage and idling.** As these fees are considered, additional thought should be given to implementing unique discounts for residents versus non-residents or discounts for specific events that may draw in a lot of tourists.

By implementing charging fees for EV stations, drivers are incentivized to follow proper charging etiquette and move their vehicles promptly when finished, reducing unnecessary idling and ensuring fair access for all users.

Charging Infrastructure Needs

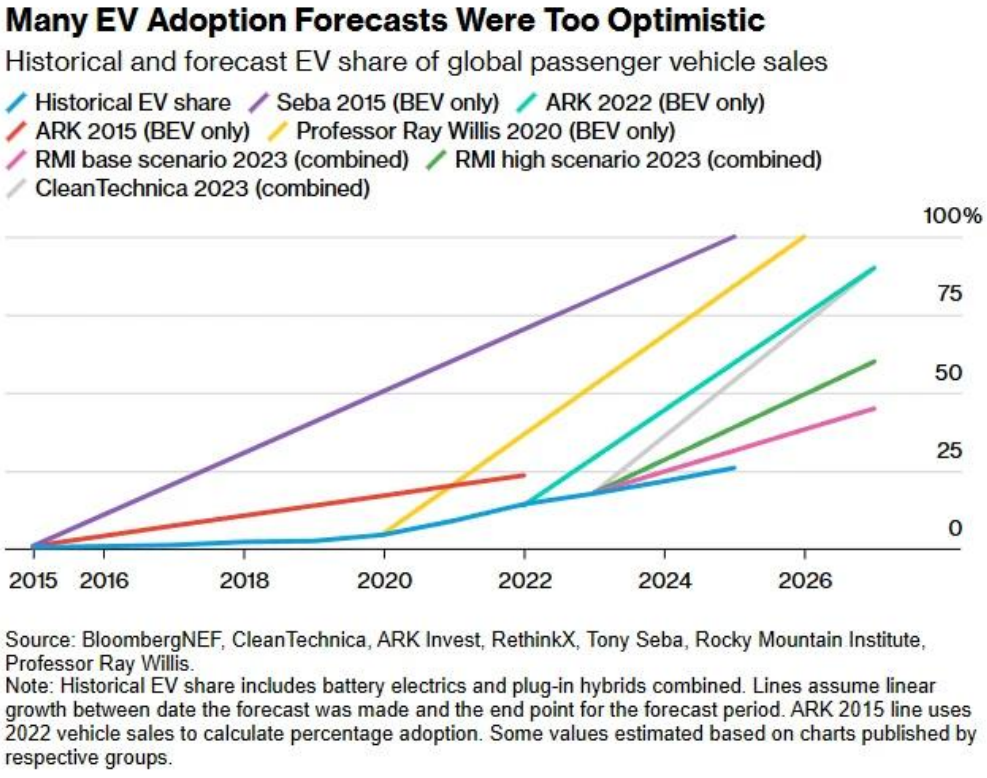
This section addresses several critical components: the projection of charging scenarios to estimate future EV registrations and corresponding infrastructure requirements, identification of recommended priority locations within the City of Dublin, an assessment of revenues and costs through a cost recovery framework, and the implementation of electrification best practices to guide both municipal and private development initiatives. The analysis is designed to provide a strategic plan for the deployment of efficient and effective EV charging infrastructure, ensuring the City of Dublin is well-prepared for continued growth in EV adoption.

Dublin's goal is to prioritize investments in strategic public charging sites that complement market deployments and fill critical gaps the private sector is not to ensure effective expansion of EV infrastructure for all residents and visitors.

Charging Projection Scenarios

It is important to acknowledge that projections for EV adoption have historically tended to overestimate actual growth (**Figure 12**). Over the past decade, numerous forecasts anticipated more rapid increases than what ultimately occurred. Given the current uncertainties within the EV market, the forecasting methodology for the City of Dublin has been refined to adopt a more conservative approach. This ensures that estimates for future EV registrations are realistic and that the City's investments remain prudent and well-aligned with actual demand.

Figure 12: EV Adoption Forecasts Over the Years



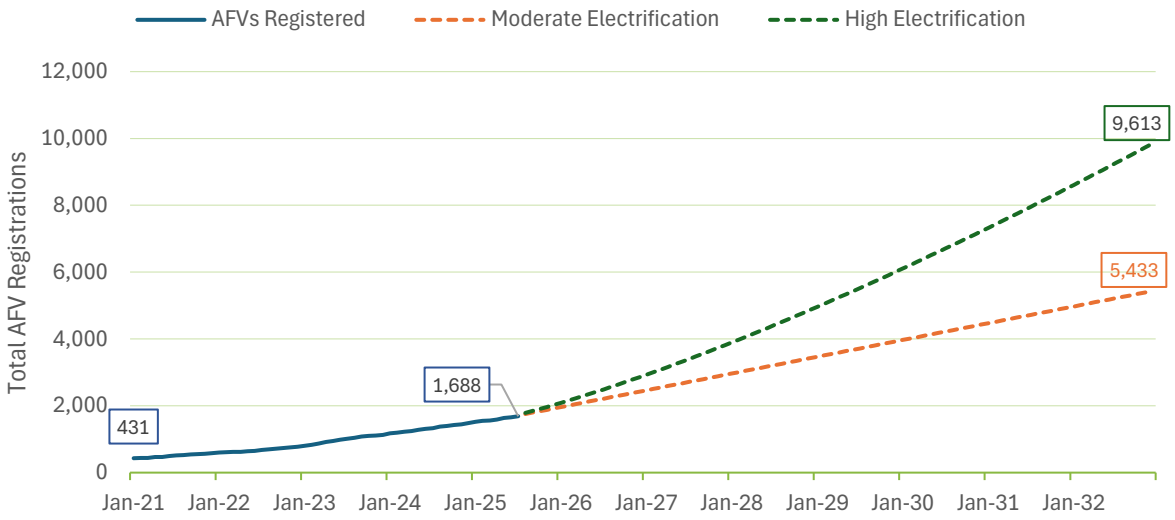
Source: BloombergNEF

As of July 2025, the City of Dublin recorded a total of 39,648 registered vehicles, with 1,688 classified as EVs. Over the previous year (July 2024 to July 2025), 358 new EV registrations were documented, indicating a steady growth in local adoption. To estimate future EV adoption, a linear forecast based on the most recent registration data suggests Dublin could reach approximately 4,200 EVs by 2032. However, given anticipated market developments, including the introduction of more affordable EV models and expanded public charging infrastructure, this projection may be too conservative.

Recognizing these factors, the analysis applies exponential smoothing—a time-series forecasting technique that places greater emphasis on recent trends. This method effectively mitigates short-term variations and reveals long-term patterns in EV adoption.

Taking into account both market uncertainty and Dublin's strong adoption momentum, a moderate electrification scenario has been identified. This scenario targets approximately **5,000 AFV registrations** in Dublin by 2032. With continuing market and technology advancements, it is reasonable to expect that around one-third of the city's households—out of roughly 18,000—will own an EV within this timeframe. This data-driven approach provides a robust foundation for planning future charging infrastructure.

Figure 13: Dublin AFV Registrations Forecast



Source: HNTB

This figure is used in the EV charging scenarios and the calculations summarized in **Table 11**, which details the ideal cumulative total EV charging station numbers including private sector and city investments. These scenarios are created by projecting how many EVSEs will be needed to support the total number of EVs. EVSE numbers include all level 2 and DCFC chargers, whether publicly or privately funded. However, it does not include chargers installed in private homes.

The recommended charging scenario for Dublin will need to be reassessed based on actual market trends due to how rapidly the EV market is evolving, but at this moment a moderately-high charging scenario for 2035 is recommended, with a 17 to 1 EV to EVSE ratio. This is recommended because of the high density of single-family homes in Dublin where most EV drivers will have the ability to charge at home, rather than relying on public charging.

Table 11: Dublin Electrification Scenarios - Low, Medium, and High (Including Private Sector and City Investments)

CHARGING SCENARIO	EV TO EVSE RATIO	EV TO EVSE RATIO SOURCE	EVSE NEEDED IN DUBLIN BY 2035
Low	37:1	McKinsey (Kampshoff et al. 2022)	135
Medium	26:1	NREL (June 2023)	192
Moderately-High	***17:1***	***Recommended EV to EVSE Ratio by 2035***	***294***
High	11:1	ICCT (Bauer et al. 2021)	454

Source: National Renewable Energy Laboratory (NREL) – Building the 2030 National Charging Network

Next, the number of each type of charger needed was reviewed – level 2 versus DCFC. In terms of the number of level 2 charging ports needed compared to DCFC ports, it is recommended to have a more conservative ratio in the Dublin area at around 20:1 level 2 to DCFC as shown in **Table 12**. This is recommended because Dublin already has a relatively low number of public level 2 ports compared to DCFC ports. Since Dublin is comprised of mostly residential and mixed-use areas, where most users will be parked for extended periods and not necessarily need rapid charging, a higher number of level 2 ports versus DCFC ports could serve most users. If grant funding for DCFC units does not become available, or if private sector deployment of DCFCs exceeds expectations, Dublin should consider reallocating its planned investment in DCFCs toward additional Level 2 chargers to better meet community needs.

Table 12: Dublin 2035 Electrification Recommendations (Including Private Sector and City Investments)

PARAMETER	VALUE
Projected Number of EVs in Dublin by 2032	5,000
Recommended EV to EVSE Ratio	17:1
Recommended Number of Public EVSE	294
Recommended Level 2 to DCFC Ratio	20:1
Recommended Public Level 2 Ports	280
Recommended Public DCFC Ports	14

Source: HNTB

Note that Dublin is already well on its way to reaching these targets with 107 existing public level 2 charging ports and 6 existing DCFC ports. **Table 13** shows targets for EVSE implementation to meet the 2035 recommendations. These will include EVSE funded by the City of Dublin and the private sector.

Table 13: Public Level 2 and DCFC Recommended Implementation Targets by Year (Including Private Sector and City Investments)

YEAR	LEVEL 2 PORTS	DCFC PORTS	TOTAL PORTS	INCREASE IN NUMBER OF PORTS
2023	83	6	89	-
2025 (Existing)	107	6	113	+24
2028	150	8	158	+45
2030	200	10	210	+52
2035	280	14	294	+84

Source: HNTB

Projected Costs

The installation of EV chargers incurs various costs. **Table 14** provides an estimate of the capital costs for deploying the chargers, broken down by charger type and charging scenario. A moderately high charging

scenario is recommended for Dublin. When this scenario is combined with a 20:1 ratio of level 2 to DCFC chargers, the projected total cost comes to approximately $5M.

It's important to note that these costs will not be borne by the City of Dublin alone. Rather, they represent the collective investment required from all parties involved in charger installation to achieve the stated charging infrastructure goal.

Assuming the City of Dublin is responsible for 20% of the total charging ports, it is recommended that the City install 36 Level 2 charging ports and 2 DCFC ports by 2035. This would represent a capital investment of approximately $1 million to support the adoption of EVs.

Implementation at this scale corresponds to the addition of **one to two new charging locations per year over the next ten years.**

Table 14: Estimated EVSE Capital Costs Through 2035 (Including Private Sector and City Investments)

EV PER EVSE	LEVEL 2 PER DCFC	ADDITIONAL LEVEL 2 NEEDED BY 2035	ADDITIONAL DCFC NEEDED BY 2035	LEVEL 2 CAPITAL COST ESTIMATE	DCFC CAPITAL COST ESTIMATE	TOTAL CAPITAL COST ESTIMATE
Low: Mckinsey 2022 (37:1)	20:1	27	1	$545,000	$135,000	$680,000
	12:1	23	5	$455,000	$945,000	$1,400,000
	3:1	0	39	$0	$7,020,000	$7,020,000
Med: NREL 2023 (26:1)	20:1	81	4	$1,628,000	$648,000	$2,276,000
	12:1	75	10	$1,500,000	$1,800,000	$3,300,000
	3:1	27	58	$540,000	$10,440,000	$10,980,000
Moderately-High (17:1)	**20:1**	**173**	**8**	**$3,460,000**	**$1,440,000**	**$4,900,000**
	12:1	169	19	$3,370,000	$3,330,000	$6,700,000
	3:1	95	92	$1,900,000	$16,560,000	$18,460,000
High: ICCT 2021 (11:1)	20:1	330	17	$6,606,000	$3,006,000	$9,612,000
	12:1	315	32	$6,303,333	$5,730,000	$12,033,333
	3:1	202	145	$4,033,333	$26,160,000	$30,193,333

Source: HNTB

***Note**: The capital cost estimate encompasses site preparation, utility upgrades, hardware, and installation. It is estimated that the capital cost for a level 2 port is approximately $20,000, while a 150 kW DC Fast port costs about $180,000 per **Table 16**. These figures do not account for ongoing operations and maintenance, electricity costs, or potential revenue generated by the charging stations. For further information, refer to the Cost Recovery Model.*

EV Charging Locations

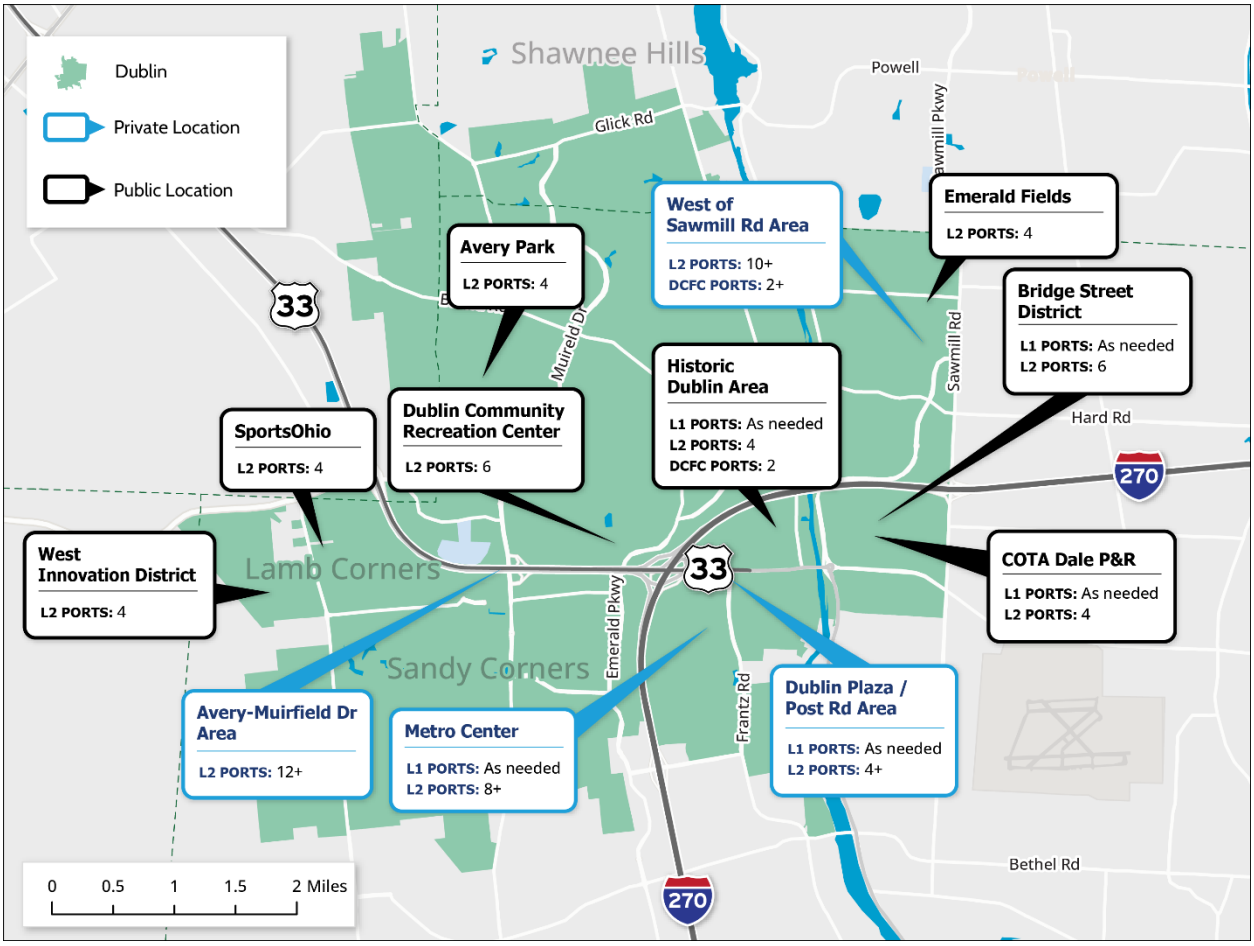
Figure 14 provides a detailed overview of the existing and the recommended locations for EV charging stations, including level 1, level 2, and DC Fast charging options across both public and private developments. These stations are strategically positioned based on existing and anticipated demand in traffic, tourism, and areas of growth as described in the Envision Dublin Community Plan.[14] These locations will help ensure accessible and convenient coverage to support the growing EV market in the area. The black callouts indicate the locations in Dublin suitable for public investment in publicly

[14] https://storymaps.arcgis.com/stories/775646484c58444e87f70a9bf507e6c6

accessible EV charging sites, while the blue callouts highlight key areas where private investment would be more appropriate.

Dublin is strategically targeting investment in 8 public EV charging sites by 2035, to complement other private sector investments and help ensure accessible and convenient coverage to support the growing EV market in the area.

Figure 14: Future EV Charging Location Recommendations



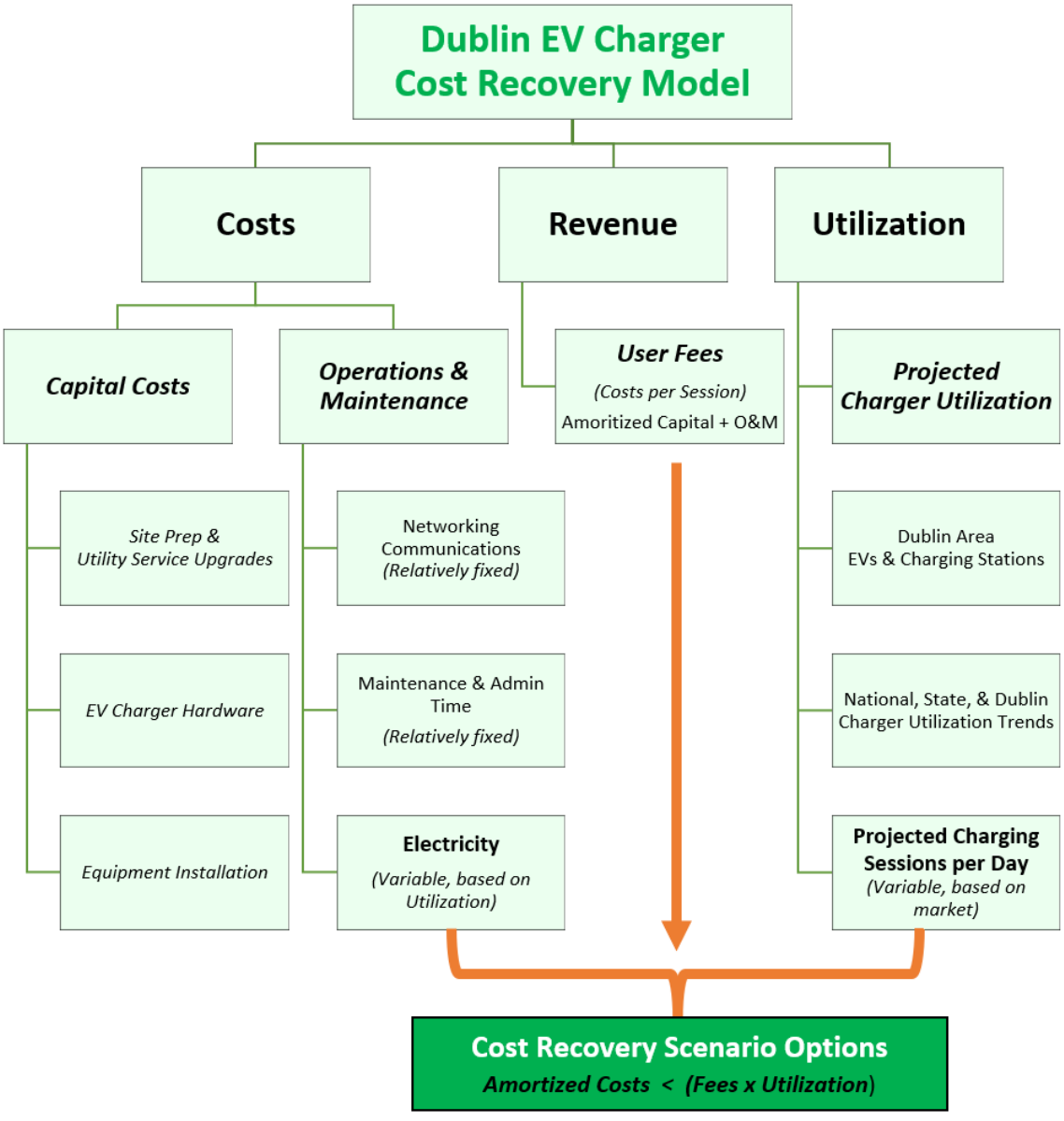
Source: HNTB

Cost Recovery Model

This cost recovery model evaluates the financial viability of EV charging infrastructure by comparing projected revenues against associated costs. Revenues streams include energy-based user fees and idle time charges, while costs encompass capital expenditures and ongoing Operations and Maintenance (O&M).

Dublin evaluated EV infrastructure costs across multiple dimensions including capital, electric, maintenance, and other expenses to ensure a holistic financial model.

Figure 15: Cost Recovery Model



Source: HNTB

EV Charging Station Costs

When deploying any EV charging station, several major cost categories must be factored in, including site preparation, utility upgrades, hardware purchases, installation costs, EV charging station management software, networking and data services, ongoing costs of electricity to power the EV charging station and EVs, and routine, preventative, maintenance costs as well as repair costs. These are detailed in **Table 15**.

Table 15: EV Charging Station Total Costs of Ownership – Categories and Components

CATEGORY		COMPONENTS
Capital Costs	Site Preparation	Includes trenching/boring, paving, lighting, ADA compliance, protective barriers (such as bollards), and landscaping.
	Utility Upgrades	Covers transformer upgrades, new meters, and service extensions.
	Hardware	Refers to the purchase of charging units (e.g., pedestal-mounted Level 2 or DCFC units).
	Installation	Encompasses labor, permits, materials, and inspections.
Operations & Maintenance	Software	Network management, user interface, payment processing, and smart grid integration.
	Networking	Connectivity costs (e.g., cellular data plans).
	Electricity	Power consumption based on usage and local utility rates.
	Maintenance	Routine servicing, part replacement, and software updates.

Source: HNTB

This analysis is structured to detail costs across four primary categories: capital costs, maintenance costs, networking costs, and the costs of the electricity to power the stations. **Table 16** provides a high-level per-port cost breakdown of the cost components for Level 2 and DC fast chargers. Costs are based on current, publicly available data, and are meant for high-level estimation purposes. Final costs and vendor fees are highly variable, requiring project specific quotes. Public chargers typically have a life cycle of 10 to 15 years, depending on utilization and environmental factors. Over this period, installation and operational costs can be reasonably recovered, and infrastructure needs can be reassessed as market conditions evolve. Replacement planning should account for new hardware, installation labor, and any necessary utility upgrades, all of which contribute to future capital costs.

