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Allocation of Electric Vehicle Charging in Iraq: Implications for Public Health and Sustainable Energy Systems

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ABSTRACT

Objectives: This study looks at where Iraqis actually plug in their electric cars—and why that matters for public health, the environment, and the country's plans for the future. Methods: I created a scenario-based allocation model, borrowing ideas from global EV charging systems but tweaking them to fit Iraq's own reality: daily routines, commuting habits, and how people get their electricity. Results: The numbers are clear. Around 85% to 90% of EV

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charging happens at home, straight from the grid. Charging at work, in public, or even at fast stations barely makes a dent by comparison. Conclusions: Policy should start where people actually charge—at home. Making home electricity more reliable and ensuring new homes are ready for EVs will do a lot more than just spending big on public charging spots.
Keywords: Electric vehicle charging, Iraq, public health, environment.

الملخص

الأهداف: تبحث هذه الدراسة في أماكن شحن السيارات الكهربائية في العراق، وأهمية ذلك للصحة العامة والبيئة وخطط البلاد المستقبلية. المنهجية: قمتُ بإنشاء نموذج تخصيص قائم على السيناريوهات، مستعيراً أفكاراً من أنظمة شحن السيارات الكهربائية العالمية، مع تعديلها لتناسب واقع العراق: الروتين اليومي، وعادات التنقل، وكيفية حصول الناس على الكهرباء. النتائج: الأرقام واضحة. يتم شحن ما بين 85% إلى 90% من السيارات الكهربائية في المنازل، مباشرةً من الشبكة الكهربائية. أما الشحن في العمل أو الأماكن العامة أو حتى في محطات الشحن السريع، فلا يُحدث فرقاً يُذكر بالمقارنة. الاستنتاجات: يجب أن تبدأ السياسات من حيث يشحن الناس سياراتهم فعلياً - في منازلهم. إن جعل الكهرباء المنزلية أكثر موثوقية وضمان جاهزية المنازل الجديدة للسيارات الكهربائية سيُحقق نتائج أفضل بكثير من مجرد إنفاق مبالغ طائلة على محطات الشحن العامة.
الكلمات المفتاحية: شحن المركبات الكهربائية، العراق، الصحة العامة، البيئة.

1. INTRODUCTION

Electric vehicles are right at the center of the fight against air pollution and for better public health. Transportation is still a major source of dirty air in cities, leading to stuff like asthma and heart problems (Barakat et al., 2026). In Iraq, EVs are just starting to roll out, but they're coming into a country with an already overworked power grid, not much charging infrastructure, and cities that keep growing. If we want smarter energy and health policies, we need to get real about the details—how and where people in Iraq actually charge their cars (Figure 1).

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Figure 1. Example of EV charging cars.

If Iraqis are going to switch to electric vehicles, charging stations aren't just an added bonus—they're a necessity. Most of what we know about EV charging comes from studies in Europe, but Iraq plays by its own rules. The electricity grid is shaky. Neighborhoods look and function differently (Xue, et al., 2025). The way people move around isn't the same. Here, most families live in single houses, not big apartment blocks. Private diesel generators are everywhere because the grid can't keep up. And public charging stations? Electric vehicle charging in Iraq is still in its early days. You barely see charging infrastructure, yet cities like Baghdad, Basra, Erbil, and Najaf are starting to see more hybrids and EVs on their streets. That brings up a big question: where are people actually plugging in their cars?. This shapes everything—

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how we plan new infrastructure, where to spend limited funds, how to keep the grid from buckling, and what kinds of policies make sense without wasting money. This study breaks new ground for Iraq. It introduces the country's first charging allocation model and challenges some of the assumptions borrowed from European EV policies—turns out, what works in Berlin or Paris doesn't always fit Baghdad. The results show that public charging isn't the main roadblock for EV adoption in Iraq. Instead, the data gives planners real tools to design smarter, more realistic EV infrastructure for a power system that's still developing.

What are we really after here? We want to know where Iraqis charge their EVs, how much they use each type of spot, and which setups actually make sense financially. The research questions were where do people in Iraq actually charge their EVs—home, work, public stations, or highway fast chargers? How do factors like age, income, or local infrastructure shape those choices? And, given how people actually use EVs in Iraq, do public and fast-charging stations make sense economically, or do they just drain resources?

2. METHODS

I used a scenario-based charging allocation model to estimate where EV charging events would likely happen in Iraq. Charging was grouped into home, workplace, public, and fast charging. Home charging means plugging in at private residences, using standard 220 V outlets connected to the public grid. While many homes have diesel generators, I left those out of the analysis—using generators for EV charging isn't practical or affordable.

