MEMO

To: Yong YIN (Mayor of Beijing, China)
From: David SHI (Secretary of Beijing Municipal Commission of Development and Reform)
Subject: Improving Accessibility of Electric Vehicle Charging Stations in Beijing's Urban Areas
Date: December 10th, 2024

ISSUE

Beijing faces a critical challenge of expanding the electric vehicle (EV) charging infrastructure to accommodate its rapidly growing EV fleet, which is projected to reach 1,500,000 by 2025[i]. Despite the existence of 114,000 public stations[ii], **high land rent** and **grid voltage constraints** have led to a **sparse** and **uneven** distribution of charging facilities, particularly in the densely populated urban districts. In addition, fossil fuel vehicles continue to outnumber EVs by 80%[iii], highlighting the need to enhance charging availability to **strengthen consumer confidence** in EV adoption. Addressing this challenge is essential not only to fulfill the targets in the *China Energy Transition White Paper*[iv]**,** but also to establish Beijing as a model for decarbonization. How could Beijing improve the accessibility of the EV charging infrastructure in its urban areas while addressing economic, geographic, and technical constraints?

STAKEHOLDERS/INTERESTS

1. **The Beijing City Government** oversees urban planning and EV infrastructure deployment, aiming to 1) boost consumer confidence in EV and meet the national goal of 30% adoption rate[v], and 2) enhance Beijing's status as a leader in green mobility
2. **State Grid Corporation of China** wants to 1) support the government's decarbonization agenda, 2) secure public funding for its projects, and 3) generate profit from electricity sale
3. **EV Owners** prioritize 1) easier access to charging stations, 2) minimal wait times, and 3) affordable charging fees
4. **Private Charging Companies** are essential partners in implementing EV charging policies. Their interests include 1) securing government subsidies, 2) expanding market presence, 3) ensuring profitability, and 4) innovating with technologies like smart charging
5. **Real Estate Developers** influence the placement of charging stations in commercial areas. They focus on 1) integrating EV charging stations into property developments to increase asset value, 2) earning profits through public-private partnership, and 3) ensuring that EV infrastructure aligns with their zoning plans and aesthetic considerations
6. **Local Residents** could worry about 1) inconveniences caused by grid renovation projects including noise, dust, and restricted access to spaces, 2) adjustments to property layouts in residential areas, and 3) rising utility prices due to increased electricity demand

ANALYSIS

1. Unbalanced Supply and Demand in Urban Districts

- **On the Supply Side:** Beijing now has 114,000 public charging stations, but a significant proportion of them are located in **suburban areas** 15 kilometers away from downtown[vi]. (also see *Exhibit 1*) While these stations benefit from lower land rent and offer reduced charging costs, they primarily attract taxi and ride-hailing drivers, leaving private car owners underserved. Many of them are reluctant to drive long distances to access suburban facilities and instead **suffer long wait times** at the central residential or commercial zones.
- **On the Demand Side:** Beijing's EV fleet has grown to **900,000** by 2024[vii] and is projected to reach **1,500,000** by 2025. The surge is driven by government subsidies for EV purchases and increasing consumer interest in reducing emissions and fuel costs. However, the sharp rise in demand for charging infrastructure risks outpacing the Beijing's current capabilities. Without sufficient charging options, potential consumers may **hesitate to adopt** EVs due to concerns about convenience and reliability.

2. **Grid Voltage Constraints**
   Many old residential and commercial districts have **outdated grid systems** that are unable to support the installation of additional charging stations without substantial upgrades. These constraints also limit the ability to integrate renewable energy sources, such as solar or wind, into the charging infrastructure, further hindering efforts to reduce emissions.
3. **High Land Rent for Private Firms**
   The high cost of acquiring parking spaces in Beijing's urban areas significantly hinders the expansion of charging stations. Parking rents range from **1,000 to 5,000 RMB** per month[viii], making it prohibitively expensive for private charging firms to secure suitable locations. Without targeted subsidies or land-use incentives to reduce these costs, the financial burden will continue to limit charging station deployment in central districts.
4. **Space Limitations**
   Beijing's high-density development has left **few underutilized public spaces** available for new charging facilities[ix]. Building entirely new lots is nearly impossible without displacing existing functions or altering land use priorities.