Table 16: Summary of Estimated Costs by Port

CATEGORY	SUB CATEGORY	LEVEL 2 PORT	DCFC PORT
Capital Costs*	Planning & Oversight	~$4,000	~$35,000
	Site preparation & Labor (Utility upgrade, trenching)	~$7,000	~$55,000
	Hardware & Installation	~$9,000	~$90,000
Maintenance (Annual)	-	~$500-$1,500	~$3,000-$10,000
Networking (Annual)	-	~$500-$1,500	~$65-$625
****Electricity (Annual)**	-	~$311	~$18,020
Initial Investment (CAPEX)	**-**	**~$20,000**	**~$180,000**

Annual Total (OPEX)	**~$3,000**	**~$25,000**

Source: HNTB

**Includes administrative legal expenses, rights-of-way, appraisals, architectural and engineering fees, project inspection fees, site work, trenching and removal, construction, and equipment (pedestal, transformer, distribution panels & breakers, main circuit breaker, remote shutdown, pull boxes, and conduits, wiring, paint, bollards, etc.).*

***Electricity costs are detailed in **Table 17**.*

Utility costs for electricity to operate EV charging stations are highly variable, influenced by multiple factors including the type of charging station, utilization rates, and local utility pricing structures. Utility rates often include demand charges, especially for commercial and industrial customers such as EV charging stations. The scenarios below are based on specified assumptions and provide an example of annual electricity cost for Dual-Port Level 2 and Dual-Port DCFC EVSE.

Table 17: Estimated Electricity Costs Breakdown

CATEGORY	ONE DUAL-PORT LEVEL 2 STATION	ONE DUAL-PORT DCFC STATION
Service Schedule	AC Single Phase	Dual Phase 480V Service
Approx. Base Charge (Flat monthly fee on utility bill)	$10.21 Single Phase/$25.95 3-phase	$25.95 (3-phase)
Approx. Energy Rate	$0.13 / kWh	$0.10 / kWh
Demand Charges	None	$12.75 flat fee winter; $9.38 / kW summer
Reactive Power Charges	None	$0.003 / kVARh
Monthly Operating Cost	$52	$3,003
Annual Operation Cost (Dual Port)	$622	$36,039
Assumptions	160 kWh per month	796 kWh per month
Annual Operation Cost (Single Port)	**$311**	**$18,020**

Source: HNTB

Note: Table 17 presents electric costs only. For comprehensive costs, including networking and maintenance, refer to **Table 16. The estimates are illustrative and intended for reference purposes only. Updates may be necessary based on utility. This is provided as general guidance.*

Revenues

Dublin's first chargers went live before state law changed to allow non-utilities to charge for electricity so they could only be provided free of charge. As the City expands its charger offerings and to respond to the congestion that could occur with more EVs on the road needing charging, it is recommended that fees be considered for both energy usage and idling. Accurate revenue forecasting hinges on a comprehensive understanding of several interconnected factors:

1. **EV Adoption Rates and Regional Demand in Dublin:** The fundamental driver of charging revenue is the actual demand for EV charging, which is directly tied to the rate of EV adoption within Dublin and its surrounding region. Accurate predictions of regional EV charging demand are crucial and involve analyzing historical charging data, considering factors such as the current

number of EVs, their typical charging patterns, existing infrastructure availability, and external variables like weather conditions and time of day. Dublin's revenue projections must therefore carefully consider its own projected EV growth trajectory and how it aligns with these broader trends.

2. **Charger Utilization Rates (Benchmarking and Forecasting):** Utilization, defined as the percentage of time a charger is actively in use, is a direct determinant of revenue; higher utilization rates translate into increased revenue and improved ROI. For EV chargers to achieve profitability, a utilization rate of at least 17%[15] is typically required, though market leaders may achieve profitability with a slightly lower rate of 14%. However, observed average daily utilization can vary widely, from a low of 13% to a high of 47% across different fast-charging stations. It is important to note that a significant proportion of chargers, even in mature EV markets like the Netherlands, operate at a loss, with 20% of DC chargers exhibiting less than 1% utilization. Factors that influence utilization include the quality of the location (visibility, accessibility, proximity to amenities), the daily number of charging sessions, the average energy dispensed per session, and the level of competition from nearby charging options.

3. **Pricing Strategy and Competitiveness:** The chosen pricing strategy directly impacts revenue. Offering a competitive price per kWh or per session is essential to ensure that Dublin's chargers remain attractive compared to alternative charging options. The pricing model must strike a delicate balance between affordability for users and the need to cover operational costs and achieve revenue targets. Experimenting with different pricing models and continuously monitoring driver responses is key to identifying the optimal price point that maximizes revenue without deterring users. It is crucial to avoid extreme pricing: setting rates too low can undermine the financial sustainability of the charging stations, while rates that are excessively high can deter EV drivers. A thorough understanding of the local utility's energy pricing structure, including any demand charges during peak hours, is fundamental for developing an effective and profitable pricing strategy[16].

4. **Charger Reliability and Uptime:** The reliability and consistent uptime of charging stations are non-negotiable for revenue generation and customer satisfaction. Any downtime directly impacts revenue potential and erodes customer trust. A reputation for reliable chargers fosters repeat business, whereas frequent outages will deter usage and lead to negative perceptions.

5. **Location Quality and Accessibility:** The strategic selection of deployment sites is paramount for maximizing utilization and ensuring long-term profitability. EV drivers prioritize stations that offer minimal wait times and straightforward access. Sites that are poorly marked or consistently occupied are likely to experience reduced usage. The optimal location varies depending on the charger type.

As the City expands its charger offerings and to respond to the congestion that could occur with more EVs on the road needing charging, it is recommended that fees be considered for both energy usage and idling.

[15] https://kalibrate.com/insights/blog/electric-vehicles/utilization-passing-the-ev-charger-roi-test/
[16] https://www.pecnw.com/blog/how-to-forecast-revenue-for-ev-charging-stations/

According to Stable Auto[17], the national average estimated price of charging at DCFC stations is $0.45 per kWh, while in Ohio it is $0.40 per kWh. For Level 2 stations, the national average estimated price is $0.26 per kWh. Several pricing scenarios can be considered for EV charging, including low, moderate, and high pricing tiers.

Table 18: Pricing Scenarios

CATEGORY	PRICING [$/KWH]
Level 2	0.26 $/kWh
DCFC – Low Price	0.30 $/kWh
DCFC – Moderate Price	0.40 $/kWh
DCFC – High Price	0.50 $/kWh

Source: HNTB

Variations in charging utilization are notable and should be considered when evaluating operational scenarios. The following outlines low, moderate, and high utilization cases.

Table 19: Utilization Scenarios by Port Type

	NUMBER OF SESSIONS PER DAY [UTILIZATION %*]		
Category	**Low** [Utilization %]	**Moderate** [Utilization %]	**High** [Utilization %]
Level 2	1 session [16.67%]	2.5 sessions [40%]	4 sessions [66.7%]
DCFC	2 sessions [6.25%]	5 sessions [15.6%]	10 sessions [31.25%]

Source: HNTB
**Note: Utilization calculations are based on 45-minute DCFC fast sessions and 4-hour Level 2 sessions*

EV Charger Financial Model

The initial funding for acquisition of the EV charger infrastructure could consist of a mix of grants, city resources, and proceeds from financing. The use of equipment lease financing could be used to acquire the charging equipment with the source of repayment derived from user fee revenue. Equipment leasing offers the structuring flexibility and relatively low cost of borrowing that would complement the funding objectives of the EV Charger program.

The program will operate on a self-sustaining model. All budgetary and financial activity would be tracked in a separate enterprise fund established for the purpose of tracking program revenue and expenditures.

The revenue from user charging fees should be used to offset the full cost of equipment acquisition, operations and maintenance of the charging stations. The cost recovery would be designed in accordance with the City's cost recovery policy as reviewed and approved by City Council annually.

[17] https://stable.auto/insights/electric-vehicle-charger-price-by-state

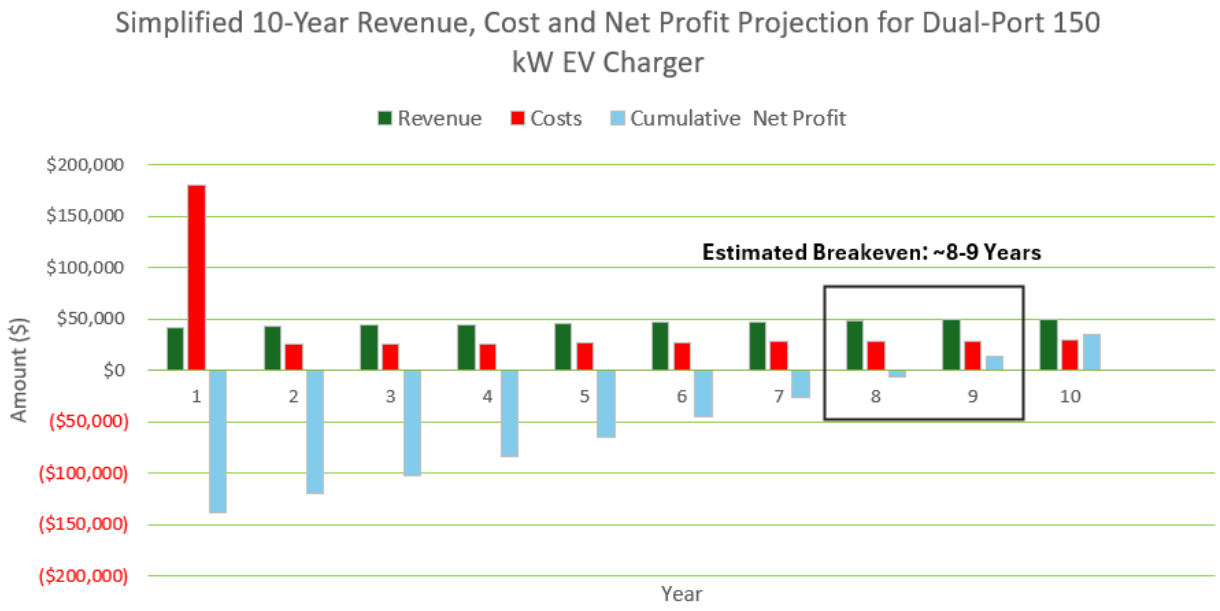
Breakeven Year Estimate

Based on different studies, it can take anywhere from 2 to 10 years for a DC fast charger to break even, depending on various factors such as initial investment cost, usage rates, and operating expenses. Some businesses might break even in 2-3 years, while others might take longer.

Assuming an average session of 60 kWh, with a moderate utilization (See **Table 19**) rate of five sessions per day (representing a 15% utilization rate), and a moderate pricing rate (See **Table 18**) of $0.40 per kWh with a projected 2% annual increase in both revenues and costs, the following summarizes a simplified 10-year cost recovery model for a 150 kW dual-port charging station. The analysis is based on 360 operational days per year at 97% uptime, and an initial capital investment of $180,000 (See **Table 16**). Under these parameters, annual revenues are estimated to range from approximately $40,000 to $50,000, while annual operating costs are projected to be around $25,000.

Estimated Annual DCFC Revenue (Dual-Port 150kW) = 5 [sessions] x 360 [days] x 97 [%] x 60 [kWh] x 0.40 [$/kWh]= **$41,904.**

Figure 16: Estimated Breakeven Year for a Dual-Port 150kW DC Fast Charger



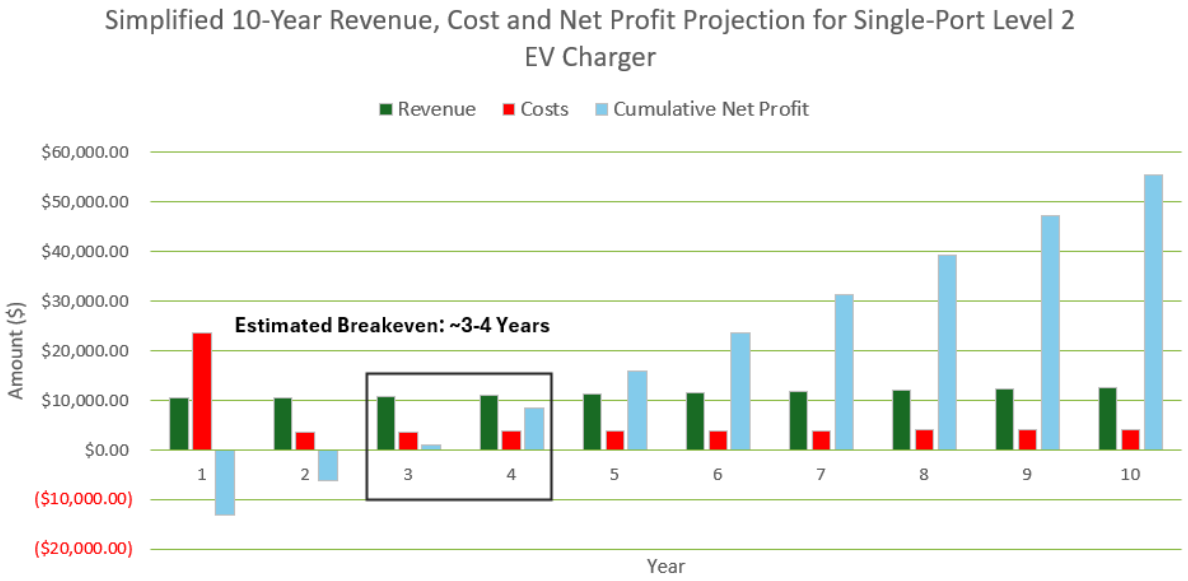
Source: HNTB

For a single-port Level 2 charger, with the assumption of an average session of 11.5 kWh at 2.5 sessions per day (equating to approximately 40% charger utilization daily), each session lasting four hours and delivering roughly 46 kWh, and a charging fee of $0.26 per kWh, the projected initial capital expenditure is $20,000 with annual operating expenses of $3,600. Assuming 97% uptime across 360 days of operation per year, the estimated annual revenue for the single-port charger is calculated as follows:

Estimated Annual L2 Revenue (Single-Port) = 2.5 [sessions] × 360 [days] × 97 [%] × 46 [kWh] × 0.26 [$/kWh] = **$10,441.**

Under these parameters, the simplified 10-year cost recovery model for a single port L2 charger is shown below:

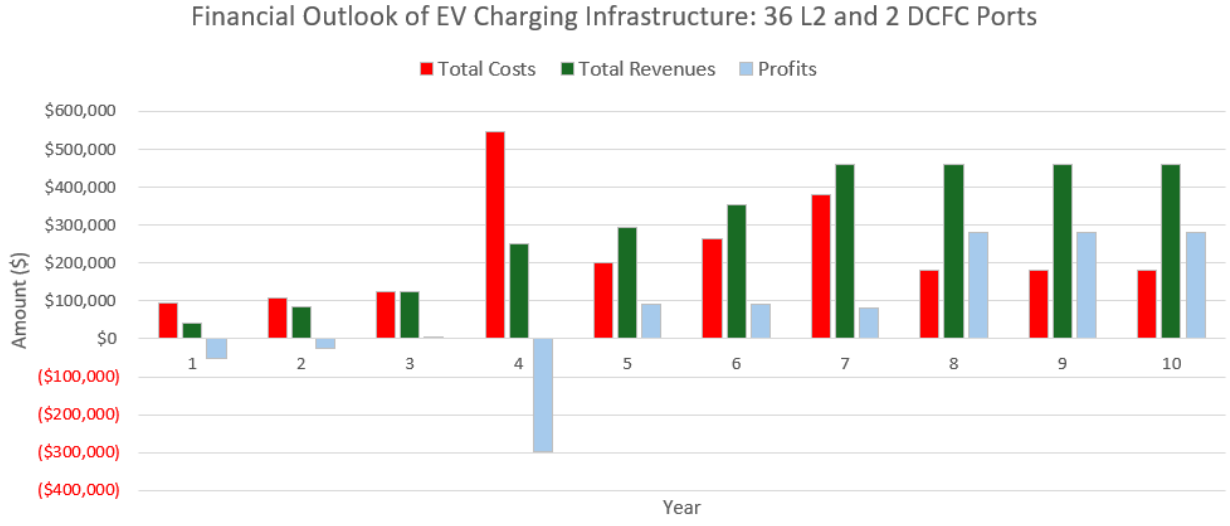
Figure 17: Estimated Breakeven Year for a Single-Port Level 2 EV Charger



Source: HNTB

Assuming the deployment schedule of two DCFC ports in Year 4, and the addition of four Level 2 ports annually starting in Year 1—with an increased rate of 6 ports in Year 6 and 10 ports in Year 7—the following analysis presents the projected revenue and cost outcomes for the planned installation of 36 Level 2 and 2 DCFC ports. This assumes moderate pricing, utilization, and adoption scenarios, with no idle fees. This deployment becomes profitable in Year 5.

Figure 18: Estimated Breakeven Year for a Phased Deployment of 36 Level 2 Ports and 2 DC Fast Ports



Source: HNTB

In light of the above analysis, Level 2 charging solutions present a clear, low-risk pathway for Dublin, offering reliable cost recovery and strong potential for positive returns, especially with phased deployment. While DC fast charging entails a greater financial commitment and inherently higher risk due to its upfront investment, the long-term prospects remain promising—both models are expected to

deliver not only a positive return on investment but also significant social benefits by promoting broader EV adoption.

By prioritizing publicly accessible facilities in its EV infrastructure strategy, Dublin positions itself as a leader and a model for other cities, demonstrating how thoughtful investment in charging stations can accelerate the transition to sustainable transportation and maximize community impact.

Electrification Best Practices

The working group reviewed the various ownership models and researched best practices for electrification from the City's perspective as a charging owner/operator and from the perspective of developers bringing EV chargers to the City.

The remainder of this section provides guidance for private developers on installing EV charging and best practices for contractual agreements for the City to own and operate chargers on their property. The recommendation is to continue contracting full services to third parties, as this approach minimizes costs, leverages skilled maintenance, and allows for flexibility in provider changes.

Ownership Models Analysis

The city must consider the impacts of EV charging station ownership models on capital outlay, ongoing O&M costs, and potential revenue before deploying chargers. Ownership types affect budget allocation, risk exposure, and infrastructure scalability. Understanding the trade-offs between financial investment and public benefit will help policymakers choose the best model for strategic sustainability goals.

Table 20: Ownership Models

CONSIDERATION	DUBLIN OWNS AND OPERATES	DUBLIN CONTRACTS WITH THIRD-PARTY FOR O&M SERVICES	THIRD-PARTY LEASES SITE FROM DUBLIN AND OWNS AND OPERATES
Capital Costs	$$$$$	$$$	$
Operations & Maintenance	$$$$$	$$$	$
Revenue	$$$$$	$$$	$
Conclusion	Higher Costs Higher Risks	Moderate Costs Moderate Risks	Lowest Costs Lowest Risks

Source: HNTB

Contracting with a **third-party vendor for full-service EVSE** delivery offers Dublin a balanced approach to infrastructure deployment. This model reduces the City's capital and operational expenditures while leveraging vendor expertise for installation, maintenance, and customer service. Although direct revenue may be lower compared to City-owned models, this approach aligns with Dublin's goals of enhancing public amenities and accelerating EV adoption. It also shifts operational risks to specialized providers, allowing City staff to focus on strategic priorities. Partnering with experienced vendors can expedite deployment timelines and ensure high-quality service standards across the network. In order to implement this model, the next step should be to develop a framework to implement user fees, operations and policy considerations to create a plan to establish the structure of the program.

City of Dublin

Table 21 presents best practices that the City of Dublin should consider when operating EV charging infrastructure on Dublin-owned property.

Table 21: Key Considerations for the City of Dublin

CATEGORY	BEST PRACTICES	DESCRIPTION
Accessibility	Scalability	Prioritize EV charging management system capabilities that meet the growing demands of handling more drivers, chargers, and transactions.
	Compatibility	Deploy chargers that are compatible with the highest number of EVs on the market and ensure interoperability with various EV models by accommodating the appropriate connector standards (such as CCS, or NACS standards).
	Code Changes	Enact code changes that allow the City to enforce EV charging only parking spaces.
	Visibility	Ensure EV drivers can easily locate the EV chargers upon entrance to the property through appropriate ground or sign markings.
	Fleet Management Capabilities	Ensure the EV charging infrastructure is optimized to fulfill the charging needs of employee drivers and fleet managers, including automatic notifications via smart connections to promptly address maintenance issues.
Standards and Integration	Data Security and Privacy	Implement robust data security measures to protect user data and privacy, in compliance with applicable regulations.
	Customer Support	Specify the provision of reliable customer support services, including 24/7 assistance and responsive maintenance teams.
	Charging Management	Require that EV charging systems notify users via app or SMS when charging is complete. This encourages timely vehicle removal, improves charger availability, and supports better etiquette at public charging sites.
	Pricing Transparency	Ensure a transparent procurement and charging pricing process. All vendors will be required to make an API available for free to third party software developers to share this information.
Sustainability and Future-Proofing	Smart Grid Integration	Promote integration with the local smart grid to optimize charging schedules and reduce strain on the electrical grid during peak times.
	Community Engagement	Include provisions for community engagement and feedback mechanisms to address concerns and ensure charger locations are well received by residents.
	Compliance and Reporting	Set up regular reporting and compliance checks to ensure that contractors meet the terms of the agreement and adhere to City standards.
	Futureproofing	Consider future technologies and standards, ensuring that the contract allows for upgrades and adaptations as the EV charging industry evolves.
	Incentives for Renewable Energy	Explore incentives for contractors to invest in renewable energy sources and energy storage solutions to reduce environmental impact.
Pricing	Stay Up to Date with State Law	An entity providing EV charging services is not considered a public utility. Pricing by kWh and time are both permitted, with per kWh gaining more popularity and being perceived as fairer. Costs around $0.50/kWh are common for privately owned DCFC. Ohio currently collects EV, PHEV, and Hybrid registration fees to supplant or replace gas tax revenue, but these fees are not being shared with municipalities.
	Charging For Usage	Set up fees to recoup energy costs and encourage good etiquette. Specific recommendations are discussed in Fee and Code Considerations.

CATEGORY	BEST PRACTICES	DESCRIPTION
	Demand Charges	Low utilization of high-power chargers can impose high demand charges.[18] Be careful not to over-build DCFCs to keep utilization high. Inconsistent or "peak" usage will incur higher fees from the utility. Talk to the utility about EV-specific rates that may exist.
	Fees for Behavior Change	Imposing idle fees once charging has substantially completed encourages turnover. Drivers have come to expect fees, and pricing this scarce resource accordingly will become more critical. Flat idle fees in the range of $0.40 - $1.00 per minute are common for DCFCs but using an escalating fee may produce better results. Tesla offers a tiered system where the fee is dynamically adjusted based on congestion at the Supercharger and the vehicle's SoC.[19]
	Equity	Outreach to people who don't have charging at home is recommended to ensure that pricing strategies do not exclude these groups. Lower-income populations are less likely to have access to home charging, a double-edged sword – higher prices will affect them disproportionately, but higher turnover of spaces could be a benefit to a group that doesn't otherwise have access.

Source: HNTB

[18] Electricity Cost for Electric Vehicle Fast Charging (nrel.gov)
[19] https://www.tesla.com/support/charging/supercharger/fees

Private Development

From offering EV charging as an incentive for employees to adding an EV charger to their place of business as a new revenue source, private businesses and developers of various types are seeing the electrification of vehicles impact their day-to-day decisions.

The City of Dublin takes an active role in partnering with businesses who choose Dublin as their home and wants to continue to offer that partnership as Dublin's EV charging network is built. This includes creating public-private funding mechanisms to promote the installation of new EV charging stations, particularly in multi-family residences and commercial developments.

