



E3's assignment

- + HQ's financial model compares revenues from residential charging to the cost of building and operating its proposed DCFC network
- + E3's question focuses on a key input: *How much additional home charging load can be attributed to HQ's proposed network?*
- + Underlying qualitative foundation:
 - Widespread availability of DCFCs is a necessary pre-condition for rapid EV adoption
 - DCFC network buildout in advance of EV adoption stimulates demand for EVs
- + To quantify this effect E3 had to address these questions:
 - How much EV adoption would occur in Quebec without HQ's proposed program?
(**Reference Scenario**)
 - How much will the rate of EV adoption in Quebec increase due to the HQ program?
(**Induced Effect**)
 - How many DCFCs are needed for a given number of EVs in Quebec?
(**BEV:DCFC ratio**)



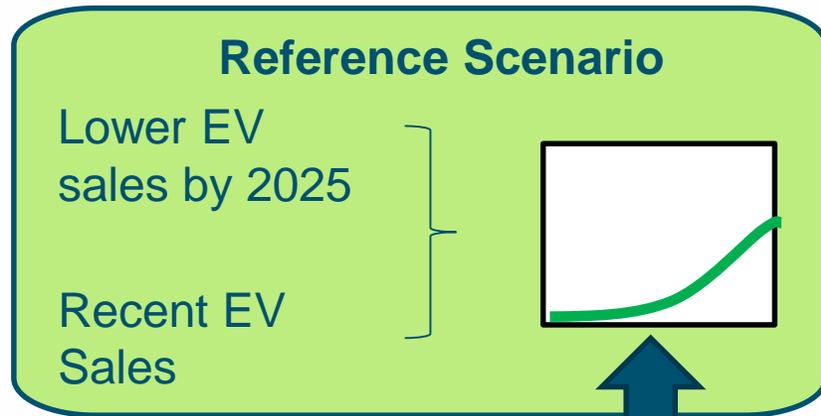
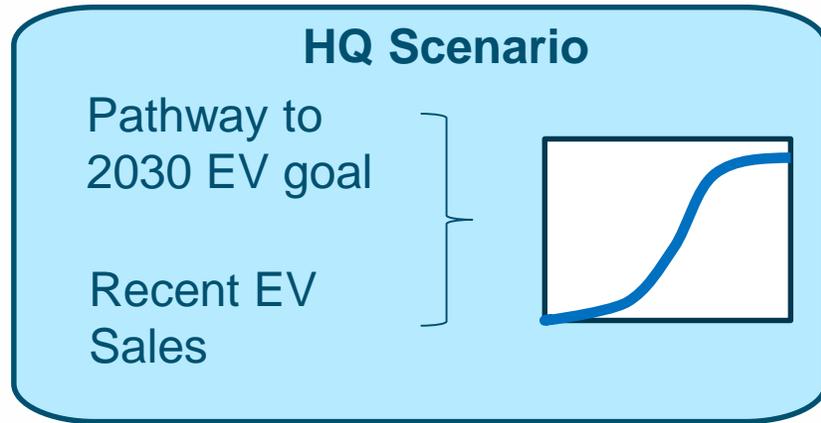
Basic qualitative foundation

- + **An extensive DCFC network is a critical enabling condition to achieve sustained, increasing EV sales growth**
 - Along travel corridors – sufficient to complete any long trip (range confidence)
 - Within cities/towns – support a large number of people without access to home charging (larger addressable market)
- + **The build-out of the DCFC network must lead rather than lag EV adoption to stimulate additional EV sales and speed up adoption**
- + **DCFCs will compliment other programs (e.g. rebates) by improving acceptance of EV's among consumers**
- + **Quebec has made a down payment with Electric Circuit (and other investments)...**

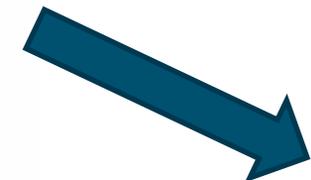
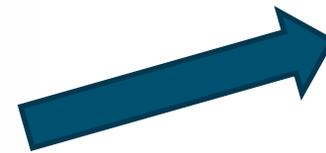
...but continued fast EV adoption is uncertain without continued DCFC investment



