DPU 21-90, 21-91, 21-92 EV Charging Comment

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After reading the Utility responses to the DPU 21-9x dockets, it is prudent to review the key health and safety hazards of the EV-charger landscape as well as the proposed AMI integration. Owning an EV is a calculated personal risk. However, the EV-infrastructure, as envisioned in the Utility testimonies, will increase air pollution, exchanging particulates and exhaust for microwaves, both being classified as carcinogenic. It is hoped that by this submission, some ecologically-minded authorities will work to make the EV deployment safe for everyone in society.

Respectfully submitted.

Author Biography

Mr. Gartner received a BSEE degree from MIT in 1987 and worked as both a hardware engineer and software developer for more than three decades. Now semi-retired, his world was rocked when his partner became Electrically Hypersensitive in 2019, immediately after moving into their newly constructed home, which had an RF broadcasting smart meter positioned to irradiate part of the home. Only after taking steps to remove all RF radiators plus shield the AMI meter did the crashing health stabilize. Now, three years later, the electrical sensitivity persists and everyday life remains challenging. Mr. Gartner now earnestly studies the entire scope of environmentally-induced electrical sensitivity — the origins, the remediations, the effects, and the paths to permanent recovery.

This written testimony represents Mr. Gartner's personal opinion, as an informed and engaged citizen of the Commonwealth.

Overview

The Mission

Common Text Expressed In Each of the The Utility Proposals

> The Commonwealth of Massachusetts has positioned itself as a leader in the United States to tackle the challenges posed by climate change by implementing ambitious programs and policies to maximize equity, the health and wellbeing of the Commonwealth's residents, and environmental benefits…
>
> Decarbonizing the transportation sector will be challenging, but the transition to a decarbonized and electric transportation future is vital and requires an immediate and aggressive set of responses…

This sentiment is shared by all three Utilities, for it appears in each of their DPU 21-90 testimonies. In the context of supporting an Electric Vehicle infrastructure, we do have optimism that EVs may well provide the promised long-term improvement over the ICE vehicles of today. Yet we are concerned that the 'immediate and aggressive set of responses' coupled with the inherent EV infrastructure health and safety challenges is going to fall far short of the universal aspiration for "maximizing the health and wellbeing of the Commonwealth's residents'.

The Big Picture

In our feedback testimony, we raise issues of concern in the areas of human health, safety, and financial prudence. We are concerned that the plans outlined could trade one kind of pervasive air pollution (particular matter and exhaust, associated with asthma and cancer) with another air pollution (microwave radiation, a possible human carcinogen and Class 2B Agent) plus exposure to extreme AC magnetic fields. We are concerned that deployment of EV-Chargers raises safety concerns that need to be more thoroughly acknowledged and mitigated. We are concerned with the vast amount of money that seems to be available to subsidize affluent EV car owners, just two weeks after we were told that there was not enough money to provide electromechanical power meters to mitigate the poor health consequences which the AMI meters have caused for a few thousand MA residents.

It does take bold vision to move society from one energy paradigm to another, and financial resources. Government's role is to establish an infrastructure framework, provide seed capital, provide carefully crafted financial incentives that aim to achieve the societal future in which all our lives are enriched, and to monitor the process along the way to make course corrections so that any missteps are caught in a timely manner. We have to acknowledge that any societal change of this magnitude, based upon new and unproven technologies, is at risk of 'unexpected' consequences and so gatekeeping, monitoring and review mechanisms should be added to the deployment plan so that ALL residents of the Commonwealth will benefit from (or, at least, not be harmed by) this EV-Charger deployment. Our communal investment leading to our communal betterment is the success metric we all share, but it is in the details that we likely differ.

What's the Big Deal?

But why take a strident tone about 'big' topics such as human health and safety, since the 'EV-chargers' plan is primarily a money allocation strategy to deploy commmercial charging products and thus foster an EV-based economy? It is precisely for the reason that such issues were completely absent from the submitted Utility proposals, that it is feared that a repeat of the 'smart meter' tempest is in the offing, where human health was presumed by wishful thinking and not by affirmed by diligent monitoring and careful process.

First, Do No Harm

Because the power Utilities are so heavily engaged in this EV-charging plan, a number of tie-ins to the burgeoning AMI infrastructure have been added for the public 'pole-mounted' kind of EV-charger deployment, the 'time of use' residential connection, and to effect the hoped-for 'bidirectional vehicle-to-grid' resiliency. Following through on the suggestions of the Utility plans could lead to many hundreds of thousands of additional smart meters, each spewing microwave air pollution 24/7. We contend that this could lead to more acute and chronic health consequences than the ICE particulate pollution it hopes to diminish. Any AMI deployments that require sophisticated networked communication must be hard-wired in some fashion, perhaps by fiber optic, and that infrastructure establishment should be part of the yield from our communal investment.

Electricity Is Not Child's Play

EV-chargers can routinely move hundred of amps of current, at high voltage. They are subject to extreme environmental conditions, vandalism, wear and are unlikley to receive the necessary inspection and upkeep schedules required by the manufacturers. There are many safety issues that

are obvious (such as electrocution or fire), but there are safety concerns that are more subtle such as extreme magnetic fields, ground currents, touch current and EMI exposure.

EV owners and manufacturers seems unconcerned with the health hazards of sitting in a vehicle while it is connected to an EV-charger. It is hard not to think of the possible ramifications of that endorsed and routine behavior.

Proving one particular device led to one particular health condition will not generally be a successful path for someone seeking legal compensation, but, when the government allows known safety considerations to remain unaddressed, then seeking a responsible party may become a lot easier.

We feel it is better to identify the issues early, recognize that perhaps these might only affect a small segment of the population and then take some steps to better warn that population, for example, by placing easily-seen warning labels on such products or setting measurement hazard exposure benchmarks that must be met by each EV-charger deployment.

No Gifts for the Bad Guys

There are inherent risks among networked components that can reach deep into our vital infrastructure. What steps are being taken to ensure that 'skimmers' are not added to public EV-chargers to steal financial or identify data? How are we safeguarding that spurious commands are not sent to EV-chargers, ones that might simultaneously coordinate Turn ON and Turn OFF commands across the charging infrastructure? How sure are we that 'logic bombs' could not be inserted into the EV-charger commmunication such that the automobiles being charged would not be damaged or made a vector for a later exploit? How sure are we that there would be no way that a security hack of these EV-chargers would not reach deeper into the core of our financial or power-providing institutions?

These are not purely theoretical concerns and modern society has repeatedly learned that 'security as an afterthought' is not a sentiment that works out well in the end.

Perhaps A Smaller Slice of Pie

We are concerned that our communal wealth will be unfairly funneled toward affluent EV owners. In the excitement to replace ICE cars with EV cars, it has been forgotten that the most environmentally friendly and responsible position has been to not own a car at all and instead rely on public transportation. Are we really putting our limited communal funds to best use by overly-generous rebates on what amounts to luxury vehicle purchases without putting a higher percentage of those funds into the public transportation sector? Are public chargers truly intended for MA residents or are they really for visitors and tourists that are only half-way to their destinations?

Might it not produce a better outcome if MA specifies a handful of EV-charging configurations that meet our specific health, safety and longevity goals and then puts out an RFP to ensure that all deployed EV-chargers (public ones, at least) can be interchangeable, well-understood and maintainable into the future? The alternative would seem to be a 'Wild West' situation of many different devices, some of which are bound to be 'dead-ends' over time.

A Simple Remedy for Range Anxiety

We are concerned that public chargers will offer haphazard pricing and consumers may experience the equivalent of price-gouging 'at the pump'. We are concerned that full rebates will be offered for deployment of chargers that only work on narrow segments of EV market (such as 'Tesla-only'). We are concerned with eventual abandonment of public chargers, previously granted generous rebates, when the technology changes, the equipment ages, today's manufacturers cease production or go bankrupt.

We do wonder why the normal aspects of capitalism cannot be made to serve in lieu of so many rebates for 'public' charging stations, especially as the existing 'gas stations' have the highest incentive to invest or become irrelevant. It seems the **entire** EV range anxiety concern could be adddressed solely by partnering with large gas stations to install only the DC Fast Charging (DCFC), which offers full charge in minutes not hours and there will a natural progression to replace gas pumps with such chargers over the next decade or two. DCFC (and eventually the Wireless Power Transfer, WPT) require such high voltage and current capabilities that only a commercial establishment is likely to have the necessary physical plant for this endeavor.

Remember: 'range anxiety' for MA residents is primarily addressed by the EV-charging plans of **other** states, and any solution MA makes to offer public EV-chargers is primarily to ease the 'range anxiety' for tourists and visitors who come from outside MA. Public charging might cost much more than charging at home, unless purposefully subsidized, so the MA residents who will take advantage may just be those who forgot to charge up at home.