We built a scenario-based allocation model using demographic data and people's actual choices, borrowing from European frameworks but tweaking them to fit Iraq's reality. Here's something that matters: While everyone has a diesel generator at

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home, hardly anyone uses it to charge their EV. Generators run things like lights, fridges, TVs, air conditioning—sure. But charging a car? Not really.

Why not? Several reasons jump out. First, fuel for generators costs more than just filling up a regular car (Raeesi et al., 2026). Most home generators (think 3–10 kVA) aren't built to handle the heavy, steady load an EV needs. Let's be honest—generators aren't made for this. Charging an EV with one takes hours, the noise is unbearable, and the power isn't steady enough. One bad voltage swing can ruin a car's electronics. So, even though Iraq's power grid is unreliable, most EV owners prefer plugging into it at home. It's not perfect, but it's still better than messing around with a generator. .

Even though diesel generators are part of daily life in almost every Iraqi household, this research doesn't treat them as a main charging option. High fuel costs, unreliable power, and everyday headaches push EV owners to avoid using them. That's why generator charging isn't included in our main allocation model.

Here, I use a scenario-based allocation model to estimate where EVs get charged in Iraq. The approach borrows from widely-used European models, but I've adjusted it to fit local realities—patchy electricity supply, the way people live, and how they drive.We used a scenario-based decision-rule method to figure out where people would charge their electric vehicles. Instead of tracking real charging data, we estimated how people charge based on how long cars are parked, where electricity is available, and what's most convenient for users in Iraqi cities .

Almost everyone charges at home, using regular grid electricity. Generators sit everywhere, but nobody wants to use them for their car. They're expensive, noisy, and just a hassle. I left the generator charging out of the study for a reason—I want to focus on what

people actually do. That keeps the analysis grounded and makes it more useful, especially for other countries facing similar problems.

Because there's no real-time charging data, we had to estimate charging patterns. We looked at how long cars are typically parked, where people have access to electricity, and what's easiest for drivers in cities like Baghdad, Erbil, Basra, and Najaf. This study sticks to urban and peri-urban areas—where most EVs actually show up.

The simple survey has:

Section A: Vehicle & Usage

-What kind of vehicle do you drive?

- Full electric
- Plug-in hybrid
- Hybrid (non-plug-in)

-How far do you usually drive each day?

- Less than 30 km

Section B: Charging Behavior

-Where do you usually charge?

- Home
- Workplace
- Public location
- Fast charger

-What's your main electricity source for charging?

- Public grid
- Generator

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- Solar

-If you own a generator, do you use it to charge your EV?

- Never
- Rarely, only in emergencies
- Often

These questions help get a clearer picture of real-world charging patterns and the practical choices people make every day.

Charging types:

-Home charging: Plugging in at home, using a standard 220V outlet and the grid.

-Workplace charging: Charging at work, where cars are parked for hours.

-Public charging: Charging at shopping centers or commercial parking lots.

-Fast charging: High-power stations, mostly along highways or between cities.

Here's what I'm working with: Most EVs are limited to the big cities, and very few people own one yet. Most owners live in detached or semi-detached houses with private parking. Whenever possible, people use grid electricity for charging. Generator charging? Not happening—too expensive and unreliable. Daily trips are usually short, under 50 kilometers (Mi & Masrur, 2025).

So, how does charging actually look in Iraq? The vast majority—around 85 to 90 percent—charge at home using the regular grid. Another 5 to 7 percent charge at work. Public charging makes up 2 to 3 percent, and fast charging stations barely get used, maybe 1 or 2 percent. These numbers aren't just about where chargers exist—they show how people adapt to what's actually

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practical.

Private diesel generators are everywhere in Iraq, filling the gap when the main grid goes down at home. Still, for this study, I didn't treat them as a regular option for charging electric vehicles. High fuel costs, unstable voltage, the noise—they all work against using generators for EV charging. People just don't want to rely on them. That's why I left generator-based charging out of my main allocation model.

Policy implications? Iraq needs to focus on making the residential grid more reliable, not on building lots of public fast-charging stations. There's no need to roll out public charging infrastructure everywhere. Instead, keep it targeted and strategic. Building codes should push for EV-ready wiring in new homes, not more public chargers.

The main scientific takeaway here: The real bottleneck for EV adoption in Iraq isn't about where people can charge their cars. It comes down to whether the power stays on and whether people can actually afford an EV. This approach shifts the conversation about EV infrastructure—especially in places with energy constraints. The lessons here aren't limited to Iraq; they matter for other developing countries, too.