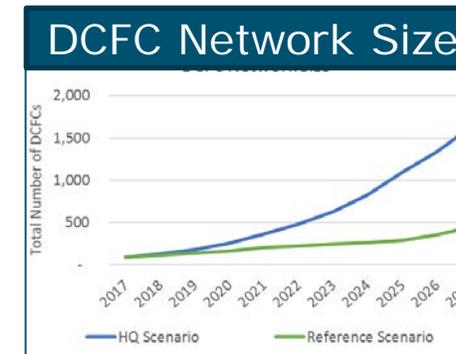
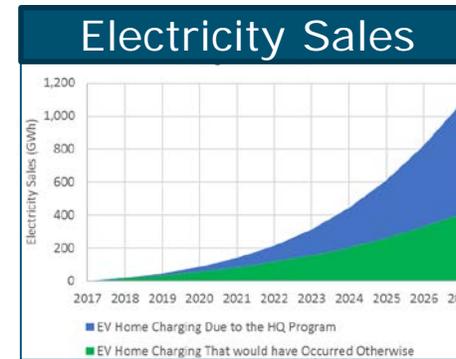
E3's Analysis Approach: Overview



EV Adoption Forecasts



DCFC: BEV ratios



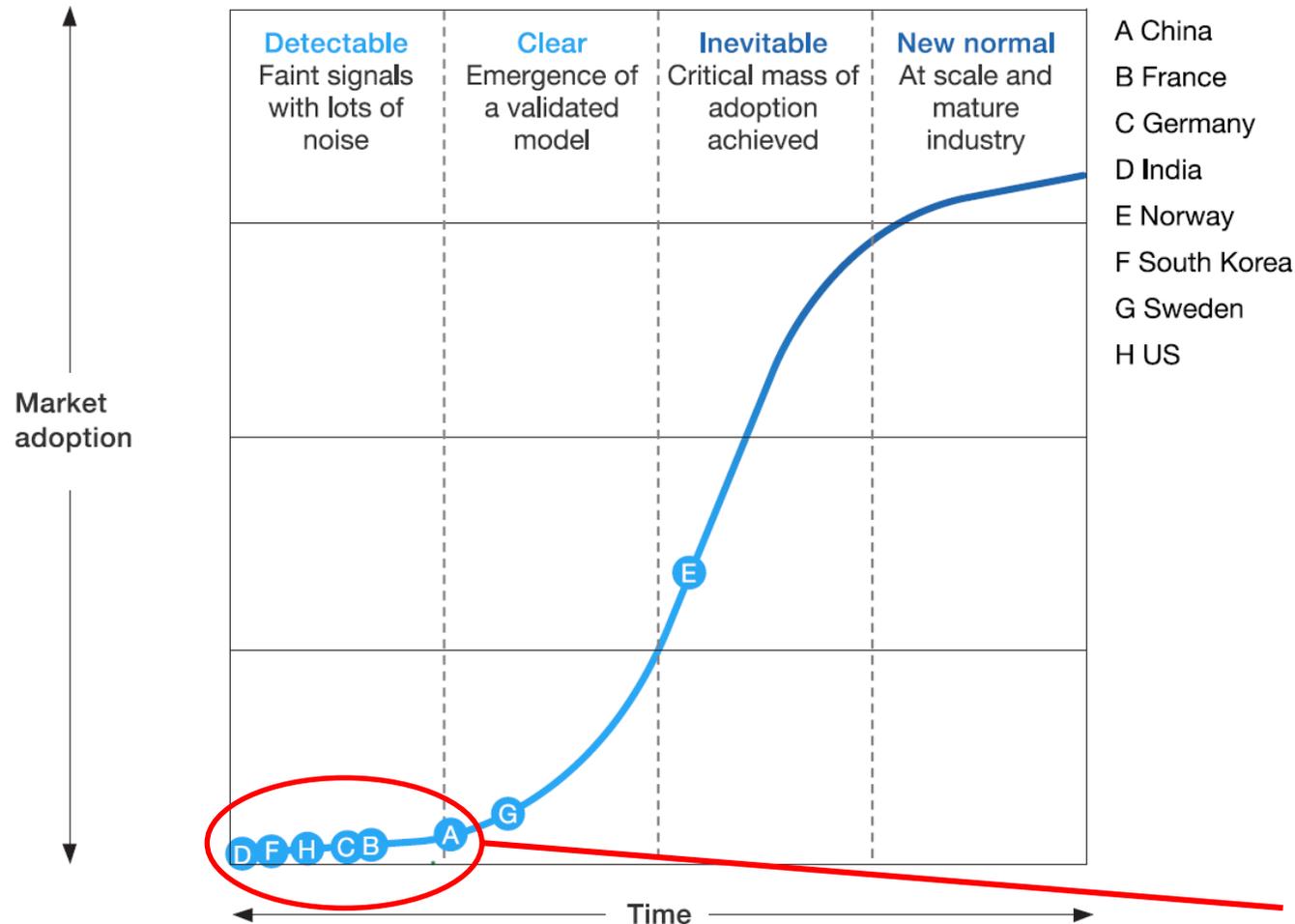
Empirical Literature Benchmarking

- Change in EV sales with change in DCFC ✓
- Avg EV per DCFC ✓
- EV market share increase per DCFC ✓



"S curves" are commonly used to characterize adoption of new consumer products

The 4 stages of a disruptive trend—focus on electric-vehicle market adoption



+ **Model based upon widely observed patterns for consumer products**

- Mobile phones
- DVD players

+ **Product adoption depends on**

- Falling prices
- Improving quality