Table presents best practices for private developers to implement when installing EV chargers. It is recommended that these best practices be shared on an electrification webpage, serving as a resource to guide effective and efficient charger installations and promote broader adoption of EVs.

Table 22: EV Charging Best Practices for Private Developers

CATEGORY	BEST PRACTICES	DESCRIPTION
Physical Space	Easy Access	Place EV chargers in well-lit, well-marked and easily accessible areas, such as near parking lot entrances and exits. This will make it easier for drivers to find and use the chargers.
	Location Convenience	Place EV chargers in locations that are convenient for users, such as near shopping centers, workplaces, and residential areas to encourage more people to use the chargers.
	Site Aesthetics	Ensure that the placement of EV chargers is carefully considered to preserve the site's visual appeal while still providing convenient access to charging stations.
Electric Utilities	Early Coordination	Coordinate with the local electric utility company early in the planning process to ensure that there is sufficient electrical capacity to support the EV chargers.
	Site Improvements	Determine if any utility upgrades such as system upgrades, distribution work, or new service work are needed and the associated costs.
	Separate Metering	Request separate metering for EV chargers to appropriately pass along electricity charges and to receive better data on electricity usage. Separately metering charging load, either with a separate meter or submetering equipment, is necessary for functions such as billing EV drivers based on usage, administering different rates, collecting charging data, and excluding charging load from demand charge calculations from the rest of the building.
	Permits and Licenses	Obtain all necessary permits and licenses from the City of Dublin to ensure that the EV chargers are in compliance with all applicable laws and regulations.
Site Feasibility	Pull-Through Spots	Prioritize pull-through spots for more efficient use of charging and to address the needs of medium and heavy-duty vehicles.
	Amenities	Install chargers near amenities such as restaurants, restrooms, seating, and vending machines.
Safety and Security	Fire Safety	Comply with all applicable fire safety codes and regulations.
	Remote Shutoff	Equip the EV chargers with remote shutoff capability, so that they can be turned off in the event of an emergency.
	Cybersecurity Measures	Implement cybersecurity measures to protect against unauthorized access and data breaches.

CATEGORY	BEST PRACTICES	DESCRIPTION
	Locked Cabinets	Store the EV charging equipment in locked cabinets to prevent theft and vandalism.
	Vandalism Resistance	Choose EV chargers that are vandalism resistant. This includes features such as heavy-duty construction, security cameras, and motion sensors.
	Cameras	Consider installing cameras at the EV charging station to improve safety.
	Lighting	Install adequate lighting at the EV charging station to improve visibility and safety.
Accessibility	ADA Compliance	Make sure that the EV charging station is accessible to people with disabilities., taking into consideration guidelines provided by the U.S. Access Board[20] for inclusive design.
	Maintenance	Establish a regular maintenance schedule for the EV charging station to ensure that it is in good working order. This includes inspecting the equipment for damage and making any necessary repairs.

Source: HNTB

Electrification Recommendations

This section provides actionable insights for stakeholders at various levels, detailing how to navigate the evolving landscape of EVs and EV charging infrastructure. These core recommendations provide a roadmap for making informed decisions and investments in the electrification journey.

Charging Infrastructure Deployment

Short-term Recommendations (2026-2027)

A **Annually review charger deployment locations and needs** through the Capital Improvement Program process, programming new equipment as funding and project priorities allow.

As part of this review, apply a standard of 30% average usage sustained over a three-month period to determine when to consider adding chargers at existing locations, while also evaluating usage data in the context of nearby events that may skew results and incorporating any public feedback about the site.

WHO'S INVOLVED: *Facilities, Transportation and Mobility, Deputy City Manager, City Manager*

Medium-term Recommendations (2028-2030)

B **Update projections every 2 years** to check adoption, regulation, funding changes, etc.

WHO'S INVOLVED: *Transportation and Mobility, Planning, Facilities, Data and Analytics*

[20] https://www.access-board.gov/ta/tad/ev/

Long-term Recommendations (2030-2035)

C	**Reassess needs** based on changes in EV technology, adoption rate, and private charging availability.	**WHO'S INVOLVED:** *Transportation and Mobility, Planning, Data and Analytics*

Planning and Zoning Codes, Building Standards

Short-term Recommendations (2026-2027)

A	**Evaluate the zoning code** to facilitate the installation of EV charging infrastructure by assessing current codes, requiring EV-ready parking, and ensuring a percentage of spaces in new parking lots and garages are EV-ready in upcoming code updates. This effort should include encouraging new homes to be constructed with 220V electrical lines to support Level 2 chargers and developing solutions for renters in multi-unit housing.	**WHO'S INVOLVED:** *Transportation and Mobility, Planning, Engineering*
B	**Use the U.S. Access Board Design Recommendations** for ADA accessible vehicle charging stations. This entails recommending a percentage of spaces to be ADA accessible ensuring inclusivity and accessibility.	**WHO'S INVOLVED:** *Transportation and Mobility, Planning, Engineering, Facilities*

Medium-term Recommendations (2028-2030)

C	**Create educational materials for development projects, establish clear guidance for EV readiness once changes in the zoning code are complete, and offer** options for varying levels of development, from basic readiness to comprehensive charging infrastructure.	**WHO'S INVOLVED:** *Planning, Communications and Marketing, Transportation and Mobility, Economic Development*

Long-term Recommendations (2030-2035)

D	**Work collaboratively with housing developers** as project proposals are submitted to request accommodating the evolving needs of EV charging infrastructure.	**WHO'S INVOLVED:** *Planning, Economic Development, Transportation and Mobility*

Partnerships

Short-term Recommendations (2026-2027)

A **Continue to collaborate with MOPRC** to identify new collaboration opportunities. This should include participating in the Central Ohio Charging Smart Cohort and seeking Gold status in the Charging Smart Program and new granting opportunities.

WHO'S INVOLVED: *Transportation and Mobility, Economic Development, City Manager's Office, MORPC*

Medium-term Recommendations (2028-2030)

B **Continue collaboration with** neighboring jurisdictions and MORPC to identify partnering opportunities.

WHO'S INVOLVED: *Transportation and Mobility, Utilities, MORPC, Neighboring Jurisdictions*

Long-term Recommendations (2030-2035)

C **Further coordinate with regional partners** to review the network of EV charging stations in the area, so that Dublin remains connected to neighboring communities.

WHO'S INVOLVED: *City Leadership, Transportation and Mobility, Regional Municipalities*

Education and Outreach

Short-term Recommendations (2026-2027)

A **Conduct public outreach** to understand community needs and share Dublin's plans. Then, use the findings to create an educational campaign that promotes EV benefits, incentives, new technologies, best practices, and EV etiquette.

The medium-term recommendation under Planning and Zoning should build upon this effort as the foundation for developing the necessary materials.

WHO'S INVOLVED: *Transportation and Mobility, Communications & Marketing with input from local community partners*

Medium-term Recommendations (2028-2030)

B **Work with Visit Dublin Ohio** to update their tourism information to include information on EV charging.

WHO'S INVOLVED: *Transportation and Mobility, Communications & Marketing, Local Community Organizations*

Long-term Recommendations (2030-2035)

C	**Reassess public education and outreach needs** as EV technology advances.	**WHO'S INVOLVED:** *Transportation and Mobility*

Dublin Fleet

Short-term Recommendations (2026-2027)

A	**Pursue light-duty vehicle conversions and conduct ongoing assessment of fleet needs** in alignment with the recommendations of the *Dublin Sustainability Plan*.	**WHO'S INVOLVED:** *Transportation and Mobility, Facilities and Fleet Management*
B	**Continue to meet with local government fleet management teams** to discuss ideas and best practices around procurement and management of EVs and chargers.	**WHO'S INVOLVED:** *Transportation and Mobility, Facilities and Fleet Management*

Medium-term Recommendations (2028-2030)

C	**Evaluate light duty fleet vehicles** that have demanding duty cycles with EVs of PHEVs to assess if operational needs are met.	**WHO'S INVOLVED:** *Transportation and Mobility, Facilities and Fleet Management*

Long-term Recommendations (2030-2035)

D	**Carry out the Dublin Sustainability Plan's** recommended implementation to identify infrastructure needs to increase EVs and equipment within parks and facilities maintenance.	**WHO'S INVOLVED:** *Transportation and Mobility, Facilities and Fleet Management*
E	**Reassess fleet needs.** Fleet needs and vehicles available to fill those needs will continue to change over time so a regularly scheduled reassessment of needs around the capital budget process is needed. Continue to actively pursue light-duty vehicle conversions as contained in the Dublin Sustainability Plan's recommendations.	**WHO'S INVOLVED:** *Transportation and Mobility, Facilities and Fleet Management*

Funding

Short-term Recommendations (2026-2027)

A	**Explore available external state and federal grants and incentives** for EV charging infrastructure and develop a strategy to secure funding. Engage with other governmental agencies on partner opportunities to develop regional grant applications. Consider priority federal grants such as the National Electric Vehicle Infrastructure (NEVI) Program.	**WHO'S INVOLVED:** *Transportation and Mobility, City Manager's Office, Transportation & Mobility*

Medium-term Recommendations (2028-2030)

B	**Incorporate dedicated funding within the ongoing five-year CIP** to support the expansion and maintenance of EV charging infrastructure, while actively monitoring federal, state, and utility grant opportunities as funding availability and project priorities allow.	**WHO'S INVOLVED:** *Transportation and Mobility, City Finance Department, City Council*
C	**Collaborate with developers and utility providers** to ensure that proposed projects are supported with adequate electrical infrastructure to maximize economic development opportunities.	**WHO'S INVOLVED:** *Transportation and Mobility, City Economic Development Department*

Long-term Recommendations (2030-2035)

D	**Explore public-private partnership opportunities for** EV infrastructure investments to reduce the burden on the City's budget.	**WHO'S INVOLVED:** *Transportation and Mobility, City Economic Development Department, Private Sector Partners*

Fee and Code Considerations

Short-term Recommendations (2026-2027)

A **Create a robust financial and operational implementation roadmap including the development of an enterprise fund and sustainable fee structures.**

B **Develop a framework to implement user fees, for both DC fast chargers (DCFC) and Level 2 chargers,** to recover electricity costs and promote sustainable use. This includes implementing higher or idle-time fees for DCFC to encourage turnover after reaching an 80% state of charge while recognizing that idle fees for Level 2 chargers may be less critical due to lower demand and usage patterns. To align with Dublin's goals—recovering costs while promoting proper EV charger usage—it is advised to avoid setting prices too high or too low and to use these average rates as a guideline: $0.26/kWH for Level 2 charging and $0.40/kWh for DC Fast charging.

WHO'S INVOLVED:
City Council, City Manager's Office, Transportation & Mobility, City Finance Department, City Engineer

Medium-term Recommendations (2028-2030)

B **Consider policy and code updates to deter** non-compliant parking at EV charging stations. This includes measures to prevent internal combustion engine vehicles from occupying EV-designated spaces and to discourage EV drivers from parking without actively charging. Such policies will help ensure fair access to charging infrastructure and promote responsible usage.

WHO'S INVOLVED:
City Planning Department, Transportation and Mobility

Long-term Recommendations (2030-2035)

C **Keep up with maintenance**, make sure fees are accomplishing the intended goals.

WHO'S INVOLVED:
City Manager's Office, Transportation & Mobility, City Finance Department

Future Considerations

Alongside the electrification recommendations, these future considerations provide additional opportunities to support continued progress in advancing EV infrastructure.

Future Considerations

- **Meet with large, private employers** to understand their roadmap on offering EV chargers for employees, including incentives such as front row parking.
- **Meet with new businesses interested in moving to or expanding in Dublin** to discuss their plans to add employee EV charging to parking areas.
- **Seek partnerships with businesses** to expand the network of public and private charging stations.
- **Update projections every 2-3 years** to check adoption, regulation, funding changes, etc.
- **Through coordination meetings with utility companies,** inquire about their challenges and needs regarding managing grid load and capacity to align sustainability efforts and to share Dublin's plans and goals to understand level of effort for deployment.
- **Develop community outreach materials** that provide information for diverse populations, ensuring equitable awareness and knowledge sharing about EVs and charging infrastructure.
- **Provide educational materials at various City-hosted events,** such as the State of the City, Homeowners Associations Leadership meetings, etc.

Appendix A – Existing Conditions

HNTB

CITY OF DUBLIN, OHIO
EXISTING ELECTRIC VEHICLE CHARGING CONDITIONS

December 1, 2023

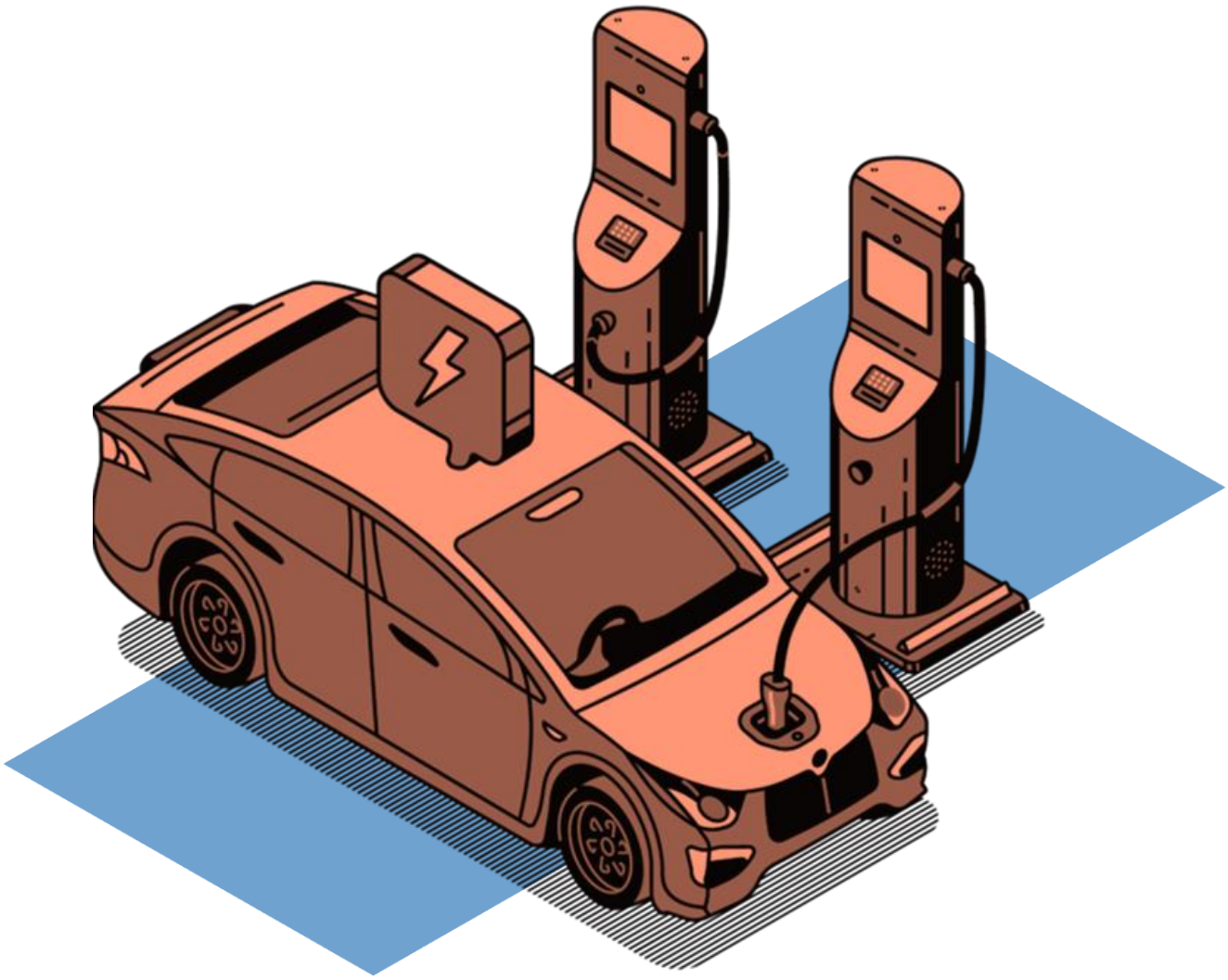


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Table 1: Acronyms

ACRONYM	DEFINITION
AADT	Annual Average Daily Traffic
AC	Alternating Current
AFDC	Alternative Fuel Data Center
AFV	Alternative Fuel Vehicle
BEV	Battery Electric Vehicle
BMV	Bureau of Motor Vehicles
CCS	Combined Charging System
CFI	Charging and Fueling Infrastructure
DC	Direct Current
DCFC	Direct Current Fast Charging
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FCEO	Franklin County Engineer's Office
GHG	Greenhouse Gas
ICE	Internal Combustion Engine
L1	Level 1
L2	Level 2
MORPC	Mid-Ohio Regional Planning Commission
NACS	North American Charging Standard
NEVI	National Electric Vehicle Infrastructure
NREL	National Renewable Energy Laboratory
ODOT	Ohio Department of Transportation
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
SOC	State of Charge
SWOT	Strengths, Weaknesses, Opportunities and Threats
TRC	Transportation Research Center
USDOT	United States Department of Transportation

1 INTRODUCTION

Dublin, Ohio, aspires to be the most sustainable, connected and resilient global City of choice through state-of-the-art infrastructure, convenient transportation and expansive broadband access. With a 100-gigabit fiber network, strategic private and public partnerships, and significant investments in innovation, Dublin is emerging as a global leader providing an ecosystem for companies to beta test new technologies. Dublin is working to "improve lives, drives and experiences" by embracing the significant shift in the automotive industry towards sustainability. Recognizing the potential of electric vehicles (EVs) to reduce carbon emissions and dependence on fossil fuels, Dublin has actively engaged in fostering the adoption of EVs and the development of necessary charging infrastructure.

This report compares the existing electrification conditions in Dublin with national and international trends to set the foundation for the development of a comprehensive implementation plan for transportation electrification in Dublin. The implementation plan will serve as a guide for future EV activities and a resource for future land use and transportation planning for the Dublin Development and Public Works Departments.

2 EV MARKET TRENDS

The EV market is witnessing a dynamic transformation in both its buyer demographics and market factors. Initially, the typical EV buyer was characterized as men over the age of 55, but the market has seen a shift towards millennials, followed by Gen X men, with over 70% of EV buyers being male compared to 60%[1] for all vehicle purchases. Higher gas prices and exposure to EVs have led to increased consideration among prospective buyers, and the profile is skewing towards the more affluent, though there is a noticeable movement towards mass-market buyers, as evidenced by the average EV buyer credit score dropping from 800 in 2019 to 788 in 2022.[2]

Driving the EV market are a variety of factors including stringent emissions standards, attractive incentives, increasing vehicle availability, improvements in battery technology, a preference for the unique EV driving experience, fluctuating fuel prices, association with other EV owners, and the increasing availability of charging infrastructure. These interconnected elements reflect a market that is maturing and diversifying, catering to a broader segment of the population and adapting to the changing transportation landscape.

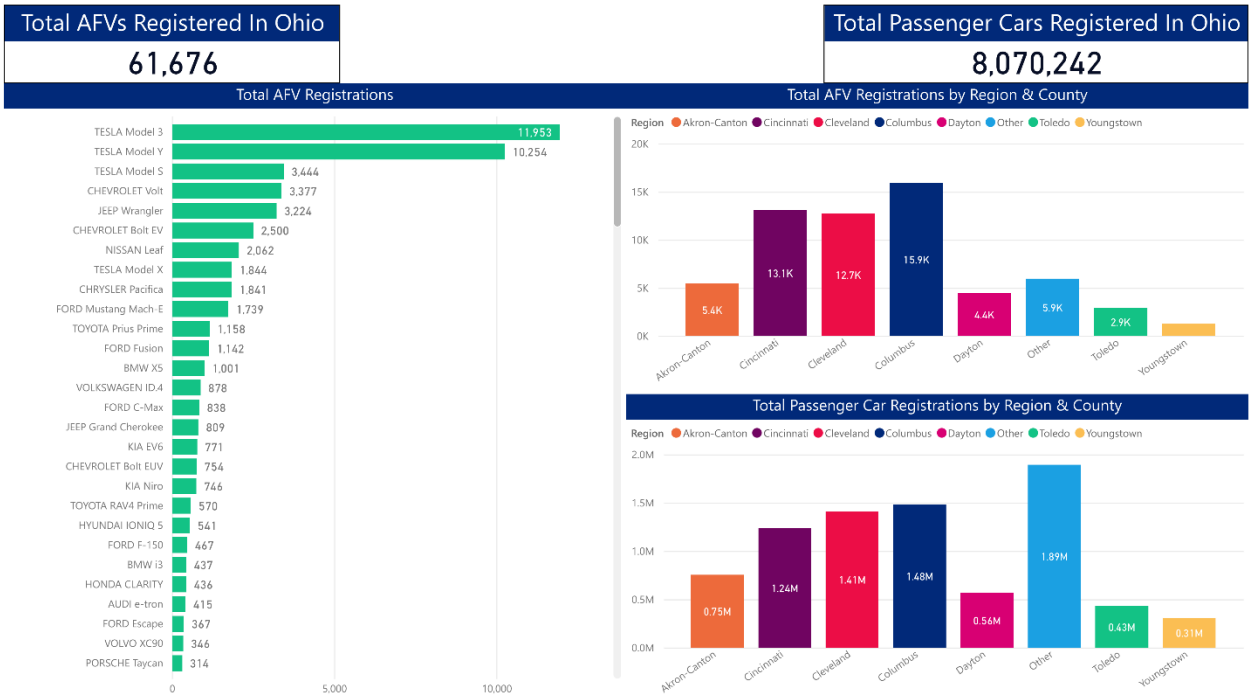
2.1 Ohio EV Trends

Ohio as a state has not been an early adopter of electric transportation technologies when compared with states like California or Oregon, but some areas, namely cities with the highest populations, are

[1] https://www.spglobal.com/mobility/en/research-analysis/women-not-buying-electric-vehicles.html
[2] https://www.businessinsider.com/typical-ev-buyer-wealthy-millennial-man-trading-luxury-for-electric-2023-2

farther ahead in EV adoption than others. DriveOhio developed the Ohio Alternative Fuel Vehicle Registration Dashboard using data from the Ohio Bureau of Motor Vehicles (BMV) to track the market penetration of all alternative fuel vehicles (AFVs), with a focus on plug-in electric vehicles (PEVs). While the overall market penetration of AFVs is low at less than 1%, nearly 4% of all new registrations in October 2023 were PEV, either battery EV (BEV) or plug-in hybrid EV (PHEV). Ohio appears to be near an inflection point of 5% of new sales which is where, once achieved, other markets have noticed rapid growth in the EV market.[3] Based on new sales in 2023, Ohio already surpassed 2022's total AFV registrations as of September 2023. Dublin is ahead of the state with over 2.84% of registered vehicles being PEV, and nearly 9.24% of vehicle sales from Aug-Oct 2023 were electric.