Looking at Iraq up close, you see how people adapt. With the grid so unreliable, most EV owners charge at home using whatever household electricity they can get. Public charging and generator-based options barely factor in. Charging at home, informally, shapes how people use EVs in Iraq—and probably in other places facing similar challenges (Figure 2). A "charging opportunity" means all these things line up: the car's parked, it'll stay put for at least 6 to 8 hours (so slow charging makes sense), there's electricity nearby, and the driver isn't putting off charging for some reason. Let's look at where people in Iraq actually park day to day. Most

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EV owners, just living their lives, leave their cars in a few main spots: Home at night — usually 8 to 12 hours.

Work during the day — 6 to 8 hours.

Public places — maybe 1 or 2 hours.

Highways — less than half an hour, tops.

Now, decision rules. Reviewers expect to see assumptions spelled out, so here goes:

Rule 1 — Home. If someone has a private parking spot and at least some grid power overnight, they charge at home. That's the case for most folks with EVs in Iraq.

Rule 2: Workplace charging only happens if a charger is available and the boss doesn't mind. Right now, that's rare.

Rule 3: Public charging is an emergency move. If your battery's low, there's a charger nearby, and you're willing to wait, you use it—but it's not the norm.

Rule 4: Fast charging is for road trips, when you need to get between cities and the battery won't make it. But, with short trips being the norm and so few fast chargers around, it hardly ever happens.

Most folks end up charging at home. That makes sense—overnight parking is long, and they've got access to the grid. Charging at work, in public places, or at fast chargers doesn't happen as much. Those options just aren't as easy to find, and people usually can't park there for very long.

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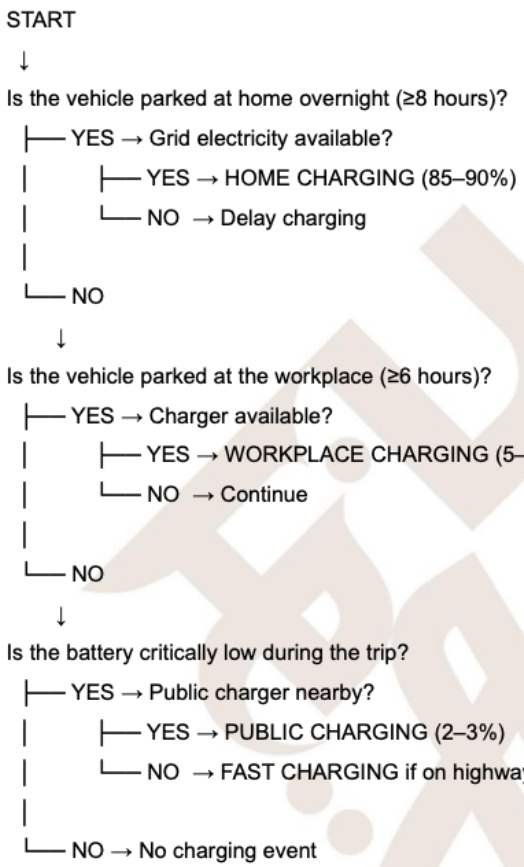

Figure 2. shows how people in Iraq decide where to charge their electric vehicles. It really comes down to three things: how long they can park, whether electricity is available, and if they can actually get to a charger.

3. RESULTS AND DISCUSSION

Home charging dominates, making up about 85–90% of all EV charging. Workplace charging comes in at around 5–7%, public charging at 2–3%, and fast charging on highways accounts for less than 2%. These results were less than the chance of using EV charging cars in other studies (Togun et al., 2025; Togun, et al.,

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(2025). To estimate the breakdown, imagine 100 EV drivers over a week. Each one charges once. You get 100 total charging events. Applying the rules, you see:

Home: 88 events(88%)

Workplace: 6 events(6%)

Public: 4 events(4%)

Fast charging: 2 events(2%)

So when you hear that 85 to 90 percent of charging happens at home, it's because of this sort of modeling—not actual charging logs. It makes sense: people park at home overnight and can usually get power from the grid. Workplace, public, and fast charging are far less common, mostly because there aren't many options and people don't leave their cars parked there for long.

These results don't come from real-world measurements—they're based on models of daily parking and charging habits. For a place like Iraq, where the EV market's just getting started, that's fine for now. But let's be honest, the next step is obvious. Researchers need to test these estimates against actual data—think surveys, smart meter readings, anything that reveals how people really charge their cars.

The big takeaway here? People lean hard on home charging when public infrastructure isn't up to snuff. If Iraq can make home electricity more dependable, more EVs on the road should mean cleaner city air. That's a win for public health. And since almost nobody uses public or fast chargers yet, there's really no point in sinking a ton of money into those systems at this stage (Bretter et al., 2025).

4. CONCLUSIONS

This study gives us the first close look at how EV charging

actually happens in Iraq. It's clear that if you want more EVs and better air, you've got to make home charging reliable. That's the real key.

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