- Expanded addressable market
- Availability of essential complementary good(s)

+ **The EV market is in the earliest stage almost everywhere**

Source: Chris Bradley, Martin Hirt, and Sven Smit, *Strategy Beyond the Hockey Stick*, McKinsey, 2018



Conditions for widespread consumer adoption of “indirect network” goods

Continuous product improvement & falling prices



Expansion of supporting network(s)



Rural and urban cell network

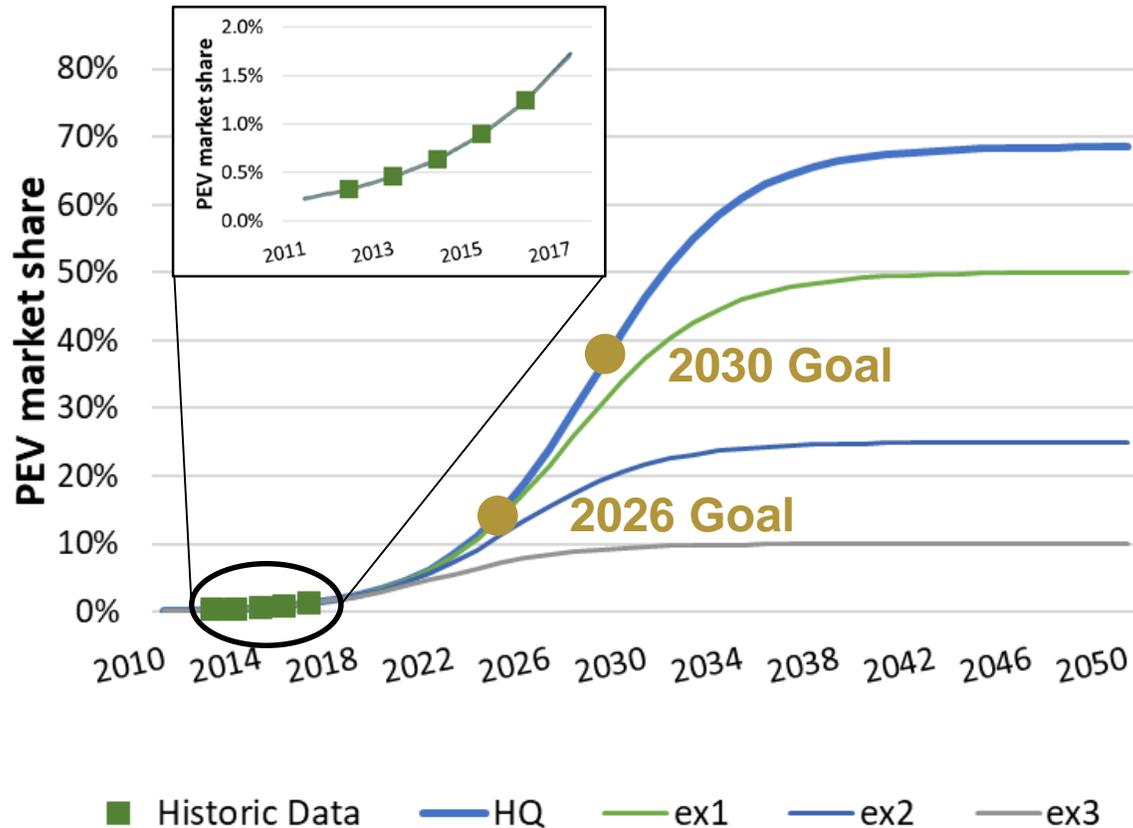


- + EVs are indirect network goods: adoption depends on the availability of **complementary goods**
- + Without full deployment of complementary goods EV market share will likely be much more limited