Figure 1: Ohio Alternative Fuel Vehicle Registrations



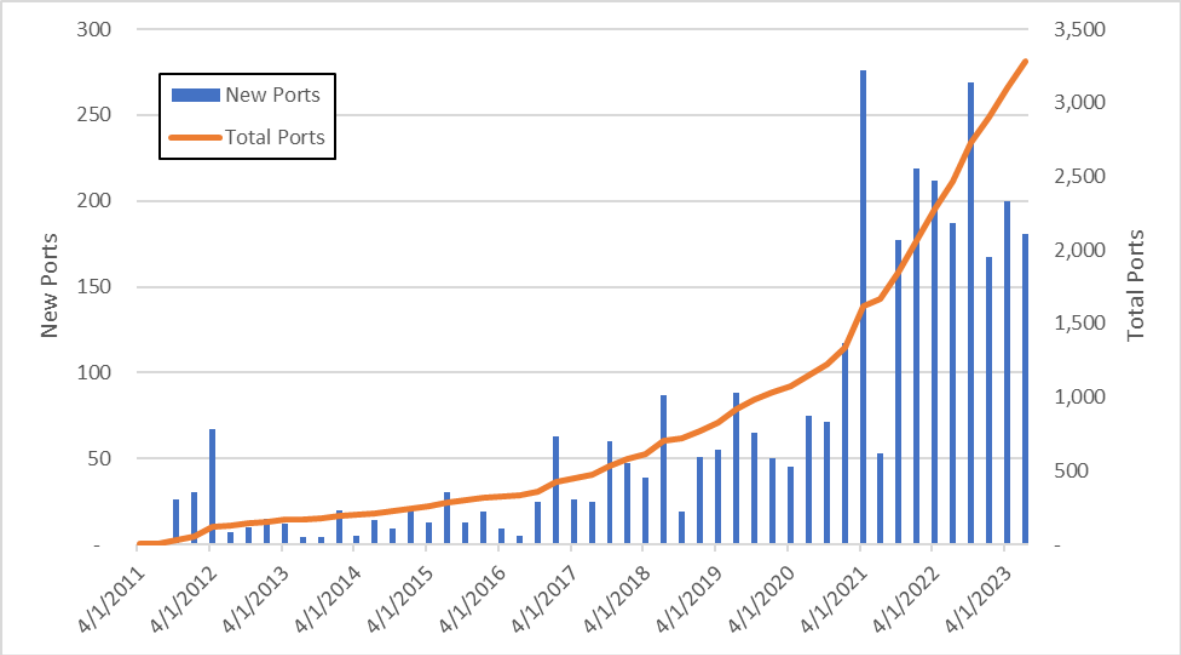
Source: Ohio Alternative Fuel Vehicle Registration Dashboard, as of October, 2023

2.2 EV Charger Trends

Among the approximately 1,400 public EV charging stations in Ohio as of October 2023, the median age of the chargers is 28 months. There was a large increase in installations starting in the first quarter of 2021. That momentum has continued and is expected to accelerate with the increased availability of federal funding for charging infrastructure. **Figure 2** on the next page shows the timeline of installation for chargers in Ohio, while **Figure 3** shows this same information spatially. Non-overlapping points were chosen over precise locations in order to not bias the apparent age of the chargers. These data are compared to Dublin in **Chapter 6**.

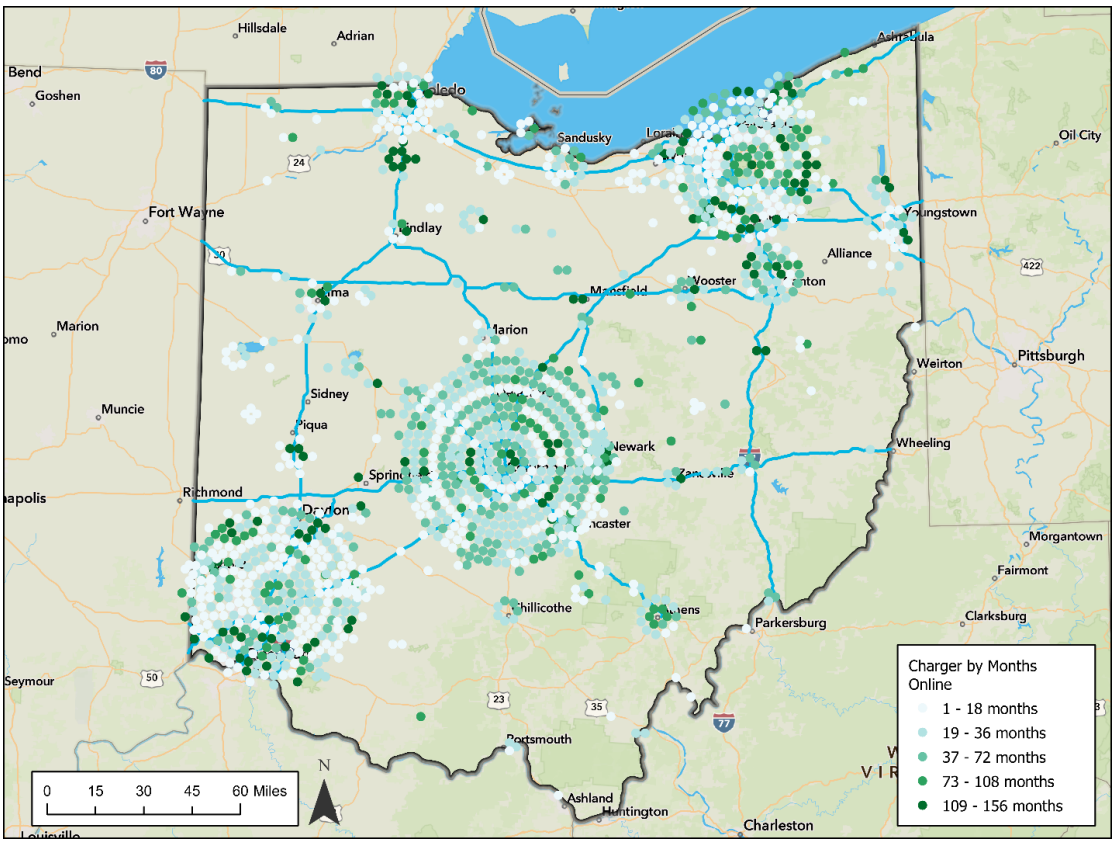
[3] https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone

Figure 2: Timeline of Chargers Coming Online in Ohio



Source: Alternative Fuels Data Center and Plugshare

Figure 3: Chargers in Ohio by Location and Age



Source: AFDC and Plugshare

3 EXISTING PLANS

Electrification planning, in earnest, started in the Central Ohio region around the time the City of Columbus won the United States Department of Transportation (USDOT) Smart City Challenge in mid-2016. Since then, the City of Columbus, the State of Ohio through DriveOhio, and Franklin County have invested in creating and implementing electrification plans and many governmental agencies in the Central Ohio region have started purchasing hybrid vehicles or EVs.

The Bipartisan Infrastructure Law, signed November 15, 2021, created numerous opportunities for federal funding of EV related infrastructure. Two funding programs for states and local governments to create and implement electrification plans: the National Electric Vehicle Infrastructure (NEVI) program and the Charging and Fueling Infrastructure (CFI) program will change the face of publicly available alternative fueling options in the US. The NEVI program is funded with $5 billion distributed to states based on formula funding and focused on building a connected, U.S. EV charging network. The CFI program is funded with $2.5 billion focused on discretionary community and other corridor grants. While the CFI program doesn't require an electrification plan be developed to apply, having a well thought out plan will better prepare the applicant to respond quickly and thoroughly.

Ohio and the Central Ohio region, including Dublin[4], have electrification and sustainability plans that can be useful as Dublin works towards an electrification implementation plan. Dublin's focus on best practices and enhanced coordination to ensure seamless integration and the realization of shared electrification goals will keep Dublin at the forefront of planning.

3.1 State of Ohio

The State of Ohio is expected to receive $140 million over five years in NEVI formula funds. DriveOhio has developed an electrification plan to build out Alternative Fuel Corridor charging efforts over the first few years of funding. Once that buildout is complete, Ohio will focus on other major roadways for charging connectivity and community projects. Ohio is using a public, private procurement (P3) model to deliver the charging stations and support the building, maintaining, and operating of EV chargers on private property. Ohio was the first state to break ground on a NEVI station and lessons learned from these near-by deployments will help inform future charging station implementation in the region, state, and U.S.

3.2 Mid-Ohio Regional Planning Commission

MORPC has had many efforts around sustainability in the region including the recent Regional Sustainability Agenda[5] that lays out the region's plan for reducing carbon emissions and increasing quality of life for people in Central Ohio. The agenda encompasses four major goals as shown in **Figure 4** which are tracked in a dashboard.

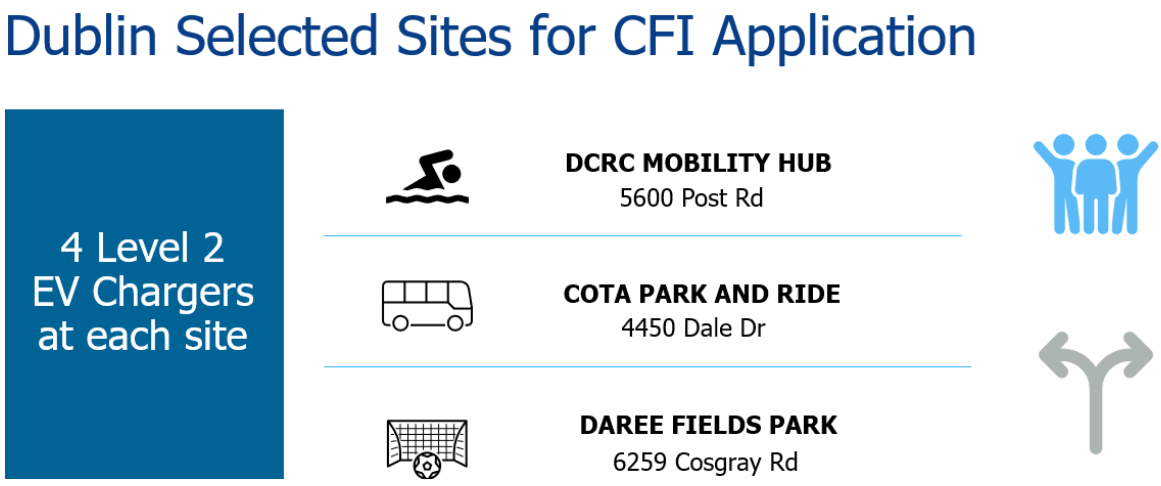
[4] https://telldublin.dublinohiousa.gov/sustainability-framework-plan
[5] https://www.morpc.org/regional-sustainability-agenda/

Figure 4: MORPC Regional Sustainability Agenda Goals

Source: MORPC

MORPC also was the lead applicant in the CFI program's first discretionary grant process which occurred in mid-2023. The Central Ohio region, including Dublin, came together to submit a project, MORE EVS (Mid-Ohio Regional Equity for Electric Vehicle Stations), for funding. The application was successfully submitted on June 13, 2023. As a region, with the total project cost of approximately $21.9 million, $15 million was requested with matching funds of $6.9 million (a 68/32 split), exceeding the program's minimum match requirements (80/20). The application consisted of installing 62 charging sites across the region including three in Dublin. **Figure 5** shows the location of the three charging sites in Dublin.

Figure 5: Dublin CFI Application Summary



Source: City of Dublin

Award announcements are expected in early Fall. At least three additional rounds of funding are expected with the CFI program. Therefore, spending time cultivating partnerships in the region and having projects ready to go will make applying easier.

3.3 Franklin County

The Franklin County Engineer's Office (FCEO) recently analyzed fleet transition options and developed an AFV fleet transition plan. As part of the analysis, the FCEO compared the operating costs of internal combustion engine (ICE) vehicles with EVs, PHEVs, and hybrid electric vehicles (HEVs) using existing fleet

telematics data. In addition, the FCEO investigated the feasibility of providing workplace charging for employees and what policies may need to be put in place prior to implementation.

3.4 City of Columbus

The City of Columbus won the USDOT Smart City Challenge in 2016. This award was both a $40 million grant from USDOT to test smart city technology and a $10 million grant from the Paul G. Allen Foundation to boost EV adoption and EV charging in the region. This funding, specifically the $10 million for electrification efforts, helped to measurably decrease light-duty transportation greenhouse gas (GHG) emissions in the region as a result of five priorities: Grid Decarbonization; EV Fleet Adoption; Transit, Autonomous and Multi-Modal Systems (implemented via USDOT grant agreement); Consumer EV Adoption; and Charging Infrastructure during the grant period compared to a baseline year (2016). Nearly 3,500 EVs were purchased and over 900 EV charging ports were installed in the region during the program. Lessons learned were published in the final project report[6] and some relevant lessons include:

- Considering challenges outside of your project and jurisdiction – Understand State and utility policies may affect an EV charging project as it moves forward so working together early on will help identify barriers and opportunities.
- Plan for the future – Always consider what's next in planning and funding opportunities.
- Partnering – Identify partners and understand their goals and requirements to work together.

3.5 City of Dublin

While most of this chapter is dedicated to existing plans outside of Dublin, it's important to take note of Dublin's forward-thinking commitment to EV charging infrastructure planning that has already been established. Dublin's sustainability efforts have been underway since at least 2000 with the first level 2 (L2) chargers installed in 2012. In addition to committing to alignment with the MORPC Sustainable2050 plan, Dublin has continued to refine its own Sustainability Framework Plan[7] to suit local needs, including goals to consider tax credits for residents and businesses for the installation of EV charging stations, reduce vehicle emissions by purchasing/leasing alternative fuel vehicles, and provide City-owned charging stations. A plan update is underway and is expected to be adopted in January, 2024. This action-based plan and its goals will be cross-departmental when it comes to electrification leading to many opportunities for varying user needs and partnerships.

Dublin also started electrifying City-owned vehicles after reviewing which vehicles would be appropriate to convert. The assessment took into consideration how each City vehicle is used (hours per day, days per week, heavy or light duty) and the availability and performance capability of the EVs on the market. After this review, Dublin decided to focus on transitioning light-duty EVs as they came up for replacement. Police vehicles are an example of a light-duty vehicle that qualified for replacement as a hybrid because the vehicles idle for much of their shift, are not required to run for 24 hours, and do not perform heavy-duty work. PHEV models of police vehicles are not available yet.

Alternatively, vehicles used for snow removal are heavy duty, can be used for 24 hours during a snow event, and no EV on the market can meet the needs of a larger, heavy-duty vehicle; therefore, they

[6] https://d2rfd3nxvhnf29.cloudfront.net/2021-03/SCC-PGAFF-FinalReport_07.31.20.pdf
[7] https://dublinohiousa.gov/dev/dev/wp-content/uploads/2021/10/C5_2018-Sustainability-Framework-Plan.pdf

were not a good candidate for conversion to an EV at this time. After discussion with the City, the vehicles in **Table 2** were identified as good candidates for electric or hybrid replacement:

Table 2: Fleet Vehicles Targeted for Electric Replacement

VEHICLE	COUNT	ANNUAL MILES	VEHICLE	COUNT	ANNUAL MILES
Ford Escape	15	3,498	**Police Dodge Caravan**	1	804
Ford E-Transit	1	2,205	**Police Ford Escape**	2	9,849
Ford Explorer	5	3,717	**Police Ford F150**	2	4,490
Ford F150	24	4,497	**Police Ford Interceptor**	33	8,543
Ford Focus	1	1,792	**Police Ford Taurus**	4	5,246
Ford Fusion SEL	2	2,749	**Police Jeep Patriot**	1	561
Ford Transit	3	2,205	**Police Nissan Altima**	1	561
Ford Van Cargo	1	2,205	**Police Nissan Leaf S**	2	4,024
Honda CRV	1	3,936	**Police Pursuit Ford Interceptor**	11	14,329
Nissan Leaf S	8	5,598	**Police Pursuit Ford Responder**	1	13,286
Police Chevrolet Tahoe	2	2,095			

Source: Dublin

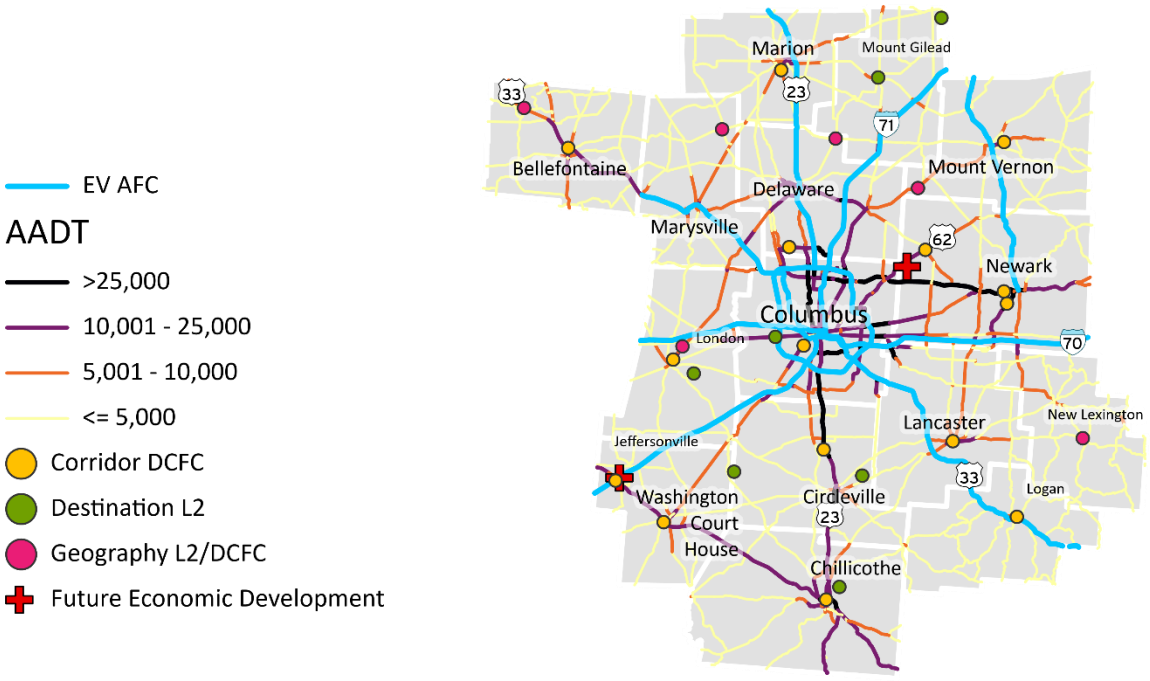
3.6 City of Marysville

Dublin and the City of Marysville are more than neighbors, they have been partners on efforts like the US 33 Smart Corridor and the Beta District, both regional test beds for transportation technology and other beta products and services. In terms of electrification, the City of Marysville is currently developing an EV Readiness Plan. This plan will help Dublin identify opportunities for collaboration across their jurisdictional boundary.

3.7 Columbus Partnership

In 2023, the Columbus Partnership developed a regional plan to identify charging needs and key stakeholders within Central Ohio. This plan is focused on workplace and intracity L2 charging in the near term and served as a springboard for MORPC's CFI grant application in 2023. Critical factors included evaluation of key corridors, important destinations, and a holistic look at what gaps remained after other charging criteria were met. The results of this study can be seen in **Figure 6**. Having locations identified before the grant launched streamlined the application process.

Figure 6: Columbus Partnership Recommended Charging Locations in Central Ohio



Source: Columbus Partnership

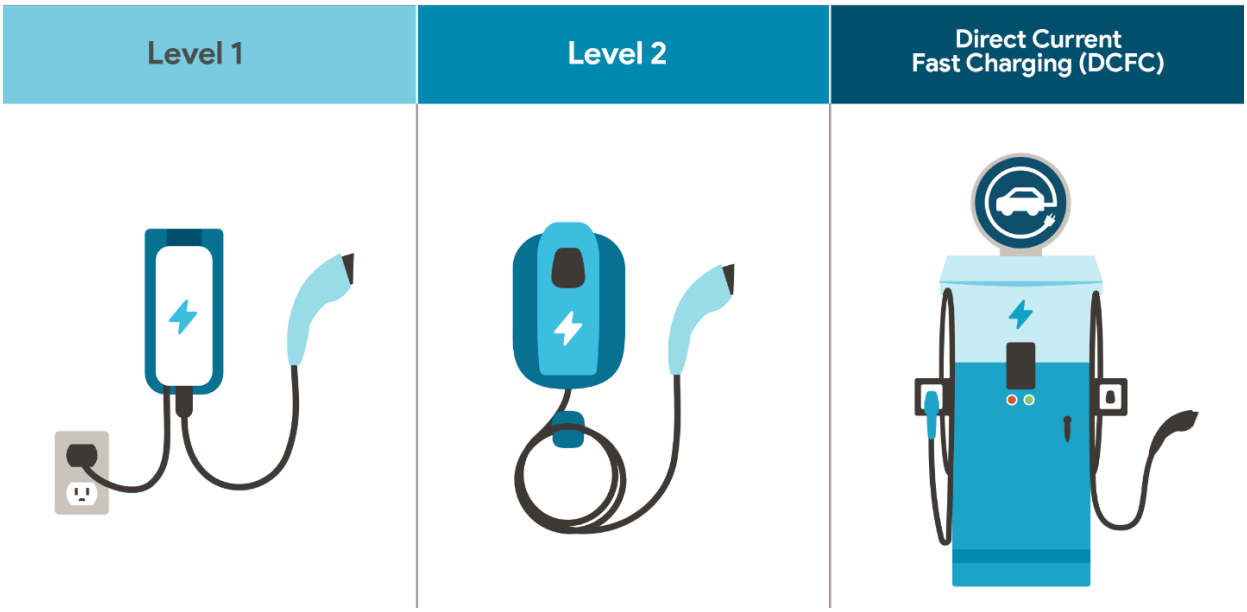
4 DUBLIN EVSE LOCATIONS AND UTILIZATION PATTERNS

This section delves into the EV charging types, an inventory of existing chargers, and the current state of EVSE infrastructure and utilization patterns in Dublin, setting the stage for future projections and planning.

4.1 EV Charging Types

To understand EVSE locations and how they can be used, it's important to understand the different EV charging types. Plug-in electric vehicle charging options are commonly divided into three general types as shown in **Figure 7** and **Table 3**.

Figure 7: Level 1, Level 2, and DC Fast Charging



Source: https://electricvehicles.bchydro.com/how-use-our-fast-chargers/what-are-different-options-charging-my-electric-vehicle-ev

Table 3: EV Charging Types

TYPE	PRIMARY USE	POWER TO VEHICLE	CHARGE (VOLTS)	POWER (KW)
Level 1 (L1)	Residential, Workplace	Alternating Current (AC)	120	≤ 1.8
Level 2 (L2)	Residential, Public	AC	240	3.6 – 19.2
Direct Current Fast Charging (DCFC)	Public	DC	480	Typically, ≥ 50 - 350

Source: https://www.sae.org/standards/content/j1772_201710/

In general, the different types of charging are best suited for:

- **Level 1:** Extremely long-dwell sites or areas where it is not feasible to install a 240V circuit. Generally, these are located at a home where overnight charging can occur, and can also be effectively utilized in workplaces where vehicles can be charged throughout the workday or for fleet charging if the daily vehicle duty cycles are small
- **Level 2:** Moderate-to-long dwell sites, including retail centers, hotels, libraries, or tourist attractions. L2 chargers can also be installed in a residence which is how most EV charging takes place – with an L2 charger at home.
- **DCFC:** Short-dwell sites where charging speed is significantly more important than installation cost (e.g., highway corridor sites, gas stations).

4.2 Inventory of Chargers

Table 4 lists the existing chargers in Dublin, their address, access type (public or private), number and type of ports, EV network and connector types (Combined Charging System (CCS) and CHAdeMO are used for DC fast charging, J1772 is used for L2 charging). Single-family residential chargers are not shown.