CRITERIA

Fiscal Feasibility	Can the government afford both initial investment and long-term operational costs without overburdening budgets?
Implementation Speed	How quickly can the policy be implemented to address the urgent demand for EV charging infrastructure?
EV Adoption	Will the policy increase EV adoption and potentially contribute to reduction of greenhouse gases?
Charging Cost	Does the policy ensure affordable charging costs for EV users while maintaining financial sustainability for operators?
Charging Flexibility	Does the policy provide convenient charging solutions?
Scalability	Is the policy flexible enough to be adopted in other cities?

OPTIONS

1. **"Park and Charge"**

- Provide an **80 million RMB subsidy package** to incentivize private charging companies to establish EV charging stations in public spaces like street parking lots, office building garages, and shopping malls.
- Set a parking rent cap of **2,500 RMB per month** to reduce acquisition expenses of private charging companies and avoid passing high costs onto EV users.
- Target commercial districts where congestion and EV adoption rates are highest first.
- Users will pay **30 RMB per charge**, ensuring a sustainable revenue stream.

Pros: Placing the stations in public spaces enhances **visibility**, potentially boosting EV sales by making charging infrastructure more apparent to potential consumers. Utilizing existing urban spaces also speeds up the implementation, as it **avoids the need for new land acquisition**. In addition, it **generates revenue** from user fees, which can be reinvested into further expansion.
Cons: Putting stations in busy commercial areas may exacerbate **traffic congestion**, especially during peak hours. High usage in these central districts can also lead to **faster wear and tear**, increasing maintenance costs for charging companies. Finally, enforcing the parking rent cap might face resistance from property owners and **delay implementation**.

2. **"Home Powered"**

- Subcontract to the State Grid Corporation of China to renovate the grid system in old residential parking lots to allow for **private home charging stations**.
- Provide initial funding of **200 million RMB** to support the renovation project.
- Homeowners will pay the installation fees themselves (between **3,000 and 5,000 RMB**).

Pros: This approach offers EV owners with the flexibility to charge their vehicles **at home**, eliminating time and spatial constraints. The charging cost is far more **affordable**: charging an EV with a 200-kilometer range costs around 18 RMB (0.09 USD) per kilometer[x]. The renovated grid can also **support future upgrades**, enabling compatibility with next-generation electricity technologies such as smart grids and renewable energy integration.
Cons: This option requires huge government financing to initiate the renovation and may **strain fiscal resources**. Moreover, some residents might resist the rezoning or modifications needed for the upgrade due to the **inconveniences**. Additionally, the extensive size of old residential areas means that the project will have a **long timeline**.

3. **"Power on Wheels"**

- Private firms have introduced a **mobile charging service** where autonomous robots deliver large batteries directly to the EV owners' locations. These robots function like ride-hailing services but without human drivers, providing on-demand charging support.
- Offer **20% tax credits** to encourage private firms to research and develop the technology.
- Set **regulatory guidelines** to ensure quality standards of both the batteries and the robots. Business licenses will be issued only to firms that pass the **safety tests**.

Pros: This approach offers exceptional flexibility, allowing mobile charging robots to reach **underserved areas** and respond to **emergencies** where permanent infrastructure is unavailable.
Cons: This service might be very **expensive** for users, as private companies control pricing. The limited battery capacity means that users might not receive a full charge, forcing them to rely on the service more frequently. Also, the return on investment for this tech is currently not very promising, with the R&D cost estimated to be **200,000 RMB per robot**[xi].

Criteria	Option 1	Option 2	Option 3
Fiscal Feasibility	Medium	Low	Medium
Implementation Speed	Medium	Low	Medium
EV Adoption	High	High	Low
Charging Cost	Medium	High	Low
Charging Flexibility	Low	High	High
Scalability	Low	Medium	High

RECOMMENDATION

I recommend **Option 2: "Home-Powered"** as the most sustainable and impactful solution. It empowers EV owners to charge their vehicles at home, reducing reliance on public charging stations. While it requires substantial upfront investment from the government and installation fee from homeowners, it offers significant long-term benefits including lower price for charging, reduced traffic pressure, future compatibility with advanced technologies, and a decentralized charging network that improves overall efficiency. Despite a longer timeline for implementation, the investment is well-justified by its potential to drive widespread EV adoption.