A high adoption rate is not inevitable

PEV Market Share - in the Long Run



- + Many S-curves pass through the historic trend of PEV sales
- + The HQ Scenario is consistent with Quebec's 2026 and 2030 EV goals
- + In other scenarios EV market share could plateau much lower
- + Many things have to go right to for the HQ Scenario to be realized:
 - Technology improvements
 - Policies
 - Price reductions



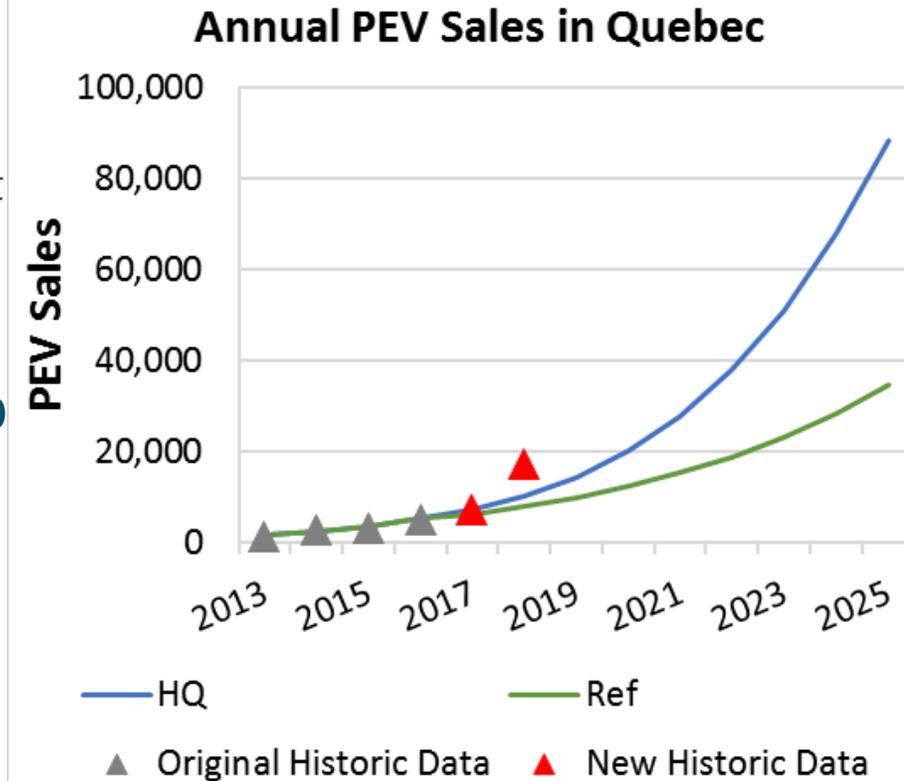
Key Scenario Assumptions

- + The **HQ Program** involves installing a large enough DCFC network to put Quebec on a pathway to the **one million car goal by 2030**
- + DCFCs will be able to support more EVs per charger over time as BEV range increases
- + The percentage of Plug in EVs that are BEVs (as opposed to PHEVs) will increase over time as:
 - 1) BEV range increases and
 - 2) more DCFCs are deployed
- + **Without the HQ Program**, EV adoption in Quebec would progress at a similar pace to the forecasted **US average adoption rate** (that is, it would not hit the one million car goal by 2030)



Reference scenario vs recent market activity

- + 2018 EV sales are stronger than our reference case forecast
- + Aided by factors such as Electric Circuit (EC)
 - Through EC, HQ provides 50% of installation costs and significant technical and deployment support
 - Currently 199 DCFCs in Quebec - **178 are Electric Circuit**
- + **Continued rapid DCFC growth needed to meet the 2030 EV goal will be very challenging without HQ support**
 - 'low-hanging fruit' largely gone – remaining DCFC sites likely to be less profitable and therefore less attractive for market DCFC deployment
 - QB EV sales currently have mostly been in metropolitan areas where EV range is less important
 - Around 20% of QB population lives outside metropolitan areas – much larger than CA (~5%)