The Future Is Unpredictable

The extensive proposals from the Utilities are based on technologies that have a limited lifetime, as they will inevitably be replaced by innovative solutions in a few years that will leave us wondering why we invested so many dollars in 'that ancient stuff'. One reason to choose older technology is because it has a 'track record' and thus offers fewer surprises, has more industry support and so on. However, the future will come quickly, it will be disruptive and it must be accounted for in any multi-decade planning.

Now, With Wireless Charging

One case in point is the Inductive Power Transer (IPT) or 'wireless EV charging', whose genesis stems from research done at MIT. This is a maturing technology which might signficantly decrease the cost of EV charging deployment as compared with utility-pole-mounted options. It might have lower maintenance costs and be subject to less vandalism. It might pose fewer health risks. It could be the best thing since sliced bread. Or it could be just an intermediate step to something else, that is even better and more widely adopted by the various industries. None of the submitted proposals to this DPU docket seemed to mention the wireless charging option.

Managing the Future With Process

So, what we need to have embedded in this large infrastructure proposal is a procedure for harnessing future innovations, to have a methodology where we look for ways to influence the deployment of nascent technologies so they inherently support the important safety, security and budget considerations necessary. Instead of 'reacting' to technology and finding all the inherent flaws after the fact, the state of MA could endeavor to become more actively engaged to steer the course and ensure a better resulting product, likely for the same cost.

How might MA do this? Specified research grants, 'X prizes' for innovative solutions, joining standards organizations, enlisting the power of local universities and entrepreneurial talent to check out these new products and give meaningful feedback to the decision-makers, funding health research for these emerging technologies, and requiring higher standards of safety, security and backward compatibility from participating vendors.

Hardwiring Is An Investment In Health And Security

One example of actively embracing change for the better would be to address the inherent harm that is associated with pulsed and polarized digital communication over microwave carrier signals. This affects humans at the cellular level and various associated tissues, organs and systems. It is a driver for chronic disease and in some unfortunate segment of the population, exposure to these common emanations (from cell phones and towers, from WIFI, from Bluetooth, from Smart Meters, and other IoT tech) results in discomfort, pain or even agony.

This problem was created by mankind, as this is not endemic to the natural form of microwave radiation, so why can't it be fixed by mankind? By choosing carrier frequencies that are not so bio-active, by eliminating the fixed frequency 'beacon' signals that run 24/7, by reducing the antenna power to the minimum necessary to complete the task, by aiming antennas more carefully rather than spraying their emanations in broad spaces, by adding 'white noise' to the signals to prevent various aspects of coherence that seem to be biologically more injurious, or even hardwiring communication to cables, the world could truly be a better place for everyone. It should not take litigation and untold suffering to have such improvements, but instead they should be a natural occurrence of technology with a steady and sober hand on the tiller.

Summary of Specific Proposals

Health-Related

- Require all components to be WIRED for their network connectivity in order to qualify for a rebate (utility meter, payment processing, EVSE and such). No microwave emanations are permissible. Any devices that still emanate microwave radiation should be made to have a large label affixed to give the public warning: "This device emanates microwave radiation, a Class 2B Agent, known to the State of Massachusetts to be a possible human carcinogen".
- To repeat: Please do not ruin state parks and forests — places which are some of the last sanctuaries where electrically sensitive people can walk in public — with any new microwave-spewing EV-charging or AMI infrastructure.
- Even if a rebate is not sought, an EV-charging setup that emanates microwave radiation shall not be deployed adjacent to a state park or forest, where there is already no more than a low (and thus more healthful) level microwave radiation.
- Even if a rebate is not sought, an EV-charging setup that emanates microwave radiation must offer local adjustment of the antenna directionality (so it can be specifically aimed), the broadcast signal strength and minimize that amount of unnecessary radiation. All, in addition to bearing the Class 2B warning label.

Financial-Related

- Any EV-charging station that applies a financial charge should makes its per-unit costs clearly

conspicuous, much like the gas station per-gallon pricing.

- Ensure there are consumer-protections from price-gouging at public EV-chargers
- There should be a clear 'municipal' bootstrap package to clearly spell out how each town could deal with zoning and permitting, the list of approved equipment, to put into their upcoming budget and receive rebates for public EV-chargers, without assuming that the power Utilities must lead the way and later sell access to these spots. A town should be able to select locations that would encourage tourism in the town.

Electrician-Related

- Add primer on NEC **250.6 Objectionable Current** and how residential EV-charging could be affected as part of Electrician train-up
- Add primer on microwave radiation safety and explain how to confirm a 100% wired EV-charger setup is OK as part of Electrician train-up

Process-Related

- Siting of all EV-charging Infrastructure in public spaces [1: Here is an example focused on Boston] should follow permit processes, with abutter notification (including renters)
- Zoning issues related to minimal parking spot counts might need to be addressed in individual municipalities
- Create an 'Accepted Electronic Infrastructure' mechanism to allow the state to ensure all public devices meet minimal standards
- Create an Office of Environmental Accomodation along with an Ombudsman to appropriately surface the needs of the environmentally intolerant

Of EVs and Their Charging

EV Cars Are NOT for Everyone

There is a push to make it easy for the public to SAFELY use an EV charging station. Not only must such stations accomodate folks of all shapes and sizes, but it has to be as simple as fueling at a self-serve gas station. Our elderly population, in particular, may find such unfamiliar technology baffling and alternately will seek a 'full service' charging station and willingly pay a premium for the privilege. Are any such things envisioned? If not, then the dream that the ICE engine vehicles will completely disappear from the road is unrealistic.

A second audience that would likely not be participating in the EV movement will be those who are already electrically sensitive, or become so. It is quite likely that such vehicles will prove to be uncomfortable or hazardous to such acutely sensitive folks. it is not merely the fact that such EVs have large electric and magnetic fields, but in fact ANY modern car will be bristling with so much non-optional RF and microwave technology that being subjected to such a vehicle would pose an unnecessary health burden to many. It has been sad to hear repeated stories this year of people purchasing or leasing new vehicles (not all were EVs) and then find themselves too ill to drive them due to all the electronic gadgetry.

A third audience of folks displeased with EV cars might well be environmentally-minded folks who believe that any new car, especially one that is so heavily laced with rare earth metals and other mined resources and for which there is no effective recycling waste stream planning, is not as light on the planet as keeping an existing ICE car running. When one performs the full ecological calculations, EVs are not the hands-down winners that the enthusiasts wish them to be.

Finally, we cannot have all of our emergency vehicles and first responders (such as ambulances, fire engines, police or military) dependent on EV, because when there is a social crisis or disaster, we might not have electricity at hand. ICE vehicles are reliable, known technology and the safer choice for many decades to come.

EV Vehicles Pose a Number of Hazards

When ICE engines were first introduced, people were afraid of them. People had not travelled faster than a horse trot or a train, so the entire experience was overwhelming. People were also afraid that having many gallons of a flammable fuel would be hazardous in the vehicles or at filling stations where a lit cigarette might ignite loose fuel. Overall, these fears were not manifested and cars exploding spontaneously mostly only happened in the cinema [2: Except for a few dozen Pintos that Ralph Nader popularized in his book **Unsafe at Any Speed**).]

Read the Signs

However, there are spectacular failures such as the 2000 explosion of a van (and part of a gas station) when a person fueling their vehicle turned on the ignition to see what their odometer read. A spark and a boom. This ICE anecdote might reassure the EV folks about their good choices, but really I tell this anecdote to draw some object lessons that will also apply to the EVs. The first is that people will do the unexpected and forbidden. The sign says: the engine should be off, do not smoke,

and do not have an active cell phone in use while pumping gas. We cannot trust that all people will follow all safety rules all the time. The consequences of a lapse should not be a catastrophic failure, if it can be helped. Second, a dumb feature — not being able to read the odometer unless the car was energized — is what led to this debacle. Dumb features are added all the time to new cars and have to be defended against where anticipated, again without catastrophic failure.

Distracted EV Charging

For public safety, we have to assume a worst, but possible, case and ensure no catastrophe ensues. Assume that people charging their cars will be extremely distracted, will not follow any written instructions, will hope to charge their car outdoors during heavy moisture conditions. Even with all these unsafe practices and any misfortunate events, no one should be electrocuted, no car should batteries should be destroyed, no car fire started. Of course, perhaps the car does not charge and a failure indicator lamp is lit instead.

In order to prevent lethal electric discharge, the EV charger circuits need to have integrated and fast-acting ground fault interruption (GFI). GFI protection is seen in bathrooms, kitchens and other places where water and electricity might mix. The GFI protection is supposed to de-energize the circuit within milliseconds of current to the ground exceeding the threshold for heart defibrillation. However, note that GFI devices are subject to failure due to aging, but also due to electricity surges and weather extremes even if they have hardly been used. Lightning surges, a nearby car crash into a utility pole and similar events could cause a sudden blowout. These GFI and other protective devices need to be frequently tested (which might also shorten their lifetime) in order to be sure that no one's life comes to a startling conclusion. How will the owners of these outdoor EV chargers take proper care of these safety features?