RISKS/UNCERTAINTIES

1. **Resistance from Local Residents:** Some property owners might oppose modifications or rezoning required for the renovation, citing disruptions to daily activities or concerns about property values. This may lead to **legal disputes** or **negotiations** that slow implementation.
2. **Grid Overload**: Increased demand from home charging could put **excessive pressure** on the grid in certain areas, particularly during peak hours when residents return from work.
3. **Inefficient Coordination**: The renovation required close cooperation between government, State Grid Corporate of China, and third-party subcontractors. Any delay in communication could lead to a **prolonged timeline** and postpone the program's benefits.

IMPLEMENTATION

Objectives and Key Results (Also See *Exhibit 2*)

Objective 1: Complete Grid Renovation and Station Installation	
Time	**Key Results**
2025 Q4	Complete grid renovation in **30%** of urban residential areas.
2026 Q3	Install personal charging stations for **100,000** EV owners.
2026 Q4	Complete grid upgrades in **60%** of urban residential areas.
2027 Q3	Install personal charging stations for **250,000** EV owners.
2027 Q4	Complete grid upgrades in **100%** of urban residential areas.
2028 Q2	Install personal charging stations for **350,000** EV owners.
Objective 2: Boost Public Confidence in EVs and Charging Infrastructure	
2026 Q3	Host **10 feedback sessions** with stakeholder representatives to adjust strategy.
2027 Q1	Conduct **30 public engagement workshops** to increase consumer confidence in EVs and charging station accessibility.
Throughout Project	Achieve a **75%+ satisfaction rate** among homeowners on charging stability and convenience in monthly customer survey.
Objective 3: Strengthen Monitoring and Evaluation	
2024 Q4	Set up a **joint task force** with the State Grid Corporation of China, aiming to monitor and report on grid upgrade progress.
Throughout Project	Secure a formal commitment from the State Grid Corporation of China to allocate resources (e.g., manpower, technical support) to areas that fall behind schedule, keeping project delay rate **under 10%**.
Throughout Project	Mandate the joint task force to conduct periodic on-site inspections, ensuring **at least 90%** of projects comply with established safety and quality standards.

BUDGET/COSTS

1. **Fixed Costs (215 million RMB)**
- Grid Refurbishment: 200 million RMB in **upfront government financing**
- Subcontracting: 5 million RMB for **initial feasibility research** and **project oversight**
- Public Outreach: 10 million RMB for information campaigns to 1) address resistance from residents by **offering rebates** and 2) organize **public campaigns** to boost consumer trust

2. **Variable Costs (221 million RMB)**
- Staff Salary (3-year-period): 201 million RMB (see *Exhibit 3* for further details)
- Maintenance and Support (3-year-period): 20 million RMB for grid maintenance