**2018 sales data from AVEQ, 2013 – 2017 data from fleetcarma.com*



Fundamental Inducement Effects of a Widespread DCFC Network

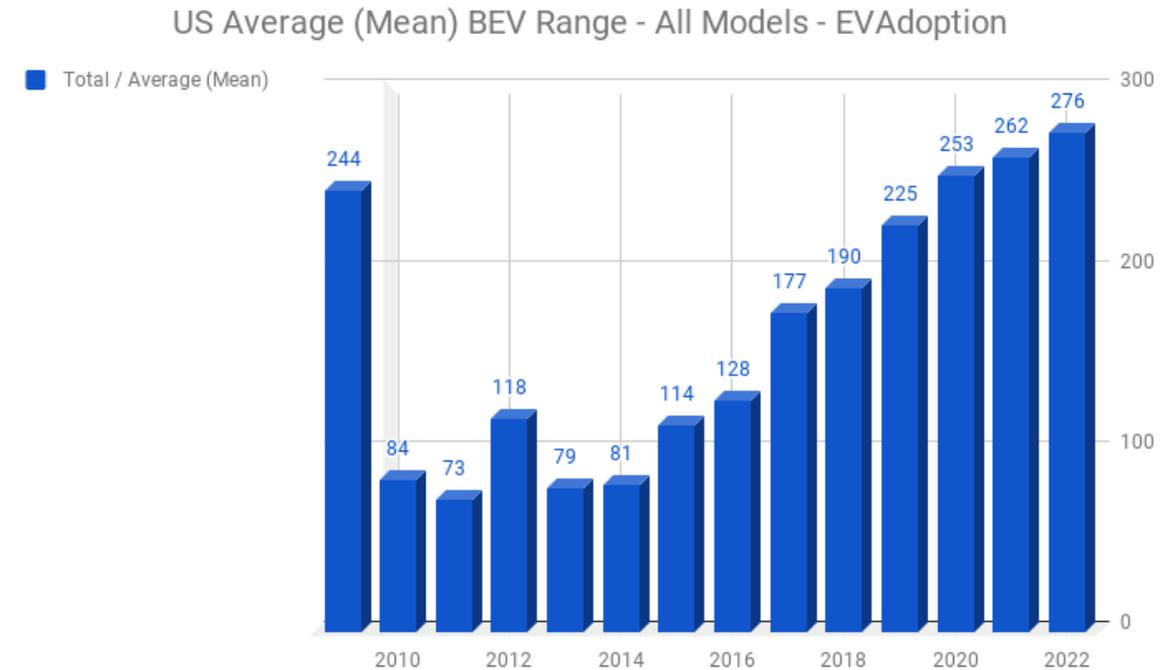
- + Our report presents a reasonable forecast of inducement effects
- + But while individual assumptions can be questioned, the fundamental impacts of charging networks are well recognized within the EV community:
 - Reduces range anxiety
 - Expands the market from affluent “second or third car” to single car households
 - Expands the market to drivers without dedicated parking spots with secure access to power (less than half of households in Quebec are detached dwellings)
 - Awareness of charging stations could increase acceptance of EVs

Sources: Canada 2016 Census <https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016005/98-200-x2016005-eng.cfm>



What about the Quebec ZEV mandate?

- + Rising requirement for EV or Hydrogen sales or leases on large and intermediate automakers
- + Targets **22% of credits** in 2025
- + Longer range vehicles get more credits
- + The forecast avg BEV in 2025 would earn 3.7 credits per vehicle - only a **5.9% market share would be needed to hit the 22% credit target** in 2025
- + PHEV in 2025 would likely earn 1 credit per vehicle, so if 1/3rd of EVs were PHEV, then the market share of EVs to hit the 22% credit target would be **7.8% --- comparable to our 7.5% assumption** for the 2025 reference case



Source: <https://cleantechnica.com/2018/10/27/us-electric-car-range-will-average-275-miles-by-2022-400-miles-by-2028-new-research-part-1/>