Can't Seem to Get Enough Microwave Exposure ...

Beyond the unique aspects of EVs, those that are rolling off the assembly lines today also share the health hazards that are common among all new vehicles, including being outfitted with many kinds of microwave-emanating devices (such as Bluetooth, WIFI, Cell connection to the manufacturer or emergency services, keyless operation, vehicle radar, and soon interior cabin radar) as well as heavy magnetic fields from unbalanced wiring harnesses or features such as 120V electric outlets in the passenger cabin. Even if the EVs were brilliant technical marvels, these demerits make them unsuitable for an ever-larger segment of the population that can no longer tolerate such intimate environmental exposure.

Charging Station Maintenance and Liability

The Utilities, generally, offer that they will initially pay for the installation of some public EV charging stations and after several years will offer the local municipality the rights for such stations. It is expected that municipalities can levy usage fees 'at the pump', which would be revenue, and by careful siting could encourage development of a shopping district or similar social benefit, especially among electron-hungry tourists.

Can't We Just Agree?

Among the proposals, is it not mentioned how long the average charging station will operate before it must be replaced, either due to age, malfunction or obsolescence? Technology changes much

more quickly and one wonders whether the chargers of today will no longer serve any but those future 'legacy' EVs. This suggests that there may be a need for a mixture of different technologies within a narrow locale in order that no EV owner feels they cannot be serviced. The only way forward is really for the auto industry to consolidate on a SINGLE charging standard, much like the gasoline tank form factor and fuel mixture consolidated down.

Who Is Responsible?

Public EV-chargers are beefy electrical equipment and should be inspected and serviced on a schedule, perhaps 'sealed' like the gas pumps are to ensure that the amount of energy billed to the chargee is accurate. This maintenance cost increases over the age of the device. Manufacturers might also have 'training' requirements they impose on the owners, to ensure safe operation, that would have to be borne by the municipality.

Since chargers are dangerous items, who is going to accept the liability if a charger damages a car, perhaps through over-charging, introducing a short, introducing malware, or posing an electrocution hazard due to misuse or misadventure? Vandalism has to be expected and prevented — whether just from malicious antisocial neerdowells, copper pilfering, or trying to get 'free' electricity — perhaps by means of surveillance cameras and a frequent inspection schedule and a 'hotline' for the public to report damage. To avoid collision or snow plow damage, bollards might need to be added. Insurance providers are likely to require special riders and might require onerous recordkeeping and inspection requirements.

How many of the EV-charger companies are stable enough that the devices purchased by a municipality are not likely to be orphaned during the planned deloyment lifetime? Will there be replacement parts long into the future or will this be one more disposable e-product that the public has paid for? Do the EV-charger companies carry sufficient liability insurance and, importantly, does their liability policy contain an exclusion against coverage related to radiofrequency (which is very common, since insurance companies such as Lloyds of London and Swiss Re know that radiofrequency litigation is going to be the next 'asbestos' and so have been dropping such coverage).

Drat, I Don’t Have Enough Charge to Find Another Charger

Chargers are a desired resource, necessary when the situation may be desperate, such as finding a gas station is for someone with an empty tank, It is very rare to encounter a gas station that is without gas, but charging stations that are incapacitated or inoperable need to be registered into some searchable database so people can avoid seeking it out in their desperation. [3: Like the 'Gas Buddy' or other phone-based app can help you find a gas station] Will all municipalities faithfully keep such info up to date and who will coordinate this important service?

Who ensures that someone whose car has finished charging is prompt to move it and free the resources?

Chargers At Home

We hope that MA supports a permitting process for at-home EV chargers, both for the safety of the residents and neighboring abutters. Chargers installed by any means other than a licensed electrician and up to NEC standards — which is certainly possible since chargers can be purchased

online and the charger merely is connected to a large circuit breaker in the residence electrical panel — should be disallowed. We also favor that EV chargers be among the electric and electronic devices regulated by the State of MA (much like plumbing fixtures are today) so that unapproved EV chargers are not installed. An EV charger might be considered 'unapproved' for many reasons, not the least of which is if it has known safety or security issues, does not adequtely protect from ground faults, requires RF use in a "No RF zone" or is not UL listed. The description of a proposed Electric and Electronic Device Registry is detailed elsewhere in this document.

New Charger, Not Like the Old Charger

Since not all EV chargers are identical, the electrical installation may differ. Some require 120V and others require 240V. Units that do not have their own integrated GFCI, will require that a GFCI circuit breaker be used. Units that do have their integrated GFCI usually require that the circuit breaker **not** have its own GFCI. However, in a garage, NEC 2020 requires all outlets to have GFCI protection. These kinds of nuances are why a licensed electrician, who has been trained about the specific permitted EV Charger models, can ensure that all safety rules are followed.

It is a valid concern that most homeowners will be unlikely to follow the manufacturer maintenance guidelines, which would include inspection, validation and possibly replacing parts on a schedule.

A complication arises when changing from one EV charger to another model, perhaps because the old one wore out or a new EV purchase requires the replacement. Here, the original circuit breaker has to be re-examined to see whether it meets the GFCI requirements of that model. Some REQUIRE GFCI and others FORBID GFCI. Of course, it is the electrician’s responsibility to confirm this detail (and for which the Utilities are proposing additional EV-specific training), but in a residential situation the handy homeowner might just plug in the new EV charger and not think twice about the safety risk. This would be a bad idea, with dire consequences.

Safety Should Be Job Number One

Human safety concerns should be paramount when bringing humans into contact with AC line current. The most obvious hazard is electrocution, but there are also less intense safety concerns, both for acute as well as long-term health considerations.

An EV charger can make 50+ amps of current at 240 V available before the over-current protection kicks in. That is more than enough to electrocute someone if they become part of the electrical circuit. For the same reasons we have Ground Fault Circuit Interruption (GFCI) protection in the wet places of our homes (to avoid electrocution when an energized hair dryer falls into the bath water, for example). EV chargers also require GFCI protection, but there a number of details needed before one can be assured that safety has been achieved.

Ground Fault Interruption

In the home, our 120V outlets are covered by Class A GFCI — constant detection of current imbalance among the conductors will trigger at a threshold of 5 milliamps of current and strive to de-energize the entire circuit within a few milliseconds. The EV chargers usually will run at 240V and are subject to a lot of physical use that can lead to worn insulators, be subject to crushing (a car running over the wires) or similar subtle changes that could lead to intermittent shorting such that the parts touched by the human become energized. Or, even a perfectly working charger could be exposed to standing water or torrential rain. Thus, GFCI interruption is critical.

GFCI protection can be complicated. Some chargers have embedded GFCI, NEC code requires GFCI circuit breakers, GFCI are fragile and require frequent testing to assure that they still offer proper protection, inadequate grounding wire at the supply can lead to a catastrophic failure leaving the nearby human to bear the brunt of all current until some self-limiting factor de-energizes the circuit. Having a self-checking GFCI, which needs no human intervention, is vitally important for safety. Finally, there is the issue of 'nuisance tripping' which is a euphemism for when the GFCI is considered 'overly sensitive' in some electrically noisy environments, such as with heavy machinery. A calculated tradeoff is made to then raise the safety threshold to avoid frequent stoppage of the equipment.

The Melrose Pole-Mounted Pilot (National Grid)

Examining the product installation guide for the National Grid Melrose pilot EV Chargers (Watt Point Model 3704 EVSE), shows that a GFCI threshold of **20 milliamps** was chosen instead of the standard 5 milliamps we associate with residential Class A GFCI protection (UL 943). This use of 20 milliamps seems to be for the Class C GFCI protection which mandates very particular **separate** safety ground installation or double-insulated components in order to meet the UL-943C. However, among all the cited Safety standards listed for that EV charger, the UL943C is not present. Is that merely a typo or has this vital safety assurance not been granted to this product? The safety certifications are shown below, and a more detailed description of the matter is found in this article.

Safety Features	
Over Current Disconnect	42A
Surge Protection	6KV @ 3000A
Ground Fault	Internal 20 mA CCID with auto re-closure (three attempts)
Compliance	
Safety	IEC/UL/CSA C22.2 61010-1, UL2594, UL2231-1, UL2231-2, NEC Article 625, SAE J1772
EMC	FCC Part 15 Class A, Canadian ICES-003

Figure 1. Watt Point Model 3704 EVSE (Used for National Grid Melrose EV-Charging Pilot)

Example 1. http://www.bassengineering.com/E_Effect.htm

> "Prolonged exposure to 60 Hz. currents greater than **18 milliamps**, across the chest causes the diaphragm to contract which prevents breathing and causes the victim to suffocate. No data is available for females or children but suffocation is presumed to occur at a lower current level."