Table 4: EV Chargers in the City of Dublin

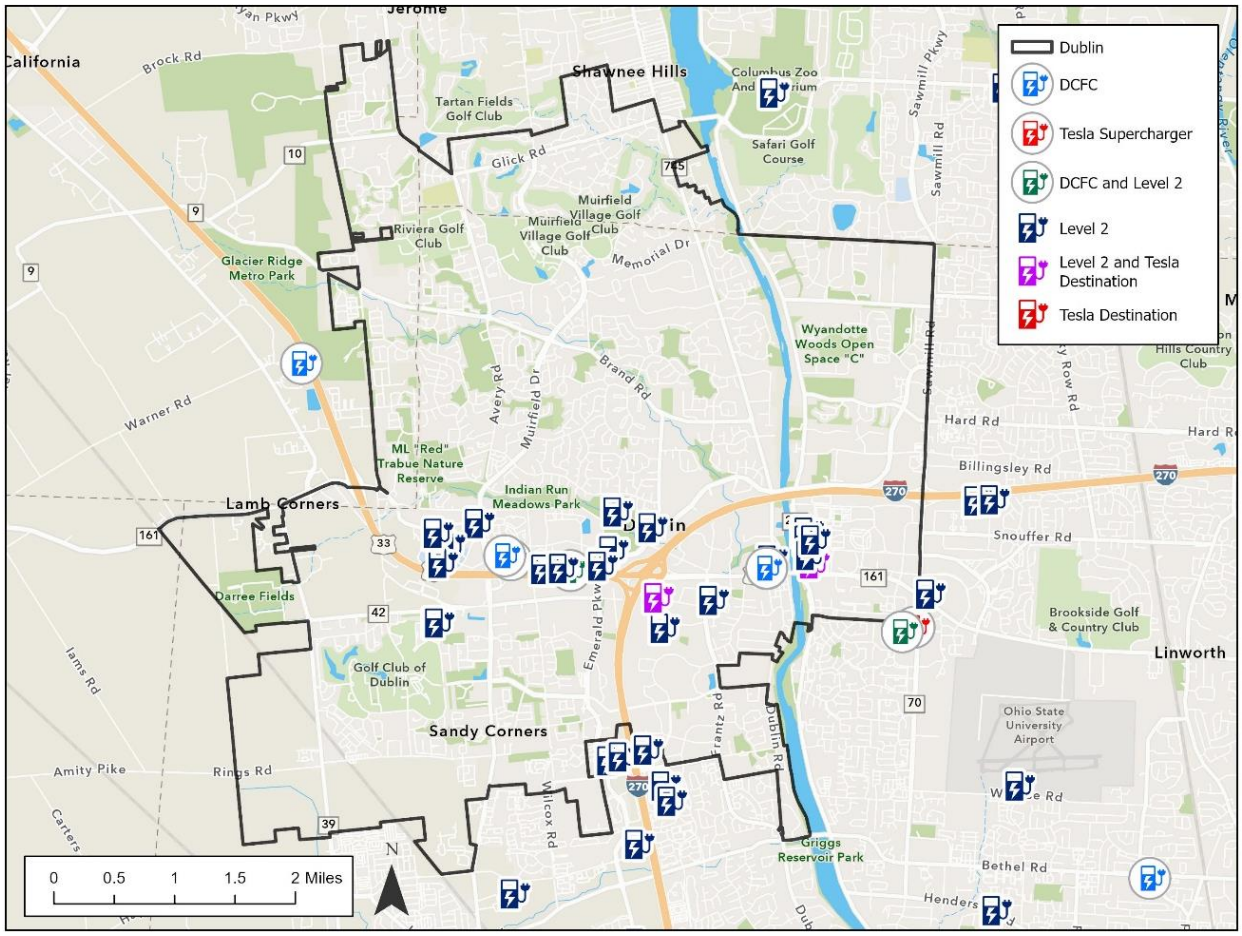
STATION NAME	ADDRESS	ACCESS	L2 PORTS	DCFC PORTS	NETWORK	CONNECTORS	SOURCE
AAA Car Care Plus* temporarily out of service	6600 Perimeter Loop Rd	Public	0	1	EVgo Network	CCS	AFDC
Acura of Columbus	4340 W Dublin Granville Road	Public	2	1	Unknown	J1772, CCS	City of Dublin
AEP	5721 Shier Rings Road	Public	3	0	Unknown	J1772	City of Dublin
D Block Garage	6750 Longshore St	Public	4	0	ChargePoint	J1772	AFDC
DoubleTree by Hilton	576 Metro Pl N	Public	3	0	Non-Networked	J1772, TESLA	AFDC
Dublin City Hall	5555 Perimeter Dr	Public	4	0	ChargePoint	J1772	AFDC
Dublin Darby Lot	35 Darby St	Public	0	2	ChargePoint	CHAdeMO, CCS	AFDC
Dublin Development CT4020	5200 Emerald Pkwy	Private	2	0	ChargePoint	J1772	AFDC
Dublin Garage	74 North St	Public	6	0	ChargePoint	J1772	AFDC
Dublin Justice Center	6565 Commerce Pkwy	Private	2	0	ChargePoint	J1772	AFDC
Dublin Rec Center	5600 Post Rd	Public	2	0	ChargePoint	J1772	AFDC
Dublin Service Center	6555 Shier Rings Rd	Private	3	0	ChargePoint	J1772	AFDC
Dublin Methodist Hospital	7450 Hospital Dr	Public	4	0	ChargePoint	J1772	AFDC
Dublin Methodist Hospital Outpatient Department	6805 Perimeter Dr	Public	4	0	ChargePoint	J1772	AFDC
Farbman Group	545 Metro South	Public	1	0	Unknown	J1772	City of Dublin

STATION NAME	ADDRESS	ACCESS	L2 PORTS	DCFC PORTS	NETWORK	CONNECTORS	SOURCE
Germain Lexus	650 Shamrock Blvd	Public	3	0	Unknown	J1772	City of Dublin
Gordon Food Service	3901 W Dublin Granville Road	Public	1	0	Unknown	J1772	City of Dublin
Hotel Parking Garage at Bridge Park	6725 Longshore Street	Public	9	0	Tesla	TESLA	AFDC
Huntington Avery Muirfield	6655 Avery-Muirfield Dr	Public	1	0	ChargePoint	J1772	AFDC
Huntington Frantz Road	6340 Frantz Road	Public	1	0	ChargePoint	J1772	AFDC
JLR Dublin DC Fast 01	5775 Venture Dr	Public	1	1	ChargePoint	CCS	AFDC
Longshore Garage	6650 Longshore Street	Public	10	0	Non-Networked	J1772	AFDC
MAG Audi	5875 Venture Dr	Public	2	0	ChargePoint	J1772	AFDC
MAG Volvo	6335 Perimeter Loop Rd	Public	1	0	Non-Networked	J1772	AFDC
Mercedes Drive	6500 Perimeter Loop Rd	Public	2	1	ChargePoint	J1772, CHAdeMO, CCS	AFDC
Midwestern Auto Group BMW	5016 Post Rd	Public	2	0	ChargePoint	J1772	AFDC
Mooney Garage	6568 Longshore Street	Public	12	0	Non-Networked	J1772	AFDC
Nature Conservancy	6375 Riverside Dr	Public	2	0	Unknown	J1772	City of Dublin
One Metro Place	545 Metro PI S	Public	2	0	SWTCH	J1772	AFDC
Subaru of America Training Center	350 Cramer Creek Ct	Public	1	0	Unknown	J1772	City of Dublin
Theodore Garage	6640 Mooney Street	Private	12	0	Non-Networked	J1772	AFDC
			102	**6**			

Source: As shown in Source column

These chargers are located mainly in proximity to I-270 and US-33, as shown in **Figure 8** below.

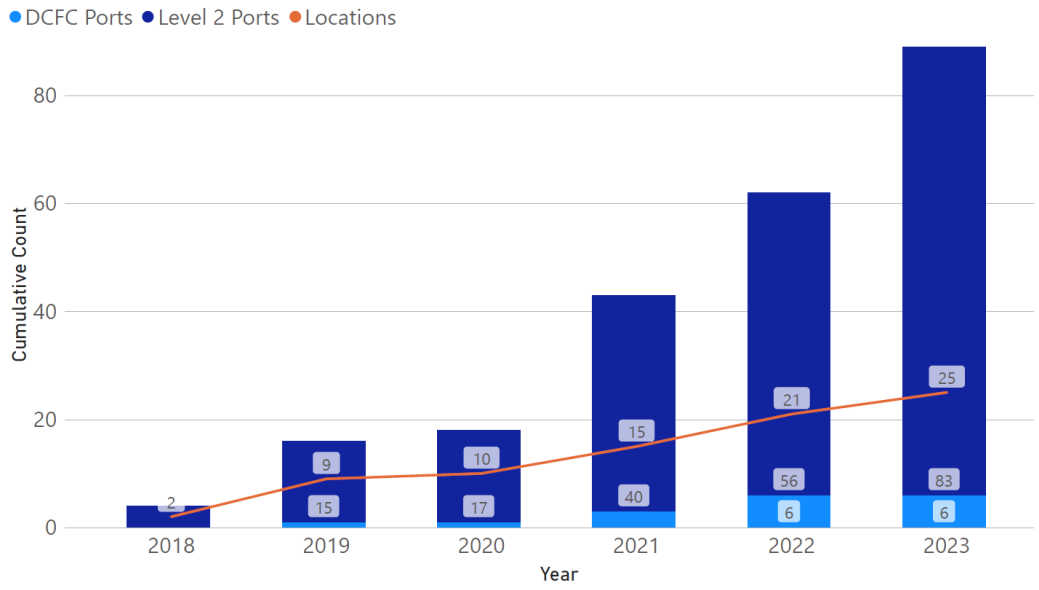
Figure 8: Existing EV Chargers in and around Dublin



Source: AFDC and City of Dublin

Figure 9 shows the rapid growth in the number of public DCFC and L2 ports in Dublin from 2018 to September 2023, with the number of L2 ports increasing by over 20-fold. Recent trends show a significant rise in L2 ports from 40 in 2021 to 83 in 2023, while the availability of DCFC ports also doubled from 3 in 2021 to 6 in 2023.

Figure 9: Public Charging Infrastructure from 2018-2023



Source: AFDC, Plugshare, accessed October 31, 2023

Table 5 lists the available public chargers in Dublin by facility type. Thirty-one percent of the public ports are L2 ports located in parking garages in the Bridge Park area.

Table 5: Type of Public Charging Facilities

TYPE OF FACILITY	NUMBER OF PLUGS	
	Level 2	**DCFC**
Parking Garage	26	0
Car Dealership	14	3
Hotel	12	0
Government Building	12	2
Hospital	8	0
Workplace	8	0
Bank	2	0
Grocery	1	0
Auto Repair	0	1
Total	**83**	**6**

Source: City of Dublin and Plugshare, accessed October 31st 2023

Table 6 lists the number and type of ports by Network. ChargePoint is the main network in Dublin with 33 L2 ports and 4 DCFC ports. The non-networked chargers are new Enel X - JuiceBox chargers that replaced old chargers in the Bridge Park parking garages.

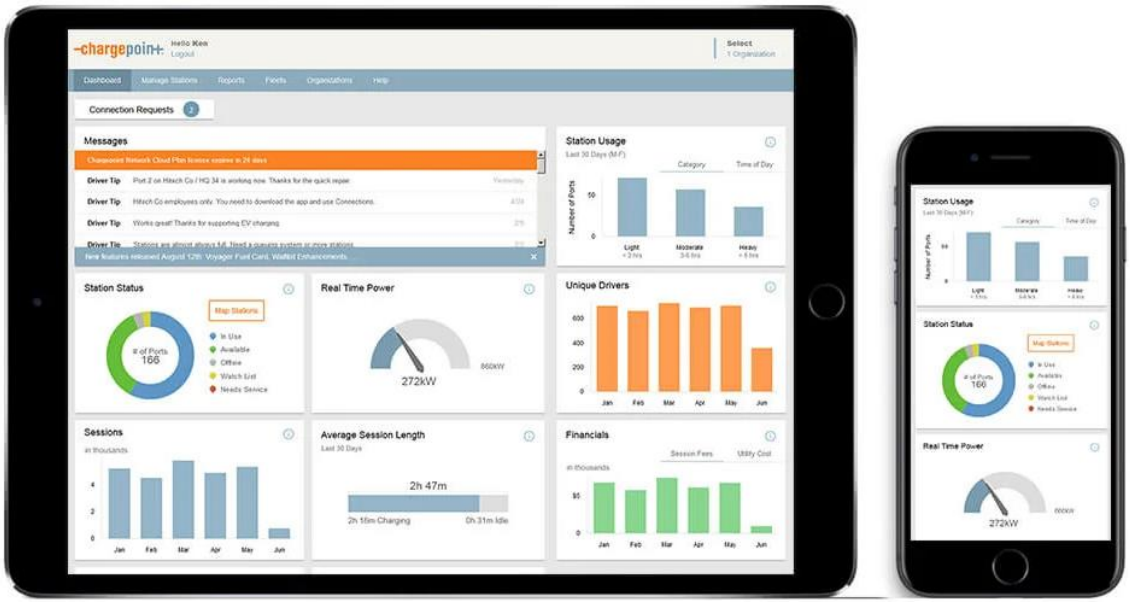
Table 6: Charging Infrastructure by Network

EV NETWORK	NUMBER OF PLUGS	
	Level 2	DCFC
ChargePoint	33	4
Non-Networked	26	0
Unknown	13	1
Tesla	9	0
SWTCH	2	0
EVgo	0	1
Total	**83**	**6**

Source: City of Dublin and Plugshare, accessed October 31st 2023

ChargePoint is the provider of the City of Dublin's public chargers. There are rolling operations and maintenance agreements for each charger that begin at installation acceptance and normally run 4-5 years. This arrangement allows for the City of Dublin to offer these chargers to the public without having the extra cost of specifically skilled employees to operate and maintain the chargers. This relationship also allows for an in-depth dashboard of charging data that is reviewed to check for maintenance issues and charging patterns.

Figure 10: Representation of a ChargePoint Dashboard



Source: ChargePoint

4.3 User Behavior Analysis

User behavior goes hand in hand with siting and planning for electric vehicle charging, as well as estimating the electrical load to help avoid costly demand charges, especially for DCFC. A data-driven approach informs the type, quantity, and location of EV charging infrastructure and uses lessons learned from other installations to make informed decisions in the future.

4.3.1 Level 2 Charger User Behavior

With the exception of workplace and fleet charging, L2 charging can largely be split between two usage types: residential charging and public charging. A 2023 study performed by the University of Rhode Island[8] compiled residential L2 charging data for 2,657 ports with over 675,000 charging sessions, and public L2 charging data for nearly 4,000 ports and 1,285,610 sessions. **Table 7** highlights the differences in average energy consumption and time plugged in when comparing residential L2 charging to public L2 charging.

Table 7: Sample Summary Statistics for Residential and Public Level 2 Charging Stations

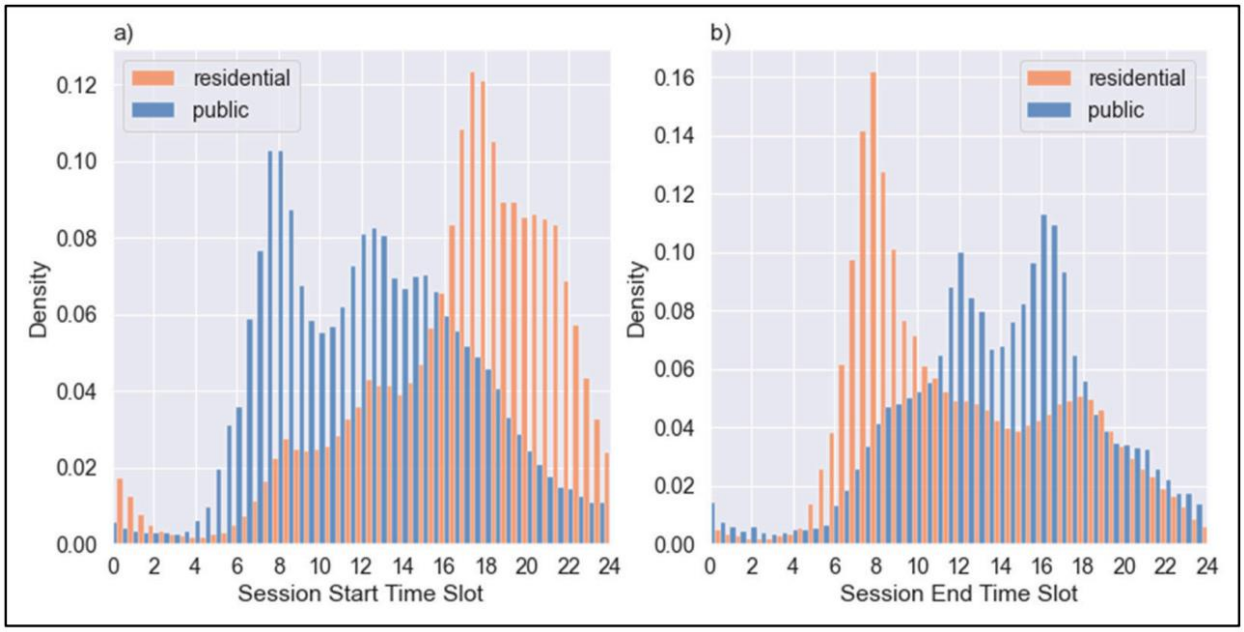
CHARGING TYPE	AVG ENERGY CONSUMPTION (KWH)	AVG SESSION DURATION (HOURS)	AVG TIME PLUGGED IN AFTER CHARGING IS COMPLETE (HOURS)	TOTAL TIME PARKED (HRS)	CHARGING FREQUENCY (AVG NUMBER OF CHARGES PER DAY)
L2 - Residential	12.06	2.61	8.09	10.70	0.73
L2 - Public	8.83	2.41	5.16	7.57	0.63

Source: https://www.mdpi.com/1996-1073/16/4/1592

In addition to the differences in energy consumption and session duration, the time of use also varied widely when comparing residential L2 charging to public L2 charging. **Figure 11** from the same study shows the highest density of start times for public charging sessions between 7:30-8:30am with a second peak between 12:00-1:30pm, before diminishing throughout the end of the day. Charging start sessions at residential chargers are mostly initiated later in the day, with a peak between 5:00-6:00pm when drivers are returning home from work. The end session times are also predictable based on usage type with most residential sessions ending in the morning when drivers are off to work and public end times staggered 2-3 hours after the session start times.

[8] Jonas T, Daniels N, Macht G. Electric Vehicle User Behavior: An Analysis of Charging Station Utilization in Canada. Energies. 2023; 16(4):1592. https://doi.org/10.3390/en16041592

Figure 11: Sample Distribution of Residential and Public Level 2 Charging Session Start and End Times



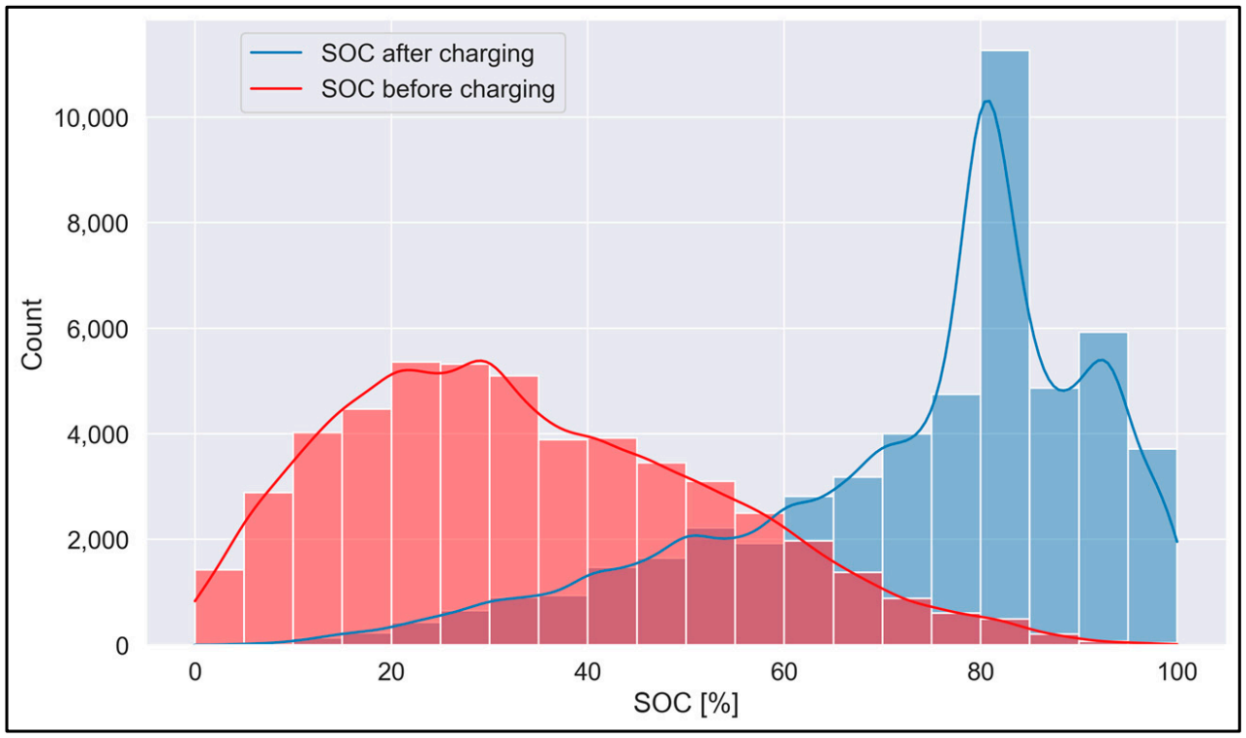
Source: https://www.mdpi.com/1996-1073/16/4/1592

Workplace charging is typically comprised of L1 and L2 chargers and the user behavior is highly dependent on day of week and location work hours. Levels 1 and 2 fleet charging is also highly dependent on the operational hours, as well as the specific duty cycles for the fleet vehicles.

4.3.2 DC Fast User Behavior

In the same 2023 University of Rhode Island study, the researchers compiled data from 59 DCFCs with approximately 51,000 DCFC sessions in Quebec and British Columbia, Canada between 2018 and 2019. **Figure 12** on the next page shows the distribution of state of charge (SOC) when vehicles were plugged in to a DCFC and when they were unplugged from a DCFC. Most charging sessions started when the vehicle was around 20–35% SOC and ended when the SOC reached approximately 80%.

Figure 12: Sample DCFC Sessions SOC Before and After Charging



Source: https://www.mdpi.com/1996-1073/16/4/1592

Table 8 shows the average energy consumption for DCFC sessions was 12.9 kWh and much shorter session durations when compared to residential and public L2 charging. The DCFC stations were also used more frequently compared to L2 chargers at a median of once per day and an average of 1.6 times per day.