FUNDING PIPELINE

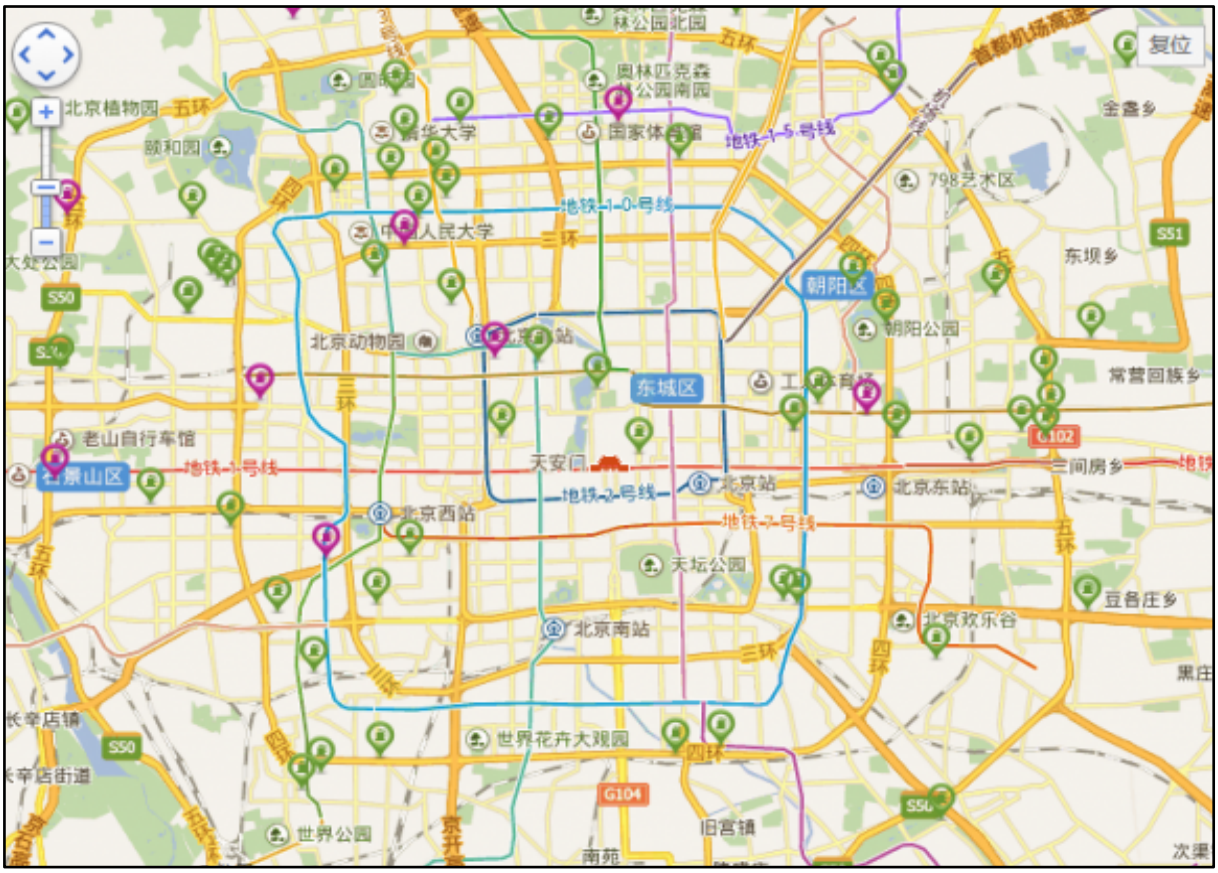
1. **Local Government Budget:** The city government will allocate funds to cover about **70%** of the total project costs, including **all the fixed costs** and **20% of the variable costs**. These funds will come from the municipality's urban development budget, earmarked for energy transition and infrastructure modernization programs.
2. **National Subsidies:** The remaining **30% of funding** will be requested from the *National Development and Reform Commission* under existing carbon neutrality action plans like the *14th Five-Year Plan for Carbon Emission Reduction.*

RISK MANAGEMENT

This option faces three key risks: **1) strategic risk** such as misalignment of stakeholder interests, **2) preventable risk** including excessive pressure on grid network, and **3) external risk** like regulatory changes and economic fluctuations. Mitigation plans are detailed in *Exhibit 4*.