Not all humans are the same, and the threshold for GFCI protection will determine how injured they might become. Above 6 milliamps, there may be loss of muscle control or even the ability to let-go of the energized charger cable, though it depends on many circumstances. Since this is effectively a 'health' decision made by the device manufacturer, this underscores the need for Masssachusetts to organize a registry of permitted devices, similar to the Accepted Plumbing database maintained by the state.

Homework for the Adults

One more illlustrative example to show why leaving safety completely to the vendors might not be the wisest course. Here is a disturbing vendor marketing photo showing a child using an EV charger under the proud gaze of an adult. This is how these devices are being pitched — as eminently safe, and perhaps even a suitable task for that child's weekly allowance.

Children Should Not Hold 240V, 50+Watt Charging Devices

Fire Prevention

An EV-charger will move a massive amount of electrical energy over a long period of time without direct monitoring. Couple that with the inherent flammability risks of EV battery packs and there should be careful attention paid to fire prevention and detection when inside or adjacent to a residence. Several considerations include arcing faults, over-current, surge-induced component damage. Complicating this situation is the requirement that Utilities place wherein electronic 'smart meters' are required, which have contributed to, if not caused, spontaneous house fires across the nation (though not in MA).

GM recently has started an $800 million recall to replace batteries in the GM Bolt, due to fires when the car was sitting idle or charging. Just like the EV that sits in one's garage every night. These are not toys and deserve our utmost respect and attention.

A 2019 Chevrolet Bolt EV parked in its owner's driveway in Vermont was charging when it caught fire. The fire has prompted one of the most expensive car recalls on record.

The GM recall was prompted by at least nine fires tied to a malfunction in the battery, all of which occurred when the cars were shut off. GM is still figuring out how to address the problem, but replacing either the battery cells or the entire battery is likely one option. The automaker has urged drivers to not park their cars in garages, or next to homes or other structures.

Arc Fault Circuit Interruption

Electrical equipment can generate arcs under a number of circumstances — pests gnawing,

mechanical wearout, salinity or other corrosive situation, loosened wire terminal screws. These conditions can lead to fire as there may be flammable material near the arcing, or other conditions that favor the blossoming of fire. To prevent the electrical fires associated with such situations, an AFCI (Arc Fault Circuit Interruptor) circuit breaker is now specified for protection in the garage in modern NEC code. Many of the garages which will house new EV-chargers may not currently have such required AFCI protection and that should be considered along with these proposed plans. AFCI is not a universal beloved protection feature as it can have false triggering and needs to be periodically tested to assure all remains well. There are dual AFCI and GFCI circuit breakers, but that has its own complications and best left to NEC-compliant electricians.

Surge Protection

Voltage surges are a constant concern because they frequently present as various motors and other devices backfeed such spikes onto the powerlines for neighbors sharing a common utility transformer and from other sources. Such surges might be too short-lived to trigger the circuit breakers, but yet can still damage or confuse delicate devices. Many EV chargers do have their own surge protection, which should help protect the vehicle being charged from the most dangerous surges, but will not likely protect itself from the continuous onslaught of smaller surges which travel through the power grid. These smaller voltage surges stress electronic devices and components (especially capacitors), shortening their lives and can confuse those that have delicate protocols [4: Electrical Surges Spark Software Confusion].

The Inherent Dangers of Electronic 'Smart Meters'

As has been reported nationally for at least ten years, some electronic 'smart meters' have a catastrophic failure mode that can lead to house fires. In addition to being hazardous from their contribution of health-damaging microwave radiation (in most cases, except PLC) and unhealthful power-line ELF harmonics, such lightweight devices are missing the fire prevention features that their electromechanical antecedents had (such as voltage gap current limiting) as well as being subject to melted solder traces leading to a short of hot incoming service wires with no practical over-current protection until the wires are incinerated or the distribution transformer slow-blow protection engages, and by then the home usually has caught fire. We have not had this happen in MA, but it has happened elsewhere and by adding so many EV-charging secondary electronic 'smart meters' to homes there is increased chance, especially since such interior meters are unlikely to receive as much scrutiny as those placed at the service entrance.

The Inherent Dangers of EV Battery Packs

Even if there is no problem with the EV-charging system, the EV, itself, can be a source of fire due to defects in wiring, improper software or other rare and unpredictable sources. These lithium technology EV batteries are the beefier brethren of the batteries in cell phones, which occasionally do spontaneously catch fire. There is no reason to suppose this is not a possibility that should be acknowledged as endemic with EVs.

Reports from firefighters indicate that battery fires involving EVs can be horrific. Not only will a vast amount of toxic gas be released during the burn, but battery fires are hard to quench and frequently can restart for a period of 24 hours.

At the very least a thermal sensor and a some kind of fire detector, integrated with the rest of the home, to a alert residents, should be considered as a mandated corequisite when an EV Charger is installed inside a residence.

Human Health and Ecology Considerations

As opposed to the serious and potentially lethal situations described elsewhere in this response, this section concentrates on health issues that arise indirectly as under-considered side effects of the Utility EV charger proposals. People tend to be excited about the new features and are less interested in merely irksome 'collateral damage' to perhaps a small segment of the population who is not the target demographic for those features.

In this section, several lesser known human health hazards are discussed.

Exposure to High Electric and Magnetic Fields

There is a new class of EV Charging that is completely 'wireless' [5: One wireless charging vendor is https://www.pluglesspower.com/]. This operates by creating very high magnetic fields underneath the car, without the need to a have direct cable connection to transfer electrical energy. Although not explicitly mentioned in the Utilities proposal, this would be a candidate for deployment within its framework. This is another novel technology which has had no human health testing and should **not** be publicly deployed until it has.

National Grid pointed out that a full electric utility pole (as opposed to a streetlight pole) was necessary for successful installation of the Melrose EV-charger pilot program. An electric utility pole is assumed to be one that carries high voltage distribution (or approximately 10,000 volts), as one might see in any suburban neighborhood. Such poles are hazardous for the general public due their high ambient AC electric fields. If such a utility pole is carrying electricity serving many downstream destinations then standing in the vicinity of such a pole may provide a high AC magnetic field exposure.

Under some circumstances, especially when the utility pole has a direct wire connection to a ground rod at its base, a voltage potential can develop across the ground where someone steps. This is unusual, but can happen, and it would be best to consider a deployment that does not increase the risk to any humans.

Exposure to Voltage Potentials on the Earth

There are other hazards, especially for utility pole-mounted EV charging units. In Massachusetts, the Utility poles that contain the distribution transformer includes a downwire that connects to the ground. Although meant for lightning and surge protection, this ground will often carry balancing current related to the neutral. The bottom line is that the earth upon which people stand can develop voltage potential in the vicinity of such a pole. In addition, such a utility-pole would be a poor candidate for an EV Charger since the approx 12kV secondary power lines would emanate very large electric and magnetic fields, high enough to be possibly injurious to people such as those who are electrically sensitive or have embedded medical implants. Thus there needs to be very careful safety-oriented site planning when placing an EV charger into the public space.

EV Chargers and Associated Infrastructure Generate EMI

Many of the 'green' technologies promulgated by the MA state government generate harmful Electromagnetic Interference (EMI). These include Solar PV, variable speed drives and pumps, CFL and LED lighting, electronic 'smart meters'. In addition to the EMI generated by 'wall warts' for personal electronic devices, all AC→DC conversion devices, generally, contribute EMI to the home's wiring due to their Switch Mode Power Suply (SMPS). The EV charger is no exception since it is powered from AC and its innards are electronic running on converted DC voltage.

DC EV-Chargers — those that provide DC electricity directly to the EV — also have an additional AC→DC conversion that is likely to generate EMI harmonics, that is backfed at least to the main panelboard and perhaps to the rest of the home.

Exposure to unrelenting low frequency voltage 'noise' has been seen to correlate with neurological symptoms such as anxiety, tingling in the extremeties, restlessness, agitation, behavior and learning issues in children, pressure in the head, headaches, urinary incontinence, self-harm ideation and a host of others. We can be more sure about the acute relationship between such noise and human health because filtering out such signals can lead to a nearly immediate cessation of such symptoms.

For a more detailed treatment of the Conducted EMI hazards, please consult the previously filed testimony, Section "Understanding the Biological Hazard: EMI Conduction".

Car Occupation While EV-Charging

We have discussed common practices of EV-owners and it is clear that EV-owners feel comfortable and confident enough to occupy their vehicle while it is being charged. Nowhere have we found a manufacturer that explicitly disrecommends this behavior. This is disturbing from both a safety and health perspective.