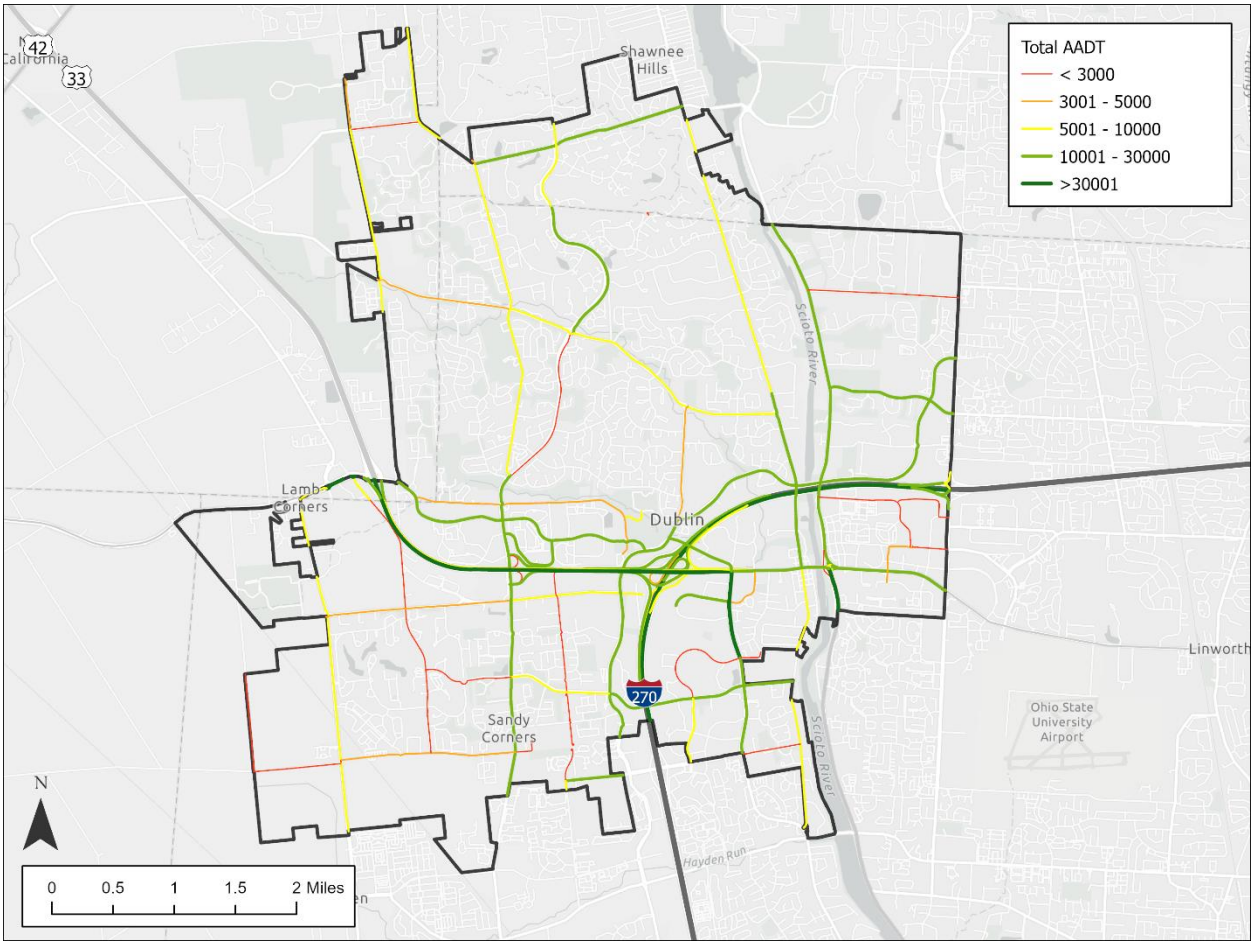
Table 8: Sample Summary Statistics for DCFC Stations

CHARGING TYPE	AVERAGE ENERGY CONSUMPTION (KWH)	AVERAGE SESSION DURATION (HOURS)	CHARGING FREQUENCY (AVERAGE NUMBER OF CHARGES PER DAY)
DCFC – Public	**12.90**	**0.43**	**1.64**

Source: https://www.mdpi.com/1996-1073/16/4/1592

DC fast charging is meant to serve EV drivers quickly and is often located along arterials and interstates, but is also increasingly expanding into urban areas. As shown in **Figure 13**, most traffic in Dublin is on I-270, US-33, and SR-161, which is where most public chargers are concentrated.

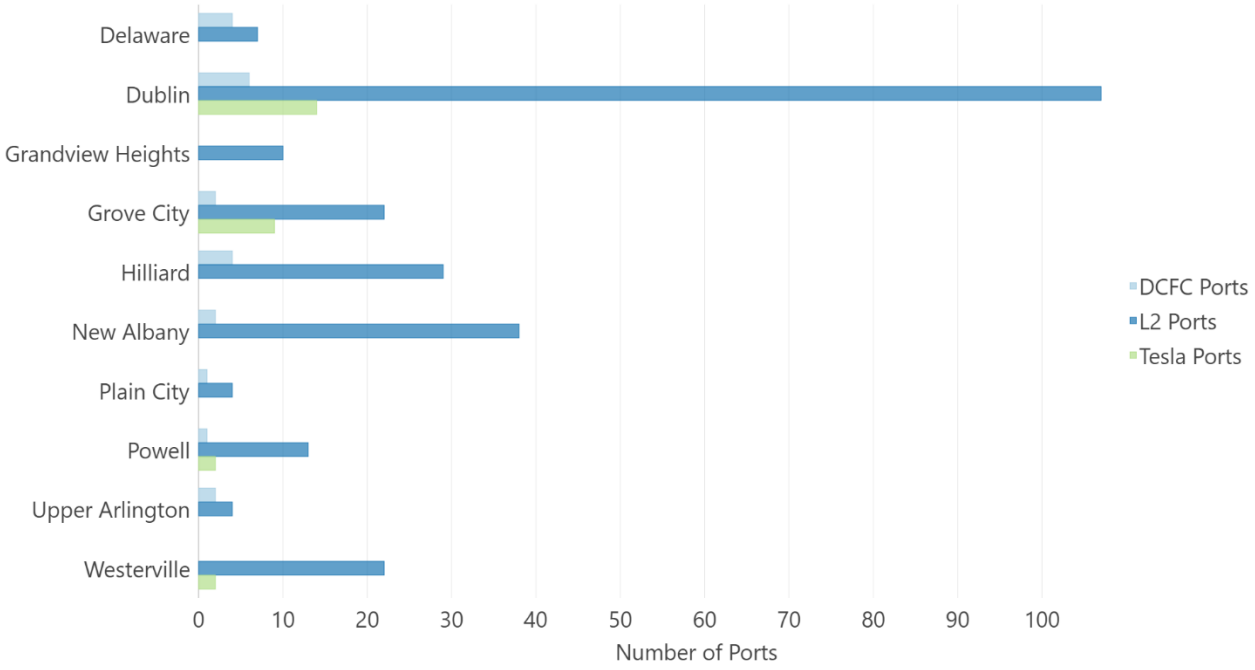
Figure 13: Annual Average Daily Traffic (AADT) Trends in Dublin



Source: ODOT Transportation Information Mapping System

Most EV charging takes place at home, with either L1 or L2 chargers. However, not everybody has access to a convenient location or the means to install a charger where they park. Workplace L2 and public DCFC can fill this gap for this segment. Among similar cities in Central Ohio, Dublin has the most public chargers of any type, as seen in **Figure 14**. Dublin is positioned well for continued growth and goes hand-in-hand with their high rate of EV adoption, climate goals, and attractions.

Figure 14: Chargers by City in Central Ohio



Source: Ohio BMV, via DriveOhio AFV Dashboard

4.4 Public EV Charging Policy

The City of Dublin does not currently charge a fee for any of their public chargers but will want to consider adding a fee as usage continues to grow. Charger policies can consider a fee for general charging, idling after receiving a full charge, charging on different days (workday versus weekend), or during different times of day (work hours versus evening) to better allow everyone the opportunity to charge.

Currently, Dublin does not charge users for the cost of electricity and does not have policies to charge or enforce removal for idling. Charging and idle fees can help alleviate vehicles using a public charger after a charging session has completed by using the fee to incentivize people to re-park once they no longer need the charger. Having fees that vary based on time of day or day of week can be confusing for customers, but it can also be a useful tool to shape user behavior towards charging at times that are better for the grid or encouraging turnover at EV chargers so more vehicles can take advantage of the charger. If the data shows many vehicles using a charger once the charging activity is over, a hybrid incentive of making the first few hours of charging free and then charging a fee for any time beyond the established incentive time period could be an option.

4.5 Impact of Deploying EV Charging for Parking Business Owners and Users

Many small business owners view EV charging as a cost, composed of both startup costs (equipment, installation, permitting) and ongoing costs (maintenance, higher electric bills). However, there are various ways to mitigate those costs, such as installation grants and new rate structures for EVSE. Once installed, they may attract new customers and encourage them to stay longer while the vehicle is charging. For customers, the ubiquity of charging stations will ease range anxiety, increasing adoption

and furthering Dublin's green energy goals. Though the technology is not widely available, some EVs have the ability to serve as backup power sources during power outages, increasing resiliency for equipped locations.

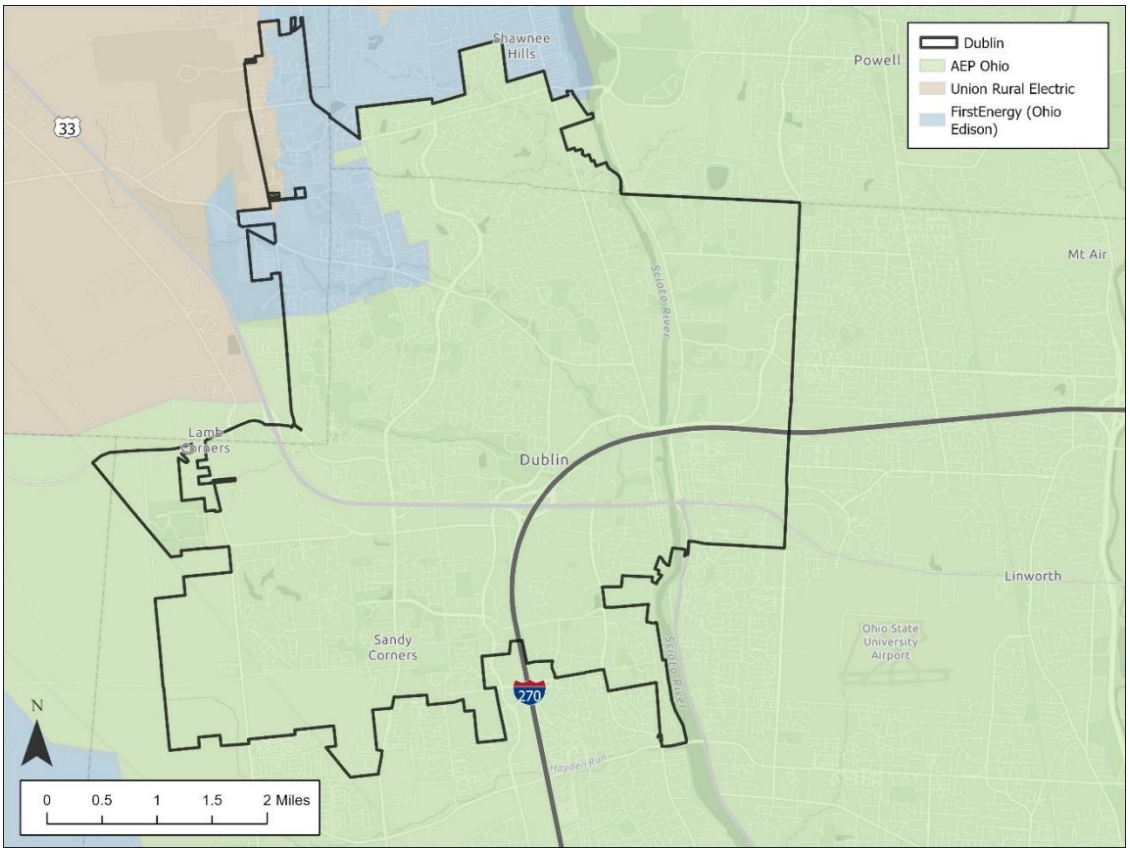
5 CURRENT ELECTRIC GRID AND CAPACITY

Navigating the complexities of electrification requires comprehensive collaboration and insights from electric utility providers. There are three utility providers in Dublin:

- **American Electric Power (AEP):** AEP is the 6th largest utility company in the U.S. based on market capitalization and covers more than 85% of the Dublin area.
- **Ohio Edison**: A subsidiary of FirstEnergy Corp. the 12th largest utility company in the U.S., Ohio Edison has a small coverage area in the northwest part of Dublin.
- **Union Rural Electric:** Union Rural Electric is a cooperative covering a small area in the northwest part of Dublin.

Figure 15 shows the different utility coverage areas in Dublin.

Figure 15: Utility Providers in Dublin



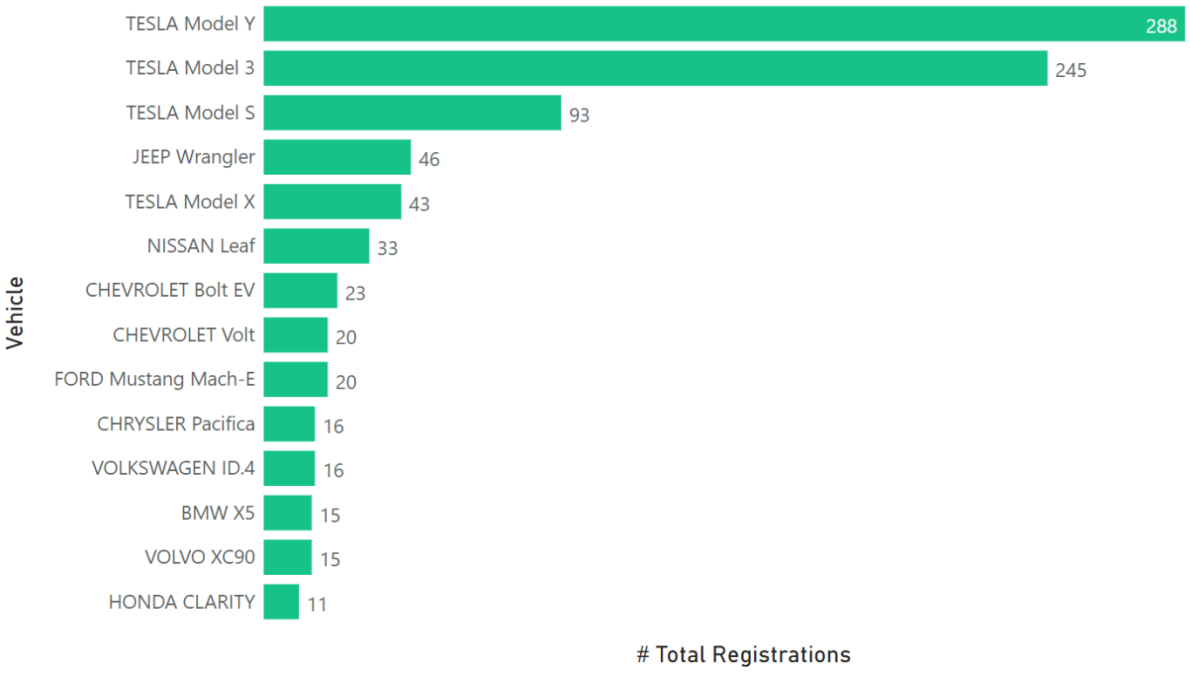
Source: ODOT Transportation Information Mapping System

It can be difficult for electric utility providers to determine capacity constraints without knowing specific planned site locations and planned electrical loads, but the electric utilities have an obligation to serve customers and will provide power as needed. Future charging sites in developed areas, where there is a higher likelihood of existing electric capacity, will likely require less upgrades compared to more rural areas without an existing, robust electric infrastructure. AEP Ohio is continuously working to upgrade their power system to support Dublin's growing energy needs, investing more than $38 million in upgrades in the past 5 years[9].

6 EV ADOPTION RATES

EV adoption rates in Ohio are being tracked and made available to the public by DriveOhio. **Figure 16** shows the most popular EV makes and models that are registered in Dublin.

Figure 16: Top EV Registrations in Dublin



Source: Ohio BMV as of October 2023, via DriveOhio AFV Dashboard

Tesla is the most popular choice by far, taking four of the top five spots. The Jeep Wrangler PHEV is a surprising addition to the top five, given that it was only released in 2021. It is also one of two PHEVs in the top ten plug-in vehicles, alongside the Chevy Volt (discontinued in 2019).

[9] https://www.aepohio.com/community/projects/Dublin-Project#:~:text=Dublin%20West%20Transmission%20Project%20%2D%20In,the%20Dublin%20West%20Innovation%20District.

Table 9 gives a broader view of EV registration trends in Ohio, counties within Dublin's borders and other Central Ohio cities of interest. Dublin is close to the national average, approaching 10%.

Table 9: Local EV Registration Trends

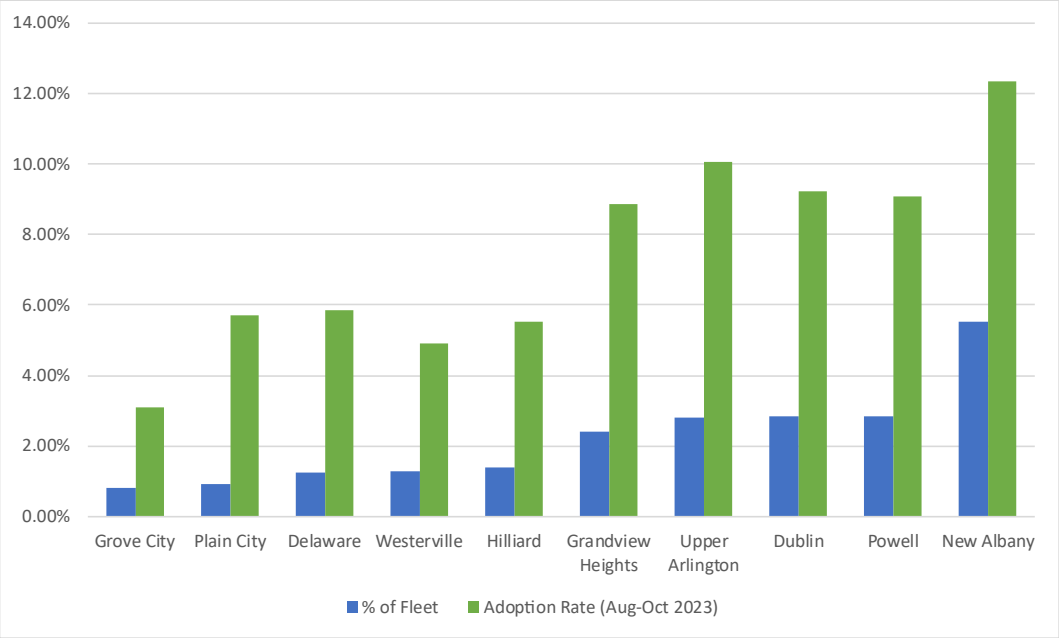
PASSENGER CAR REGISTRATIONS

	Total Vehicles	AFVs	% of Fleet	Adoption Rate (Aug-Oct 2023)
Ohio	8,070,242	61,676	0.76%	3.40%
Franklin County	887,051	9,753	1.10%	4.32%
Delaware County	169,139	3,421	2.02%	7.82%
Union County	51,135	718	1.40%	5.60%
Dublin	39,025	1,107	2.84%	**9.24%**
Delaware	31,258	389	1.24%	5.87%
Grove City	30,678	252	0.82%	3.11%
Westerville	29,163	375	1.29%	4.90%
Upper Arlington	28,230	792	2.81%	10.06%
Hilliard	27,123	383	1.41%	5.52%
Powell	11,501	327	2.84%	9.09%
New Albany	9,248	512	5.54%	12.35%
Grandview Heights	6,104	148	2.42%	8.88%
Plain City	3,003	28	0.93%	5.71%

Source: Ohio BMV, via DriveOhio AFV Dashboard

Dublin has the most AFVs of comparable cities in the region and the third highest adoption rate for new vehicle purchases, as seen in **Figure 17**. Adoption rate is the percentage of new vehicles sold.

Figure 17: EV Local Adoption Rates

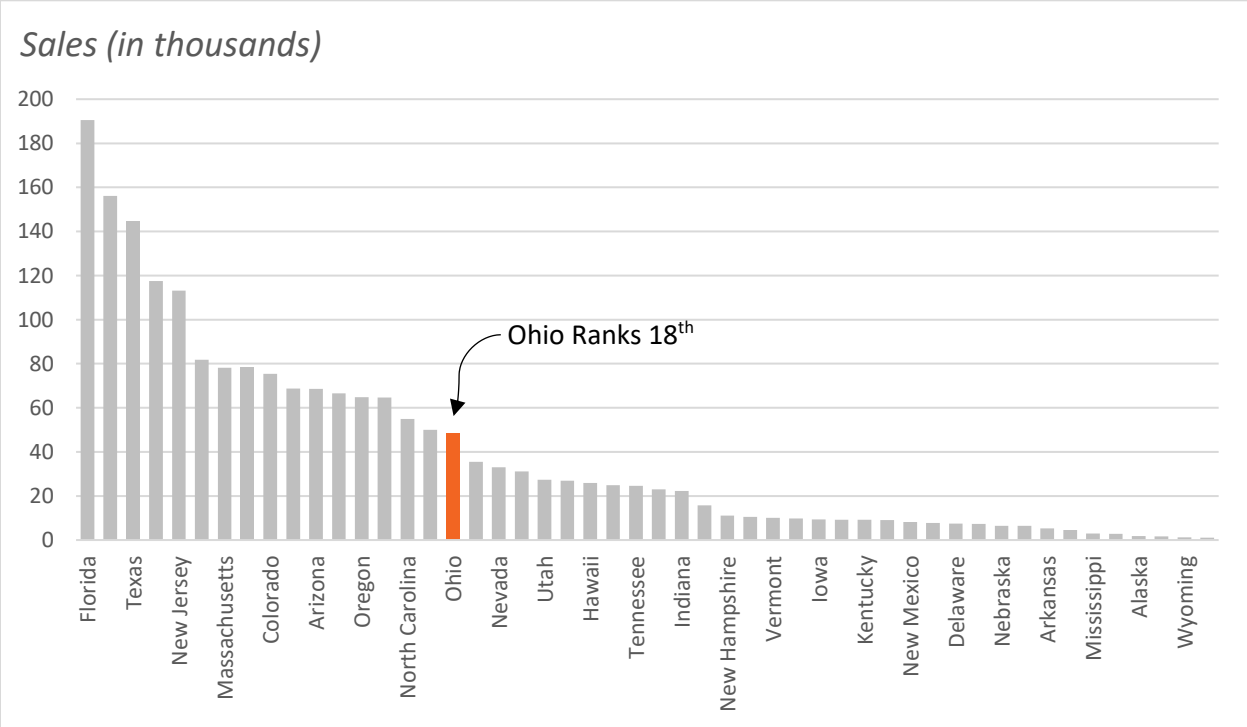


Source: Ohio BMV as of October 2023, via DriveOhio AFV Dashboard

6.1 Comparison with National Trends

Figure 18 shows EV sales by state (excluding California) with Ohio ranked 18th.

Figure 18: Cumulative EV Sales by State (Jan 2011 to Dec 2022 - excluding California)



Source: https://www.autosinnovate.org/resources/electric-vehicle-sales-dashboard

It's difficult to do a city-to-city comparison when looking at EV adoption rates since other states do not publish their alternative fuel vehicle registration information. Indiana does post their EV registration data, but only by county and year. **Figure 19** shows Marion County, Indiana, which includes Indianapolis, with an EV adoption rate of 2.65% as of November 2023. In comparison, Franklin County, Ohio, had a 3.99% EV adoption rate during the same period in 2023.