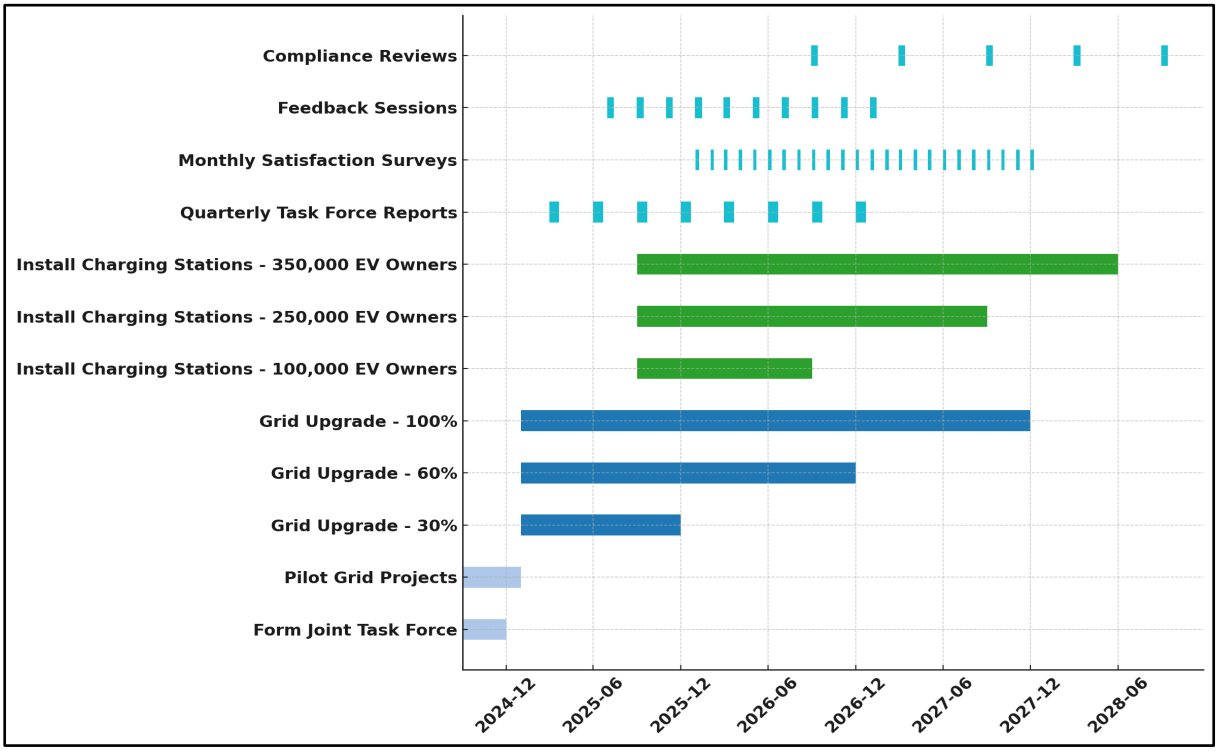
APPENDIX

Exhibit 1 Distribution of Public Charging Stations in Beijing



From the map, it is evident that a large proportion of public charging stations are concentrated in suburban areas, particularly in the northwestern part of the city. In contrast, downtown areas show considerably lower coverage, highlighting a stark imbalance in infrastructure deployment.

Exhibit 2 Gantt Chart for Implementation



I attest that I did not give or receive unauthorized assistance, including from any form of AI, while working on this paper.

Exhibit 3 Staff Salary (3-Year-Period)

Title	Salary (RMB/year)	Number of Positions	Total Cost
Project Manager	600,000	1	1,800,000
Assistant Project Manager	300,000	5	4,500,000
Electrical Engineer	500,000	50	75,000,000
Installation Supervisor	250,000	10	7,500,000
Installation Staff	150,000	200	90,000,000
Customer Support Staff	150,000	10	4,500,000
Drivers/Logistics Staff	120,000	50	18,000,000
Total			201,300,000

Exhibit 4 Risks and Mitigation Plans

Risks	Type	Mitigation Plans
Conflicting interests among stakeholders	Strategic	Establish **MOUs** to clarify responsibilities and conduct regular stakeholder meetings.
Resistance from property owners	Preventable	Offer financial **rebates** to resisting households; launch awareness campaigns.
Grid overload during peak hours	Preventable	Adopt **time-of-use** pricing to encourage owners to charge their vehicles during off-peak period.
Regulatory changes	External	Maintain proactive communication with central government officials to **predict potential shifts** in national policy focus.
Economic fluctuations	External	Secure **contingency funds** of 50 million RMB from private donors.

Endnotes

[i] https://auto.cctv.com/2022/02/11/ARTIBhf36zjSKfE0MdcrbEnH220211.shtml
[ii] http://chezhuangw.com/sys-nd/2471.html
[iii] https://bg.qianzhan.com/trends/detail/506/230120-ce4d4ab3.html
[iv] https://www.gov.cn/zhengce/202408/content_6971115.htm
[v] https://www.beijing.gov.cn/zhengce/zhengcefagui/202208/t20220809_2788814.html
[vi] https://m.thepaper.cn/newsDetail_forward_26896009
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[xiv] https://www.gov.cn/xinwen/2015-01/20/content_2806663.htm
[xv] https://www.in-en.com/article/html/energy-2318015.shtml
[xvi] http://www.caam.org.cn/chn/8/cate_79/con_5211182.html