In the illustration below, the physics model of interior magnetic fields during charging from a wireless (induction) power transfer EV-charger. The model shows that there will be some induced magnetic fields in the passenger cabin, but not above the ICNIRP exposure standard. The ICNIRP exposure standard for AC magnetic fields is far higher than much research shows for humans, so it is a poor indicator of health outcomes for anythng but acute injury. ICNIRP suggests that the yellow line at 270 milligauss is the uppper bound exposure threshold.

In comparison to the above theoretical model, an actual vehicle being similarly charged via an Inductive EV-charger has been measured. The measurements show that the internal fields are a lot higher, deeper into the worrisome levels. For example, Kaiser-Permanente performed a study to measure miscarriage rates among women who wore a magnetic field meter around during a typical day. That study showed that there is more than a 2X increase in the occurrence of miscarriage for women who seem to be routinely exposed to magnetic fields of more than 2.5 milligauss.

Another EMF field exposure study shows hazardous exposures while crouching low to the car (at

the height of a child perhaps?) and suggests that all inductive coils will have a safety feature to disengage when a living object strays too close. That is comforting, but who wants to rely on it for their safety or for their pets?

Exposure to Microwave Radiation Near EV Charger

The EV Charger infrastructure as proposed by the Utilities will be bristling with microwave radiating devices. It is assumed that as long as the individual signals are within FCC guidelines then there is no health problem. This is false for many reasons and, as ruled [6: Environmental Health Trust v. Federal Communications Commission, No. 20-1025 (D.C, Cir. 2021)] by Federal Court in August 2021, the FCC has been found to be negligent in its duty to incorporate scientific evidence of biological harm and effect and significantly lower operating energies.

FCC Grants Cover Multiple Fixed Devices

Even if one were to only consider the FCC thermal heating guidelines (which deal with only one of many health-related aspects), it is clear that the FCC Grant for such devices always includes a restriction to NOT deploy fixed radiating infrastructure without confirming that the aggregate radiation exposure does not exceed even the FCC's rather permissive guidelines. Yet, here we see that an EV charger is coupled with a payment system is coupled with a utility smart meter, which is likely coupled with a seurity camera and other remote telemetry. Such utility poles might also have other devices, from the municipality (perhaps remotely controlled lighting) and maybe even microcell antennas from the telecom industry. Add that to the massive RF generated by modern cars that will be parking there on a routine basis. All of these are broadcasting with antennas in the microwave frequencies. And, much like the banks of smart meters seen at condo and apartment complexes, the lack of clear planning to ensure the aggregate of all radiation from all of these devices will never exceed even the permissive FCC grant.

Any humans in the vicinity will be blasted for the duration of their stay, but more importantly, the folks who reside immediately in the path of those antennas can be exposed to the injurious emanations 24/7.

Overwhelming To People Who Have Electrical Sensitivity

Many of the technologies and deployment strategies mentioned in the Utilities EV-charging and Grid Modernization proposals produce a number of unhealthful electromagnetic fields, which are acutely felt by those suffering from electrical sensitivity. Electrical senstivity is a disabilty for individuals when their environment cannot be controlled to avoid excess exposure. In Sweden, quite a bit of attention has been paid to this new health impairment and it is believed that about 3% of the Swedish population can be considered to have the symptoms associated with electrical sensitivity. In many other countries, electrical exposure thresholds are much more restrictive than here in the United States, which lags behind Austria, Russia, Khazakstan and other countries when it comes to human safety. There are many reasons for this, and the curious reader is referred the Harvard University "Captured Agency" paper.

To be conservative and assuming that humans and their exposures are similar in Sweden and

Massachusetts, a one percent population will mean about 60,000 people here. Isn’t that enough people to be worthy of attention? I have met quite a few electrically sensitive people and I live with one, so I am very familiar with the quality of life and health challenges. Many of the most severe are essentially housebound, made prisoner by all the environmental microwave pollution in public spaces. These EV-charger and Grid Modernization proposals both add a huge amount to the 'e-smog' landscape with no thought as to the harm that can be introduced if those new devices are sited near the 'sanctuary' spaces that are still available for the electrically sensitive — their homes and some outdoor venues, far from the beaten path. There are better ways to deploy this technology so it is safe for more people, but it will take a can-do spirit to make that happen.

Basic, Common Decency for Those With E-Disabilities

I want to also take to task the State of Massachusetts government for ignoring the needs of the electrically sensitive in all of its major initiatives, especially the 'green' ones [7: Including Solar PV, LEDs/CFLs, variable speed pumps, smart meters]. The electrically sensitive have been complaining for years, even during the Worcester Pilot Smart Meter program monitored by the DPU. This health impairment becomes a disability when the environment proves an obstacle.

There is a responsible pathway to deal with this situation. I will cite Rule 13 of the **United Nations 22 Standard Rules**. It is for this reason that elsewhere in this document I recommend that something like The Office of Environmental Accomodation be established with an Ombudsman to help implement these point here in the Commonwealth, since no single department seems to have the authority, the mandate and the interest to rectify this situation.

United Nation 22 Standard Rules, Rule 13

States assume the ultimate responsibility for the collection and dissemination of information on the living conditions of persons with disabilities and promote comprehensive research on all aspects, including obstacles that affect the lives of persons with disabilities.

- States should, at regular intervals, collect gender-specific statistics and other information concerning the living conditions of persons with disabilities. Such data collection could be conducted in conjunction with national censuses and household surveys and could be undertaken in close collaboration, inter alia, with universities, research institutes and organizations of persons with disabilities. The data collection should include questions on programmes and services and their use.
- States should consider establishing a data bank on disability, which would include statistics on available services and programmes as well as on the different groups of persons with disabilities. They should bear in mind the need to protect individual privacy and personal integrity.
- States should initiate and support programmes of research on social, economic and participation issues that affect the lives of persons with disabilities and their families. Such research should include studies on the causes, types and frequencies of disabilities, the availability and efficacy of existing programmes and the need for development and evaluation of services and support measures.
- States should develop and adopt terminology and criteria for the conduct of national surveys, in cooperation with organizations of persons with disabilities.
- States should facilitate the participation of persons with disabilities in data collection and research. To undertake such research States should particularly encourage the recruitment of qualified persons with disabilities.
- States should support the exchange of research findings and experiences.
- States should take measures to disseminate information and knowledge on disability to all political and administration levels within national, regional and local spheres.

'Accomodating' the Electrically Sensitive — which might mean restricting how public EV-Chargers are sited, allowing low-cost electromechanical meters to replace AMI meters, reducing or eliminating the use of public microwave broadcasting antennas, and similar means of reining in the pervasive e-hazards of our world — will have benefits for many others because this 'e-smog' which the general population cannot feel is actually at the root of many chronic health conditions. This is akin to the broader societal benefits which ensued after curb cuts and ramps were put in to support wheelchair-bound access: appreciative mothers pushing strollers, deliverers of wheeled parcels and skateboarders.

A Quick Backgrounder on Electrical Sensitivity

All humans are affected by their electrical surroundings — we are electrical beings, after all — yet most cannot perceive it unless the intensity is too strong. A small percentage of the population might become electrically sensitive after some overexposure and then may experience a wide range of conditions, such as racing heart, ringing in the ears, tingling or intense heat sensations in

the limbs, chest constriction and dozens of others. Somewhat less than one percent of the population may become acutely and immediately affected by EMFs — whether from the household wiring or broadcasting devices — and may have intense discomfort or pain. These Electrically Hypersensitive (EHS) folks find it very difficult to participate in society or even to have their basic needs met, especially due to the pervasive nature of cell towers and public WIFI deployment and some have had to flee their own homes.

Although we cannot yet predict who is likely to become electrically sensitive, there are five main observed precursors that lead to EHS: high electrical exposure, high chemical exposure, biological trauma (mold, lyme, parasites), physical trauma (whiplash), a compromised immune system. It has been observed that the EHS person is more often female and the age of manifestation often seems to be between ages 40 and 60 years old. It is frequently the case that a person who is 'chemically sensitive' will also be 'electrically sensitive', and vice-versa. The EHS condition is legally considered a disability in some countries, thus accorded various rights for accommodation. 'Microwave Illness' was the original name given to the same condition seventy years ago when researchers started reporting military injuries with similar frequencies and power levels that we now integrate into our personal devices.

The Environment

Air Quality is Not just About Particulate Matter

Wires Are Inconvenient, But Premature Death Is More So

A key concern for thousands of residents in MA will be the enormous added 'e-smog' pollution that will come from the proposed EV-charger and Grid Modernization efforts. We will trade the long-term irritant and chronic health damage caused by ICE engines (whose future diminution is purportedly only held up by the absence of a public charging infrastructure) with the immediate and acute pollution of the public space with an acutely injurious 'e-smog', primarily composed of RF signals which are known to be a Class 2B Agent (a possible carcinogen in the same category as DDT and some organophosphate insecticides).