Figure 19: Marion County, IN - EV Registrations

Registered Vehicles (2023)

Fuel Type	Count	Percent of Total
Electric & Gas Hybrid	17,612	2.17%
Electric	3,881	0.48%
Hydrogen Fuel Cell	5	0.00%
Electric & Diesel Hybrid	2	0.00%
Total	**21,500**	**2.65%**

Notes: Fuel types that do not have a count value of at least 1 are omitted from this table. The Counts are based on the total registered vehicles given the filters being applied.

Percent of Total = Fuel Type Count / 811,198

Source: https://www.in.gov/oed/resources-and-information-center/vehicle-fuel-dashboard/

7 NEXT STEPS

The information in this document is the first building block in the future movement to build on the past efforts to electrify Dublin. Dublin has a strong foundation from which to build including the city's existing charging station infrastructure and the notable public commitment to sustainability. These elements demonstrate Dublin's readiness for further electrification and ensure that future developments will be supported by both the infrastructure and the people of Dublin.

Appendix B – EV Charging Forecasting

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Date
December 1, 2023

To
J.M. Rayburn, City of Dublin, Ohio

From
HNTB Corporation

PROJECT CORRESPONDENCE

Subject
Potential EV Charging Scenario Forecasting

Introduction

The EV market is changing rapidly, with indicators pointing to greater EV adoption throughout the decade. The White House set an ambitious goal to make 50% of all new vehicles sold in 2030 zero-emissions vehicles, including battery electric, plug-in hybrid electric, and fuel cell electric vehicles (EVs)[1]. A survey[2] of 1,500 U.S. consumers in March 2023 showed nearly half of United States (US) car buyers plan to buy an electric vehicle in the next two years, a 20% jump from the prior year. In July 2023, Carvana reported a 786%[3] increase in EV sales over the past 5 years.

Various projections exist and are updated regularly trying to predict the adoption rate of EVs in the future. To support and help foster future EV adoption, public charging infrastructure needs to keep up with EV growth.

The purpose of this document is to present low, medium, and high future projection scenarios for EV charging infrastructure needs in Dublin, Ohio, including level 1, level 2 and Direct Current Fast Charging (DCFC) on both public and private property.

Dublin Transit and Parking

Existing transit operations, public and private parking and charging infrastructure are foundational elements upon which the future EV charging scenarios are developed. Each are summarized below.

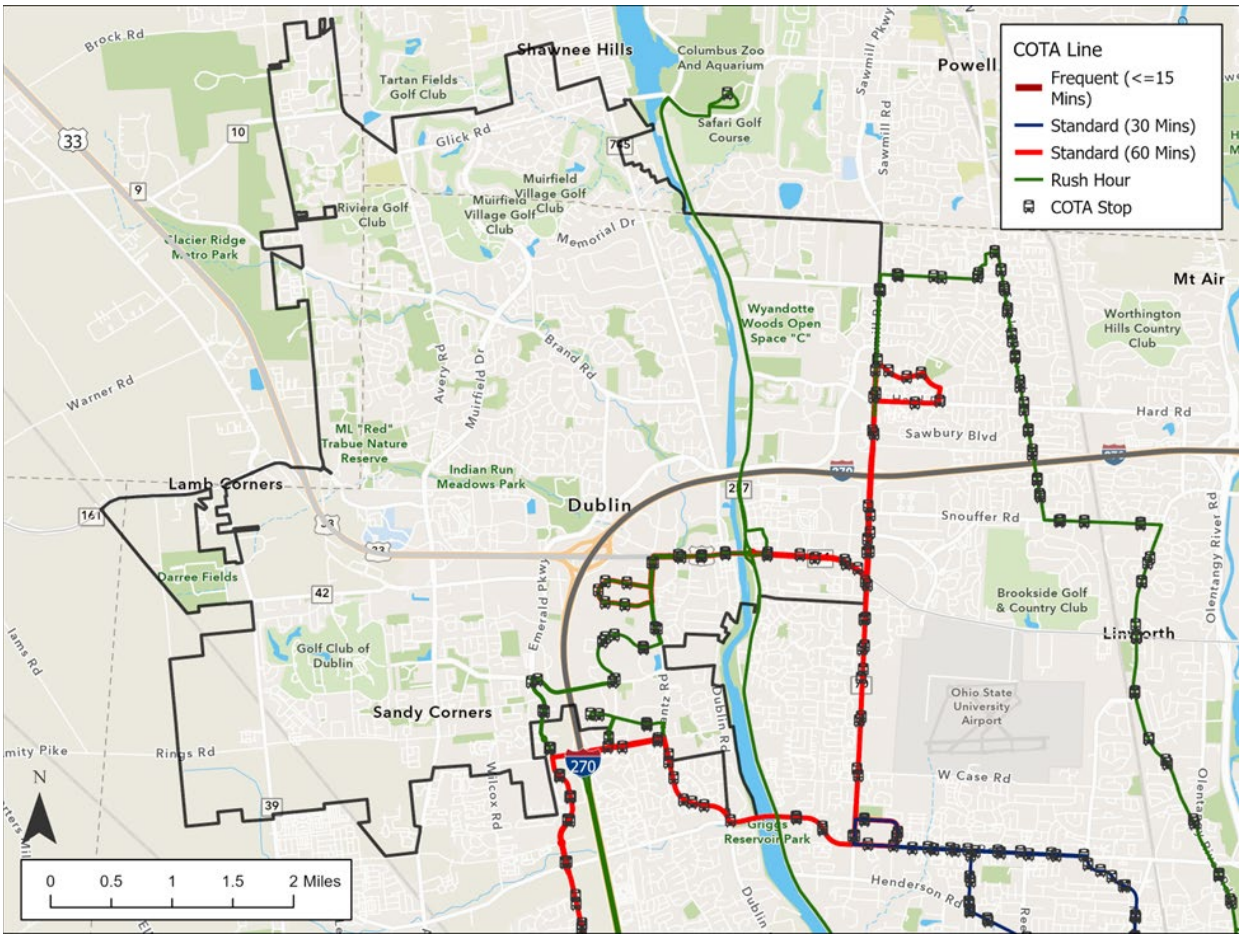
Transit

Dublin is currently served by six COTA routes, the 21, 33, 72, 73, 74 and Zoo bus. The 21 route runs every 60 minutes. The 33 route runs every 30 minutes south of Dublin Granville Road, where it splits and alternates trips to Olde Sawmill Square and Microcenter every hour. The 72, 73, 74, and Zoo bus all operate on a Rush Hour schedule with 1-4 trips in the morning and evening peak periods. The Zoo bus

[1] https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/
[2] https://www.prnewswire.com/news-releases/ey-research-nearly-half-of-us-car-buyers-intend-to-purchase-an-electric-vehicle-charging-and-safety-concerns-weigh-on-consumers-301863850.html
[3] https://investors.carvana.com/news-releases/2023/07-10-2023-140014673

only operates from May to October. Given that some riders using these routes leave a personal vehicle at the COTA Park & Rides while they are commuting to and from downtown, these lots may be ideal for level 1 and level 2 chargers. All six routes operate in the southeast portion of the City of Dublin.

Figure 31: COTA Lines and Stops in Dublin



Source: Dubscovery and COTA GIS and Mapping Hub

The Dublin Connector service is a unique, free mobility service for residents over 55 years old, residents with disabilities or anyone who works in Dublin. Dublin contracts with SHARE Mobility to offer the service and rides to work, the library, grocery shopping, medical appointments and other needed locations scheduled through an app, website or by phone. Currently, vehicles used for this service are located at Dublin's fleet building which already has EV charging.

Future Opportunity: Convert Dublin Connector vehicles to EVs and provide additional charging at Dublin's fleet building. LinkUS is an initiative to bring world class transit and mobility to central Ohio. The backbone of the system is a high-capacity transit network, with other features such as mobility hubs envisioned at key points as well. The Northwest Corridor of the system is planned to pass through Dublin along State Route (SR) 161 and possibly terminate at the Ohio University Dublin Integrated Education Center. **Figure 2** shows the locally preferred alternative route for the Northwest Corridor.

Future Opportunity: Electrification along this route so people can park, ride, and charge.

Figure 32: LinkUS Northwest Corridor

Source: LinkUS Northwest Corridor Locally Preferred Alternative

Related to LinkUS, Dublin also has an ongoing study of SR-161 to better understand how bus rapid transit, pedestrian friendly amenities and other roadway uses can benefit this corridor.

> **Future Opportunity**: Incorporate electrification opportunities along Dublin's SR-161 corridor so people can park, ride, and charge.

Public Parking

Of the 6,220 public parking spaces in Dublin, slightly over 10%, or 645, are for on-street parking. This street parking is located in the Bridge Park and Historic Dublin districts. When considering electrifying these spaces, both areas present different challenges. For Bridge Park, there are a number of parking structures with chargers already present and new chargers should be focused within the same garages where possible to avoid digging up streets to construct additional infrastructure. Similarly, on-street charging is going to be a challenge in Historic Dublin due to space constraints and existing infrastructure and is not recommended.

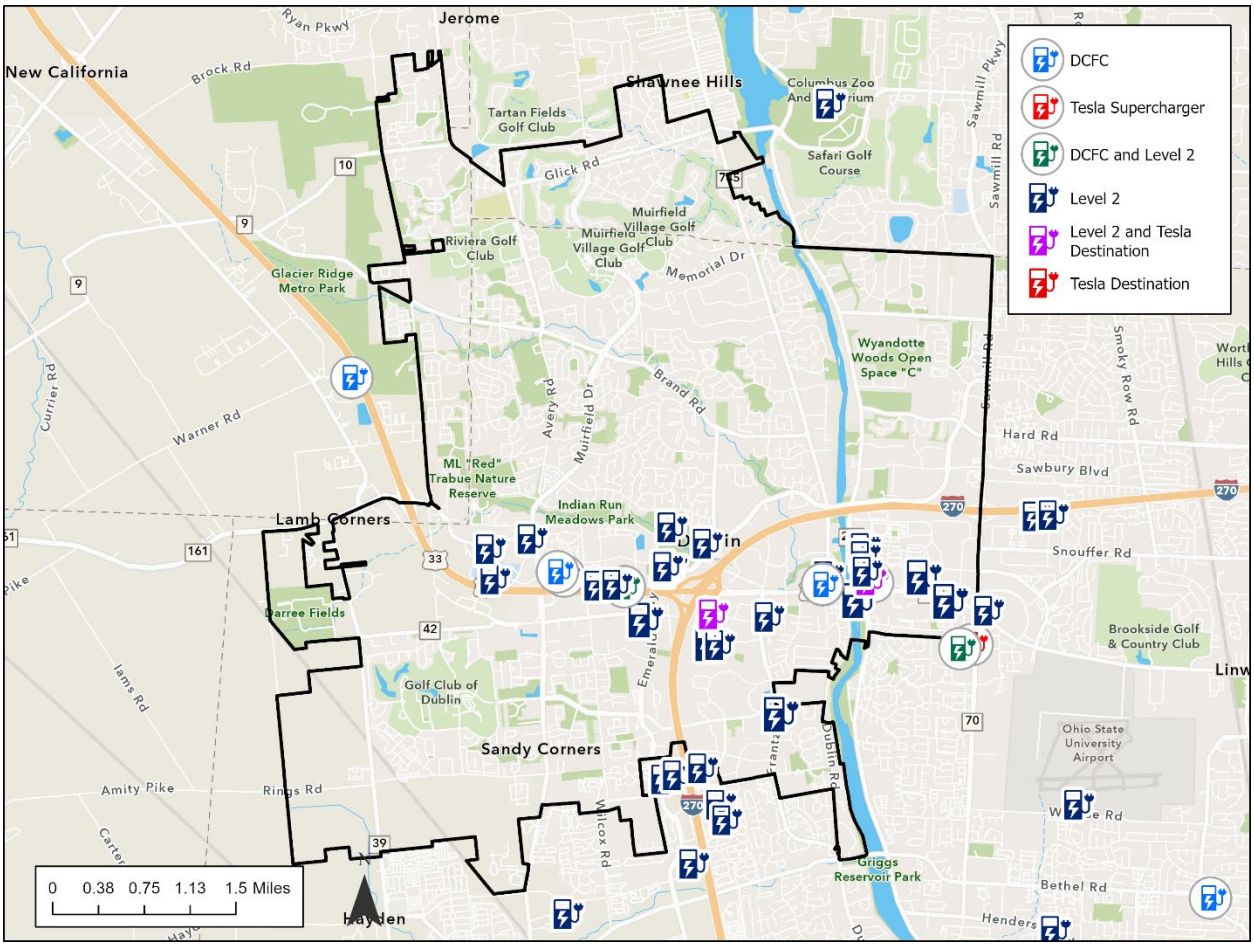
> **Future Opportunity**: Consider streamlining the permitting process to aid in the installation of public charging stations or offering parking incentives similar to the City of Cincinnati's Electric Car Incentive Program to help encourage EV drivers in Dublin.

Existing Charging Infrastructure

The existing charging infrastructure in Dublin, as shown in **Figure 3**, coincides with the areas of high-density commercial activity. The recommended locations of future EV charging will also largely be concentrated in these areas.

Future Opportunity: As EV adoption increases, Dublin can install charging infrastructure at city-owned facilities outside of the Bridge Park and Historic Dublin areas and encourage private businesses to do the same to help distribute charging resources throughout Dublin.

Figure 33: Existing Public EV Charging in Dublin



Source: AFDC, Plugshare, City of Dublin

Scenario Forecasting Methodology

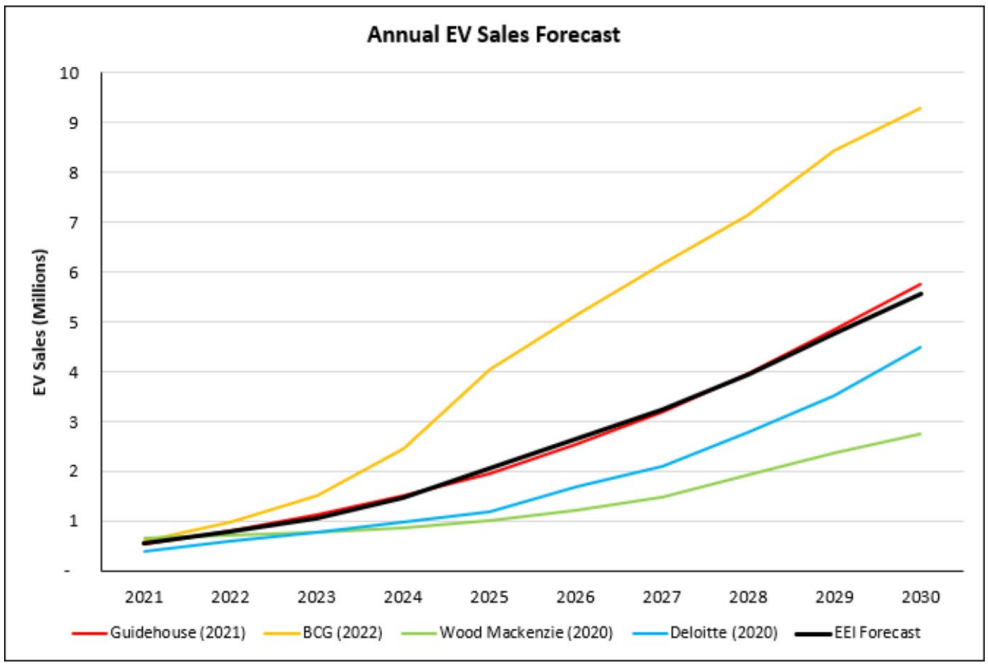
As a way to estimate the number and type of charging infrastructure that might be needed in Dublin by 2030, various EV sales forecasts and charger ratios were analyzed to develop a low, medium, and high future projection scenario. The *Edison Electric Institute (EEI) developed an EV forecast in 2018 and again in 2022[4] based on four independent forecasts:*

[4] https://www.eei.org/-/media/Project/EEI/Documents/Issues-and-Policy/Electric-Transportation/EV-Forecast--Infrastructure-Report.pdf

- Guidehouse – Guidehouse Insights: Plug-in EV (PEV) Sales by Region, World Markets (Q4 2021).[5]
- Boston Consulting Group (BCG) – Electric Cars Are Finding Their Next Gear (June 2022).[6]
- Deloitte – Electric Vehicles: Setting a Course for 2030 (July 2020).[7]
- Wood Mackenzie – Electric Vehicle Outlook to 2040 (2020).[8]

As shown in **Figure 4**, the models used to generate these forecasts show a wide range in projected EV adoption by 2030 since they use inputs such as customer preference to determine general interest in EVs, technological advances related to declining battery costs that influence EV cost competitiveness with internal combustion engine (ICE) vehicles, and fuel efficiency standards/environmental regulations which will drive investment in EVs by the automakers.

Figure 34: Annual EV Sales Forecast Compared to Selected Forecasts



Source: Edison Electric Institute

[5] Guidehouse. Market Data: EV Geographic Forecast – North America. https://guidehouseinsights.com/reports/market-data-ev-geographic-forecast-north-america

[6] Boston Consulting Group. Electric Cars are Finding Their Next Gear. https://www.bcg.com/publications/2022/electric-cars-finding-next-gear

[7] Deloitte. Electric Vehicles: Setting a Course for 2030. https://www2.deloitte.com/us/en/insights/focus/future-of-mobility/electric-vehicle-trends-2030.html

[8] Wood Mackenzie. Electric Vehicle Outlook to 2040. https://www.woodmac.com/our-expertise/capabilities/electric-vehicles/

EV Adoption Percentage by 2030

S&P Global Mobility[9] forecasts EV sales in the US could reach 40% of total passenger car sales by 2030, and more optimistic projections foresee electric vehicle sales surpassing 50% by 2030. It's important to note that these figures represent new sales of EVs, and not the vehicle stock on the road.

The City of Dublin has already shown to be a leader in Ohio in terms of EV adoption with:

- An EV adoption rate of 9.24% between Aug-Oct 2023 and 2.84% of all vehicles registered in Dublin being EVs.
- The average passenger vehicle age in Dublin is 3 years newer than the state as a whole (10 years vs. 13 years).

Higher vehicle turnover means that Dublin will likely electrify faster. Therefore, for the purposes of this document, it is assumed that 40% of registered vehicles in Dublin will be EVs in 2030[10].

To determine the number of EV chargers required to support the EV adoption forecast, EV to EVSE charging ratios and level 2 to DCFC port ratios were explored. The following sources were used to develop a low, medium, and high scenario for the number of chargers needed in Dublin by 2030.

- Norway: Internationally, Norway is often considered to be the leader in EV adoption with PEV sales in June 2023 reaching over 90%.[11]
- California: This state leads EV adoption in the US with PEVs making up a market share of 25% in Q2 2023.[12]
- US Department of Energy: The US Department of Energy (DOE) released a report in 2017 exploring how much charging infrastructure will be needed to support EV adoption in the US.[13]
- S&P Global Mobility: S&P Global compiled existing registration data and projected 28.3 million EVs by 2030[14].
- Alternative Fuel Infrastructure Directive (AFID): Regulates the deployment of public EV charging infrastructure in the European Union.[15]
- Edison Electric Institute: EEI compiled various trend data and adoption projections to forecast the number of chargers needed in the US by 2030.[16]

EV to EVSE Port Ratio

The EV to EVSE ratio represents the number of EVs on the road compared to the number of publicly available level 2 and DC fast chargers. This metric serves as a starting point to understand how many chargers might be needed based on the number of EVs registered. **Table 1** summarizes the existing and

[9] https://www.bls.gov/opub/btn/volume-12/charging-into-the-future-the-transition-to-electric-vehicles.htm
[10] Note that this figure will need to be monitored and updated based on future trends.
[11] https://insideevs.com/news/675163/norway-plugin-car-sales-june2023/
[12] https://www.veloz.org/california-ev-sales-reach-25-percent-market-share/
[13] https://www.energy.gov/sites/default/files/2017/09/f36/NationalPlugInElectricVehicleInfrastructureAnalysis_Sept2017.pdf
[14] https://www.spglobal.com/mobility/en/research-analysis/ev-chargers-how-many-do-we-need.html
[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02014L0094-20211112
[16] https://www.eei.org/-/media/Project/EEI/Documents/Issues-and-Policy/Electric-Transportation/EV-Forecast--Infrastructure-Report.pdf

recommended EV to EVSE ratios from low to high using the sources listed above, as well as the existing Dublin ratio.

Table 1: Existing and Target EV to EVSE Ratios

SOURCE	EV TO EVSE RATIO
Norway Existing	34:1
California Existing	26:1
US DOE Recommendation	18:1
S&P Global Recommendation	12:1
Dublin Existing	12:1
AFID/European Union Goal	10:1
EEI Goal	8:1
California Goal	7:1

Source: Listed on page 6

Electrification Scenarios

As of October 2023, 38,465 vehicles are registered in Dublin. Historically, population growth rates have averaged between 2 and 3%. Accounting for future growth, annexation, and visitors outside of Dublin that are not part of the population, using the high end annual growth rate of 3% seems reasonable to forecast the number of EVs registered in Dublin by 2030. If a 3% annual growth rate for vehicle registrations is compounded annually, about 47.4k vehicles will be registered in Dublin by 2030. To simplify the projections, the estimated vehicle registrations by 2030 was rounded to 50,000 vehicles. Using the assumed 40% EV adoption rate with the estimated 50,000 vehicles, the projected number of EVs registered in Dublin in 2030 is estimated to be 20,000. This figure is used below in each scenario and in calculations summarized in **Table 2**.

Table 2: Dublin Electrification Scenarios - Low, Medium, and High

	EV TO EVSE RATIO	EV TO EVSE RATIO SOURCE	EVSE NEEDED IN DUBLIN BY 2030
Low Electrification	34:1	Norway Existing	588
Medium Electrification	18:1	US DOE Recommendation	1,111
High Electrification	7:1	California Goal	2,857

Source: HNTB

Low Electrification

Using the lowest EV to EVSE ratio from Norway at 34 EVs for every EVSE, Dublin would need about 588 EVSE ports by 2030.

Medium Electrification

Using the medium EV to EVSE ratio recommended from the USDOE report at 18 EVs for every EVSE, Dublin would need about 1,111 EVSE ports by 2030.

High Electrification

Using the highest EV to EVSE ratio set as a goal by California of seven EVs for every EVSE, Dublin would need about 2,857 EVSE ports by 2030.

Fleet Electrification

Dublin's fleet was also examined to determine which municipal vehicles were good candidates for electrification based on use cases and duty cycle in order to assess future fleet transition opportunities and charging needs. Dublin had 232 fleet vehicles as of August 29, 2023, and 218 of those were driven in the preceding year. Of the 218 to be evaluated for electrification, 18 vehicles were identified for snow and leaf removal and excluded from consideration. An additional 88 vehicles were removed from consideration because they were either medium-duty or their use cases were not compatible with electrification in the near term. One Nissan Altima with no miles was re-included for replacement analysis. As a result, a portion of the remaining 113 vehicles are possible candidates for electrification. Nine of these were police pursuit vehicles, which were targeted for replacement by hybrids due to operational constraints. Plug-in Hybrid (PHEV) and Battery Electric (BEV) vehicles were examined for each of the remaining models.

Table 3: Dublin Fleet Vehicles Analyzed

Total Fleet Vehicles as of 8/29/2023	**232**
Vehicles with Miles in Preceding Year	218
No Miles but Re-Included	1
Snow and Leaf Removal	18
Medium Duty or Incompatible with Electrification	88
Total Vehicles Analyzed	113

Source: City of Dublin, HNTB Analysis

Based on this analysis, we recommend a level 2 charger be installed for each fleet vehicle converted to electric. This 1:1 ratio would guarantee that the fleet vehicles can be recharged overnight without requiring city employees to move vehicles. In addition, any BEV police vehicles should have access to DCFCs at a 1:25 ratio. These ratios would result in a requirement for 109 level 2 chargers, plus 2 DCFC ports. Level 1 chargers could be implemented on an as needed basis for fleet vehicles with very low duty cycles or for any fleet PHEVs and would likely be easy to utilize since 110V outlets would be available at Dublin facilities.

Level 2 to DCFC Ratio

Another important ratio to aid in planning for the appropriate number of EV charging infrastructure is the level 2 to DCFC ratio, which informs the *type* of chargers needed by location. To determine what ratio of public level 2 chargers to DCFC is appropriate, ratios from other geographies were benchmarked. **Table 4** summarizes these ratios from low to high, including the existing Dublin ratio.

Table 4: Existing and Target Level 2 to DCFC Port Ratios

SOURCE	LEVEL 2 TO DCFC RATIO
California Goal	25:1
US DOE	25:1
EEI Goal	25:1
Dublin Existing	12:1
S&P Global	12:1

SOURCE	LEVEL 2 TO DCFC RATIO
California Existing	5:1
Norway Existing	3:1

Source: Listed on page 6

Type of EV is important when considering what charging level is appropriate. PHEVs, which represent 21% of alternative fuel vehicles in Dublin, cannot use DCFCs and many can rely on level 1 chargers since battery sizes are smaller compared to BEVs.

Recommended Electrification Scenario

Based on discussions with working group members and the Dublin Economic Development team, Dublin wants to ensure that adequate charging will be offered for incoming workers, tourists and residents who may not be able to access charging at-home, i.e. multi-unit dwellings, while not overbuilding as the technology is changing rapidly. Alignment with Norway's existing 34:1 ratio is justifiable based on similar home charging availability in Dublin. For example, 82% of EVs in Norway charge at home[17]. Although at home charging data was not available for Dublin, 68% of Dublin's total housing units are single family detached homes, with an additional 15% comprised of single family attached housing products[18]. Assuming that both types of homes have the ability to setup a home charger, over 80% of Dublin homes could provide charging for EVs. As a result, **it is recommended that Dublin start with a 34:1 EV to EVSE ratio goal for 2030, although this goal should be reassessed biennially based on existing data, market trends, and funding availability.**

When determining the number of level 2 charging ports needed compared to DCFC ports, it's important to consider the usage type and location of the chargers. Most retail centers, multi-unit dwellings, and higher vehicle AADTs are clustered along the US-33/SR-161 corridor, especially near Bridge Street. Given this higher concentration within the Dublin area, with the availability of home charging being very high, it is recommended to have a more conservative ratio in the Dublin area at a 20:1 level 2 to DCFC as shown in **Table 5**.

Table 5: Dublin 2030 Electrification Recommendations

Assumed Total Number of Vehicles Registered in Dublin (based on 2023 registrations)	**50,000**
Projected Number of EVs in Dublin (40%)	20,000
Recommended EV to EVSE Ratio (to be reassessed at least biennially)	34:1
Recommended Number of Public EVSE	588
Recommended Level 2 to DCFC Ratio	20:1
Recommended Public Level 2 Ports	559
Recommended Public DCFC Ports	29

Source: HNTB

Note that Dublin is already well on its way to reaching these targets with 83 existing public level 2 charging ports and 6 existing DCFC ports. **Table 6** shows targets for implementation to meet the current 2030 recommendations. It's important to note that these targets do not follow a linear trendline, but

[17] https://www.theglobeandmail.com/business/article-ev-charging-stations-norway/.
[18] https://communityplan.dublinohiousa.gov/character/demographics

instead mirror the EV adoption curves that show more exponential growth later in time. Another important note is that this table represents the recommended number of ports in the Dublin area, which includes public and private facilities.

Table 6: Public Level 2 and DCFC Recommended Implementation Targets by Year

YEAR	LEVEL 2 PORTS	DCFC PORTS
2023 (existing)	83	6
2025	150	15
2028	300	22
2030	559	29

Source: HNTB

Locations and Usage Type

The following section addresses how the assumptions presented in the previous section translate into opportunities for level 1, level 2, DCFC, and private parking use cases. Based on the recommended electrification scenario, the following types of chargers could be implemented for the applications shown below.

Level 1 Charging

Although specific level 1 recommendations are not included above, there are some use cases where this level of charging can serve as a low-cost solution. Level 1 charging is ideal for applications where EVs have very long dwell times or when the vehicle has a small battery. Since PHEVs rely on both an electric motor and an internal combustion engine, the battery sizes are typically much smaller than a BEV. Micro-mobility solutions such as e-scooters or e-bikes can also use level 1 charging due to the small battery sizes. Locations that could be applicable for level 1 charging could include:

- Mobility hubs that accommodate micro-mobility
- Fleet hubs, particularly for PHEVs or EVs that have smaller daily duty cycles and are able to charge overnight or are not used on a daily basis

Level 2 Charging

Level 2 charging is the most common EV charging level, where vehicle dwell times are typically a couple hours to overnight. These types of chargers are ideal for the following types of publicly available applications:

- Restaurants
- Retail stores
- Parks
- Public parking (on-street, parking lots, parking garages, park and rides)
- Mobility hubs (for EVs with long dwell times)

The following private applications are also ideal for level 2 charging but not part of the recommended electrification scenario presented in **Table 5** with 559 level 2 ports:

- Single-family housing
- Multi-unit dwellings
- Workplaces
- Fleet hubs, including for on-road vehicles, off-road vehicles, and micro transit shuttles (the City of Dublin's existing fleet chargers are level 2)

DCFC

This charging level is best suited for BEVs with short dwell times. Relevant public applications should be along major arterials and interstates and near high-population density areas such as:

- High turnover retail (e.g. grocery stores)
- High turnover restaurants
- Mobility hubs (for Transportation Network Company vehicles or vehicles with short dwell times)

Private applications for DCFC include:

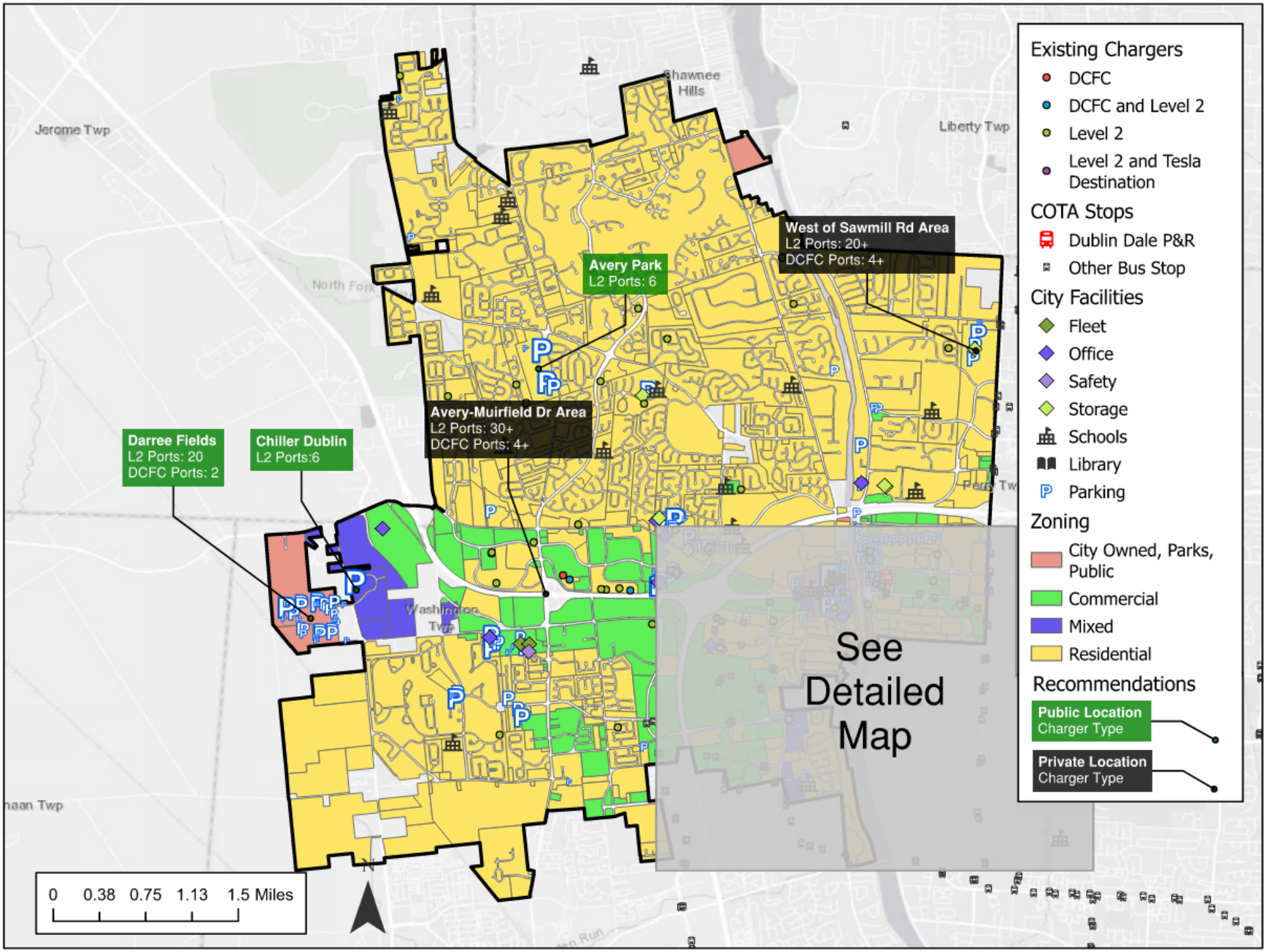
- Fleet charging with aggressive duty cycles (e.g. police vehicles)
- Transit buses

Private Parking

Since the City of Dublin has limited influence on which private businesses decide to install EV chargers, the recommended private location EV charger deployments referenced in the recommended projection scenario section just show a representation of a couple general commercial areas within Dublin.

Recommended Projection Scenario

Figure 5 and **Figure 6** show the recommended public and private level 2 charging locations and public DCFC ports based on the recommended electrification scenario of 34:1 EV to EVSE ratio and 20:1 level 2 to DCFC ratio. **Table 7** also summarizes these recommendations.


Jerome Twp
Shawnee Hills
Liberty Twp
North Fork
Washington Twp
Darree Fields
L2 Ports: 20
DCFC Ports: 2
Chiller Dublin
L2 Ports:6
Avery Park
L2 Ports: 6
Avery-Muirfield Dr Area
L2 Ports: 30+
DCFC Ports: 4+
West of Sawmill Rd Area
L2 Ports: 20+
DCFC Ports: 4+
See Detailed Map
Existing Chargers
DCFC
DCFC and Level 2
Level 2
Level 2 and Tesla Destination
COTA Stops
Dublin Dale P&R
Other Bus Stop
City Facilities
Fleet
Office
Safety
Storage
Schools
Library
Parking
Zoning
City Owned, Parks, Public
Commercial
Mixed
Residential
Recommendations
Public Location
Charger Type
Private Location
Charger Type
0 0.38 0.75 1.13 1.5 Miles

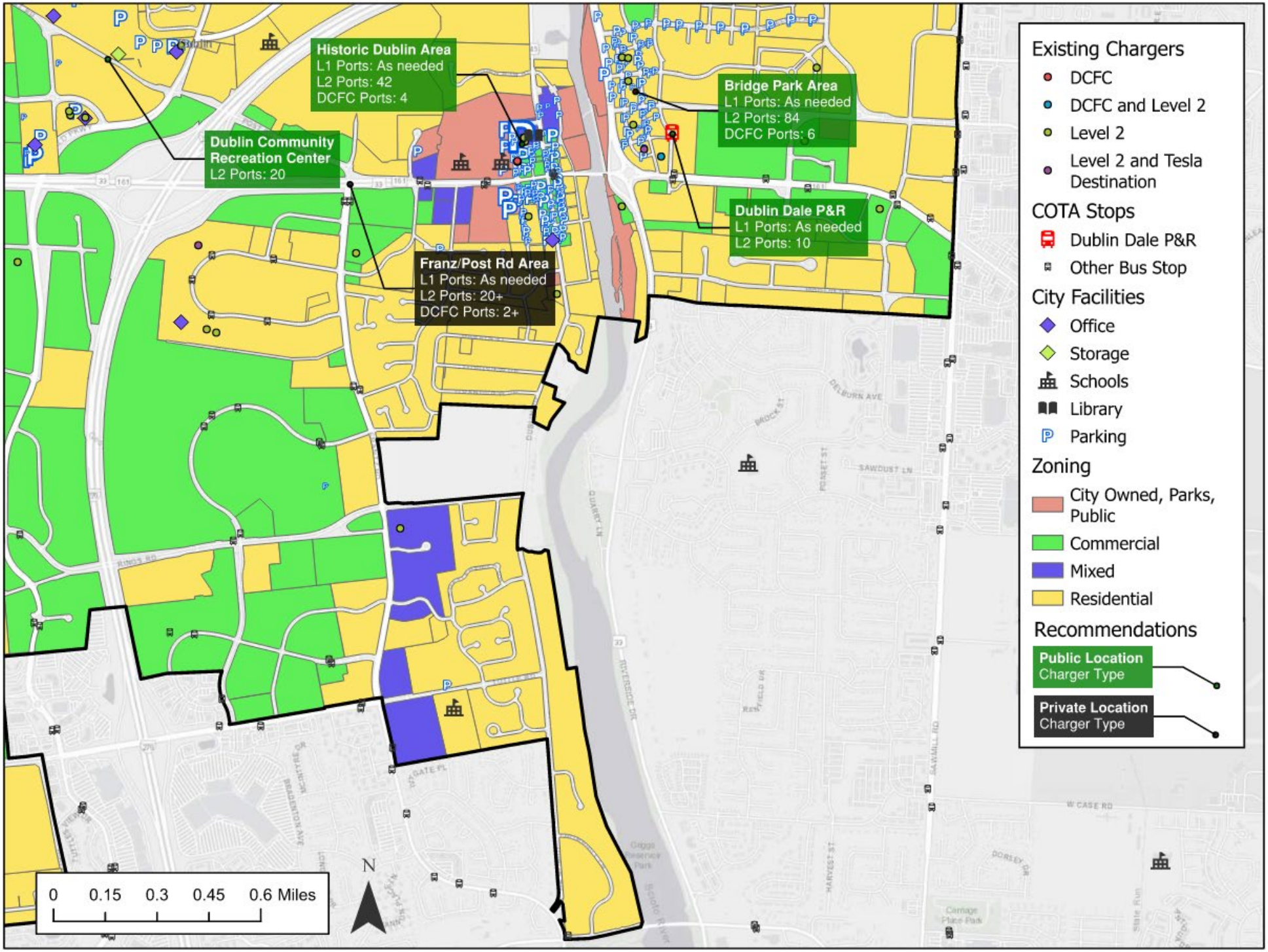

Historic Dublin Area
L1 Ports: As needed
L2 Ports: 42
DCFC Ports: 4
Dublin Community Recreation Center
L2 Ports: 20
Bridge Park Area
L1 Ports: As needed
L2 Ports: 84
DCFC Ports: 6
Dublin Dale P&R
L1 Ports: As needed
L2 Ports: 10
Franz/Post Rd Area
L1 Ports: As needed
L2 Ports: 20+
DCFC Ports: 2+
Existing Chargers
DCFC
DCFC and Level 2
Level 2
Level 2 and Tesla Destination
COTA Stops
Dublin Dale P&R
Other Bus Stop
City Facilities
Office
Storage
Schools
Library
Parking
Zoning
City Owned, Parks, Public
Commercial
Mixed
Residential
Recommendations
Public Location
Charger Type
Private Location
Charger Type
0 0.15 0.3 0.45 0.6 Miles
N

Table 7: Recommended Charging Locations and Estimated Costs

PROPERTY TYPE	LOCATION	LEVEL 2 PORTS	DCFC PORTS	ESTIMATED LEVEL 2 COST†	ESTIMATED DCFC COST‡
Public & Private	Existing	83	6	-	-
Public	Historic Dublin Parking	42	4	$283,500	$800,000
Public	DCRC	20	0	$135,000	-
Transit	Dublin Dale Dr P&R	10	0	$67,500	-
Public	Darree Fields	20	2	$135,000	$400,000
Public	Dublin Chiller	6	0	$40,500	-
Public	Avery Park	6	0	$40,500	-
Public	Bridge Park Garages	84	6	$567,000	$1,200,000
Public	Other Public Locations*	64+	0+	$432,000	-
Private	Avery-Muirfield Dr Area	30+	4+	$202,500	$800,000
Private	Franz/Post Rd Area	20+	2+	$135,000	$400,000
Private	West of Sawmill Rd Area	20+	4+	$135,000	$800,000
Private	Other Private Locations*	154+	1+	$1,039,500	$200,000
		559+	**29+**	**$3,213,000**	**$4,600,000**
				$7,813,000	

*: Not shown on maps
†: Assuming level 2 cost per port of $6,750
‡: Assuming DCFC cost per port of $200,000
Source: HNTB

These targets are meant to be the minimum recommendations to support 20,000 EVs in Dublin by 2032. Dublin should also look for opportunities to distribute EV charging throughout the Dublin area to be used by both the public and fleet vehicles. In areas without an abundance of commercial activity, where a private company may not be able to justify a business model for installing chargers, the City should consider installing their own chargers in that area if a city-owned facility exists. For example, both level 2 and DCFC are recommended for Darree Fields, an area further away from commercial activity. Dispersed charging locations like this could be used by the public but also by Dublin fleet vehicles (such as police vehicles) as needed so they wouldn't necessarily need to go back to the depot to charge. Level 1 charging locations are also shown in the maps at a high level in high density areas as needed for micro transit and other uses as needed.

Note that the estimated costs shown in **Table 7** can vary widely based on specific site characteristics. Various funding options to install charging infrastructure also currently exist and will likely be available in the future to offset costs.

EV Charging Station Ownership

Dublin's existing model for public and private EVSE ownership is to contract with a third-party to have chargers located on city property. This contract allows Dublin to purchase and own the chargers, but the installation, operations, and maintenance are covered by the third-party. Dublin has taken advantage of grants to support a portion of the cost. This model allows Dublin to benefit from owning the EVSE while not having to carry specialized staff or contracts to operate and maintain the chargers.

Currently, no fees exist for public EV charging in Dublin – users may charge for free. This may help spur EV adoption in the short term, but as adoption increases, and with it the demand for more public charging, a fee structure is recommended. Charging a fee at public charging stations is a best practice for both level 2 and DCFC stations for the following reasons:

- Free charging can lead to poor charger etiquette where users may plug in even if they don't need to, resulting in less charging options for drivers that actually do need a charge, or people unplugging other vehicles to charge their own.
- A fee structure can offset demand charges incurred during peak electricity usage periods.
- Free public charging can hinder private investment in charging since site hosts can't compete.
- Free charging (especially DC fast charging without idle fees) does not incentivize drivers to move their vehicle after charging is complete (or at least 80%).

While there are myriad ownership options, three are discussed below: Dublin owned and operated, Dublin owned but services contracted out, and third-party owned but leases land from Dublin.

Dublin Owns and Operates EVSE

Charging infrastructure is purchased, installed, and maintained by Dublin, which allows for full control over the station and the ability to keep all revenue from the station (if applicable). In this scenario, Dublin is responsible for all associated costs, including any maintenance[19] or payment transaction fees. Challenges of this model are high up-front capital investment; needing highly skilled personnel for installation, operations, and maintenance; and worrying about changing out equipment as vehicles change how they interact with EVSE.

Dublin Contracts Full-Service EVSE

This is the existing setup in Dublin and allows for predictable overhead costs to the City while maintaining a level of service spelled out in the contract. The City has less control over the station and possible revenue from charging, but also has less overhead cost and can take advantage of any data collection that comes with the EVSE. Favorable contract terms, such as uptime requirements and electric metering and billing, can make or break the public's impression of the chargers. Challenges of this model are long contract terms, which may not allow for a change out of equipment as frequently as preferred and relying on a third-party to perform maintenance which may be slower and less reliable than expected.

Third-Party Leases Site from Dublin and Owns and Operates EVSE

Charging infrastructure owned by a third-party is installed on Dublin property through a lease and maintained by the third-party, which minimizes responsibility to Dublin as the site host. In some cases, the lessor may earn revenue instead of or on top of lease payments. Many of the National Electric Vehicle Infrastructure (NEVI) partnerships are structured this way, and it may be preferred by charging vendors who are used to this structure. The party who pays for the electricity can vary between the site host and the third-party based on the arrangement. Contract terms also make or break this type of arrangement, with additional key considerations being access by the site host if needed, restoring the site to its original condition after the lease ends, and ownership of the chargers after the contract

[19] https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html

period. The main challenge with this model is loss of control of all charging activities (i.e., fee charged) unless negotiated in the lease agreement.

Table 8: EVSE Charging Ownership Types

CONSIDERATION	DUBLIN OWNS AND OPERATES	DUBLIN CONTRACTS WITH THIRD-PARTY FOR FULL SERVICE EVSE	THIRD-PARTY LEASES SITE FROM DUBLIN AND OWNS AND OPERATES
Equipment Cost	High up-front cost for EVSE	High up-front cost for EVSE	Low to no up-front cost for EVSE
Installation	Need to contract with someone to install (with proper experience)	Installation handled by third-party	Installation handled by third-party
Operations & Maintenance	Need to train existing staff or contract someone to operate and maintain	Operations and maintenance are handled by third-party	Operations and maintenance are handled by third-party
Revenue from Fees	If a fee is charged, Dublin can keep all fees. If site-host is a government, fees made for services need to be reasonably in line with the cost of providing such services.	If a fee is charged, Dublin can keep all fees. If site-host is a government, fees made for services need to be reasonably in line with the cost of providing such services.	Depending on contract terms and if a fee is charged, revenue may first go to third-party to pay for equipment, installation, operations and maintenance then to Dublin.
Measuring Performance	May need additional software to track charging data	Contract allows access to charging data dashboard	Minimal data will be shared unless negotiated
Cost of Electricity	Responsible for electricity cost	Typically responsible for electricity cost, depending on contract terms	May or may not be responsible for electricity cost

Source: HNTB

For Dublin, continuing to contract out full services through a third-party is recommended. This contract type presents the lowest risk due to lower overall costs, skilled professionals maintaining equipment, and changing out third-party providers if the EVSE does not meet needs or expectations. EVSE equipment, like most technologies, is expected to get better, more efficient, adapt to the new vehicle technology, and provide better service to the users. Until that level of service is achieved, contracting out for this service is recommended.

Conclusion

Dublin is growing quickly, and EV adoption is expected to remain ahead of the rest of the state. It is estimated that Dublin will need roughly 588 public EVSE by 2030, depending on EV adoption. Dublin is already well positioned to meet this target based on the existing number of chargers currently available but should reassess often to align with actual EV adoption trends and funding opportunities. Fleet

deployments, specifically for city operations, will be another area for Dublin to focus on. Assumptions used to determine the recommendations presented here should be updated at least every couple years to ensure they are in line with the latest EV market factors.