If the plans of the Utilities are realized and an EV usage rises and ICE usage diminishes in lock step, the 'particulates smog' will diminish at the same pace. Over the course of years, incrementally. However, from the first moment the new EV Charger and Grid Modernization infrastructures are deployed, the 'e-smog' will be with us because such devices spew radiation 24/7 regardless of whether they are providing charging services or not. Thus on day one, the Utilities plan will make the air pollution situation much worse for some residents of MA.

It’s Just Smog By A Different Name, Just As Unhealthful

If 'e-smog' were a real health hazard, why haven’t we heard about it? You have heard of it before, when people have levied a steady stream of complaints for health degradation after a 'smart meter' has been installed at their home. You have heard of it before, when you’ve read of people suddenly developing headaches and nervous twitches after too much cell phone usage. You have heard it before as the news discussed whether cell phones do or do not cause cancer. You have heard it when in 2011 the WHO agreed to declare microwave radiation (of the kind that will be used with the EV Charger and Grid Modernization efforts) as a Class 2B Agent (a possible carcinogen).

While 'e-smog' affects all species in some way, it is often over long time periods. It is yet another invisible possible carcinogen in the environment that stresses and damages the body at the cellular level, affects the body’s ability to repair and leads to many forms of chronic diseases, that are collectively known as 'the diseases of civilization'. However, for people who have become sufficiently electrically sensitive, being within a few hundred feet of any of these devices will produce acute discomfort or even lasting pain within moments at levels far, far below those deemed acceptable to the FCC (which are not, and never have been, complete human health thresholds). It is already hard enough to exist in our public spaces due to the proliferation of cell phone radiation, but now adding many thousands of EV-charging stations in public and on shared housing properties further narrows their ability to leave their homes. In the worst situation, poor siting of this infrastructure — such as having any broadcasting antennas within one hundred feet of their house or apartment could make that home unlivable for them. It has happened before with such 'modernization efforts' and it will happen again this time unless some siting restrictions can be incorporated.

Preserve Sanctuaries, Not Further Pollute Them

Wherever possible, we really wish to see that new technology does not corrupt the pristine and unpolluted parks and other sanctuary areas that are 'escapes' from our overwrought lives. Microwave-spewing devices, such as EV-chargers that are not hardwired, create an unwelcome and unhealthful space for both wildlife and the humans who wish to tread softly, taking only pictures and leaving only footprints.

Where Does The Extra Electricity (to Charge EVs After Dark) Come From?

All three utilities are optimistic about offering public and private EV charging infrastructure. This will all be accomplished while minimizing particulate air pollution. One wonders where the source electricity, hitherto not used for EV-charging, is going to come from and whether it will follow the promise of not being created from fossil fuels. One way to accomplish this will be to tap into the large solar generating capacity. However, this would imply that overnight charging opportunities might be limited. Wind-generation capacities would need to be increased quite a bit to meet this increased need, but was that mentioned somewhere in these filings?

Are the Utilities promising, both, that each public charging station will be available for use 24/7 and that the supplemental energy used to provide this will **not** be generated by means that increase air pollution? As stated in each Utility testimony: people need to rely that there will be an available charging station in order for them to feel comfortable to purchase EVs, so will expect all public charging stations to produce energy 24/7.

Specific Response to the Utility Testimonies

Offering Rebates to Encourage Societal Behaviors

As written in the Utility proposals, it seems that the primary behavior that is to be encouraged is the diminished use of ICE vehicles — and in so doing one expects the air quality improvements sought — in favor of their replacement by EVs (both pure EVs and Hybrid EVs). The assumption is that the additional electricity for those EVs will, itself, not add to poor air quality, or at least not more than the ICEs so displaced. The purpose of these EVcharger rebates seems to be geared especially to overcome reticence of people on the fence to purchase EVs, especially due to 'range anxiety' that they will not be able to complete long trips inside MA because of a lack of charge. This extrapolates further to non-Commonwealth visitors and tourists who might not take that trip to MA because of range anxiety. Another demographic targeted with EV-Charger rebates will be building managers of multi-unit housing (aka, apartments and condos), whose occupants today have been stifled from EV acquisition because of the lack of local overnight vehicle charging.

Road Maintenance Equity

Admittedly, we have only studied the rebate structure to raise a few concerns but we know that the total pool of money for rebates should be constrained to the minimum needed to accomplish the clear goals. Overall, we can assume that the total miles driven across all MA residents will stay the same, no matter whether they drive an ICE or an EV. Is there a reason to believe otherwise? Will the lower per-mile fuel cost for an EV raise the number of driving miles? So, the first concern is how to fairly apportion road use taxes to EVs and ICEs, since the ICEs have their contribution made via the per-gallon gas taxes. Are similar taxes going to be levied as part of the EV-charging proposal, and if so, how will those be decided so that our budget for road management remains constant through this transition? If people who charge their EVs at home, what mechanism will ensure that their road usage fees accurately match the number of miles they have driven?

Although making a private home 'ready' for a Level 2 or Level 3 EV charger is of societal value in the long term (and hence could warrant a rebate incentive, as well as a real estate tax assessment increase), the actual EV charging device is so specific to the current EV model that it does not seem to warrant any significant coverage by the rebate program. Similarly, if a house already has one Level 2 or Level 3 EV-charger installed, there is no need to provide any rebate for a second EV charger, even if the house has multiple EVs, for the obvious reason that the owner is obviously not reticient about EVs and needs no further convincing.

How about rebates and incentives to actually REDUCE the number of miles driven, such as an EV fleet of taxis and shuttles that are somewhat subsidized so as to be plentiful, perhaps enough in some areas to obviate the need to purchase an extra car for the household? Most cars for commuters are parked and idle most hours of the day. Clean, quiet public transportation, can be a better investment than encouraging individual car ownership, especially in congested areas.

Consumer Protections

When there is an EV-charger that has an attached payment platform, who sets the prices charged? Might it be the case that an unscrupulous landlord could receive rebates for creating several EV-charging slots, yet artificially raise the price to an unreasonable level, effectively nullifying the

reason for rewarding the rebate. Similarly, a public or municipal charging station (which received a rebate) might later charge by the minute instead of by the kWh, so that people who have purchased older EVs might be excessively penalized. Where is the consumer protection to report price gouging and what enforcement mechanisms will be in force so that our communal funds were not squandered?

The typical range of EV-charger payment options and rates is described here. Some EV-charging services require paid memberships and other do not. Most will charge per-minute instead of per-kWh so older cars with slower chargers will be penalized. A typical Level 2 EV-charging rate is 7.2kWh (maybe 30 miles of range per hour) and might be billed for a few dollars per hour for paid members, and for a 50 kWh 'full tank' takes 7 hours, so this kind of fill-up might be twice the cost of doing it at home. The 'idle' fee (after the charging is done until you leave the charging location) of $0.40 to $1.30 **per minute** demands your immediate attention and this could lead to a high stress experience [8: An idling fee is likely to engender the kind of desperate actions that per-minute late fees do for daycare]. Payment methods can vary and presumably the building manager for a condo complex would have a cost that is closer to the actual costs of electricity and the hardware maintnenance, though that is not guaranteed.

No Rebates for Polluters

If there is one message that is repeated in this testimony it is that it is destructive to society to in any way encourage further microwave-based broadcasting among any of the components of a subsidized EV-charger. Microwaves pose biological hazard to all human beings and acute symptoms among many of those who are electrically sensitive.

As mentioned in the Overview, the budget for this EV-charging initiative is generously large. The program goals are somewhat nebulously connected to the health of MA residents by the reduction of air pollution. Just last month, folks who have been begging for years to have the injurious microwave-emanating AMI 'smart' meters replaced with electromechanical meters were told that 'there is no money available'. Somehow, we DO have money for marketing campaigns to explain the EV-charger rebates program, but yet there is insufficient funding to replace the Class 2B (possible human carcinogen) AMI meters. Are we sure the state's priorities, overall, supports this dichotomy?

Security Implications

The proposals from the Utilities show an interconnected world, with its benefits. As shown, that same interconnectivity works to serve those who would exploit security flaws.

Quoted from the security researchers' explanatory web page:

- We found vulnerabilities that allowed account hijack of millions of smart EV chargers
- Several EV charger platforms had API authorisation issues, allowing account takeover and remote control of all chargers
- One platform had no authorisation at all: knowing a short, predictable device ID allowed full remote control of the charger
- The same charger had no firmware signing, allowed new f/w to be pushed remotely and the charger used as a pivot on to the home network

- One public charging platform exposed an unauthenticated GraphQL endpoint that we believe also exposed all user and charger data
- Some EV chargers were built on a Raspberry Pi compute module, which could allow an easy extraction of all stored data, including credentials and the Wi-Fi PSK
- As one could potentially switch all chargers on and off synchronously, there is potential to cause stability problems for the power grid, owing to the large swings in power demand as reserve capacity struggles to maintain grid frequency

The same researchers have updated their continued studies of EV chargers [9: https://pv-magazine-usa.com/2021/09/03/how-safe-are-smart-ev-chargers/] and summarize the classes of problems found in commerical products, quoted:

- Hardcore credential, which provides privilege access and the ability to provide reserve privilege access.
- Remote code execution, which allows for the remote injection of malicious code, opening users up to Distributed Denial of Service (DDoS) attacks.
- SQL injection vulnerabilities, which allow interface access, giving control over the interface of the charger itself. With this an individual could control who can use it and how much can they use.

This list of major exploitable vulnerabilities is not surprising. Proper security is hard, takes constant vigilance and does reduce the profit margin of any sophisticated deployment. If just the EV infrastructure were affected, that would be bad enough, but because of the extensive internetworking the risk extends far into the power infrastructure and associated financial domains. Compartmentalization, continued monitoring and other securing techniques need to be budgeted into the costs. How will product recalls be handled in the field (in case the problem is a hardware issue)? How will field updates be handled? Will prior configurations be backed up so that they can be restored to a known security profile? Will the planned deployment prevent the equivalent of ATM 'skimmers' or faux cell towers or other ways for the Bad Guys to silently intercede as our financial data and login credentials fly through the network.

Since 2015, there have been many documented instances of heavily networked modern cars (not just EVs) being 'hijacked' or controlled remotely or their remote keyfob bypassed. So many of these security problems are not unique to EVs, but are the common ones seen such as default passwords.

An important feature of the 'Smart Grid' is the Vehicle-to-Grid (V2G), wherein an EV attached to an EV-charger can actually supply its stored electricity to the utility in times of need. This requires the ability for the car and charger combo to send the DC electricity as AC and onto the powerlines. There are a number of security issues in this area, specifically in the area of trusted certificate management [10: https://www.sae.org/news/2020/08/iso-ev-plug-and-charge-standard-faces-security-concerns], just as might occur on your personal computer or phone, but in this case a periodic 'security update' might require more hands-on effort.

An interesting upshot of these security risks is that having public charging stations privately situated at, and owned by, the gas stations might significantly reduce the security risk, as that can support customers who wish to pay by cash (and thus be completely anonymous) or use the well-established financial mechanisms.

There are many excellent guidelines [11: https://www.etsi.org/deliver/etsi_en/303600_303699/303645/02.01.01_60/en_303645v020101p.pdf] for security assessment of 'internet-connected devices' such as the EV-charging infrastructure that the Utilities propose. Any acceptable hardware and software systems should be able pass such assessments by design and confirmation and that there should exist a central mechanism for filing and monitoring security issues are they are found and fixed. Security is neither glamorous nor inexpensive, but it is necessary.

Training Electricians for EV-Charger Installation

It is proposed to include additional training to licensed MA electricians to help them understand the various installation scenarios associated with EV Chargers. This is a good idea, as it both streamlines the installation process, but also ensures that each installation will be of similar quality.

NEC Specifics for EV-Chargers

Sometimes the rules are not unambiguous, for example if the manufacturer's installation instructions for a UL listed device do conflict with the NEC code, such as they might when an EV-charger vendor product (such as Watt Point Model 3704 EVSE, on Page 1 and the bottom of Page 7) has a builtin GFCI and requires that the power line feeding it NOT be redundantly GFCI-protected (presumably because the EV-Charger performs a self-test and reset of the GFCI as part of its own operation). Electricians are required to follow the manufacturers written instructions for all UL Listed equipment, of course.

Installation of new EV-chargers is a bit less confusing than replacing or upgrading an existing EV-charger, as the new EV-charger may have different requirements. In this case, the existing home electrical configuration first needs to be examined and might need changes, for example to replace the circuit breaker with one protected by GFCI (or AFCI) or replace the wiring with a heavier gauge. It gets progressively more difficult to make this determination in cases where the existing configuration cannot be examined such as whether a wireless charging system's primary pad has already been separately grounded or not [12: Such options are explained in NEC Article 625.101].

Article 625 (Electric Vehicle Power Transfer System) and Article 626 (Electrified Truck Parking Spaces) in National Electric Code 2020 edition are very relevant to this EV-charging initiative. Even though NEC 2020 is freshly approved in MA, these two sections already have dozens of feedback pending for NEC 2023, suggesting that this area has shifting sands until innovation settles. The electrician needs to be aware of all the nuances in order to do a proper job. A quick overview of the NEC and UL with respect to EV-chargers can be found here.

Note that upcoming Building Code is likely to mandate that all new home construction be made 'EV-Ready', so electricians will be asked to do this frequently. As mentioned above, a number of the electrical details depend on the actual EV-charger manufacturer instructions, which will not be known when a new house is constructed. Electricians will need clear guidance about what to do when making a house 'EV-Ready' with enough 'future-proofing'.

250.6 Objectionable Current

There are several related training opportunities for electricians. In particular, truly understanding the implications of **250.6 Objectionable Current** is necessary when making electrical changes for a

household with delicate health or children on the premises. Objectionable Current may stem from one of several common wiring errors, each of which is an NEC violation, though still commonly found. By understanding this topic better, electricians can more quickly troubleshoot EV-charger deployment complaints.

NEC interpretation experts such as Mike Holt say the definition of 'objectionable current' also includes its paraphrase "current that someone objects to" in addition to the more bookish NEC definition. Objectionable current is upsetting to some electrically sensitive people who can actually feel the unbalanced current as it causes acute discomfort [13: In our home, my electrosensitive partner can point to the areas in the floor or wall that contain such unbalanced current and she keeps her distance from it.]. Although devices in the home continue to "work", there are dangerous conditions created that can also lead to house fires or shocks from supposedly de-energized wiring.

Things to be on the lookout for include —

- Connection of the Neutral and Equipment Grounding Conductor anywhere but at the service connection (usually in the main panelboard).
- A Neutral-Neutral intertie for two or more circuits, such as in a junction box where multiple unrelated neutrals are linked under one wire nut

Both of these conditions will allow the LINE and NEUTRAL current to become unbalanced as some portion of the LOAD current returns on the NEUTRAL of one of the other intertied circuits. Similarly, if the neutral and ground are intertied then the EGC can actually carry current, and that can lead to a shock for the unwary. An unbalanced current — which comes when the same amount of current from the LINE (black wire) does not match the return current in the same cable (white wire) — leads to the production of magnetic fields on all the involved wires, which can run hundreds of feet in the home. An excellent video demonstration of this phenomenon, how to diagnose it and how to repair it was made by Electrician Karl Riley and he has written a book to explain the same material.

Bidirectional V2G

National Grid's testimony indicated that 'Bidirectional V2G' was an important goal. This scheme would allow the Utility to **receive** power from any vehicle that is still connected to a smart EV-charger. Due to a grid shortfall, the Utility can take a little power from all local EVs (paying for it), to avoid a regional brownout.

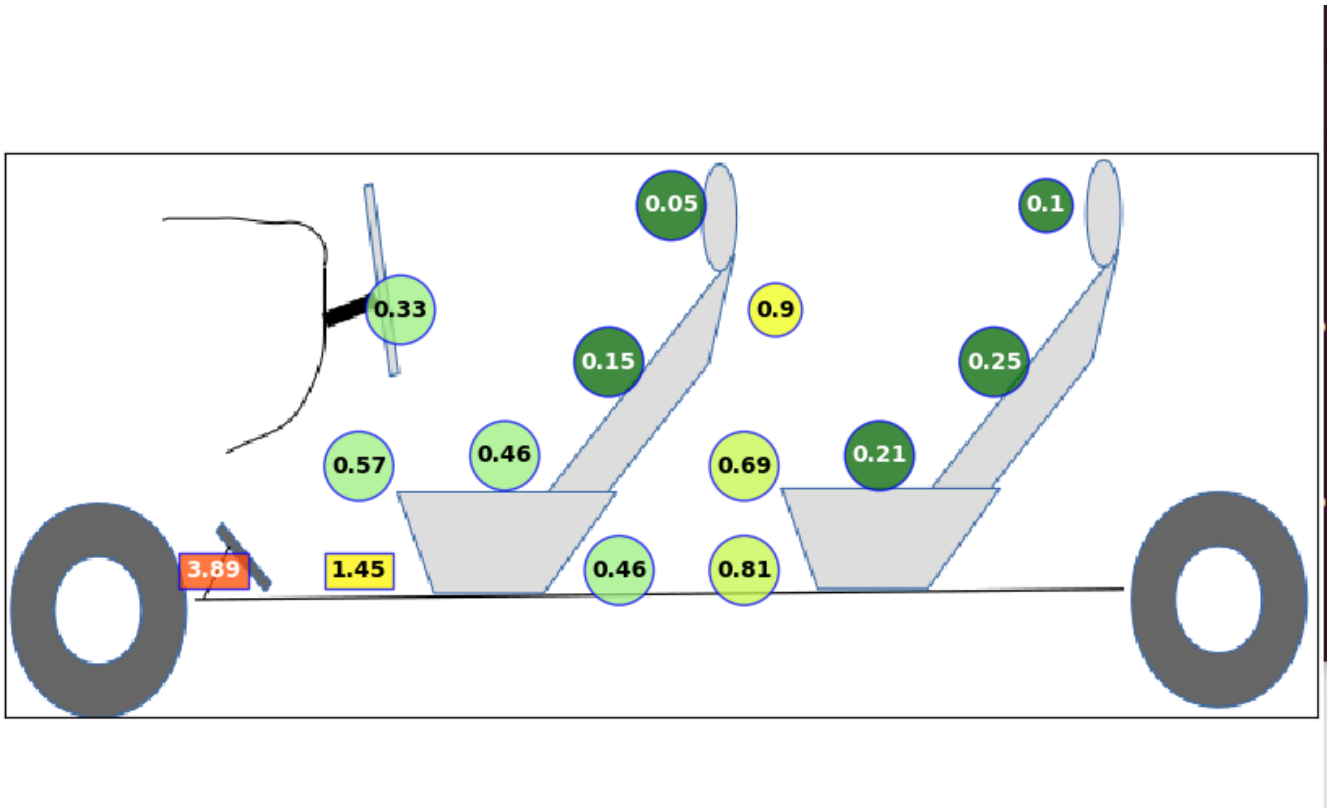
Having one's house simultaneously receive power from the grid and to provide electricity for sale to the grid (from the EV battery) seems to ask the same of the electrician as does a Solar PV array. This also means that it may pose a similar health hazard to the residents, namely, that the DC to AC inverter produces pronounced conducted EMI (also known as dirty electricity) on the home wiring. It would be ideal if the electrician or AHJ (such as the electrical inspector) were trained to understand such power quality issues so that the most sensitive customers are made aware of the situation and may find an after-market line filter to reduce that hazard.

There is at least one variation to consider and that is when a local microgrid is established, say at a condo community, and the electricity from the EV car is uploaded into the local microgrid instead. More info on the value proposition for this V2G sell-back charging feature can be found here

Busing Safely

Among the Utility testimonies are specific mention of electric school buses. Safe, clean, quiet, and able to backfeed the grid while connected to a bidirectional V2G charging apparatus. Everything that we would want. As far as safety and health is concerned,, it is better to 'trust, but verify' when new technology is first deployed. How do we know that such devices are at least as safe and healthful as the ICE vehicles they intend to displace?

One way to check safety will be to measure the magnetic fields at the seats of the driver and each student seating [14: An example measurement can be found at EV bus assessment]. Typically a seat check is done at the level of the head, the torso, the bottom, the knees and the feet. It is often the case in vehicles, where wiring is sometimes unbalanced or high amperage wiring has not been shielded that there are magnetic 'hot spots', such as near the position where the battery management circuitry is. Although students spend comparatively a short amount of time in their seating, the bus driver is exposed to a long day and any excess fields can lead to health issues and possibly serious conditions. For example, a 2018 Kaiser-Permanente study monitored 1000 pregnant women and found that the rate of miscarriages more than doubled for continued exposure to fields as little as 2.5 milligauss.



Example Seat AC Magnetic Seat Mapping

Some EV manufacturers have put more thought into maintaining safe EMF exposures, but not all have. For example, here are the measured AC magnetic field levels at different positions in a car using a Gigahertz Solutions NFA-1000 3-axis meter. The exact car models have beeen anonymized. It is obvious that the values vary wildly within this space, some deep into the range of hazardous exposure.

AC Magnetic Field Measurements In EVs

Vehicle	Year	Type	Highest Seat Values (milliGauss)
225 kW EV	2020	EV	58 mG (driver), 5 mG (passenger)
99 kW Hybrid	2019	Hybrid	3.2 mG (driver), 5.5 mG (passenger)
67 kW EV	2011	EV	0.35 (driver), 0.60 (passenger)
386 kW EV	2018	EV	0.8 (driver and passenger)
100 kW EV	2020	EV	0.8 (driver and passenger)
150 kW Hybrid	2018	Hybrid	1.6 (driver), 11 (passenger)

The Considered Utility Testimonies

Table 1. Primary Filings Refernced (from Utilities)

Utility	Author	Date	Control#	Title	URL
Eversource	Kevin Broughan	07-14-2021	ES-KB-1	DPU 21-90 Testimony	DPU URL
National Grid	Sondhi, et al	07-14-2021	NG-EVPP-1	DPU 21-90 Testimony	DPU URL
Unitil	Carroll, et al	07-14-2021	CSVG-1	DPU 21-90 Testimony	DPU URL
Unitil	—	—	CSVG-4	FG&E EV TOUU Service Requirements	DPU URL

Proposal: MA Accepted IoT and Telecom Device List

Don’t Deploy Random Hardware Purchased Online

Currently, MA government requires that all plumbing fixtures and components be found on the Accepted Plumbing Products [15: https://licensing.reg.state.ma.us/pubLic/pl_products/pb_pre_form.asp] before they are allowed for installation. This ensures that products that meet basic criteria have had at least cursory scrutiny and have an active manufacturer. Currently, this database has 100,000 entries. To be placed on the list requires manufacturers to file sufficient paperwork every few years for each of their devices which will be permitted to be installed in Massachusetts. Many an internet shopper has been surprised to be told that the soaking tub or faucet they have purchased was not on the list and thus could not be installed by a licensed plumber.

The various devices — smart meters, EV chargers, cell antennas, or other parts of our IoT or Telecom landscape, need at least a modicum of scrutiny and accountability in a similar manner. Here are various aspects that could be considered, to have on file even if they are not actually researched more deeply before being placed on the Accepted list. Being 'Accepted' does not confer any blessing that the device is safe or functions properly, but it does mean that the manufacturer can be found and held accountable for problems, among other aspects. Might this stifle progress? Maybe, but the unbridled pace of technology does need to be slowed down a little if it results in a safer result for the public.

How Might This Work (Hint: Similar to the Plumbing Parts List)

How might this work? For each kind of device — such as an EV Charger — an application profile is established. The form is easily found via the MA state government website and the submission of the information is easily down via upload of the requirement information. The placement on the Accepted list might be done without any human scrutiny, some human scrutiny or a lot of human scrutiny.

When permission is sought to install a new EV-charger in the public space, each of the devices (only in the categories tracked by this Accepted database) is looked up to ensure all is well and any conditions imposed will be met. Such conditions could be limits to a device’s placement, a requirement for yearly auditing or anything deemed appropriate. If any do not exist on the list, the manufacturer will be required to file the paperwork in order to continue, or a different Accepted product must be selected. Not especially onerous.

What is the Benefit?

What might be the tangible benefits of such registration and permitting overhead? This can help the state planning process as it wishes to develop criteria to set minimum standards of performance and security, to correlate filed complaints with the deployed devices, to improve the state-wide response to security threats and so on. Relying on 'market forces' and the 'integrity of for-profit businesses' to make in-field corrections in a timely manner, is not a solid strategy. Some examples where this kind of scheme could help reduce scope and duration of negative effects —

- A news items describe a 'hack' using a certain model EV charger, where the consumer's private info is gathered
- A security alert that a particular AMI smart meter model can be made to TURN ON and TURN OFF grid power via remote control
- Suspicious bank fraud alert where customer financial data used at EV chargers was captured and later used for other purchases
- Due to new health research, the FCC lowers the acceptable RF power thresholds and enforces total power among all fixed location devices

Since so much of the proposed infrastructure relies heavily upon wireless technologies, which are known to the State of Massachusetts to be a Class 2B Agent (a possible human carcinogen), it will be vital that all manufacturers of devices, municipalities, Utilities and anyone in authority who signs off on deployment of these in public and private spaces to carry sufficient liability insurance. Of particular concern is the recent trend for large insurance agencies (Lloyds, Swiss Re) to add **exclusions** to their policies: [16: https://scientists4wiredtech.com/what-are-4g-5g/insurance-underwriters-refuse-to-cover-wireless-industry/] against any coverage related to lawsuits involves health damage caused by electromagnetic fields. The August 2021 Federal Court decision against the FCC's mishandling of adjusting the health limits to reflect modern science may have liability implications for anyone not following prudent scientific and medical exposure guidelines.

In summary, the complex IoT infrastructure at the heart part of the Grid Modernization, EV Charging infrastructures and other Commonwealth initiatives do merit at least as much oversight as our plumbing parts do.